

Vet Call

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Puberty — endocrine control and methods for intervention

Puberty in the beef heifer is considered to be the time at which she is able to express estrous behavior (heat) and ovulate a fertile egg. The maturing of the system that induces ovulation of the first egg, as well as the hormonal changes that induce the first expression of behavioral estrus, are the result of a gradual increase in hormone production (luteinizing hormone [LH] and follicle-stimulating hormone [FSH]) by the pituitary gland.

The gradually increasing secretion of LH initiates ovarian production of steroid hormones (estrogens), resulting in follicle maturation and ovulation. The first ovulation is usually not accompanied by signs of heat. It is generally believed that a certain amount of progesterone is needed during a period preceding estrus in order to induce estrous behavior and for the following cycle to be of normal length.



Once the heifer has gone through a cycle with corpus luteum (CL) development or has been exposed to sufficient progesterone levels from other sources (such as MGA® in the feed), the following cycles are normal.

The onset of puberty is primarily influenced by age and weight within breed. Other factors that can influence the onset of puberty include exposure to bulls, time of year and exposure to progestogens.

Weight and age

Veterinarians and reproductive physiologists know target weights can be used to ensure that a large percentage of heifers within breed types have reached the body weight that coincides with onset of puberty. An Angus heifer is predicted to reach puberty at about 60-65% of her mature weight. If you know the average mature weight of the herd, the target weight for heifers to reach puberty is simply that weight multiplied by 0.65. If you do not know cow weights, the herd's average frame score can be used to predict mature weight, and hence heifer target weight.

However, weight is not the only controlling factor. A minimum age requirement must be reached in order for heifers to reach puberty. Age at puberty can be decreased by selecting for breeds that tend to be younger at puberty, selecting within a breed for younger age at puberty, or crossbreeding with another breed that has a similar or younger age at puberty. Angus cattle are considered to be about average in age at puberty when compared to other breeds.

Exposure to adults

Some studies indicate exposing prepuberal heifers to bulls or bull urine decreases age at puberty. However, other studies do not show the same results.

Exposure of prepuberal heifers to mature cows or cycling heifers does not decrease age or weight at puberty.

■ Season

Although considered animals with a nonseasonal estrus, cattle are prone to exhibit seasonal effects on reproductive performance. This is shown by a younger age at puberty for heifers born in the fall vs. those born in the spring.

Progestogens

LH secretion (and hence the hormonal control mechanism) during the prepuberal period is controlled predominantly by negative feedback of estrogens on the area of the brain known as the hypothalamus. Estrogen negative feedback starts to decrease about 50 days before heifers reach puberty, and LH secretion then begins to increase.

In addition to the direct effect increased LH secretion has on ovarian/follicular development, LH also indirectly influences uterine growth as ovarian/follicular development matures. Uterine weight increases in association with increased estradiol, which is produced as follicular development nears puberal status.

Progesterone and synthetic progestogens have been shown to induce puberty in heifers, and management systems that capitalize on this result have been developed. If the heifer is within approximately 50 days of puberty, and estrogen negative feedback has already begun to decline, treatment with progestogens will increase LH secretion. Hastening the decline of estradiol negative feedback will result in attaining puberty at a younger age and a lighter weight than without progestogen treatment.

Researchers at the USDA Experiment Station in Miles City, Mont., showed that more prepuberal heifers (8.5 months old and 549 pounds) given a progesterone implant for six days plus an estradiol injection 24 hours after implant removal showed estrus and ovulated within four days than heifers treated with estradiol alone. The implant used in the Syncro-Mate-B® synchronization system is a synthetic progestogen and acts to help induce puberty in heifers.

Another commercially available synthetic progestogen is melengestrol acetate (MGA). Research has demonstrated the ability of MGA to induce puberty in heifers, especially heifers near the age and weight requirements for spontaneous induction of puberty. Conception rate at first service for heifers that attained puberty while being treated with MGA administered orally for 14 days, followed by prostaglandin (PGF_{2α}) given as an intramuscular (IM) injection 17 days after the final day of MGA feeding, was not different from that of control heifers that attained puberty during the same period.

Ionophores

Ionophores were originally cleared for use to improve the feed efficiency of feedlot cattle on high-concentrate diets and to improve pasture cattle gains. Now cleared for use in replacement heifers, inclusion of ionophores in heifer diets has been shown to increase the number of heifers reaching puberty by the start of the breeding season, decrease age at puberty, decrease weight at puberty, increase

CL weight, and increase the amount of progesterone produced.

The decrease in age at puberty was independent of improved average daily gain (ADG) and increased body weight. Some researchers have speculated that changes in ruminal fermentation patterns to favor propionic acid production generates a response that influences the mechanisms regulating puberty.

Anthelmintic treatment

Internal parasites can negatively affect virtually any production characteristic of beef cattle, including gains from weaning through first pregnancy.

The presence of internal parasites affects nutrient utilization and possibly alters metabolism in infected animals. Minimizing the negative effect of internal parasites with the use of broad-spectrum anthelmintics able to kill inhibited stages of *Ostertagia ostertagi* improves the efficiency of gain for replacement heifers. This, in turn, increases body weight and hence the number of heifers cycling at the beginning of the breeding season.

It is interesting, however, to note that improvements in reproductive response in replacement heifers treated with anthelmintics is not solely due to reaching target weights faster than untreated heifers.

It is noteworthy that some experiments found the correlations between weight gain or prebreeding heifer weight and puberty in ivermectin-treated heifers approached zero. This indicates the gain response does not fully explain the earlier onset of puberty.

Therefore, other pathways affecting onset of puberty, besides weight

gain, are being stimulated due to treatment with anthelmintics. These pathways are probably related to parasite burden in the growing animal.

Summary

- Earlier puberty in heifers can be attained by genetic selection for earlier sexual maturity both within a breed and between breeds.
- Nutritional development so heifers will reach target weights is also necessary in order to have a high percentage of heifers reaching puberty prior to the start of the breeding season.
- Exposure of prepuberal heifers to bulls may have a beneficial effect on age and weight at puberty, but simply being with cycling heifers or cows will not.
- Utilizing progesterone products will induce puberty and is most successful in heifers near the age and weight of spontaneous initiation of puberty.

Proper nutritional development, as well as utilization of the commercially available progesterone-containing products to synchronize estrus (Synchro-Mate-B or MGA), ionophores and anthelmintics, will ensure the greatest percentage of heifers are puberal and available for breeding at the start of the breeding season.



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