

The Dairy Cow Heat Cycle

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The Colorado dairy industry has seen tremendous changes in the past 12 years. New and more effective heat synchronization and superovulation programs have been developed. Sexed semen is now commercially available in Europe and should be available in the US after various non-science issues have been resolved. New heat detection aids (e.g. HeatWatch) are available to more accurately detect heat, and bST has been approved for use in lactating dairy cows. We have also made advances in our basic understanding of nutrition and genetics.

As a result, milk production has increased approximately 15% over the past 12 years (20,736 lbs per lactation in 1990 compared to 23,722 lbs in 2002). However, not all changes have been positive. Reproductive performance has continued to decline during this period. Services per conception have increased by 27% (2.03 in 1990 compared to 2.77 services per conception in 2002) and days open by 24% (130 in 1990 compared to 170 days open in 2002).

Managing reproduction in large dairy herds is difficult and can be just down right frustrating. We are continuously looking for that magic elixir that is going to solve all of our cows' reproductive problems. However, that is simply not going to happen. Mel DeJarnette of Select Sires once stated, "When a piece of equipment or machinery is broken, it's impossible to fix it unless you thoroughly understand the parts and how they are 'supposed' to work. The same is true with your cows and your reproductive management program. The more you understand about the cow, the more your management will cater to her needs, improving your AI results, and the quality of your cow herd at the same time". I agree with this statement wholeheartedly. The intent of this article is to review the hormonal changes that occur during the heat cycle of the cow. Knowing how the reproductive system normally functions will allow you to better manage reproduction in your problem cows.

The heat cycle for the cow is approximately 21 days in length (range 18 to 24 days). There are a number of ovarian and hormonal changes that occur during this 21-day period. These changes are shown in figure 1 and are describe in detail thereafter.

The Period of Heat

Day 0 of the heat cycle is the day of heat. This is the period of the heat cycle in which the cow will stand to be mounted by the bull or herd mate. Most textbooks will tell you that heat lasts for approximately 18 hours in the cow. However, under continuous surveillance with the HeatWatch system, it was observed that cows are in heat for only 6 to 8 hours. During this time, there is a structure on the ovary known as the follicle. The follicle is a fluid filled blister-like structure that contains the egg. The follicle also produces the hormone estrogen and it is this hormone that is responsible for the increase in vaginal mucous secretion during heat, standing heat, and the increase in uterine 'tone' that aids in sperm transport. Another function of estrogen is to trigger the release of gonadotropin releasing hormone (GnRH) from within the brain.

Ovulation, Fertilization and Formation of the Corpus Luteum

GnRH is responsible for causing the release of another important hormone from within the brain – luteinizing hormone (LH). LH is the hormone that will act on the ovary to cause the follicle to ovulate (the release of the egg from the ovary). The egg is released into the oviduct about 32 hours after the onset of heat. Fertilization will take place in the oviduct if sperm are present. The fertilized egg (embryo) will remain in the oviduct for 3 to 4 days before entering the uterus.

Following ovulation, LH will also cause the remnants of the follicle to develop into the corpus luteum. The corpus luteum is an extremely important structure on the ovary. As the corpus luteum grows it begins to secrete the hormone progesterone between 4 and 5 days after heat and reaches maximum size and progesterone output at 9 to 10 days after heat. Progesterone is essential for pregnancy. It prevents the cow from coming into heat and ovulating as well as prepare the uterus for pregnancy

Regression of the Corpus Luteum

If the cow does not become pregnant, the uterus will release the hormone prostaglandin (PG) on day 16 to 18 of the heat cycle. PG will cause regression (death) of the corpus luteum, resulting in a rapid decline in progesterone. However, if there is a successful pregnancy, the embryo will block the release of PG so that the corpus luteum continues to secrete progesterone.

Period from Corpus Luteum Regression to Heat

The decrease in progesterone allows for an increase in GnRH. In addition to stimulating the release of LH, GnRH also stimulates the release of follicle stimulating hormone (FSH). FSH acts on the ovary to stimulate rapid growth of another ovulatory follicle. The follicle will secrete estrogen to cause the next heat and ovulation. The cycle is repeated until a successful pregnancy occurs.

The heat cycle of the cow is much more complex than what I have described. However, understanding the basic principles of the heat cycle will allow you to better utilize heat synchronization, AI, and management of problem cows.