Since January 2020 Elsevier has created a COVID-19 resource centre with free information in English and Mandarin on the novel coronavirus COVID-19. The COVID-19 resource centre is hosted on Elsevier Connect, the company's public news and information website.

Husbandry of Dairy Animals – Goat: Replacement Management[☆]

S Hart, Langston University, Langston, OK, USA
C Delaney, University of Vermont, Burlington, VT, USA

Prenatal Care

Doelings to be raised for replacement should be identified before birth. Since it takes a large investment in feed and labor to raise replacements, only those doelings with genetic superiority should be raised and the remaining kids culled. Doelings should be from does that are good milk producers and have good body conformation. The sires should also be genetically superior for milk production and body conformation.

Prenatal care of the doe begins during the last 3 months of lactation. Does should be fed so that they are in a body condition score of 3.0–3.5 when they are dried off and only need to maintain that body condition during the dry period. Steps should be taken to prevent pregnancy toxemia (maintaining the doe in proper body condition and giving them exercise). Does should be vaccinated for tetanus (*Clostridium tetani*) and overeating (*Clostridium perfringens* type C and D) disease 2–4 weeks before kidding. This will increase the level of antibodies to these pathogens in the colostrum and provide protection against these diseases during the first few weeks of life of the kid. In some areas, it may be appropriate to give an injection of vitamin E and selenium. Hay loses vitamins A and E, so injections for does could be warranted. This will add vitamins to the colostrum, which is rich in antibodies (called immunoglobulins) that will be easily absorbed through the intestinal wall after birth.

Caprine arthritis encephalitis (CAE) virus causes encephalitis, arthritis, progressive pneumonia, and hard udders that do not produce milk. This disease causes serious problems for the dairy goat industry and needs to be eradicated. The major route of transmission is through the milk. The disease can also be spread laterally from infected animals in the herd and through bodily secretions. There are two blood tests (enzyme-linked immunosorbent assay (ELISA) and agar gel immunodiffusion (AGID)) available to test for the disease, but it has been documented that animals can carry the virus for years without testing positive (due to not producing antibodies against the virus). Therefore, a negative test result cannot be relied upon to indicate that an animal is not infected. However, animals that test positive are infected. One caveat, a kid that consumed pasteurized milk that contained dead CAE virus may test positive for several months. Eradicating the disease requires a commitment to strict management protocols, including biosecurity.

There are three parts of a CAE eradication program: prevention of the disease in kids, prevention of the disease in the CAE-free herd by lateral transfer, and biosecurity to prevent reintroduction of the disease. Kids need to be taken away from their dam immediately after birth before their dam licks them. The kid should be removed to a separate area that is isolated from contact with adult animals. The kid should be fed heat treated colostrum (heated in a water bath at 56 °C for 1 h) for the first few feedings and then should be fed pasteurized goat milk, milk replacer, or pasteurized cow milk until weaning. Milk can be pasteurized by heating to 63 °C for 30 min or 72 °C for 15 s. Milk must be stirred occasionally as it is heated so that all of it gets up to pasteurization temperature and kills the CAE virus. It is of paramount importance to put safeguards in place so that kids are not accidentally fed unpasteurized milk since several drops may be sufficient to transmit CAE.

The kids that are raised on a CAE-free program should be kept separate from other does/kids to prevent lateral transfer such as by sneezing. Basically, there should be a 2 m wide alley between herds to prevent lateral transfer. When does are milked, the CAE-free herd should be milked first. One needs to be careful to avoid potential transfer of the disease from an infected herd to the CAE-free herd. All replacements raised on a CAE-free program should be tested at 6 months of age to verify that they are truly CAE-free. CAE can be transferred between animals by using the needles or syringes on more than one animal, tattoo equipment, or clippers, so they need to be sanitized between animals. After one works to eradicate the disease, one has to be careful to not introduce the disease back into the herd by bringing new animals into the herd or by taking animals to the show or sale and returning them home.

[☆]*Change History*: June 2016. Pasquale Ferranti (Section Editor) updated the Further Reading Section.
Update of: S.P. Hart. Husbandry of Dairy Animals: Goat: Replacement Management, Encyclopedia of Dairy Sciences, 2nd Edition, 2011, pages 825–833.

Neonatal Care

Colostrum is very important for neonate immunity and survival, especially for prevention of scours and pneumonia, as well as for subsequent kid growth. Colostrum is the secretion milked from the udder at the first milking after the doe kids. This milk will have a much higher concentration of antibodies than the second milking. For best results, the kids should receive colostrum in the first 6 h of life when immunoglobulin absorption is highest. Intestinal absorption decreases after 24 h of age. Kids should receive 60 ml of colostrum (heat-treated if on a CAE prevention program) per kg of bodyweight per feeding for three feedings in the first 24 h. Cow colostrum (heat treated) can be used as a substitute. Most commercial colostrum substitutes have not proven to be effective. Successful feeding of colostrum will increase serum total protein to greater than 5.5 g dl^{-1} or serum immunoglobulin concentration to greater than 1200 mg dl^{-1}. The sodium sulfate serum turbidity test can be used to ascertain the adequacy of colostrum feeding. Good prenatal care will help to improve the concentration of immunoglobulins in colostrum. It is useful to have frozen colostrum for emergencies. Colostrum can be frozen in an ice tray and cubes transferred to plastic ziplock bags for storage. Colostrum cubes of appropriate weight can be thawed, heat-treated, and fed to kids. Colostrum should not be thawed in the microwave.

Kids that have a birthweight less than 2.5 kg are at risk for hypothermia and are likely to have a higher mortality than normal-weight kids. Kids that have a birthweight higher than 5 kg are also at risk, because of dystocia. Kids that are suffering from hypothermia lack a sucking reflex and may need to be tube-fed to get colostrum into them to provide energy to aid in warming their bodies. A #14 French urethral catheter can be used for a feeding tube. It is carefully inserted in the esophagus and proper placement is checked by feeling in the esophagus and instillation of a few milliliters of water. Kids can be given 60 ml of colostrum per feeding at 2 h intervals until the kid can suck. If a kid is severely hypothermic (rectal temperature $<36.5\ ^{\circ}C$), he needs to be warmed either in warm water or by blowing warm air such as from a hair dryer or portable electric heater. Hot air should not be used and care should be taken so as to not overheat the animal.

Feeding the Neonate

Commercial dairy goat farms rarely feed their kids with the does' milk because of the cash value of the milk. CAE-free goat milk is superior to milk replacers for raising kids since goat milk contains immunoglobulins at low levels. This may be helpful in protecting the intestinal lining and the respiratory tract from infections. It is possible to raise kids on their dams by allowing kids to nurse during the day and separating them from the does overnight and milking once a day in the morning. Kids with access to their dams only during the day will grow well and have the advantage of learning feeding and social behavior from the dams. Disadvantages are that disease prevention (CAE and Johne's disease) is precluded.

Milk replacers are used to spare milk from the doe for sale and yet provide similar nutrition for the kid. Some milk replacers contain lactose-digesting bacteria or probiotic organisms, which may mitigate digestive upset. Lactose-digesting bacteria can be added to the milk in the form of a heaping tablespoon of yogurt or a dry commercial product. Milk replacers contain 20–28% milk-based protein and 16–24% fat. Since protein is limiting for a young kid, a higher level of protein would be expected to increase growth rate. Fat is used as an energy source for kids to grow and to keep warm. Other important nutrients are fat-soluble vitamins A, D, E, and K, which help maintain the epithelial lining of the skin, gut, and the respiratory systems, which are the physical barriers to infection. Vitamin C, copper levels, and the addition of probiotics should also be listed on the feed tag. Milk replacers should be mixed according to the manufacturer's recommendations.

Farmers have successfully used cow, sheep, and kid milk replacers to raise kids. Artificial rearing is necessary for CAE control. Whey has been fed at 20–45% of the milk with variable results. Some producers mix milk replacer with one-third to one-half goat or cow milk. The kid should be gradually transitioned to different milk sources after the first day of feeding only goat colostrum.

During the first 4 weeks of life, kids have a very high nutrient requirement, especially for protein (see **Figure 1**). Given free-choice access to milk, kids could consume about 700–800 ml each day in their first week of life, 1200 ml each day in the second week, and 1500 ml each day in the third week. Milk intake will be lower when feeding milk only 2 or 3 times per day. However, feeding large quantities of milk at any one time can cause digestive upsets such as bloat or diarrhea. For this reason, it is preferable to feed three or four smaller meals the first 4 weeks of life or to limit feed milk. An alternative is to provide free-choice cold (5–10 °C) or acidified milk, which causes kids to consume numerous small meals throughout the day. Milk or milk replacer can be acidified with dilute formic acid (1 part of 85% formic acid diluted with 9 parts of water) at the rate of 30 ml dilute formic acid to 1 l of milk or milk replacer. This works best if milk is cool at the time of acid addition and the mixture is mixed vigorously. The pH should be maintained between 4 and 4.5 pH paper (test with) to prevent pathogen growth and preserve the milk. Nipple bucket feeders with cooled or acidified milk need only one nipple per three kids in a pen since the kids consume only small meals (**Figure 2**).

There are several protocols for limit feeding of milk replacer, which also reduces digestive upsets in addition to greatly reducing milk replacer costs. With one protocol, 1 kg of milk per day divided into two feedings, beginning at 3 weeks of age, and starter is offered. This resulted in a gain of 150 g day^{-1}, similar to *ad libitum* milk alone to 10 weeks of age. Kids weighed 13.5 kg when weaned at 10 weeks of age and required only 68 l of milk replacer and 7 kg of starter feed. Another protocol fed 400 ml of milk replacer divided into three feedings on days 1–3, 500 ml divided into two feedings on days 4–14, 650 ml divided into two feedings on days 15–21, and fed 780 ml in two feedings on days 22–28 and 780 ml fed in one feeding on days 29–42 and weaned on day 42.

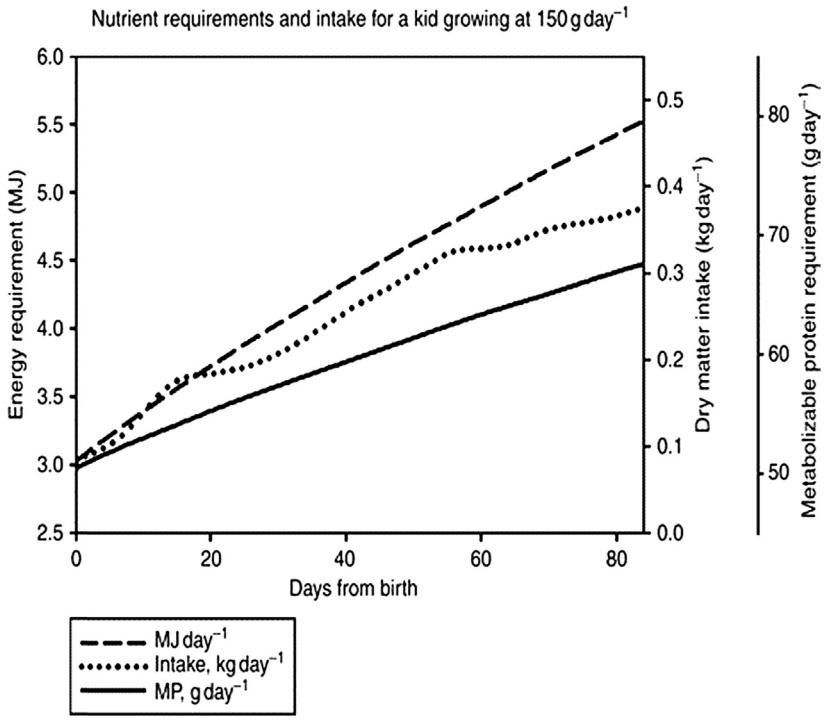

Figure 1 Nutrient requirements and intake of young kids.

Figure 2 Acidified milk fed free choice with two nipples per pen of six kids.

A high-quality pelleted starter was offered beginning at 3 days of age. Kids were able to gain the necessary 150 g day^{-1} through 7 months of age and consumed 27.5 l of milk replacer during this time, but starter and hay intake were not measured.

When feeding groups of kids, offer a minimum of one nipple per kid, so that all have an equal chance to feed (Figure 3). Automatic milk/milk replacer feeders may be employed to save labor and administer meals free choice or programmed for interval feeding. In large farms, this saves labor. One nipple will severe up to 10 kids (Figure 4).

A pelleted starter feed should be introduced at 1 week of age and should contain 18% crude protein (CP), 10.6 MJ of metabolizable energy (ME) per kg, and a coccidiostat such as Rumensin or Deccox (in a recent work with dairy calves, it was shown that the mash form (crumbled pellets) resulted in greater intake than pelleted starter, which in turn gave greater intake than did ground or meal form). Many calf starters fit these requirements. Hay should be introduced at 2–4 weeks of age and should be of very high quality, such as an immature alfalfa or vegetative stage grass–legume mixed hay. Uneaten hay needs to be replaced twice weekly.

Figure 3 Bucket milk feeding with nipples.

Figure 4 Automatic milk replacer feeder.

Weaning at later ages such as 12 weeks results in a larger kid and ultimately a larger doe, which may have potential to produce more milk, but at a greater feed cost. Many producers wean as early as possible to reduce feed costs since milk (or milk replacer) is expensive. Minimally, a kid must be at least 6 weeks of age to be weaned, should have a starter intake of at least 250 g day^{-1}, and weigh at least 10 kg. It is best to have a several–day transition period during weaning in which milk is reduced to one feeding so that the kid is adapted to consuming starter in place of milk. Table 1 contains a common feeding regimen for raising newborn kids through weaning to attain breeding weight (60% of adult weight) at 8 months of age.

Raising Bucklings

Buck kids selected for breeding stock may be raised with doelings until about 3–4 months of age with separation at weaning time to prevent unwanted breeding. Buck should be raised together with at least one other buck or wether for company. Bucks will grow fast, weigh at least 25% more than does, and can be used as sires starting at 8 months of age. Mature breeding bucks may be fed solely on high-quality forage, but will need some concentrate beginning at least 2 months before breeding season to improve body condition. Attention should also be given to proper mineral and vitamin nutrition to promote fertility and health. Feeding high levels of grain may result in urinary calculi, which are stones that form and block urination. By feeding a minimum of grain (less than one-fourth of the diet as grain) and by providing free access to clean water, this may be avoided. Other steps that may be taken to reduce the potential for urinary calculi with high-concentrate diets include increasing calcium-to-phosphorus ratio to greater than 2:1, using only sufficient phosphorus to meet nutrient requirements, using urine acidifiers such as ammonium chloride

Table 1 Artificial feeding recommendations for large-goat breeds from birth to breeding age (8 months)

Age	*Weight*	*Feed (daily intake)*	*Management notes*
Newborn	(Ideal)	Colostrum heat-treated	Dip the umbilical cord in a 7% tincture of iodine
Single	4.5 kg	Consumption: 150–300 g in first 24 h	Heat colostrum at 56 °C for 1 h
Twin	4 kg		Give colostrum within 6 h after birth
Triplet	3.5 kg		Give vitamin E/selenium shots if necessary
Quadruplet	3 kg		
One month old	6.8–9 kg	Pasteurized milk, milk replacer, CAE-free raw milk, or Johne's disease-free cow milk	Daily weight gain, 0–2 months: 180–200 g
		Limit the consumption at 3 weeks of age to 2 l day^{-1}	Have homogeneous groups by weight
		Hay,[a] starter, and water available at all times	Sufficient nipples should be available to feed each kid easily
Two months old	12–15 kg	Limit milk to 2–3 l day^{-1}	Coccidiosis treatment if necessary
		Limit and start to decrease the quantity and frequency of milk	Wean kids when starter consumption is at 250–350 g day^{-1}
		Hay[a] intake: 200–300 g day^{-1}; starter intake:150–200 g day^{-1}	Wean kids over a period of 3–5 days by reducing milk feeding to one time a day
From weaning to breeding			
From weaning to 4 months old	15–24 kg	High-quality hay[a] (<26% ADF) intake: 800 g	Daily weight gain: 150 g
		Concentrate intake: 400 g	At 4 months old, create weight groups
		Concentrate intake: 600 g with lower quality hay (>36% ADF)	Too much grain will decrease rumen capacity to ingest forages
		Access to water	May change from 18% crude protein concentrate to 16% crude protein concentrate
		May graze or browse	Before going to pasture, feeding transition and time in the pasture should be taken into consideration. Even on a pasture system, hay should be offered
At 6–7 months old	26–29 kg	Good-quality hay[a] intake: 1.1–1.4 kg per animal, on a dry matter basis	Daily weight gain: 85–100 g
Breeding period (7–8 months old)	32–34 kg	Hay: 1.2 kg on a dry matter basis	Vitamin A, D, and E injection 15 days prior to breeding
		Concentrate: 270–450 g	
From breeding to kidding		*First 3 months*	3 weeks prior kidding: Yearlings should consume same forages and concentrate (less quantity) as a lactating goat
		Hay: 1.2 kg,[a] on a dry matter basis	Avoid any sudden feed changes at kidding
		Concentrate: 270–450 g	
		Last 2 months	
		High-quality hay[a]	
		Concentrate: 500 g	

ADF, acid detergent fiber.

[a]Hay containing 8.76 MJ of metabolizable energy per kg and 12% crude protein (high-quality grass hay or mixed legume hay) to meet nutrient requirements.

Adapted from Corcy, J.-C., 1991 La Chevre. La Maison Rustique, Paris, Pole d'Experimentation et de Progres Caprin publications. e.g., L'élevage des chevrettes (des rendez-vous ratés). http://www.pep.chambagri.fr/caprins/html/contenu/pdf/mail%20du%202dec08/F.%20chevrette%20g%e9n%e9rale_A3-RV.pdf (accessed April 2010).

(0.5–2.0%), and the addition of salt up to 3% of the diet to encourage water consumption. Bucklings in the 10–40 kg weight range need a minimum of 8.0 MJ ME kg^{-1} for maintenance and up to 11 MJ ME kg^{-1} for gaining 250 g day^{-1}. The publication by National Research Council provides details on nutrient requirements.

Feeding Doelings

The target weaning weight for large-breed doe kids is 15 kg. The target breeding weight for large breeds like Alpine or Saanen is 35 kg by 7–8 months of age. Although does can breed and conceive at 3–4 months of age and at lower weights, this will stunt their growth and reduce milk production. To prevent this, it is best to separate the buck kids from the doe kids at weaning. To meet the target weaning weights and breeding weights, a kid will need to gain 150 g day^{-1} although many are capable of gaining 175 g day^{-1} before weaning. These weight gain objectives are achievable when a commitment is made to management, feeding, health care, and housing. Slower weight gains may be acceptable and farmers may breed kids at 10–12 months of age, but one must consider seasonal anestrus that occurs in the winter and early spring. Table 2 has the monthly nutrient requirements and target bodyweights for each month of age. Basically, 0.36 kg concentrate per day is required to maintain growth rate when high-quality hay is provided. Bodyweights should be monitored monthly and nutrition adjusted accordingly.

Kid Health

The greatest threats to the health of the newborn kid are pneumonia, scours, and coccidiosis. Organisms that cause pneumonia are commonly present in the environment. Two practices will help prevent pneumonia: ventilation to reduce humidity and the concentration of pneumonia causing organisms; and the consumption of sufficient colostrum. In addition, the bedding must be kept clean, dry, and free of ammonia odor at animal level. Early detection of pneumonia is critical in its treatment. Animals must be carefully observed for abnormal behavior, such as a kid lying differently from the rest, separated from the group, not coming up to the kid bar, and not as active as others. Pupil shape may change to round in a sick kid. Heavy breathing, nasal discharge, and coughing are present after the animal has been sick a while. Check the kid's body temperature; a temperature over 40 °C indicates fever. Treatment should follow veterinary protocol. Sometimes, moving kids outside as soon as practical will improve kid health. Overcrowding increases the risk for pneumonia. Animals should be kept healthy since other diseases such as soremouth or coccidiosis will provide opportunity for pneumonia. Stress such as mixing animals should be minimized and good nutrition is also very important.

Neonatal diarrhea is caused by several infectious organisms such as *Escherichia coli*, rotavirus, coronavirus, cryptosporidia, and salmonella. The disease is promoted by a buildup of these organisms in the environment, usually as the kidding season progresses and sanitation is neglected. Kids are more prone to diarrhea when fed large quantities of milk at one time. Insufficient colostrum intake may also be a predisposing factor as is overcrowding. Animals with diarrhea should be strictly isolated to prevent the spread of the organism to other animals. They should be taken care of after healthy animals, and one should be careful not to carry the infection on their clothes or hands to healthy animals. Milk-feeding containers may also spread the disease and need to be thoroughly cleaned and sanitized. Sanitation should be reevaluated and corrected at the first sign of diarrhea. Most of the common causes of diarrhea are self-limiting and therefore antibiotics are seldom used for treatment. Treatment should follow veterinary protocol. Generally, treatment consists of keeping the kid hydrated and warm. Usually, electrolytes are given to the kid in place of milk for several feedings and milk gradually introduced along with the electrolytes. It is best to give milk in small feedings every 2–4 h. Electrolytes may need to be administered subcutaneously to correct dehydration.

Table 2 Nutrient requirements for growing replacement kids postweaning

Age (months)	*Weight (kg)*	*Gain (g day^{-1})*	*Energy (MJ ME)*	*Protein (g day^{-1})*	*Calcium (g day^{-1})*	*Phosphorus (g day^{-1})*	*Concentrate*[a] *(kg day^{-1})*	*Hay*[b] *(kg day^{-1})*
3	17.3	150	4.55	109	2.65	1.85	0.36	0.48
4	21.8	150	5.41	118	2.91	2.03	0.36	0.68
5	26.3	150	6.23	123	3.17	2.22	0.36	0.77
6	30.8	150	7.01	132	3.43	2.40	0.36	0.86
7	35.3	150	7.72	136	3.66	2.56	0.36	1.0
8	38.3	100	8.26	123	3.54	2.48	0.27	0.95
9	41.3	100	8.74	114	3.52	2.46	0.27	1.05
10	43.3	100	9.06	114	3.63	2.54	0.27	1.05
11	45.3	100	9.37	118	3.76	2.63	0.27	1.09

ME, metabolizable energy.

[a]Quantity of a concentrate diet containing 11.2 MJ ME kg^{-1} and 16% crude protein to meet requirements.

[b]Quantity of hay containing 8.76 MJ ME kg^{-1} and 12% crude protein (high-quality grass hay or mixed legume hay) to meet nutrient requirements.

Data from http://www.luresext.edu/goats/research/nutreqgoats.html.

Coccidiosis is a protozoal organism that is part of the normal gut microflora and is present in low numbers. Coccidiosis should be suspected in kids over 2 weeks of age that have pasty diarrhea (has white streaks in it) with a history of stress. As the disease progresses, diarrhea becomes watery, causing rapid dehydration of the kid. Goats seldom have bloody feces as observed in other animal species with coccidiosis. Other symptoms of coccidiosis include off feed, listlessness, weakness, and the infected animal may show abdominal pain by crying or getting up again as soon as it lies down. Coccidia parasitize and destroy cells lining the intestinal tract of the goat and the resultant scarring of the small intestine may stunt the kid. The disease is caused by the kid somehow consuming fecal material, such as in the water trough or feedtrough, in combination with a weak, depressed or immature immune system. The immune system can be depressed by the stress of weaning and therefore coccidiosis can be a major problem at weaning. Damp, cool conditions promote the disease because the infective coccidial oocysts survive longer in the environment.

Coccidiosis can be best prevented by keeping the kid from consuming fecal material, usually through contaminated feed, feedtroughs, or water containers. Sanitation and promoting a dry environment aid in the prevention of coccidiosis. Good sanitation can be facilitated by use of slatted floors where feces and urine fall through (**Figure 5**). Feeding acidified milk or yogurt appears to be beneficial. Deccox M can be mixed in the milk and fed for 4 days every 4 weeks as a preventative, or Albon can be mixed in the milk 2 days a week. Good nutrition can help the immune system to prevent coccidiosis. Since older animals have greater immunity to the disease and may shed high levels of oocysts in the feces, young animals should not be housed with older animals. Coccidiostats such as decoquinate (Deccox) and Rumensin are used in feeds to prevent coccidiosis. Animals to be weaned should be fed a feed containing a coccidiostat for 4 weeks before weaning until 3 weeks after weaning. These coccidiostats are best fed when there is a high risk of coccidiosis such as in young animals less than 6 months of age or in animals undergoing a severe stress such as weaning or if there are cool damp conditions. Coccidiosis is generally treated with Albon or Corid.

Colostrum can provide passive immunity to enterotoxemia up to 5 weeks of age if does were vaccinated shortly before parturition. Kids on full feed of milk are at risk for enterotoxemia, especially if the milk is being fed only a few times a day. Sudden changes in feed or feeding routine can also precipitate enterotoxemia. Lush pasture or high-concentrate diets can cause enterotoxemia if the kid is not gradually adapted to them. Feeding high levels of concentrate with insufficient fiber intake from inadequate hay consumption can cause enterotoxemia. The major symptom of enterotoxemia is sudden death. The affected kid has an elevated temperature and severe abdominal pain. As the disease progresses, the animal will lie down on its side with the head down and may have convulsions. It may throw its head over its back. The kid will have diarrhea, and the urine will test positive for glucose if diabetic test strips are used. The disease is best prevented by vaccinating the kid (usually 4, 8, and 12 weeks of age) and by good feed management (gradual changes in feed, sufficient good-quality forage in the diet).

Internal parasites (gastrointestinal nematodes) generally infect kids over a month old. Kids usually acquire infective larvae from grazing, but may acquire some from consumption of bedding. The major strongyles include *Haemonchus contortus*, *Teladorsagia circumcincta*, and *Trichostrongylus colubriformis* with *Strongyloides papillosus* occasionally being a problem, being transmitted through the bedding. Tapeworms (*Moniezia* species) are an ever present problem in young goats raised in semiconfinement (where they have access to grass since a grass mite is necessary for transmission). When kids are allowed to graze during the warm season, *Haemonchus* will be the dominant problem in warmer climates and can be particularly deadly. Beginning at 6 weeks of age, fecal samples should be monitored for roundworm eggs every 3 weeks to determine when there is a problem with internal parasites. Symptoms of parasitism include diarrhea, pale mucous membranes, thin, poor-doing animal, and edema. In temperate and tropical climates, one can monitor FAMACHA eye scores during the warm season, which assesses the degree of anemia, which could be assumed due to infection with *Haemonchus*. One should work with a local veterinarian or parasitologist, who should have a good idea of the species and

Figure 5 Kids on raised slatted floors.

effective treatments. Deworming all animals by some time schedule promotes dewormer resistance and is unacceptable. In the more humid climates of the United States, there is considerable resistance in parasites to dewormers. Kids raised in confinement where there is no grass growing or those raised on elevated floors are not affected by internal parasites.

Kids need to be protected from external parasites including horseflies, stable flies, horn flies, biting and sucking lice, and mites. Cleanliness and avoiding contact with older animals can help to prevent these problems. Insecticides may be necessary to achieve control of these pests. High populations of these pests can reduce growth and facilitate the spread of disease; therefore, control of these parasites is important.

Housing Environment Considerations

From birth to weaning, the kids should be housed separately from the adults (when removed at day 1) to minimize exposure to an environment with high amounts of potential pathogens. Then, after a successful transition to a diet without milk, the weaned kids may be placed in housing more similar to adults. Therefore, nursing kids should have their own building or at least have an independent ventilation system. For confinement rearing, the floor space and ambient air recommendations can be found in Tables 3 and 4.

For kids, up to 2 months of age, it is best to place them in groups of no more than 12–25 kids within 1–2 kg range of weight and no more than 2 weeks range in age. After weaning, kids can be combined in groups of 25–30 allowing for sufficient feeder space, dry bedding, and air quality. One waterer per 25 kids is recommended.

After weaning, kids may be raised outdoors provided that they have shelter from the wind and rain. If raised on browse such as tree saplings, woody shrubs, and broad-leaved plants, internal parasites should not be a problem, especially if the hay, concentrate, water, and mineral feeding areas are also kept clean of feces. This is done by offering access to these supplements through a feed space where only the kids' heads may enter for eating. Kid, should be kept separate from adults on pasture to reduce infection by internal parasites. Rotation grazing, especially with a long rest period, reduces parasite infection.

Other Management Considerations

Dairy kids need to be disbudded so that they do not develop horns, since they will injure one another with horns and the horns will not fit into feed mangers. Disbudding at an earlier age is easier on the kid and it is easier for the operator also as compared to horn removal later. The most popular method of disbudding kids is to use a hot-iron dehorner. This is best done when kids are less than 2 weeks old. The hair around the bud may be clipped. Lidocaine may be used as an analgesic under veterinary supervision if deemed necessary. The kid is best confined to a kid-holding box during this procedure. A hot iron is applied to burn a copper colored ring (approximately 6 s) around the horn bud. It is possible to apply the dehorner too long and cause brain damage. Proper dehorning

Table 3 Floor space requirements according to age

Surface	*Unit*	*<1 month old*	*1–2 months old*	*2–7 months old*	*7 months old to kidding day*	*Adult*
Floor space	m^2	0.2–3	0.5	1	1.5	1.5–2
Linear feeder space	cm	20	25	35	40	40

Adapted from Le Logement des Troupeaux Caprins du Centre Ouest (2006) France: L'Institute de L'Elevage. http://www.inst-elevage.asso.fr/html1/IMG/pdf_CR_120755014.pdf (accessed October).

Table 4 Ambient air recommendations for two age groups

	Unit	*<1 month*	*>1–7 months*
Temperature range desired	°C	10–18	6–16
Air volume	m^3 per kid	3–4	5–6
Air speed	m s^{-1}	0.2	0.5
Air renewal			
Winter	m^3 h^{-1} kid	5	25
Summer	m^3 h^{-1} kid	25	75
Humidity	%	65–80	
Levels of ammonia	No odor and maximum 5 ppm		

Adapted from Le Logement des Troupeaux Caprins du Centre Ouest, 2006. L'Institute de L'Elevage, France. http://www.inst-elevage.asso.fr/html1/IMG/pdf_CR_120755014.pdf (accessed October).

eliminates scurs (which are parts of the horn that are not killed by burning and that grow in unusual shapes). If scurs occur, they can be reburned if they are small (check kids a month later). Kids are often tattooed at this time if they are to be registered.

Every kid should be identified by attaching an ear tag or neck chain or collar (Figures 6 and 7) on their day of birth. Because goats and kids like chewing and playing, they can easily lose their tags. To prevent this, an appropriate tag size is recommended, along with a strong material (i.e., metal) and/or a duplicate tag. For LaMancha breed (earless), if a necklace is unsuitable, the tail may be tattooed on the underside.

Records should include tag number, name of sire and dam, birth date, and any issues observed. The records of the dam should be known to aid the decision of retaining the kid as a replacement. Writing down health records, including disease occurrence, vaccinations and treatments, or symptoms, may help your veterinarian diagnose and treat an ill goat quickly.

Raising replacement kids requires good planning and execution as well as attention to detail. Local veterinary assistance should be involved in the planning stage, especially for health issues. Not only is good nutrition of paramount importance, but also animals should be weighed regularly to verify that kids will be breeding size by breeding season. Raising replacement kids requires much more planning and management than any other class of animals as well as a greater expenditure of time and managerial intensity.

Figure 6 Ear tag.

Figure 7 Necklace.

Further Reading

Corcy, J.-C., La Chevre, 1991. La Maison Rustique, Paris, France.

de Cássia Ramos do Egypto Queiroga, R., Costa, R.G., Madruga, M.S., de Medeiros, A.N., Dos Santos Garruti, D., Magnani, M., de Souza, E.L., 2016. Influence of lactation stage and some flock management practices on sensory characteristics of goat milk from Brazilian Saanen breed. Anim. Sci. J. 87, 600–606.

Genadoy, H., Sahlu, T., Davis, J., et al., 2002. Effects of different feeding methods on growth and harvest traits of young Alpine kids. Small Rumin. Res. 44, 81–87.

Goetsch, A.L., Gipson, T.A., Askar, A.R., Puchala, R., 2010. Feeding behavior of goats. J. Anim. Sci. 88, 361–373.

Le Logement des Troupeaux Caprins du Centre Ouest, 2006. L'Institute de L'Elevage, France. http://www.inst-elevage.asso.fr/html1/IMG/pdf_CR_120755014.pdf (accessed June 2016).

Mary Smith, D.V.M., 2005. Managing Kidding and Lambing Cornell Sheep & Goat Symposium. Cornell University, Ithaca, NY.

National Research Council, 2007. Nutrient Requirements of Small Ruminants: Sheep Goats, Cervids and New World Camelids. National Academies Press, Washington, DC.

Robertson, L.J., 2009. *Giardia* and *Cryptosporidium* infections in sheep and goats: a review of the potential for transmission to humans via environmental contamination. Epidemiol. Infect. 137, 913–921.

Roger, P.A., 2012. Welfare issues in the reproductive management of small ruminants. Anim. Reprod. Sci. 130, 141–146.

Valasi, I., Chadio, S., Fthenakis, G.C., Amiridis, G.S., 2012. Management of pre-pubertal small ruminants: physiological basis and clinical approach. Anim. Reprod. Sci. 130, 126–134.