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The detection of estrus in cattle raised under tropical conditions: What we know and what we need to know

Carlos S. Galina [a,*], Agustín Orihuela [b]

[a] *Departamento de Reproducción, Facultad de Medicina Veterinaria y Zootecnia, Universidad Nacional Autónoma de México, 04510 México*
[b] *Facultad de Ciencias Agropecuarias, Universidad Autónoma del Estado de Morelos, Av. Universidad 1001 Colonia Chamilpa, Cuernavaca Morelos 62210, México*

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Abstract

Lack of accuracy in estrus detection in cattle is a major constraint affecting the implementation of techniques such as artificial insemination (AI) and embryo transfer (ET). For this reason clinicians have opted to pharmacologically manipulate the estrus cycle. The advantages and shortcomings of using this approach to improve the implementation of AI and ET are discussed in this review. Moreover, in order to highlight the reasons why estrus detection is difficult in cows kept at grazing in the tropics, this review underlines social and behavioral traits hindering the capacity of the casual observer to accurately identify cows in estrus.

Keywords: Tropical conditions; Estrus cycle; Bovine; Estrus synchronization; Progesterone

Introduction

The development of more efficient and cost effective estrus detection techniques for cattle depends on a thorough understanding of the changes in behavior and physiology of the female during its estrus cycle. Variability in the expression of estrus behaviors both between individuals and over successive estrus cycles complicates this process (Orihuela, 2000).

Social interactions including dominance may play an important role in the manifestation of estrus behavior (Hafez and Lindsay, 1965; Galina et al., 1996). The accuracy and efficiency of direct observation as an estrus detection technique is affected by the frequency, duration and timing of the observation periods (Hurnik et al., 1975; Orihuela et al., 1983). Furthermore, environmental factors related to the time of year (Galina and Arthur, 1990), such as weather conditions (Williamson et al., 1972), day length (Phillips and Schofield, 1990), ambient temperature (Zakari et al., 1984; Tucker, 1982; Pennington et al., 1985) and photoperiod (Hansen and Hauser, 1984) can influence the sexual receptivity and reproductive efficiency of cattle. Management practices, housing environment, nutrition, genetic factors, age and physiology status can also affect the manifestation of overt signs of estrus (Orihuela, 2000).

Hormones related to the estrus cycle with particular reference to the onset of estrus

Estrus detection is a major constraint for the successful implementation of procedures such as artificial insemination (AI) or embryo transfer (ET). The accuracy of estrus detection is associated with sound management practices such as the correct identification of estrus signs, of which riding behavior (mounting) is the most reliable. However, other signs such as licking and smelling the genital area, chin resting and butting can complement the picture for achieving accurate results.

At the onset of estrus, cows display sniffing and chin resting followed by mounting behavior and then standing heat. Sniffing and chin resting are, however, not useful as predictors of estrus because they are not displayed by all animals at every estrus, and they are also exhibited at other stages of the estrus cycle with no apparent consistency (Solano et al., 2005).

* Corresponding author.
E-mail addresses: cgalina@servidor.unam.mx (C.S. Galina), aorihuela@uaem.mx (A. Orihuela).

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During the normal bovine estrus cycle there are visible changes in the ovary, for instance: close to estrus, the preovulatory follicle grows to a larger size producing noticeable amounts of estradiol (Beg et al., 2003). These increasing estrogen concentrations will, in turn, promote behavioral estrus and the release of LH to cause ovulation. Blood estradiol concentration reaches its highest level at the same time as the maximum behavior score (Lyimo et al., 2000). Indeed, the mean milk estradiol concentration increases up to the milking period, immediately before the first expression of standing behavior, and is followed by a decline at milking, immediately after the onset of estrus (López et al., 2002). About 10 h after the display of estrus behavior, ovulation occurs and a corpus luteum (CL) is formed, which leads to the production of increasing concentrations of circulating progesterone as this structure matures (Okuda et al., 2001). Early embryonic development and the sustainability of a pregnancy are regulated by the life span of a healthy CL. If pregnancy fails to be established, the release of prostaglandin F2α ensures luteolysis and the formation of a new follicular wave, which in turn will produce the ovulatory follicle capable of promoting the behavioral signs of estrus (Fig. 1).

With the increasing use of ultrasonography, a body of information has been published in the last 10 years documenting in great detail the follicular dynamics around the time of estrus and following ovulation (Fricke, 2002). Several authors have advanced the concept that a rhythmic follicular growth during diestrus will facilitate the formation of a vigorous follicle increasing the opportunity for pregnancy (Bo et al., 2003). Moreover, the manipulation of follicles growing during diestrus either by puncturing (Eppig, 2001) or by using GnRH (Wiltbank et al., 2002) prolongs the life span of a CL, decreasing estradiol concentration and the further secretion of PGF2alpha, which is a communication path between the growing follicle, the CL and the embryo in the uterus to ensure the establishment of a pregnancy or the restoration of a new cycle (Thatcher et al., 1989; Mann and Lamming, 1999).

The scenario in cattle with regular estrus cycles facilitates the pharmacological manipulation of estrus as, when the majority of animals have a CL, this structure can be eliminated by using a luteolytic agent such as prostaglandin. Alternatively, a normal CL lysis can be achieved by keeping the animal on an artificial progesterone regimen. However, dairy cattle have been metabolically pushed almost to the limit. Milk production indices per cow have increased nearly twofold in 15 years and the reproductive capacity of cattle specialized in milk production has suffered the consequences of this metabolic burden. For example, conception rate following artificial insemination (AI) has gone down from 40–50% in the 1960s to 20–25% at the turn of the 20th century (Lucy, 2001).

Economic profitability of a dairy farm is based, in part, on the calving interval of the cows. The optimal interval is 365 days. To achieve this, the cow needs to be pregnant within 85 days postpartum. The first and most problematic step in this process is the determination of the optimal time for AI, which is based on estrus behavior. The expression of estrus behavior is very discrete in modern dairy herds, which results in missed opportunities for breeding and, consequently, in longer calving intervals.

According to Saumande and Humblot (2005), estradiol and other ovarian hormones regulate not only the duration of intervals between the onset of estrus and the LH surge but also between the LH surge and ovulation. Moreover, milk production also affects the duration of estrus and standing time to accept

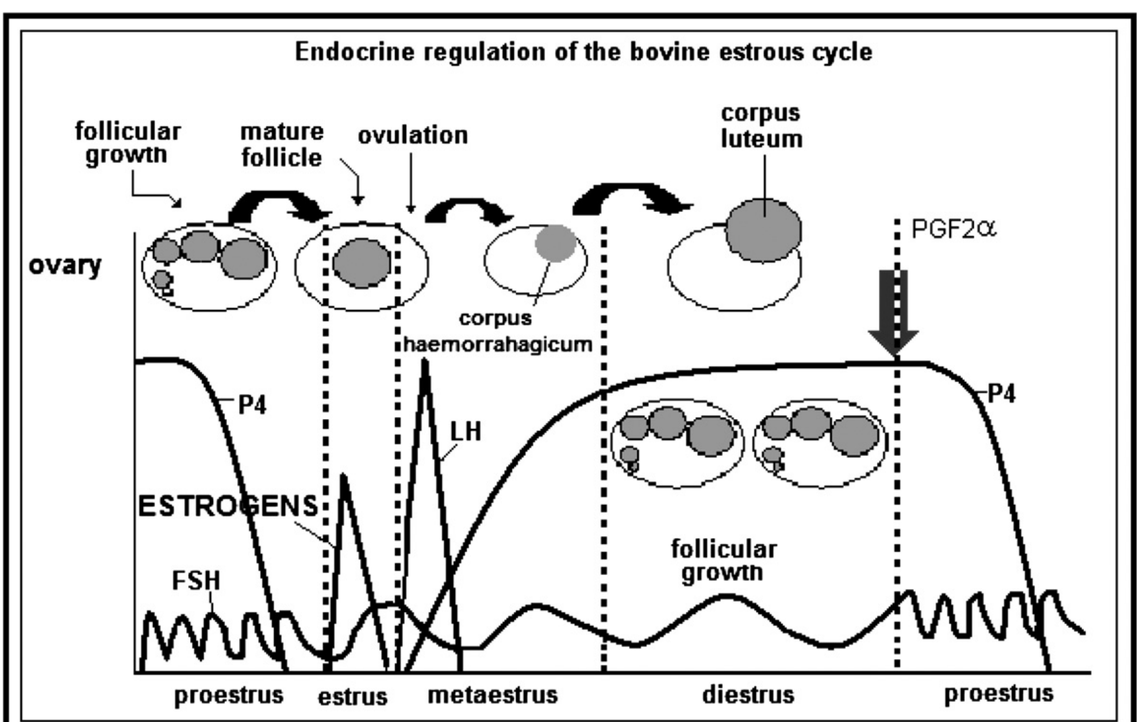

Fig. 1.