

Buck evaluation and semen handling

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Abstract

Buck selection and management are critical to maintaining or improving the performance of the herd. The buck's health and breeding soundness should be evaluated regularly to ensure his ability to successfully breed and/or be collected for semen preservation. The ability to collect and cryopreserve semen has greatly changed the goat industry. Artificial insemination (AI) allows better control of reproduction, control of sexually transmitted diseases, and the rapid distribution of valuable genetics. This lecture will review the selection parameters for bucks and will discuss important aspects of handling preserved semen.

Keywords: Buck, selection, semen, evaluation, cryopreservation

Introduction

Buck selection and management are vital to maintaining or improving the performance of the herd. Bucks should be routinely evaluated as part of the farm's herd health program and receive annual breeding soundness evaluations. The ability to collect and cryopreserve semen has greatly changed the goat industry. Artificial insemination allows better control of reproduction, control of sexually transmitted diseases, and the rapid distribution of valuable genetics. Satisfactory fertility to AI requires careful attention to semen storage, handling and cryopreservation.

Buck evaluation

Buck selection

Bucks are selected based on their individual performance or progeny testing for traits such as meat traits, adaptability, twinning rates, and milk production. Obviously, prolific bucks are preferred. In addition, birth, weaning, and yearling information are valuable when evaluating bucks for suitability as potential sires. Bucks should be large with good musculature and have good conformation. Bucks with any conformational and genital tract abnormalities should be avoided. Because the intersex condition has been linked to the polled gene, the use of phenotypically polled bucks should be avoided. Changing bucks every two years will help preserve vigor and reduces inbreeding in the herd.

Scrotal circumference should also be evaluated as bucks with large scrotal circumference usually produce the highest-quality sperm.^{1,2} Serving capacity tests may be used to help determine how many does a buck can be expected to service. Serving capacity tests are performed to measure how many times a buck services does during a defined period. Typically, the buck is placed into a pen (3 m by 5 m) with two to four cycling, unrestrained does for a period of 20 to 40 minutes. All sexual behavior is monitored and recorded with an emphasis on the number of breedings. These tests are the best predictor of the adequacy of an animal's libido. Using bucks identified as high-performing or having a high degree of libido, in comparison with low-libido bucks, will result in higher kidding percentages and greater numbers of live-born kids per exposed doe.¹ Serving capacity tests may also be used to determine proper buck-to-doe stocking ratios. These tests may help produce a shorter, more uniform kidding season. Adult bucks achieving four to six or more breedings during 30 minutes are preferred.

Breeding soundness evaluation

All breeding bucks should be evaluated for breeding soundness three to four weeks prior to the breeding season. The examination of the buck should include a physical examination, reproductive examination, measurement of scrotal circumference, and semen collection and evaluation. Breeding soundness examinations are only able to evaluate the physical soundness and semen quality of the buck. The breeding soundness examination does not evaluate the buck's libido or ability to breed a doe.

Therefore all bucks that pass a breeding soundness examination with a satisfactory rating should also be observed for ability to breed a doe and to assess libido.

The physical examination of the buck includes a general examination for health which includes an assessment of body condition and musculoskeletal condition of the feet and legs. A satisfactory buck should be in good body condition; thin or obese animals should be avoided.^{1,3,4} The buck should be free of genetic defects such as hernias, cryptorchidism, supernumerary teats, musculoskeletal defects and intersex condition (phenotypically polled). The examination of the reproductive tract includes evaluation of the testes, epididymis, spermatic cord, and penis. The testes should be evaluated for size, symmetry, and consistency. A buck should have two large, oval-shaped testes of equal size. The testes should be firm during the breeding season and slightly softer during the non-breeding season. Ultrasound examination may be beneficial confirming suspected abnormalities.^{1,3,4} Gross changes in the epididymis are fairly rare in goats. The penis should be examined for abnormalities when collecting semen. The penis must be manually extended from the sheath so that the entire length of the extended penis can be evaluated. The absence of the urethral process in bucks with a history of obstructive urolithiasis is of no real concern as it appears to have no detrimental effect on the buck's fertility.⁴ Because of the high association between testicular size and capacity for sperm production, scrotal circumference is an important measure to evaluate in the buck. The scrotal circumference in 45 kg dairy goats has been reported to be 25 to 28 cm with larger bucks having scrotal circumferences of 34 to 36 cm.^{3,4} No age or breed standards exist for scrotal circumference in meat goats. One evaluation of meat goats found that the scrotal circumference in 45 kg, seven month old Kiko and Boer bucks averaged 26 to 29 cm.⁵

Semen collection may be performed with an artificial vagina (AV) with a trained buck or by electroejaculation with the buck restrained. The normal buck ejaculate is 0.5 to 1.5 mL in volume. Semen is evaluated for color, concentration and sperm characteristics such as gross and progressive motility and morphology (Figure).^{1,4} Semen quality and quantity may vary with age, season, temperature, and breed. The volume of semen is of little value when collected by electroejaculation as this is not a physiologic ejaculation; volume collected by AV is of some value. The color of semen depends on the concentration and can range from milky to creamy. Gross motility and progressive motility are examined microscopically.

Figure. Minimum acceptable reproductive criteria for a satisfactory potential breeder buck	
Volume	0.5 mL
Progressive Motility	70%
Concentration	2 billion
Morphology	80% normal

Modified from Edmondson MA, Roberts JF, Baird AN, et al. Theriogenology of sheep and goats. In: Pugh DG, AN, editors. Sheep and goat medicine. 2nd edition. St. Louis: Elsevier Saunders; 2012. p. 150-230.

Management of bucks

Bucks are often overlooked and neglected from many herd health management practices. Urolithiasis, although more common in castrated males, is still one of the most important diseases seen in bucks and can be quite detrimental to the breeding potential of a buck. Providing fresh clean water, increasing salt concentration in the diet (2% to 4%), sufficient trace mineral intake, maintain a 2:1 of dietary calcium to phosphorus ratio and using urinary acidifiers (1% to 2% ammonium chloride) are important steps in the herd health management of bucks.

Bucks should be in good body condition (BCS 3-3.5) before the onset of the breeding season without excessive fat.⁶ Bucks should be maintained at a pre-breeding body condition score of 3 to 4 because they may lose more than 10% to 12% of their body weight in 1.5 months of a breeding season.⁷ It is usually beneficial to feed a concentrated energy-protein supplement to bucks approximately four to six weeks prior to the breeding season. Depending on the body condition and size of the buck and the quality of forages, a daily ration of six to eight pounds of forage and one to two pounds of 12 to 14%

crude protein concentrate usually is sufficient.⁷ After the breeding season, it may be necessary to feed some concentrate to help the buck regain adequate body condition. The buck can be maintained on good quality hay during the remainder of the year.

In addition, bucks should be evaluated regularly for routine hoof trimming and level or degree of gastrointestinal parasite burden. Before the breeding season, the buck should undergo a breeding soundness evaluation as previously described.

Breed, age and nutrition play a major role in the onset of sexual maturity in the buck. The age at puberty with pygmy breeds ranges from two to three months and in Nubian and Boer bucks ranges from four to five months. Most goats raised in the northern hemisphere will have spermatozoa present in the ejaculate at four to five months of age. However at this age, semen quality is poor, and these young bucks are not suitable for breeding.² Nubian and Boer bucks begin to exhibit sexual behavior at ten to 12 weeks and start producing good quality semen at eight months of age.¹ Natural adhesions of the urethral process and glans penis to the prepuce make the immature buck incapable of copulation. This attachment begins to break down or separate at three months of age. Fertile mating is possible at four to five months of age.² Fast-growing, well-fed and well-managed kids are able to breed sooner than malnourished males of the same age.

Semen handling

Semen collection and storage

The collection and storage of semen from mature, healthy bucks can be a valuable component of a reproductive program that maximizes the overall fertility of a herd and emphasizes genetic progress.⁵ The two most common methods of semen collection include the use of an electroejaculator and an AV, respectively. The use of a warm AV (39°C) is the preferred method for semen collection as it is faster and less stressful for a trained male and produces a more physiologically normal sample. The electroejaculation method may be necessary for single collections. While samples obtained by electroejaculation tend to have a larger volume, they are inconsistent and often contain a large amount of seminal fluid and a lower concentration of spermatozoa than samples collected with an AV. In order to maintain good concentrations and adequate libido, collections in bucks are often performed two to three times daily on alternate days with intervals of 30 minutes to one hour between collections. However, the timing of collections is often dependent on the age, condition and temperament of each buck.¹ Semen quality is also dependent on the season of collection with the frequency of morphologically abnormal spermatozoa more common during the spring and summer.

Upon collection, the ejaculate is placed into a warm waterbath (37°C) and evaluated immediately. The evaluation consists of a macroscopic examination (volume, consistency, and color) and a microscopic examination (gross motility, individual motility, morphology, and sperm concentration). The same parameters for semen evaluation for a breeding soundness evaluation are used. The normal color of semen is off-white to milky. Other colors may be seen as well: hints of pink (blood contamination), brown (infection of the reproductive tract), and yellow (urine contamination). All of these color variations indicate a poor quality ejaculate.¹

A two hour semen stress test should also be performed prior to cryopreservation. The semen is collected and evaluated immediately for progressive motility. The sample is then incubated at room temperature for two hours. Progressive motility is then reevaluated. The incubated sample should maintain 20% of the motility of the initial sample. The fertility potential of cryopreserved semen is dependent on or influenced by the natural variation in semen quality among bucks, management, nutrition, and environmental stressors. Once semen has been collected, semen can be used raw or undiluted, extended and chilled, or frozen and thawed. When using raw semen, females can be inseminated with approximately 0.1 mL of normal good quality semen immediately after collection. After evaluation, semen is diluted with appropriate extenders to achieve final semen-to-extender ratios of 1:1 to 1:4, depending on the sperm concentration of the ejaculate. If necessary, semen can be diluted with the extender at 30°C and cooled to 4°C and then kept at this temperature for up to 24 hours.

Freezing and thawing semen

A variety of methods of freezing semen have been used. Semen that is intended for freezing should have a concentration greater than 3×10^9 /mL and a motility rate greater than 70% of the ejaculate. Normal concentrations range from 2.5 to 5.0×10^9 mL. Traditionally, buck semen has been centrifuged to remove the seminal plasma which enhances freezability. However if semen is adequately diluted, centrifugation may be excluded. Semen extenders are commercially available with most formulated to enhance sperm cell maintenance by providing energy, isotonic osmotic pressure, a buffering system and protection from cold shock.¹ Temperature control is extremely important when successfully freezing semen. The semen should be placed in an incubator or waterbath (30°C). Semen should be diluted as appropriate using a warm extender (30°C). For freezing semen, several packaging systems have been developed for cryopreservation of semen (straws, pellets, ampules). The type of packaging system used for cryopreservation is dependent on the dilution of extender and semen.¹ The most popular way of freezing semen is to use plastic straws (0.25 to 0.5 mL). The thawing and handling procedures for semen must be consistent with on-farm recommendations. Improper thawing procedure as well as other factors can degrade the semen and affect fertility. Appropriate semen handling techniques are critical in helping to maximize conception rates.

Handling of frozen semen

Frozen semen for bucks is stored in liquid nitrogen (-196°C). Any deviation from this storage temperature can alter semen quality. The straw is placed into the holding goblet with two goblets attached to a cane. Multiple canes are set inside a canister which is submerged and maintained in a liquid nitrogen tank. The liquid nitrogen tank should be stored in a cool, well-ventilated room. The lid of the liquid nitrogen tank should be kept closed at all times. The liquid nitrogen level should be checked and maintained at an adequate level with regularly planned tank maintenance. It is important to maintain accurate records so that the straws are easily to locate which will expedite semen transfer and retrieval.

The straws should be thawed with extreme care. Once the desired straw is correctly identified, the canister is raised until the cane tops can be seen (5 to 7 cm below the mouth of the tank). Straws should be maintained below the “frost line” in the neck of the tank at all times. Using a light source to identify the correct cane, the straw is removed from the cane with tweezers or forceps. The cane is immediately replaced into the canister which is then re-immersed in the liquid nitrogen. Straws should not be touched by the handler’s hands. The straw is then quickly immersed in a water bath (33 to 35°C). Thawing procedures should follow manufacturer’s recommendations. However, general thawing procedures require only 30 to 40 seconds for 0.5 mL straws and 20 to 30 seconds for 0.25 mL straws. Only as many straws as can be used in 10 to 15 minutes should be thawed at one time. If at all possible, no more than three straws should be thawed at one time in order to avoid lowering the thaw water temperature. The straw should then be thoroughly dried, the air bubble shaken to the crimped end, and the straw opened.¹

If pellets are used, then the pellets should be removed from liquid nitrogen storage and two or three placed into a dry, sterile tube. The tube is kept in a warm waterbath (37°C). The thawed semen should be pulled into a pipette and used for AI immediately. Alternatively, some processing procedures may require the addition of a warm diluent to the frozen pellets.¹

Evaluation of thawed semen

For the evaluation of frozen semen samples, the semen should be thawed using the recommendations that were made by the company where it was originally processed or frozen. The straw should be properly identified, thoroughly dried, the semen examined for motility and morphology and a two hour semen stress test performed. The Society for Theriogenology has set the following expected standards for ram spermatozoa which appear to be applicable to the buck as well: 70% normal, 50% intact acrosomes, initial motility of 25%, and a two hour percent motility of 15%. The Society also recommends a motile sperm dose of 25×10^6 .¹

Conclusion

Buck selection and management are critical to maintaining or improving the performance of the herd. The buck's health and breeding soundness should be evaluated regularly to ensure his ability to successfully breed and/or be collected for semen preservation. The ability to collect and cryopreserve semen has greatly changed the goat industry. Artificial insemination allows better control of reproduction, control of sexually transmitted diseases, and the rapid distribution of valuable genetics. Satisfactory fertility to AI requires careful attention to semen storage, handling and cryopreservation.

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