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Artificial Insemination in Goat: A New Prospect for Scientific Goat Breeding

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ABSTRACT

In India major portion of goat farming is extensive and breeding system follows uncontrolled natural mating. For better breeding management, there should be sufficient good quality stud bucks. However, it is unfortunate that due to lack of breeding bucks, more than 30% estrus does remain without service. Cryopreservation of superior native buck semen and artificial insemination are (AI) important tools for the proper management of breeding policy, including the ability to check for negative selection. AI is a part of assisted reproductive technology (ART) providing augmentation of genetic make-up in individuals. AI in sheep and goat was first described in detail in 1987. Globally, 0.5 million AIs are performed annually in the case of goats which is very less compared with other animals. Research on cryopreservation of goat semen and AI has been limited to few research institutes, and AI is least practiced in field condition. Therefore, the current manuscript focuses on the steps and advancement of AI in goat.

Introduction

Goat farming acts as an important tool in socio-economic development of rural small farmers, because of easy adaptability of this animal species in adverse climatic and nutritional conditions. In the changing livestock scenario goat farming has a promising future (Rana, 2019). Goat husbandry plays a significant role in the economy and nutritional security of landless, small and marginal farmers. The poor man's cow – goat can be maintained on a limited area and they can survive on a wide variety of vegetation in various agro-climatic conditions as well as on available shrubs and trees in adverse environmental conditions. Thirty-five million families in the country are dependent on goat husbandry for their livelihood and source of protein (Yadav et al., 2018). The decline of the pure breed from their native place is now becoming an issue worldwide, which leads to disappearance of the pure germplasm line. Low male to female ratio in goat population also become a biggest problem due to indiscriminate slaughter of the male goat and early castration of the male kids (Khandoker et al., 2011). There are only few breeding bucks of good genetic merit are available for breed improvement (Karim et al., 2019). According to the 20th livestock census of India,

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there are 32.10 million of a male goat in our country which is 14.65% lesser than the population in 2012 (37.62 million) whereas there is a 19.71%increased female population (116.78 million) than 19th census (97.56 million) (Livestock Census-2019, Govt. of India). In India, the major portion of the goat farming is extensive and breeding system follows the uncontrolled natural mating. Detection of superior breeding buck is challenging for the goat farmers (Tajonar et al., 2022). Small flock holders are not maintaining the breeding males and are completely dependent upon the large flock holders who generally maintain breeding males (Goel and Kharche, 2016). For better breeding management, there should be sufficient good quality stud bucks. However, more than 30% estrus does remain without service due to unavailability of breeding bucks (Karim et al., 2019). To reverse this trend of negative selection, preservation of pure and superior germplasm, cryopreservation of high-quality goat semen (Ranjan et al., 2022) and artificial insemination (AI) is the need of the hour. Keeping the importance of AIs of goat, current manuscript elaborately discusses about the steps and important information about AI in goat.

Importance of artificial insemination in goat

AI is first generation assisted reproductive technology. It is defined as the deposition of sperms into the female reproductive tract by artificial means and is popularly adopted in cattle and buffalo breeding. However, the introduction of AI in case of small ruminant breeding is still not popularized in India. However, AI has a huge importance in goat breeding.

Unavailability of the breeding buck: In India, the majority of the goat farmers are small, marginal or landless. They rear goats with a small flock size of about 4-5 animals and mostly in extensive or semi intensive management system. These farmers are not interested in maintaining the breeding buck in their small flock due the specific odor of the stud buck and most importantly as it is not economically viable to them. The farmers carry estrus does to the stud buck maintained by other farmers who have large flocks. However, sometimes due to the unavailability of the stud buck many of the does in heat are not mated and farmers face economical loss.

Genetic up-gradation: Our local and non-descriptive breeds have high prolificacy and ability to breed throughout the year. However, these breeds are mostly smaller in size and have low productivity. Therefore, genetic up-gradation of these breeds is possible by AI with high genetic merit buck semen such as Beetal or Sirohi to bring optimum economic benefits for farmers.

Conservation of pure germplasm: It is very unfortunate that due to early castration of the male goat, the farmers face the shortage of pure breed breeding buck. Due to indiscriminate cross breeding, we are losing our pure and native goat germplasm. Therefore, to conserve goat's genetic resources, AI with frozen semen from the pure breed buck is very important.

Prevention of diseases spread: Apart from the rapid distribution of superior sire's genes, AI also helps to eliminate the chances of spread of venereal and zoonotic diseases like Brucellosis, Vibriosis, Trichomoniasis etc.

Sustainable utilization of genetic merit: A buck with high genetic merit can breed a single doe in a single ejaculation during natural mating. Whereas, more than 100 does can be inseminated with single ejaculate using AI.

Techniques of artificial insemination in goat

There is wide variation in the size of different goat breed and therefore, we should standardize the insemination protocol accordingly. Different AI techniques are documented in small ruminants such as vaginal, cervical, laparoscopic intrauterine, and transcervical intrauterine insemination (Sathe, 2018).Vaginal (peri cervical) insemination (Evens and Maxwell, 1987; Nuti, 2007), cervical (intracervical) insemination (Nuti, 2007), laparoscopic intrauterine insemination (Shipley et al., 2007; Parkinson, 2009) and transcervical intrauterine insemination (Sohnrey and Holtz, 2005) were recorded in small ruminants with 5-15%, 40-80%, 60-80% and 71% conception rate, respectively. The overall pregnancy rate of AI with frozen-thawed goat semen ranges from 7 to 79% (Arangasamy et al., 2018).

Vaginal (peri-cervical) insemination: Vaginal insemination or peri-cervical insemination is mostly used for fresh or chilled buck semen. In this method, the semen is deposited in the cranial vagina of the estrus does without attempting to locate the cervix (no visual aid is used here). Vaginal insemination is effective in the does, where directly fresh semen is used; however, it gives poor conception rate with chilled or frozen buck semen (Leboeuf et al., 2000).

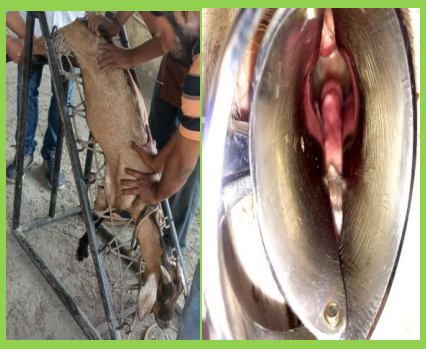
Cervical (intracervical) insemination: Cervical or Intracervical insemination is the universally preferred technique of insemination in small ruminants, where the external OS-cervios-service is assessed by using an illumination device and the insemination pipette or syringe (also called gun) is then passed through the vaginal speculum directly into the cervix. AI of does is generally very similar

to that of ewes. However, this is much easier to perform an intrauterine insemination via the cervix (cervical insemination) in goats than in sheep, as the caprine cervix is relatively easier to traverse than the ovine cervix. Among above mentioned techniques, cervical or intracervical insemination technique is more popular and economical in field conditions. The steps of this technique are discussed below in Fig. 1, and while doing following points should be kept in mind: - 1. Do not penetrate the cervix more than 1.5 inches, 2. Use slight pressure to work the insemination gun through the cervix, and 3. Inseminator can massage the clitoris or vulva of the doe for a few seconds.

1. Take proper history from the owner

2. Examine the doe for vaginal swelling and discharge

3. Confirming the estrus by a sterile vaginal speculum after restrain the doe and lifted the hind quarter with an angle of 45°.



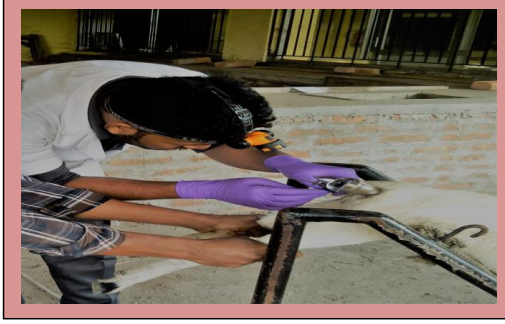
4. Remove the frozen straw from liquid nitrogen tank with the straw tweezer and place it in a thawing box filled with warm water at 37°C for 30 seconds

5. Dry the straw with paper towel and load in a sterile AI gun

6. Lubricate the vaginal speculum with non spermicidal lubricant

7. Clean the vulva and perineal region of the doe with sterile cotton

8. Insert the lubricated vaginal speculum into the vulva carefully and assessed the cervical opening by a light source



9. Insert the insemination gun into the speculum positioned it into the opening of the cervix

10. Deposit the semen slowly by pushing the plunger forward

11. Remove the insemination gun and vaginal speculum slowly.

12. Hold the doe in same position for 60 to 90 sec.

Fig. 1. Steps of cervical artificial insemination (AI) in goat

Laparoscopic intrauterine insemination

In the case of laparoscopic insemination, the semen is introduced directly into the uterine horns at a location closer to the site of fertilization. Therefore, we can reduce the amount of semen used for insemination by using this strategy to go through the cervical barrier. This approach allows for more sustainable use of semen because fewer sperm are needed for each insemination.

Transcervical intrauterine insemination

A special, unique catheter is used to painlessly and directly transfer the semen into the uterine lumen. However, in this technique, the animal must be positioned specifically, the cervical region must be retracted and fixed, and tools with unique shapes must be used to hold the animal and allow the insemination gun to pass through the cervix.

Heat symptoms and insemination time in doe

In case of does, the length of estrus is 36- 48 hours with an estrous cycle of 18-21 days (Fatel et al., 2011). The does in estrus show different symptoms by which farmers can detect the heat of the animals. They show symptoms like restlessness, off fed, frequent bleating, frequent micturition, flagging of the tail, etc. The vulvar mucosa of the estrus does become pink in color and swollen and moist. During the start of the heat, the vaginal mucous remain watery and seen in the cranial vagina. During the late heat or standing heat, the mucous became thick cloudy and observed on the floor of the vagina. This is the ideal time of insemination because the ovulation of the does occur during the late estrus. So, the farmers are advised to bring the does after 24-30 hours of heat symptoms. Sometimes, if the farmers are not able to notice the exact time of heat symptoms, then double insemination is also advised. In case of double insemination first insemination should be done 12-24 hours after the observation of heat signs and second insemination is done after 12 hours of first insemination.

Conclusions

AI is a potential first generation tool of assisted reproductive technology that can be used as a part of scientific goat breeding. Still AIs techniques are not so much popular in case of goats due to lack of proper training of the field veterinarians, AI workers and government interventions. In India, the AI is currently practiced by some research institutes, universities and non-governmental organizations. Indeed, the technique is easy to perform and economical to the goat breeders, however field level training, awareness and availability of frozen buck semen are needed.

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