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Popular Article

Seasonality of reproduction in sheep

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Sheep is an important economic livestock species, contributing in Indian economy especially in arid, semi-arid and mountain areas. According to 20th census (2019), total livestock population is 536.76 million among that sheep population in country is 74.26 million which is increased by 14.1% over previous census. In sheep population, India has 3rd position in the world. In India, Telangana is major contributing state in sheep population. The harsh environmental conditions in arid and semi-arid areas, lack of pasture land for grazing, low fecundity, prolonged postpartum anestrus, seasonality of breeding are some reasons for poor economic returns experienced by rural sheep farmers depend solely on sheep for their livelihood.

Sheep is seasonal polyoestrous animal with average length of oestrus cycle is 17 days and oestrus period last for 24-36 hours. Generally, there are 3-4 follicular waves are evident in sheep during breeding season and results in ovulation. It has been noticed that during the transition period from breeding to seasonal anestrus, there is failure of emergence of follicular waves due to insufficient FSH level, low oestradiol production which may attributed to decreased sensitivity of ovaries to gonadotropin.

Seasonality is one of the most special characteristics in ovine reproduction described as “Nature’s Contraceptive”, a naturally occurring phenomenon to induce reversible pattern of fertility and infertility in adult mammals. Seasonality in reproduction is an adaptation by the animals whereby

they give birth to young ones when the period of their survival is at most favourable. The seasonality is most pronounced in temperate regions as compared to tropical and subtropical regions. Due to less variation in day length in tropical climate; sheep tends to breed throughout the year.

Factors affecting seasonality:

1) Photoperiodism: Day length and photoperiod is key regulator of reproduction in seasonal breeders. Day length has dominating control over the initiation and termination of breeding season in temperate regions. As the day light decreases, the breeding season of sheep is initiated while increasing day light or equal length of day and night leads to ending of reproduction. The eyes of mammals are only photoreceptor organ responsible for photoperiodism and retina transmits the signal to the Suprachiasmatic nuclei (SCN) of hypothalamus which exerts control over pineal gland for nocturnal production of melatonin.
2) Melatonin hormone: Melatonin hormone is synthesised and secreted by pineal gland in diurnal fashion where level is highest during night and undetected during the morning. The role of melatonin in breeding is not direct but it has been noted that pinealectomy, lesions in SCN disrupts the photoperiod responses. Anterior pituitary expresses maximum numbers of MT1 receptors play vital role in seasonality via control over the production of Gonadotropins (LH& FSH) and Prolactin and ultimately results in onset of breeding season.
3) Thyroid hormone: Thyroid hormone also have key role in seasonality. Thyroid hormone are required for transition from breeding to anestrus state but not vice-versa from anestrus to breeding season. In short day breeders, the longer photoperiod induces the expression of Deiodinase2 enzyme which convert T4 into T3 leading to termination of breeding season. It is supposed that T3 acts via nuclear receptors in Medio Basal Hypothalamus (MBH) and other areas of brain and KISS1 and Rfrp genes which encodes the neuropeptides KISS1 and Rfrp3 which are major targets of thyroid hormones in MBH in context to seasonal breeding. KISS1 is a potent stimulator of GnRH and express its peak during breeding season while Rfrp3 has both negative and positive control over the Gnrh production, expressed at peak during non-breeding season in sheep.
4) Neural mechanism: Seasonal breeding is under the control of Hypothalamus-Pituitary-Gonadal axis where secretion of Gonadotropins (LH and FSH) is activated during the breeding season. The pronounced seasonal changes in the hypothalamus response to estradiol also has effect on seasonality where the negative feedback during the seasonal anestrus period while positive

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feedback during breeding season on GnRH secretion. Dopaminergic neurons also have role in seasonal breeding in sheep which blocks the estrogen negative block in anestrus ewes while direct stimulation of these neurons inhibits GnRH/LH pulses frequency irrespective of season. Estrogen also increases the neural activity of Tyrosine hydroxylase (TH) which is rate limiting enzyme in dopamine synthesis, result in inhibition of GnRH pulses.

5) Kisspeptin: kisspeptin is a key regulator of GnRH release (gateway of GnRH release) and has important role in seasonality in sheep. The strong inhibition by oestradiol decreases the number of kisspeptin peptides as well its mRNA expressing cells during anestrus in sheep and decreasing the positive input by kisspeptin to GnRH release.

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