WELCOME

We deeply appreciate your attendance at this 26th Annual Goat Field Day of the E (Kika) de la Garza American Institute for Goat Research of Langston University. The Field Day is one of the most important things we do each year. The primary purpose of the Field Day is for education and extension in areas of greatest interest to clientele of the Institute. Thus, please share your thoughts with us on today's activities and suggestions for the Field Day next year. In addition to extension and education, the Field Day provides an excellent opportunity for the staff of the Institute to meet other people that work with goats. Such interaction helps make our program the most appropriate it can be for the people it serves. The proceedings of the Field Day is a very useful tool for the Institute beyond impact realized from the program today. First, there are reports on Field Day presentations. After this information, there are highlights of research, extension, and international activities of the Institute in the past year. This section is an aid to assess our recent progress, display current activities, and contemplate future directions to be followed. This year's general theme is "Healthy Goats, Healthy Herds". Here is the exciting program planned for today that has developed from your input.

The morning program consists of:

- **An Overview of Goat Health and Disease: Around the Horn in 60 Minutes** *Dr. Susan Kerr*
- **Avoiding Drug/Anthelmintic Residues** *Dr. Jacqueline Johnson*

The afternoon workshops are:

- **Goat Emergencies** *Dr. Susan Kerr*
- **Neonatal Kid Care** *Dr. Susan Kerr*
- **Biosecurity: It's Worth the Effort!** *Dr. Susan Kerr*
- **Internal Parasite Control** *Dr. Jacqueline Johnson*
- **Basic Herd Health** *Dr. Jacqueline Johnson*
- **Goat Reproduction** *Dr. Dave Sparks*
- **Nutrition for Health and Production** *Dr. Steve Hart*
- **eXtension** *Dr. David Keisling*
- **DHI Training** *Ms. Eva Vasquez*
- **Benefits of USDA Programs** *Mr. Dwight Guy*
- **Cheesemaking** *Ms. Gianaclis Caldwell*
- **Social Media** *Dr. Nelson Escobar*
- **Body Condition Score** *Mr. Glenn Detweiler*
- **Fitting and Showing for Youth and Adults** *Ms. Kay Garrett*
- **Fun Tent** *Ms. Sheila Stevenson*

On behalf of the staff of E (Kika) de la Garza American Institute for Goat Research, we thank you for your continuing interest and support.

Tilahun Sahlu

Director, E (Kika) de la Garza American Institute for Goat Research

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An Overview of Goat Health and Disease: Around the Horn in 60 Minutes

Dr. Susan Kerr
Washington State University - Klickitat County

Introduction

Many Problems Can Be Prevented!

- Buy from reputable and disease-free sources with a long history of healthy animals
- Provide a safe environment
- Provide good nutrition
- Maintain good farm sanitation
- Isolate new additions to herd
- Remove and compost manure
- Vaccinate, worm and trim feet regularly
- Colostrum essential for neonatal health
- Minimize stress

Some Sources of Stress

- Malnutrition
- Parasitism
- Overcrowding
- Dust
- Poor ventilation
- Ammonia fumes
- Lack of colostrum
- Transportation/shipping
- Introduction of new animals/ re-grouping
- Dampness/rain/wet/chilling

Assessing Health

- Good body condition
- Normal temperature
- Normal heart rate
- Normal respiratory rate
- Good appetite
- Normal manure
- Lymph nodes normal
- No external parasites
- No abnormal swellings
- Well hydrated
- Normal breath (no foul smell)
- Not lame
- Nice coat
- Bright eyes
- Teeth good

- Pink membranes
- No pot belly
- No discharge from eyes, nose, mouth, vulva or prepuce
- Bright and alert

Normal Health Parameters *What's normal for <u>your</u> goats?*

- Temperature 101.3 to 104.5°F (hot days)
- Pulse 70-80 per minute
- Respiration 16-34 per minute

What is Colostrum?

- First milk
- Produced for about 3 days after kidding
- Full of antibodies, fat, proteins, vitamins, natural laxative
- *Essential that a kid consume at least 10% of body weight within first 12 hours of life.* The sooner the better--aim for a colostrum meal within one hour of birth!
- Antibodies deposited in milk are stored in udder during last 3 wks of pregnancy (time booster vaccination accordingly)
- If kid doesn't receive adequate colostrum, risks of illness and death are greatly increased

Vaccinations

- Ask your vet and other producers in your area about what to vaccinate for
- Minimum: Clostridium C, D & T at 6, 9 and 12 weeks (and every 6 to 12 mo. for breeding animals)
- Booster pregnant does 2 weeks before kidding
- May need to use Clostridial 8-way (be sure it contains C, D &T)
- Others: CL, foot rot, orf, pneumonia, *<u>E. coli</u>*, listeriosis, leptospirosis, brucellosis, rabies
- Remember quality assurance: injection sites, methods, withholding time

Caprine Arthritis & Encephalitis Virus (C.A.E.)

- 80% of U.S goats are positive
- Causes paralysis and death in kids; chronic arthritis, pneumonia, mastitis in adults
- No treatment, no vaccine
- Not transmissible to humans
- Spread through white blood cell exchange; most common means of transmission = colostrum/milk
- Blood test detects those infected with the virus
- Buy from negative herds
- Breed to negative animals

Creating a CAE-Free Herd: It Can Be Done

- Blood test all animals older than 6 months old
- Separate positive and negative animals (10' minimum)
- Retest every year
- Isolate, test and re-test all additions to herd
- Remove kids from does immediately at birth
- Tape does' teats if you might miss kidding
- Feed heat-treated colostrum or colostrum from negative does; pasteurized milk, milk replacer or milk from negative does
- Cull positive animals

Heat-Treating Colostrum

- Heat colostrum to 134.6°F for 10 minutes, then put in thermos pre-heated with boiling water; must be kept above 132.8°F for 60 minutes. Stir often so all colostrum remains above critical temp for 60 min.
- Heat-treated or negative colostrum may be frozen for up to one year. Thaw in warm water bath.
- Do not pasteurize (pasteurization = 165°F for 30 sec.) or thaw in microwave (inactivates antibodies).
- Heating above 140°F will turn colostrum into indigestible mass; easy to do at high elevations

Caseous Lymphadentitis

- *Corynebacterium pseudotuberculosis* bacterium
- "Lumps" (abscesses of lymph nodes)
- Very contagious
- Internal or external abscesses with thick, pasty pus
- Treatment ineffective long term (and unethical?)
- Vaccination possible but debatable
- A reason to be refused entry to a show
- Spread via needles, clippers, wounds, contaminated wood…
- Avoid bringing into your herd! You don't want it!
- Cull positives for quickest elimination from herd

Orf "(sore mouth)"

- A viral disease
- Very contagious; rarely fatal
- Complications are mastitis (doe) and starvation (kid)
- Incubation period = 7- 30 days
- Often contracted at shows
- Reason to be excluded from a show
- Contagious to humans
- Modified live vaccine available; give to kids

Foot Rot (contagious pododermatitis)

- Stinky!
- Contagious (bacterial cause)
- Common in muddy areas
- Predisposed by unhealthy, overgrown feet and poor mineral program
- Isolate and treat lame animals
- Address environmental factors (mud control)
- Use foot baths wisely; Copper sulfate or Zinc sulfate; change often; use only for lame animals
- Vaccination possible

Mastitis

- Usually caused by bacteria
- Can be mild to fatal
- Udder: pain, redness, swelling, abnormal milk
- Most common in unsanitary conditions and at dry-off time
- Treatment varies: supportive care, +/- antibiotics; milk out as often as possible
- Bacterial culture and sensitivity best

Overeating Disease

- More common in lambs than goats

- Can be due to sudden dietary change
- Animals usually on high grain diets
- Animals are usually found dead
- Intestines are usually bright red or dark purple; kidneys usually swollen
- Caused by toxins of *Clostridium perfringens* types C and D
- Biggest animals often show first cases
- Prevent by vaccinating (CD&T) and making any changes in ration gradually
- Antitoxin available--use during outbreaks

Tetanus ("lock jaw")

- Preventable! (CD&T vaccine)
- Very common in goats
- Banding scrotum creates dead tissue => high risk
- Poor response to treatment
- Caused by toxin produced by a bacteria that usually enters via puncture wound (hoof trimming?)
- Signs: lying down, drooling, stiff; die of respiratory paralysis
- Booster all goats at least once a year

Floppy Kid Syndrome

- Cause = ?
- Very weak and depressed
- Kids normal at birth; sick between 3-10 days old
- Severe metabolic acidosis without dehydration
- Diagnose via signs, bloodwork, response to treatment
- Treatment: sodium bicarbonate orally or by IV, tube feed, IV fluids, keep warm, TLC
- Positive response to ½ tsp. oral baking soda considered diagnostic

Johne's Disease

- Always fatal
- Contagious to all ruminants
- Fecal-oral spread
- No treatment, no goat vaccine yet
- Signs: severe weight loss in adults despite good appetite; +/- diarrhea; often precipitated by stress such as kidding or transportation
- Confirm via blood test or fecal culture (lab tests challenging in goats)
- Excellent management can eventually eliminate this disease from a herd
- Avoid this disease--buy negative animals from herds with old animals with good body condition

Black Leg

- Caused by *Clostridium chauveoi* (and/or *C. septicum*, *C. sordelli*, and *C. novyi*) which thrive in absence of oxygen
- Spores in soil are ingested; go from GIT to muscles. If muscles traumatized, spores activated and bacteria secrete potent toxins that damage muscles; often fatal
- Can also result from contaminated wounds.
- Treatment: Call vet. High doses of penicillin, fluids, anti-inflammatories, surgery to expose muscles to oxygen
- If present in your area, prevent by vaccinating with Clostridial 8-way vaccine every 6 to 12 months

Scrapie

- MUCH more common in sheep than goats

- Fatal disease of nervous system
- Caused by a prion (sub-viral protein)?
- Spread by biting insects? Milk? Placenta? Water? Breeding?
- Signs: act itchy, odd behavior, weight loss, death
- Brain looks spongy on microscopic exam
- Federal identification and eradication program for sheep and goats
- Youth market sale animals and breeding stock need ear tags
- For more info call 1-866-USDA-TAG

Pneumonia

- *Pasteurella, Mycoplasma* and other bacteria
- Can be fatal before diagnosis or treatment
- Often contagious and secondary to viruses
- Common during periods of temperature fluctuation
- Affected animals depressed, poor appetite, discharge from nose, coughing, fever (104° to 107°F). Dyspnea when stressed
- Diagnosis – Exam, history, necropsy lesions, culture
- Treatment—work with vet; sometimes specific antibiotics needed
- Mycoplasma can be spread through mastitic milk, so feed milk replacer or pasteurized milk

Selenium Deficiency

- White Muscle Disease of young animals
- Often fatal
- Reproductive disorders and poor immune system performance of adults
- Muscles are pale and soft
- Secondary pneumonia possible
- In deficient areas, provide Selenium in injections, supplements and trace-mineralized salt

Pregnancy Toxemia

- Most common in late-term fat does carrying multiple kids (high energy demands, little room for food)
- Can be precipitated by a sudden lack of feed or decreased feed intake for any reason
- Off feed, depressed, weak, act strange, fruity breath; urine ketones positive
- Preventable by good management: make sure does are in a gaining plane of nutrition during last 6 wks. of pregnancy; keep them eating!
- May need emergency C-section to save doe's life

Urinary Calculosis (stones)

- Usually found in wethers
- Result of early castration?
- Usually on high-grain diet with Ca:P $\leq$ 1:1; high Mg
- Signs: straining to urinate, bloody urine, crying, water belly
- Prevention: Acidify urine (10 gm ammonium chloride per animal daily), Ca:P $\geq$ 2:1
- Water, water, water
- Feed minimal grain for gain desired

Acidosis

- An important and under-diagnosed disorder
- Result of any sudden or excessive intake of carbohydrates such as apples, molasses, grain…
- Common in animals on high levels of grain
- Can be fatal

- Signs: +/- bloat, diarrhea, off feed, no rumen contractions, no cud chewing. Rumen pH drops severely; GIT ulcers, low body pH, depression, diarrhea, coma, death. May founder if survive
- Treatment: Call vet; fluids, antacids, high fiber/bland diet, microbes, anti-inflammatories

Polioencephalomalacia

- Softening of the brain secondary to anything that causes thiamine deficiency
- Predisposed by high carbohydrate diets, sudden dietary changes, oral antibiotics, anorexia due to another illness; Thiaminase in bracken fern and equisetum
- Thiamine (a B-vitamin) normally produced by rumen microbes
- Signs: blindness, down, paddling, change in behavior, death
- Responds well to thiamine injection +/- steroids

Poisonous Plants

- LOTS of them!
- Many are fatal
- Learn about those in our area: cherry, poison hemlock, yew, elderberry, St. Johnswort, lupine, tansy, locoweed, mountain laurel, water hemlock, rhododendron...

Parasites—refer to other presentation

WARNING!

- Few medications are approved for use in goats. It is unlawful to use a non-approved product in a food animal without prior approval by a veterinarian. A valid veterinarian-client-patient relationship must exist for extra-label use to be legal.

Extra-Label Use = Using any medication...

- *at a dose rate,*
- *for a length of time,*
- *in a species,*
- *or with a different route of administration*

...than stated on the label with a veterinarian's approval. Legal with valid veterinary-client-patient relationship

Record Keeping: Essential for profitable enterprise

- Birth weight
- Breeding dates
- Sire, dam
- Birth date
- Weaning weight
- Kidding ease
- Number kids born
- Number kids weaned
- Pounds of kids weaned
- Pounds of milk produced
- Dates of routine procedures (vacc, worm)
- Illnesses
- Reason culled
- Autopsy results
- Where sold
- Fertility test results (buck)
- Grafting details

- Rate of gain
- Dressing %
- FAMACHA scores
- Number of times dewormed
- Etc., especially anything else you wish you had written down!

Quality Assurance: Your Responsibility!

- Do not give injections in loin or leg
- Give injections under skin vs. in muscle when possible
- Read and follow all label instructions
- Inject no more than 10 cc in one spot
- Keep accurate records
- Store medications properly
- Do not combine injections in one syringe
- Abide by all meat withholding times
- Contact your vet before using any unapproved medications
- Do not give more than the prescribed dosage
- Your animals will enter our food supply!
- Use medications JUDICIOUSLY

Books and Extension Resources

- www.sheepandgoat.com
- www.cals.ncsu.edu/an_sci/extension/animal/meatgoat/ahgoats_index.html
- http://outlands.tripod.com/farm/national_goat_handbook.pdf
- National 4-H Cooperative Curriculum Systems meat goat and dairy goat curricula available at www.n4hccs.org
- Veterinary Parasitology by Foreyt, 2001, 5th edition
- Raising Goats for Meat and Milk, Heifer Project International
- Meat Goats, Alberta Agriculture, Food and Rural Development
- Goat Medicine by Smith and Sherman, 1994 ISBN 0-8121-1478-7
- Goat Health Handbook, 1983, ISBN 1-57360-001-6

Non-Extension Resources (not all content can be validated as accurate or science-based)

- www.jackmauldin.com
- www.goatworld.com
- www.tennesseemeatgoats.com/articles2/articlesMain.html

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Goat Emergencies

Dr. Susan Kerr
Washington State University - Klickitat County

WARNING!
This information is not intended to replace the advice of your veterinarian. These are hints to help when a veterinarian is not readily available.

STAY LEGAL!
- Few medications are approved for use in sheep and goats
- To use any medication mentioned here, you must do so on the advice of a licensed veterinarian with whom you have a valid veterinarian-client-patient relationship
- Using any unapproved medication or an approved medication in any way not specifically listed on its label without the advice of a veterinarian is a violation of the federal Food Safety Act and punishable by fines and incarceration
- Sheep and goats are food animals! Avoid residues!

BASIC PRINCIPLES OF FIRST AID
- Protect yourself from harm
- Do no further harm to your animal
- Stabilize and prevent secondary injuries
- Seek assistance ASAP
- Stay calm; things often look worse than they are
- PREVENT injuries and illnesses!

QUICK ASSESSMENT
- Know what is normal for your animal(s)
- Take T P R (temp, pulse and respiration rate)
- Assess attitude, appetite, anatomy, behavior
- Review history (vaccinations, worming, kidding/ lambing recent changes in management, etc.)
- Be observant--look at environment and herd

ANAPHYLACTIC SHOCK
- Allergic reaction to any antigen
- Can happen at any age to any new or previous antigen
- More common after previous exposure to antigen
- Signs: trembling, respiratory distress, vomiting, diarrhea, drooling, collapse, seizures, death before help can arrive
- Treatment: epinephrine (IV > IM); may need fluid therapy
- Prevention: always have appropriate epinephrine dose drawn up in syringe and ready for use when giving any injection. Use proper injection techniques (aspirate before injecting) when using any product.

ELECTROCUTION
- Due to electricity/water interface, faulty wiring, lightning, chewing on wires
- Death can be instantaneous due to respiratory and/or circulatory arrest
- If non-fatal: coma, depression, weakness, paralysis and/or hypersensitivity, perhaps for life
- May see singe marks on hair and skin
- Animals can be thrown by the shock and even sustain fractures from extreme muscular contractions
- Peracute treatment: epinephrine
- Use caution! What was the cause? Avoid risk to self

LACERATIONS AND HEMORRHAGE
- Stay calm; things often look worse than they are
- Firm direct pressure stops most bleeding
- Apply clean barrier, then firm pressure; don't let go; can overwrap with very, very firm pressure

- May need to apply hemostat to individual blood vessels if you can see them or even brief tourniquet to stop bleeding to assess injury
- Protect from contamination
- Stitches will hasten healing, reduce scarring
- Antibiotics, anti-inflammatories, tetanus booster
- PREVENT! Look for hazards in environment

PUNCTURES

- Clean well, soak, keep open
- May need to bandage for protection
- Do not suture
- +/- antibiotics, anti-inflammatories
- Tetanus booster and/or anti-toxin
- Prevent

CHOKE

- Potentially fatal
- Usual cause: grain, carrot, apple, potato
- Distress, anxiety, drooling, bloat
- Protect self if examine animal's oral cavity (teeth; Rabies exposure potential)
- Pass stomach tube with caution—may not be able to pass tube; can do injury with force
- May need to use trocar (rumen puncture) to relieve gas; get to vet ASAP--may need surgery
- Know anatomy– larynx isn't a potato!

FREE GAS BLOAT

- Usually secondary to choke or some other primary problem
- Can hear "ping" on distended upper left side
- MAY respond well to stomach tube or "bit"
- Can suffocate from severe pressure on lungs
- Trocar is LAST RESORT!
- Try to eliminate primary cause (choke, etc.)

FROTHY BLOAT

- Usually caused by fresh legumes or finely-ground grain
- Ruminants cannot burp out frothy gas (tiny bubbles)
- Rumen distends out greatly on upper left side
- Pressure from rumen can cause suffocation
- Tympanic (gas ping) sound unlikely
- Responds poorly to stomach tube or trocar
- Need surfactant like poloxalene, oil of turpentine, vegetable oil or mineral oil to make bubbles into free gas
- May need to pass stomach tube to administer surfactant and again afterward to expel free gas
- PREVENT!

DYSTOCIA

- Rarely are true EMERGENCIES
- Posterior presentations are most time-sensitive for kid survival
- Could you do a terminal C-section? Think about it; be ready

FRACTURES/DISLOCATIONS

- Severe lameness, swelling, crying
- Not usually immediately life-threatening
- Splint or cast AND strict rest needed for 3-6 weeks
- Splints are reasonable salvage effort for market animals
- Anti-inflammatories help with pain and swelling; no antibiotics if no wound

- No cast or splint if fracture is above stifle or elbow (makes things worse)
- Try to prevent by reducing environmental hazards

SPLINTING

- MUST be able to immobilize joint above and below fracture
- Fractures heal more quickly in young animals
- Need splint/cast AND STRICT REST for rapid healing; keep clean and dry, too
- Monitor for normal heat (toes not too hot or cold), swelling, smell
- Leave on for at least 3-6 weeks (check daily; kids and lambs grow fast); controlled access after
- Anti-inflammatories reduce swelling and pain
- If wound, need to change daily

TOXIC INDIGESTION

- Caused by acute or chronic carbohydrate overload
- Quite common; favorite or boss goat factor
- Can be fatal even days later
- Bloat, severe diarrhea, depression, recumbency, death
- May need IV fluids, probiotics, oral antibiotics, bicarbonate, anti-inflammatories, shock-dose steroids and/or lots of other medications
- Many serious sequellae (founder, etc.)
- PREVENT!

MILK FEVER

- Can be fatal
- Usually in older, high-producing does; rarely seen in sheep
- Usually 24 hours before or after kidding or even 3-4 weeks later but can be any time during lactation
- Cold, weak, down, muscle tremors, droopy ears, poorly responsive, seizures
- Give calcium PO, SQ, IM, IP or IV (best if given by vet; give slowly and monitor heart rate for irregularity)
- Grass tetany is similar, but usually when animals are on lush spring feed or low magnesium; need Cal-MPK; more common in sheep
- PREVENT through nutritional management (generally: lower calcium diet pre-parturition, higher post-parturition)

PREGNANCY TOXEMIA

- Due to negative energy balance at end of pregnancy
- Dull, depressed, poor appetite, weight loss, fruity breath, ketones in urine
- Need propylene glycol, IV dextrose; may need to have C-section or labor induction
- First aid: get carbohydrates in ASAP– grain, molasses, Karo syrup...
- PREVENT through ensuring gaining plane of nutrition in last 6 weeks of pregnancy

RESPIRATORY DISTRESS

- Many causes: allergic reaction, bloat, stress, electrocution, cancer, pneumonia, toxicity, poisonous plants, choke, acidosis, WMD, etc.
- Prevent with good ventilation, no overcrowding
- Can be precipitated by high daytime and low nighttime temperature weather
- Do not stress
- Isolate from herdmates
- Take temp
- Antibiotics may not help
- Try to get diagnosis for sake of herdmates

TOXIC MASTITIS

- PREVENT
- Very serious; can be fatal
- Usually due to a coliform or gas-producing bacteria
- Udder may be blue and cold or red and hot

- Milk may be watery or bloody or gassy
- Anti-inflammatories can be very effective
- May need IV fluids and shock-dose steroids
- Oxytocin and milk out?
- +/- antibiotics…

URINARY CALCULI

- Usually a problem of wethers on high-grain diets when Phosphorus levels higher than Calcium levels
- Life-threatening if completely block urethra
- No urine; straining, crying; wet or bloody prepuce
- Can be mistaken for constipation
- May be able to treat by snipping off urethral process if stones lodged there
- Get to vet ASAP for treatment before urethra ruptures
- PREVENT! (feed minimal grain; 10 gm. ammonium chloride daily; salt to increase water intake; Ca>P)

UTERINE PROLAPSE

- Looks awful!
- Usually with milk fever or after difficult/prolonged labor
- Protect, keep clean (garbage bag), get to vet
- No need to stitch up vulva if replaced properly
- If no vet available: restrain doe; elevate uterus; clean it with HOT water; GENTLY replace using fists, not fingers (be patient); give calcium and oxytocin after 100% returned; uterine boluses; should breed back fine if no infection

POISONINGS

- Plants (know the toxic ones in your area), chemicals
- Few specific or readily-accessible antidotes
- General: activated charcoal, mineral oil, fluids
- Focus on prevention

FIRST AID KIT

- See list for contents
- Contact vet before giving extra-label medications
- Monitor expiration dates
- Follow label recommendations re: storage (temperature, light, etc.)
- Have epinephrine on hand whenever giving injections
- Anti-inflammatories can be a life saver for toxic animals
- 3/8" I.D. vinyl or polyethylene tube with rounded edges is effective stomach tube; use w/ bite block or oral speculum

RESOURCES

- www.merckvetmanual.com
- www.sheepandgoat.com
- Goat Medicine, 2nd ed. by Mary Smith and David Sherman. Publisher: Wiley-Blackwell, 2009. ISBN-10: 0781796431. ISBN-13: 978-0781796439.

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Small Ruminant First Aid Supplies

Epinephrine
Oxytocin
Non-steroidal anti-inflammatories
Antihistamines
Vitamin B complex
Injectable Vitamin E/Selenium supplement
Injectable antibiotics
Antitoxins (Overeating, tetanus)
Sterile 50% dextrose
Pepto Bismol®
Milk of Magnesia®
Propylene glycol
Baking soda
Mineral oil
Electrolytes
Probiotics
Activated charcoal
Karo® syrup
Molasses
Triple antibiotic ointment
Bandages
Sterile gauze pads
Waterproof bandage tape
Non-adherent bandage pads
Cotton bandage rolls
Vet Wrap® or similar bandage
Duct tape
Splints
Tourniquets
Antibiotic ointment
Betadine® or Nolvasan® scrub and solution
Isopropyl alcohol
Saline solution for irrigation
Hydrogen peroxide
Ophthalmic ointment
Oral calcium supplements
Epsom salt
Scissors, hemostats, scalpel blade, forceps
Suture
Knife
Blood stop powder
Chemical ice pack
Latex disposable gloves
Sterile needles, various sizes
Sterile syringes, various sizes
60 cc drench syringe
Blanket
Stethoscope
Thermometer
Weight tape
Halter and lead rope
5-gallon bucket
Stainless steel pail
Funnel
Various sized naso-gastric tubes
PVC pipe (speculum for stomach tube)
Trocar
Garbage bags
Paper and pen
Flashlights and batteries
Emergency contact list
Hoof trimmers
Bleach
Sterile lubricant
Livestock marking crayon
Clippers
Disposable razor
Tube feeder
Head snare
Towels
Elastrator
Prolapse paddles
Fly repellent
Calculator

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Neonatal Kid Care

Dr. Susan Kerr
Washington State University - Klickitat County

Introduction

NEONATAL KID CARE

Dr. Susan Kerr, WSU-Klickitat Co. Extension

TO MINIMIZE NEONATAL KID CHORES: BE READY, KNOW DATES, PLAN!

Breeding dates beget…

- Feeding program change dates…
- And vaccination dates…
- And facility readiness…
- And kidding time!

CAUSES OF ORPHANING

- Death of dam
- Rejection by dam (behavior, interference, neonate's health, twins, etc.)
- Dam's health issues (e.g. no milk)
- Neonate health: hypoxia, prematurity, WMD...
- Special health situations (e.g. CAE)
- High lambing/kidding percentages
- May choose to bottle feed: friendly kids/lambs, sell milk, you are nuts and love bottle baby chores

NEONATAL LAMB CONCERNS

- Starvation
- Hypothermia
- Scours
- Pneumonia
- Failure to thrive
- Meconium impaction
- Poor socialization

IDENTIFYING/SELECTING BUMMERS/ORPHANS

- Gaunt, hunched up twin or triplet any age
- Weak, recumbent neonate, esp. ≤12 hrs.
- Best outcome = early ID and fostering ≤6 hrs.

GRAFTING

- Try it—saves work!
- "Slime method"
- Pelt method
- Restraint method
- Things get easier when dam can detect her milk smell at baby's anus
- Tie feet of older graftees —struggle and cry like newborns

NEONATAL CARE

- Clip
- Dip
- (Strip)
- Sip
- Keep warm and dry

- Hypothermia is a huge concern; only born with enough "brown fat" to maintain body temperature for 5 hours max

WARM VS. COLD VS. DEAD
- If temp below 99°F, neonate poorly responsive and ≤5 hours old: dry, warm, tube feed
- If temp below 99°F, neonate poorly responsive and ≥5 hours old: give warm dextrose IP, warm, tube feed

INTRAPERITONEAL DEXTROSE FOR HYPOTHERMIC NEONATES
- 20% warm dextrose solution at a rate of 10 mL/kg body weight
- Calculate amount needed and multiply by 0.4 to determine how much 50% solution to use. Example: 5 kg x 10 mL/kg = 50 mL of 20% solution needed. 50 mL x 0.4 = 20 mL of 50% solution. Draw this amount into syringe. Then draw up the difference (30 mL) in sterile water and warm to body temperature.
- Inject into abdominal cavity 1" below and 1" off the midline, pointing needle toward pelvis using 60 cc syringe and 20 gauge needle

WARMING METHODS FOR CHILLED NEONATES
- Warm towels
- Warm bath
- Warming box
- Forced hot air
- Elevate baby
- Monitor
- Remove when mouth warm (temp ≥ 99°F)

COLOSTRUM = LIFE
- Source of nutrition (calories from fat and lactose, protein, vitamins, water), laxative, *antibodies*
- Failure of Passive Transfer increases likelihood of illness and death
- Neonate's gut is non-selective at birth, initially lets antibodies cross intact. Becomes increasingly more selective with every passing hour
- Target 1: minimum of 10% BW in colostrum in 24 hours. Target 2: 3 oz. per pound of body weight div. into 3-4 meals
- After 48 hours: serum Ig level of 1200 mg/dl protective
- Colostrum with specific gravity ≥ 1.029 is good quality
- Tube feeding = essential skill; can you do it?

PASTEURIZATION VS. HEAT TREATMENT
- Heat treatment of colostrum: Heat and hold at 135°F for one hour; stirring
- Pasteurization of milk: Heat to 165°F for 30 sec.; stir so all milk heated evenly

FEEDING POST COLOSTRUM
- Milk vs. milk replacer?
- Bottle vs. Lam-Bar vs. bucket?
- Warm vs. cold?
- Feed about 3 oz. per pound of body weight daily divided into several feedings. Small frequent feedings are safer than fewer, larger meals.
- Increase amount fed with increasing body weight
- Quality milk replacer has animal-origin fat source and milk protein source; 20% fat, 26% protein
- Creep feed, hay, water: start within first week; keep clean and fresh

MILK CONSUMPTION
- Weeks 0-2: 1+ quart/day
- Week 2-3: 1.5 quarts/day
- Week 3-4: ~2 quarts/day

KEEP 'EM ALIVE
- Cleanliness and sanitation paramount

- Sanitize equipment
- Ventilation, not drafts
- Supplemental heat: coats, heating lamp. Prevent mobbing/crushing
- Use good quality milk replacer

CONCERNS: SCOURS AND PNEUMONIA
- Prevention!
- Keep pen and feeding equipment clean
- Ensure adequate colostrum intake
- Do not overcrowd
- Feed smaller, more frequent meals vs. few large meals
- Do not mix ages in pens
- Fresh air, no drafts
- Move groups into new, clean pens; clean and rest previous pens
- Make changes gradually
- Provide supplemental heat to prevent chilling

SCOURS TREATMENT
- Isolate
- Keep warm
- Replace milk feedings with electrolyte feedings
- Do not hold off milk for more than 24 hours
- Do not give oral antibiotics unless directed by veterinarian
- Give probiotics
- If severe, may need SQ or IV fluids
- Re-introduce milk in small feedings at least 4 hours after electrolytes
- If persists or widespread, consider diagnostic work-up

CONTINUED CARE
- Selenium supplementation
- Vaccinations
- Coccidia prevention/treatment
- No urea in diet until rumen fully functional (3 months)
- 18-20% CP supplement to 40#, then 12-14%
- Weaning

WEANING
- *Must be eating solid feed well and be gaining weight well before weaning*
- Timing: Depends!
- At around 20# if feeding milk replacer? (saves $)
- After feeding 20-25# of milk replacer?
- At 3-6-8 weeks? 3-6 months?
- Method: Abrupt seems best
- Low-stress fenceline weaning: kids can see and hear does but not nurse; excellent fence needed!

"THE HUSBAND'S EYE"

Signs all is well:
- Stretches after rising, then runs to nurse
- Group not huddled in corner or always under heat lamp
- No excessive bleating
- Obvious urination and defecation
- Belly looks full, not gaunt or bloated
- Mouth is pink, warm, moist
- Back not hunched up

- Contented sleep
- Bright, alert, responsive, active, playful
- "Happy attacks"

The information herein is supplied for educational or reference purposes only, and with the understanding that no discrimination is intended. Listing of commercial products implies no endorsement by WSU Extension. Criticism of products or equipment not listed is neither implied or intended.

Some medications mentioned herein are available only by prescription, and other drugs are not labeled for use in goats. These drugs can only be used on the advice of a licensed veterinarian when a veterinarian-client-patient relationship exists. Other use violates federal law. Consult your veterinarian about the extra-label use of medications.

This information is not intended to replace the advice of your veterinarian. Consult your veterinarian whenever you have a question about your animal's health.

Suggested Kidding Supplies

- 7% Iodine for navels
- Disinfectant soap (Betadine®, Nolvasan®)
- Sterile syringes
- Sterile needles
- Propylene glycol to treat ketosis
- Uterine/vaginal prolapse retainers (prolapse paddles)
- Surgical instruments (scissors, hemostats)
- OB lubricant
- Disinfected OB equipment (head snare, ropes)
- Thermometer
- Dextrose
- Disinfected feeding tube
- Heat-treated colostrum
- Clostridium C, D and T antitoxin
- Stethoscope
- Hydrogen peroxide
- Gloves and OB sleeves
- Aspiration bulb for noses
- Scalpel blades
- Clippers
- Kid sweaters
- Ear tags and tagger or tattoo gun
- Paint sticks/marking crayons
- Castration equipment
- Clean towels
- 4X4 gauze squares or cotton wads
- Milk replacer
- Clean stainless steel pail
- Pelt knife for grafting
- Fly repellent
- Styptic pencil for open umbilical cords
- Umbilical tape for prolapse paddles and navels
- Heat lamp
- Weigh scale
- Record-keeping sheets and pencils
- Calculator
- Flashlight
- Disinfected milk bottles and nipples

Medications *(most are not approved for use in goats; need veterinarian's approval for extra-label use and advice on dosage; some require special training to use)*

- Lidocaine for nerve blocks (must use with caution in goats)
- Banamine® for fever, toxicity, inflammation
- Dopram® (respiratory stimulant)
- Aspirin for fever or inflammation
- Epinephrine (adrenaline)
- Injectable selenium (Bo-Se®)
- Mastitis medication
- Injectable antibiotics (penicillin, etc.)
- Uterine antibiotic boli
- Oral or injectable calcium for milk fever, etc.
- Eye ointment
- Oxytocin to contract uterus & for milk letdown
- Electrolytes for scours

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Cooperating agencies: Washington State University, U.S. Department of Agriculture and Klickitat County. Extension programs and employment are available to all without discrimination. Evidence of noncompliance may be reported through your local Extension office.

Biosecurity: It's Worth the Effort!

Dr. Susan Kerr
Washington State University - Klickitat County

MANY PROBLEMS CAN BE PREVENTED!

- Buy from reputable and disease-free sources
- Provide a safe environment
- Provide good nutrition
- Maintain good farm sanitation
- Isolate new additions to herd
- Minimize stress
- Remove and compost manure
- Vaccinate, worm and trim feet regularly
- Ensure adequate colostrum intake

SOME SOURCES OF STRESS

- Malnutrition
- Parasitism
- Overcrowding
- Dust
- Poor ventilation
- Ammonia fumes
- Lack of colostrum
- Transportation/shipping
- Introduction of new animals
- Dampness/rain/wet/chilling

WHAT IS BIOSECURITY? PROTECTING YOUR LIVESTOCK FROM HEALTH RISKS

- Disinfecting equipment, facilities and clothing
- Using protective clothing (rubber boots, coveralls)
- Limiting visitors
- Doing hospital chores last
- Washing your hands
- Vaccinating
- Purchasing from negative herds
- Keeping a closed herd (?)
- Isolating additions to herd for 3 mo.
- Controlling flies, mice, cats, birds
- Avoiding bummers and not holding animals back

SANITATION CONSIDERATIONS

- Isolate new additions to herd
- Sanitize needles and instruments
- Good ventilation
- Use disinfectants
- Sunshine
- Limit visitors (?)
- Parasite control
- Do not feed on ground
- Drain wet areas if possible
- Provide clean water
- Avoid sales, shows and auctions

- Spread manure on hayfields; harrow pastures

BIOSECURITY AS A PART OF DISEASE PREVENTION

- Excellent ventilation
- Prevent overcrowding
- Avoid taking animals to shows and sales
- Isolate new animals
- Separate animals by age groups after weaning
- Good nutrition
- Deworming if indicated
- Good sanitation
- Provide shelter
- Reduce stress
- COLOSTRUM for neonates

BOOKS AND EXTENSION RESOURCES

- www.sheepandgoat.com
- www.cals.ncsu.edu/an_sci/extension/animal/meatgoat/ahgoats_index.html
- http://outlands.tripod.com/farm/national_goat_handbook.pdf
- National 4-H Cooperative Curriculum Systems meat goat and dairy goat curricula available at www.n4hccs.org
- Veterinary Parasitology by Foreyt, 2001, 5th edition
- Raising Goats for Meat and Milk, Heifer Project International
- Meat Goats, Alberta Agriculture, Food and Rural Development
- Goat Medicine by Smith and Sherman, 1994 ISBN 0-8121-1478-7
- Goat Health Handbook, 1983, ISBN 1-57360-001-6

NON-EXTENSION RESOURCES (not all content can be validated as accurate or science-based)

- www.jackmauldin.com
- www.goatworld.com
- www.tennesseemeatgoats.com/articles2/articlesMain.html

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Reproduction and the Bottom Line

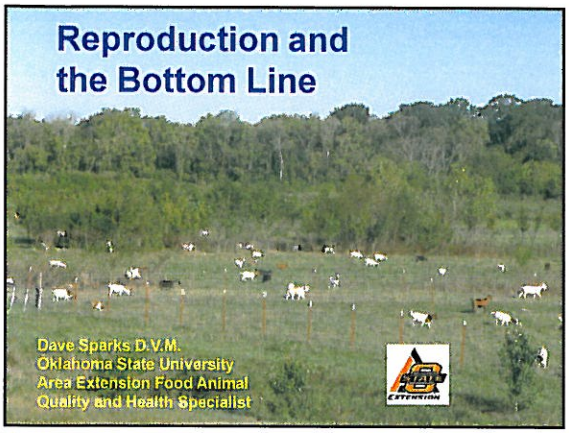
Dr. Dave Sparks
Oklahoma State University

Introduction

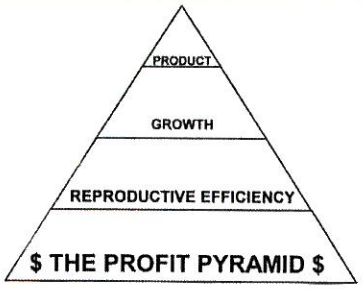
Reproductive efficiency probably affects the profitability of meat goat operations more than any other factor. It seems like reproduction should be the simple part of the goat management plan. After all we only have to let nature take its course, right? Remember that in nature all that is required is to reproduce efficiently enough to maintain the population, not show a profit. A better understanding of the reproductive physiology and some simple management tips can help producers manage to have more product to offset the expenses, and maybe even have a little black ink left over.

As I give talks on meat goat health and productivity I find that most of us are in this industry because we enjoy working with our goats. Most of the folks I visit with, however, tell me that they would enjoy it a lot more if they were taking some profits to the bank. Many producers don't realize that although carcass quality and growth rate are important, it is reproduction performance that spells the difference between profit and loss. Today in Oklahoma, there is about a $5/cwt difference in the sale price of a number 1 or number 2 kid. On a 60 Ib. kid, this translates to about $3.00 per goat. Obviously kids that reach market weight faster are more profitable. If however, your doe can wean twice as many kids, then the income is doubled, while the expense of maintaining the does is unchanged. This is important for commercial producers, but it is even more important for purebred breeders who are depreciating large investments for their breeding herd. The easiest and fastest way to increase profits is simply to have more kids to hop in the trailer when it is time to go!

Reproduction and the Bottom Line

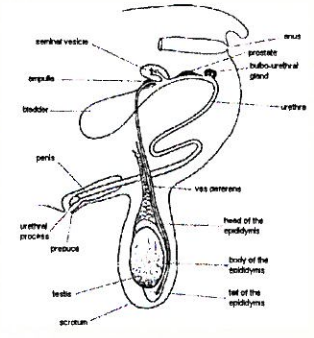


Relative Economic Value of Traits



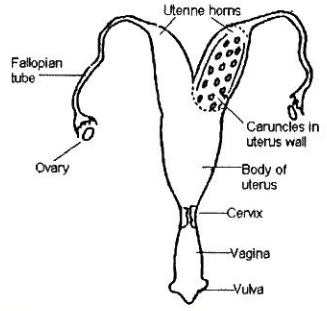
Male Reproductive System

The male continues to manufacture haploid cells, the sperm, throughout his life.



Female Reproductive Tract

The female is born with a predetermined number of haploid cells, the ova or egg cells, in her ovary and will never make any more.



Goat Estrous Cycle

- Anestrous
  - The time between breeding seasons when the doe is not coming into heat
- Estrus
  - The time the doe is "in heat"
- Metestrus
  - The time between heat periods when the doe is trying to become pregnant

Anestrus

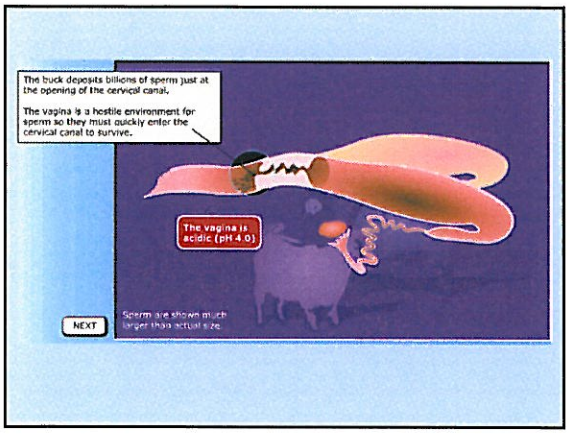
- Goats are seasonal breeders. Anestrous is the part of the year when does are not cycling.
- All reproductive hormone levels are low.
- The onset and decline of the breeding season are controlled by day length and buck activities.
- Poorly influenced by drugs, but can be influenced by artificial lights and teaser bucks.

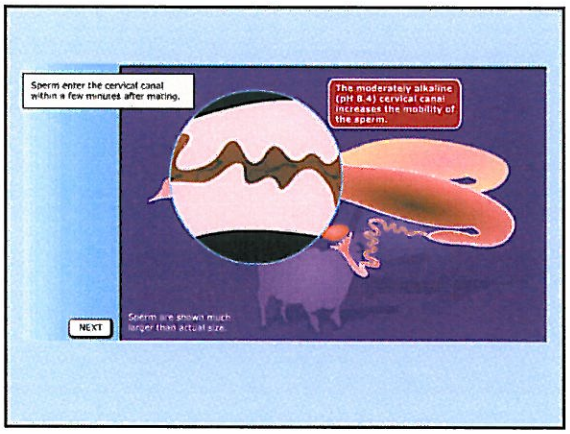
Estrus

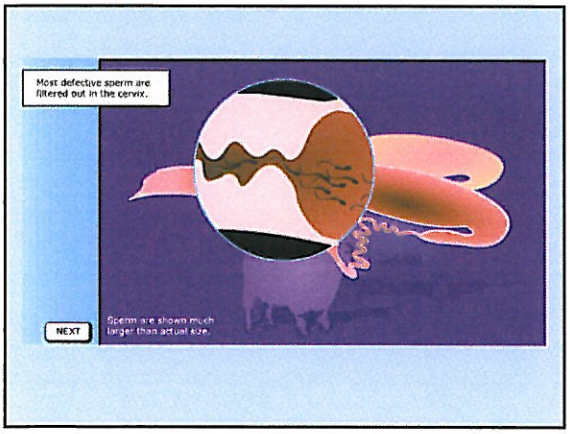
- This is the period just before, during and just after the egg is released in the ovary.
- The dominant structure on the ovary is the follicle which releases estrogen as the dominant hormone in the system.
- The estrogen causes the doe to be receptive to the male.

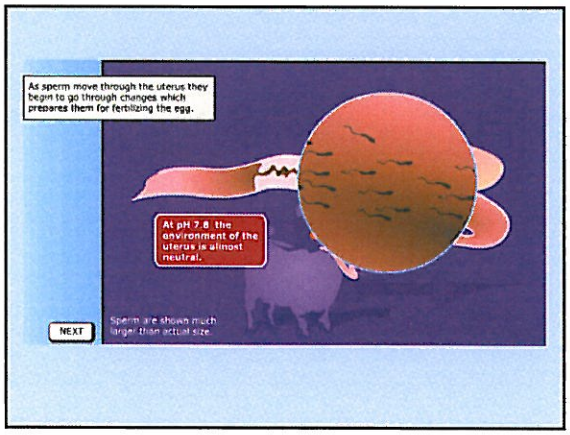
Metestrus

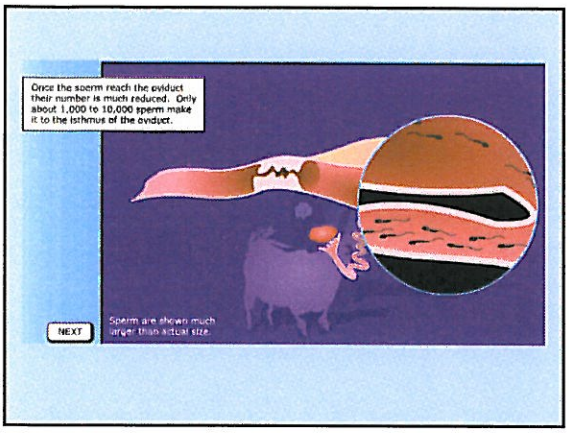
- The part of the cycle between heat periods.
- The dominant structure on the ovary is the Corpus Luteum and the dominant hormone is progesterone.
- Under the influence of progesterone the doe rejects the buck and the reproductive tract undergoes changes to allow for attachment of the embryo and support of the pregnancy.

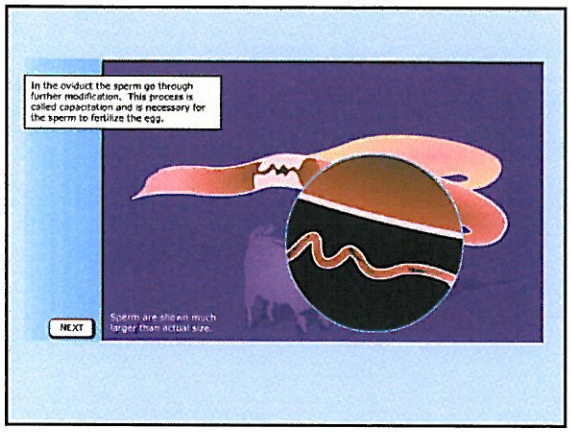


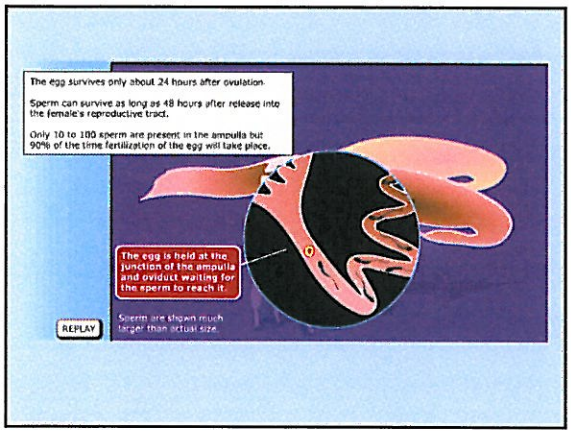












How Big is Big Enough?

Kid doe body weight at mating (lb)	First kidding%	Average lifetime kidding%
Below 40	2	48
40 – 44	21	70
44 – 51	32	72
51 – 55	55	79
55 – 60	78	82
60 – 70	81	86
Above 70	88	89

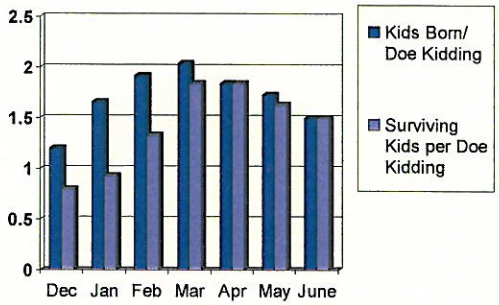
Weaning Traits of Boer Does (3 Matings)

Dam ID	Litter Size, n	Litter Wt, lbs
220	2.33	100.27
217	2.00	90.93
Herd Avg	*1.48*	*58.00*
Boer Avg	*1.19*	*47.57*
247	1.00	35.48
207	1.00	34.20

You Can't Afford Singles

- The average meat goat doe eats about 1 ton of "something" per year!!
- First time does have a higher percentage of singles.
- Second pregnancies tend to be singles if first time was twins.
- Higher percentage of singles in mature does following triplets in prior year.
- Does above the age of 6 years have a higher percentage of singles.

Does Bred Early or Late Have More Singles



Teaser Bucks Can Help!

- Teasers are intact vasectomized males used to stimulate the does.
- Teasers stimulate does to cycle but cannot cause a pregnancy.
- When herd sires are introduced the doe is more fertile than on her first cycle of the season.
- Quality or size is not a concern but teasers should be tough, vigorous and trouble free.

Nutrition and Reproduction

- **Flushing – Increasing nutritional plane by adding .5 lbs of corn or protein supplement for 2 weeks before and 2 weeks after breeding increases pregnancy rate and litter size at birth.**
- **Does in good body condition at breeding deliver more kids and have better kid survival rates.**
- **Pregnancy toxemia**

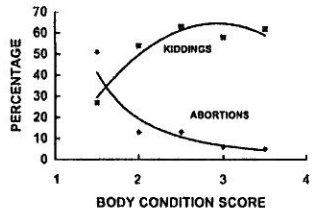


Fig. 1. Relationship between body condition score of goats at mating and abortion and kidding rates.

Pregnancy Toxemia

- **Inadequate carbohydrates in diet in last trimester causes mother to metabolize her body fat.**
- **By product is ketones which build up to toxic levels.**
- **Doe carrying twins, carbo requirement increases to 180%, with triplets 240%.**
- **Doe should gain ½ lb. day last trimester.**

Pregnancy Diagnosis

- **Can reduce costs, increase income, and maximize returns on available inputs.**
- **Several possibilities, each with advantages and disadvantages.**
  - Doppler Ultrasound
  - "A Mode" Ultrasound
  - Blood Hormone Assay

Doppler Ultrasound

- Expensive to purchase.
- Delicate and only somewhat portable.
- Requires extensive training and practice to use accurately.
- Accurate and early results.
- Use with multiple species and multiple functions.
- May show number of fetuses.
- Slower to operate accurately.

Ultrasound of 55 day Pregnancy

"A Mode" Ultrasound

- Inexpensive to purchase and operate
- Purchase preset for one type of animal.
- Quickly operate successfully.
- Accurate at 30 to 40 days.
- Audio tones. Can not tell how many kids are present.
- Tough and easily portable.

Blood Chemical Assay

- BioPRYN – Measures the amount of a very specific protein, released from the plancenta, present in the maternal blood.
- Accurate at 26 days
- 95% accurate
- Samples received in lab by Wednesday are reported Friday
- Cost is $7.50/test + supplies and shipping

- www.biotracking.com
- 208-882-9736

Assisted Reproduction

- **Artificial Insemination**
- **Embryo Transfer**

Valuable tools for increasing the impact of outstanding genetics, but also require increased management, cost, and risk.

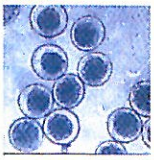
Artificial Insemination

- **Bucks are collected via;**
  - **Artificial Vagina and estrus doe**
  - **Electro-ejaculator**
- **Semen is examined, extended, and frozen.**

- **Semen is placed inside the cervix by means of a glass speculum and pipette.**
- **Typical conception rates are 30-50% for one insemination or 60-80% with 2 or three inseminations.**
  - **May get 2 or 3 straws with one certificate.**
- **Laparoscopic AI increases the success rate but also the danger to doe and the cost.**

Embryo Transfer

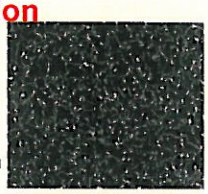
High value doe is synchronized with lower value does, super-ovulated, and bred to high value buck. At about 1 week of pregnancy the fertile embryos are flushed from the donor doe and introduced surgically into heat synchronized recipient does.



- Typically harvest from 0 to 20 fertile embryos from donor.
- Very expensive and management intensive, must have strong market for high value kids.
- Difficult to do legally in goats due to restrictions on drugs used in the procedure.

Buck Breeding Soundness Examination

- Not so much to identify sterile males as to identify marginally fertile males.
- Late kidding, low conception rates and small litter sizes cost big dollars. (Especially since goats are seasonal breeders and goat markets are seasonal)



Breeding Soundness Exam

- Evaluation of semen sample
  - Semen volume and concentration
  - Correct morphology
  - Motility
- Physical examination for ability to breed
  - Reproductive system
  - Musculoskeletal system
- Libido determination must be made from observations over time.

Your local veterinarian can help you identify problems before they are problems.

Oklahoma Veterinary Medical Association
www.okvma.org

American Association of Small Ruminant Practitioners
www.aasrp.org

Meat Goat Nutrition

Dr. Steve Hart
Langston University

Introduction

Proper nutrition is essential for the health and productivity of all animals and is the basis of successful production systems. A well planned and executed preventive health program cannot overcome problems that are created by poor nutrition. Nor can advanced reproductive technologies overcome nutritional limitations of reproduction. Therefore, nutrition of the goat is of paramount importance for successful goat production. Nutrition is the science of providing nutrients to animals in adequate amounts and in forms that the animals will consume. For sustainable and profitable production, these nutrients must also be provided in a cost-effective manner.

The ruminant stomach

Goats are ruminants, animals with a four-compartment stomach, as are cattle, sheep, and deer. The compartments are the reticulum, rumen, omasum, and abomasum (true stomach). Monogastric or simple-stomached animals such as humans, dogs, and cats consume food that undergoes acidic breakdown in the stomach and enzymatic digestion in the small intestine where most nutrients are absorbed. In ruminants, feed first undergoes microbial digestion in the reticulum and rumen (together often called the reticulo-rumen) prior to acidic digestion in the abomasum and enzymatic digestion and nutrient absorption in the small intestine. It is the microbial digestion in the reticulo-rumen that enables ruminants to consume and utilize grass, hay, leaves, browse, etc.

The reticulum and rumen form a large fermentation vat that contains microorganisms, mainly bacteria, that breakdown and digest feedstuffs, including the fibrous component of grass, forbs, and browse that cannot be digested by monogastric animals. Some of the breakdown products produced through digestion of feed by bacteria are absorbed by the animal through the rumen wall and can supply a large part of an animal's energy needs. The rest of the byproducts of digestion, undigested feed, and ruminal microorganisms flow out of the reticulo-rumen into the omasum where large feed particles are trapped for further digestion and water is reabsorbed. Material then flows into the abomasum where acidic digestion takes place and then to the small intestine for further enzymatic digestion and nutrient absorption.

The rumen provides several advantages to the goat in addition to digestion of dietary fiber. The bacteria in the rumen are capable of synthesizing all B vitamins needed. Bacteria can also synthesize protein from nitrogen recycled in the body, which may be advantageous on low protein diets. For proper ruminal function, goats require a certain level of fiber (measured as crude fiber, acid detergent fiber, or neutral detergent fiber) in the diet. Goats have bacteria in the rumen that can detoxify antinutritional factors, such as tannins. This enables goats to better utilize feedstuffs containing high tannin levels such as those found in browse. There are very few situations in which a goat will not consume adequate fiber, but one is when a very high grain diet is being fed. Inadequate fiber consumption can then lead to several disease conditions. The most important disease condition is acidosis or an extremely low pH in the rumen, causing decreased feed consumption.

When ruminants are born, the first three compartments of the stomach are underdeveloped and the stomach functions similar to that of a monogastric animal. This enables absorption of antibodies in colostrum and efficient utilization of nutrients in milk. As the young ruminant consumes solid feed, especially high in fiber, and the microbial population is established, the rumen is stimulated to develop. The rumen must have an acceptable degree of development for successful weaning.

The greatest asset of goats is the ability and tendency to utilize woody plants and weeds, not typically consumed by other species of animals (e.g., cattle and sheep), converting them into a saleable product. Therefore, these plant species can be inexpensive sources of nutrients and make for a very profitable goat enterprise. Goats typically consume a number of different plant species in any one day and can utilize some poisonous plants because they do not consume enough to be toxic. Similarly, goats are believed to have a relatively high ability to detoxify absorbed anti-nutritional factors. Goats are more resistant to bloating than other ruminants, and after a brief adaptation may graze alfalfa without bloating.

Nutrients

Nutrients are defined as substances that aid in the support of life. The six classes of nutrients include protein, carbohydrate, fat, vitamins, minerals, and water. Nutrients are often classified as organic (carbon-containing) or inorganic (minerals).

Energy is not considered a nutrient, but can be derived from the breakdown of several nutrients including fat, protein, and both simple and complex carbohydrates. Energy is required to propel the biochemical processes that are necessary to sustain life. A deficiency of energy will cause weight loss, low productivity, and ultimate death of an animal. An oversupply of energy will usually result in excessive fatness, which is also unhealthy. A simple unit of measurement of energy is pounds of total digestible nutrients (TDN). A lb of TDN, equivalent to a pound of digested carbohydrate, equals 2,000 Kilocalories (or Calories as used in human nutrition) of digestible energy. There are a number of other measures of energy used, but they are less easily understood.

Water

Water is an essential nutrient for all animals and is sometimes overlooked. While goats require less water than cattle, they do need water and require additional quantities when lactating or coping with hot weather. A 110 lb goat will require 1 to 3 gallons of water per day depending upon diet, intake, and weather, toward the lower range in winter and toward the upper range in the hottest days of summer. A lactating goat will require an additional 1 quart of water for every 1 pint of milk produced. If a goat is producing 5 pints of milk at peak lactation while raising twins, 2.5 gallons of water are required each day. If goats are eating green material, a substantial part of their water requirement can be met by water contained in the plant material. However, if dry feed such as hay is consumed, water must be supplied to meet the requirement.

Water should be kept clean to encourage intake. This usually involves regular cleaning of the waterer. It is important that the area around the waterer not be muddy, as this is a good environment to spread foot rot and internal parasites. Placing some rock or gravel around the waterer can help keep feet dry and reduce disease problems. Water cleanliness is especially important for bucks on high grain diets. Their water needs to be shaded in summer and warm in the winter to encourage intake and reduce the risk of urinary calculi.

Carbohydrates

Carbohydrates usually provide the majority of energy to goats. Carbohydrates can be classified as simple, such as sugars (easily identified by their sweet taste; maybe 1, 2, or 3 sugar molecules linked together), or complex, such as starch (found in grains) or cellulose (i.e., fiber). Grass, forb, and browse plant species generally contain high levels of cellulose, which must be digested by rumen bacteria to provide energy.

Cellulose is often referred to as fiber, although the term fiber also pertains to other substances such as hemicellulose and lignin. Fiber in young plants may be highly digestible and provide a high level of energy, but fiber in older, mature plants is often poorly digested and may only provide half the energy of other carbohydrates. Fiber in the diet may be characterized chemically in several ways, such as crude fiber (CF), acid detergent fiber (ADF), and neutral detergent fiber (NDF). These abbreviations are used in hay analysis

and may appear on feed tags. In general, the lower the fiber level, the higher the level of digestible energy. However, a certain minimum fiber level is required for healthy rumen function.

Goats do not adapt as easily to high concentrate diets as cattle and sheep and are more likely to get acidosis, founder, urinary calculi, and enterotoxemia. To avoid these problems, the concentrate level in the diet should be increased when placing goats on high concentrate diets and maintain a minimum of 12% crude fiber in the diet or about half of the diet as grass, browse, or hay. Goats are typically not feed efficient, except for some rapidly growing Boer goats, and may require 7 lbs or more of feed per pound of gain. Also, one must be very alert for health problems with goats on high grain diets.

Fats

Fats, also called lipids, are very high in energy, providing more than twice the energy of carbohydrate on a weight basis. The fat content of ruminant diets is generally low, as plants have a low fat content. Plant waxes are fats that goats consume as they graze and browse, but they are not digested. Fat may be added to diets to increase the energy content. However, high levels of added fat depress fiber digestion unless treated to be inactive in the rumen. These fat sources are termed "bypass" and may be used in dairy goat diets but are generally not used in meat goat diets.

Protein

Protein is composed of building blocks called amino acids that the body uses to produce all of the different proteins required for growth, production, and maintenance. Protein is required in the diet for accumulation of new body mass (growth) and for replacing protein lost by normal wear and tear.

Ruminant animals are usually fed supplemental protein to make up for dietary shortfalls. In the rumen, bacteria degrade much of the consumed protein and use the amino acids to form bacterial protein. Bacteria can also form protein from nonprotein sources such as urea and, if provided with sufficient energy, can form significant quantities of protein. To prevent breakdown and digestion by ruminal bacteria, some protein sources are protected from degradation by coating or other means. Some natural proteins are also resistant to ruminal degradation by bacteria. These types of proteins are referred to as "bypass protein" as they bypass digestion in the rumen. Other common terms for bypass protein are "ruminal escape" and "rumen undegraded." Bypass protein sources are very important in dairy cow nutrition, but have lesser significance in most meat goat production systems.

Urea is the main nonprotein nitrogen source fed to ruminants. However, goats are not commonly fed urea as frequently as cattle. This may be because goats are more subject to urea toxicity than cattle. Goats appear more efficient than other species at recycling nitrogen in the body to the rumen where it can be used to form microbial protein, given that sufficient energy is available. This recycling of urea to the rumen helps to reduce the amount of protein required in the diet. When goats are consuming a low quality forage, a grain supplement may also improve protein status by providing additional energy for protein synthesis by ruminal microbes.

Vitamins

Vitamins function as critical chemicals in the body's metabolic machinery and as co-factors in many metabolic processes. The deficiency of a vitamin will slow or block the metabolic process in which that vitamin is involved, resulting in deficiency symptoms. Vitamins are divided into those that are fat soluble (i.e., A, D, E, and K) and those that are water soluble (i.e., B vitamins and C).

The bacteria in the rumen of the goat can synthesize adequate amounts of the water soluble vitamins. Thiamine, or vitamin B1, may become deficient under some conditions (e.g., feeding a high concentrate diet, especially those with high sulfur which may come from a high level of molasses) and cause the disease polioencephalomalacia. Sometimes, however there are other unexplained causes of polioencephalomalacia.

Another situation that could lead to thiamine deficiency is improper feeding of the coccidiostat Corid®. The coccidiostat ties up thiamine, making the coccidia unable to reproduce. Feeding Corid® longer or at higher levels than recommended could lead to polioencephalomalacia. Polioencephalomalacia is a nervous disorder where the animal becomes blind, depressed, presses with his head, and the pupil slit in the eyes becomes up and down rather than the normal side to side profile. Treatment requires immediate injection of large quantities of thiamine.

Fat soluble vitamins must be supplied to the goat because the body cannot directly make them. The recommended levels of vitamins in formulated feed is 5,000 IU (international units, a measure of the potency of vitamins) of vitamin A per lb, 2,000 IU/lb of vitamin D, and 80 IU/lb of Vitamin E. The liver can store significant amounts of the fat soluble vitamins.

Vitamin A can be synthesized from carotene, the pigment that gives grass and hay their green color. As long as sufficient green feed is consumed, vitamin A intake will be adequate. Vitamin A is necessary for normal epithelium (skin) development and vision. A deficiency of vitamin A causes many symptoms, including tearing of the eyes, diarrhea, susceptibility to respiratory infection, and reproduction problems. Vitamin A is often supplied to animals not consuming green forage such as in winter months. Many mineral and vitamin supplements contain vitamin A.

Vitamin D is called the sunshine vitamin because animals can synthesize the vitamin with the help of the sun. Ultraviolet light in sunshine converts pre-vitamin D found in the skin to a pro-vitamin D form that is used by the animals. Usually, even limited sunlight exposure is adequate to provide a day's supply of vitamin D. Sun-cured hay contains Vitamin D. Vitamin D is necessary for calcium absorption and metabolism by the body. A deficiency of vitamin D, called rickets, results in lameness, weak bones, and bowed and crooked legs. The liver is the main Vitamin D storage site in the body. Vitamin D is normally present in mineral supplements and often added to complete feeds.

Vitamin E functions as an antioxidant in conjunction with the mineral selenium. The requirements for one can be partially met by the other. Thus, vitamin E is very important in areas with marginal or deficient levels of selenium. A common vitamin E deficiency disease, particularly in newborn or young animals, is white muscle disease, where white spots are seen in the heart and skeletal muscle due to oxidation damage. A marginal deficiency of vitamin E can depress the immune system and cause reproductive failure. Green grass and green sun-cured hay have high levels of vitamin E. Most mineral supplements and complete feeds contain vitamin E, especially in areas that are deficient in selenium. Vitamin E is expensive and minimal supplemental levels are used in contrast to vitamins A and D that are less expensive and often included at generous levels.

Vitamin K is technically required by animals and functions in the clotting of blood. Vitamin K is produced by bacteria in the lower digestive tract and absorbed. Generally, there is no need to supplement goats with vitamin K.

Minerals

The inorganic nutrients are called minerals. Minerals are further subdivided into macrominerals, those required at 0.1% or more in the diet (macro means large), and microminerals, those required at the part per million (ppm) level (micro means small). A ppm is the weight of a paperclip in a thousand pounds of feed. A hundred ppm is equal to 1.6 ounces in a thousand pounds of feed. Macrominerals include calcium, phosphorus, sodium, potassium, chloride, sulfur, and magnesium. Microminerals include iron, copper, cobalt, manganese, zinc, iodine, selenium, molybdenum, and others. Minerals function in many ways in the body. Some such as calcium and phosphorus are major structural components of bones and teeth, as well as having other functions. Other minerals facilitate nerve functioning or fulfill a role as electrolytes. The mineral requirements

for goats are not as well known as they are for other livestock species and have often been extrapolated from sheep or cattle requirements due to a lack of studies in goats. As such, mineral recommendations for goats often have a wide range because of lack of accurate goat-specific information.

Macrominerals

The macrominerals are listed below, followed by the abbreviation, normal dietary range, function, deficiency symptoms, and major dietary sources.

Calcium (Ca) 0.3 - 0.8%

The major biological function of calcium is for bones. Bones contain 99% of the calcium in body. Calcium is also necessary for muscle contraction, nerve conduction, and blood clotting. The main deficiency symptoms are seen in the skeletal system. Bones can become soft and weak and may be deformed resulting in lameness. This condition is called rickets or osteomalacia. Vitamin D deficiency causes similar symptoms due to the role of vitamin D in the absorption and metabolism of calcium. Calcium is relatively high in milk and lactating goats need adequate levels of calcium for milk production. Does can get hypocalcemia (milk fever) while lactating due to a metabolic disorder which results in a shortage of calcium in the blood due to calcium being used for milk production. Urinary calculi is a condition brought about in part by an imbalance in the calcium to phosphorus ratio in the diet. Generally, about twice as much calcium as phosphorus should be in the diet of ruminant animals. An excess of calcium can cause abnormal bone growth. Major common dietary sources of calcium include forages, limestone and dicalcium phosphate.

Phosphorus (P) 0.25 - 0.4%

Approximately 80% of the body's phosphorus is found in bones, with the remainder in the blood and other tissues. In addition to skeletal structural functions, phosphorus is essential in energy metabolism, acid-base balance, and is a constituent of enzymes and genetic material. The major symptoms of phosphorus deficiency include reduced growth, listlessness, unkempt appearance, depressed fertility, pica (depraved appetite-eating wood, rocks and bones), and decreased serum phosphorus. Phosphorus is the most commonly encountered mineral deficiency and also the most expensive macromineral. Sources of phosphorus include protein supplements, cereal byproducts, mineral supplements, and dicalcium phosphate.

Sodium (Na) 0.2%

Potassium (K) 0.8 - 2.0%

Chloride (Cl) 0.2%

All three of these minerals function as electrolytes in the body. Electrolytes are mineral ions, carrying a positive or negative charge that the body uses for osmotic balance, pH balance, and water movement. They are also essential in transmission of nerve impulses. These minerals are highly water soluble and are easily lost with diarrhea. Electrolyte solutions used to treat animals with diarrhea contain all three of these minerals. A deficiency of potassium could occur on high concentrate diets, with symptoms including poor appetite, urinary calculi, body stiffness progressing from front to rear, and pica (depraved appetite as described above). A deficiency of chloride depresses growth. A deficiency of sodium causes reduced growth and feed efficiency. Salt provides both sodium and chloride. Most forages have adequate levels of potassium.

Sulfur (S) 0.2 - 0.32%

The major biological function of sulfur is as a component of sulfur-containing amino acids. Therefore, sulfur is important in protein synthesis, milk and hair production, enzymes, hormones, hemoglobin, and connective tissue, and is a component of the vitamins biotin and thiamine. The major deficiency symptoms include poor animal performance, hair loss, excessive salivation, tearing of eyes, and weakness. Major source of sulfur is protein which contains sulfur as a component of some of the amino acids. Therefore, sulfur is important in

diets where nonprotein nitrogen (e.g., urea) is used to substitute for some protein. Sulfur-containing mineral blocks are often used for control of external parasites in goats. Excessive sulfur in high concentrate diets can contribute to polioencephalomalacia as discussed for the water soluble vitamin thiamine.

Magnesium (Mg) 0.18 - 0.4%

Magnesium is found in bones (60 to 70% of that in the body), liver, muscle, and blood. It is required for normal skeletal development, and nervous and muscular system functions, as well as for enzyme systems. It is also closely associated with metabolism of calcium and phosphorus. In ruminants, a major magnesium deficiency disease is grass tetany, often seen in animals grazing fast-growing, lush, cool season pastures. Affected animals have low blood magnesium levels, exhibit a loss of appetite, are excitable, stagger, have convulsions, and may die. High fertilization rates, cool temperatures, and high levels of plant potassium and(or) rumen ammonia may contribute to the disease. A major supplemental source of magnesium is magnesium oxide, which is often supplemented on winter wheat pasture and mixed with a protein source to encourage consumption.

Micro or trace elements

The first level after the mineral name is what is thought to be the minimum requirement in the diet, while the second is the value above which the element can become toxic. Most supplemental trace minerals are provided by trace mineralized salt or mineral mixes that are designed to provide 10 to 50% of the daily minimal requirement. This is adequate if the animal's diet is marginal in a mineral but inadequate if that mineral is severely deficient. Unless a documented deficiency exists, it is best not to provide 100% of a trace mineral, because an excess of one mineral may depress the absorption of another creating a deficiency. Excess supplementation of some minerals can cause toxicity problems, especially with copper.

Iron (Fe) 35 - 500 ppm

The major function of iron is as a component of hemoglobin, required for oxygen transport. It is also a component of certain enzymes. The major iron deficiency symptom is anemia. Anemia can also be caused by blood loss due to several factors, including injury, internal parasites (barberpole worm or liver fluke), and a bad case of external parasites such as lice. Iron is stored in the liver, spleen, and bone marrow. Milk is very low in iron; therefore, kids raised for a long time on milk alone will develop anemia. Soil contamination on forages can provide significant levels of dietary iron. Iron sulfate, which is red, is a common means of adding iron to the diet. Forages in some areas have excessively high levels of iron that suppress utilization of other trace minerals.

Copper (Cu) 10 - 50 ppm

Copper is essential in formation of red blood cells, hair pigmentation, connective tissue, and enzymes. It is also important in normal immune system function and nerve conduction. Deficiency symptoms include anemia, "bleached" looking (lighter color) and rough hair coat, diarrhea, and weight loss. Young goats may experience progressive incoordination and paralysis, especially in the rear legs. High dietary molybdenum can depress absorption of copper and cause a copper deficiency. There should be at least four times as much copper as molybdenum in the diet.

Sheep (both hair and wool types) are sensitive to copper toxicity, whereas goats require copper levels similar to beef cattle. Angora goats may be more sensitive to copper toxicity than meat and dairy goats. There are differences in copper requirements for several sheep breeds, and this could be true for meat goats, but no data are available. Although most of the United States has adequate copper levels (Figure 7), many areas have high levels of molybdenum (Figure 6) due to soil geology and, therefore, require copper supplementation. The liver stores copper, which can protect against toxicity in the short term. However, when liver capacity is exceeded, animals can die rapidly from a hemolytic crises caused by stress, such as being chased.

Cobalt (Co) 0.11 - 25 ppm

The only well accepted biological function of cobalt is as a component of vitamin B_{12}. Rumen microbes utilize cobalt for growth and produce vitamin B_{12}. Cobalt deficiency symptoms include loss of appetite, anemia, decreased production, and weakness. Most natural feedstuffs contain adequate levels of cobalt. There are cobalt-deficient areas in the United States (Figure 1).

Zinc (Zn) 40 - 500 ppm

Zinc is found in all animal tissue and is required by the immune system and for normal skin growth. Zinc is also essential for male reproduction. Deficiency symptoms include dermatitis (thick, dry patches of skin), hair loss, skin lesions, swollen feet, and poor hair growth. The bran and germ of cereals contain high levels of zinc.

Manganese (Mn) 40 - 1000 ppm

Manganese is important for bone formation, reproduction, and enzyme functioning. Deficiency symptoms include a reluctance to walk, deformity of forelegs, delayed onset of estrus, poor conception rate, and low birth weight. It is unusual to have a manganese deficiency.

Selenium (Se) 0.1 - 20 ppm

Selenium functions with vitamin E as an antioxidant, protecting cell membranes from oxidation. Selenium also affects reproduction, metabolism of copper, cadmium, mercury, sulfur, and vitamin E. Deficiency symptoms include poor growth rate, kids being unable to suckle, white muscle disease (cardiac and skeletal muscles have white spots), sudden death by heart attack, progressive paralysis, and retained afterbirth. Selenium is deficient in many areas because of low soil levels (geological factors; Figure 8); however, there are a few regions of high selenium soils leading to high to toxic levels in plants. Toxic levels of selenium cause shedding of hair, diarrhea, and lameness. Most plants that are not grown in selenium deficient soils will have adequate selenium levels. It is more effective to provide selenium supplementation through feed than by injection. Injection of BoSe is often given to kids at birth, but an excess of BoSe can be quite toxic.

Molybdenum (Mo) 0.1 - 5 ppm

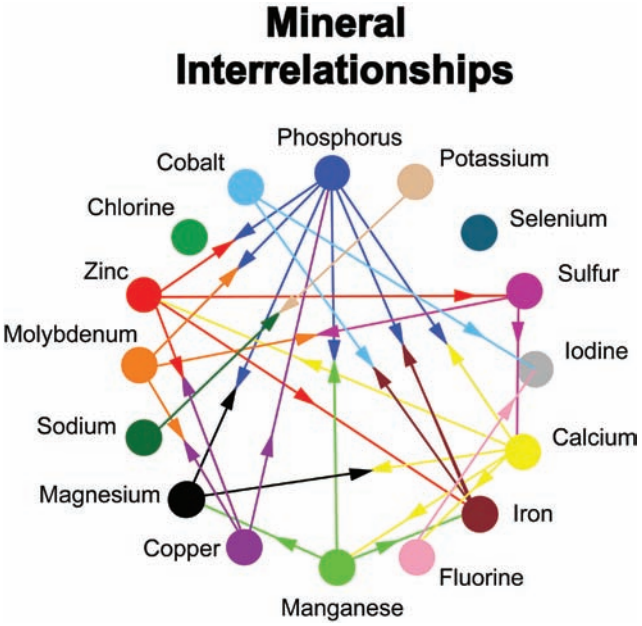
Molybdenum deficiencies are very rare. Toxicity occurs above 3 ppm due to reduced copper absorption, resulting in a copper deficiency. The copper level must be four times the molybdenum level to overcome this effect. High dietary levels of molybdenum are usually related to soil content. Molybdenum (as ammonium tetrathiomolybdate) is often used to treat copper toxicity in animals (Figure 6).

Iodine (I) 0.5 - 50 ppm

The only proven biological function of iodine is as a component of thyroid hormones that regulate energy metabolism and reproductive function. The major iodine deficiency symptom is goiter - a swelled or enlarged thyroid gland in the neck. This should not be confused with the thymus gland in the neck on young animals (the thymus gland is especially pronounced in Nubian and some Boer kids, but shrinks after several months and mistakenly called milk goiter). Also, iodine deficiency causes reduced growth and milk yield, pregnancy toxemia, and reproductive problems such as late term abortion, hairless fetus, retained placenta, and weak kids. Most of the southern U.S. has adequate iodine in the soil and most minerals and trace mineralized salts contain iodine. A number of areas in the northern U.S. are deficient in iodine due to soil geology.

Mineral nutrition considerations

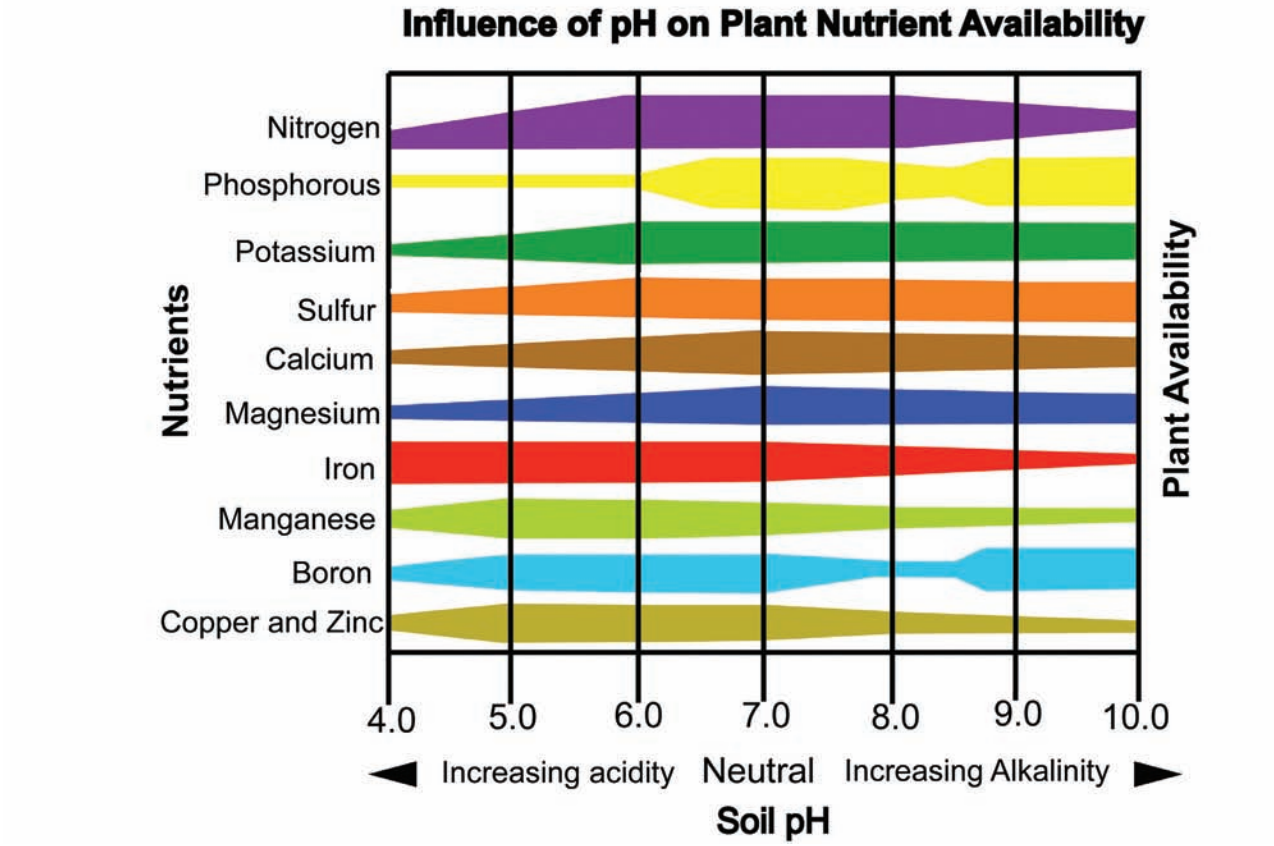
Plants are a major source of minerals for the goat, requiring all minerals that goats require except iodine. However, plant requirements for minerals, such as cobalt and selenium, may be much lower than the level required for animals. Some soils are inherently deficient in some minerals such as iodine and selenium due to soil geology. Plants grown on soils deficient in a mineral are likely to be deficient in that mineral. However,



Drawing by K. Williams.

some plants have an ability to concentrate the minerals available in the soil. Maps of mineral deficient areas of the U.S. are available. However, consulting local extension agents is a better method of determining soil mineral deficiencies or toxicities that could affect mineral levels in local forages. Soil maps showing deficient areas of selenium, copper, molybdenum, and cobalt are located at the end of this article.

Various factors other than soil mineral level can interact to influence the mineral content of forages. Soil pH is one factor that affects mineral uptake by plants. Under acidic soil conditions, many trace minerals are less available for plant uptake. Environmental temperature at certain times of the year may also affect mineral uptake. Interactions among minerals after soil fertilization can also affect their availability for incorporation into plant material. Season of the year affects plant mineral concentrations, mainly due to a



Influence of pH on availability of plant nutrients.
Redrawn from S.S.S.A.P., 1946. 11:305 by K. Williams.

dilution effect, with decreasing mineral levels as plants mature. Different plant species will also have varying contents. Browse and forb plant species may have higher mineral concentrations than do some grasses. As goats eat a variety of plants, they are less likely to have mineral deficiencies than other species of animals that eat predominantly one plant species.

To determine plant mineral content a producer can collect and send samples for analysis. Parts of plants that are being consumed throughout the day and growing season should be sampled. Analysis of a sample will cost a minimum of $25.00. To obtain enough data to formulate a custom mineral supplement would require sampling several times over a growing season and over more than 1 year if possible. This could be worthwhile for a large goat herd but too expensive for most producers. The alternative is to use a commercially prepared mineral block or loose supplement. Some mineral mixes are formulated for regions and are more appropriate to use than a mineral formulated for the whole United States. Many state extension specialists know what minerals are likely to be deficient in given areas of a state and know what levels of calcium and phosphorus are appropriate for beef cattle production. Those recommendations are a good place to start for goat mineral nutrition.

Mineral supplements should not be overfed. Mineral supplements are formulated for goats to consume a sufficient quantity. Many minerals interact with one another (interactions shown on opposite page) and excess consumption of one mineral may decrease absorption and(or) utilization of another. For example, it is well known that excess iron depresses absorption of zinc, copper, manganese, and selenium. There are several regions of the United States that have high enough levels of iron to depress absorption of these other minerals, requiring them to be supplemented. Feeding a regional mineral with no supplemental iron would be preferable to feeding an all-purpose mineral containing high levels of iron that would further depress absorption of these minerals.

Formulation of mineral supplements requires considerable expertise since the addition of high levels of one mineral may depress the utilization of another, causing a deficiency. Also, some trace minerals can be toxic in excess. Calculation of supplemental levels for feed formulas requires a certain amount of technical expertise and specialized scales for weighing, along with sophisticated mixing equipment. Most common farm mixing methods are inadequate, resulting in "pockets" of dangerously high mineral levels in a batch of feed.

Choosing a mineral supplement

The most important consideration in choosing a mineral supplement is the level of calcium and phosphorus. Some mineral mixes are designated 12 - 8, which means they contain 12% calcium and 8% phosphorus. The levels of these two minerals should be the same that is being fed to cattle in your area (contact your county agent or livestock extension specialist). Phosphorus is expensive, so a 12 - 12 mineral will cost more than one that is 12 - 8. However, most forages are low in phosphorus, making it the most common mineral deficiency.

The mineral supplement should also contain trace minerals that are deficient in the area. Levels of trace minerals used in local cattle supplements can provide a guide for goats. Most mineral supplements are formulated to provide less than half the trace mineral requirements due to toxicity concerns. A mineral supplement should be provided in the loose form to maximize consumption. The salt level in the mineral drives intake; therefore, no other sources of salt should be available. A mineral feeder should be used to protect the mineral from rain and keep the supplement clean. Replenish minerals frequently to keep them fresh.

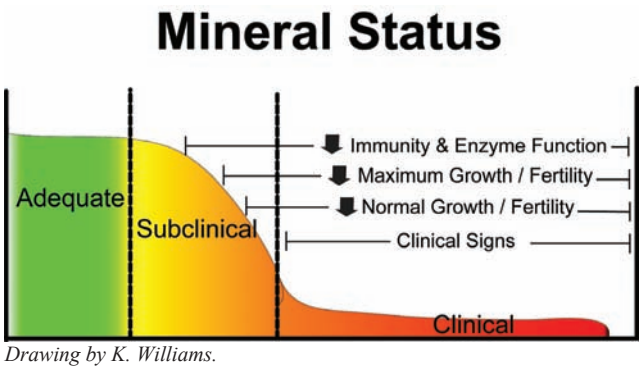
Current approximate wholesale costs for supplying 100% of mineral needs of a 150 lb goat for various minerals in 1 year are as follows:

Calcium	$1.15
Phosphorus	$4.50
Salt	$0.40
Magnesium	$1.11
Potassium	$1.50
Trace minerals	$0.45
Other minerals	$0.65
Total	$9.70

Feedstuffs will normally provide at least half of all minerals and in some cases all required. It should be noted that phosphorus alone accounts for half the total mineral cost.

Diagnosing mineral deficiencies or toxicities

The proper procedure for diagnosing a mineral deficiency or toxicity depends on which mineral is being considered. Secure the assistance of a local veterinarian and extension animal nutritionist in the state who are familiar with minerals in the region.



Drawing by K. Williams.

1. Deficiency or toxicity symptoms usually provide initial indications of mineral status (e.g., manganese and "knuckling over"). However, deficient animals do not always show classic symptoms and the major symptom may only be a 'poor doing' animal.
2. Blood tests are adequate for some minerals such as magnesium, calcium, selenium, zinc, and phosphorus, and for other blood factors that give an indication of mineral status. Examples of these factors include: glutathione peroxidase for selenium, hemoglobin for iron, zinc binding protein for zinc, and thyroid hormones for iodine.
3. Hair analysis has been used for zinc and selenium but in general is a poor diagnostic test.
4. The liver is a good tissue to test for iron , cobalt, manganese, selenium, zinc, and copper adequacy. Liver samples can be obtained via biopsy or from animals that are slaughtered or die.

Take home lessons on mineral nutrition

1. The diet should contain adequate levels of calcium and phosphorus and have close to a 2:1 calcium to phosphorus ratio.
2. Provide a free-choice loose mineral supplement with appropriate levels of calcium and phosphorus that contains trace minerals deficient in the region. Do not provide salt or other salt containing minerals as salt is used to control mineral intake.
3. Monitor intake of the mineral to make sure the animals are eating an appropriate amount.
4. Avoid excessive feeding of any supplementation.

Body Condition Scoring

The adequacy of a nutritional program can be assessed by observing changes in body weight and condition of the animal. If animals lose weight, body condition will be reduced (animal is thinner), alerting an observant manager to a problem. Body condition is particularly responsive to energy and protein adequacy.

Body condition scoring is a system of assigning a numerical score based on physical characteristics indicative of fatness. These include the amount of muscle and fat covering the spine in the loin area and ribs and fat pad at the sternum. Body condition scores range from 1 (very thin) to 5 (obese) in one-half score increments. Langston University has information on the American Institute for Goat Research website describing Body Condition Scoring of Goats (see following section on BCS or http://www2.luresext.edu/goats/research/bcshowto.html) and Examples of Body Condition Scores in Goats (see following section on BCS or http://www2.luresext.edu/goats/research/bcs.html).

Animals should achieve a certain body condition during specific periods of the production cycle. For example, animals should have a body condition of at least 2.5 but no more than 4.0 at the beginning of the breeding season. Prior to entering the winter a minimum score of 3.0 is desirable. Also, if body condition score is 4.5 or greater, pregnancy toxemia prior to kidding is likely, as also is the case with a score of less than 2.0.

Using the Langston Interactive Nutrient Calculator

Practical goat nutrition involves providing sufficient nutrients for a desired level of productivity (milk, meat, or kids) at a reasonable cost. Nutrients are supplied via a combination of pastures, hay, supplements, and other feedstuffs; adequate amounts are required for animals to produce at an economically viable level. For commercial meat goat production, the economics of nutrition are of paramount importance due to their great impact on cost of production and subsequent profit. For show, purebred, and companion goats, the economics of nutrition may be of lesser importance.

Applied nutrition involves determining nutrient requirements and then working with available feedstuffs, including pasture, hay, or supplemental feeds, to provide the required nutrients in proper amounts. Nutrient requirements are affected by an animal age, weight, and production type and stage. For example, pregnancy, number of fetuses, etc. will affect the amount of nutrients needed by a doe.

Calculating nutrient requirements by hand can be difficult, but the Langston Interactive Nutrient Calculator (LINC) makes the task easy, only requiring answering several questions. In addition, it is linked to a nutrient balancer program that allows selection and use of pastures and feeds to meet the requirements. The calculator will determine not only protein and energy requirements, but also calcium and phosphorus needs.

Getting started

To teach you to use LINC, we will go through an example. Here is the assignment, calculate the nutrient requirements for a nonpregnant 3 year old mature ½ Boer cross doe that had twins 6 weeks ago. The doe has a 32 inch heartgirth and is under intensive grazing management. Her body condition score is 2.5.

First, go to the Langston web site http://www2.luresext.edu/goats/research/nutritionmodule1.htm.

Question 1 asks the biotype of goat. A drop down menu will give the choices of Boer, Boer cross, Spanish or indigenous (native) goat, dairy goat, or Angora goat. For Kiko goats, use the selection for Spanish and indigenous. Select “Boer cross.”

Question 2 asks the class of goat, and selections include suckling, growing goat less than a year and a half of age, mature goat including late gestation, and lactating goat including meat and dairy goats. If a lactating goat is selected, another drop down menu asks information needed to predict milk production. This information includes litter size (number of kids), week of lactation (weeks since she kidded), and age of doe at kidding in years. Milk production, along with fat and protein percentages, are then predicted. These figures can be edited, which is useful for dairy goat producers who are more likely to know the amount of milk produced and its fat and protein contents.

For the example, select "lactating goat". Then in the subsequent menu, select the number of kids (twins) and input week of lactation (6) and age at kidding (2 - 3 years). The program predicts that the doe will produce 3.6 lbs of milk containing 3.6% fat and 3.3% protein.

Question 3 asks the gender of the goat, and the drop down menu has choices of doe, buck, and wether. Select "doe."

Question 4 asks the body weight of the goat. If the weight is known or a good estimate is available, it should be entered in the box. If the weight is unknown, the heartgirth (chest circumference) can be measured to predict body weight. Check the box to estimate weight via heartgirth and enter heartgirth in inches. A menu will appear with choices of genotype (breed) of goat (Alpine, Angora, Boer, ½ or less Boer, ¾ or ⅞ Boer, LaMancha, Nubian, Oberhasli, Saanen, Toggenberg, and Spanish). Some breeds require input of body condition score. Body weight is then estimated. Input "32" inches for a "½ or less Boer" and the estimated weight of the doe is 105 lbs. This can be used for estimating bodyweight for medicine dosage or weights for management purposes.

Question 5 asks the desired amount of weight gain or loss expected in a 1 month period, with selections ranging from losing 5 pounds (-5) to gain of 30 pounds. This gain is in addition to any pregnancy weight gain. Select 0 lbs per month.

Question 6 adjusts nutrient requirements for the energy expended during grazing if goats have access to pasture. The drop down menu includes choices of stable feeding, intensive management, semi-arid grazing (goats on extensive ranges), and arid (desert) grazing. For the sample calculation select "intensive management, temperate or tropical range." This selection will be used in all the examples that follow.

Question 7 asks the percentage TDN of the diet being fed and uses a default value of 60. If the TDN level in the feed is known, this value can be adjusted. For dairy goats, the default value is 65%. Use the default of 60%. If you know the value of the feed you plan to use put it in here. This value is important in prediction of intake.

Question 8 asks the percent protein in the diet and the default is 10%. For dairy goats, the default is 14%. Use the default of 10%. If you know the value of the feed you plan to use, put it in here. This value is used to help predict intake.

Click on the "Calculate Requirements" button to calculate the energy and protein requirements, estimated dry matter intake, and calcium and phosphorus requirements. In this example, the requirements should be 2.5 lbs of TDN for energy, 0.34 lbs of crude protein, 6.65 grams of calcium, and 4.65 grams of phosphorus, with a predicted intake of 3.65 lbs of dry matter.

Providing needed nutrients

After calculating the nutrient requirements for goats, those nutrients must be provided using feedstuffs such as pasture, hay, concentrate, and minerals. For most goats throughout much of the year, nutrient requirements can be met by available pasture, a mineral supplement, and water. During times of limited forage availability or quality such as winter, or feeding poor quality hay or stockpiled forage, a supplement will be needed to supply deficient nutrients. The level of supplemental feeding should be adjusted with changes in animal requirements, such as increased needs of late pregnancy. Sometimes it may be preferable to put an animal in a lot and feed a complete diet or one high in concentrate such as with dairy goats.

There may be periods when nutrient requirements cannot be met, resulting in loss of body weight. This is acceptable at certain times in the production cycle if body condition is sufficient for the animal to draw upon body reserves and maintain the desired production level. An example would be weight loss during early lactation because sufficient nutrients cannot be consumed. However if the doe is in poor body condition, is a growing yearling, or has severe weight loss during this time, milk production will be depressed. During a

drought, it may be acceptable for open or early pregnant animals that are not lactating to lose weight. During late pregnancy, inadequate nutrition can have adverse effects on pregnancy outcome and subsequent lactation. We can estimate what the projected bodyweight losses would be by reducing the bodyweight gains in question five and then calculating nutrient requirements until the energy and protein requirements match intake of those nutrients. Severe undernutrition can cause abortion, reduced livability of the kid(s), reduced milk production and adversely affect maternal behavior.

Feeding Different Classes of Goats

The feeding suggestions that follow are oriented to commercial goat producers. Purebred, show, and companion animals are often fed more for larger frames and better body condition, but excessive body condition can be deleterious to the animal health.

Feeding bucks

Mature bucks can obtain most of their nutrients from pasture. However, yearling and 2 year old bucks have greater nutrient requirements since they are still growing. Bucks need to be in good body condition (BCS greater than 3) before the breeding season because feed intake may be relatively low during that time, resulting in loss of body weight. Thus, body condition should be evaluated 3 months before the breeding season. Decisions can then be made on the supplemental nutrition needed for the buck to achieve the desired BCS.

Whenever bucks cannot meet nutritional needs from pasture, supplementation is necessary. Under most conditions, whole shelled corn or sweet feed at 0.25 to 0.5% of body weight will be adequate (0.5 to 1 lb of feed for a 200 lb buck). Feeding bucks high levels of grain (greater than 1.5% of body weight) for a long period of time makes them prone to urinary calculi. The levels of grain recommended above are safe for bucks. When pasture is scarce, bucks can be fed medium quality hay free-choice (all they can eat).

Using LINC, calculate the nutrient requirements for a 3 year old, 200 lb Boer cross buck, gaining no weight, and on pasture (intensive management). The calculated requirements are 2.39 lbs of TDN, 0.26 lbs of crude protein, 5.05 grams calcium, and 4.09 grams phosphorus, with predicted dry matter intake of 3.55 lbs. However, it is important to note that the estimated dry matter intake is influenced by the dietary TDN and CP concentration inputs. Therefore, if the default values are used and a forage, which makes up all or most of the total diet other than a mineral supplement, has different levels, then the predicted dry matter intake may not be close to the actual amount. In the example above, default values were assumed. To determine if these nutrient requirements can be met by native range with a mineral supplement, click on "Select Feed Ingredients" at the bottom of the page. A page listing different feeds will appear. In the "Forages" section below "Concentrates," click on "range, early summer," and under "Minerals" choose a 12-12 mineral supplement. Go to the bottom and click on "Input These Feed Ingredients into the Ration."

The ration window will appear that lists each ingredient chosen. Intake figures should be entered in the column labeled "Amount, lbs as fed." The estimated intake for this buck is 3.55 lbs dry matter (lbs of diet not including the water content of the feedstuffs), whereas in this window the consumption amount is entered as the "as fed" form. Because feedstuffs vary in water content (compare the water content of fresh, green pasture to the same forage dried and harvested as hay), nutrient requirements and intake estimations are calculated on a "dry matter basis." Dry matter basis means that all water has been removed. However, animals eat feed in an "as-fed" form. This calculator will determine the amount of dry matter intake for each ingredient from the as-fed figures entered. This relieves the producer from having to estimate dry matter, allowing the amount fed to the animal to be entered, with the program performing the needed dry matter calculations.

The mineral supplement bag label predicts intake of 0.5 to 1 lb/month/hundred lbs of body weight. At that rate, the 200 lb buck will consume 2 lbs/month or 0.067 lbs/day (2 lbs ÷ 30 days), roughly 1 ounce. Some supplements estimate an intake such as 1 to 1.5 oz/day, but this can vary with the size of the goat. Enter 0.07

lbs for the mineral. Therefore, in this example it can be assumed that forage dry matter intake is 3.55 lbs. The value of 3.55 is entered into the "Amount, as-fed" column for range forage. Clicking in the "Amount, lbs DM" column will calculate the amount of DM and nutrients provided (Running total) compared with the Requirements. The amount of as-fed native range grass provided should be increased until the forage dry matter provided equals the 3.55 lbs previously calculated. This is done by trial and error method until a correct answer is found. In this case, the correct amount is 3.95 lbs of as-fed native range, which will provide 3.55 lbs of dry matter. Therefore, the estimated daily ration for this buck is 3.95 lbs of native range grass hay, or an equivalent amount of pasture, on a dry matter basis plus 0.07 lbs of mineral per day.

Comparing the Running total with the Requirements shows that this diet did not meet the requirement for TDN (2.12 lbs provided vs a requirement of 2.39; 89%). Crude protein, calcium, and phosphorus are supplied in excess of requirements. Because the equations used in these predictions include a small safety margin (i.e., requirements are most likely slightly greater than actual), if the deficiency is not marked the diet could be used as is with careful monitoring of performance measures, most notably BCS. In addition, one should consider that the diet actually consumed could be higher in quality than the 'book' composition values used. In this regard, when taking plant samples, plants are often cut at the ground level, such as for hay. Conversely, goats select certain plant parts (especially leaves) that have higher nutrient contents. Therefore, the composition analysis used in the calculations might not have matched what was actually eaten. For example, if a TDN concentration in consumed forage of 65% and a crude protein level of 12% are assumed, the predicted TDN intake is 95% of that necessary to satisfy the TDN requirement.

Accurate and abundant data on the nutrient content of plant parts consumed by goats are lacking. When hay is fed and animals are 'forced' to consume most of it, the hay analysis will more closely match what is consumed. The same applies to supplemental feeds that are totally consumed. One way to more accurately determine the true composition of diets of grazing goats is to follow the animals for a couple of hours and hand pluck the portions of plants consumed and send the sample in for analysis. However, plant composition and plant parts selected vary over time, making it desirable to sample plants monthly or more frequently.

In the absence of feed nutrient analysis, it is important to try to match the description of feeds or pasture as closely as possible to that in the LINC feed tables. If actual analysis has been determined, it can be entered into LINC at the bottom of the feed library. Information required includes concentrations of TDN, crude protein, calcium, and phosphorus. Hopefully in the future, more applicable data will be available for herbage grazed by goats.

Feeding replacement bucks and does

Replacement bucks and does must gain sufficient weight from weaning to breeding to be of adequate size and sexually mature. A Spanish doe weaned at 12 weeks of age would be expected to weigh 40 lbs and gain 5 lbs per month to achieve a minimum breeding size of 60 lbs at 7 months of age. A Boer doe weaned at 12 weeks of age would be expected to weigh 50 lbs and would need to gain 7.5 lbs per month to be 80 lbs at breeding. These are minimum weights, and it is advantageous for animals to be slightly heavier. Some purebred breeders wait to breed their doelings at 19 months of age because a doe with a bigger frame size is desired. Most commercial goat producers cannot afford the cost of an extra year of maintaining an animal with no production.

Does will generally gain sufficient weight if an adequate amount of a moderate quality forage is available. If doelings are not gaining adequate weight (as measured by a scale or through the heartgirth-body-weight conversion program), they could be supplemented with whole shelled corn at 0.5 to 1% of body weight per day (¼ to ½ lb of corn per head per day for 50 lb doeling). Feeding excessive grain to does causes an overly fat condition. Fat may be deposited in the udder, leading to reduced development of milk secretory tissue. The doe is also more likely to have pregnancy toxemia and birthing problems. If sufficient good quality pasture

is not available, growing doelings will need good quality hay and a supplement such as whole shelled corn, sweet feed, or range cubes or pellets at 0.5 to 1.0% of body weight.

Bucklings must gain more weight than doelings to reach puberty. While there are no available recommendations for weight of meat goat bucklings at first breeding, these animals need to reach an adequate size to achieve puberty. Like doelings, body condition should be monitored and bucks can be supplemented at 0.5 to 1% of body weight per day (¼ to ½ lb of corn per head per day for 50 lb buckling, if necessary). Most bucks do not let a lack of body weight interfere with breeding assuming that they reach puberty, but some body reserves are necessary to maintain fertility and mating activity throughout the breeding season.

Feeding does throughout their life cycle

The four production periods of does are dry nonpregnant, pregnant, late gestation, and lactating. Does that are open (nonpregnant) or in the early stage of pregnancy (< 95 days) have fairly low nutrient requirements. For open does, the goal is to gain a little weight to be in good condition for breeding. A medium quality pasture, such as in late summer, or a medium quality hay is sufficient to prepare for breeding and the early stage of pregnancy. However, adequate quantities of feed are necessary.

Use the LINC to calculate the nutrient requirements for a 130 lb nonpregnant, mature Boer doe without change in body weight and with intensive pasture grazing. The requirements are 1.50 lbs of TDN, 0.18 lbs of crude protein, 4.03 grams of calcium, and 2.82 grams of phosphorus, with an estimated dry matter intake of 2.31 lbs. Feeds used are fall bermudagrass and a mineral supplement. A 130 lb doe is expected to consume the mineral at 0.1% of body weight per month = 1.3 lbs/30 days = 0.04 lbs of mineral per day. The estimated 2.27 (2.31-0.04 = 2.27) lbs dry matter intake of fall bermudagrass (3.25 lbs as-fed based on the composition of fall bermudagrass; 50% TDN and 9% CP) provides 1.14 lbs of TDN (76% of requirement) and 0.20 lbs of crude protein (111% of requirement). In this example, it appears questionable as to whether or not body weight of the doe could be maintained with this forage (i.e., 50% TDN). The goat's ability to select higher quality plant parts, as noted above, might enable them to maintain their body weight. In this regard, if they are able to select a diet with a TDN concentration of 60% rather than 50% then the amount of TDN supplied is (2.27 × 0.60 = 1.36 lbs) which is 91% of the required amount, somewhat close to her requirements. Again, it is important to monitor body condition.

Calculate the nutrient requirements for a Boer doeling weighing 70 lbs, gaining 5 lbs per month, and with intensive pasture grazing, using LINC. The requirements are: 1.3 lbs TDN, 0.25 lbs crude protein, 2.98 grams of calcium, and 2.08 grams of phosphorus with a dry matter intake estimate of 2.06 lbs. If we adjust estimated TDN and estimated protein for the forage (questions 7 and 8 in LINC) since the 50% TDN of fall Bermudagrass is different than the 60% assumed, and use 9% CP instead of the 12% assumed, predicted dry matter intake is 2.32 lbs. Using the same feeds, fall bermudagrass and mineral, with a mineral consumption of 0.02 lbs (1% of body weight /month, divided by 30) and using fall bermudagrass for the remainder of her intake (3.3 lbs as fed), both TDN (1.16 lbs intake, 89% of requirement) and crude protein (0.21 lbs intake, 84% of requirement) are inadequate. To achieve the desired growth rate, supplementation may be necessary. By trying sweet feed as a third feedstuff it is determined, through trial and error, that 0.75 lbs of sweet feed along with 2.0 lbs of fall pasture will provide most of the energy requirement but only 0.19 lbs of crude protein (76% of requirement), which is inadequate. By deleting the sweet feed and changing to a 16% dairy ration to supply the needed crude protein, it is finally determined that 0.75 lbs of a 16% crude protein dairy ration, 2.0 lbs pasture, and 0.02 lbs of mineral will provide 1.3 lbs of TDN (100% of requirement) and 0.25 lbs of protein (100% of requirement). The weight gain to achieve adequate breeding size should continue to be monitored with possible feeding adjustments made. The lesson here is that this doeling, because of the need for growth, has higher requirements than a mature doe and needs extra nutrition.

Flushing meat goats

Some people advocate "flushing" of meat goats prior to breeding. Flushing refers to the practice of providing extra nutrition to does approximately 2 weeks prior to breeding and for a variable portion of the breeding period (e.g., 1-2 weeks) to increase the number of ovulations and have a greater proportion of twins and triplets. This is widely advocated with sheep producers and Angora goat producers. Producers have extrapolated the practice to meat goats. However, several controlled studies with Spanish goats in reasonable body condition (BCS 2.5 – 3.5) have shown no response in kidding or conception rate of meat goats to flushing with extra protein, energy, or both. The practice may have utility for meat goats in poor body condition, but there does not appear to be justification for flushing does in acceptable body condition.

Winter feeding of does

Early to mid-winter is a time when does should be in early pregnancy. The goal of a wintering program is to economically provide the necessary nutrients to maintain a reasonable body condition, lose no weight, and keep them warm. In general, most wintering programs consist of both forage and supplement components. The forage component can consist of hay, stockpiled forage, or a cheap byproduct roughage feed. The supplement usually contains energy, protein, and often vitamins and minerals, although these may be provided separately as a mineral mix. Commonly utilized supplements include whole shelled corn (inexpensive source of energy), range cubes (inexpensive source of energy and protein), sweet feed, protein blocks, molasses blocks or tubs, and liquid feed.

Stockpiled forage is forage that is grown during the summer or fall upon which animals are not allowed to graze, reserving it for the winter months. In drier areas, the forage is well preserved, but in a more humid climate quality declines rapidly, making the practice less satisfactory. Stockpiled forage is a very inexpensive forage source since it does not have to be mechanically harvested (baling forage doubles the cost of forage); animals harvest stockpiled forage by grazing. Animals make much more efficient use of stockpiled forage when strip grazed (using temporary electric fence to limit animal access to an area containing a 1 to 3 day supply of forage) to minimize trampling. Fescue is used in many temperate regions for stockpiling and retains its quality well into late winter even in humid areas. Most recommendations for stockpiling fescue include late summer fertilization, clipping, and deferred grazing. Warm season grasses such as native range and bermudagrass can be stockpiled. The amount of deterioration is dependent on grass species and rain. If local cattlemen are using stockpiled forage it will probably work for certain classes of meat goats. Consult your state forage extension specialist for further information.

Calculate the requirements for wintering a 95 lb mature Kiko doe (use Spanish biotype) in early pregnancy gaining no weight and with intensive pasture grazing, using LINC. The requirements are 1.19 lbs TDN, 0.14 lbs protein, 3.13 grams of calcium, and 2.19 grams of phosphorus, with 1.86 lbs of dry matter intake estimated (based on default dietary TDN and CP levels). Feedstuffs that can be used include stockpiled (winter) bermudagrass and a 16% molasses lick. The estimated intake from the molasses lick label is 4 ounces or 0.25 lbs. Assume the remainder of dry matter intake is from the stockpiled bermuda pasture.

The molasses lick is not in the feed library so must be entered manually as a new feedstuff. Click on "Add/ Delete Ingredient to Feed Library," to bring up a table to be filled out. First, the feedstuff class is selected. This molasses lick is in the "concentrate" class. Then the name "16% molasses lick" is entered, and remaining values are entered. These values can be obtained from the feedstuff tag or label or by calling the manufacturer. If a value is unknown, leave it blank. For this example, enter dry matter of 85%, 16% crude protein, 75% TDN, 2.8% calcium, and 0.45 % phosphorus. Click on "Add Feed Ingredient to Library" and the Select Feed Ingredient page appears. If needed, click on refresh feed library and 16% molasses lick appears under "Your Feed Ingredient Library." If you have a dry hay or feed, 85% dry matter is a good assumption.

To continue formulating the ration, select the 16% molasses lick and winter bermudagrass, then click on "Input these Feed Ingredients to the Ration." Enter 0.25 lbs for the 16% molasses lick under the "Amount, as-fed" column and guess at 1.5 lbs of winter bermudagrass. Through trial and error a total of 2.0 lbs bermudagrass is selected to fulfill intake requirement. The table shows that this diet provides 0.91 lbs of TDN (76% of requirement), 0.12 lbs CP (86% of requirement), 4.74 grams of calcium, and 1.52 grams of phosphorus (deficient). The diet is quite deficient in energy. To provide additional energy, add whole shelled corn. The diet is then reformulated to contain 0.6 lbs whole shelled corn, 1.4 lbs winter bermudagrass, and 0.25 lbs of lick molasses. This provides 1.15 lbs TDN (97% of the energy requirement) and meets the CP needs. Phosphorus is slightly deficient (13%), but if the bermudagrass is better than average the requirement can be satisfied. Mineral supplements vary in their phosphorus levels as phosphorus is an expensive ingredient. If a mineral supplement with a high phosphorus level is selected for feeding, the requirement would be met but likely at a high monetary cost.

Feeding does in late gestation

Energy requirements increase dramatically in late pregnancy. Using LINC, calculate the nutrient requirements for a 130 lb mature Boer doe, 140 days pregnant (10 days from kidding), gaining no weight, other than that due to pregnancy, and carrying twins. Under question 3, after clicking on the box for greater than 95 days pregnant, a form drops down for pregnancy number (twins), breed (predicts birth weight, can enter yours if known), and days of pregnancy (140). The requirements are 2.45 lbs TDN, 0.45 lbs crude protein, 3.97 lbs intake, 6.03 grams calcium, and 4.22 grams phosphorus.

A ration can be balanced using bermudagrass hay and 20% range cubes to meet the requirements by feeding 1.5 lbs of range cubes and 3.0 lbs of bermudagrass hay. This illustrates the high level of nutrition that is needed, especially in the last 3 weeks of pregnancy. High quality hay as well as supplementation is usually required. The range cubes contain a mineral supplement so no additional mineral mixture is needed.

Doelings require more supplementation than mature does, as the doelings are still growing. The nutrient requirements for a 95 lb growing Boer doeling with a predicted intake of 3.37 lbs, gaining 1 lb per month in addition to pregnancy weight gain and 140 days pregnant with a single kid are 1.77 lbs TDN, 0.36 lbs CP, 5.23 grams calcium, and 3.66 grams of phosphorus. If the same ingredients are used as those for the mature doe, how much of each will be required? The doeling could be fed 3.8 lbs of bermudagrass hay alone to meet the nutrient requirements for pregnancy with a single kid. However, if the doeling is carrying twins and is 140 days pregnant, her requirements are 2.27 lbs TDN and 0.47 lbs CP. This doeling will require 1.0 lbs of range cubes and consume 3.3 lbs of hay. If an abundance of high quality pasture is not available, the doeling will need some type of supplementation. If the forage (or hay) of adequate quality is available, only 1 to 1.5% of body weight of whole shelled corn may be needed as an energy supplement. This is important in that feed intake may be reduced in the last 4 to 6 weeks of gestation by the growing kids that reduce available abdominal space.

Feeding the lactating doe

The lactating doe has very high nutrient requirements. Calculate the requirements for a 4 year old 110 lb Boer cross doe nursing twins in week 4 of lactation. When lactating is selected under question #2 on LINC, a form drops down. Select litter size (twins), week of lactation (4), and age at kidding (4). The program then predicts production of 4.5 lbs of milk per day with 3.6% fat and 3.3% crude protein. Nutrient requirements are 2.65 lbs of TDN, 0.41 lbs of protein, 7.61 g of calcium, and 5.33 grams of phosphorus, with 4.14 lbs of dry matter intake predicted (based on default dietary TDN and CP concentrations). During lactation, the doe can consume nearly enough nutrients if an abundant supply of high quality pasture is available, such as in spring or early summer. If "Range, early summer" is selected and fed at 4.7 lbs, the diet meets protein and calcium requirements, and 90% of energy requirement. However, phosphorus is deficient (3.76 vs. 5.33)

and needs to be supplemented. However, does will likely lose some bodyweight due to the high demands of peak lactation (weeks 3 to 8 of lactation) and an inability to consume an adequate quantity of feed. Kidding should take place when there is an adequate supply of high quality pasture. If there is not adequate pasture, supplemental feed will be required. Inadequate nutrition will decrease body condition, reduce milk production, reduce kid weaning weight, and increase kid mortality.

If feeding bermudagrass hay and a 16% dairy ration, 2.6 lbs of hay and 2.0 lbs of the ration are required to fulfill requirements. However, the doe will still lose 2.0 lbs of bodyweight per month. When feeding high levels of grain such as the amount in this example, the animal should go through an adjustment period of two to three weeks during which time the grain portion of the diet is gradually increased to prevent digestive problems from occurring. Feeding a dairy ration and hay to a doe during late gestation and the lactating period will cost approximately $40 per animal. Utilizing available pasture as a feed source is a much cheaper alternative.

Kids are usually weaned at about 12 weeks of age. Milk production of the doe begins to decrease after the 6th week of lactation and is quite low by the 12th week. Nutrient requirements decline as stage of lactation advances, enabling the doe to maintain or even increase body condition on pasture alone. Kids may be creep fed while nursing to increase growth rate of the kids and reduce nutrient demands on the doe for milk production.

Creep feeding

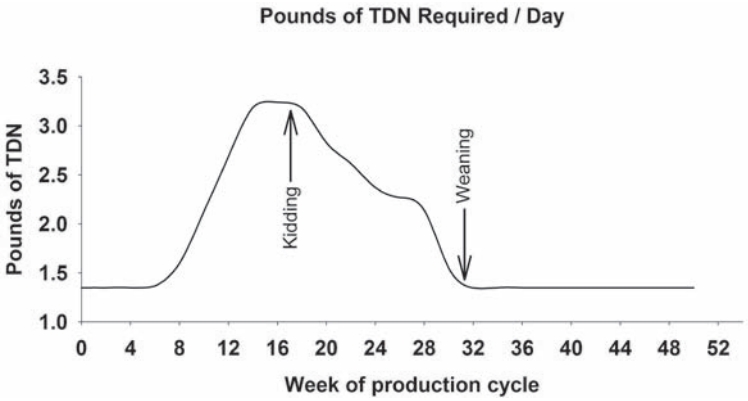
Creep feeding is a method of providing feed for the kids only. This is accomplished by fencing around a feeder and using a creep gate that has holes about 5 inch wide by 1 ft high. These holes are small enough so that kids can enter the feeder, but adults are excluded because they are too big to go through the hole. Creep feeding will provide extra growth for the kids and train them to eat feed, facilitating weaning. A commercial creep feed with at least 16% crude protein that is medicated with a coccidiostat should be used. It requires about 6 lbs of feed to produce 1 lb of animal gain. The more rapid growth from creep feeding may be beneficial for producing show prospects.

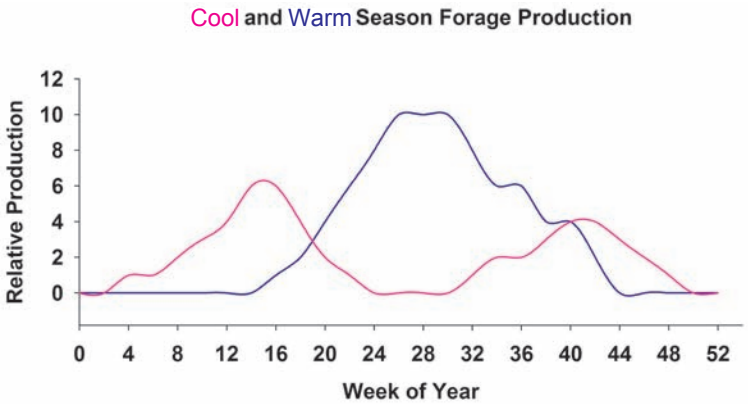
An alternative to grain-based creep feeds that is used in the beef cattle industry is to creep graze calves, using a creep gate that allows calves access to ungrazed high quality pasture. This may have application for goats using high quality pastures (crabgrass or sudangrass that is planted for the kids). In rotational grazing of cattle, the calves are often allowed to creep graze the next pasture before cows so that they have relatively high nutrient intake. Those pastures often have less parasites and disease organisms because of the time since last grazing.

Effect of Kidding Season on Nutrient Requirements

Nutrient requirements of does change dramatically with stage of production. Requirements increase dramatically the last 6 weeks of gestation due to increasing fetal growth and remain high in early lactation (kidding occurred on week 18 in chart). During the month prior to kidding and for the following 3 months (assuming weaning at 12 weeks of age), the doe will consume nearly as much nutrients as in the remaining 8 months of the production cycle. Thus, during that time it makes sense to supply nutrients from an inexpensive source, typically pasture. The cost of providing the same nutrients as hay is more than twice that of pasture, and supplying through purchased feeds may be four to five times greater than for pasture.

Kidding should be planned for a time when pasture is rapidly growing. This period corresponds to late spring for pastures comprised of warm season forages such as bermudagrass or native range, browse, and forbs, but could be either fall or early spring for cool season grasses such as ryegrass, wheat, orchardgrass, and fescue. Cool season grasses usually produce less forage per acre than warm season forages, but generally are higher in energy and protein. The accompanying figure shows the relative production of cool and warm





season forages for central Oklahoma. Consult a local pasture extension specialist or livestock extension specialist for local forage growth patterns. Rapidly growing pasture is high in protein and energy. A major consideration in determining the date to kid is level of forage production at that time. However, there are other considerations in selecting kidding date, such as parasites and market opportunities. Some markets provide a substantial price premium from kidding at a specific time of the year, such as producing prospect show wethers or registered animals. However, it may take a considerable market premium to cover the cost of purchased feed, so general reliance on pastures and forages is best.

Artificial Raising of Kids

Sometimes it is necessary to bottle feed young kids due to death of the mother or the mother refusing to take them. Milk feeding of commercial meat goats is usually not economical. It may be avoided by cross-fostering kids onto another doe as described under the goat management section. If a bottle raised kid is with other kids and does, they may learn to 'steal' sufficient milk to raise themselves. Kids can be raised on cow milk replacer, goat milk replacer (expensive) or, if none is available, cow milk from the store may be used.

It is very important that kids receive colostrum within 12 hours of birth. After 24 hours, antibodies absorption decreases. Colostrum may be milked from another doe that recently kidded. Colostrum contains antibodies that strengthen the immune system for the first months of life. A kid should be fed one ounce of colostrum per lb of weight (average birthweight 7 lbs, therefore, 7 ounces of colostrum) at each of three feedings in the first 24 hours. If the kid is too weak to nurse, it is appropriate to provide the colostrum via stomach tube. This does take some practice, but obtaining colostrum is critically important to kid survival.

Initially kids can be fed using a baby bottle or a nipple such as the Pritchard teat which fits on a plastic soda bottle. Kids can be bottle fed twice a day, although three times a day the first 4 to 6 weeks of life may increase growth rate. Kids are very susceptible to bloating and other gastrointestinal problems from milk replacers that contain a high level of lactose due to use of dried whey in their formulation. Reduced lactose milk replacers will reduce bloating problems.

A calf starter feed (with a coccidiostat such as Rumensin or Deccox, sometimes called medicated) and high quality hay should be made available the second week of life. Deccox can be used in the milk from week 2-6 to prevent coccidiosis. After 4 weeks of life, kids can be limit fed milk at one pint in the morning and also in the afternoon. This will stimulate consumption of starter feed and facilitate weaning.

Kids can be weaned after 8 weeks of age if they are consuming 2 ounces of starter per day and weigh two and a half times their birth weight (about 18 lbs). Weaning shock can be reduced by going to once a day milk feeding for several days to encourage consumption of the starter.

Considerations in Ration Formulation

Rations should be balanced not only for protein and energy, but calcium and phosphorus contents should be calculated, macrominerals supplemented, and a trace mineralized salt used to provide microminerals. A vitamin premix should be used to provide at least vitamin A and E.

If the diet is being fed at high levels to bucks or wethers, there is risk of urinary calculi. To prevent urinary calculi, the ration should be formulated with a minimum of phosphorus, over twice as much calcium as phosphorus, and a urine acidifier such as ammonium chloride at 0.5-1.0 % of the diet. Salt can also be included in the diet, such as at 1-3%, to reduce incidence of urinary calculi.

If the ration is being fed at high levels, sufficient fiber should be included in the diet to prevent acidosis. Dried brewers yeast and probiotics are often used in rations fed to animals at high levels to help prevent them from going off feed.

Feeds may have a coccidiostat included in the formulation to prevent coccidiosis. There are a number of coccidiostats, but Food and Drug Administration approved drugs commonly used include Deccox and Rumensin. Since goats are very susceptible to coccidiosis when stressed, such as at weaning or shipping, many starters and show feeds contain coccidiostats and have the term 'medicated' on the feed tag. Management considerations to reduce coccidiosis incidence include sanitation, cleanliness, and dry housing.

Feeding Systems

There are many methods of feeding goats. Feeds should be offered in such a way to minimize mold growth or fecal contamination that reduces intake. Mineral mixes must remain dry and should be replenished at 2 week intervals to avoid caking. Feed troughs should be designed to facilitate removal of feces and leftover feed. Troughs generally require a bar running above the length of the trough to keep goats from defecating in them.

Self feeders can be used for feeds containing sufficient roughage for use as a complete feed or for feed that has a built-in intake limiter. For large range operations, feeds such as whole shelled corn or range pellets or cubes are often fed on the ground. The feeding area is moved each day to have clean ground upon which to feed.

Round hay bales should be fed in a rack off the ground. Feeding round hay bales on the ground results in hay wastage and leaves a mess that is difficult to clean. Hay can be fed in a manger or hay feeder with keyhole slots, but horns may cause problems preventing access to feed. For large operations, unrolling round bales on the ground works well.

Nutritional Disorders

There are several diseases associated with nutritional management. These include acidosis, founder, enterotoxemia, pregnancy toxemia/ketosis, polioencephalomalacia, and urinary calculi.

Acidosis, founder, and enterotoxemia are all related to either feeding high levels of grain or a rapid increase in the level of grain in the diet. Acidosis is associated with the production of high levels of lactic acid in the rumen from a large supply of starch that the animal consumed. Endotoxins may also be produced by ruminal bacteria that exacerbate the problem.

Founder refers to problems that occur with the feet of the animal as a consequence of acidosis. The blood vessels in the hoof constrict and in the long-term cause the hoof to grow rapidly, necessitating weekly hoof trimming.

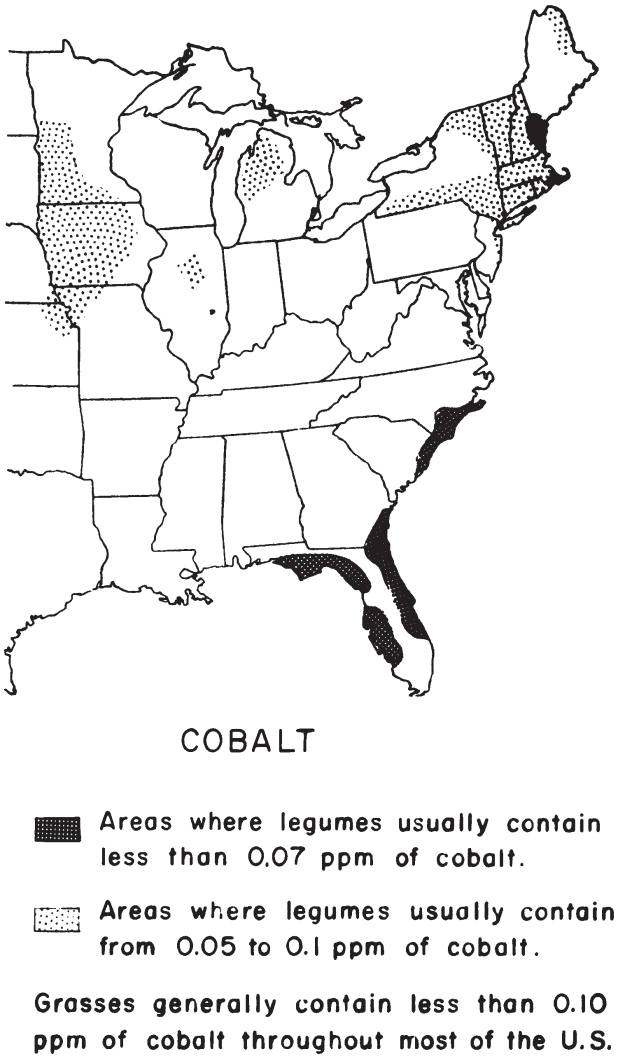
Enterotoxemia is caused by bacteria in the intestine that grow rapidly and produce an endotoxin in response to high levels of starch (grain) in the diet. Animals are in extreme pain from the effect of the endotoxin and often die quickly. Vaccination will help prevent this disease.

High levels of grain in the diet and stress are associated with polioencephalomalacia, which is a thiamine deficiency. High dietary levels of sulfur (such as from molasses in the diet) can increase incidence of the condition. The animals appear drunk, may not be able to stand, become blind, and slowly die. There is often a dramatic response to a large dose of thiamine (5 mg/lb), which may need to be repeated. These diseases can be best prevented by increasing the grain level in the diet slowly and maintaining 50% forage in the diet. Thiamine can be added to high concentrate diets at 0.25 lb/ton to aid in the prevention of polioencephalomalacia.

Pregnancy toxemia is a metabolic disease usually caused by animals being too fat (body condition score greater than 4) prior to kidding; although very thin animals (body condition score less than 2) are subject to the disease also. It is caused by a high demand for nutrients by the growing fetus in late pregnancy that is not being met (excess fat in the body and the growing fetus limit room in the stomach for food, reducing intake of the diet). This unmet nutrient demand causes a rapid breakdown of fat reserves, forming ketone bodies at high levels which are toxic. Treatments include administration of propylene glycol, large doses of B vitamins, glucose given intravenously and possibly Caesarian-section (to remove the fetuses and immediately reduce energy demand; see the Goat Health section). Prevention of the disease is far easier and more effective than treatment. Simply monitor animal body condition and adjust nutrition, especially energy, to manipulate body condition. Do NOT sharply reduce feed in late gestation as this may cause pregnancy toxemia. Also, pregnant goats in the last third of pregnancy will need a more nutrient dense diet (higher quality) due to fetal growth and reduced intake because of reduced stomach capacity. Exercise will help. Does can be encouraged to exercise by separating hay, feed and water at a substantial distance, forcing them to walk more.

Soil-Related Nutritional Problem Areas for Grazing Animals

Figure 1. Geographical distribution of Co-deficient areas in the eastern United States (ppm = 1 μg/ g^{-1}). From Kubota and Allaway, 1972, by permission Soil Science Society of America.



All soil maps were taken from Kubota, Welch, and Van Campen. 1987. Adv. Soil Sci. 6:189-215.

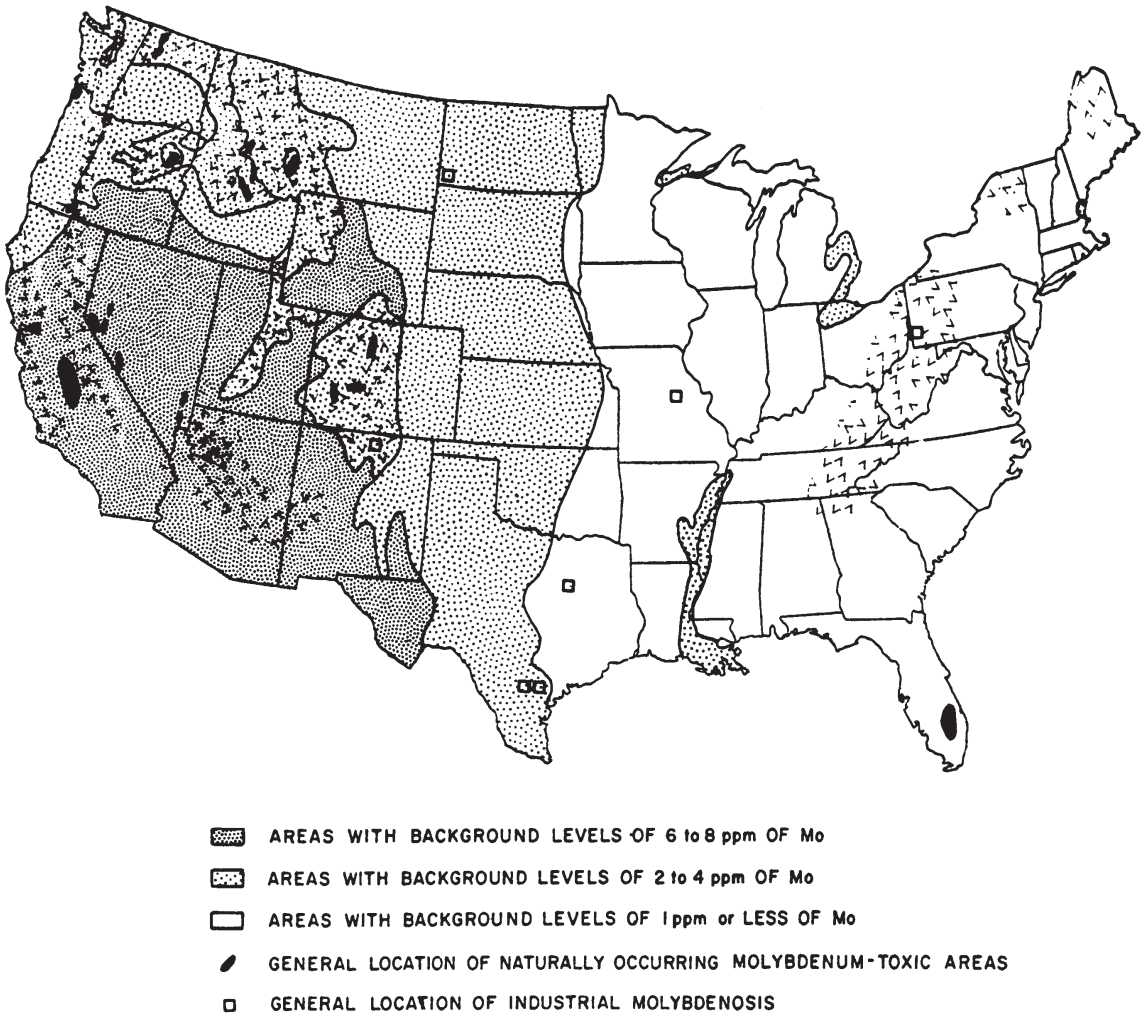


Figure 6. Generalized regional pattern of molybdenum concentration in legumes of the United States (ppm = 1 $\mu g/ g^{-1}$). From Kubota, 1977, by courtesy Marcel Dekker, Inc.

All soil maps were taken from Kubota, Welch, and Van Campen. 1987. Adv. Soil Sci. 6:189-215.

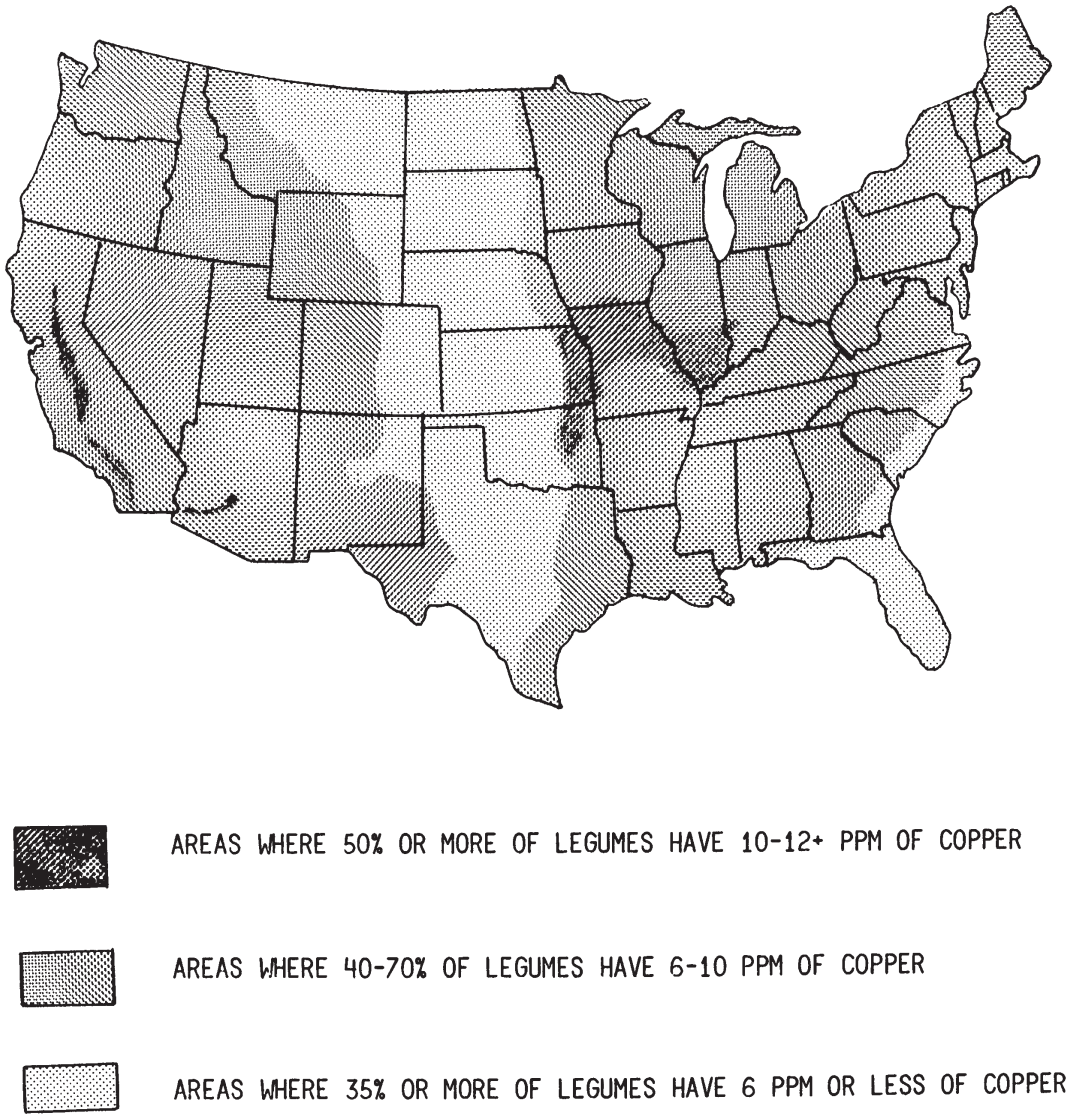


Figure 7. Generalized distribution of copper concentration in legumes of the United States (ppm = 1 μg/ g^{-1}). From Kubota, 1983a, by permission Amer. Society of Agronomy.

All soil maps were taken from Kubota, Welch, and Van Campen. 1987. Adv. Soil Sci. 6:189-215.

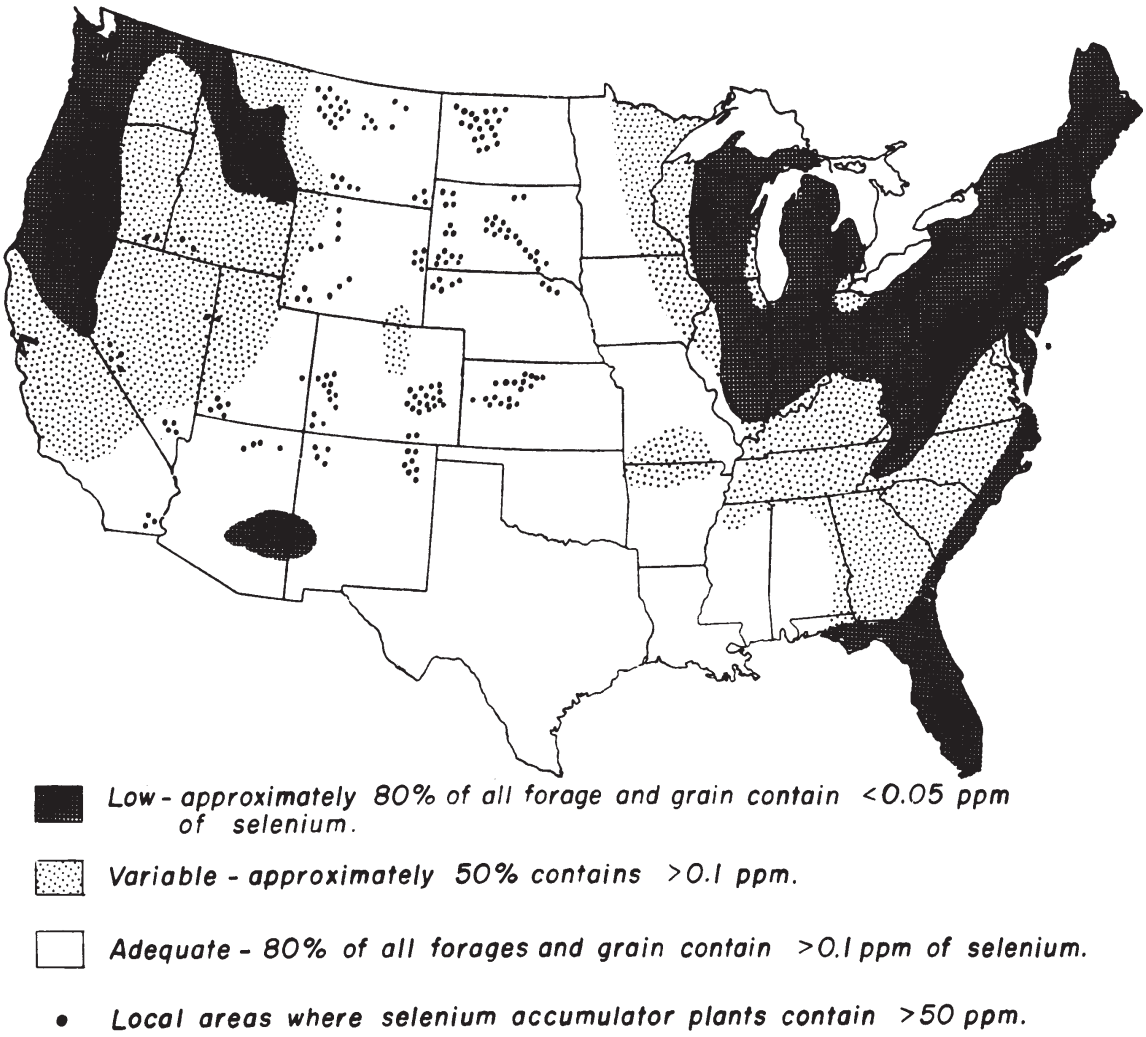


Figure 8. Geographical distribution of low-, variable-, and adequate-Se areas in the United States (ppm = 1 μg/g). From Kubota and Allaway, 1972, by permission Soil Science Society of America.

All soil maps were taken from Kubota, Welch, and Van Campen. 1987. Adv. Soil Sci. 6:189-215.

Definitions useful for this section

Acidosis - A disease usually caused by feeding too much grain or increasing the level of grain in the diet too rapidly. It results in the rumen having very acid conditions, and endotoxins may be produced that adversely affect various parts of the body.

Body condition score - Abbreviated BCS. Applying a numerical score to describe the amount of muscle and fat cover on an animal. Usually performed by feeling along the backbone in the loin area, over the ribs, and at the breastbone (sternum). Scores range from 1 (extremely thin) to 5 (extremely obese).

Browse - Vegetative parts of woody plants, primarily leaves and twigs, that typically contain high levels of tannins.

Carbohydrates - The major energy source found in most feedstuffs. Carbohydrates contain twice as many hydrogen atoms as carbon and as many oxygen atoms as carbon, commonly designated as CH_2O. They include substances such as sugar, starch, fiber, cellulose, and hemicellulose.

Cellulose - A major structural carbohydrate in plants. A component of fiber that is poorly digested by nonruminant animals. Cellulose is composed of glucose molecules chemically linked by a "beta" linkage that is only digested by bacteria such as those in the rumen and(or) cecum.

Coccidiosis - An infectious intestinal disease caused by protozoan organisms (coccidia). The disease causes diarrhea and damages the lining of the intestine. Moisture, stress, and unsanitary conditions are conducive to coccidiosis.

Concentrates - A feed with less than 20% crude fiber and usually more than 60% TDN on an as fed basis. Often a mixture of feedstuffs with added minerals and vitamins.

Crude fiber - The more fibrous, less digestible portion of a plant primarily consisting of cellulose, hemicellulose, and lignin. A method of estimating the fiber content of a feedstuff through sequential extraction with acid and alkaline solutions.

Enterotoxemia - A disease caused by an overgrowth of bacteria (*Clostridia perfringens*) in the intestine usually due to fermentation of a large quantity of starch, with production of endotoxin. Usually causes rapid death of animals.

Fiber - A component of the feed that consists of cellulose, hemicellulose, and lignin. It is necessary for normal rumen health.

Forage - The edible part of the plant, other than separated grain, that can provide feed for grazing animals.

Founder - Refers to a consequence of acidosis, resulting in rapid growth of the hoof.

Mineral - The inorganic group of nutrients including elements such as calcium, phosphorus, copper, etc.

Nutrient - One of six classes of chemical compounds having specific functions in the nutritive support of animal life.

Nutrient requirements - The level of specific nutrients required to keep an animal healthy and productive.

Nutrition - The study of nutrients, determining what nutrients are required, what levels of nutrients are necessary for various levels of productivity, and how to provide those nutrients.

Polioencephalomalacia, PEM, or 'polio' - A neurological disease of goats caused by thiamine deficiency. The rumen normally produces adequate levels of thiamine, but under some conditions such as a high grain diet, high sulfur in the diet, stress, or being 'off feed,' the thiamine is degraded, thus causing the disease.

Stockpiled forage - Forage that is allowed to accumulate for grazing at a later time.

Supplement - A feed designed to provide nutrients deficient in the animal's main diet.

TDN - Total Digestible Nutrients, a measure of digested energy. A lb of TDN equals 2,000 Calories (kilocalories).

Vitamins - Specific organic substances required for various metabolic functions.

Dairy Nutrition Worksheet

Dr. Steve Hart
Langston University

Go to www2.luresext.edu

Select the goat in the middle, Go to Nutrient Calculators, Select Producer Version Calculator

1. Calculate the nutrient requirements for a dry, open, mature Alpine dairy doe with a 34" heartgirth under intensive management.

   A. How much does she weight? _____
   B. Requirements for TDN_____ CP_____Calcium_____ Phos_____DMI_____
   C. Can she meet her nutrient requirements from sudangrass, fresh, immature? _____

2. Calculate her nutrient requirements to gain 3 lbs/month.

   A. Requirements for TDN_____ CP_____Calcium_____ Phos_____DMI_____
   B. Can she do this on sudangrass, fresh, immature? _____

3. Calculate her requirements if she is 125 days pregnant with twins.

   A. Requirements for TDN_____ CP_____Calcium_____ Phos_____DMI_____
   B. How much Bermuda grass hay and sweet feed are required?
      Hay_____Sweet feed_____

4. Calculate her requirements if she is in the 4th week of lactation producing 7 lbs of 3.5% fat and 3.2% protein milk and is 4 years old.

   A. Requirements for TDN_____ CP_____Calcium_____ Phos_____DMI_____
   B. Let's calculate how much Dairy feed, 16% and early bloom Alfalfa it will take to feed her. Do not feed more grain than hay so we do not have a rumen upset problem.
      Alfalfa hay _____ Dairy feed _____
   C. Will this meet her nutrient requirements? What will happen to her bodyweight?
   D. How much weight will she lose?

***Answers**: 1A. 123 lbs B. 1.71 lbs TDN, .19 lbs CP, 3.85 g P, 2.60 lbs DMI C. Yes, 12 lbs fresh sudan 2A. 1.84 lbs TDN, .23 lbs CP, 4.05 g CA, 2.83 g P, 2.87 lbs DMI. B. Yes, 15 lbs sudan 3A. 2.31 lbs TDN, .36 lbs CP, 5.85 g Ca, 4.09 g P, 4.13 lbs DMI B. 3.4 lbs hay, 1.2 lbs sweet feed. 4A. 3.98 lbs TDN, .81 lbs CP, 10.21 g Ca, 7.14 g P, 5.38 lbs DMI 4B Hay 3.0 lbs, feed 3.0 lbs. C. No, she will lose weight. D. 2 lbs per month.*

Meat Nutrition Worksheet

Dr. Steve Hart
Langston University

Go to www2.luresext.edu

Select the goat in the middle , Go to Nutrient Calculators, Select Producer Version Calculator

1. Calculate the nutrient requirements for a lactating, open, 4 year old Boer doe with a 32" heartgirth under intensive grazing management She has twins 6 weeks old and body condition score 2.5.

A. How much does she weight? _____

B. Requirements for TDN_____CP_____Calcium_____ Phos_____DMI_____

C. Can she meet her nutrient requirements from early summer range? _____

D. What nutrients is she deficient in?_____ _____ _____.

E. What will happen to her bodyweight?

F. Calculate the doe's requirements except allow that she will lose 2 lbs of bodyweight /month.

Can we meet this doe's requirements using early summer range? Is this weight loss acceptable?

2. Let us supplement her with 2.0 lbs of whole shelled corn per day and .05 lbs of a 12-12 mineral mix. Feed her prairie hay like she is wintering. This is about the most grain that we can feed her without causing digestive upsets. Assume no body weight loss.

A. Can we meet her energy requirements? _____

B. What will it cost to feed this doe for 12 weeks if she kids in the winter? (Hay $.05/lb, Corn $.10/lb).

3. Calculate the requirements for this doe if she is dry, open and gaining 1 lb/month.

A. Requirements for TDN_____ CP_____Calcium_____ Phos_____DMI_____

B Can these requirements be met by late summer range?_____

D. For wintering this doe, if she gets .5 lbs of whole shelled corn and has bermudagrass hay, can we meet her requirements?_____

E. How can you really tell if you are meeting the animal's nutrient needs?

Answers *1A. 120 lbs B. 2.69 lbs TDN, .53 lbs CP, 7.30 g Ca, 5.10 g P, 3.97 lbs DMI. C. Nearly D. Protein, calcium E. Lose weight F. 2.29 lbs TDN, .47 lbs CP, 6.83 g. Ca, 4.78 g. P 3.68 lbs DMI, Closer to meeting requirements. 2A. 2.69 lbs TDN, .53 lbs CP, 7.30 g Ca, 5.10 g P, 3.97 lbs DMI, yes B. 2.0 lbs corn x .10 +2.4 lbs hay x .05 = $.32/day x 84 days = $26.88. 3 A. 1.30 lbs TDN, .18 lbs CP, 3.87 g Ca, 2.71 g P, 2.07 lbs DMI. B Deficient in energy and protein. D. Yes (1.8 lbs Bermuda hay) E. Observe body condition.*

eXtension Goat Information on the Web

Dr. David Kiesling
Lincoln University

Introduction

eXtension is a Website (http://www.extension.org) that provides research based information on topics as diverse as horses, fire ants and energy conservation. Established in 2004, eXtension is part of Cooperative Extension Service. Topics under eXtension are known as Communities of Practice (CoP). Eight communities of practice were established in the fall of 2005 and an additional 14 CoPs were added in the fall of 2006. These CoPs were launched on the eXtension public site in February 2008. Presently there are 40 CoPs published to the Website formed under one of eight resource areas shown in Table 1.

Information found in the communities of practice is developed by extension specialists and researchers from land grant universities, veterinarians, and numerous specialists from various USDA agencies across the United States. eXtension, therefore, is considered to: 1) offer credible expertise, 2) provide reliable answers based upon sound research, 3) have connections to the best minds in American universities, 4) provide creative solutions for today's complex challenges, 5) supply customized answers to your specific needs, 6) offer trustworthy, field-tested data and 7) provide dynamic, relevant and timely answers to your questions (http://www.extension.org/main/about).

Recently, members of the 1890 land grant universities took the lead in developing a Community of Practice on goats (Goat Industry). It was felt that this was important to place on the eXtension Website because of their growing importance in the U.S. The Goat Industry started as an eXtension CoP in March 2008. The CoP was launched to the live site of eXtension one year later in March 2009.

The Goat Industry Website provides basic information for the producer, consumer and extension personnel. Currently, the site contains information on breeds, genetics, goat industry assessment and outlook, establishing a goat operation, facilities, herd health, marketing, management, goat milk products, nutrition, organic goat production, reproduction, pastures and forages, predator control, targeted grazing, vegetation management and youth. In addition to the above information, there are also announcements, a glossary of goat terms, a meat goat management tool and instructional videos. Resources are continuously being added to the site to benefit the people interested in learning more about goats. Some of the content that will be added to the resource area in the future: fiber production, basic herd health procedures and biosecurity, crossbreeding, farm business planning and budgeting, legal issues, risk management, economics of goat production, business plans and enterprise budgets, and disaster preparedness.

This Website provides opportunities for persons interested in learning more about goats to find the information, and if it is not there they can ask an expert and receive an answer within 48 hours. Presently there are 203 frequently asked questions (FAQs) that are published on the live site. These questions were asked by individuals or were questions put together by experts in the Goat Industry.

Eventually, the Goat Industry Website (http://www.extension.org/goat) will be a one-stop source for goat information.

Table 1. eXtension Communities of Practice under Resource Areas on the Public Website

Alerts
Financial Crisis

Community
Community Planning and Zoning
Cooperatives
Diversity, Equity and Inclusion
Entrepreneurs & Their Communities
Extension Master Gardener
Gardens, Lawns & Landscapes
Geospatial Technology
Imported Fire Ants

Disaster Issues
Agricultural Disaster Preparedness
Floods
Oil Spill
Wildfire

Energy
Farm Energy
Home Energy
Wood Energy

Family
Child Care
Drinking Water and Human Health
Families, Food and Fitness
Family Care Giving
Food Safety
Parenting
Personal Finance

Farm
Animal Manure Management
Bee Health
Beef Cattle
Blueberries
Corn and Soybean Production
Cotton
Dairy
Goats
Grapes
Hogs, Pigs, and Pork
Horses
Organic Agriculture
Plant Breeding and Genomics
Small Meat Processors

Pest Management
Pest Management In and Around Structures
Wildlife Damage Management

Youth
Science, Engineering, and Technology for Youth

DHI Training

Ms. Eva Vasquez
Langston University

STANDARD OPERATING PROCEDURES FOR DAIRY GOAT PRODUCTION TESTING

Effective January 1, 2004

CONTENTS

STANDARD OPERATING PROCEDURES

1.0 SCOPE & APPLICATION

1.1 This Standard Operating Procedure (SOP) is applicable to the systematic collection of data documenting milk yield including the measuring milk fat and protein for participants in DHI. The application of these procedures is to provide the framework for a uniform, accurate record system to be used for (1) making farm management decisions; (2) educational programs and research, including the genetic evaluation of does and sires; (3) breed association(s); and (4) the promotion and sale of animals.

2.0 SUMMARY OF PROGRAM

2.1 Sampling should be done in accordance with the National DHIA Uniform Operating Procedures (UOP). All UOP procedures, unless specific to dairy cows only, are to be followed. For purposes of compliance, the use of the terms “cows and heifers” is synonymous with “goats and kids”.

2.2 Procedures outlined in this document are specific to dairy goat production testing only. These basic and minimum standards are to be uniformly followed. They serve to ensure that records will provide the accuracy, uniformity, and integrity essential to dairy goat production records.

3.0 AUTHORITY

3.1 A Memorandum of Understanding exists between the ADGA and the Agricultural Research Service of the United States Department of Agriculture (USDA) to ensure the flow of DHIA records for industry purposes including genetic evaluation programs.

4.0 RESPONSIBILITY

4.1 DHIA dairy goat test supervisors and herd owners as well as persons in their employ are individually and collectively responsible for adherence to these Procedures.

4.2 To participate in this dairy record keeping program, herdowners must agree to conform to these procedures, registry requirements, the NDHIA Uniform Operating Procedures and the associated Code of Ethics.

5.0 DEFINITIONS

5.1 **Dairy Goat -** any goat from which milk production is intended for use or sale, or which is kept for raising replacement dairy kids and is an integral part of the dairy herd.

5.2 **Test Supervisor (TS) –** Any person authorized to collect milk weights and samples for inclusion in the Goat Genetic Evaluation Program (interchangeable with ‘tester’, ‘field sampler/technician’ or ‘supervisor’).

5.3 **Group Testing** – Must meet registry requirements. Each member of the test group is trained to perform supervisor responsibilities when weighing and sampling milk in the herds of other group members. All group testing is conducted under the jurisdiction and supervision of the DHIA.

6.0 PERSONNEL QUALIFICATIONS

6.1 All Test Supervisors are required to be approved by the DHIA of record prior to engaging in any field collection activities.

6.2 Training should be done in accordance with the Council on Dairy Cattle Breeding (CDCB) QCS Field Service requirements with the following being specific to dairy goat testing.

7.0 MINIMUM PERSONNEL TRAINING REQUIREMENTS

7.1 The minimum requirements for new test supervisors (TS) to test non-commercial herds (as determined by the herd's DHIA) without immediate supervision include demonstrated knowledge of (1) barn and parlor techniques, (2) data entry, (3) the *Code of Ethics* and *Uniform Data Collection Procedures, and (4) the Standard Operating Procedures for Dairy Goat Testing*. Commercial herds must have testers meeting the criteria of the CDCB auditing guidelines.

7.2 Documentation of the initial training must include (1) the name and date of training of the new TS, (2) the name and credentials of the trainer, and (3) a list of the topics covered during the training.

7.3 Continuing Education (CE) or refresher sessions should be provided in accordance with the CDCB Auditing guidelines. In addition, newsletters, videos, attendance at an ADGA annual meeting training session can serve as meeting CE requirements. Documentation must include (1) the name of each TS, (2) the name and credentials of the trainer, and (3) a list of the topics covered during the training.

7.4 TS other than those approved to test cowherds or commercial herds (as determined by the herd's DHIA) must obtain CE or attend an initial or a refresher session every 3 years. This is an exception to the CDCB auditing guidelines as it applies to those testers supervising herds using 'pail and scale' techniques. This exception is allowed as this type of test plan is subject to little change over time. Documentation of CE/Refresher must include (1) the name of each TS, (2) the name and credentials of the evaluator, (3) a list of the topics covered during the evaluation, and (4) a performance assessment based upon the CE/Refresher information provided.

8.0 EQUIPMENT AND SUPPLIES

8.1 Equipment needed for collection of dairy goat milk samples includes:

- sample vials or whirl paks*
- approved meter*, or
- sampling device (dipper) and scale*
- sample preservative
- field data sheets

*The appropriate sampling and measuring devices must be of proper composition. See Section 10 for SOP Meters and Scales

9.0 SAMPLE COLLECTION – PREPARATION

9.1 Determine the extent of the sampling effort, the sampling methods to be employed, and which equipment and supplies are needed.

9.2 Obtain necessary sampling and/or weighing equipment.

9.3 Coordinate with herdowner and partner agencies, if appropriate.

10.0 SAMPLE COLLECTION - METHOD OPTIONS

10.1 Meters **-** All portable weighing and sampling devices being used for the generation of certified data must be of a National DHIA approved type. Meters for goat milk sampling must be calibrated in conformance to manufacturer specifications.

GOAT METERS

Manufacturer	Device	ICAR Approved	DHIA Approved
Tru-Test Limited - New Zealand	Goat Meter model 50000		Yes
Waikato - New Zealand	Goat Meter		Yes

10.2 Scales being used for the generation of milk weights to be included in the *Goat Genetic Evaluation Program* must meet the following weight tolerance ranges at each specified weight:

Pounds	Minimum	Maximum
1	0.9	1.1
2	1.9	2.1
5	4.8	5.2
10	9.7	10.3
20	19.4	20.6

10.3 All scales must be checked for calibration by a certified meter technician or an individual approved by the DHIA prior to being placed in active service. The field technician or the herdowner may own Scales. Approved individuals must calibrate scales using certified weights.
10.4 Scales should be identified with a unique identification number.
10.5 All scales must be submitted for an approved routine calibration check by a certified meter technician or an individual approved by the local DHIA on an annual basis.
10.6 All scales receiving repairs that may have affected accuracy must be checked for calibration by a certified meter technician or an individual approved by the local DHIA before returning to active service.
10.7 Each scale must be identified with a tag, sticker, engraving, or other marking indicating the last calibration year and meter center used.
10.8 Documentation of scales must include (1) the make and unique identification number of the scale, (2) the meter technician's or approved individual's name, (3) the meter center used, (4) the date of calibration check, and (5) the final calibration check readings.
10.9 Dip Sampling must be done in a manner that assures a representative sample from the entire milk volume collected.

11.0 SAMPLE HANDLING AND PRESERVATION

11.1 Use pre-preserved sample vials.
11.2 Samples should be kept at room temperature and out of direct sunlight.
11.3 Keep samples in control of the tester – ***EXCEPTION*** – for group tests, samples may also be in control of the group leader, or person designated to ship the samples/data to the laboratory.
11.4 Record all pertinent data on a field data sheet.
11.5 Samples should be shipped so that they arrive at the lab no later than 6 days after the test is performed.

12.0 DATA COLLECTION AND RECORDS MANAGEMENT

12.1 When a breeding date is available, and a doe freshens less than 10 days prior to the expected kidding date, it will be considered a normal kidding and the record initiated will be used for buck and doe evaluations. Does freshening 10 days or more prior to the expected kidding date, whether in milk or dry, will be coded as abnormal and the record initiated will not be used for buck and doe evaluations.
12.2 If a doe aborts while in milk and has carried a kid less than 80 days, her current record will continue without interruption. If a breeding date is not available, and the doe aborts while in milk for less than 240 days, her current record shall continue without interruption. Except for specific situations stated above, the current record shall end and a new lactation will begin.
12.3 Verification tests may be a required condition of test type plan or registry recognition level. It is the herdowner's and/or test supervisor's responsibility to arrange for such tests dependent on registry or regional requirements. Verification testing should be done in accordance with registry policies.
12.4 All data and information must be documented on field data sheets
12.5 Minimum Suggested Record Retention

- Field Sheets – 2 years
- Record Center sheets – 2 years
- Verification Sheets – 2 years

13.0 QUALITY CONTROL (QC) AND QUALITY ASSURANCE (QA)

All field QC requirements of the ADGA QA Project must be followed.

14.0 REFERENCES

Dairy Goat Registry Guidelines, 2003
Uniform Operating Procedures, June 2002
California DHIA, Dairy Goat QC Program
Council on Dairy Cattle Breeding, Auditing Guidelines, June 2002

2011 Langston DHI Supervisor Test

(Must return by Mar. 1, 2011 if you want a certificate)

Were you previously certified by Langston to be a supervisor? ___ ___
Yes No

Name:_____

Address:_____

City:_____ **State:**_____ **Zip:**_____

Telephone:_____

Who do you test for:_____ **E-mail** _____

1. A transfer doe is….
   A: A doe from another herd on test, that is entering your herd.
   B: A doe in your herd that has just freshened.
   C: A doe coming into your herd who has not been on test before.
   D: None of the above.

2. A verification test consist of how many milkings?
   A: 1
   B: 2
   C: 3
   D: 1 AM & 1PM

3. If I have a milk weight entered for a doe, and she has a D in the second column on the barn sheet (DMS 201) there is no problem.

   _____ True _____False

4. Before sending the paperwork, I always ensure that I have put down fresh dates for does that have freshened and dry dates for does that have since the last test.

   _____ True _____False

5. If I have not put down a milk weight for a doe who has an I in the second column on the barn sheet (DMS 201) there is no problem.

   _____ True _____False

6. What is the difference between the Service Affiliate Fee (.08) and the Milk Analysis Fee (1.15).

7. My neighbor has bought some goats from me, but she is not interested in testing them. Therefore she can still test my goats.

_____ True _____False

8. In order for my tests to be valid, my scales have to be checked for calibration …
   A. Three months
   B. Six months
   C. Eight months
   D. One year

9. When I find a mistake (Eva never makes mistakes. ;)) I should…

   A: Wait until the end of the year
   B: Wait until another test to see if the problem was corrected.
   C: Call as soon as you see a problem
   D: Make a note of the error and highlight it.

10. Doe pages are automatically sent to the owners when the doe dries or leaves the herd.

____ True ____ False

11. Milk samples must be refrigerated before shipping….
   A. So they don't spoil
   B. Because they will cool and not spill easily
   C. So the butter fat will be on top
   D. None of the above

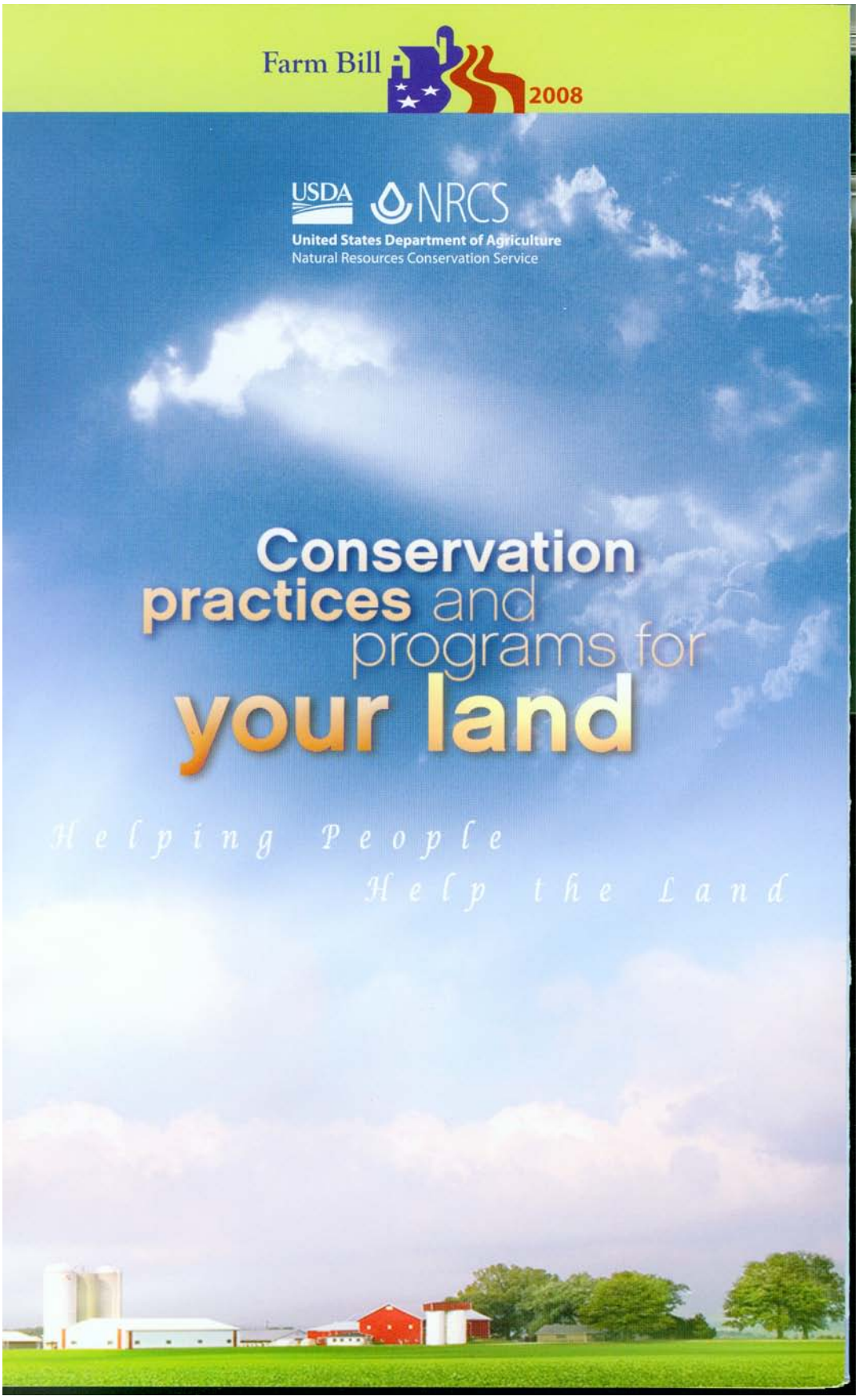
12. If the pill falls out of the vial, I should…..
   A. Pick it up and put it back in the vial
   B. Wash it off and put it back in the vial
   C. Throw it in the trash and get a new vial
   D. None of the above.

13. The best way to label the vial is to…
   A: Put the does name on the vial.
   B: Put the order in which the does were milked on the vial, (1,2,3,4..ect.).
   C: Put the index number for the doe on the vial.
   D: Use a unique numbering system with a secret code.

IF YOU HAVE ANY QUESTIONS, PLEASE ASK THEM HERE:

Benefits of USDA Programs

Mr. Dwight Guy, Mr. Phil Estes, Mr. Kenneth Hitch, and Mr. Wil Hundl
USDA


Farm Bill 2008
USDA NRCS
United States Department of Agriculture
Natural Resources Conservation Service
Conservation practices and programs for your land
Helping People Help the Land

FAQ

frequentlyasked**questions**

How do I improve the chances of my conservation program application being accepted?

Most program applications are selected according to ranking processes specific to your area. Working with your local NRCS representative, you can develop a conservation plan for your land that provides alternatives for various levels of resource treatment relevant to application ranking considerations in your area. You can select the level of treatment that best meets your individual needs while improving your chances of being accepted for funding.

If I enroll my land in a conservation program, do I maintain ownership? Am I required to allow public access to my land?

If you enroll land in any of our conservation programs, you retain ownership of the land. Although participation in conservation easement programs limits certain uses of the land during the term of the agreement or easement, you still maintain control of public access.

Will I be responsible for maintaining practices that I install under a conservation program?

All programs require practice operation and maintenance as stated in the agreement.

What types of wildlife will I attract if I enroll in conservation programs?

The practices you implement and the plants you establish will affect the types of wildlife you attract to your land. Practices can be designed and managed to attract particular species, such as turkey, quail, deer, songbirds, and other wildlife species.

PA - 2037 November 2009

What USDA Offers

	Program	What Land is Eligible?	Length of Agreement	Contract Payments	Easements	Program Payments	Producer Responsibilities
Financial Assistance Programs	Agricultural Management Assistance (AMA) Program	Private or Tribal land in agricultural production including cropland, hayland, pastureland, rangeland, grassland, and non-industrial private forest land.	1-10 years			Payments support practice implementation based on incurred cost and income foregone*	Develop and follow an AMA plan that describes the conservation and environmental objectives. Contribute to installation costs.
	Agricultural Water Enhancement Program (AWEP)	Private, public, and Tribal land in agricultural production including cropland, grassland, and non-industrial private forest land. Does not include land enrolled in CRP, WRP, or GRP.	Up to 5 years for AWEP partnership agreements; 1-10 years for producer EQIP contracts			Payments support practice implementation based on incurred cost and income foregone*	Develop and follow an AWEP EQIP plan that addresses water conservation and water quality and describes the environmental objectives. Incur installation costs.
	Conservation Stewardship Program (CSP)	Private or Tribal agricultural land and non-industrial private forest land. Does not include land enrolled in CRP, WRP, GRP, or Conservation Security Program.	5 years; 5-year renewal option, subject to funding availability	Annual payment based on level of conservation stewardship; supplemental payment available for participants who adopt a resource-conserving crop rotation			Implement a conservation stewardship plan that addresses resource concerns in a comprehensive manner by installing and adopting additional conservation activities and improving, maintaining, and managing existing activities.
	Environmental Quality Incentives Program (EQIP)	Private, public, and Tribal land in agricultural production including cropland, grassland, and non-industrial private forest land. Does not include land enrolled in CRP, WRP, or GRP.	1-10 years			Payments support practice implementation based on incurred cost and income foregone*	Develop and follow EQIP plan of operations that describes the conservation and environmental objectives. Incur installation costs.
	Wildlife Habitat Incentive Program (WHIP)	Private or Tribal agricultural land. Does not include land enrolled in CRP, WRP, HFRP, or a similar program.	1-10 years, or minimum of 15 years for long-term agreements for critical habitat			Payments support practice implementation based on incurred cost*	Prepare and follow WHIP plan of operations that describes the wildlife habitat objectives to be achieved. Contribute to installation costs.
Easement Programs	Farm and Ranch Lands Protection Program (FRPP)	Private land that contains at least 50% prime, State, or locally important farmland; contains historic or archeological resources; or supports the policies of a State, local farm, or ranch protection program. Includes cropland, rangeland, grassland, pastureland, and forest land.	Cooperative agreements obligate funds annually to entities that acquire permanent easements		One-time, up-front payment or up to five annual payments		Continue to use the land for agricultural purposes. Comply with conservation plan for highly erodible land and terms of conservation easement deed.
	Grassland Reserve Program (GRP)	Private or Tribal grassland, shrubland, land containing forbs (including improved rangeland and pastureland) for which grazing is the predominant use, and land in an area that historically contained those features.	10-, 15-, and 20-year rental contracts or permanent easements	Annual rental payment based on county rate determined by FSA	One-time, up-front payment or up to 10 annual payments	50% of actual cost	Develop and comply with a grazing management plan for the easement, rental contract, or restoration agreement. Contribute to installation costs and maintain practices.
	Healthy Forests Reserve Program (HFRP)	Non-industrial private or Tribal forest land capable of supporting habitat for a selected wildlife species.	10-year cost-share agreements, 30-year contracts, and 30-year or permanent easements		One-time, up-front payment or up to 10 annual payments	Up to 75% for cost-share agreements, 30-year contracts, and 30-year easements; up to 100% for permanent easements	Develop and implement HFRP restoration plan that promotes restoration, protection, enhancement and maintenance of forest land functions and values. Contribute to installation costs.
	Wetlands Reserve Program (WRP)	Private or Tribal farmed wetlands or wetlands converted prior to December 23, 1985, and adjacent lands that maximize wildlife benefits.	30-year or permanent easements, 30-year contracts, or cost-share restoration agreements		One-time, up-front payment or up to 30 annual payments for either easement option or 30-year contract	Up to 75% for restoration cost-share agreements, 30-year contracts, and 30-year easements; 100% for permanent easements	Develop and implement WRP plan of operations for the restoration and maintenance of the wetland. Contribute to restoration costs.

All programs are subject to final USDA regulations. ***Historically underserved participants may be eligible for increased payment rates up to 90%; EQIP offers up to 30%.**

2008 FARM BILL: WHAT'S IN IT FOR YOU?

Conservation practices & programs for your land

What's in it for you?

The 2008 Farm Bill offers America's agricultural producers and non-industrial private forest landowners more assistance than ever before to voluntarily conserve natural resources on our Nation's privately owned farm and ranch lands. Its provisions provide technical and financial assistance to help producers implement conservation practices that reduce erosion, protect our waters, improve fish and wildlife habitat, improve air quality, and conserve energy. This guide introduces the assistance available.

What's New?

- Increased focus on energy conservation, organic and specialty crop production, forestry, air quality, and climate change.
- New programs and initiatives that include the Agricultural Water Enhancement Program (AWEP), Cooperative Conservation Partnership Initiative (CCPI), Chesapeake Bay Watershed Initiative (CBWI), the Environmental Quality Incentives Program (EQIP) Air Quality Initiative, and the Conservation Stewardship Program (CSP).
- Set-aside funding for beginning and socially disadvantaged farmers and ranchers.

Financial & Economic Incentives

The Natural Resources Conservation Service (NRCS) of the U.S. Department of Agriculture (USDA) offers a variety of programs to producers and landowners interested in conservation. Some programs offer annual conservation for long-term contracts and conservation easements. Whether through an agreement or easement purchase, all programs include Federal funds to assist with or offset costs of conservation practices and activities.

Technical Assistance

NRCS helps customers plan and implement conservation practices on private lands through technical assistance of the highest quality and standards. Technical assistance is also available through certified Technical Service Providers (TSPs).

Partnerships Enhance Assistance to NRCS Private Land Programs

NRCS works with many partners to deliver conservation services and programs. Partners such as local conservation districts, Resource Conservation and Development (RC&D) Councils, Cooperative Extension, State natural resource agencies, and nongovernmental conservation organizations all play important roles. Professionals in each organization provide technical help. Additional educational and financial assistance for establishing conservation practices on farms and ranches may be available.

For More Information

Contact your local NRCS office, USDA Service Center, or local conservation district,

Water Erosion

Curbing water erosion

To reduce soil movement and nutrient runoff, consider these or similar practices:

- Grassed waterways
- Residue management
- Grassed riparian buffers
- Grade stabilization structures
- Contour buffer strips

Begin with a look at these programs: **EQIP, AMA, WHIP, CSP**

Wind Erosion

Curbing wind damage

To mitigate the effects of wind on farm and ranch lands, consider these or similar practices:

- Residue management
- Shelterbelts
- Windbreaks
- Field stripcropping

Begin with a look at these programs: **EQIP, WHIP, CSP**

Soil

Conserving soil and water resources

To improve soil and water quality, consider these or similar practices:

- Nutrient management
- Pest management
- Crop rotation
- Filter strips
- Riparian buffers
- Surface water management

Begin with a look at these programs: **EQIP, AWEP, AMA, WHIP, CSP**

Waterways

Protecting waterways from erosion and degradation

Consider these or similar practices:
- Riparian buffers
- Filter strips
- Stream crossings
- Stream bank stabilization/Shoreline protection

Begin with a look at these programs:
EQIP, WHIP, AMA, CSP, CRP

Manure

Managing manure

To prevent nutrient loss and protect air, soil, water, fish, and wildlife resources, consider these or similar practices:
- Waste storage structures and lagoons
- Nutrient management
- Compost facilities
- Waste utilization

Begin with a look at these programs:
EQIP, CBWI

Grasslands

Managing grasslands

To improve forage quality, control invasive species, and conserve fish and wildlife habitat, consider these or similar practices:
- Prescribed grazing
- Pest management
- Prescribed burning
- Watering facilities
- Brush management

Begin with a look at these programs:
EQIP, GRP, WHIP, WRP, CSP, CRP

Wildlife

Establishing wildlife habitat

To enhance, restore, manage and protect fish and wildlife habitat, consider these or similar practices:
- Upland/Wetland habitat management
- Wetland restoration
- Forest stand improvement
- Stream habitat improvement
- Prescribed burning
- Tree/Shrub establishment

Begin with a look at these programs:
WHIP, WRP, GRP, EQIP, HFRP, CSP

Forest Lands

Managing forest lands

To restore and protect forest resources and improve fish and wildlife habitat, consider these or similar practices:
- Tree planting
- Forest stand improvement, thinning
- Prescribed burning
- Controlling invasive plants

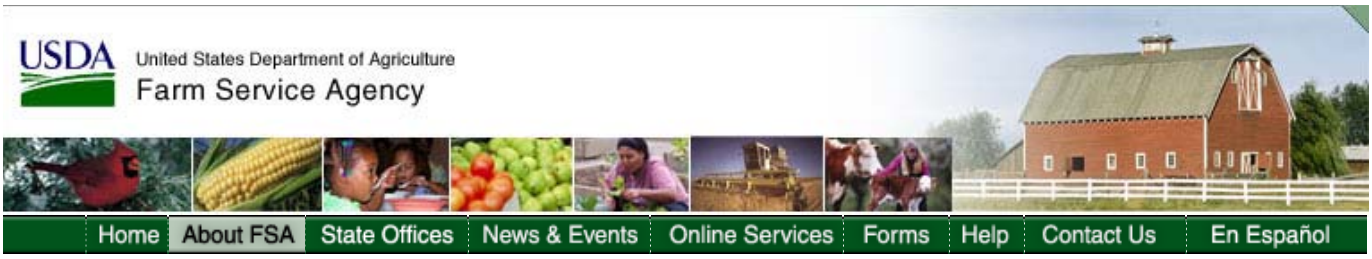
Begin with a look at these programs:
HFRP, WHIP, EQIP, CSP

Air, Energy & Climate Change

Improving air quality, conserving energy, and mitigating climate change

Consider these or similar practices:
- Residue management
- Dust abatement
- Cover crops
- Conservation buffers
- Windbreak/ Shelterbelt plantings
- Tree planting
- Conversion of cropland to grassland

Begin with a look at these programs:
EQIP, AMA, HFRP, GRP, CSP



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About FSA

Office of the Administrator

The Farm Service Agency (FSA) administers and manages farm commodity, credit, conservation, disaster and loan programs as laid out by Congress through a network of federal, state and county offices.

These programs are designed to improve the economic stability of the agricultural industry and to help farmers adjust production to meet demand. Economically, the desired result of these programs is a steady price range for agricultural commodities for both farmers and consumers.

In the Eisenhower administration, the Congress split the functions of the Triple A committees, creating the state and county office system to take care of administrative functions and kept the farmer county committee to oversee implementation of federal programs in their county.

State and county offices directly administer FSA programs. These offices certify farmers for farm programs and pay out farm subsidies and disaster payments. Currently, there are 2,346 FSA county offices in the continental states. FSA also has offices in Hawaii, and a few American territories.

More than 8,000 farmer county committee members serve in FSA county offices nationwide. Committee members are the local authorities responsible for fairly and equitably resolving local issues while remaining dually and directly accountable to the Secretary of Agriculture and local producers though the elective process. They operate within official regulations designed to carry out Federal laws and provide a necessary and important voice in Federal decisions affecting their counties and communities.

Committee members make decisions affecting which FSA programs are implemented county-wide, the establishment of allotment and yields, commodity price support loans and payments, conservation programs, incentive, indemnity, and disaster payments for commodities, and other farm disaster assistance.

Structure & Organization

Provides contact information as well as a listing of the programs and offices that make up the Farm Service Agency.

FSA Biographies

Includes biographies of the Farm Service Agency leadership.

History & Mission

Provides a history of the agency and describes its vision and mission.

Budget & Performance

Includes information about the budget, the strategic plan, and efforts to ensure that activities are managed efficiently.

Related Topics

- **Structure and Organization**
- **FSA Biographies**
- **History and Mission**
- **Budget and Performance Management**
- **Human Resources**
- **Customer Perspectives**

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You are here: FSA Home / Farm Loan Programs

Farm Loan Programs

Background

FSA makes direct and guaranteed farm ownership (FO) and operating loans (OL) to family-size farmers and ranchers who cannot obtain commercial credit from a bank, Farm Credit System institution, or other lender. FSA loans can be used to purchase land, livestock, equipment, feed, seed, and supplies. Our loans can also be used to construct buildings or make farm improvements. See our loan information chart which describes maximum loan amounts, rates, term, and use of proceeds.

Many FSA loan application forms are available on our website! We also encourage you to contact your local office or USDA Service Center to learn more about our programs and the information you will need for a complete application.

Our Customers

FSA loans are often provided to beginning farmers who cannot qualify for conventional loans because they have insufficient financial resources. FSA also helps established farmers who have suffered financial setbacks from natural disasters, or whose resources are too limited to maintain profitable farming operations.

Last Modified: 10/09/2007

Related Topics

- **Beginning Farmers and Ranchers Loans**
- **Direct Farm Loans**
- **Emergency Farm Loans**
- **Funding**
- **Guaranteed Farm Loans**
- **Socially Disadvantaged Farmers and Ranchers Loans**

I Want To...

- **Find Farm Loan Program Notices**
- **Find Real Estate for Sale**

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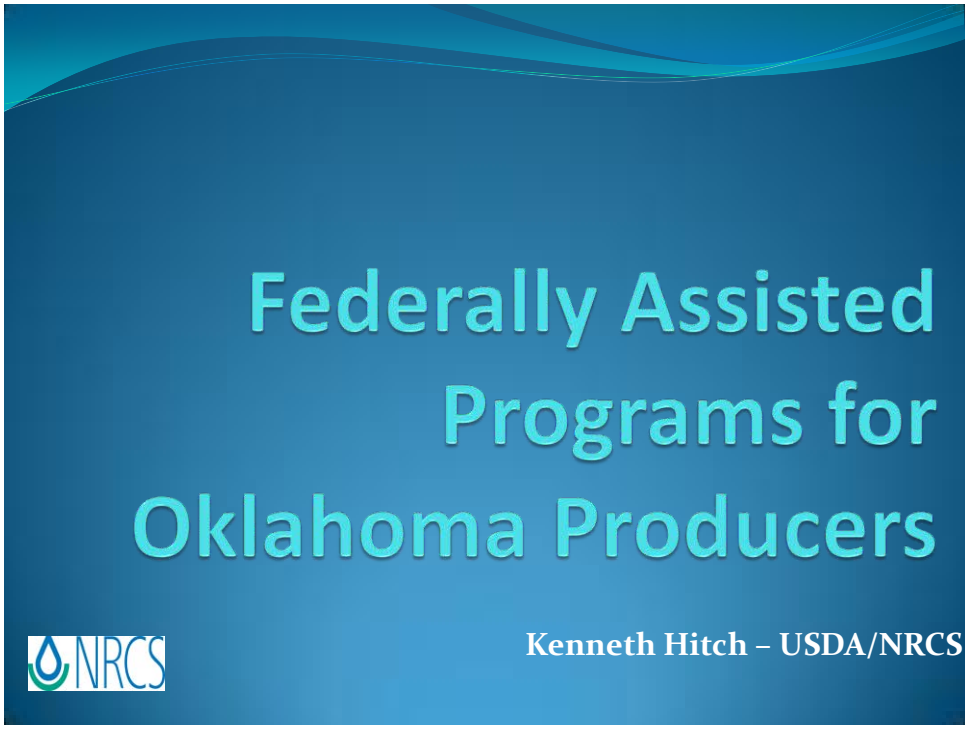


Programs Available

- Environmental Quality Incentives Program (EQIP)
- Wildlife Habitat Incentive Program (WHIP)
- Agriculture Water Enhancement Program (AWEP)
- Environmental Quality Incentives Program Organic Initiative
- Conservation Stewardship Program (CSP2008)

Program Characteristics

- Voluntary participation.
- Program funds dedicated to historically underserved groups.
- Historically Underserved payment rates.
- Ranking tools are size neutral.

EQIP

- EQIP is implemented at the county and state level.
- Local resource concerns are identified and addressed through the locally led process.
  - Base Funding
  - Local Emphasis Areas

EQIP

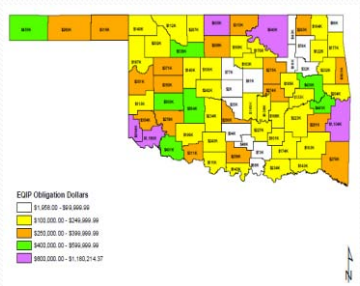
- Multi-County or statewide concerns are also addressed.

  - Historically Underserved Funding
  - Irrigation Water Conservation
  - Lagoon Closures
  - No-Till LEAs
  - Organic Initiative
  - Lesser Prairie Chicken Initiative
  - Quail Habitat Restoration Initiative
  - AFO/CAFO Animal Waste Management
  - Ag Energy Initiative
  - Oil Spill Prevention and Containment Initiative
  - Forestry LEAs

Review of 2010 Environmental Quality Incentives Program (EQIP)

Practices With the Highest Obligation Rates for 2010	
Practice	**$ Obligated**
314 Brush Management	$3,015,466
329 Residue management No-Till	$2,647,604
382 Fence	$1,908,209
378 Pond	$1,039,396
442 Irrigation - Sprinkler	$1,010,527
590 Nutrient Management	$983,790
512 Pasture and Hay Planting	$890,361
595 Pest Management	$657,368
410 Grade Stabilization Structure	$570,124
441 Microirrigation System	$452,987

•$20,151,396 were obligated in 1,138 contracts
•Historically underserved participants accounted for 25% of those contracts.



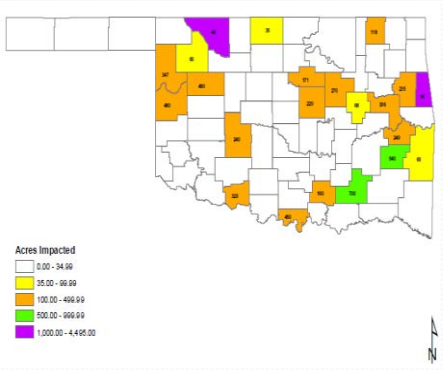
WHIP

- WHIP is implemented at the State level.
- Applications are ranked and evaluated based on National and State Priorities.
- Applicants compete for funds against applications for similar habitat types.
- Financial assistance for enhancement and maintenance of wildlife habitat.

Review of 2010 Wildlife Habitat Incentives Program (WHIP)

- 47 contracts were written impacting wildlife habitat on over 12,400 acres.
- Total obligations were $559,305.
- 47% of these funds were allocated to Historically Underserved Applicants.
- An additional $102,000 was available through the LEPC Initiative to restore habitat for this candidate species.

WHIP Acres Contracted in FY 2010



CSP

- Conservation Stewardship Program
  - 2008 Farm Bill.
  - Nationwide continuous signup.
  - 5 year contracts.
  - Average payment for 2010-1 sign-up was $14/acre/year.
  - Currently taking applications for 2012 sign-up.

CSP

- 5 geographic areas in agricultural lands and statewide NIPF, each with unique resource concerns.
- Operators are eligible, must meet at least one resource concern at application and one additional priority concern by end of contract.
- Must document control throughout the contract.
- Applications ranked on information provided by producer.
- Preapproved applications will be field verified.
- 5 year contract w/additional enhancement activities

Geographic areas for Oklahoma Ag Lands in 2010-2 CSP Sign-up.

AWEP

- Conservation of surface and ground water and improve water quality on agricultural lands.
- Eligible partners will enter into multi-year agreements with NRCS
- Oklahoma has two areas totaling $739,581 for 2009

EQIP Organic Initiative

- Assistance for practices related to organic production.
- Applicants must develop and carry out an Organic System Plan (OSP) or carry out practices in a manner consistent with development of an OSP.
- Must be certified as organic, organic transitional, or certification Exempt.
- Assistance limited to $20,000 per year and $80,000 during 6 year period.
- Activities must be related to a resource concern. Not intended for production.
- Participants must be in compliance with Organic Food Production Act of 1990.

Questions

The U.S. Department of Agriculture (USDA) prohibits discrimination in all its programs and activities on the basis of race, color, national origin, age, disability, and where applicable, sex, marital status, familial status, parental status, religion, sexual orientation, genetic information, political beliefs, reprisal, or because all or a part of an individual's income is derived from any public assistance program. (Not all prohibited bases apply to all programs.) Persons with disabilities who require alternative means for communication of program information (Braille, large print, audiotape, etc.) should contact USDA's TARGET Center at (202) 720-2600 (voice and TDD). To file a complaint of discrimination write to USDA, Director, Office of Civil Rights, 1400 Independence Avenue, S.W., Washington, D.C. 20250-9410 or call (800) 795-3272 (voice) or (202) 720-6382 (TDD). USDA is an equal opportunity provider and employer.

Getting Started with Goat Cheese

Mrs. Gianaclis Caldwell
Pholia Farm Creamery, Rogue River, OR

Getting Started With Goat Cheese

Gianaclis Caldwell

Uniqueness of Goat Milk

- Higher content of the fatty acids (capric, caproic, and caprylic) than cows milk.
- Casein (protein) to whey-protein ratio is lower in goat's than in cows milk (70:30 vs 80:20) often leading to a softer curd or lower yield. This can lead to the need to add Calcium Chloride as available calcium levels tend to follow casein levels. Use about 1cc/gal milk
- Typically easier to digest than cows milk.
- Lactose content almost the same as cows milk
- Lack of beta-carotene in fat molecules leads to whiter cheese.
- More seasonal variation than in cows milk.

Good Goat Cheese Choices

- Soft Fresh- chevre (fromage blanc)
  - Lactic acid coagulation
    - Starter culture choices
    - Rennet options
  - 12 hour fermentation at 72 F or until 1 inch of whey (about 4.6 pH)
  - Drain to texture
  - Salt to taste
  - Use and storage tips

Good Goat Cheese Choices

- Ricotta (whole milk)
  - Added-acid coagulation with heat
  - 185-195 F
  - Acid choices- citric, vinegar, lemon juice
  - Set and scoop
  - Drain to texture
  - Salt to taste
  - Use and storage tips

Good Goat Cheese Choices

- Feta style
  - Starter culture choices
  - Ripen at 88F
  - Rennet options and rate
  - Cut at clean break, rest 10 min.
  - Stir at 88 x 20 min.
  - Drain in bags or lined forms without pressure
  - Dry salt or brine
  - Use and storage tips
  - Aging options

Goat Cheesemaking Tips

- Milk/cheese flavor
  - Clean, rapidly chilled, fresh
- Curd texture
  - Seasonality
  - Using Calcium Choloride
  - Enzymes fall and winter milk
- Culturing temperatures and times
- Pasteurizing at home
- Checking milk for somatic cells

Building Technology Bridges in an Era of Budget Cuts

Dr. Enrique Nelson Escobar
University of Maryland Eastern Shore

I. ABSTRACT

It is no secret! Budget cuts, budget reductions, budget adjustments…it all means the same thing: less resources to do the same amount of work or more. In order to continue reaching goat/sheep producers, consumers, and 4-H Club members, extension educators have to constantly adjust and develop strategies to meet expectations and demands. In this 21st Century, technology transfer is taking place regardless of barriers, cost, and obstacles mainly because of the widespread use of the Internet and other novel communication media. While nothing will replace face-to-face dialogue and the hands-on approach that is distinctive of extension specialists, many agriculturists, extension educators, and researchers have adopted several alternative ways of continuing the high-touch interactive extension outreach.

II. CUTBACKS, ETC.

First things, first…every professor, extension educator, student, administrative assistant, etc., has been affected in more than one way by the limited availability of resources and the hasty reduction of state and local funding for Extension. Fisher (2009) has cited several striking examples of extension budget reductions at many of the land-grant universities. Even with a slight increase from federal sources (3.6% from the last fiscal year), the other two funding partners (state and local) have drastically reduced or ceased any financial support to the mission of the cooperative-extension programs. The "reorganizations" or "regionalizations" affect the face-to-face and on-farm services offered by sheep/goat specialists. Consequently, clients have to adjust to the shift to remote-access service networks.

III. BUILDING BRIDGES

The accomplishment of an extension educator's career goals relies on the process of disseminating science-based practices, knowledge, applications, and methods of food manufacturing/processing to producers, who in turn apply the concepts to ensure farm sustainability.

Ideally, sheep/goat producers will progress both economically and socially as the end result of networking with the experts. Also, consumers of agricultural products use information to shape and complement their knowledge about their preferences and choices. In the process of building technology bridges, several obstacles need to be identified to design an appropriate avenue for technology delivery. For example:

- Client knowledge and acceptance of the medium used; i.e., computer literacy
- Hardware/software availability
- Language
- Funding
- Accessibility – Internet services
- Compatibility with legacy services
- Transportability

Several alternative ways to continue the high-touch interactive extension outreach are webinars and blogs. Both are used with some degree of acceptance and success. *Webinars,* are seminars or workshops transmitted over the Web (the World Wide Web) and allow a completely interactive environment. In contrast with a webcast in which the presenter is the one transmitting data. A *Blog* (Web log*)*, is a Web page, publicly accessed used as a journal by an individual or institution. Blogs will accept text, pictures, MP3, files, charts, links, etc. Clients visiting and reading the blog are able to leave comments or ask questions in an interactive format. An example of an active blog is http://mdgoattest.blogspot.com/, the blog conveys information related to a buck test conducted in Keedysville, MD.

Langcuster (2010) expressed what many agriculturists, extension educators, and researchers have adopted as a way to continue the high-touch extension outreach approach. The use of social media systems for delivery will have an immediate impact on funding.

Examples of social media systems include: Twitter, Facebook, Linked In, Flickr and YouTube.

When using social media systems, users need to be aware of privacy issues and spam. Finin et al. (2007) mentioned that spam is a serious problem for users of social media systems and suggested developed techniques to detect spam blogs for present and future challenges.

There are many examples of organizations using social media systems for communication agility and cost reduction. NASA (Monroe, 2009) developed a unique social-networking application. NASA employees can use Facebook features in a secured environment. The addition of the Facebook feature allows NASA employees to effectively participate in collaborative projects. Beizer (2010) reported on NASA's social networking and how the federal agency, in less than 12 months, has become more efficient and effective as a result of employees using Facebook as an extension of the existing e-mail service.

Recently, social media placed a crucial role in the events in the Middle East where citizens used Twitter and Facebook to communicate and organize for political goals with a remarkable and historic success.

Sheep/goat specialists have to make plans to prepare their clientele if social media systems are to be incorporated in their delivery programs. Training on how and when to access the blogs, Tweets, or YouTube files must be provided. Also, upgrading an employee's current hardware and software will affect a rapid adoption of the social media systems.

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Body Condition Scores in Goats

Mr. Glenn Detweiler, Dr. Terry Gipson, Dr. Roger Merkel, Dr. Arthur Goetsch, and Dr. Tilahun Sahlu

Langston University

Introduction

Every goat producer has animals that are either too thin (under-conditioned) or too fat (over-conditioned). Failure to recognize these animals and take corrective actions will cost dearly in terms of decreased fertility, increased disease or internal parasite incidence, decreased milk production, and increased operating costs. Thus, goats need to be maintained with a moderate amount of body condition. When overall body condition starts to decrease in the herd, it is a sign that managerial intervention is needed such as supplemental feeding, deworming, pasture rotation, etc. Conversely, when overall body condition starts to increase in the herd, it is a sign that the producer should reduce supplemental feeding. Ignoring an animal's body condition and waiting to intervene until goats become either too thin or too fat may result in production and(or) animal losses or decreased profits from overfeeding. Therefore, producers need to develop skills in assessing body condition of their goats so that a desired moderate body condition can be maintained.

Body condition score (BCS) has been shown to be an important practical tool in assessing the body condition of cattle, sheep, and goats because BCS is the best simple indicator of available fat reserves which can be used by the animal in periods of high energy demand, stress, or suboptimal nutrition.

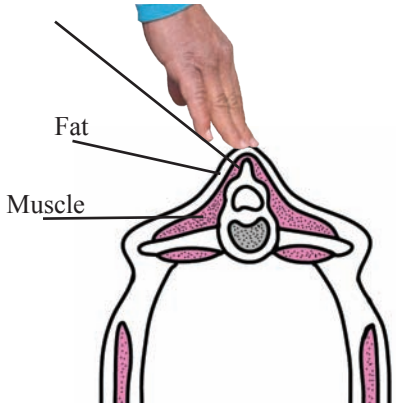
Scoring is performed in goats using a BCS ranging from 1.0 to 5.0, with 0.5 increments. Examples of BCS of 1.0, 2.0, 3.0, 4.0, and 5.0 are given using photographs and written descriptions. Assigning the 0.5 score increment is done when the animal being evaluated is intermediate to the BCS described. A BCS of 1.0 is an extremely thin goat with no fat reserves and a BCS of 5.0 is a very over-conditioned (obese) goat. In most cases, healthy goats should have a BCS of 2.5 to 4.0. BCS of 1.0 , 1.5, or 2.0 indicate a management or health problem. A BCS of 4.5 or 5 is almost never observed in goats under normal management conditions; however, these BCS can sometimes be observed in show goats.

It is important to note that BCS cannot be assigned by simply looking at an animal. Instead, the animal must be touched and felt. The first body area to feel in determining BCS is the lumbar area, which is the area of the back behind the ribs containing the loin. Scoring in this area is based on determining the amount of muscle and fat over and around the vertebrae. Lumbar vertebrae have a vertical protrusion (spinous process) and two horizontal protrusions (transverse process). Both processes are used in determining BCS. You should run your hand over this area and try to grasp these processes with your fingertips and hand. The second body area to feel is the fat covering on the sternum (breastbone). Scoring in this area is based upon the amount of fat that can be pinched. A third area is the rib cage and fat cover on the ribs and intercostal (between ribs) spaces.

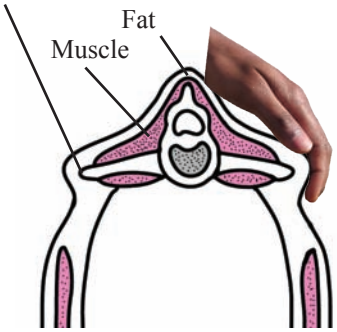
With practice, evaluating the BCS of an animal will only take about 10-15 seconds. By adding BCS as a regular part of your management program, you can more effectively monitor your feeding and herd health program for a healthy and productive herd.

Lumbar Region

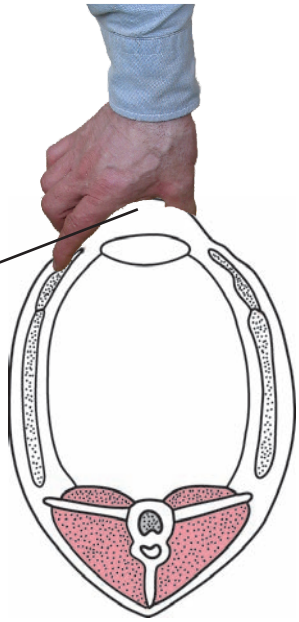
Spinous process



Transverse process



Sternum



BCS 1.0

Visual aspect of the goat: Emaciated and weak animal, the backbone is highly visible and forms a continuous ridge. The flank is hollow. Ribs are clearly visible. There is no fat cover and fingers easily penetrate into intercostal spaces (between ribs).

The spinous process of the lumbar vertebrae can be grasped easily between the thumb and forefinger; the spinous process is rough, prominent, and distinct giving a saw-tooth appearance. Very little muscle and no fat can be felt between the skin and bone. There is a deep depression in the transition from the spinous to transverse process.

The hand can easily grasp the transverse processes of the lumbar vertebrae which are very prominent. Clearly half of the length of the transverse process is discernible.

Diagrams adapted from Edmonson, et. al, 1989. J. Dairy Science, 72:68-78. Used with permission from the American Dairy Science Association.

Sternal fat can be easily grasped between thumb and fingers and moved from side to side. The cartilage and joints joining ribs and sternum are easily felt.

BCS 2.0

Visual aspect of the goat: Slightly raw-boned, the backbone is still visible with a continuous ridge. Some ribs can be seen and there is a small amount of fat cover. Ribs are still felt. Intercostal spaces are smooth but can still be penetrated.

The spinous process of the lumbar vertebrae is evident and can still be grasped between the thumb and forefinger; however, a muscle mass can be felt between the skin and bone. There is an obvious depression in the transition from the spinous to transverse process.

The hand can grasp the transverse process but the outline of the transverse process is difficult to see. About one-third to one-half of the length of the transverse process is discernible.

Sternal fat is wider and thicker but can still be grasped and lifted by the thumb and forefinger. The fat layer can still be moved slightly from side to side. Joints are less evident.

BCS 3.0

Visual aspect of the goat: The backbone is not prominent. Ribs are barely discernible; an even layer of fat covers them. Intercostal spaces are felt using pressure.

The spinous process of the lumbar vertebrae cannot be easily grasped because the tissue layer covering the vertebrae is thick. When running a finger over the spinous process, a slight hollow is felt. There is a smooth slope in the transition from the spinous to transverse process.

The outline of the transverse process of the lumbar vertebrae is slightly discernible. Less than one-quarter of the length of the transverse process is discernible.

Sternal fat is wide and thick. It can still be grasped but has very little movement. Joints joining cartilage and ribs are barely felt.

BCS 4.0

Visual aspect of the goat: The backbone cannot be seen. Ribs are not seen. The side of the animal is sleek in appearance.

It is impossible to grasp the spinous process of the lumbar vertebrae, which is wrapped in a thick layer of muscle and fat. The spinous process forms a continuous line. There is a rounded transition from the spinous to transverse process.

The outline of the transverse process of the lumbar vertebrae is no longer discernible. The transverse process forms a smooth, rounded edge, with no individual vertebrae discernible.

Sternal fat is difficult to grasp because of its width and depth. It cannot be moved from side to side.

BCS 5.0

Visual aspect of the goat: The backbone is buried in fat. Ribs are not visible. The rib cage is covered with excessive fat.

The thickness of the muscle and fat is so great that reference marks on the spinous process are lost. The spinous process forms a depression along the backbone and there is a bulging transition from the spinous to transverse process.

The thickness of the muscle and fat is so great that reference marks on the transverse process are also lost. It is impossible to grasp the transverse process.

The sternal fat now extends and covers the sternum, joining fat covering cartilage and ribs. It cannot be grasped.

Fitting and Grooming for Youth Market Doe Shows in Oklahoma

Ms. Kay Garrett
GG's Boer Goats
www.ggsgoats.com kewlkay@hotmail.com cell: 918-686-3257

- **Remember** – ***ALWAYS SAFETY FIRST*** – Never use anything that does not appear safe. If you don't think something is right, stop and ask someone before you do it. Better to be safe than sorry.
- Never leave an animal tied up alone or on the stand alone. Learn how to tie a quick release knot. We suggest the slip knot.
- Never wash an animal in cold weather without the ability to dry them and warm them up quickly. Always wash and completely dry your animal before you start clipping to preserve the life of your clipper blades and a smoother clipping job.
- Until you feel confident in your ability to trim, never start out on your show animal, practice on an older animal or an animal that won't go to the show ring.
  - Equipment: Foot trimmers, clippers and shampoo. The rest of what we use is nice to have.
    * Halter
    * Grooming Stand
    * Clippers with #10 blade and 5/8" blade (Andis or Oster blades. I think Wahl's are coming out with a line comparable to the Andis and Oster)
    * Brushes and shedding comb
    * Coat finisher
- Start about 6 weeks out before your first show to get your animal into condition.
  - We condition our animals by worming, vaccinating, treating with a parasite control and good feed and hay. We suggest worming with Cydectin (1 cc per 10 pounds), vaccinating (CDT – Covexin 8, follow label), parasite control (Cylence 1 cc per 25 pounds along the back). We recommend and use Honor Show Feeds and high quality alfalfa hay.
- About a week before the show, wash your animal and trim it's feet. This will give the animal time to adjust to it's new "shoes" (feet). A couple of days before the show, rewash and finish trimming.
- A rule of thumb, if you cut long at first, then you can trim out faults. If you start short, you have no way to correct mistakes.
- We start with a # 10 and trim the wild hairs on the following places:
  - Ears
  - Chest floor
  - Front legs, dew claw, pasterns and hoof band
  - Belly
  - Tail
  - Hip
  - Hock
- We will change blades and use the 5/8 blade on the belly and hip depending on the hair length, type and quality. We will also use the shedding blade along the neck, topline and hip to smooth it out.

Fitting and Grooming for Youth Market Wether Shows in Oklahoma

Ms. Kay Garrett
GG's Boer Goats
www.ggsgoats.com kewlkay@hotmail.com cell: 918-686-3257

- **Remember** – ***ALWAYS SAFETY FIRST*** – Never use anything that does not appear safe. If you don't think something is right, stop and ask someone before you do it. Better to be safe than sorry.
- Never leave an animal tied up alone or on the stand alone. Learn how to tie a quick release knot. We suggest the slip knot.
- Never wash an animal in cold weather without the ability to dry them and warm them up quickly. Always wash and completely dry your animal before you start clipping to preserve the life of your clipper blades and a smoother clipping job.
  - Equipment: Foot trimmers, Lister Stablemate clippers and shampoo. Some other equipment that we like to use:
    - Halter
    - Grooming Stand
    - Slick sweater
    - Body blanket
    - Small clippers with #10 blade for small areas
      - Head, Feet, Trim legs, Horn base, Tail
- The wethers are completely slick shorn above the hocks. It is not wise to leave hair on the wethers. Leaving lots of hair on wethers make the wethers to appear fat and overly conditioned and finished when the judge handles them and analyzes them at a show.
- To trim below the hocks and tail, be very careful. You do not want to slick shear the legs. You only need to trim up the wild hair. You want to leave as much hair on as possible. You do not want the animal to appear "deer like". You will want to trim the hoof band and slick up the tail. The head needs to be slick sheared paying special attention under the chin and around the horns. Leave no hair on in the head area. I suggest using a small clipper such as the doe clippers around the head, leg and tail area with a number 10 blade. The tail should be trimmed up close but not completely sheared.
- Keep the blades oiled every 10 minutes or every time you switch sides on an animal.
- If the weather is cold, be sure to cover up your animal with blankets and slickies and use a heat lamp if necessary.
- Never, Never, Never, Never, Never, Never, Never, Never, Never, Never, Never, Never trim a doe in this fashion unless you plan on showing her with wethers for her show career. She will not compete in a regular doe show if she is slick sheared.
- Some suppliers that we use and are reputable dealers.
  - Outback Laboratories - www.outbacklabs.com - 405-527-6355
  - Hoegger Caprine Supply - 1800-221-4628 – www.thegoatstore.com
  - Jeffers – 1800-533-3377 – www.jefferslivestock.com
  - Mid-State – 1800-835-9665 – www.midstatewoolgrowers.com

Goat Cookery

Dr. Terry Gipson
Langston University

Introduction

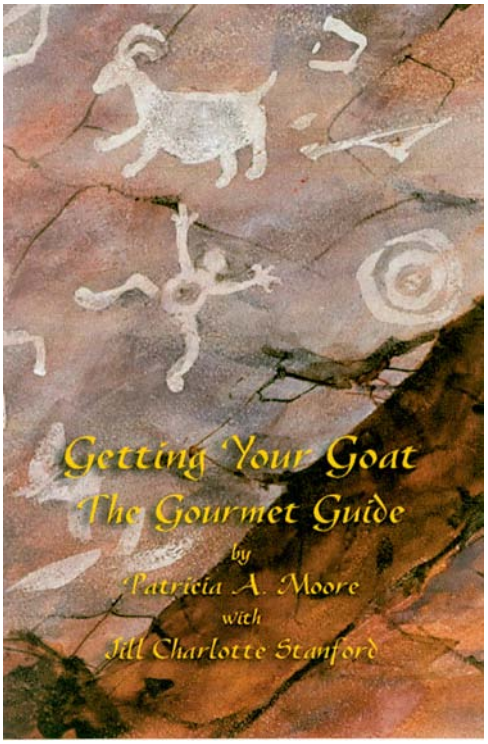
Often, we receive calls about goat cookery and the best way to prepare goat meat. Many of the recipes that one can find, either in print publications or on the Internet, has been about barbecued goat. Indeed, our barbecued chopped goat is always a popular lunch item for our annual Goat Field Days. Recently, I came across a new goat cookbook, *Getting Your Goat: The Gourmet Guide* (Evertype 2009) by Patricia A. Moore and Jill Charlotte Stanford. This cookbook covers a wide array of dishes and I think that the section headers reveals the breadth of the cookbook. They include 1) appetizers, 2) roasts, 3) shanks and chops, 4) soups, stews, and casseroles, 4) ground goat, 5) on the side, 6) desserts, and 7) miscellaneous. I recently contacted Patricia Moore and asked her if she would please share her favorite recipes from the cookbook with our Goat Field Day participants. She recommended Chevon Osso Buco (page 34 of the cookbook), Chevon Moroccan (page 51 of the cookbook), African Goat Soup (page 52 of the cookbook), and Pat's Goat-Loaf Muffins (page 85 of the cookbook) and those four recipes have been included in the proceedings. For those of you seeking new ways to prepare goat, I highly recommend this cookbook. I don't think that you will be disappointed.

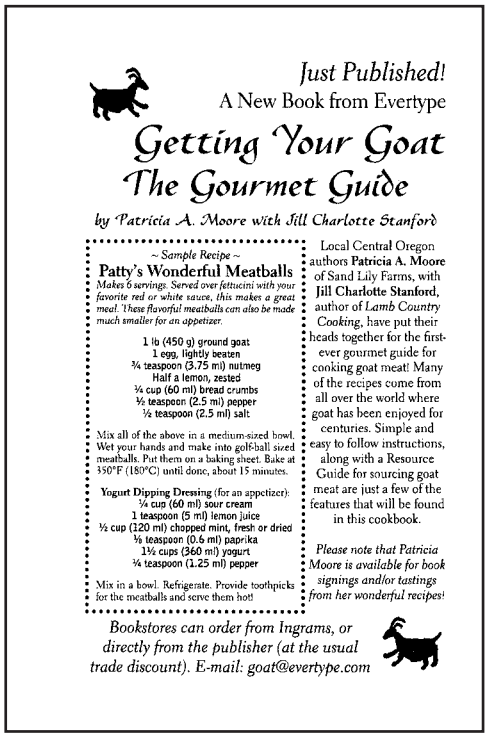
About the authors:

Patricia A. Moore spent 25 years in horticulture, running a landscape maintenance business in the San Francisco Bay area before moving to Central Oregon in 1988. She raises Boer goats, serves on the State Board of the Oregon Meat Goat Producers and is involved with her local chapter of the OMGP. Cooking is Patricia's passion. This book contains many wonderful recipes from her own kitchen, as well as recipes from other goat gourmets.

Jill Charlotte Stanford has been a writer, editor, and author since 1978. She is the author of Lamb Country Cooking (Culinary Arts 1994), The Cowgirl's Cookbook (Globe Pequot 2008), and Going It Alone (Evertype 2008). As a Restaurant Reviewer as well as a Lamb Cook-Off Judge, she has a highly developed sense of good food. Jill lives and writes in Sisters, Oregon, with her faithful Australian Shepherd Elsa.

Susan Koch (illustrator) studied life drawing and watercolor at the American Academy of Art in Chicago, Illinois. Over the past thirty-five years her paintings have won many awards, including "Best of Show" and "Peoples' Choice" several years running in the Watercolor Society of Oregon annual shows.





Getting Your Goat: The Gourmet Guide is also available at Amazon.com

Chevon Osso Buco

4 servings

Osso Buco is a northern Italian tradition. The slow cooker is the ideal way to cook this dish flavored with rosemary. Try spooning the sauce over mashed potatoes or polenta.

- 4 goat shanks
- 2 tablespoons (30 ml) flour
- ¾ teaspoon (3.75 ml) black pepper
- 1 tablespoon (15 ml) olive oil
- 1 cup (240 ml) chopped carrot
- 1 cup (240 ml) chopped celery
- 1 cup (240 ml) chopped white onion
- 1 large garlic clove, minced
- ½ cup (120 ml) red wine
- One 14.5 oz (430 ml) can diced tomatoes, drained
- 1 tablespoon (15 ml) chopped rosemary
- ½ teaspoon (2.5 ml) salt
- 1 bay leaf

Combine the flour and pepper in a shallow pan. Wash and dredge the shanks in the flour, coating them evenly.

Heat the oil in a large skillet. Add the goat shanks and braise for 2 minutes each side or until evenly browned. Place the shanks in a slow cooker.

Put all the vegetables in the pan and sauté for 5 minutes. Add the wine. Scrape the pan to loosen any browned bits. Cook over medium low heat for 1 minute.

Pour the vegetable mix over the shanks in the cooker. Add the tomatoes, rosemary, salt and bay leaf. Stir well.

Cover and cook on Low 8-9 hours.

Discard the bay leaf before serving.

African Goat Soup

6 servings

Goats are a symbol of a family's wealth in Africa. The more goats they have, the wealthier they are. Too many goats? They serve them up in this tasty soup which is more like a stew. Serve it with a good loaf of crusty bread and a bottle of hearty red wine.

- 2 lbs (900 g) lean goat meat, cut into 1" (2.5 cm) cubes
- ¼ cup (60 ml) of flour
- 3 tablespoons (45 ml) olive oil
- 1 large yellow onion, sliced
- 1 cup (240 ml) celery/ cut into pieces
- 1½ cups (360 ml) carrots, cut into pieces
- 2 cups (480 ml) sweet potatoes (or yams) washed, skinned, and cubed
- 3 cups (710 ml) vegetable broth
- 1 cup (240 ml) water
- ¼ cup (60 ml) white wine (optional) salt and pepper to taste
- 1 clove garlic, mashed
- 1 teaspoon (5 ml) cinnamon
- 1 tablespoon (15 ml) cumin

Trim any excess fat from the meat. Dredge the meat in the flour that has the salt and pepper added to it. Coat it well.

In a heavy skillet, put 1 tablespoon of the olive oil and sauté the meat until browned on all sides. Remove from the pan.

Add the remaining olive oil and sauté the vegetables until the onions are clear.

Put the meat back into the pan and add the vegetable broth, white wine, water and spices.

You may also put everything into a Slow Cooker. Simmer, covered, for 5 or 6 hours on Low, stirring occasionally.

Chevon Moroccan

6 servings

Cat Addison is a go-get 'em kind of gal. She loves new adventures and especially new recipes. She says, "Chevon Moroccan was my first taste of goat meat. It is now one of my favorite dishes and I have prepared it for others to get them to see how wonderful goat meat is too."

- 3 tablespoons (45 ml) olive oil
- 2 lb (900 g) goat meat, cubed in 1" (2.5 cm) pieces
- ½ lb (225 kg) fresh, sliced mushrooms
- ½ onions/ chopped
- 1 garlic clove, minced
- 1 lb (450 g) fresh tomatoes, peeled and quartered
- ½ cup (120 ml) raisins
- ½ cup (120 ml) toasted almond slices
- 2 tablespoons (30 ml) sugar
- 1 teaspoon (5 ml) cinnamon
- 1 teaspoon (5 ml) salt
- ¼ teaspoon (1.25 ml) allspice
- ¼ cup (60 ml) chicken broth

Heat the oil in a large skillet. Add the goat meat and sauté until browned. Add the mushrooms, onions and garlic. Sauté for 2 more minutes.

Add the tomatoes, raisins, almonds, sugar, cinnamon, salt and allspice.

Add the broth and simmer for one hour, stirring occasionally, until the meat is tender. Add more broth if needed as it simmers.

Serve the stew over couscous for a truly authentic dish.

Pat's Goat-Loaf Muffins

6 servings

A simple and fast way to cook and serve "diner-style" meat loaf.

- 1 teaspoon (5 ml) olive oil
- 1 cup (240 ml) sweet onion, chopped very fine
- ½ cup (120 ml) carrot, chopped fine
- 1 teaspoon (5 ml) oregano
- 2 cloves of garlic, minced
- 1 cup (240 ml) tomato ketchup, divided
- 1½ lb (680 g) ground goat
- 1 cup (240 ml) (about 20) saltine crackers, crushed very fine
- 2 tablespoons (30 ml) prepared yellow mustard
- 1 teaspoon (5 ml) Worcestershire sauce
- ¼ teaspoon (1.25 ml) black pepper
- 2 large eggs

Preheat the oven to 350°F/180°C/Gas 4

Grease 12 muffin cups (you can use cooking spray).

Heat the olive oil in a large skillet. Add the vegetables and herbs and spices. Sauté for about 2 minutes and then allow to cool.

In a large bowl, combine the vegetable mixture with half the ketchup and the remaining ingredients. Mix well.

Spoon the mixture into the muffin cups and top each with 2 teaspoons of the remaining ketchup.

Bake at 350°F/180°C/Gas 4 for 25 minutes, or until the tops are browned.

Let them stand for 5 minutes before removing.

CURRENT PROGRAM SUMMARY

E (Kika) de la Garza American Institute for Goat Research
Langston University
Langston, Oklahoma 73050

- **EXTENSION OVERVIEW**
- **INTERNATIONAL OVERVIEW**
- **RESEARCH OVERVIEW**
- **USDA/CSREES PROJECTS**
- **EXPERIMENTS**
- **ABSTRACTS**
- **ARTICLE SUMMARIES**
- **VISITING SCHOLARS, GRADUATE STUDENTS, AND INTERNS**

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Extension Overview

Dr. Terry A. Gipson
Goat Extension Leader

The year 2010 was a busy year for the Langston Goat Extension program. The goat extension specialists have answered innumerable producer requests for goat production and product information via the telephone, letters and e-mail, have given numerous presentations at several state, regional, national and international goat conferences for potential, novice and veteran goat producers, and have produced a quarterly newsletter. They have also been busy with several major extension activities. These activities include the annual Goat Field Day, Langston Goat Dairy Herd Improvement (DHI) Program, grazing demonstrations, the eighth annual meat buck performance test and various goat workshops on artificial insemination and on internal parasite control.

Goat Field Day

Our annual Goat Field Day was held on Saturday, April 24, 2010 at the Langston University Goat This year's theme was Bridging the Future and the Past. Our featured speaker was Dr. Frank Pinkerton (AKA The Goat Man). Dr. Pinkerton became The Goat Man at Prairie View A&M University in 1978. Here is the history, in his own words, of The Goat Man becoming the The Goat Man.

> *"... Frank was reassigned to develop the International Dairy Goat Research Center. He recalls that the interview for the new job was very short. The Dean asked him if he knew anything about dairy goats; yes, he said, they were those funny little cows with two tits. Close enough, said the Dean, and so it was that The Goat Man came to be. In '83, as the result of a bureaucratic political shuffle, he relocated to Langston University in OK, to do extension work in dairy, Angora, and meat goats. He retired in '93 to raise meat goats in east TX and do consultant work in goat management and marketing in TX, NY, VA, NC, and LA."*
>
> *"During his 40 year career, Frank managed to publish 10 articles on Ruminant Nutrition and Milk Technology early on, then write 17 Extension Fact Sheets/Technical Bulletins on dairy, Angora, and meat goats, and prepare 41 articles on meat goat production, marketing, and meats for popular periodicals. He also did 13 international consultancies on livestock and goat nutrition and 16 domestic consultancies on goat management and marketing, not to mention conducting 5 large-scale goat-grazing demonstrations for vegetative control in public forests and grasslands in OK, AR, AL, NC and TN."*
>
> *"Since March of 2005 it has been my [Frank's] pleasure to write a monthly question-and-answer column for The Goat Rancher and also to share occasional articles on various facets of the industry. As a retired Extension Specialist, these exchanges and offerings have allowed me to stay in touch with producers and to keep more or less abreast of events and developments affecting management and marketing of meat goats."*

In the afternoon session, participants were able to break into small-group workshops. There were a total of twelve workshops; however, participants only had time enough to attend three. The afternoon workshops included:

- Frankly Speaking - noted Goat Rancher columnist will expound upon questions that are often asked including basic goat nutrition, feedstuffs, forage-only feeding programs, production economics, target marketing, on-farm testing, and many more with Dr. Frank Pinkerton.
- Basic Goat Husbandry - hoof trimming, body condition scoring, FAMACHA scoring, farm management calendar, etc. with Mr. Jerry Hayes.
- Basic Herd Health - herd health program including vaccinations, injection sites, and approved drugs with Dr. Lionel Dawson.

- Nutrition for Health and Production - calculation of energy, protein and feed intake requirements with Dr. Steve Hart.
- Internal Parasite Control - sustainable internal parasite control program with Dr. Steve Hart.
- Goat Reproduction - basics of goat reproduction and techniques and equipment for artificial insemination in goats with Dr. Dave Sparks.
- Goat Farm Budgeting - basics of budgeting and financial recordkeeping with Mr. Roger Sahs.
- Cheese-making Overview - basics of making cheeses from goat's milk with Mr. Neville McNaughton.
- Pack Goats - basic goat training as a pack animal and equipment needs with Mr. Dwite Sharp.
- Mortality Composting - basic composting techniques and equipment for disposing of goat mortalities with Dr. Roger Merkel.
- DHI Training - supervisor/tester training for dairy goat producers including scale certification with Ms. Eva Vasquez.
- USDA Government Programs - overview of USDA Natural Resource Conservation Service's work with goats and its cost-sharing program with Mr. Dwight Guy.

Fun Tent Youth Activity: Ms. Sheila Stevenson hosted a full day of activities for youth ages 5-12 in the Fun Tent. This allowed the parents and older teens to enjoy the workshops knowing that their little ones were having fun in a safe environment.

GPS Scavenger Hunt Youth Activity: Ms. Sheila Stevenson also organized a ½-day GPS scavenger hunt on campus. Youth learned the basics of GPS and how to use a GPS unit to finds "hidden" objects.

Fitting and Showing Youth Activity: The Fitting and Showing workshop was not held this year but will return in 2011.

A total of 275 participants from five different states attended the 2010 Goat Field Day.

Goat DHI Laboratory

The Langston Goat Dairy Herd Improvement (DHI) Program is housed at the dairy farm, west of campus, operates under the umbrella of the Texas DHIA. In February 1998, the Langston DHI program became the first DHI program to introduce forms and reports in goat terminology to dairy goat producers in the United States. A national Dairy Herd Improvement Association (DHIA) has been in existence for a number of years. However, until 1996 DHIA catered only to cow dairies. The Langston DHI program has been very popular with dairy goat producers and has grown significantly since its establishment in 1996. Goat producers are now able to get records for their animals that reflect accurate information with the correct language. Currently we are serving a 29 state area that includes a majority of the eastern states. Currently, we have 140 producer herds in these 29 states enrolled in the Langston Goat Dairy DHI Program. In 2010, the DHI laboratory processed more than 9,000 samples, representing 1,510 does. Langston University continues to serve the very small-scale dairy goat producer. The average herd size on test with Langston University is 10 animals. This is significantly smaller than the herd size average for the five other processing centers.

For those interested in becoming a Langston goat DHI tester, training is available either in a formal classroom setting or through a 35-minute video tape. Every tester is required to attend the DHI training session or view the tape and take a test. Upon completion of the DHI training, the milk tester can start performing monthly herd tests.

Goat Newsletter

To date, the Goat Extension program published four issues of the 8-page Goat Newsletter in 2010. Interest in the newsletter has grown and we currently have over 2400 subscribers to our free quarterly Goat Newsletter and the subscription list continues to increase every year. The Goat Newsletter is mailed to every state in the

nation and to 10 countries overseas. Ninety-seven percent of the mailings go to American households. At least one newsletter is mailed to a household in every state in the nation. Fifty percent of the newsletters are mailed to Oklahoma households. An additional thirty percent of the newsletters are mailed to households to state adjacent to Oklahoma.

Artificial Insemination Workshop

The use of superior sires is imperative in improving the genetic composition of breeding stock. Artificial insemination has long been used in the dairy cattle industry and is a simple technology that goat producers can acquire. However, opportunities for goat producers to the necessary skills via formal and practical instruction are not widespread. Langston University has instituted a practical workshop for instruction in artificial insemination in goats. Producers are instructed in the anatomy and physiology of the female goat, estrus detection and handling and storage of semen. Producers participate in a hands-on insemination exercise. An understanding of the anatomy and physiology enable the producer to devise seasonal breeding plans and to troubleshoot problem breeders. An understanding of estrus detection enables the producer to effective time inseminations for favorable conditions for conception and to effectively utilize semen. An understanding of semen handling and storage enables the producer to safeguard semen supplies, which can be scarce and costly. The experience of actually inseminating a female goat enables the producer to practice the knowledge that they have gained. The acquisition of these inseminating skills will allow producers the use of genetically superior sires in their herds that they normally would not have access to. It also allows producers to save money by conducting the inseminating themselves instead of hiring an inseminator. In 2010, AI workshops were held in September at the Langston University campus and in October at the county fairgrounds in Antlers.

Meat Goat Production Handbook

The Meat Goat Production Handbook, which is a companion to the Web-based Training and Certification Program, both of which were funded through an USDA/FSIS grant. The 400-plus page Meat Goat Production Handbook is an answer to the paucity of information, especially on the aspect of quality assurance, which will be a key production element as the meat goat industry grows and evolves. A quality assurance program ensures the production of a safe, healthy product that satisfies consumers and increases profit for the production industry. Conventional topics such as herd health, nutrition, herd management, and many others are covered comprehensively, yet remain clear and easy-to-read. Additional topics generally not covered in conventional handbooks are also included, topics such as disaster preparedness, legal issues, and organic meat goat production. Even though Langston University has taken the lead in this project, this handbook is not the product of one person or of a single university. Our collaborating project institutions/organizations, which include Alcorn State University, American Boer Goat Association, American Meat Goat Association, Florida A&M University, Fort Valley State University, Kentucky State University, Langston University, Prairie View A&M University, Southern University, Tennessee Goat Producers Association, Tennessee State University, Tuskegee University, United States Boer Goat Association, University of Arkansas Pine Bluff, and Virginia State University. Handbook contributing institutions/organizations include Allen Veterinary Clinic, American Boer Goat Association, American Meat Goat Association, BIO-Genics, Ltd., Bountiful Farm, Cornell University, Fort Valley State University, Kentucky State University, Langston University, Law Office of Wheeler and Mueller, Louisiana State University, Louisiana State University AgCenter, NCAT / ATTRA National Sustainable Agriculture Information Service, North Carolina State University, Oklahoma State University, Texas A & M University, United States Boer Goat Association, and Virginia State University.

Controlling Internal Parasites Workshop

Internal parasites (Barberpole worm, *Haemonchus contortus*) is the leading cause of death in goats in the Southern US, accounting for as many deaths as the total of the next three leading causes of death in goats. Several factors contribute to the high mortality caused by internal parasites.

Goats which originated in dry areas where there was no internal parasite challenge have been brought to the humid South where there is great parasite challenge. Only a few animals have good genetic resistance against internal parasites. In addition, goats are forced to graze rather than browse which provides greater opportunity to consume infective larvae and especially so when animals overgraze. Producers are not familiar with monitoring animals for signs of parasitism and do not understand how animals get infected. In addition internal parasites have developed a high level of resistance to dewormers from the overuse of dewormers in goats. To address these concerns, Langston developed a parasite workshop to educate producers about internal parasites. It includes 3 hours of lecture on biology of the parasite, pasture management to avoid worms and monitoring parasite infection using the FAMACHA chart which assesses the degree of anemia. This is a cooperative effort with OSU Extension Veterinarian who addresses dewormer resistance and correct use of dewormers. Producers receive hands-on instruction in use of the FAMACHA card, taking fecal samples and running fecal egg counts.

Nutrient Requirements of Goats

Under a research project which developed equations for energy and protein requirements for goats, as well as prediction of feed intake, an extension sub-project developed a website calculation system for "Nutrient Requirements of Goats" (http://www2.luresext.edu/goats/research/nutreqgoats.html). Most calculators were based on studies of the project reported in a Special Issue of the journal Small Ruminant Research. For calculators with score inputs (i.e., grazing and body conditions), pictures are available to aid in determining most appropriate entries. Realistic examples are given, as well as discussion of appropriate and inappropriate usage. However, for the experienced user there is an option to hide text and examples and to view only inputs and outputs.

In 2005, a calculator for calcium and phosphorus requirements was added to the existing calculators for metabolizable energy, metabolizable protein, and feed intake for suckling, growing, mature, lactating, gestating, and Angora goats. Also in 2005, the interface of the calculators was unified into a single calculator with the English measurement system used. This will encourage the use of the calculators by American producers. The least-cost ration balancer was modified so that it incorporates the least-cost feed percentage into the diet. Also, calculators are equipped with printable version commands to obtain inputs and outputs in hard copy format. In 2010, the calculators were continued to be updated.

In summary, for nutrient requirement expressions to be of value, they must be readily accessible and reasonably simple. Therefore, a web-based goat nutrient requirement system was developed based on findings of a recent project. It is hoped that this system will enjoy widespread usage and enhance feeding practices for goats.

Internet Website

http://www2.luresext.edu

The Agricultural Research and Cooperative Extension program of Langston University continued to maintain and update the Internet web site. Capabilities of the web site include a document library with the complete proceedings of the annual Goat Field Day and the quarterly newsletter for the past thirteen years. Both the proceedings and newsletters are available in portable document format (pdf), which allows for the viewing and printing of documents across platform and printer without loss of formatting.

Information, recent abstracts and scientific articles of completed and current research activities in dairy, fiber and meat production are available for online viewing and reading. Visitors are able to take a Virtual Tour of the research farm and laboratories, complete with digital photos and narrative. Visitors can register for our annual Goat Field Day and subscribe to our free quarterly newsletter online. Contact information for faculty & staff is also available.

In 2010, tracking code for Google Analytics was embedded in each page of the web site (http://www2.luresext.edu/goats). Overall, there were 62,850 visits (75% new visits), 230,473 page views resulting in 3.67 pages per view. The unique number of visitors was 47,229. The bounce rate was 59.5%. Visitors spent an average 3 minutes and 26 seconds on the site on each visit. Search engines accounted for 52% of the visits; referred by other web sites at 29%; direct (bookmarked) traffic at 19%. Of the search engines, Google predominated at 34%; Yahoo at 11%; and Bing at 5%. Primary keywords for the search were "langston university" or "langston university goats:" which are 5% of the searches. Browser preference was Internet Explorer at 62%; Firefox at 26%; Chrome at 6%; other browsers at 6%. The online certification program accounted for 46% and the nutrient calculators accounted for 21% of the page views; otherwise there was a fairly even distribution of page views across the web site. In 2010, there was 5,744 downloads with pdf version of the newsletter accounting for 9% of the downloads.

eXtension.org

In 2008, Langston University was a member of a group of goat extension specialists and researchers who met in Atlanta and formed a Goat Community of Practice (CoP) for eXtension (pronounced e-extension). eXtension is an Internet-based educational partnership of the seventy-four 1862 and 1890 institutions of the land-grant university system that helps people improve their lives by providing access to objective research-based information and learning opportunities. In 1994, USDA debated Cooperative Extension's survival in a new customer-driven marketplace and in 2001, made the decision to transform the way Cooperative Extension delivers its mission and message through technology (eXtension). In 2004, Cooperative Extension System adopted an assessment to provide project start-up funds and in 2007, launched the full system at http://www.extension.org. eXtension was created to provide 24/7/365 access to information to help people make life-improving decisions; educational products and programs at any time, from any place, in any format on any Internet-ready device; complementary resources to the community-based Cooperative Extension System; increased visibility to Cooperative Extension by reaching new audiences and expanding partnership opportunities; collaborative development of Internet-based educational materials with minimal duplication; and sustained connections between Communities of Practice (CoP) and Communities of Interest (CoI). A CoP is a group of specialists and others who are knowledgeable in the subject area, in this case goats. The Goat CoP's membership includes goat specialists at all the major universities, plus regional and county extension agents with goat knowledge. A CoI is the clientele. In this case, goat producers or just anyone who wants to learn more about goats. The first year, the CoP met to develop materials for the web site and in March of 2009, the Goat extension site was launched.

Rehabilitation of Under-Utilized Forest Land by Goats for Economic Benefits

In 2007, Langston University and the Kiamichi Forestry Research Station of Oklahoma State University located in Idabel, OK established a RREA-funded project entitled Rehabilitation of Under-Utilized Forest Land by Goats for Economic Benefits. This project established a forestry and goats demonstration site in an overgrown pine forest. In 2008, twenty-five young goats were placed on the demonstration site for 12 weeks. During the first week, the goats were fitted with GPS collars that recorded a fix every five minutes. Goats spent 62% of their time within 10 m of the fence, which was a cleared area, and 38% of their time within the interior of the site. Based upon GPS attributes, goats were more active in foraging within the interior and

rested more in the fence buffer. In 2009, fifteen Spanish wethers were placed on the demonstration site for 28 weeks. In 2009, goats spent 55% of their time within 10 m of the fence, which was a cleared area, and 45% of their time within the interior of the site. These are significantly different times than in the preceding year with 62% and 38%, respectively. Based upon GPS attributes, goats actively foraged 39% and rested 61% of the time in 2009 which contrasted with 2008 with values of 65% and 35%, respectively. These behavioral differences may be attributable to the breed differences or to the change in vegetation from year one to year two of the study. However, the results of the animal impact upon undesirable plant species is unmistakable, regardless of breed. In 2010, twelve Alpine females were placed on the demonstration site for 21 weeks. During the first week, the Alpine females spent nearly all of their time around the holding area and did not explore the paddock extensively.

Also in 2010, the first year of a forestry, goats, and cattle demonstration site was conducted at the Lindley Farm of the Kiamichi Forestry Research Station of Oklahoma State University. The site was divided into four paddocks: goats only (35 acres), cattle only (21 acres), goats and cattle co-grazing (39 acres), and control (6 acres). The goats-and-cattle paddock was stocked with 12 cows and 36 goats; the goats-only paddock was stocked with 36 goats, and the cattle-only paddock was stocked with 10 cows. Eleven Spanish goats in the goats-and-cattle paddock and 10 goats in the goats-only paddock were fitted with GPS collars which recorded a fix every five minutes for the first two weeks. Goats assigned to the goats-and-cattle paddock routinely broke through the electric fence and spent considerable time in the goats-only-paddock. Even when goats were reassigned and retained within their paddocks, the goats in the goats-and-cattle paddock spent the vast majority of their time near the fence in the southwest wedge of their paddock. A point-in-polygon analysis using a 10 × 10 m grid was conducted for each paddock. 87% (1376 of 1584) of the grids were not explored in the goats-and-cattle paddock and 8% (119 grids) only had a single digit number of fixes. This compared to 35% (522 of 1473) of the grids unexplored in the goats-only paddock and 29% (430 grids) only had a single digit number of fixes. The favored locations for goats in each paddock were near the water source in the eastern intersection of the two paddocks and along the central fence line that divided the tow paddocks. Goats in the goat-only paddock also had a favorite central location shaded by trees. The presence of cattle may have had a double detrimental effect upon the goats. Firstly, the goats had never been exposed to cattle before, which may have been a reason why goats initially fled the goats-and-cattle paddock. Secondly, the presence of cattle could have physically inhibited the goats from fully exploring their paddock.

Hide Tanning Workshop

In 2007, the Goat Extension Program expanded its selection of producer workshops by instituting a "Tanning Goat Hides Workshop." The focus of the workshop is tanning hair-on hides for the hobbyist tanner but the process of dehairing hides for leather or buckskin making is also discussed. Producers learn about skin structure, proper skinning methods, hide handling and preservation, and about tanning chemicals and procedures. Hands-on sessions give attendees the opportunity to work with goat hides in different stages of the tanning process putting their newly-gained knowledge into practice and learning new skills. In those sessions, participants flesh, pickle and neutralize, apply different types of tanning chemicals, and soften goat skins prepared for the workshop. Tanning Goat Hides Workshops have been given to adult and youth groups, short- or long-term visitors to the Institute, and Langston University students. In 2009, a visiting graduate student from Japan was instructed in the art of tanning hides. In 2010, a "wet lab" on tanning goat hides was given for veterinary students from Oklahoma State University's Center for Veterinary Health Sciences and a workshop was given to a group of soldiers of the Oklahoma Army National Guard prior to their deployment to Afghanistan.

Oklahoma and Tulsa State Fairs

Most children are not raised on a farm and do not get to see the miracle of birth. Langston University has collaborated with the Oklahoma Veterinary Medical Association to bring the miracle of birth to the public. We have provided pregnant females for the birthing center at Tulsa State Fair for last 9 years and for last 3 years at the State Fair of Oklahoma. The births are videotaped and replayed on a monitor so that the births can be seen at any time. The does are the highlight of the centers every year as the children laugh at the kids jumping on their mothers and playing. In addition and since 2002, Langston University has provided personnel to be the superintendent of the meat goat show at the Oklahoma State Fair.

Web-based Training for Meat Goat Producers

Meat goat production is one of the fastest growing sectors of the livestock industry in the United States. New producers, as well as some established ones, have an expressed need for current, correct information on how to raise goats and produce safe, wholesome products in demand by the public. As the meat goat industry grows and evolves, a quality assurance program is essential. Such a QA program ensures the production of a wholesome product that satisfies consumers and increases profit for the meat goat industry.

Langston University was awarded funding by the Food Safety and Inspection Service of USDA to develop training and certification for meat goat producers. Langston University organized and led a consortium of 1890 universities and producer associations in this project. The consortium identified the subject topics most pertinent and pressing for the instructional modules. The consortium then identified experts on the selected subject topics and pursued these experts as module authors. These authors represent the most qualified persons in their field in academia as well as in the industry. Langston University translated the sixteen instructional modules into web pages with accompanying images, and pre- and post tests for those producers wishing to pursue certification. All modules are also available in pdf for easy printing and the introductory module is available as a podchapter for downloading and listening on your favorite mp3 player. The web-site (http://www2.luresext.edu/goats/training/qa.html) was unveiled in late 2005.

Even though this web-site (http://www2.luresext.edu/goats/training/qa.html) was only unveiled in 2007, 1,500 producers have enrolled for certification and 201 have completed the certification process. These instructional materials will best serve meat goat producers in assisting them to produce a safe, wholesome, healthy product for the American consumer. Funding source for this project was USDA/FSIS/OPHS project #FSIS-C-10-2004 entitled "Development of a Web-based Training and Certification Program for Meat Goat Producers."

Breed Association	Number of Members Certified
Alberta Goat Breeder's Association	2
American Boer Goat Association	63
American Kiko Goat Association	9
American Meat Goat Association	20
Empire State Meat Goat Producers Association	1
International Boer Goat Association	8
International Goat Association	3
International Kiko Goat Association	7
Missouri Meat Goat Producers Association	1
Myotonic Goat Registry	1
Southern Virginia Meat Goat Association	1
Spanish Goat Association	1
Sunbelt Goat Producers	1
United States Boer Goat Association	27
None	91

The table above shows the association affiliations for the 201 certified producers. Please note that certified producers may be a member of more than one association.

Meat Buck Performance Test

The twelfth annual meat buck performance test started June 5, 2010 with 40 bucks enrolled from 9 different breeders (28 bucks from private producers and 12 from Langston University). Geographical distribution is 3 from Missouri, 5 from Nebraska, 16 from Oklahoma, and 16 from Texas. Breed distribution is 35 Boer; 1 Boer Cross; 2 Ranger; and 2 Spanish. Bucks were given a physical examination by Dr. Lionel Dawson, dewormed with Cydectin (moxidectin), deloused with Atroban De-Lice, given a preemptive injection of long-acting antibiotic for upper respiratory infections, and those bucks that needed booster or initial vaccinations for enterotoxemia and caseous lymphandinitis. All bucks underwent a two-week adjustment period and the test officially started on June 23, 2010. Weights at entry averaged 46 lbs and ranged from 22 to 73 lbs. Age at entry averaged 105 days and ranged from 65 to 147 days of age.

Adjustment Period

All bucks underwent an adjustment period of two weeks immediately after check-in and the test officially started on June 23, 2010. During the adjustment period, bucks were acclimated to the test ration and to the FIRE system. Feed intake is automatically recorded every time a buck enters into the FIRE system to eat. The area immediately around the FIRE feeders and waterers is concrete, however, the large majority of the inside pen is earth and is covered by pine shavings. Pine shavings were periodically added as needed to maintain fresh bedding. Bucks had free access to water provided by float-valve raised waterers. Whenever the weather was permitting, the bucks had access to the outside pens as well as the inside pens. This year we were fortunate to hire an Oklahoma State University graduate student, Ms. Amanda Manley, to help with the bucks. Amanda has done a wonderful job with the bucks.

Ration

Nutritionists at Langston University formulated the test ration. The ration was fed free-choice during the adjustment period and during the 12-week test. The crude protein content of the ration is 16% with 2.5% fat, 20.4% fiber and 60.6% TDN. Calcium phosphorus and sodium levels are .74%, .37% and 1.07%, respectively. Zinc concentration is 33.04 ppm, copper is 17.15 ppm and selenium is .21 ppm.

ABGA Approved Performance Test

In the year 2000, the Oklahoma performance test was designated by the American Boer Goat Association Board of Directors as an ABGA Approved Performance Test. Qualified fullblood or purebred Boer bucks are eligible to earn points towards entry into the "Ennobled Herd Book". Candidate bucks must pass a pre-performance test inspection conducted by one (1) or more ABGA approved breeders. Ten (10) points will be awarded to a Boer buck that shows an average daily weight gain (ADG) in the top five percent (5%) of the animals on test. Five (5) points will be awarded to a Boer buck that shows an average daily weight gain (ADG) in the next fifteen percent (15%) of the animals on test. All bucks must gain at least three tenths (.3) pounds per day to be awarded any points.

International Boer Goat Association, Inc. Sanctioned Test

In 2003, the Oklahoma buck performance test was sanctioned by the International Boer Goat Association, Inc.

Gain

The official performance test started on June 23 after the adjustment period was finished. Weights at the beginning of the test averaged 55 lbs with a range of 19 to 91 lbs. Weights at the end of the test averaged 99 lbs with a range of 57 to 138 lbs. Weight gain for the test averaged 43 lbs with a range of 18 to 60 lbs.

Average Daily Gain (ADG)

For the test, the bucks gained on averaged 0.51 lbs/day with a range of 0.21 lbs/day to 0.71 lbs/day.

Feed Efficiency (Feed Conversion Ratio)

For the test, the bucks consumed an average of 295 lbs of feed with a range of 169 to 423 lbs.

For the test, the bucks averaged a feed efficiency of 7.04 (feed efficiency is defined as the number of lbs. of feed needed for one lbs. of gain), with a range of 4.85 to 14.84.

Muscling

The average loin eye area as determined by ultrasonography was 1.7 square inches with a range of 1.0 to 2.4 square inches and the average left rear leg circumference was 14.2 inches with a range of 11.0 to 18.0 inches.

Index

For 2010, the index was calculated using the following parameters:

30% on efficiency (units of feed per units of gain)
30% on average daily gain
20% on area of longissimus muscle (loin) at the first lumbar site as measured by real time ultrasound adjusted by the goat's metabolic body weight (BW0.75)
20% circumference around the widest part of the right rear leg as measured with a tailor's tape adjusted by the goat's metabolic body weight.

The adjustment to metabolic body weight gives lighter weight goats a fair comparison of muscling to heavier goats.

The deviation from the average of the parameters measured from the goats in the performance test was used in the index calculation. Thus, the average index score for bucks on-test was 100%. Bucks that are above average have indices above 100% and those below average have index scores below 100%.

Congratulations

The Oklahoma Meat Goat Association and the Agricultural Research and Extension Program at Langston University congratulate:

Mrs. Wanda Shurley of Sonora, TX for having the Top-Indexing buck

Also, deserving congratulations are:

Mrs. Wanda Shurley of Sonora, TX for having the #1 Fastest-Gaining buck
Mr. Jim Rosenbaum of Gainesville, TX for having the #2 Fastest-Gaining buck
Mr. A.L. Paul of Aubry, TX for having the #3 (tie) Fastest-Gaining buck
Mr. Jim Rosenbaum of Gainesville, TX for having the #3 (tie) Fastest-Gaining buck
Mrs. Wanda Shurley of Sonora, TX for having the #5 Fastest-Gaining buck
Morrison Farms of Monett, MO for having the Most-Feed-Efficient buck
Mrs. Wanda Shurley of Sonora, TX for having the Most-Heavily-Muscled buck

Acknowledgments

The Buck Test supervisor wishes to acknowledge Dr. Lionel Dawson of Oklahoma State University for his contributions as the admitting and on-call veterinarian, Ms. Amanda Manley for her management and oversight of the day-to-day activities, Mr. Jerry Hayes and Mr. Erick Loetz of Langston University for aid and supervision, Mr. Les Hutchens and his associates at Reproductive Enterprises, Inc. for conducting the ultrasound measurements for the loin eye area, and Stillwater Milling for custom mixing the feed.

International Overview

Dr. Roger Merkel
International Program Leader

Objectives

Part of the mission of the American Institute for Goat Research is to effect positive change in goat production throughout the world. To fulfill this aspect, the Institute has developed and maintains many strong ties with research and academic institutions around the world. In addition to collaborative work with foreign institutions, the Institute hosts visiting scientists from over 20 foreign countries to conduct research. Training for foreign livestock workers and scientists as well as for U.S.-based persons who will travel and work overseas are other ways in which the Institute is active in the international arena. General objectives of the Institute's international program are to: 1) increase our knowledge of goat production systems worldwide and current constraints to increased production; 2) build human capacity through training foreign scientists and agricultural workers in goat production thereby allowing them to more effectively carry out their missions of teaching, research, and extension; 3) increase Langston University and the Institute's involvement in agricultural development and impact on human welfare; and 4) enhance the Institute's knowledge of development and development issues. As recognition of the impact that the Institute has had on international development, five Langston University scientists, Drs. Terry Gipson, Arthur Goetsch, Roger Merkel, Tilahun Sahlu, and Steve Zeng, were jointly awarded the 2006 George Carver Agricultural Excellence Award of USAID for their efforts and positive impact on international agriculture.

International Research

While most international projects conducted by the Institute have aspects of research, training, and extension, some are more research oriented. Many of these types of grants are typified by a number of projects with countries in the Middle East.

Research grants with Middle Eastern Institutions

Over the past six years, the Institute has been awarded three grants from the U.S.- Egypt Joint Science and Technology Fund for collaborative research with the Desert Research Center of Egypt. In 2005, the Institute and the Desert Research Center embarked on a research project to ascertain the "Effects of Acclimatization on Energy Requirements of Goats." That project was completed in June of 2008. The second of these three grants, "The Grazing Activity Energy Cost of Goats," began in 2007 and ran through 2010. In 2010, the Institute and the Desert Research Center initiated a project entitled "Effects of Nutritional Plane on the Maintenance Energy Requirement of Goats" that is scheduled to run through 2011.

In 2010, the Institute was awarded a grant for a project entitled "Enhanced Safety and Product Quality from On-Farm Thermization/Pasteurization of Goat Milk in the Middle East" by the United States – Israel Binational Agricultural Research and Development Fund as a Facilitating Grant in the MARD (Multinational Agricultural Research and Development) program. Collaborators in this project are Langston University; Kimron Veterinary Institute and Agricultural Research Organization, Bet Dagan, Israel; Al-Quds University, East Jerusalem, Palestine; and the Jordan University of Science and Technology, Irbid, Jordan. Objectives of this project are to develop specifications of an inexpensive thermization/pasteurization equipment system suitable for use on small goat farms in the Middle East, conduct preliminary evaluations of the prototype for possible refinement, and determine procedures for an associated MERC grant proposal to be developed.

Education and Training

Increasing the Capacity of Higher Education in East Africa through the creation of a Consortium of African and United States Educators (CAUSE)

In 2009, the Institute entered into a partnership with Oklahoma State University, three universities in Ethiopia (Haramaya, Hawassa, and Mekelle), two universities in Kenya (Kenyatta and Moi), the International Livestock Research Institute and the International Maize and Wheat Improvement Center to form the Consortium of African and United States Educators (CAUSE). The objective of the grant was to establish relationships among U.S. and African institutes of higher education and to develop a strategic plan to address critical societal issues by increasing human and institutional capacity of higher education in East Africa in teaching, research, and outreach. The goals of the partnership are to: 1) Enhance Academic Programs through Regional Collaboration; 2) Develop Research-Based Solutions to Address Food and Nutritional Security in East Africa; 3) Transfer Knowledge and Skills to Enhance Community Development; and 4) Provide Research Based Information to Stakeholders and Policy Makers. The partnership held meetings in Ethiopia and Kenya to gather information and develop the strategic plan that was submitted in November, 2009. While the formal period of funded activities has ended, all institutions involved are searching for ways to continue and expand collaborative efforts.

Agricultural Development

Ethiopian Sheep and Goat Productivity Improvement Program

In 2005, the American Institute for Goat Research of Langston University and Prairie View A&M University, Prairie View, TX were awarded a $5.5 million grant from the USAID Mission in Ethiopia for a 5-year project entitled "Ethiopia Sheep and Goat Productivity Improvement Program." The project was extended for 1 year into 2011 with an additional $750,000 of funding. The project entails collaboration with the Ministry of Agriculture and Rural Development of the Government of Ethiopia. The overall goal of the program is to conduct research and extension activities in the areas of production and marketing that will result in a sustainable increase in small ruminant productivity in Ethiopia to improve food and economic securities. The project works in six regions of Ethiopia (Tigray, Amhara, Oromia, Southern States, Afar, and Somali), and addresses a number of factors including human and institutional capacity building, research and technology transfer, and introduction of improved animal genetics.

There have been four major components of the project. The Genotype component deals with the introduction of improved genotypes, Dorper sheep and Boer goats, nucleus and crossbreeding stations, and distribution of animals. The Animal Health component searches for means of enhancing productivity through improved health practices. A third area is termed "Production," which has primarily entailed on-farm research and demonstration of useful feeding and nutrition practices. Finally, the Training component is designed to improve information delivery services and content to enhance the effectiveness of extension agents who work directly with farmers and pastoralists in small ruminant production.

In 2007, the Genotype component worked with Ethiopian officials to import Boer goats and Dorper sheep from South Africa. These animals form the backbone of purebred and crossbreeding programs designed to utilize the fast growth rate and larger carcass of these animals with the native adaptability and toughness of local breeds. The resulting crossbreds will be able to supply the export market with the desired frame size and carcass characteristics. The ESGPIP built a quarantine facility and nucleus and crossbreeding facilities to carry out project activities. After the quarantine period expired, the Boer goats were divided and transported to the Adami Tulu Nucleus Breeding site and to the Hawassa Nucleus breeding site, in the central and southern region of Ethiopia, respectively. The Dorper sheep were divided and transported to the Melkawarer Nucleus Breeding site and to the Fafen Nucleus breeding site in the central and eastern region of Ethiopia,

respectively. In addition to the four nucleus breeding sites, 10 Breeding, Evaluation, and Distribution (BED) sites have been established across Ethiopia with the express intent of propagating and disseminating crossbred animals. In 2008 and 2010, Boer goat semen was purchased in South Africa, imported into Ethiopia and used in artificial insemination projects to broaden the genetic base of the purebred Boer goat nucleus flocks. Purebred Boer goats and Dorper sheep have been used to crossbreed with indigenous breeds and animals have been distributed to private farmers.

The Animal Health component is combating the problem of external parasites downgrading the quality of Ethiopian sheep and goat skins for the important leather industry by training villagers to be providers of dipping and spraying services to control these pests. Studies on lamb and kid mortality aim to find most common causes of mortality of young animals and design means to ameliorate this problem.

For the Production component, as is also true for all other areas, activities have occurred in collaboration with the Ministry of Agriculture & Rural Development, regional research and extension entities, and universities and colleges. Furthermore, there have been efforts to involve extension agents who work directly with farmers and pastoralists and received the small ruminant production training.

The great majority of ESGPIP research has been on-farm. In this regard, extension is integral in these activities, with inclusion of field days near the end. Moreover, frequently nearby farmers not directly involved in the activities have been observed to adopt the new technologies without assistance.

Many different topics have been studied in on-farm research. One area also addressed in demonstrations and field days is ammoniation of crop residues via treatment with urea. Previously, ammoniated crop residues were used with cattle but not extensively with small ruminants. This technology has been readily adopted in all areas where introduced and a number of other non-governmental organizations have followed the ESGPIP lead and copied its methods in other areas. Byproduct feedstuffs studied include leftover khat and poultry litter, and experiments have been conducted with urea-molasses multi-nutrient blocks, various supplements such as cactus, noug cake, sweet potato vines, and wheat bran, and trace mineral supplementation. Recent attention has been given to comparisons of performance and carcass and skin characteristics of crossbreds of Dorper sheep and Boer goats with local breeds.

Field days not directly associated with on-farm research also have been conducted. Typically, a number of technologies are demonstrated, such as ammoniation, making and use of urea-molasses blocks, and improved forages. There has been a major effort to aid in the distribution of seeds and seedlings of improved forages, in coordination with similar activities at sites of introduction of improved genotypes. And, as women typically are responsible for care of sheep and goats in Ethiopia, the formation of women groups for sheep and goat production has been promoted and technical assistance provided.

The Training component of the project aims to enhance the knowledge and ability of village development agents to assist farmers in raising small ruminants via direct training in small ruminant productivity. Village development agents receive training in sheep and goat production and management. In support of this program, the Sheep and Goat Production Handbook for Ethiopia was published in 2008. This text, written by Ethiopian scientists, is the first of its kind in Ethiopia and has over 400 pages of information that can be used by development agents. The depth of information in the book also allows its use as a classroom text by university faculty. In addition, technical bulletins of certain aspects of sheep and goat production have been produced and distributed to development agents and institutions throughout the country. The technical bulletins are designed to contain material that a development agent could use directly in training village farmers. These bulletins are very popular and are now being translated into several different regional languages of Ethiopia to broaden their use. In 2008, the ESGPIP and Institute staff established a project website, www.ESGPIP.org, that contains the technical bulletins, handbook, and other materials and reports produced by the ESGPIP.

Finally, all project components work together to enhance the ability of Ethiopian institutions and personnel to effect sustainable, positive change in small ruminant production.

The End Result

The American Institute for Goat Research is proud of its international activities and the impact they have on strengthening human and institutional capacity of foreign institutions, providing important and relevant research results on local issues of importance, and in the assistance provided to small farmers, and particularly women, in enhancing family nutrition and income generation. These are unique activities that support the mission and goals of the Institute.

Recent International Grants

Years	2010–2011
Title	Enhanced Safety and Product Quality from On-Farm Thermization/Pasteurization of Goat Milk in the Middle East
Collaborators	Langston University; Agricultural Research Organization, Bet Dagen, Israel; Al-Quds University, East Jerusalem, Palestine; Jordan University of Science and Technology, Irbid, Jordan
Funding source	United States – Israel Binational Agricultural Research and Development Fund
Funding amount	$50,000
Years	2009
Title	Increasing the Capacity of Higher Education in East Africa through the creation of a Consortium of African and United States Educators (CAUSE)
Collaborators	Langston University; Oklahoma State University; Haramaya University, Hawassa University, and Mekelle University in Ethiopia; Kenyatta University and Moi University in Kenya; International Livestock Research Institute and the International Maize and Wheat Improvement Center of the Consultative Group on International Agricultural Research system.
Funding source	Higher Education for Development, USAID
Funding amount	$50,000
Years	2008–2010
Title	Effects of Nutritional Plane on the Maintenance Energy Requirement of Goats
Collaborators	Langston University; Desert Research Center, Egypt
Funding source	U.S. – Egypt Joint Science and Technology Fund
Funding amount	$60,000
Years	2007–2010
Title	The Grazing Activity Energy Cost of Goats.
Collaborators	Langston University; Desert Research Center, Egypt
Funding source	U.S. – Egypt Joint Science and Technology Fund
Funding amount	$60,000
Years	2006-2007
Title	Sustainable Interventions to Increase Child Education in Ethiopia: Models for Poverty Reduction and Overcoming Child Labor Constraints
Collaborators	Langston University; Hawassa University, Hawassa, Ethiopia
Funding source	United Negro College Fund Special Programs
Funding amount	$25,000

Years	2005-2010
Title	Ethiopia Sheep and Goat Productivity Improvement Program
Collaborators	Langston University; Prairie View A & M University, Ministry of Agriculture and Rural Development of the Government of Ethiopia
Funding source	USAID Ethiopia
Funding amount	$5,500,000
Years	2005-2008
Title	International Collaboration in Goat Research and Production Web-Based Decision Support Aids
Collaborators	Langston University; Jordan University of Science and Technology; Northwest Science-Technology University, China; Département des Sciences Animales of Institut National Agronomique, France; University of Chapingo in Mexico
Funding source	USDA International Science and Education Competitive Grants Program
Funding amount	$99,959
Years	2005-2008
Title	Energy Expenditure for Activity in Free-Ranging Ruminants: A Nutritional Frontier
Collaborators	Langston University; Newe Ya'ar Research Center of the Agricultural Research Organization, Israel
Funding source	United States – Israel Binational Agricultural Research and Development Fund
Funding amount	$310,000
Years	2005–2007
Title	Effects of Acclimatization on Energy Requirements of Goats
Collaborators	Langston University; Desert Research Center, Egypt
Funding source	U.S. – Egypt Joint Science and Technology Fund
Funding amount	$58,500
Years	2000 – 2008
Title	Multinational Approaches to Enhance Goat Production in the Middle East
Collaborators	Langston University; Desert Research Center, Cairo, Egypt; Volcani Center, Bet Dagan, Israel; Al-Quds University in East Jerusalem working in the West Bank; Jordan University of Science and Technology, Irbid, Jordan
Funding source	USAID/Middle East Regional Cooperation Program
Funding amount	$1,199,725

Research Overview

Dr. Arthur Goetsch
Goat Research Leader

There has been and is a wide array of research areas addressed by our program. All major types of goats produced in the US are considered, i.e., ones raised for meat, milk, and(or) fiber, both cashmere and mohair. The increasing demand for goat meat and decline in the mohair industry in recent years have resulted in an expansion of research topics with meat goats, but because the future is unknown, all goat industries will continue to receive attention. The Institute has and will in the future conduct research to increase levels and efficiencies of goat production, enhance utilization of goat products, and improve use of goats for specific purposes such as vegetation management. There is intent to increase economic returns to those raising goats or processing their products, as well as providing other benefits such as enhanced sustainability of livestock production systems.

A large proportion of the Institute's research program is made possible by grants, many of which are through USDA programs. Although dissemination of information generated from all of these projects occurs, some entail strong extension components. Likewise, there are projects listed in our international section that entail significant research components.

To provide an idea about our research program since the last Field Day, listed below are research projects and experiments we have been involved with in 2009, abstracts for 2010, and summaries of scientific articles that were published in 2009 and 2010 or currently are "in press."

Standard Abbreviations Used

BW = body weight
CP = crude protein
dL = decaliter
DMI = dry matter intake
kg = kilogram
M = mole
MEI = ME intake
mm = millimeters
ng = nanogram
OM = organic matter
SE = standard error
wt = weight
vs = versus
cm = centimeters
d = day
DM = dry matter
g = gram
L = liter
ME = metabolizable energy
mL = milliliter
mo = month
NDF = neutral detergent fiber
P = probability
TDN = total digestible nutrients
vol = volume
μ = micro

Current Research Projects

Title: *Enhanced Goat Production and Products in the South-Central U.S.*
Type: CSREES project
Project Number: OKLX-SAHLU
Period: 2006-2011
Investigators: T. Sahlu, A. L. Goetsch, R. Puchala, R. C. Merkel, T. A. Gipson, S. P. Hart, S. Zeng, and Z. Wang
Institution: Langston University
Objective: Study goat feeding and management, relevant health issues, and milk product technologies in order to increase the level and efficiency of goat productivity for increased profitability from goat production and lower costs to consumers of goat products.

Title: *Characterization of the Energy Requirement for Activity by Grazing Ruminants*
Type: USDA 1890 Institution Research Capacity Building
Project Number: 2005-38814-16352
Period: 2005-2010
Investigators: T. Sahlu[1], R. Puchala[1], A. L. Goetsch[1], T. A. Gipson[1], and B. Kouakou[2]
Institutions: [1]Langston University and [2]Fort Valley State University
Objectives: Determine effects of animal and dietary conditions on energy expenditure, metabolizable energy intake, the grazing activity energy cost, grazing and walking times, and horizontal and vertical distances traveled.

Title: *The Ability of Goats to Withstand Harsh Nutritional Environments*
Type: USDA 1890 Institution Research Capacity Building
Project Number: 2005-38814-16353
Period: 2005-2010
Investigators: A. L. Goetsch[1], R. Puchala[1], T. Sahlu[1], and H. C. Freetly[2]
Institutions: [1]Langston University and [2]Meat Animal Research Center
Objectives: Determine if there are differences between goats and sheep and between meat goat species of the US in the ability to utilize diets with limited supplies of nitrogen and energy and to characterize the physiological bases of any such differences.

Title: *The Grazing Activity Energy Cost of Goats*
Type: United States - Egypt Joint Science and Technology Fund Program
Project Number: BIO11-001-005
Period: 2007-2010
Investigators: A. L. Goetsch[1], R. Puchala[1], T. A. Gipson[1], H. El Shaer[2], and A. Helal[2]
Institutions: [1]Langston University and [2]Desert Research Center
Objective: Determine the magnitude of the grazing activity energy cost of goats under different common production settings in an arid region of Egypt and in the south-central U.S.

Title: *Impact of Sub-Clinical Mastitis on Production and Quality of Goat Milk and Cheese*
Type: USDA 1890 Institution Research Capacity Building
Project Number: OKLXSTEVEZENG2007
Period: 2007-2012
Investigators: S. S. Zeng[1], D. Bannerman[2], and L. Spicer[3]
Institutions: [1]Langston University, [2]USDA ARS Bovine Functional Genomics Laboratory, and [3]Oklahoma State University

Objectives:
1) Assess prevalence of subclinical mastitis in dairy goats during a year-round lactation in Oklahoma
2) Quantify and qualify losses in milk yield and cheese production associated with subclinical mastitis test the impact of major types of CNS bacteria
3) Test the impact of major types of CNS bacteria species causing IMI (*S. epidermidis*, *S. simulans*, S. *caprae*, and *S. chromogenes*) on the inflammatory response in milk and to relate it to caseinolysis, coagulation properties, and cheese yield
4) Study the mechanism by which CNS affects caseinolysis and in turn the coagulation properties
5) Investigate changes in PL and SCC of milk caused by subclinical mastitis and their effects on milk coagulation, and cheese yield and texture

Title: *Effects of Nutritional Plane on the Maintenance Energy Requirement of Goats*
Type: United States - Egypt Joint Science and Technology Fund Program
Project Number: BIO12-001-016
Period: 2008-2010
Investigators: R. Puchala[1], A. L. Goetsch[1], T. A. Gipson[1], A. R. Askar[2], and A. Helal[2]
Institutions: [1]Langston University and [2]Desert Research Center
Objective:
1) Determine how nutrient restriction impacts energy expenditure (EE) and the maintenance energy requirement (ME_m) with common goat genotypes of Egypt and Oklahoma
2**)** Determine how adequate nutrient intake following nutrient restriction affects EE and ME_m with common goat genotypes of Egypt and Oklahoma
3) Use data from specific objectives 1 and 2 to develop a method of predicting the impact of low nutritional planes on ME_m

Title: *Boer Goat Selection for Residual Feed Intake*
Type: USDA 1890 Institution Research Capacity Building
Project Number: 2008-38814-02661
Period: 2008-2011
Investigators: T. A. Gipson[1], A. L. Goetsch[1], R. Puchala[1], T. Sahlu[1], and C. Ferrell[2]
Institutions: [1]Langston University, and [2]USDA ARS Meat Animal Research Center, Nutrition Research Unit
Objective:
1) Determine and demonstrate efficacy of use of residual feed intake to achieve genetic progress in improving efficiency of feed. utilization without elevating mature size or body fatness compared with selection based on growth rate.
2) Characterize relationships between residual feed intake and animal activities, feeding and social behaviors, and energy expenditure, and assess potential means of prediction of residual feed intake at an early age.

Title: *Establishing a Pilot Tannery and Capability for Goat Leather Research at Langston University*
Type: USDA 1890 Institution Research Capacity Building
Project Number: 2008-38814-02520
Period: 2008-2011
Investigators: R. C. Merkel[1] and C. K. Liu[2]
Institutions: [1]Langston University and [2]USDA ARS Eastern Regional Research Center
Objective:
1) Establish a pilot tannery and capability for goat leather research at the LU campus
2) Determine the effects of goat breed, diet and age upon skin chemical composition and the mechanical properties of resulting leather
3) Evaluate environmentally friendly tanning methods on U.S. goat skins

Title: *Enhanced Safety and Product Quality from On-Farm Thermization/Pasteurization of Goat Milk in the Middle East*
Type: United States - Israel Binational Agricultural Research and Development Fund
Project Number: FG-9503-09R
Period: 2010-2011
Investigators: T. Sahlu[1], A. L. Goetsch[1], S. Zeng[1], Z. Abdeen[2], M. Fanum[2], K. Azmi[2], N. Silanikove[3], G. Leitner[3], K. Ereifej[4], L. Alrousan[4], and K. Al-Qudah[4]
Institutions: [1]Langston University; [2]Al-Quds University, East Jerusalem, Palestine; [3]Agricultural Research Organization, Bet Dagen, Israel; [4]Jordan University of Science and Technology, Irbid, Jordan
Objectives: Develop specifications of an inexpensive thermization/pasteurization equipment system suitable for use on small goat farms in the Middle East, conduct preliminary evaluations of the prototype for possible refinement, and determine procedures for an associated MERC grant proposal to be developed.

Title: *Effects of Selected Nutritional Components on Immunity to Haemonchus in Goats*
Type: USDA 1890 Institution Research Capacity Building
Project Number: OKLXWANG10
Period: 2010-2013
Investigators: Z. Wang[1], A. L. Goetsch[1], S. P. Hart[1], T. Sahlu[1], and G. Chen[2]
Institutions: [1]Langston University, and [2]Oklahoma State University
Objectives: Investigate immune regulation by *H. contortus* and reversing this regulation by nutritional components in small ruminants.

Title: *Establishing a Langston University Testing Center for Electric Fence Modifications of Cattle Barb Wire Fence for Goat Containment*
Type: USDA 1890 Institution Research Capacity Building
Project Number: OKLXGOETSCH10
Period: 2010-2013
Investigators: A. L. Goetsch[1], T. A. Gipson[1], T. Sahlu[1], and J. Burke[2]
Institutions: [1]Langston University, and [2]USDA ARS Dale Bumpers Small Farms Research Center
Objectives: Develop a repeatable method of testing effectiveness of the various means of cattle fence modifications with electric fence for goat containment.

Experiments Active in 2010/2011

Title: *Effects of gender and age on the maintenance energy requirement of Boer goats*
Experiment Number: ITL-08-06
Project Number: OKLX-SAHLU
Investigators: I. Tovar-Luna, A. L. Goetsch, R. Puchala, K. Tesfai, and T. Sahlu
Objectives: 1) Determine effects of gender and age of Boer goats on a) fasting heat production, b) maintenance energy requirement, c) efficiency of metabolizable energy utilization for maintenance, and d) efficiency of energy utilization for growth
2) Determine the relationship between heart rate and heat production measured in growing Boer goats with ad libitum consumption and when fed near maintenance and fasted

Title: *Effects of CNS bacteria induced subclinical mastitis on the gene profile of dairy goats and casein fractions and the plasmin system of goat milk*
Experiment Number: RS-09-04
Project Number: 2007-38814-18474
Investigators: R. Shangguan, L. Wang, S. Zeng, L. J. Spicer, and C. DeWitt
Objectives: Investigate the effect of subclinical mastitis caused by major types of CNS bacteria species (*S. Epidermidis*, *S. Simulans*, *S. Caprae*, and *S. Chromogenes*) on the plasmin system, casein fractions, the mechanism by which CNS affects caseinolysis, and gene profiles in Alpine and Nubian dairy goats

Title: Effects of goat breed, diet, and age on skin chemical composition and the mechanical properties of resulting leather
Experiment Number: RM-09-08
Project Number: 2008-38814-02520
Investigators: R. C. Merkel, A. L. Goetsch, and T. A. Gipson
Objectives: Determine effects of goat breed (Boer vs Spanish), diet (high and low nutritive plane), and age on skin chemical composition and the mechanical properties of resulting leather

Title: *Management of lactating Alpine goats to minimize internal parasitism and the activity energy cost*
Experiment Number: AG-09-11
Project Number: OKLX-SAHLU
Investigators: A. L. Goetsch, Z. Wang, S. P. Hart, L. J. Dawson, T. A. Gipson, R. Puchala, E. Loetz, J. Hayes, R. C. Merkel, G. D. Detweiler, and T. Sahlu
Objectives: Determine effects of different pasture access schemes conceivably impacting ingestion of infective larvae of *Haemonchus contortus* and the activity energy cost on production and behavior of Alpine dairy goats

Title: *Effects of method of processing broiler litter on feed intake and performance by meat goat doelings*
Experiment Number: AG-09-12
Project Number: OKLX-SAHLU
Investigators: A. L. Goetsch, G. D. Detweiler, J. Hayes, and T. Sahlu
Objectives: Compare feed intake, growth rate, and efficiency of feed utilization of meat goat doelings consuming diets with deep-stacked versus ensiled broiler litter

Title: *Observations of efficacy of anthelmintics in goats infected with nematode parasites*

Experiment Number: ZW-10-02
Project Number: OKLX-SAHLU
Investigators: Z. Wang, S. P. Hart, L. J. Dawson, A. L. Goetsch, and T. Sahlu
Objectives: Determine effects on internal parasitism in Alpine dairy goats of treatment with Cydectin, Levasole, Valbazen, or different combinations of these products

Title: *Development of a model to evaluate methods of modifying cattle barb wire fence for goat containment – experimental design (study number 2)*
Experiment Number: AG-10-03
Project Number: OKLXGOETSCH10
Investigators: A. L. Goetsch, G. D. Detweiler, R. Puchala, T. A. Gipson, and T. Sahlu
Objectives: Compare Latin square and completely randomized design approaches

Title: *Testing efficacy of anthelmintic combinations*
Experiment Number: SH-10-05
Project Number: OKLX-SAHLU
Investigators: S. P. Hart, L. J. Dawson, and Z. Wang
Objectives: Determine effects of various levels and combinations of commercially available anthelmintics and copper oxide wire capsules on internal parasitism in goats

Title: *Comparison of nematode parasite-susceptibility and performance of Boer and Spanish goats supplemented with garlic*
Experiment Number: ZW-10-06
Project Number: OKLX-SAHLU
Investigators: Z. Wang, A. L. Goetsch, S. P. Hart, L. J. Dawson, and T. Sahlu
Objectives: Compare performance and nematode-infection in Boer and Spanish goats and their suckling kids supplemented with garlic

Title: *Boer goat selection for residual feed intake: Phase II, Year 1*
Experiment Number: AM-10-07
Project Number: OKLXGIPSON08
Investigators: A. Manley, A. L. Goetsch, T. A. Gipson, R. Puchala, and T. Sahlu
Objectives: 1) Determine and demonstrate efficacy of use of residual feed intake to achieve genetic progress in improving efficiency of feed utilization without elevating mature size or body fatness compared with selection based on growth rate
2) Characterize relationships between residual feed intake and animal activities, feeding and social behaviors, and energy expenditure, and assess potential means of prediction of residual feed intake at an early age

Title: *Pregnancy rate following the use of chorionic gonadotropins and GnRH in an estrus/ovulation synchronization protocol for trans-cervical AI in cyclic goats*
Experiment Number: EL-10-08
Project Number: OKLX-SAHLU
Investigators: E. Loetz, L. J. Dawson, J. Hayes, and I. Portugal
Objectives: 1) Determine the influence of various gonadotropins and a gonadotropin releasing hormone (GnRH) on ovulation and which of these hormones provides the best kidding rate
2) Establish the pattern of hormonal secretion during the use of different E/OS protocols

Title: *Boer goat selection for residual feed intake: Phase I, Year 2*
Experiment Number: AM-10-09
Project Number: OKLXGIPSON08
Investigators: A. Manley, A. L. Goetsch, T. A. Gipson, R. Puchala, and T. Sahlu
Objectives: 1) Determine and demonstrate efficacy of use of residual feed intake to achieve genetic progress in improving efficiency of feed utilization without elevating mature size or body fatness compared with selection based on growth rate
2) Characterize relationships between residual feed intake and animal activities, feeding and social behaviors, and energy expenditure, and assess potential means of prediction of residual feed intake at an early age

Title: *Characterization of cytokine gene expression in PBMC stimulation by H. contortus antigens*
Experiment Number: RZ-10-10
Project Number: OKLXWANG10
Investigators: R. Zhong, Z. Wang, A. L. Goetsch, and T. Sahlu
Objectives: Characterize the profile of cytokine gene expression in peripheral blood mononuclear cells (PBMC) stimulated by *H. contortus* and to demonstrate the effects of garlic expression of these genes

Title: *Effects of supplementation on selectivity of forage components by yearling meat goat doelings*
Experiment Number: IR6-11-01
Project Number: OKLX-SAHLU
Investigators: R. C. Merkel, R. Puchala, G. D. Detweiler, T. A. Gipson, T. Sahlu, and A. L. Goetsch
Objectives: Determine effects and potential interactions between level of feeding a coarsely ground grass hay (i.e., 110, 140, and 170% of consumption on the preceding 3 days) and supplementation (no supplementation, corn-soybean meal, and corn-fish meal for varying levels of energy and rumen degraded and undegraded protein)

Title: *Effects of the number of animals per pen and time of automated feeder access on feed intake, efficiency of feed utilization, and feeding behavior by yearling Spanish wethers*
Experiment Number: IR3-11-02
Project Number: OKLX-SAHLU
Investigators: R. C. Merkel, R. Puchala, G. D. Detweiler, T. A. Gipson, T. Sahlu, and A. L. Goetsch
Objectives: Determine effects of the number of animals per pen (maximal potential average feeder access per animal of 2 and 4 hours) and time of automated feeder access (continuous, night, and day) on feed intake, efficiency of feed utilization, and feeding behavior by yearling Spanish wethers

Title: *Effects of (-)-Epigallocatechin-3-gallate (EGCG) on viability of H. contortus and immune responses of white blood cells of goats in vitro*
Experiment Number: RZ-11-03
Project Number: OKLXWANG10
Investigators: R. Zhong, Z. Wang, A. L. Goetsch, and T. Sahlu
Objectives:
1) Determine whether EGCG exerts a direct inhibitory effect on the viability of third-stage larvae of *H. contortus* and whether such effects shows a dose-dependent manner in in vitro conditions using larval viability inhibitory assay (LVIA)
2) Detect cytokine production by white blood cells stimulated by EGCG
3) Observe whether changes in cytokine expression affect viability of third-stage larvae of *H. contortus*

Title: *Boer goat selection for residual feed intake: Phase II, Year 2*
Experiment Number: AM-11-04
Project Number: OKLXGIPSON08
Investigators: A. Manley, A. L. Goetsch, T. A. Gipson, R. Puchala, and T. Sahlu
Objectives:
1) Determine and demonstrate efficacy of use of residual feed intake to achieve genetic progress in improving efficiency of feed utilization without elevating mature size or body fatness compared with selection based on growth rate
2) Characterize relationships between residual feed intake and animal activities, feeding and social behaviors, and energy expenditure, and assess potential means of prediction of residual feed intake at an early age

Abstracts

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Comparison of nematode parasite-susceptibility and performance of Boer and Spanish goats supplemented with garlic

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Changchun, China
[2]American Institute for Goat Research, Langston University, Langston, OK

Twenty Boer (2-7 yr of age) and 20 Spanish (4-6 yr of age) does with their single- or twin-kids (1-4 mo of age) were used to compare nematode parasite-susceptibility and performance of the two breeds supplemented with garlic. Initially, all does and kids were treated with a combination of Cydectin (0.8 mg/kg BW), Levasole (11.2), and Valbazen (21.6) on 2 consecutive days to clear existing nematode parasites. The goats were kept in a barn for 7 d and fecal samples from the does were checked for fecal egg count (FEC). Then all does and kids were moved to a pasture known to be contaminated with mainly *H. contortus*. The goats grazed together for 3 wk before being assigned to 2 treatments for a 98-d experiment. Five does (3 Boer and 2 Spanish, or 2 Boer and 3 Spanish) with their kids grazed 8 0.4-ha pastures. Treatments were control and garlic, with 4 pastures per treatment. Control does received 200 g/d of concentrate (%: corn 54.4, SBM 26.0, molasses 12.9, dical 1.3, limestone 1.3, trace mineralized salt and vitamin mixes 3.4, $MgSO_4$ 0.7), garlic does received the same amount of concentrate plus 20 g/d of garlic powder. Kids were weaned on d 32 and removed from the experiment. On d 0, 32, 67, and 98, all goats were weighed and fecal and blood samples collected. Means were separated by LSD. Initial mean FEC was 533 (range of 0 to 8,650) and 440 (range of 0 to 2,050) for Boer and Spanish does, respectively (SEM = 257; $P > 0.05$). The FEC was not different ($P > 0.05$) between breeds or treatments on any day. Likewise, ADG, packed cell volume, FAMACHA score, and body condition score of does and ADG of kids were similar ($P > 0.05$) for Boer and Spanish regardless of treatment. In conclusion, nematode parasite-susceptibility appears similar in these two common meat goats and garlic supplementation has no effect on internal parasitism under these experimental conditions.

Feed intake and performance by yearling Boer goat doelings consuming deep-stacked or ensiled broiler litter

A. L. Goetsch, G. D. Detweiler, B. Bah, T. Sahlu, and J Hayes

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Boer goat doelings (48; 8/treatment), 10.4 ± 0.13 mo of age and 27.1 ± 0.98 kg BW, were used in a 9-wk experiment to compare feeding value of deep-stacked (DS) and ensiled (EN) broiler litter. Broiler litter was processed for 82 d before a 24-d adaptation period. Temperature in the upper area of DS was 55-65°C for 2 wk and that in the lower area was 45-57°C for 10 wk; EN temperature ranged from 0-20°C. Treatments were feeding 1% BW (DM) of a 3:1 corn-soybean meal mixture and moderate to high-quality grass hay free-choice (Cont-Hay), 1% BW hay and concentrate mixture free-choice (Cont-Conc), 1% BW hay, 1.1% BW corn, and DS or EN free-choice (DS-L and EN-L, respectively), and 1% BW hay and DS or EN free-choice (DS-H and EN-H, respectively). Daily samples of DS and EN averaged 70.9 and 73.3% OM (DM basis), 21.8 and 23.2% CP, and 34.0 and 37.2% NDF, respectively. Total DM intake was less for H vs. L treatments, similar between DS-L and EN-L, and greater ($P < 0.05$) for EN-H than for DS-H (1.13, 1.28, 0.98, 1.13, 0.59, and 0.80 kg/d Cont-Hay, Cont-Conc, DS-L, EN-L, DS-H, and EN-H, respectively; SE = 0.072). There were similar differences in ADG (126, 234, 58, 75, -46, and -8 g; SE = 10.1) and the ratio of ADG:DM intake (118, 188, 60, 66, -84, and -11 g/kg for Cont-Hay, Cont-Conc, DS-L, EN-L, DS-H, and EN-H, respectively; SE = 12.7). There appeared to be more adaptation over time to EN-H than DS-H, with similar DM intake in wk 1-3 (0.48 and 0.64; SE = 0.082) but greater values in wk 4-6 (0.65 and 0.88; SE = 0.076) and 7-9 (0.64 and 0.87 kg/d for DS-H and EN-H, respectively; SE = 0.080). Likewise, ADG was similar between H treatments in periods 1 (-60 and -42 g; SE = 18.5) and 2 (6 and 27 g; SE = 12.5) and greater for EN-H in wk 7-9 (-83 and -9 g for DS-H and EN-H, respectively; SE = 22.2). In conclusion, feeding value of DS and EN for yearling meat goat doelings appears similar with moderate dietary levels, but with limited consumption of other feedstuffs, feeding value of EN may be greater.

Effects of night-locking on intake, digestion, behavior, and energy use by meat goat does grazing grass/legume pasture

I. Tovar-Luna[1,2], R. Puchala[1], T. A. Gipson[1], G. D. Detweiler[1], L. J. Dawson[3], T. Sahlu[1], A. Keli[4], A. L. Goetsch[1]

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Boer × Spanish does (24), 8 with ruminal cannula, were confined at night with access to grass/legume pasture from 0700 to 1900 h (R) or had continual access (C) in a completely randomized design with repeated measures. Data collection periods (15 d) were in late gestation (L-G; 137 d), early lactation (E-L; 43 d), late lactation (L-L; 97 d), the dry period (Dry), and early gestation (L-G; 65 d). Most does had a litter size of 2, and kids were weaned at 118 d. Pasture access treatment did not affect ingesta composition; CP (20, 13, 15, 13, and 20%) and NDF (51, 59, 63, 61, and 38% in L-G, E-L, L-L, Dry, and E-G, respectively) varied among periods. Kid ADG tended ($P<0.08$) to be greater for C vs R (138 vs 118 g). Fat-corrected (4%) milk yield was greater ($P<0.05$) for C vs R in E-L but not L-L (2.04, 0.86, 3.27, and 1.23 kg/d for R/E-L, R/L-L, C/E-L, and C/L-L, respectively). Intake of ME was greater ($P<0.05$) for R vs C (823 vs 735 kJ/kg $BW^{0.75}$). Treatment affected ($P<0.05$) time lying (12.4 and 10.5), grazing (4.5 and 5.8), and resting (18.5 and 16.7 h for R and C, respectively). Energy expenditure (EE) was greater ($P<0.05$) for C vs R (754 vs 687 kJ/kg $BW^{0.75}$) and recovered energy (RE) in tissue gain was similar between treatments. The RE of lactation (RE_l) from dietary ME was greater ($P<0.05$) for C vs R (244 vs 194 kJ/kg $BW^{0.75}$); however, RE_l from mobilized tissue differed between treatments ($P<0.05$) in E-L but not L-L (54, 15, 175, and 11 kJ/kg $BW^{0.75}$ in L-G, E-L, L-L, Dry, and E-G, respectively). The EE of activity tended to be greater ($P<0.07$) for C vs R (243 vs 202 kJ/kg $BW^{0.75}$). In conclusion, R decreased activity EE to an extent less than it lessened ME intake, and greatest R impact was in E-L, with reduced RE_l and a tendency for lower kid ADG.

Comparison of FAMACHA scores and need for deworming in hair sheep and meat goats grazed together or sheep grazed alone

S. Hart[1], T. Gipson[1], R. Pirtle[2], and W. Cubbage[2]

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[2]Oklahoma State University County Extension Program, Stillwater, OK

This study compared FAMACHA scores and need for deworming in hair sheep and goats being grazed together or hair sheep grazed alone. The study involved Boer and Spanish goats and hair sheep crosses of Katahdin, St. Croix, Dorper, Gulf Coast Native, and Barbadoes Blackbelly. Treatments were 1) hair sheep grazed alone (88 animals/16.2 ha) or 2) goats and hair sheep grazed together (38 hair sheep and 71 goats/24.3 ha) on tallgrass native range during the summer (average annual precipitation of 922 mm). Animals were FAMACHA scored (FS) April 30 at the beginning of the study and animals scoring 4 and 5 were treated with moxidectin (MOX; 10 ml). Animals then were FAMACHA scored May 17, June 8, July 26, August 18, and September 20. Animals with FS of 4 were administered either 2.0 g of copper oxide wire particles (COWP) or 3.4 g of Cayenne pepper (CP). Animals with a FS of 5 were treated with MOX. Animals that were dewormed were fecal sampled for determination of fecal egg counts (FEC) by McMaster procedure and an additional three to six animals that were not dewormed. On the hair sheep and goat treatment, goats had higher FS than hair sheep (3.80 vs 2.63; $P < 0.01$), higher FEC (532 vs 188 epg; $P < 0.02$) and required more deworming (61.8 vs 13.5%; $P < 0.001$). Hair sheep grazing alone had a lower FS than hair sheep grazing with goats (2.20 vs 2.63; $P < 0.01$), lower FEC (50 vs 188 epg; $P < 0.01$), and required less deworming (2.1 vs. 13.5%; $P < 0.001$). When animals were administered CP, FEC at the subsequent sampling increased by 63%. whereas COWP decreased FEC 36% at the subsequent sampling. Administration of MOX reduced FEC 47% in the subsequent sampling. Hair sheep grazed with goats had lower FS, lower FEC, and required substantially less deworming than the goats they grazed with, but sheep grazing with goats required more deworming than sheep grazing alone. COWP was more effective than CP in reducing FEC.

Demographic factors of meat goat producers completing an online certification program

T. A. Gipson, R.C . Merkel, and T. Sahlu

American Institute for Goat Research, Langston University, Langston, OK

In 2006, an on-line training program for meat goat producers was unveiled, consisting of 22 learning modules (http://www2.luresext.edu/goats/training/qa.html). Participants take a pre-test for each module and if a score of 85% or greater is recorded, the post-test is not required. If required, participants may retake the post-test until a passing score of 85% or greater is achieved. For certification, passing scores are required on all 16 required modules and a minimum of 3 elective modules. Demographic data are collected upon enrollment. Participants had the option of not responding to certain demographic questions and those observations were removed from this analysis. As of the end of 2010, 198 of 1,430 enrollees successfully completed the certification program, with 182 from the US and 16 from foreign countries. For those 182 certified in the US, a higher percentage (62%, $\chi^2 = 143.2$, $P < 0.01$) was from the South than from any other region, followed by 22, 12, and 4% from the Midwest, West, and Northeast, respectively. All certified producers reported their gender and there were more males (60% vs. 40%, $\chi^2 = 8.1$, $P < 0.01$) than females. Of the certified, 92% responded to the question on race, and an overwhelming percentage classified themselves as white (89%, $\chi^2 = 686.5$, $P < 0.01$ for equal proportions); however, this is similar to the US population as a whole (89% vs. 80%, $\chi^2 = 0.1$, $P = 0.73$). The response to a question on farm size was 88%; 9% owned < 2 ha, 43% 2-8 ha, 14% 9-16 ha, 13% 17-32 ha, 9% 33-65 ha, 8% 66-130 ha, and 4% > 130 ha ($\chi^2 = 162.5$, $P < 0.01$). An 84% of the certified responded to a question on occupation; 78% were part-time farmers and 22% were full-time ($\chi^2 = 53.2$, $P < 0.01$). The response of those certified to a query on herd size was 82%, with 46% owning less than 25 goats, 29% 25-49, 16 % 50-99, 6% 100-250, and 3% greater than 250 ($\chi^2 = 103.9$, $P < 0.01$). Demographics indicate that the typical certified participant is a white male living in the southern US and farming part-time with less than 25 goats on 2-8 ha.

Variability among enumerators in assigning Body Condition Scores in meat goats

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Body condition score (BCS) is a subjective measure of an animal's condition. In research settings, teams of three enumerators determine a true BCS, defined as the median score. The variability among team member scores in determining an animal's true BCS is not well studied. 24 Spanish (28 – 40 wk of age; 26.6 ± 4.43 kg) and 28 predominately Boer (B) blood (24 - 75%B, 4 – 100%B; 33 – 46 wk of age; 33.9 ± 6.99 kg) wethers were allocated to 4 groups having equal breed numbers. Goats were raised on pasture with unlimited access to alfalfa hay with 2 groups consuming either 0.5% or 1.5% BW of a pelleted diet (16% CP, 29% ADF, 60% TDN). BCS (1 = very thin, 5 = obese, 0.25 increments) was taken bi-weekly by the same three enumerators with the median value recorded as the true BCS. A total of 1728 observations (576 per enumerator) were recorded. Data was analyzed using repeated measures. The repeatability score was 0.6 ± 0.05. Median BCS and percent of individual scores at the median, respectively, for the BCS given throughout the trial were 2.0, 0.35; 2.25, 1.56; 2.5, 25.0; 2.75, 43.4; 3.0, 20.0; 3.25, 5.9; and 3.5, 3.8 ($\chi^2 = 107.1$, $P < 0.01$). On the same animal at the same time, all enumerators gave the same BCS 37.9 and two of the three enumerators agreed 56.4% of the time. When only two enumerators agreed, enumerators A and B, B and C, and A and C agreed 24.3, 17.7, and 14.4% of the time, respectively. In only 5.7% of animals were all three scores different. All scores were either at the median, 0.25 above, 0.25 below, 0.5 above, or 0.5 below (77.4, 10.8, 11.2, 0.23, and 0.46%, respectively; $\chi^2 = 166.2$ $P < 0.01$ for equal distribution). In no instance did an individual score deviate from the median by 0.75 of a score. Results show close agreement in assigning BCS to growing meat goats with 99.4% of scores given by enumerators either at or within 0.25 of the median score. In 94.3% of animals scored by three enumerators, at least two scores were at the median whereas combinations of two enumerators giving the same score ranged from 52.3 to 62.2%. Data confirms that three enumerators are preferable to two in determining an animal's true BCS.

Effect of subclinical mastitis and stage of lactation on somatic cell count, milk composition, and plasmin activity in goat milk

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A total of 91 goat milk samples from individual udders of Alpine does during early, middle, and late lactations were used to investigate the impact of subclinical mastitis induced SCC increase on changes in chemical composition and plasmin (PL) activity in milk. Samples were collected and analyzed for fat, protein, lactose, solids non-fat (SNF), total solids (TS), SCC, and PL activity. Within three stages of lactation, all milk samples were sorted into three groups based on levels of SCC (low < 2.5×10^6, middle = $2.5 - 5.0 \times 10^6$, high > 5.0×10^6) and statistically analyzed in a 3×3 factorial ANOVA. There were no interactions of level of SCC and stage of lactation on variables measured ($P > 0.05$). Log_{10} (SCC) and percentage lactose in milk were negatively correlated ($r = -0.34$, $P = 0.001$). Fat, protein, SNF, TS, and PL were altered by stage of lactation ($P < 0.05$). PL activity was greatest in early lactation. In conclusion, in high SCC milk, lactose content may be more indicative of SCC level than milk fat, protein, SNF, TS, and PL activity during lactation. Stage of lactation is an important factor affecting milk composition and PL activity in goats with infection, and thus a necessary parameter in optimizing goat milk quality in conditions of subclinical mastitis.

Summaries of Recent Journal Articles
(2010, 2011, and In Press)

Effects of small ruminant species and origin in Ethiopia (Highland vs Lowland areas) and lengths of rest and feeding on harvest measures

Abebe, G., G. Kannan, and A. L. Goetsch

African Journal of Agricultural Research 5:834-847. 2010

Yearling goats (G) and sheep (S) from Highland (H) and Lowland (L) areas of Ethiopia were used to determine effects of species and origin and lengths of rest and feeding on harvest measures, particularly carcass surface lightness. The H goat used was Arsi-Bale, and the L goat was Somali. The fat-tail indigenous H sheep is thought to be an Arsi-Bale genotype, and the fat-rump indigenous L sheep genotype was the Black Head Ogaden. There were two experiments (each a 2 x 2 x 3 factorial), one with rest for 0, 1, and 2 d before slaughter (R0, R1, and R2, respectively) and the second with feeding 0, 2, and 4 wk (0 wk=2 d rest; 0F, 2F, and 4F, respectively). There were 10 animals per treatment. In the rest experiment, the instrumental color measure L* (indicating lightness) for the hind leg surface 3 d post-slaughter was lower ($P<0.05$) for H than for L (34.8, 36.3, 37.4, and 38.9 for G-H, G-L, S-H, and S-L, respectively). Surface L* on d 3 was increased ($P<0.05$) by 1 and 2 d of rest compared with 0 d for goats regardless of origin, but was not affected for sheep (33.2, 36.3, 37.2, 38.5, 37.8, and 38.2 for G-R0, G-R1, G-R2, S-R0, S-R1, and S-R2, respectively). In the feeding experiment, surface L* on d 3 was lower ($P<0.05$) for H than for L (36.5, 39.0, 36.2, and 39.8 for G-H, G-L, S-H, and S-L, respectively). Feeding 4 wk increased ($P<0.05$) surface L* on d 3 regardless of species and origin (37.7, 36.8, and 39.2 for F0, F2, and F4, respectively). In summary, goat and sheep carcasses from Highland areas of Ethiopia may darken more quickly compared with Lowland areas, and 1 or 2 d of rest before slaughter can increase lightness of the surface of goat carcasses.

Energy expenditure and activity of different types of small ruminants grazing varying pastures in the summer

Beker, A., T. A. Gipson, R. Puchala, A. R. Askar, K. Tesfai, G. D. Detweiler, A. Asmare, and A. L. Goetsch

Journal of Applied Animal Research 37:1-14. 2010

Objectives were to determine the activity energy cost for different types of goats as well as a breed of sheep and to evaluate methods of prediction. Thirty-two animals were used, with eight of four different types. Animal types were yearling Angora doeling goats, yearling Boer wether goats, yearling Spanish wether goats, and Rambouillet wether sheep slightly more than 2 yr of age. Two animals of each type were randomly allocated to one of four pastures 9.3, 12.3, 4.6, and 1.2 ha in area. Forage conditions varied markedly among pastures. The experiment was conducted in the summer with three periods, 30, 26, and 26 days in length. Energy expenditure (EE) was estimated from heart rate (HR) on pasture and EE:HR for each animal determined in a calorimetry system. A leg position/movement monitoring system and a GPS collar with position and movement sensors were used to estimate distance traveled and time spent grazing/eating, resting while lying, resting while standing, and walking without grazing/eating. EE attributable to activity (EE_a%), expressed as a percentage of the ME requirement for maintenance plus activity in confinement, was determined based on total EE, BW, and ADG. Forage mass in the different pastures and periods ranged from 2801 to 8672 kg/h. ADG was similar among animal types (-4, 30, -1, and 8 g for Angora goats, Boer goats, Spanish goats, and sheep, respectively; SE = 8.2). Distance traveled was affected by an interaction ($P < 0.05$) between animal type and period (Angora goats: 2.98, 2.33, and 2.47; Boer goats: 3.17, 3.46, and 2.68; Spanish goats: 2.85, 5.28, and 3.30; sheep: 3.04, 3.43, and 2.25 km in periods 1, 2, and 3, respectively (SE = 0.423)). Time spent grazing was lowest among animal types ($P < 0.05$) for Angora goats (4.3, 8.4, 7.8, and 6.8 h/day) and time spent walking without grazing was lower ($P < 0.05$) for Angora goats and sheep than for Boer goats (1.7, 2.4, 2.1, and 1.2 h/day for Angora goats, Boer goats, Spanish goats, and sheep, respectively). Total EE was affected by an interaction ($P < 0.05$) between animal type and period (Angora goats: 5.89, 5.55, and 5.16; Boer goats: 9.63, 10.92, and 8.55; Spanish goats: 6.73, 8.17, and 7.02; sheep: 12.54, 11.84, and 12.93 MJ/day in periods 1, 2, and 3, respectively (SE = 0.442)). EE_a% was affected by an interaction ($P < 0.05$) between animal type and period (Angora goats: 15.7, 17.4, and 15.1; Boer goats: 59.7, 67.4, and 34.4; Spanish goats: 46.2, 61.7, and 41.6; sheep: 22.3, 11.8, and 21.9% in periods 1, 2, and 3, respectively (SE = 6.07)). EE_a% of goats was predicted with moderate accuracy (R^2 = 0.40-0.41) and without bias from estimates of 5.79 and 5.05%/h spent grazing/eating and grazing/eating plus walking, respectively, determined in a companion experiment; however, these methods were not suitable for sheep.

Effect of somatic cell count in goat milk on yield, sensory quality and fatty acid profile of semi-hard cheese

Chen, S. X., J. Z. Wang, J. S. Van Kessel, F. Z. Ren, and S. S. Zeng

Journal of Dairy Science 93:1345-1354. 2010

This study investigated the effect of somatic cell count (SCC) in goat milk on yield, free fatty acid (FFA) profile, and sensory quality of semi-soft cheese. Sixty Alpine goats without evidence of clinical mastitis were assigned to three groups with milk SCC level of <500,000 (Low), 500,000-1,000,000 (Medium), and 1,000,000-1,500,000 (High) cells/mL. Thirty kilograms of goat milk with mean SCC levels of 410,000 (Low), 770,000 (Medium), and 1,250,000 cells/mL (High) was obtained for the manufacture of semi-soft cheese for two consecutive weeks in three lactation stages. The composition of milk was analyzed and cheese yield was recorded on day 1. Cheese samples on day 1, 60, and 120 were analyzed for scores of total sensory, flavor, body/texture by a panel of three expert judges, and FFA. Results indicated that the milk composition did not change when milk SCC varied from 214,000 to 1,450,000 cells/mL. Milk with higher SCC had a lower standard plate count while Coliform count and psychrotrophic bacteria count were not affected. However, milk components (fat, protein, lactose, casein and total solid) among three groups were similar. As a result, no significant differences in the yield of semi-soft goat cheeses were detected. However, scores of total sensory and body/texture for cheeses made from the high SCC milk were lower than those from the low and medium SCC milk. The difference in milk SCC levels also resulted in diverse changes in cheese texture (hardness, springiness, etc.) and FFA profiles. Individual and total FFA increased significantly during the ripening, regardless the SCC levels. It is concluded that SCC in goat milk did not affect the yield of semi-soft cheese, but resulted in inferior sensory quality of aged cheeses.

Feeding behavior of goats

Goetsch, A. L., T. A. Gipson, A. R. Askar, and R. Puchala

Journal of Animal Science 88:361-374. 2010

Factors influencing feeding behavior of goats include grazing management practices, type of vegetation and season, breed and stage of production, group size, and properties of diets fed in confinement. Considerable information has been gathered from visual observation during daylight. However, there are now tools available to characterize feeding behavior of goats while grazing and in confinement throughout the day. Global positioning system collars can be used to assess horizontal and vertical distances traveled, up or down position of the head, and movement within pasture or rangeland areas. A commercially available leg activity monitor allows estimation of the number of steps and time spent standing, lying, and moving rapidly without grazing. However, these measurements do not directly determine grazing. Therefore, prediction equations based on visual observation must be developed. Classification tree analysis is a robust method in developing these equations because the decision tree can be pruned or expanded to provide the best fit. Another equipment system determines time spent eating, ruminating, and idle from pattern of jaw movement. In addition to use of *n*-alkanes as internal markers to estimate digestibility, their profile can provide an indication of botanical composition of the selected diet. Automated feeding systems for confined goats permit determinations such as number of feeder visits and meals, eating time, and rate and pattern of feed intake. Heart rate measured while goats are in normal production settings can be used to predict total energy expenditure through multiplication by energy expenditure per heart beat of individual animals. To partition the activity energy cost, an estimate of ME intake or measures of change in body energy status and milk energy yield are needed to determine other sources of heat to be subtracted from total energy expenditure. These methods create opportunity to gain a fuller understanding of factors influencing feeding behavior of goats and relationships with levels and efficiencies of production.

Effects and interactions of origin of sheep in Ethiopia (Highland vs Lowland areas), feeding, and lengths of rest and feeding on harvest measures

Merera, C., G. Abebe, A. Sebsibe, and A. L. Goetsch

Journal of Applied Animal Research 37:33-42. 2010

Yearling sheep from Highland (H) and Lowland (L) areas of Ethiopia were used to determine effects and interactions of animal origin, feeding, and lengths of rest and feeding on harvest measures. The fat-tail indigenous H sheep used is thought to be an Arsi-Bale genotype, and the fat-rump indigenous L sheep genotype was the Black Head Ogaden. Ten sheep of each origin were rested for 1, 2, or 3 days (R1, R2, and R3, respectively) after arrival at the abattoir and before slaughter, with ad libitum availability of grass hay and water and an overnight fast preceding slaughter. Eighteen to 20 sheep of each origin were subjected to feeding periods 2, 4, or 6 wk in length (F2, F4, and F6, respectively), during which time grass hay was consumed ad libitum and a concentrate supplement was provided at 200 g/day per animal (dry matter basis). There was an interaction ($P<0.05$) between origin and the linear effect of feeding period length in average daily gain, with a much greater value for H-F2 compared with other treatments (209, 120, 125, 118, 90, and 113 g/day for H-F2, H-F4, H-F6, L-F2, L-F4, and L-F6, respectively). Hot carcass weight increased linearly with increasing length of rest ($P<0.05$), with a tendency ($P<0.09$) for greater change for H vs L animals, and the effect ($P<0.05$) of feeding vs rest tended ($P<0.16$) to be greater for H sheep (8.09, 8.34, 8.73, 7.88, 8.19, 8.02, 9.08, 8.54, 9.13, 8.17, 8.03, and 8.57 kg for H-R1, H-R2, H-R3, L-R1, L-R2, L-R3, H-F2, H-F4, H-F6, L-F2, L-F4, and L-F6, respectively). There were no appreciable treatment effects on carcass pH or instrumental color measures. In conclusion, there is considerable opportunity to increase carcass weight of H by use of periods of rest after arrival at the abattoir and before slaughter longer than 1 day. Moreover, a short period of feeding, such as 2 wk, can be employed with H to markedly increase carcass weight.

Effects of stage of lactation and dietary concentrate level on energy utilization by Alpine dairy goats

Tovar-Luna, I., R. Puchala, T. Sahlu, H. C. Freetly, and A. L. Goetsch

Journal of Dairy Science 93:4818-4828. 2010

Twenty-four lactating and 13 nonlactating Alpine goats were used to determine effects of stage of lactation and dietary concentrate level on energy utilization. Diets 60 or 20% concentrate (60%C and 20%C, respectively) were consumed ad libitum by lactating animals and at a level of intake near maintenance by nonlactating animals. Measurement periods were d 25 to 31 (E), 87 to 94 (M), and 176 to 183 (L) of lactation. The number of observations was 11 in E and M for each diet and 8 and 7 in L for 60%C and 20%C, respectively. Efficiency of ME use for maintenance (66.9, 71.4, and 61.1%) and the maintenance ME requirement (479, 449, and 521 kJ/kg $BW^{0.75}$ for E, M, and L, respectively) determined with nonlactating animals differed among stages of lactation. The efficiency of ME use for maintenance was similar between diets, but the maintenance requirement tended to be greater for 60%C than for 20%C (504 vs. 463 kJ/kg $BW^{0.75}$). The latter difference may have involved greater ME intake for 60%C, resulting in a slightly greater difference between ME intake and total heat energy for 60%C vs. 20%C (11 vs. -8 kJ/kg $BW^{0.75}$). Intake of ME by lactating goats was greater for 60%C than for 20%C (18.6 vs. 16.3 MJ/d). Recovered energy in lactation from mobilized tissue tended to be greater for 60%C than for 20%C (8.44 vs. 6.55 MJ/d) and differed among stages of lactation (2.60, 1.59, and 1.13 MJ/d in E, M, and L, respectively). Recovered energy in tissue gain was similar among stages of lactation and between diets and not different from 0. Efficiency of use of dietary ME for lactation differed among stages of lactation (59.5, 51.9, and 65.4% for E, M, and L, respectively) and tended to be greater for 60%C than for 20%C (64.2 vs. 54.9%). The efficiency of use of dietary ME for maintenance and lactation was similar among stages of lactation and greater for 60%C vs. 20%C (64.3 vs. 60.9%). Predicted milk yield from National Research Council requirements was reasonably accurate. In conclusion, there may be limitations in use of data of nonlactating goats to study energy utilization for maintenance in lactation. Efficiency of energy use by lactating dairy goats consuming diets high in concentrate appears greater than with diets low in concentrate. Despite differences in nutrient requirement expressions, observations of this study support National Research Council recommendations of energy requirements of lactating dairy goats.

Effects of stage of lactation and level of feed intake on energy utilization by Alpine dairy goats

Tovar-Luna, I., R. Puchala, T. Sahlu, H. C. Freetly, and A. L. Goetsch

Journal of Dairy Science 93:4829-4837. 2010

Thirty-six lactating Alpine does were used to determine effects of stage of lactation and level of feed intake on energy utilization. Twelve does were assigned to measurement periods in early, mid-, and late lactation (wk 5, 13, and 27, respectively). For six does of each group, after ad libitum consumption of a 60% concentrate diet feed intake was restricted to near the ME requirement for maintenance (ME_m) for 8 d followed by fasting for 4 d. Fasting was immediately after ad libitum consumption for other does. Intake of ME was similar among stages of lactation with ad libitum intake (22.1, 22.1, and 19.8 kJ/d, respectively). The efficiency of ME utilization for maintenance determined with does fed near ME_m averaged 81%. Fasting heat energy was greater with ad libitum vs. near ME_m consumption (368 vs. 326 kJ/kg $BW^{0.75}$) and was numerically lowest among stages in late lactation with near ME_m intake (334, 350, and 295 kJ/kg $BW^{0.75}$) and ad libitum consumption (386, 384, and 333 kJ/kg $BW^{0.75}$ in early, mid-, and late lactation, respectively). The efficiency of use of dietary ME for lactation was greater for consumption near ME_m than for ad libitum intake (67.9 vs. 58.6%) and with ad libitum consumption tended to decrease with advancing stage of lactation (63.9, 57.3, and 54.5% for early, mid-, and late lactation, respectively). Estimated ME_m was greater with ad libitum than near ME_m intake and was lowest during late lactation (429, 432, and 358 kJkg $BW^{0.75}$ with near ME_m intake, and 494, 471, and 399 kJ/kg $BW^{0.75}$ with ad libitum consumption in early, mid-, and late lactation, respectively). Although, because of increasing BW as the experiment progressed, ME_m in MJ/d was similar among stages of lactation with both levels of intake. The efficiency of ME use for maintenance and lactation was similar among stages of lactation and greater with intake near ME_m than ad libitum (77.1 vs. 67.7%). In conclusion, the ME_m requirement in kJ/kg $BW^{0.75}$ of does in late lactation was less than in early and mid-lactation. There was marked effect of restricted feed intake subsequent to ad libitum consumption on estimates of efficiency of energy use for maintenance and lactation compared with use of nonlactating animals. Level of feed intake can have substantial effect on estimates of energy utilization by lactating dairy goats.

Effects of small ruminant type and restricted protein intake on metabolism

Asmare, A., R. Puchala, K. Tesfai, G. Detweiler , L. Dawson, A. Askar, Z. Wang, and A. Goetsch

Small Ruminant Research (In press). 2011

Boer goat (BG), Spanish goat (SG), and Rambouillet sheep (RS) wethers, ≥ 2 yr of age, were used in a crossover experiment with 28-day periods. Diets were ad libitum consumption of wheat straw alone (CON) or with a 90% soybean meal, 10% molasses supplement given at 0.22% BW (SBM). Initial BW was 35, 55, and 32 kg for BG, RS, and SG, respectively. NDF digestibility was similar among animal types and between diets. BW change tended to be lowest for RS (-92, -158, and -107 g/day for BG, RS, and SG, respectively; SE = 22.6). ME intake was similar among animal types (244, 230, and 259 kJ/kg $BW^{0.75}$ for BG, RS, and SG, respectively; SE = 16.6) and greater ($P < 0.05$) for SBM vs. CON (320 vs. 168 kJ/kg $BW^{0.75}$). Total energy expenditure (EE) was greater ($P < 0.05$) for RS than for BG (362, 415, and 402 kJ/kg $BW^{0.75}$ for BG, RS, and SG, respectively) and for SBM vs. CON (413 vs. 374 kJ/kg $BW^{0.75}$). EE by the portal-drained viscera (PDV) (1.34, 1.33, and 1.17 MJ/day; SE = 0.122) and liver (1.48, 1.44, and 1.32 MJ/day; SE = 0.133) was similar among animal types. Liver EE was greater ($P < 0.05$) for SBM vs. CON (1.60 vs. 1.22 MJ/day), but PDV EE was similar between diets. Net fluxes of ammonia N (AMN) and urea N (UN) across the PDV (AMN: 3.4, 2.4, and 3.2 g/day (SE = 0.69); UN: -5.2, -3.3, and -4.6 g/day (SE = 1.19)) and liver (AMN: -3.6, -3.2, and -4.3 g/day (SE = 0.78); UN: 7.6, 4.8, and 4.2 g/day for BG, RS, and SG, respectively (SE = 1.17)) were similar among animal types. In conclusion, the magnitude of any difference in N recycling among animal types was less than necessary to affect fiber digestibility. Nonetheless, some findings suggest a lesser ability of sheep to modify metabolic functions to cope with limited nutritional planes elicited by feeding crop residue-based diets, perhaps relating to metabolism by extra-splanchnic tissues.

Factors affecting goat meat production and quality

Goetsch, A. L., R. C. Merkel, and T. A. Gipson

Small Ruminant Research (In press). 2011

Deposition of relatively less subcutaneous fat by goats than sheep adversely affects storage properties of meat, most importantly dehydration and cold-shortening. High concentrate diets increase internal and carcass fat in goats, including intramuscular fat though levels are less than in cattle or sheep. Levels of saturated and monounsaturated fatty acids are greater in goats consuming concentrate in confinement compared with rangeland grazing. Because the botanical composition of the diet selected by goats is more reflective of plant species available compared with cattle and sheep, changes in the botanical and chemical composition with high vs. low stocking rate or as forage mass declines with increasing stocking rate should be smaller compared with cattle and sheep, with greatest differences when browse plant species are available. The magnitude of effect of castration on carcass fatness varies considerably with plane of nutrition, although some gender comparisons have not considered stage of maturity. Limited nutrient intake maximizes lean tissue accretion and minimizes fat deposition regardless of gender. Pre-weaning growth rate is greater for single-kid litters compared with kids of multiple births depending on factors influencing milk production. Concentrate supplementation should increase pre-weaning growth when milk yield is low regardless of litter size but not with moderate-high milk yield when concentrate substitutes for milk. Genetic variability in performance traits is considerable and has been the target of various breed improvement and crossbreeding programs. Breed and genotype differences in carcass traits also exist; however, few improvement programs have included these traits in selection objectives.

Factors affecting goat milk production and quality

Goetsch, A. L., S. Zeng, and T. A. Gipson

Small Ruminant Research (In press). 2011

Differences between production systems based on grazing and browsing vs. use of harvested feedstuffs in confinement largely depend on specific feedstuffs and plants available and being consumed. Low forage nutrient ingestion should have relatively greater impact on tissue mobilization than milk production in early than later periods of lactation, with a transition to proportionally greater change in milk production in late lactation. However, low body condition at kidding would limit tissue energy mobilization and restrict impact of level of nutrient intake to milk yield and, likewise, tissue mobilization would be less with one vs. two or three milkings per day. As lactation advances after freshening, fat and protein levels decrease with increasing milk yield, and when production declines in mid- to late lactation, fat and protein concentrations increase. Milk production generally peaks at a parity of 3 or 4, thereafter declining slowly. Elevated somatic cell count alone in dairy goats is not a valid indication of mammary infection. Extended lactations offer opportunities to minimize or avoid seasonal fluctuations in milk production and lessen production costs. If differences in performance between suckled and machine-milked dairy goats occur, they may be restricted to or of greater magnitude during the suckling period compared with post-weaning, and differences in milk yield will either be absent or less with one kid compared with greater litter sizes. The magnitude of effects of milking frequency on milk yield is less for goats of low vs. high production potential and with low vs. high diet quality. Likewise, the effect of milking frequency is greater in early and mid-lactation when yield is higher than in late lactation, along with a shorter period of peak production with one vs. two daily milkings. Physical form of the diet can affect production and composition of goat milk, although effects appear of smaller magnitude than in dairy cattle. When tissue is mobilized to support milk production in early lactation, levels of C18:0 and C18:1 *cis* in milk increase and levels of medium-chain fatty acids decline. Effects of elevated levels of dietary fatty acids on specific long-chain fatty acids in milk and milk products vary with the fatty acid profile of fat sources used.

Change in behavior of goat producers after on-line training in health practices

Merkel, R., and T. Gipson

Small Ruminant Research (In press). 2011

In 2006, Langston University (Oklahoma, USA) unveiled an on-line training and certification program for meat goat producers (http://www2.luresext.edu/training/qa.html). The program consists of 22 learning modules, including herd health, biosecurity and internal parasite control. In March 2010, an electronic survey was sent to 160 certified producers to assess impact of the training. Fifty-four surveys were completed for a response rate of 33.7%. Prior to certification, 52.8% of respondents used selective deworming criteria. Current deworming practices and percentage of responses include: FAMACHA, 43; visual condition, 28; pasture rotation-based, 15; and calendar-based, 14 (χ^2=19.02, P<0.001). When asked if individual animals or all animals in a pasture or pen received anthelmintic when deworming, 76% of respondents said that only animals requiring deworming received anthelmintic (χ^2=14.52, P<0.001). The dosage of dewormer given was most often calculated based upon table guidelines given in the certification course (54%), vs. 35% who relied on veterinarian instructions and 11% who self-determined dosage amounts (χ^2=18.22, P<0.001). Over 60% of respondents reported that prior to becoming certified they did not consult a veterinarian for use of drugs extra label. When asked how current withdrawal times for drugs not approved for goats are determined, 41% of responses reported using veterinarian instructions with an identical percentage using table guidelines from the certification course; with 19% of responses using information from the internet (χ^2=7.32, P<0.03). Results of the survey show changes in behavior of certified goat producers when compared with previous practices in anthelmintic usage. More emphasis on the importance of veterinarian approval for lawful use of extra-label drug is needed. Changes in production practices noted imply that an on-line training course can be effective in promoting proper herd health practices for goat producers.

Effects of feed restriction and realimentation on mohair fiber growth and tissue gain by growing Angora goats

Puchala, R., A. K. Patra, G. Animut, T. Sahlu, and A. L. Goetsch

Livestock Science (In press). 2011

Angora wethers (48), approximately 6 months of age and 15.7 kg initial BW (SEM = 0.38), were used to determine the effects of the level of feed intake and realimentation on mohair fiber growth and tissue gain. There were two 12 weeks phases in which dehydrated alfalfa pellets (18% CP and 48% NDF, DM basis) were fed. In phase 1, feed amounts were intended to provide ME adequate for 0, 15, 30, 45, 60, and 75 g/day of tissue (non-fiber) gain and 0, 1.5, 3.0, 4.5, 6.0, and 7.5 g/day of clean mohair fiber growth, respectively (L1, L2, L3, L4, L5, and L6, respectively), although actual levels were slightly greater; intake was ad libitum in phase 2. DM intake in both phases increased linearly (P < 0.05) with increasing level of feed offered from 0.48 to 1.00 kg/day in phase 1 and 1.08 to 1.48 kg/day in phase 2. Tissue gain increased linearly (P < 005) with increasing level of feed offered in phase 1 from 15.3 to 72.1 g/day and decreased slightly in phase 2 from 105.6 to 97.0 g/day. Greasy mohair fiber growth was not affected by treatment in phase 1 (6.31, 6.18, 6.85, 7.14, 7.07, and 6.47 g/day; SEM = 0.431) or 2 (6.59, 6.67, 6.52, 7.21, 7.69, and 6.64 g/day for L1, L2, L3, L4, L5, and L6, respectively; SEM = 0.349). During the entire experiment, mohair fiber growth relative to DM intake decreased linearly (P < 0.05) from 8.40 to 5.37 g/kg with increasing level of feeding in phase 1. Mohair fiber diameter increased linearly (P < 0.05) from 22.4 to 23.8 μm in phase 1 and 25.4 to 27.1 μm in phase 2. Digestibility of DM components and energy utilization were determined once per phase. Digestibility of OM was similar among treatments in phase 1, whereas values in phase 2 increased linearly (P < 0.05) from 68.0 to 73.4% as the level of feed offered in phase 1 increased. Assuming the requirements of 37.2 and 157 kJ/g of tissue and clean mohair fiber gain, ME used for maintenance (ME_m) in phase 1 was not affected by treatment. In phase 2, ME_m was greater than in phase 1 (mean = 431 kJ/kg $BW^{0.75}$) and increased linearly (P < 0.05) as the level of feed offered in phase 1 increased (551, 599, 647, 765, 788, and 902 kJ/kg $BW^{0.75}$ for L1, L2, L3, L4, L5, and L6, respectively; SEM = 97.5). The phase difference and unrealistically high values for some treatments may have resulted from a greater requirement than assumed for tissue gain in phase 2. This may have been because levels of fat and energy in tissue gained was greater in phase 2 than 1 and increased in phase 2 as the level of feed offered in phase 1 increased. In summary, with levels of intake above maintenance, growing Angora goats partition nutrients to mohair fiber growth at the expense of tissue gain. Realimentation likewise does not affect mohair fiber growth but can increase tissue gain, the magnitude of which depends on the severity of previous intake restriction.

Effects of level of feeding on energy utilization by Angora goats

Tovar-Luna, I., R. Puchala, T. Sahlu, H. C. Freetly, and A. L. Goetsch

Journal of Animal Science 89:142-149. 2011

Twelve mature Angora does were used in a replicated 3 × 3 Latin square to determine effects of feeding level on energy utilization. Fiber growth and change in tissue (non-fiber) mass were determined in the first 4 wk of 6-wk periods, preceded by 14 or 18 d of adaptation. Determination of ME intake and gas exchange measures occurred in wk 4, followed by feeding near maintenance then fasting in wk 5 and 6 to determine the ME requirement for maintenance (ME_m). A 60% concentrate diet was fed at levels to approximate 100, 125, and 150% of assumed ME_m (L, M, and H, respectively). Digestibilities and diet ME/GE were not affected by treatment with different levels of offered feed and subsequent intake near ME_m. Heat energy (HE) during fasting (261, 241, and 259 kJ/kg $BW^{0.75}$; SEM = 8.7) and efficiency of ME use for maintenance (71.6, 69.6, and 69.2%; SEM = 2.29) were similar among treatments, although ME_m differed ($P < 0.04$) between M and H (365, 344, and 377 kJ/kg $BW^{0.75}$ for L, M, and H%, respectively; SEM = 10.3). Tissue gain was lower ($P < 0.01$) for L than for the mean of M and H (-0.6, 23.7, and 29.8 g/d), although clean fiber growth only tended ($P < 0.09$) to differ between L and the mean of M and H (5.60, 6.57, and 7.36 g/d for L, M, and H, respectively; SEM = 0.621). Intake of ME was greater ($P < 0.01$) for the mean of M and H than for L (6.87, 8.22, and 8.41 MJ/d for L, M, and H, respectively). Total HE was lower ($P < 0.02$) for L vs. the mean of M and H and tended ($P < 0.07$) to be greater for H than for M (6.03, 6.31, and 6.77 MJ/d); mobilized tissue energy was low but greater ($P < 0.02$) for L vs. the mean of M and H (0.16, 0.01, and 0.04 MJ/d for L, M, and H, respectively). Efficiency of ME use for fiber growth was similar among treatments (17.2, 16.3, and 17.7% for L, M, and H, respectively; SEM = 1.61). In conclusion, efficiency of ME use for fiber growth was similar to the NRC recommendation regardless of feeding level, although ME_m was lower perhaps because of experimental conditions employed. Energy appeared partitioned to fiber growth, but preferential usage was not complete possibly because energy metabolism for tissue accretion reached a plateau with the highest feeding level.

Effect of proteolysis and calcium equilibrium of natural cheddar cheese during ripening and the resultant processed cheese on functional properties

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Journal of Food Engineering and Physical Properties (In press). 2011

The changes in proteolysis, calcium (Ca) equilibrium and functional properties of natural Cheddar cheeses during ripening and the resulted processed cheeses were investigated. For natural Cheddar cheeses, the majority of the changes in pH 4.6 soluble nitrogen as a percentage of total nitrogen (pH 4.6 SN/TN) and the soluble Ca content occurred in the first 90 d of ripening, and subsequently the changes were slight. During ripening, functional properties of natural Cheddar cheeses changed, i.e., , hardness decreased, meltablity was improved, storage modulus at 70°C (G'T=70) decreased and the maxmium tan delta (TDmax) increased. Both pH 4.6 SN/TN and the soluble Ca were correlated with changes in functional properties of natural Cheddar cheeses during ripening. Kendall's partial correlation analysis indicated that pH 4.6 SN/TN was more significantly correlated with changes in hardness and TDmax. For processed cheeses manufactured from natural Cheddar cheeses with different ripening times, the soluble Ca content did not show significant difference and the trends of changes in hardness, meltability, G'T=70 and TDmax were similar to those of natural Cheddar cheeses. Kendall's partial correlation analysis suggested that only pH 4.6 SN/TN was significantly correlated with the changes in functional properties of processed cheeses.

Sensory profile and Beijing youth preference of seven cheese varieties

Zhang, X. Y., H. Y. Guo, L. Zhao, W. F. Sun, S. S. Zeng, X. M. Lu, X. Cao, and F. Z. Ren

Food Quality and Preference 22:101-1009. 2011

The sensory characteristics that determined consumer preference for seven imported cheeses were investigated. Descriptive sensory analysis was performed by seven trained assessors penalists? who used 17 descriptors to quantitatively describe the flavors of these cheeses. In parallel, 268 Beijing teenagers expressed their preference for the cheeses on a nine-point hedonic scale. Descriptive sensory data were analyzed using principal component analysis to determine the relationships between cheeses and sensory attributes. Significant differences were found between the cheeses ($P<0.05$) on the first two principal components??? accounting for 81% of the experimental variance. Hierarchical cluster analysis of the preference data identified seven consumer segments with different preferences and showed that there existed a potential market for each of the cheeses. Descriptive and consumer-preference data were related using external preference mapping and the sensory characteristics of cheeses preferred by the consumer segments were identified. Overall, most Chinese teenagers preferred cheeses with a mild flavor such as “milky”, “sweet”, or “soured milk”, and disliked cheeses with a “salty” “nutty” “umami” “toasted” or “bitter” character.

Visiting Scholars (2010/2011)

DDr. Ignacio Tovar-Luna
Native of Mexico
Research Projects: The Grazing Activity Energy Cost of Goats (BIO11-001-005) and Effects of Gender and Age on the Maintenance Energy Requirement of Boer Goats
Experiments: ITL-08-01, ITL-08-06

Dr. Liping Wu
Native of China
Research Project: Impact of Sub-Clinical Mastitis on Production and Quality of Goat Milk and Cheese (OKLXSTEVEZ-ENG2007)

Ms. Rulan Shangguan
Native of China
Research Project: Impact of Sub-Clinical Mastitis on Production and Quality of Goat Milk and Cheese (OKLXSTEVEZ-ENG2007)
Experiment: RS-09-04

Dr. Rongzhen Zhong
Native of China
Research Project: Effects of Selected Nutritional Components on Immunity to *Haemonchus* in Goats
Experiments: ZW-10-02, ZW-10-06, RZ-10-10, RZ-11-03

Dr. Abdelhafid Keli
Native of Morocco
Research Project: Management of lactating Alpine goats to minimize internal parasitism and the activity energy cost
Experiment: AK-09-11

Ms. Amanda Manley
Research Project: Boer Goat Selection for Residual Feed Intake
Experiments: AM-10-07, AM-10-09, AM-11-04

Dr. Taher Shujaa
Native of Iraq
Research Projects: Effects of Supplementation on Selectivity of Forage Components by Yearling Meat Goat Doelings and Effects of the Number of Animals Per Pen and Time of Automated Feeder Access on Feed Intake, Efficiency of Feed Utilization, and Feeding Behavior by Yearling Spanish Wethers
Experiments: IR6-11-01, IR3-11-02

Mr. Abdullah Nuaman
Native of Iraq
Research Project: Effects of Supplementation on Selectivity of Forage Components by Yearling Meat Goat Doelings
Experiment: IR6-11-01

Mr. Ahmed Mohammed
Native of Iraq
Research Project: Effects of the Number of Animals Per Pen and Time of Automated Feeder Access on Feed Intake, Efficiency of Feed Utilization, and Feeding Behavior by Yearling Spanish Wethers
Experiment: IR3-11-02

Meat Goat Herd Health Procedures and Prevention

Dr. Lionel Dawson
Oklahoma State University

Introduction

The goal of a herd health program is to improve the goat herd's productivity through general husbandry, nutrition, parasite control, vaccination, and environmental management. An understanding of various management practices and common diseases on the farm is necessary to accomplish this goal. An effective herd health program is an essential part of a successful goat management program. Good feeding and breeding will not result in maximum production if goats are not kept in good health. Conversely, good nutrition and herd management will greatly reduce the complexity and cost of the herd health program.

Herd health programs are always described in very general terms and then modified to fit individual herds. The exact makeup of any program depends on the herd size, purpose of having the herd, and the production goals of the owner. For the most part, goats are managed as small groups of five to a hundred animals per herd. There are relatively very few large commercial goat herds with numbers above 500 head in the United States. Large herds may have problems associated with high density of animals and continuous turn over. Small herds tend to have higher nonproductive/productive ratios than do larger herds. This is because small herd owners often keep animals that would normally be culled in large commercial herds. Often, the net result is the maintenance of animals with chronic illnesses that may serve as reservoirs of disease.

Since each herd is different, each owner should work with his/her veterinarian to create an individual herd health plan. Keep good records for each animal regarding medications, vaccinations, dewormers, diseases, breeding, culling etc., and use this information to plan your herd health program. Preventive medicine is usually less expensive than treating the disease as the highest economic returns are realized when disease problems are at a minimum. Many diseases have similar symptoms and a producer should work with a veterinarian familiar with common goat diseases. A veterinarian familiar with goats has the training and experience needed to provide diagnosis and recommend animal health products used in goats to treat these conditions.

Common Herd Health Procedures

In the normal course of herd health management it will be necessary to perform different herd health procedures. Some of these procedures are performed to collect information on an animal's condition that can be relayed to a veterinarian. Others are needed in the course of disease prevention or treatment. A producer should only attempt those procedures in which they feel comfortable and sufficiently proficient so that no harm can come to the animal. If there is any doubt, consult a veterinarian. The most common procedures done by producers are listed below with a brief explanation of correct methods.

Taking temperature – rectally

The first procedure usually performed on an animal suspected to be ill is to take its temperature. In goats, this is performed rectally. Either a digital or mercury thermometer can be used. Plastic digital thermometers do not break and may be considered as safer to use than a mercury thermometer. A small amount of lubricant may be put on the thermometer and it should be inserted with a twisting motion. A normal goat's temperature should be 103 - 104ºF (39 - 40ºC).

Pulse or heart rate

There are several places on the goat where the pulse or heartbeat can be felt and measured. Heartbeat can be felt by placing one's fingertips between the ribs behind the elbow. Pulse can be measured using the femoral artery on the inside of the rear leg roughly ⅓ of the way down. Pulse may also be detected by placing the index and middle fingers on the artery located below and slightly inside of the jaw roughly two-thirds to the rear of the muzzle. A normal range is 70 to 90 beats per minute.

Respiration

Respiration is detected by watching movement of the flank or chest. A normal range is 12 to 20 per minute.

Rumen movements

Adequate rumen function is essential for a goat's health. One sign of adequate function is regular ruminal movement. This can be detected by placing the hand on the left flank of the animal. If the rumen feels soft and water-filled this should be noted and reported to your veterinarian. Rumen contractions should be easily felt and should occur 1-2 times per minute.

Checking mucous membranes

Paleness of the mucous membranes in the mouth (gums), vagina and prepuce can be an indicator that the animal is in hypovolemic shock, meaning that there is a decrease in the blood volume circulating in the animal. The color of the conjunctiva around the eyes can be an indicator of anemia that could be caused by a heavy internal parasite burden. Roll down the lower eyelid to look at the color. A pale, whitish color indicates anemia. This color can be scored using the FAMACHA system which is described in the section on Parasites of Goats. Remember that irritation of any type causes membranes to turn red. This means that an anemic goat with pinkeye may still have red membranes.

Drenching and dosing

Drenching or dosing an animal entails the oral administration of a liquid. The obvious goal of this procedure is to ensure that the animal swallows the full amount given. Grasp the animal under the jaw to raise its head. Raising the head of the animal will assist in ensuring the liquid is swallowed. A finger or thumb can be put into the mouth where there are no teeth (goats lack canine teeth as do all ruminants) to assist in opening the mouth for the drenching equipment. Generally a bottle with a tube over the end or a drenching gun is used. Liquids should be given slowly to allow time for the animal to swallow. Dewormers must be given using appropriate drenching equipment ensuring that they are given over the back of the tongue and swallowed.

Tubing an animal

In some cases it may be necessary to pass a tube down the mouth directly into the stomach in order to administer a large volume of a liquid. This could also be used to feed a young animal incapable of nursing or to either sample rumen contents or insert rumen contents into an animal having severe digestive problems. The size of the tube passed should be appropriate for the animal's size. Generally, a ½ to ¾ inch (1 to 2 cm) diameter tube should be used for adult goats. A short metal or PVC pipe (speculum) larger in diameter than the tube to be inserted is placed in the mouth to prevent the goat from biting or chewing the plastic tube. Some people prefer to use a "Harp" speculum instead. The hard-sided tube or speculum is inserted into the mouth of the goat and holds their mouth open while you pass the tube. The plastic tube is then passed down the throat and into the stomach. Administer liquids slowly. Have a veterinarian or person trained in this technique instruct you before attempting it the first time.

The procedure for tubing a neonatal kid is similar to that for adult animals with a few distinctions. For kids, one does not need to use a PVC tube or speculum. The size tube used is smaller for baby goats (12 to 14 French or roughly ¼ inch inner diameter). The tube should be flexible without any hard edges to harm the kid's mouth or throat. Hold the kid's mouth open and pass the tube gently over the hump or base of the tongue at the back of the mouth and into the stomach.

There are some precautions to take in tubing an animal to ensure that liquids are not inadvertently administered into the lung. The first precaution is to always hold the goat's head in its normal flexed position. If you extend the head and throat, your tube has a straight shot down the trachea. When doing this, preferably have the goat standing. As the tube is inserted, watch and feel the throat area. The tube needs to enter the esophagus and not the trachea or windpipe. The esophagus is a smooth, flexible tube leading to the stomach and one can feel or see the stomach tube sliding downwards. The trachea is a rigid tube and the stomach tube can neither be seen nor felt from outside the animal. When the tube is in the esophagus, feel the bottom of the neck. You should feel "two tubes." One will be the trachea and the other will be the rigid tube inside the esophagus.

Another check can be done while midway down the trachea/esophagus is to suck on the end of the tube. If you are in the esophagus, it will collapse on the tube and you will create a vacuum. Alternatively, blow in the tube and you will see a bolus of air go down the esophagus. If using a stethoscope applied to the goat's rumen on the left side of the body, you will hear air bubbling. Sucking on the tube while it is in the rigid walled trachea will not create a vacuum. One can also check for the smell of rumen fluid to ensure correct placement. To ensure proper depth of penetration, place the tube along the outside of the animal stretching from the mouth to the last rib, a point that would be inside the stomach, and put a mark on the tube. Use this as a guide when inserting the tube. Never rely on the goat coughing as a guide to proper tube placement. It is not a reliable test.

Bolus administration - "Balling"

A "balling gun" is used to administration tablets or boluses to an animal. A balling gun has a holder for the tablet in the end and a plunger to expel the tablet into the throat. Large boluses should be lubricated with vegetable or mineral oil for easier swallowing. Pass the balling gun over the hump of the tongue and press the plunger while holding and tilting the goat's head upwards. Ensure the tablet is swallowed by holding the mouth shut. Stroking the throat can also elicit a swallowing reflex.

Be very gentle in placing the balling gun into the mouth and expelling the pill. The tissues of the throat are very delicate and pills and guns have sharp edges. This can result in serious damage to your goat or minimally a goat with a very sore throat that will not eat. Newer model balling guns have soft plastic heads that reduce the potential for injury.

Paste administration

Dewormers, rumen pastes, and the like may come in a tube and are given through the use of an instrument resembling a caulking gun. Hold the animal as described for "balling," insert the end of the tube into the mouth and squeeze the handle the correct number of "clicks" to deliver an appropriate dose. Again, holding the goat's mouth shut will assist in swallowing.

Giving injections

Administering drugs via injection is a common herd health procedure routinely practiced by almost all producers. Following proper guidelines for each type of injection and using proper equipment will ensure that injections are done correctly and inflict minimum stress on an animal. Proper sanitation will ensure that you don't inject bacteria into your goat and cause an infection. Dirty needles and syringes should never be

used. Using needles and syringes on multiple animals can transmit disease. After making six to ten injections with a needle it will be dull and should be changed and disposed of properly.

Needle selection

Proper injection technique includes selection of an appropriate size syringe and needle. Syringes should have volume markers that would ensure administration of the correct amount of drug. Needle gauge should be considered as it relates to injection type and thickness or viscosity of drug. In general, 18 to 20 gauge needles (as gauge number increases, needle diameter decreases) are sufficient.

Proper injection sites

Live animals are considered unprocessed food, especially if those goats are intended for slaughter and later used in the food chain. Injection site lesions should be a major product quality concern for goat producers raising goats for meat. Injection-site defects are lesions or scars found in cuts of meat that result from tissue irritation caused by the administration of intramuscular or sometimes subcutaneous injections. In addition to the scarred tissue, tenderness of the meat is also significantly reduced in the affected area surrounding the site. Proper injection sites are described for each type of injection described.

Common injection methods

The three most common injection methods are subcutaneous (SQ, under the skin), intramuscular (IM, in the muscle), and intravenous (IV, into a blood vessel, usually the jugular vein). Subcutaneous injections are the easiest to give and intravenous the most difficult. Whenever a drug or vaccine lists SQ as an option for injection use the SQ route. Only experienced personnel should attempt to give an intravenous injection and professional assistance should be used in most instances. Intravenous injections provide the fastest absorption of a drug by the animal while subcutaneous the slowest.

Subcutaneous injections

To inject subcutaneously, pull up a pinch of skin making a tent. Insert the needle into the tent taking care not to pierce through the other side. Depress the plunger slowly. Injecting with the needle pointing towards the ground will lessen the likelihood of the material leaking out of the hole left by the needle. Massage the injected area. If administering large amounts of a drug, over 3 milliliters (ml or cc), it is best to divide the dose among two or more sites not giving more than 2 or 3 cc per site. The preferred site for SQ injections is the skin just behind the elbow, although they can also be given in the triangular area in front of the shoulders between the top and bottom of the shoulder blade and corner of the jaw. Vaccines often cause swellings or "knots" and a knot behind the elbow indicates an injection site whereas a knot in the neck in front of the shoulder could possibly be confused with a caseous lymphadenitis abscess.

Intramuscular

An intramuscular injection calls for the needle to be inserted into a muscle. Intramuscular injections are commonly given in the triangular area of the neck, in front of the shoulder. Do not give intramuscular injections in the loin or hind leg of goats that are used for meat purposes to prevent injection site blemishes from occurring that lowers the value of the meat. Volume given in the muscle should not be more than 3 ml per site.

After inserting the needle, pull back on the plunger slightly to make sure a blood vessel has not been penetrated. Administer the drug slowly. If a blood vessel has been pierced, the needle can be withdrawn slightly, repositioned, and checked again. Never give an injection near the spine to prevent accidentally causing nerve damage.

Intravenous

An intravenous injection requires skill to locate a vein, usually the jugular vein in the neck, insert the needle, and ensure that the needle remains in the vessel while the drug is given. Prior to attempting this, it is best to receive training from a veterinarian. Animals may react quickly to drugs given in this fashion due to rapid absorption. Very few drugs need to be given intravenously; however, blood samples often need to be collected and the technique is the same. The easiest approach is to have someone straddle the goat to hold it securely. The holder will elevate the goat's head up and to the side. If you have clippers, clip all of the hair off the bottom third of the neck. Feel for the trachea on the neck and move towards the top of the neck. The area between the trachea and the muscles of the neck is the "jugular groove" and is where the jugular vein lies. Put pressure at the bottom of the groove and you will see the groove swell from your finger up to the jaw of the goat. The vein is now filled with blood. Using an 18 to 20 gauge needle, direct it at an angle of 45 degrees then stab through the skin. Pull back on your syringe and see if there is blood present. If not, adjust the depth (deeper or more shallow) or move up or down the side of the groove until blood is obtained.

When you are injecting drugs IV, it is important to ensure that all of the drug enters the vein. Give the drug slowly. The jugular vein will take the administered drug straight to the heart and at high concentrations many drugs can cause problems with the heart. IV drugs given around the vein instead of in the vein can cause an irritation or inflammation of the vein.

Minor Surgical Procedures

Castration

Males not wanted as replacement bucks should be castrated. Castration can be done by various mean as early as between 2 to 4 weeks of age. There are several methods of castration and the method selected will depend upon the age of the animal. The most common methods are elastrator band, Burdizzo® or other clamp, or surgical methods. General sanitation and vaccination precautions should be followed. Additional information on castration procedures can be found in the Meat Goat Management section.

Some producers may delay castration until bucks are 2 to 3 months of age. This may lessen the incidence of urinary calculi or bladder stones (see the Goat Diseases section) in animals on a high grain or concentrate diet. Also, remember that intact bucks have high levels of testosterone which acts as a growth promotant and stimulates the production of lean muscle mass. Many goat meat consumers that eat young goats do not care if the meat comes from intact or castrated males. There are some ethnic markets that actually prefer meat from mature bucks. Know the market in your area. The point being that if it is not necessary to castrate goats for marketing purposes, then don't. However for breeding purposes realize that some bucks are fertile and ready to breed by 3 months of age and unwanted males should be castrated or separated from fertile females. In most climates photoperiod effects keep this from being a practical problem until kids are 9 to 12 months of age. In general, castration at an early age is the normal practice to reduce shock to the animal. Older animals should receive some type of anesthesia prior to castration and a veterinarian consulted.

Dehorning

Most meat goat producers will elect not to dehorn their goats. If the decision is made to raise goats without horns then kids should be disbudded in the first two weeks of life. Buck kid horns grow faster than doe horns. Some large single buck kids should be disbudded within the first week after birth. Disbudding a buck kid is the true test of proficiency of the person doing the dehorning and many fail, judging by the number of scurs seen on adult bucks. If you try to disbud a buck kid whose horn base is wider than a regular disbudding iron, you will get regrowth of the horn in a crown outside the burned area. If you try to disbud a small kid with a wide calf dehorner, you may get regrowth of the horn from the center of the ring. If one person is

doing the job, a disbudding box offers the best and safest restraining device. Approximate dimensions are given the accompanying illustration.

The use of a local anesthetic is commonly advocated; however, the actual technique is not easy and the baby goat will scream while being held in preparation for a ring block or a cornual nerve block. One week old kids are small animals and cannot be given large doses of lidocaine or toxicity will result. A one week old kid should get no more then 1 cc total of lidocaine. One technique used is to dilute the lidocaine with distilled water allowing a larger volume to be injected into the locations shown below. Have a veterinarian administer the anesthetic or train you in the procedure.

Veterinarians typically use systemic anesthetics to anesthetize the goat for dehorning. The commonly used drugs are xylazine (Rompun) and ketamine (Vetalar). These can only be administered by a veterinarian.

The disbudding equipment most commonly used is an electric-heated metal rod with a hollowed-out end. Newer cordless, butane gas powered dehorners are available. Some disbudding irons have problems in maintaining a constant temperature, and it is extremely important to match temperature and time. Under-burning of the horn bud will result in scurs while over-burning will lead to brain damage or death. The horn buds can generally be felt in young kids to ensure proper location to burn. After the disbudding iron is hot, apply it firmly over the horn area and rock it around slowly for 3.5 to 4 seconds. Remove the iron and repeat if necessary and do the other side. Evaluate the success of the procedure by its appearance. The goal is to have the area look like "chrome tanned leather." Black color represents burned hair and is indicative of inadequate burning. Clipping the site prior to burning will eliminate the problem of burned hair. Scent glands are located near the base of the horn and descenting could be done at the same time if desired. Inject the kids with 150 IU tetanus antitoxin. Although the risk of tetanus after disbudding is not great, it is a good practice to administer tetanus antitoxin.

An alternate disbudding method is the use of a caustic paste. The hair around the horn bud should be clipped and the paste applied. A ring of petroleum jelly around the horn bud may help prevent the paste from burning other skin tissue. Caustic paste sounds more benign than burning horn tissue; however, the paste has a bad habit of causing chemical burns on other parts of the goat or on his/her pen mates. To use caustic paste, make sure the kid is kept by itself so that it doesn't rub the chemical on the udder of its mother or the faces of its friends (not practical with most meat goat kids) and that it is kept out of the rain so that rain water doesn't wash the chemical into the goat's eyes.

Lancing abscesses

Goats get a variety of swellings or "knots" at various locations on their bodies. Some of these are cysts (fluid filled structures) and some of these are abscesses (puss filled structures). There is a disease of goats called caseous lymphadenitis (CL) that causes abscesses in the lymph nodes of goats. See the section on Meat Goat Herd Health - Common Diseases for more details.

One way of speeding the healing of an abscessed goat and of containing all of the infectious material from the abscesses is to lance it. This is usually a very simple and safe procedure. The first thing to do is be patient. Wait until the abscess comes to a "head." This is when the abscess is attached to the skin and the hair has begun to come off at the top of the abscess. The center of the abscess will soften. At this point, there are no vital blood vessels or other structures between the puss in the abscess and the outside of the goat.

Since pus is infectious to other animals and humans, wear gloves when performing this procedure. Remove any remaining hair from the region. Scrub the area with disinfectant soap (Betadine Scrub®) and restrain the goat. If this is done correctly it is not a painful procedure for the goat. Take a pinch of skin in the center of the abscess with your gloved hand or a surgical tool (such as a towel clamp) and stab a scalpel or sharp, sterilized knife blade deeply into the abscess and cut out a circle of skin. Just slashing the abscess

Recommended needle sizes and lengths used in goats			
Age	Gauge	Needle length	
		Intramuscular injection	Subcutaneous injection
< 4 weeks old	20	½ inch	½ inch
4 to 16 weeks	20	⅝ to ¾ inch	½ inch
4 to 6 months	20	1 inch	½ inch
> 6 months	18 to 20	1 inch	½ inch

may allow the cut to seal over before the abscess has healed from the inside out. There will be some white, or greenish white, odorless puss come out of hole created in the abscess. Catch it in a disposable bag and dispose of it where other goats can't get into it. Caseous lymphadenitis is a contagious disease. It is also a zoonotic disease, meaning it can be transmitted to humans, so wear gloves and sanitize your hands and equipment used after this procedure.

After lancing the abscess flush the area with diluted Betadine Solution® (10:1, 10 parts water to 1 part solution) to flush out any residual puss or bacteria. Make sure you keep the goat away from other goats until the lesion has completely healed.

Normal Range for Goat Physiological Parameters

Temperature, rectal	103–104° F (39–40° C)
Heart rate	70–90 beats per minute
Respiration	12–20 per minute
Rumen movements	1–2 per minute
Puberty	4–10 months
Estrous cycle	21 days
Estrus (standing heat)	12–48 hours
Gestation	150 days

Extra-Label Drug Use

There are few drugs for use in goats that have Food and Drug Administration (FDA) approval. Administering any drug not specifically labeled for use in goats or any product, either prescription or over the counter, that is not used as directed on the label is considered "Extra-label" or "off-label" drug use. Only veterinarians may prescribe or use products "off-label" or "Extra-label" provided they have a valid veterinarian - client - patient relationship (VCPR) with the producer.

The issue of "extra label" use also applies to feed medications not approved for use in goats. While extra-label use of medications in or on animal feed is prohibited, in 2001 the FDA provided guidance on extra-label use of medicated feeds in minor species such as goats. In brief, extra-label use of medicated feed in minor species is limited to treatment of animals whose health is suffering or is threatened or whose death may result from failure to treat. If medicated feed is to be used in a food producing minor species, the product used must be approved for use in a food producing major species. The FDA discourages use of medicated feed in an extra-label manner for improving rates of weight gain, feed efficiency, or other production purposes.

Most goat producers are unaware that they do NOT have "extra-label" drug use privileges. Only veterinarians who have established a VCPR with a particular client may prescribe or use drugs in an extra-label

manner on that client's animals if the animal health is threatened and suffering or death may result from failure to treat. To establish a VCPR, the veterinarian should have visited the farm, and have a thorough knowledge of the management of these animals, or has recently seen the animal to be treated. Once a VCPR has been established, the veterinarian may use drugs in an extra-label manner provided that the client has agreed to follow his or her recommendations.

Three conditions of extra-label drug use:

1. The veterinarian has examined the animal(s) in question recently and has made a diagnosis and a determination that products with proper labeling will not work in this instance.
2. The client has been instructed by the veterinarian in the proper use and administration of the product, a withdrawal period has been determined, and the client is willing to follow the instructions given by the veterinarian.
3. The veterinarian is available to respond to any adverse reaction or follow up examination and treatment that may occur to the animal due to the administration of the drug or failure of the drug to work.

FDA criteria for Using Pharmaceuticals Extra-Label

The FDA has also established five criteria that must be met before any drug may be used in a food-producing animal in a manner different from that product's label.

1. The veterinarian must first examine the animal and assumes responsibility for making clinical decisions regarding the health and treatment of the animal within the guidelines of a VCPR. Often a goat owner will not have the animal examined by a veterinarian, but will telephone a veterinarian, who may never have visited the farm, with a list of symptoms and ask for a recommended treatment. This does not qualify as VCPR!
2. The second criterion requires that the veterinarian determine there is no marketed drug specifically labeled to treat the diagnosed condition, or that the recommended dosage on the label for that product is clinically ineffective. Since there are few drugs labeled for use in goats, it is not difficult to determine whether or not there is a legally licensed product available.
3. The third criterion requires that the individual animals to be treated are clearly identified, and that accurate records be maintained regarding the treatment of those specific individuals. If there is no permanent identification such as an ear tag, notch, or tattoo, the owner must make some effort to identify the treated animals with a visible temporary mark by using temporary tags or paint. If possible, these animals should be isolated. Records on animals and treatment must be kept for future reference to avoid any drug residues in the meat or milk.
4. The fourth criterion requires that a significantly extended time period be assigned for drug withdrawal prior to marketing meat or milk from treated animals. The owner must keep accurate records of the treatment, namely the person treating this animal, date, route of administration, product used and a proper withdrawal period. Proper withdrawal period can be obtained from your veterinarian. Veterinarians can access drug information at the Food Animal Residue Avoidance Databank, http://www.farad/org.
5. Many goat owners casually treat their animals and do not keep proper records of animals treated, drugs used, or proper withdrawal period for that product. If no information is available to establish a withdrawal time, then the treated animal or animal products such as milk and meat are permanently barred from the human food chain. This is to prevent illegal drug residues in products for human consumption. Although there are no drug residue test kits marketed specifically for goat meat, owners should be aware that drug residue testing is conducted on milk and meat produced for human consumption.

6. The last criterion details the information that must be listed on the drug dispensed for extra-label use. The label should include the name and address of the veterinarian, the established name of the drug(s), and the specific directions for use including: dosage, routes of administration, frequency of treatment, duration of therapy, cautionary statements, and the withdrawal time for any food that might be derived from the treated animal.

Ten Drug Use Tips

The following drug use tips can help ensure the proper administration of drugs and adherence to proper withdrawal times. All producers should restrict access to drugs to prevent indiscriminate or improper use. Remember that animal health products can be human health hazards.

1. Read the label carefully – labeling directions change frequently.
2. Use drugs only in animal species listed on the label or follow the "extra label" directions of a veterinarian.
3. Use the proper dose for the size of animal to be treated – overdosing can cause illegal residues.
4. Calculate pre-slaughter drug withdrawal times accurately – determine pre-slaughter withdrawal and milk discard times from the latest drug administration.
5. Use the correct route of administration – giving drugs incorrectly can lead to drug ineffectiveness, adverse reactions, illegal residues, and possible animal deaths.
6. Do not "double dose" – use of the same drug in the feed and by injection can cause illegal residues.
7. Select needle size and injection sites carefully, if injections are necessary – misuse can lead to tissue damage, reduced effectiveness, and/or illegal residues.
8. Allow proper withdrawal times for feed containing drugs – during the withdrawal time ensure that storage bins and feed are completely free of medicated feed and feed only drug-free feed or illegal residues may result.
9. Keep accurate records of drugs used and animals dosed – poor records can be costly if drug residue violations occur.
10. Seek the advice of your veterinarian – your records will allow him/her to provide safer and more effective treatment and save you money by preventing illegal residues.

For a complete explanation of all the precautions you need to take in using any particular drug or feed medication, first consult the drug label or feed tag. If you have any questions about the proper use of any drugs, see your veterinarian.

Medications Commonly Used in Goats and Approximate Withdrawal Times

The following tables list medications commonly used in goats with their dosages and estimated withdrawal times (WDT). These tables are adapted with permission from the author Dr. Seyedmehdi Mobini of Fort Valley State University, Fort Valley, GA, from a paper that appeared in the proceedings of the Georgia Veterinary Medical Association Food Animal Conference in 2003. These recommendations were formulated by Dr. Mobini through a review of the literature in the United States and foreign countries, recommendations of the Food Animal Residue Avoidance Databank (FARAD), and personal experience. For many of the drugs mentioned, FARAD has calculated a Withdrawal Interval (WDI) to distinguish from the regulatory and approved WDT. The WDI is based on foreign drug approvals or extrapolations based on available tissue residue and/or related pharmacokinetic data on these drugs. In some cases, there is insufficient or no pharmacokinetic data from which FARAD can derive a WDI for goats. In those instances, FARAD has relied on sheep or cattle data and then added a scientifically-based time period to extend beyond the approved WDT to ensure safety as well as compliance with the Animal Medicinal Drug Use and Clarification Act of 1994 (AMDUCA).

Finally, the reader should be aware that there are several drugs which may be approved for specific species at a specific dose and route of administration, but are PROHIBITED FROM EXTRA-LABEL USE in any major or minor food animal species. These include Fluoroquinolones/Enrofloxacin (Baytril) and Phenylbutazone (Dairy). Other drugs are PROHIBITED FOR USE UNDER ANY CONDITION IN ANY ANIMAL THAT WILL BE USED FOR HUMAN FOOD. These drugs are: Dipyrone, Clenbuterol, Nitrofurazones, Nitrofurans (Furacin), Nitroimidazole (Metronidazole, Dimetridazole, Ipronidazole), Diethylstilbesterol, Glycopeptides (Vancomycin) and Chloramphenicol.

Herd Health at Different Production Stages

Goats have different health needs according to their stage of production. Providing for these health needs will increase your chances of having a healthy, productive herd.

Pre-breeding

Breeding does

Thirty to sixty days before the breeding season does should be examined for their udder and teat conformation, dentition (teeth), musculo-skeletal problems, and feet and body condition. Culling decisions should be made. Some common conditions seen in does include lameness, chronic mastitis, bad teats, and poor body condition due to a chronic disease, parasitism, old age, or other cause. Doelings should be at least 65 to 70% of their mature weight before their first breeding.

Prebreeding vaccination for *Chlamydia* should always be given. *Leptospirosis* and *Campylobacter* are less common causes of reproductive failure and abortion and vaccinations may be done, if the disease is present. Monitor fecal egg counts and deworm if needed. Does can be supplemented (flushed) with grain 2 to 4 weeks before breeding this will improve their fecundity (number of kids born per doe). Abrupt fence line exposure to bucks in the late transition period in the fall when does can begin to come into heat can help bring about cycling.

Breeding bucks

Bucks are too often neglected and omitted from herd health management practices. Some of the common conditions seen in bucks are urinary calculi (stones), lameness, urine scalding around the prepuce, and front leg injury due to a dominant buck in the pen. In the case of urinary scald, wash the affected area. Application of petroleum jelly can help protect the affected areas. Maintain a 2:1 ratio of dietary calcium to phosphorous and provide a high level of salt (up to 4%) and 1 to 2% ammonium chloride in the diet to prevent urinary calculi. Bucks should be vaccinated at the same time as the does and for the same diseases. Body condition and breeding soundness should be evaluated at least 4 weeks before the breeding season and adjustments made to prevent bucks from becoming overly thin or obese. As breeding season approaches, extremely aggressive and dominant bucks may need to be penned separated to prevent injury. Monitor fecal egg counts in bucks or FAMACHA score and deworm as needed.

Breeding Season

Watch does and bucks carefully during the breeding season. This is a particularly strenuous time for bucks. Lame or sick bucks will not be able to breed adequate numbers of does. Fertility is drastically decreased by hot weather. Do everything you can to cool the buck off. This may include shade and fans during the day in very hot climates.

Gestation

Pre-parturition

A kid health and management program should actually begin prior to parturition with attention to the nutritional needs of the gestating doe in late lactation and during the dry period. An adequate diet for dry does is essential to produce healthy kids. Pregnant does should be fed to have a good body condition (score of 3.0 to 3.5 just prior to kidding). Does should be scored in early pregnancy and again six weeks prior to kidding. Remember that most fetal growth occurs in the last one-third of gestation and feed quantity and quality may need to be increased during this time. Clean, cool water and free choice trace-mineralized salt should be available.

Booster vaccinations for Clostridium perfringens C and D and tetanus toxoid should be given not less than 3 weeks prior to kidding. Vitamin E/selenium injections may be given during the dry period to prevent white muscle disease in kids, especially in areas where soils are selenium deficient and supplementation is inadequate. However, a nutrition program designed to provide adequate dietary selenium is preferable to providing injections. Provide other vaccinations or boosters for diseases causing abortion. Monitor fecal egg counts or FAMACHA score and deworm as needed.

Parturition (kidding)

While most meat goat does kid on pasture, there may be times when animals are brought indoors for kidding. The doe should kid in a clean environment; either a well-drained clean pasture or a stall bedded with straw or other absorbent material. The kid prior to birth has been existing in a germ-free environment and parturition represents exposure to common disease organisms to which the mature animal has developed resistance. The kidding stall or pasture should be located near a well-traveled area so that the doe can be frequently observed for kidding difficulties. Few adult does require assistance at the time of kidding though problems are always a possibility. First-freshening does should be closely watched, especially if bred to bucks known to sire large kids.

Signs of impending kidding include udder engorgement, swelling of the vulva, restlessness, and mucous discharge. The ligaments in the pelvic area will relax and the udder secretion's will change from clear honey-like to thick white milk (colostrum). The doe may also lose appetite. There are three stages of parturition. Stage 1 consists of uterine contraction and cervical dilation. This stage may last from three to six hours or more. The water bag ruptures at the end of this stage. Abdominal contractions will occur in Stage 2 and the fetus should be born within one hour. If the doe is having to provide undue straining or birth is delayed then examination and assistance may be needed; particularly if the doe is straining hard for 15 minutes or more. A veterinarian may need to be called. Stage 3 consists of expulsion of the placenta and usually occurs within a few hours after the last fetus is born.

Problems in parturition

Most does will kid with little to no assistance required; however, problems can occur. Many of these problems revolve around either incorrect presentation of the fetus or a kid that is to large for the mother's pelvis. In a normal birth presentation the forefeet will enter the birth canal first, the hooves will be pointed downwards, and the head will be between the legs. Another presentation that is sometimes seen that usually causes little problem is when the rear legs enter the birth canal first. In this case, the kid's hooves will be pointed upwards. Abnormal presentations include the rump first (breech) or any of the legs or the head bent backwards. In these cases, assistance is required.

When assisting birth, it is important to clean the area around the vulva with disinfectant soap and warm water and to have clean hands. Wear gloves. There are certain diseases that can be transmitted to humans during this time period. Pregnant women should not assist with the kidding process. Lubricate the hand prior

to entering the vagina. Feel and identify the parts of the kid. Try to ensure that all body parts felt belong to the same kid and not to two separate bodies. If you feel only one leg or no legs at all, reach further and try to determine the exact position of the fetus. Arrange the legs and/or head gently in a proper position for birth. The fetus may have to be pushed forward towards the doe's head until a leg can be grasped and repositioned. Once the limbs are in a proper position, the kid should be gently pulled out and downwards using only your hands. Clear the mouth and nasal passages of the kid with straw or a towel and ensure it is breathing. Rubbing the body with a piece of cloth can sometimes stimulate breathing. Never pull on any presentation other than a normal presentation of two front legs and a head or a presentation of two hind legs and a tail. Pulling on any other arrangement of limbs and body parts will only make the problem worse.

If the anticipated kidding problems appear severe, call for a veterinarian immediately.

Kid management at birth

At birth two management practices are critical to the future health and survival of the newborn kid. The navel cord should be dipped in a solution of tincture of iodine (7% iodine solution) to prevent entry of disease-causing organisms through the navel cord and directly into the body of the kid. Make sure the entire cord is immersed in the iodine solution. If necessary, a long navel cord can be cut to 3 or 4 inches in length. Dipping the cord in iodine not only prevents entry of organisms but promotes rapid drying and the eventual breaking away of the cord from the navel.

Another critical practice is the feeding of colostrum as soon after birth as possible. The colostrum, or first milk, contains antibodies, which the doe does not pass to the fetal kid in the womb. Consumption of colostrum must occur as early as possible, ideally within 2-4 hours of birth. At 24 hours after birth there is a rapid reduction in the permeability of the intestinal wall to colostral antibodies. If a newborn kid does not or cannot nurse, the colostrum should be bottle-fed or the kid should be tube fed to insure adequate consumption. Excess colostrum can be frozen for use in orphan or bonus kids. Recent research indicates that disease organisms, especially caprine arthritis encephalitis (CAE), may pass from doe to kid through milk and transmission might be avoided through the use of extra colostrum frozen from does tested and shown to be CAE-free or by feeding pasteurized colostrum. CAE is not considered to be a problem on most meat goat farms.

Kids should receive colostrum equal to 10% of their body weight during the first 24 hours of life. For example a six pound kid (96 ounces) should receive 10 ounces (roughly 300 ml) of colostrum within 24 hours of birth. This should be divided into at least 3 feedings. If fresh or frozen goat colostrum is not available, a commercial goat, sheep or cow colostrum replacement could be used. Fresh cow colostrum may also be used if necessary.

Under certain conditions newborn kids may benefit from injections of vitamins A and D approximately four days after birth. An iron dextran injection can be given but care is needed as iron is potentially toxic. A vitamin E/selenium injection may be beneficial in areas of selenium-deficient soils. These injections should be planned with your veterinarian as part of your herd health calendar. In general injection of vitamins and minerals is not necessary. If supplementation is necessary it is done more safely by dietary supplements. Realize that the fat soluble vitamins and minerals are toxic if given in excess.

Kids should be checked carefully at birth for any physical deformities or abnormalities. Pneumonia is a major killer of young kids. A clean, dry, draft-free environment is an excellent preventative measure.

Artificial raising of kids

Milk is the principal component of the diet of the pre-weaning kid. Most meat goat kids will nurse their dam until weaning. However, for orphaned kids or for kids of does that have lactation problems it may be necessary to use a milk replacer. Goat milk replacers are commercially available. If necessary, a lamb milk

replacer may be used as a substitute for goat milk. Typical lamb milk replacers contain 22 to 24 % protein and 28 to 30% fat (on a dry matter basis). If no other milk replacer is available whole cows milk or calf milk replacers can be used. Maintaining milk replacer quality after mixing is particularly important when kids are fed ad libitum (all they can consume).

Milk can be fed by using bottles, pails, or self-feeder units. The method chosen will depend upon such factors as the size of the herd and available labor, as well as personnel preference. With any system, the health of the kid, sanitation, and available labor are the major factors to consider.

Under natural suckling, kids consume small amounts of milk at very frequent intervals. Ideally, artificial rearing should mimic natural suckling but the constraint of available labor precludes frequent feeding. Nevertheless, kids should be fed 4 to 5 times daily for the first and second week and 2 to 3 times daily thereafter. Bottle feeding is more labor intensive but kids receive more individual attention and are easier to handle post-weaning than kids that are allowed to suckle does. Pail or pan feeding may reduce labor somewhat but bodyweight loss and need for extra "training sessions" at the beginning must be expected.

For larger herds, self-feeder units such as a "lamb bar" may successfully reduce labor. The key to use of the system is the maintenance of a low temperature of the milk (40°F) that will limit intake by the kid at any one time. Small, frequent feedings increase digestibility and decrease digestive disturbances. Rapid consumption of large quantities of milk may lead to fatal bloat due to entry of milk into the reticulo-rumen. Rapid passage of milk through the abomasum and small intestines can result in diarrhea or nutritional scours.

The biggest problem with kids bottle fed lamb milk replacer occurs with the feeding schedule. Frequently kids become "pets" and there is a tendency to feed them as much milk as they will consume each feeding. Unfortunately, this may result in bloat and sudden death due to enterotoxemia or diarrhea. A restricted feeding schedule and amount is necessary.

Feeding schedule and amount for bottle fed kids.

Age	Amount of Fluid/Feeding	Feeding Schedule
1 to 3 days	4 ounces	5 times a day
3 days to 2 weeks	8 to 12 ounces	4 times a day
2 weeks to 3 months	16 ounces	3 times a day
3 months to 4 months	16 ounces	2 times a day

Dam raised kids

Most meat goat kids will be raised with their dams on pasture. While this removes the need for feeding milk replacer, these kids should not be forgotten in terms of nutritional and health needs. Producers must remember that since these kids are raised in the same environment as their dams, they are also exposed to the same health, disease, management, and grazing conditions. If internal parasites are a problem in the dams, expect the same in the kids and take management steps to reduce exposure to internal parasites through pasture rotation or other means. Crowding should be avoided and, if housed at any time, clean bedding and adequate ventilation are a must. Kids are naturally curious and will begin nibbling on items in their surroundings early in life. If there are toxic substances or plants, plastic, or other harmful materials lying about chances are some kids will eat them. If pasture is of very poor quality, kids beginning to nibble on grass or hay will not receive much nutritional benefit. This can slow down early growth.

Medications Commonly Used in Goats and Approximate Withdrawal Times

Dr. Seyedmehdi Mobini, Georgia Small Ruminant Research & Extension Center, Fort Valley State University, Fort Valley, GA

The drugs listed in this table are commonly used in goats. There are only a few drugs approved by the FDA to be used in goats. ***Use of drugs listed as "extra-label" is legal only if prescribed by your veterinarian in the context of a valid client-patient relationship.*** The withdrawal times for various drugs were compiled from different sources. The listed dosages and withdrawal times, as well as drug status and legality of use, is subject to change. Your veterinarian will prescribe the latest, most up-to-date drugs, dosages, and provide the correct withdrawal period. ***Consult your veterinarian before beginning any treatment!***

I. Antibiotics:	**Brand Name**	**Approval**	**Dosage**	**Route**	**Frequency**	**Withdrawal Time**	
						Meat	Milk
Ceftiofur	Naxcel®	APPROVED	0.5-1 mg/lb	IM	Once a day	0 days	0 days
Neomycin	Biosol® and other products	APPROVED	5 mg/lb	PO	Twice a day	3 days	NA
Amoxicillin	Amoxi-inject®	extra-label	5 mg/lb	SQ	Once a day	26 days	120 hours
Ampicillin	Polyflex®	extra-label	5 mg/lb	SQ	Once a day	10 days	72 hours
Benzathine Pen G	Pen BP-48®	extra-label	20,000 IU/lb	SQ	Every 48 hours	30 days	NA
Erythromycin	Erythro-200®	extra-label	1 mg/lb	SQ	Once a day	5 days	96 hours
Florfenicol	Nuflor®	extra-label	9 mg/lb	IM	Every 48 hours	28 days	120 hours
Oxytetracycline	LA-200®	extra-label	9 mg/lb	SQ	Every 48 hours	29 days	144 hours
Procaine Pen. G	Crysticillin®	extra-label	10,000-20,000 IU/lb	SQ	Once a day	16-21 days	120 hours
Sulfadimethoxine	Albon®	extra-label	25 mg/lb Day 1, 12.5 mg/lb Days 2 - 5	PO	Once a day	12 days	5 days
		EXTRA-LABEL USE IS PROHIBITED IN LACTATING DAIRY COWS. DO NOT USE IN LACTATING DAIRY DOES.					
Tylosin	Tylan®-200	extra-label	10 mg/lb	IM	Once a day	30 days	96 hours
Chloramphenicol	Chloramphenicol	EXTRA-LABEL USE IS PROHIBITED					
Enrofloxacin	Baytril® 100	EXTRA-LABEL USE IS PROHIBITED					
Furacin, nitrofurantoin	Furox®	EXTRA-LABEL USE IS PROHIBITED					
Gentamicin	Gentocin®	DO NOT USE					
Tilmicosin	Micotil®	DO NOT USE – TOXIC TO GOATS					

II. Anti-inflammatory Drugs:	Brand Name	Approval	Dosage	Route	Frequency	Withdrawal Time	
						Meat	Milk
Aspirin	Aspirin	extra-label	100 mg/kg	PO	Once a day	1 day	24 hours
Flunixin meglumine	Banamine®	extra-label	1.1-2.2mg/kg	IV or IM	Once a day	10 days	72 hours
Phenylbutazone	Bute	extra-label	10-20 mg/kg	PO	Once a day	60 days	DNU
		DO NOT USE IN LACTATING ANIMALS					
Dipyrone	Dipyrone	EXTRA-LABEL USE IS PROHIBITED					

III. Prevention of Coccidiosis:	Brand Name	Approval	Dosage	Withdrawal Time	
				Meat	Milk
Decoquinate	Deccox®	APPROVED	13-91 gm/ton of feed	0 days	24 hours suggested minimum, DNU
Monensin	Rumensin®	APPROVED	15-20 gms/ton of feed	0 days	96 hours suggested minimum, DNU
Amprolium	Corid®	extra-label	25-50 mg/kg BW in feed or water	2 days	48 hours
Lasalocid	Bovatec®	extra-label	20-30 gms/ton of feed	0 days	24 hours

IV. Anthelmintics:	Brand Name	Approval	Dosage	Route	Withdrawal Time	
					Meat	Milk
1. Avermectins:						
Doramectin	Dectomax®	extra-label	0.3 mg/kg	SQ	56 days	40 days
Eprinomectin	Eprinex®	extra-label	0.5 mg/kg	PO	NA	NA
Ivermectin	Ivomec® Drench	extra-label	0.3 mg/kg	PO	14 days	9 days
Ivermectin	Ivomec® 1%	extra-label	0.3 mg/kg	SQ	56 days	50 days
Moxidectin	Quest®, Cydectin®	extra-label	0.5 mg/kg	PO	23 days	56 days
	Cydectin® drench	extra-label	0.3 mg/kg	PO	14 days	NA
	Cydectin® Injectable	extra-label	0.2 mg/kg	SQ	30 days	DNU

2. Benzimidazoles:						
Albendazole	Valbazen®	extra-label	10 mg/kg	PO	7 days	120 hours
Fenbendazole	Panacur®/ Safeguard®	APPROVED at 5 mg/ Kg, extra-label as recommended	10 mg/kg	PO	14 days	120 hours
Oxfendazole	Synanthic®	extra-label	10 mg/kg	PO	14 days	120 hours
3. Cholinergic Agonists:						
Morantel Tartrate	Rumatel®	APPROVED	10 mg/kg	PO	30 days	0 days
Levamisole	Levasole®	extra-label	8 mg/kg	PO	10 days	4 days

V. Anesthetics and Tranquilizers	**Brand Name**	**Approval**	**Dosage**	**Route**	**Withdrawal Time**	
					Meat	Milk
Ketamine	Ketaset®	extra-label	5-10 mg/kg	IV or IM	3 days	48 hours
Lidocaine	Lidocaine	extra-label	Variable for local anesthesia use, 1% in goats			
Thiamylal Na	Biotal	extra-label	10-20 mg/kg	IV	1 day	24 hours
Xylazine	Rompun®	extra-label	0.05-0.1 mg/kg	IV or IM	5 days	72 hours
Yohimbine	Yobin	extra-label	0.25 mg/kg	IV	7 days	72 hours

VI. Hormones:	**Brand Name**	**Approval**	**Dosage**	**Route**	**Withdrawal Time**	
					Meat	Milk
Cloprostenol	Estrumate®	extra-label	125 microgram	IM	0 days	0 days
Dexamethasone	Azium®	extra-label	20-25 mg	IM	14 days	4 days
Dinoprost	Lutalyse®	extra-label	5-10 mg	IM	1 day	24 hours
Oxytocin	Oxytocin	extra-label	10-20 IU	IM	0 days	0 days

VII. Electrolytes	**Brand Name**	**Approval**	**Dosage**	**Route**	**Withdrawal Time**	
					Meat	Milk
Calcium	Calcium borogluconate	extra-label	60 to 100 ml of 20 to 25% Solution	IV	0 days	0 days
Calcium	Calcuim gluconate	extra-label	50 to 100 ml 10 to 23% calcium ion solution	IV	0 days	0 days

NOTE: In the table above PO = oral administration; SQ = subcutaneous injection; IM = intramuscular injection; IV = intravenous injection. DNU = insufficient data available to make WDI estimation, this drug is not approved for lactating goats.

Early access to a creep feed or creep pasture containing lush, nutritious forage will benefit kids becoming accustomed to solid feed, the development of their gastrointestinal tract, and in their early growth. Entry into the area containing creep feed or pasture should be restricted to kids by fencing or gates that prevent the entry of adult animals.

Weaning

In raising goat kids, increases in size and weight are not the only measure of success. A well-formed skeleton and proper development of internal organs are often neglected when the emphasis is on rapid gains. Dry feed consumption is important in developing body capacity. By increasing body capacity, feed intake and digestion increase.

In bottle fed kids over two weeks of age, limiting daily milk consumption to about 48 ounces will encourage daily consumption of dry feed. No later than three to four weeks of age a goat/lamb creep feed, other suitable creep feed, or even a calf starter should be offered. As the hay and grain consumption increases, gradually reduce the milk being fed. When the kid is eating ¼ pound of grain per day plus some hay and is drinking water from a bucket, it is time for weaning. Research has shown that at two months of age a weaned kid has a reticulo-ruminal capacity 5 times as large as suckling kids of the same age.

Kids on pasture should be consuming forages such as pasture grass or hay by two weeks of age and grain within four. Careful attention needs be given to formulation of a concentrate supplement for the pre-weaning kid. Palatability is of primary concern. Molasses at the rate of 10% of the total dry matter, corn (preferably chopped or rolled) and whole or rolled oats make up the energy "core" of a good pre-weaning diet. Balance the crude protein needs by adding cottonseed or soybean meal or another high protein source. Though few studies with kids have been done, crude protein contents of the pre-weaning ration should be within the range of 14-18%. Ground alfalfa may be added at 5% or less to provide additional stimulation for reticulo-ruminal development.

Several factors need to be considered when making the decision as to weaning. The most important consideration is whether or not the average daily consumption of concentrate and forage is adequate for growth and development to continue in the absence of milk. Fixed weaning ages are less desirable than weight goals such as 2.0 to 2.5 times birth weight.

Vaccination Schedule for Meat Goats

Other disease preventive measures

Dam – 1 month prior to kidding

- CDT vaccine to help increase antibodies against enterotoxemia and tetanus in the colostrum. In areas deficient in Se and where supplementation is inadequate, BoSe® to raise selenium levels and prevent white muscle disease in kids and retained afterbirth in dam. Providing a proper mineral nutrition program to ensure adequate consumption of all minerals is preferable. Get local veterinary advice on selenium injections as the need and dosage level depend upon how much selenium is in the soil in the region, as well as on the dietary supplementation.

Kid – birth to first week

- BoSe® + vitamins A&D – use depends on soil in the region and the diet of the dam.

Kid – 3 weeks – begin coccidiosis prevention

- 4 and 8 weeks – CDT series.
- 4 to 8 weeks - BoSe® - repeat if in selenium deficient area.
- 6 to 8 weeks – begin monitoring for parasites and deworm as needed, especially if kid has access to outdoors.

Period	Time to Vaccinate	Disease	Booster
Kids	4 and 8 weeks of age.	C. perfringens C&D*. C. tetanus – toxoid.	Prebreeding.
	Between 8 and 12 weeks of age (single vaccination).	Contagious ecythma.	If a problem in herd.
	8 and 12 weeks of age.	Caseous lymphadenitis.	If a problem in herd.
	16 weeks of age.	Rabies.	Given if there is a rabies concern. Yearly booster.
Prebreeding			
Doelings and bucklings	60 and 30 days prior to breeding.	Chlamydia. Campylobacter. Leptospirosis.	If a problem in herd.
Does and bucks	30 days prior to breeding.	Chlamydia. Campylobacter. Leptospirosis. C. perfringens C&D*. C. tetanus - toxoid.	If a problem in herd.
Gestation			
Does	30 days prior to kidding.	C. perfringens C&D*. C. tetanus - toxoid.	

-8-way clostridials like Covexin 8 could be used instead of C. perfringens C, D &T.

Herd Health Calendar

A custom designed calendar is an excellent way to ensure the health of the herd is maintained. A calendar can be designed based upon your specific herd's production cycle. Consult with a veterinarian on the timing and need for vaccinations and other management procedures related to the health and well-being of your herd.

Planning Calendar for Meat Goat Herd Health

Stage	Suggested Health Practices	Additional Practices
Pre-breeding (30-60 days)	*Bucks* • Be aware of heat stress. • Breeding Soundness Evaluation done. • Vaccinate for Clostridium perfringens type C&D, plus Tetanus Toxoid. • Vaccinate for Chlamydia, Campylobacter and Leptospirosis, if necessary. • Trim feet. • Body Condition Score and adjust management accordingly. • Deworm based upon fecal egg counts or FAMACHA score. *Does* • Vaccinate for Chlamydia, Campylobacter, and Leptospira if necessary. • Vaccinate for Clostridium perfringens type C&D, plus Tetanus Toxoid. • Trim feet. • Body Condition Score and adjust management accordingly. • Deworm based upon fecal egg count or FAMACHA score at least two weeks before breeding. • Final cull of does based on production records, udders, feet, and type.	• Vitamin E and selenium given to does 30-45 days before breeding in selenium-deficient areas. • See Vaccination Schedule for Meat Goats • Put bucks next to doe pens. The "buck effect" will bring transitional does into heat.

Breeding	*Bucks* • Provide additional feed. • Be aware of heat stress, provide shade. *Does* • Observe for heat or use marking harness on bucks • If desired, check for pregnancy at 45-60 days with ultrasound.	• Make sure cats are not defecating in feed to prevent Toxoplasmosis. • Perform fecal egg count or check FAMACHA score and deworm if necessary. • Treat for flukes if a problem in the herd.
Pre-kidding (15-30 days)	*Does* • Booster Clostridium perfringens type C&D, plus Tetanus Toxoid. • Deworm based upon fecal egg counts or FAMACHA score. • Body Condition Score, adjust management accordingly • Watch for pregnancy toxemia.	• Perform fecal egg count or check FAMACHA score and deworm if necessary. • Begin to collect supplies for kidding.
Kidding	*Does* • Observe 3-5 times per day. • Assist if needed. *Kids* • Clip, dip, and strip: • Clip navel cord to 2-4”, • Dip navel in 7% iodine, • Strip small amount of milk to make sure teat ends are open.	

Nursing/Lactation	*Does* • Feed extra feed to does with multiple kids. *Kids* • Observe daily for signs of diarrhea or respiratory disease. • Vaccinate – Clostridium perfringens type C&D and Tetanus, revaccinate at four weeks after first injection. • Castrate males before three months of age. • Start creep feeding by two weeks of age.	• See Vaccination Schedule for Meat Goats
Weaning	• Weaning at three to five months or when marketed as young kids. • Check for internal parasites and deworm if needed.	• May want to use coccidiostat in creep feed and post-weaning feed.
Post-weaning/Drying	• About every four weeks, check for internal parasites and deworm as needed. • Reduce feed to does just before weaning. • May want to reduce water availability for a day or two after weaning.	

Goat Guideline for Anthelmintic Dosages (internal parasite dewormers) July 2006

Important --- Please read notes on the following page before using this chart

		Oral dosing. Note: 1 ml = 1 cc						Subcutaneous injection
		Valbazen Albendazole[1]	SafeGuard Fenbendazole[2]	Ivomec Ivermectin[3]	Levasole Levamisole[4]	Cydectin Pour-on Moxidectin[5]	Cydectin Drench Moxidectin[6]	Cydectin *Injectable* Moxidectin[7]
Animal Weight		20 mg/kg	10 mg/kg	0.4 mg/kg	12 mg/kg	0.5 mg/kg	0.3 mg/kg	0.2 mg/kg
lbs	kg	2 ml/ 25 lb	1.1 ml/ 25 lb	6 ml/ 25 lb	3 ml/ 25 lb	1.1 ml/25 lb	3.4 ml/25 lb	1 ml/ 110 lb
20	9.1	1.6	0.9	4.8	2.4	0.9	2.7	0.2
25	11.4	2.0	1.1	6.0	3.0	1.1	3.4	0.2
30	13.6	2.4	1.4	7.2	3.6	1.4	4.1	0.3
35	15.9	2.8	1.6	8.4	4.2	1.6	4.8	0.3
40	18.2	3.2	1.8	9.6	4.8	1.8	5.4	0.4
45	20.5	3.6	2.1	10.8	5.4	2.1	6.1	0.4
50	22.7	4.0	2.3	12.0	6.0	2.3	6.8	0.5
55	25.0	4.4	2.5	13.2	6.6	2.5	7.5	0.5
60	27.3	4.8	2.7	14.4	7.2	2.7	8.2	0.5
65	29.5	5.2	3.0	15.6	7.8	3.0	8.8	0.6
70	31.8	5.6	3.2	16.8	8.4	3.2	9.5	0.6
75	34.1	6.0	3.4	18.0	9.0	3.4	10.2	0.7
80	36.4	6.4	3.6	19.2	9.6	3.6	10.9	0.7
85	38.6	6.8	3.9	20.4	10.2	3.9	11.6	0.8
90	40.9	7.2	4.1	21.6	10.8	4.1	12.2	0.8
95	43.2	7.6	4.3	22.8	11.4	4.3	12.9	0.9
100	45.5	8.0	4.6	24.0	12.0	4.6	13.6	0.9
105	47.7	8.4	4.8	25.2	12.6	4.8	14.3	1.0
110	50.0	8.8	5.0	26.4	13.2	5.0	15.0	1.0
115	52.3	9.2	5.2	27.6	13.8	5.2	15.6	1.0
120	54.5	9.6	5.5	28.8	14.4	5.5	16.3	1.1
125	56.8	10.0	5.7	30.0	15.0	5.7	17.0	1.1
130	59.1	10.4	5.9	31.2	15.6	5.9	17.7	1.2
140	63.6	11.2	6.4	33.6	16.8	6.4	19.0	1.3
150	68.2	12.0	6.8	36.0	18.0	6.8	20.4	1.4

Footnotes:

1. **Valbazen** Suspension (11.36 % or 113.6 mg/ml): ***Do NOT use in pregnant does in the first trimester of pregnancy.*** Meat withdrawal time is 9 days and 7 days for milk (FARAD).
2. **Safe-Guard/ Panacur** Suspension (10% or 100 mg/ml): Approved in goats at 5 mg/kg with meat withdrawal time of 6 days and no withdrawal period for milk. Although the label dose in goats is 5 mg/kg, it is generally recognized that 10 mg/kg dosage is required for good efficacy. At 10 mg/kg dosage, meat withdrawal is 16 days and 4 days for milk (FARAD).
3. **Ivomec Sheep Drench** (0.08% or 0.8 mg/ml): Protect from light. Coughing may occur during and following drenching. Meat withdrawal time is 14 days (FARAD).
4. **Levasole Soluble Drench Powder (Sheep)**: Oral solution ONLY. To prepare use 1 packet (13 gm/11.7 gm active ingredient) dissolved in 262 ml [8.9 oz.] water (44.7 mg/ml) {or 52 gram packet dissolved in 1048 ml water [35.4 oz.].} NOTE: This is different dilution from the label directions for administration. Meat withdrawal time is 4 days (FARAD).
5. **Cydectin Pour-on for cattle** (0.5% or 5 mg/ml): Meat withdrawal time is 23 days. ***Not for use in lactating dairy goats.***
6. **Cydectin Drench for sheep** (.1% or 1 mg/ml): Meat withdrawal time is 14 days. ***Not for use in lactating dairy goats***.
7. **Cydectin Injectable for cattle** (1% or 10 mg/ml): GIVE SQ. Meat withdrawal time is 30 days. ***Not for use in lactating dairy goats.***

NOTE for Guideline for Anthelmintic Dosages in Goats

The attached chart was developed by Ray M. Kaplan, D.V.M., Ph.D. (University of Georgia) and modified by Patty Scharko D.V.M., M.P.H. (University of Kentucky) and Lionel Dawson D.V.M., M.S. (Oklahoma State University). It is provided as a possible guideline for anthelmintic (deworming) dosages for goats. Producers should consult their veterinarian for advice on their specific management situation for determining dosages for their herd. ***With the exception of fenbendazole administered at the 5 mg/kg dose, these drugs are not approved by the Food and Drug Administration (FDA) for use in goats, and when used in goats are considered extra-label use (fenbendazole at the recommended dose rate of 10 mg/kg is considered extra-label usage). The FDA regards extra-label use of drugs as an exclusive privilege of the veterinary profession and is only permitted when a bona fide veterinarian-client-patient relationship exists and an appropriate medical diagnosis has been made. The chart is intended to serve as guideline for improving accuracy when dosing goats with an anthelmintic, but these drugs should be used in goats only when appropriate veterinary advice has been received.***

Drug resistance in parasites of goats is extremely common. The effectiveness of an anthelmintic should always be tested before being used by performing a FECRT (Fecal Egg Count Reduction test) or larval development (DrenchRite) assay if available.

*** The current recommendation is to use the Cydectin cattle **injectable** formulation and **NOT** the **pour-on** formulation (orally) or the sheep oral drench. When administered by subcutaneous injection, moxidectin provides improved drug levels as compared to oral administration.*

FAMACHA for Parasite Control

Dr. Steve Hart
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There are several sources for information on parasite control and FAMACHA. The best single source is http://www.SCSRPC.org. You can also find information on Langston's web site at http://www2.luresext.edu.

Internal parasites (worms) are the number one health problem of goats in the Southern United States and kill more animals than the total of the next three diseases. Worms function in nature's ecology by preventing populations of animals from overrunning an area when production conditions are good and reduce populations when food is limited.

The most common worm is the Barberpole worm (Haemonchus contortus) which feeds on blood in the abomasum (true stomach) and if there are too many, they cause anemia, poor performance and ultimately death of the animal. The Barberpole worm is responsible for the death of 85% of the animals that die of worms and therefore a very important worm. The red stripe of the Barberpole worm is his gut full of your goat's blood and the white stripe being the worm's uterus full of eggs-essentially a blood-sucking egg-laying machine. The Barberpole worm is about an inch long and as big around as a paperclip wire, so it is easy to see him in the stomach of a freshly dead goat-most are attached sucking blood (looks like a hairy stomach), but a few will be swimming around. Since it is a tropical worm, it is a greater problem during the summer.

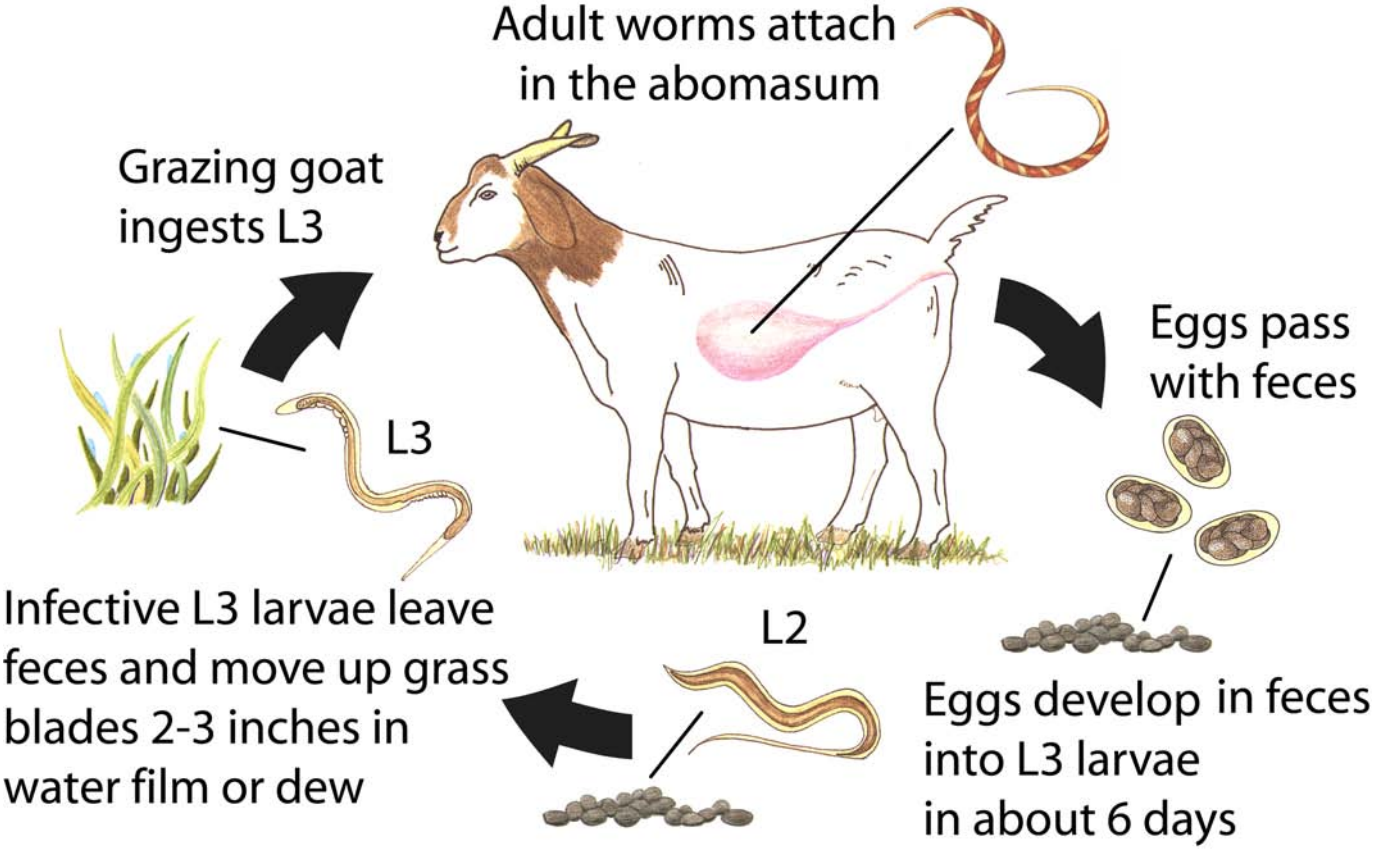
There are two other worms of secondary importance, one is the Black Scour worm (*Trichostrongylus colubriformis*) which feeds on mucous in the small intestine and causes diarrhea, reduced appetite and poor performance. The other worm is the Brown Stomach worm (*Teledorsagia circumcincta*, formerly Ostertagia) which feeds on the secretory cells of the abomasum and causes loss of blood plasma, diarrhea, reduced appetite and poor performance. None of these two worms cause anemia, you only see diarrhea and a poor doing animal. These worms are very small-the size of an eyelash. They are difficult to see, but you can see them wiggling if you put a little digesta on a white card. These worms are temperate species and cause more problems in the spring and fall rather than the summer.

The life cycle of the worm is very important to understand so we know some management steps that we can take to reduce the infection of goats. Worm eggs are in the feces and will hatch when it is over 50ºF, but hatch best at 85°F. This is why worms are less of a problem in the winter. It takes 1-6 days for the eggs to hatch, but they have to go through several developmental stages before they can infect animals. They hatch to the first stage larvae, abbreviated l-1. The l-1 eats bacteria in the feces, grows and molts (sheds skin like a snake) and becomes an l-2. Both the l-1 and l-2 can be killed by drying out when the weather is dry. When we have a dry July and August we have much fewer worm problems because of this.

The l-2 eats bacteria in the fecal pellet and grows and molts to an l-3, but this is an incomplete molt. The old skin slides up and he grows a new skin underneath which is a good news/bad news proposition. He is more resistant to drying out since he has two layers of skin, but also when he partially shed his skin, it covers his mouth so that he can no longer eat and must live off his stored fat. This means that he must get into your goat before he runs out of fat. How long can he live? Since he is cold blooded, his metabolism goes slow when he is cool and he may live 120-240 days. However, when the weather is hot like 95ºF, his metabolism really speeds up and he may only live 35-40 days before he runs out of fat. It takes about 6-14 days for an egg to develop to an l-3, the infective stage of the larvae, depending on how warm temperatures are.

Since goats don't go around eating fecal pellets, the larvae has to escape the fecal pellet and get on grass so that the goat can eat him. Since the outside of the fecal pellet dried into a hard shell and he can't penetrate it, he needs some rain or heavy dews to soften or break the crust so that he can escape. It takes about 2" of rain in a month's time to crack a pellet open. If he runs out of fat before there is enough rain or dew to release him, he dies. Once the pellet is softened or cracked open, the larvae is like a canoe, going wherever the water takes him, hopefully up a leaf of grass so that your goat will eat it along with the 3rd stage infective larvae. The larvae is unable to swim or crawl. Infective larvae are very small, slightly longer than the period at the end of the sentence and about as big around as spider web.

If the larvae is lucky enough to get into your goat, he immediately moults to an l-4. The l-4 has a decision to make-he can decide to grow into an l-5 and go to adulthood and lay eggs or he can decide to enter a state of suspended animation called hypobiosis or arrested form. He nestles down in the stomach gland and the immune system does not know that he is there. He is also harder to kill with the Benzamidole class of drugs. This is a survival mechanism for overwintering since he would die in the cold temperatures over the winter. It may also be used to keep worms alive during a prolonged drought when they would die outside the animal. The hypobiotic worm can be triggered to awaken and develop to an l-5 and onto adulthood by several mechanisms. The act of kidding, the goat eating green grass, kidding, lactating, increasing daylength all may trigger him to awaken and develop to an egg-laying adult.



Life Cycle of Haemonchus contortus, the barber pole worm

The immune system is the first line of defense against worms. Good nutrition supports the immune system in its fight against worms. Some animals have a genetically stronger immune system and goats can be selected for low fecal egg counts. Other diseases which depress the immune system such as coccidiosis, or pneumonia may make an animal more susceptible to worms. When goats are lactating, the immune system is suppressed and does not fight parasites as well. Also, those arrested l-4 larvae that overwintered awaken with kidding in the spring to feed on your goat. This is the reason for the general recommendation to deworm your goats around kidding time.

The Barberpole worm as we said likes a warm climate and it reproduces rapidly, laying as many as 6,000 eggs per day. This enables one resistant worm to produce many resistant worms. An adult Barberpole worm consumes 1-5 drops of blood per day. A thousand worms will consume nearly a pint of blood in a week. This causes your goat to have a low red blood cell number (anemia), low blood protein (hypoprotenemia) which causes edema or bottle jaw and ultimately death when there is not enough blood to sustain your goat's life. Coccidiosis, liver flukes and lice can all cause anemia also and need to be ruled out. Anemia can be determined by looking at the color of the mucous membranes. These are tissues under the lower eyelid, gums and inside the vulva. A normal amount of red blood cells gives them a healthy pink color. A reduced amount of red blood cells makes them more pale (white). You can use a FAMACHA card to determine the degree of anemia (FAMACHA score) and need for deworming.

Our biggest problem with dewormers is that some worms have become resistant to our dewormer. When an animal is dewormed with an effective dewormer, it will kill 100% of the worms. When the dewormer only kills less than 95% of the worms, we can be sure that we have significant dewormer resistance which will increase within a year or two so that the dewormer only kills 40% of the worms and is worthless as a dewormer. Dewormer resistance is measured by taking a fecal egg count, deworming and taking another fecal egg count 7-l4 days later. The percent reduction in fecal egg count is called fecal egg count reduction. Figure 2 shows that there is a high level of dewormer resistance to Ivomectrin, Valbazen works on some farms and not others and Levasole was highly effective on all farms. Cydectin was highly effective in 2001, but less so now. When an animal is dewormed and any worms survive in an individual or flock, it is because they are resistant to the dewormer and if the worm(s) mates with another resistant worm, 100% of the eggs will hatch out resistant worms. However, if there are a number of susceptible worms for that worm to mate with, we can reduce the worm's chance of mating with a resistant worm. This is the concept of refugia. Animals that have not been dewormed provide a source of worm eggs (ultimately adult worms) that are genetically susceptible to the dewormer to dilute the eggs of worms that survived deworming (resistant worms) and slow the rate of dewormer development. We increase refugia by only deworming only the animals that need to be dewormed as determined by FAMACHA color score of the eyes. This is different from our old strategy of trying to kill every worm which has gotten us to where dewormer resistance is a bigger problem than having a few worms around. It must be remembered that a few worms are OK and even desirable because they keep the immune system alert against worms. Excessive worms that cause us problems.

Table 1. Oklahoma Farm FECR %

Farm	IVM	VAL	LEV	CYD
1	12	87	98	
2	37	88	99	
3	7	67	99	
4	63	85	92	
5		55	99	100
6	46	42	98	
7	41		91	
8		0	97	
9	69	74	94	

Worms are like wealth, not equally distributed to all. 20-30% of the animals produce 70-80% of the eggs. These are predominantly the animals that will need dewormed. Most of the other animals will not need dewormed-they can cope with the worms that they have and the level of eggs in their feces does not cause a high level of pasture contamination. If we get rid of animals that consistently have high fecal egg counts, there will be fewer infective larvae on the pasture for all the other animals.

The Barberpole worm causes anemia and therefore the degree of anemia tells us how much difficulty the worms are causing the animal. The Brown Stomach worm and Black Scour worm do not cause anemia and we have to depend on diarrhea and loss of body condition to detect them. We measure anemia with the FAMACHA card by rolling the lower eyelid down and comparing the color of the inside of the eyelid where it was touching the eyeball to the color chips on the card. A healthy pink color will match chips #1 or 2 whereas a very pale color, white as a sheet will match # 5. If the color match is in between two chips, score it the higher number (more pale) color. Do not hold the eye open for more than a few seconds because the color will change. Check the other eye if necessary. One should remember that pink eye can affect the color of the eye. Also, one should remember that there are other causes of anemia such as coccidiosis, lice and liver flukes and if animals do not respond to deworming, these may need to be investigated as well as determining if the dewormer is working.

Treat all animals with a FAMACHA score of 4 or 5 with an effective dewormer and check again two weeks later if it is during the summer worm season. At deworming, many producers give the animal a blood building supplement such as Red Cell to support producing replacement red blood cells. If >10% of the animals have FAMACHA scores of 4 or 5, then consider deworming animals that score 3, especially ewes around lambing/kidding or nursing kids, young animals, does nursing kids and thin, poorly conditioned animals. Try to rotate animals to another pasture. Be sure to check animals which lag behind the herd. Also if an animal gets "bottle jaw", deworm them regardless of their FAMACHA score. Score animals using the card, not from memory and replace the card every 12 months because the colors fade. Record animal numbers as they are dewormed. If you add up the number of times that animals are dewormed across the summer, those requiring the most deworming are also those producing the most eggs and causing pasture contamination for others. Their offspring are also likely to be like them, so those animals that were dewormed the most are good candidates for culling.

FAMACHA is not a parasite control program, but a tool in a parasite control program. Your parasite management program should include monitoring of fecal egg counts periodically as well as FAMACHA eye scores. When you have a parasite problem, determine why and change the parts of management that

you can. Only use a dewormer when necessary to reduce the rate of development of dewormer resistance. Cull wormy animals because they cause worm problems for everyone else and it is often passed onto their offspring. Deworm new animals coming onto your place with at least two classes of dewormer and check a week later to make sure their feces are free of eggs to prevent importing resistant worms. Notice animals with pale color around the eyes when you check animals and deworm them promptly. Good nutrition (not only protein and energy, but also vitamins and minerals) is necessary to fuel the immune system in its fight against worms.

Some management steps that you can use to reduce parasite problems are grazing cattle or horses with goats. Avoid forcing goats to graze close to the ground since most infective larvae are within 3 inches of the ground. Making hay or tilling the ground can clean parasites off of a pasture. If you can rest a pasture 6 weeks, especially during warm weather, it will reduce contamination level greatly. If animals are browsing or eating high off the ground, they pick up much fewer infective larvae. As stocking rate increases above two head per acre, parasite problems also increase. There are certain conditions that increase the risk for worms such as: warm weather, two or more inches of rain in a month, grazing pastures close to the ground (such as during a drought), high stocking rates, long residence time on pastures, thin animals or animals nursing young. The more risk factors that you have, the greater the parasite challenge and the more attention to parasite management will be needed.

Dewormers are classified into action families. All members of an action family use the same mode of action to kill worms, but some members of that family may be more potent than others. The benzamidoles are one of the first marketed class of dewormers and because of that there is more dewormer resistance to

this class. The Benzamidoles not only kill worms, but also worm eggs, lungworms and tapeworms. They are especially useful for these latter two worms. Members of this group include fenbendazole (Panacur, Safeguard), oxfenbendazole (Synanthic) and albendazole (Valbazen), the most potent member of the family which also kills liver flukes. The cell depolarizers includes levamisole (Tramisole, Levasole and Prohibit) are basically only effective against roundworms and is generally the dewormer used after worms develop resistance to Cydectin. Morantel or Pyrantel tartrate (Rumatel or Positive Pellet Dewormer) is a form of the dewormer that is in the feed. It is not as potent as Levasole. The Avermectin/Milbermyucin class has been very effective in the past, but there is an accumulation of dewormer resistance to this class. It includes ivermectin (Ivomec), dormectrin (Dectomax), eprinomectin (Eprinex) and moxydextin (Cydectin) which is the most potent member of this class, but has a long withdrawal time.

Selection of a dewormer depends on what works in your herd as well as the withdrawal time. If you are milking animals or animals are going to market, you want a drug that has a shorter withdrawal, but also works. Every year, you should check to make sure your dewormer is working by taking some stool samples collected from animals that were dewormed 7-14 days previously to your vet (or do it yourself) to make sure that they have no fecal eggs in them. When you develop resistance to a dewormer, you may be able to use it at a higher dose, but generally it is better to use another drug. When you have resistance to all common dewormers, you will have to resort to combinations of dewormers or alternative dewormers such as copper oxide wire capsules or sericea lespedeza. With good parasite management, we can reduce the development of dewormer resistance, but it involves the use of FAMACHA, pasture rotation and having a good parasite management program in place. In conclusion, if you fail to manage your parasites, they will manage to put you out of the goat business.