THE ESTROUS CYCLE AND SEASONALITY IN SHEEP AND GOATS

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Defining the Estrous Cycle

The estrous cycle is commonly defined as the series of physiological events occurring between periods of estrus, where estrus is the time of sexual receptivity, or heat[1]. Females that exhibit estrus, or cycle, multiple times within a given period are considered polyestrous species. Some females will cycle year-round, whereas others, such as sheep and goats, exhibit estrus during a specific season. In sheep and goats, peak sexual activity occurs during fall months, making them a seasonally polyestrous species.

Length of the estrous cycle in sheep is on average 17 days but can vary between 14 and 19 days. Average duration of estrus is 24 to 36 hours, with ovulation occurring toward the end of estrus or approximately 24 hours after the onset of estrus. In goats, the length of the estrous cycle is an average of 21 days but can vary between 18 and 24 days. Average duration of estrus is 36 hours. However, the estrus stage may last 12 to 48 hours, depending on breed and environmental factors, such as the presence of a buck and the season. Ovulation tends to occur toward the end of estrus, although it may occur anywhere from nine to 72 hours after estrus begins.

Communication Between Hormones

Communication between the brain and reproductive tract is established by many hormones. Some of the primary reproductive hormones responsible for events of the estrous cycle are:

- Gonadotropin releasing hormone (GnRH) — Produced by the hypothalamus in the brain. Its main function is to stimulate the production of luteinizing hormone (LH) and follicle-stimulating hormone (FSH) from the anterior pituitary.
- Luteinizing hormone (LH) — Produced by the anterior pituitary within the brain in response to GnRH. The two primary functions of LH are to promote formation of a corpus luteum on the ovary and to stimulate ovulation.
- Follicle-stimulating hormone (FSH) — Produced by the anterior pituitary within the brain in response to GnRH. Like its name states, the main function of FSH is to stimulate growth of follicles on the ovaries. The largest and dominant follicle is referred to as a Graafian follicle and will be the follicle that ovulates. Goats may have more than one follicle mature into a Graafian follicle, therefore causing multiple ovulations for the development of twins, triplets, etc.
- Estrogen (E_2) — Produced by follicles on the ovaries. As a follicle grows, it produces greater amounts of estrogen. The dominant follicle, called a Graafian follicle, produces the most estrogen and ends up being the follicle that ovulates. Estrogen also stimulates heat, or sexual receptivity, during estrus.
- Progesterone (P_4) — Produced by the corpus luteum on the ovary. After ovulation, the follicle develops into a corpus luteum in response to LH. The corpus luteum will produce progesterone for most of the estrous cycle. Progesterone has many functions, but it primarily works to support pregnancy (think pro-gestation) when conception occurs. Progesterone also works to suppress the production of GnRH, LH, FSH and estrogen through negative feedback mechanisms.
- Prostaglandin (PG or $PGF_{2\alpha}$) — Produced by the uterus when pregnancy does not occur. It works to destroy the corpus luteum and stop production of progesterone. This allows follicles to develop again and allows estrogen production to increase. Consequently, if prostaglandin is administered during pregnancy, it can cause abortion.

Commercial ewe with twin lambs in a pasture.

Understanding Seasonality

In seasonally polyestrous species, the hormone melatonin regulates the production of GnRH. Goats and sheep, as well as deer, are referred to as short day breeders because they exhibit peak sexual activity throughout the fall months. Longer nights in the fall and winter months stimulate increased melatonin production from the pineal gland in the brain. Melatonin then stimulates an increase in GnRH from the hypothalamus to initiate the course of hormones involved in the estrous cycle.

When daylight begins to increase and nights become shorter, less melatonin is produced. A decrease in melatonin corresponds with a decrease in GnRH. Consequently, estrous cycles become irregular or cease altogether until fall occurs again. Animals lacking or not exhibiting regular periods of estrus are said to be in a period of anestrus. More specifically, since most sheep and goats do not exhibit signs of sexual receptivity during the spring and summer months, they are experiencing a period of seasonal anestrus. It should be noted that some breeds of sheep do tend to exhibit estrus regularly throughout the year. This is particularly common in hair breeds, such as Dorper sheep, in tropical and subtropical climates.

Summary

An understanding of the hormones and physiological processes involved in the estrous cycle of sheep and goats can improve herd management through setting the breeding season at the most opportune time. It also gives a foundation for the use of an appropriate estrus synchronization protocol for timing of artificial insemination or breeding by natural service. All of these can serve to decrease labor input, improve management efficiency and increase profit in a flock or herd.

References

[1]Senger, P. L. Pathways to Pregnancy & Parturition. Edited by P. L. Senger. 3rd ed.: Current Conceptions, Inc., 2015.

Grey doe with twin kids grazing between trees.

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