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Bubaline versus bovine reproduction

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Abstract

Fertility in water buffalo (*Bubalus bubalis*) is considerably lower than that in cattle (*Bos taurus* and *Bos indicus*). Poor breeding efficiency is attributed to late onset of puberty, seasonality, poor estrus expression, and long calving intervals. Accurate estrus detection is a prerequisite for efficient reproductive management. Established reproductive management techniques in cattle can be successfully applied to water buffalo because of the similarities in the anatomy, physiology, and endocrinology of reproduction between the two genera.

Keywords: Water buffalo; Cattle; Reproduction; Technology; Management

1. Introduction

Water buffalo are generally managed quite differently from cattle. Most of the buffaloes in India and Pakistan, and the countries of Southeast Asia, where the vast majority of the world's population of ~170 million buffalo [1] reside, are in the care of small holders. Buffalo in these countries are kept primarily for draft purposes and as a source of milk. By contrast, most cattle are raised in herds and on farms. Cattle have been selected specifically as dairy animals or beef animals largely, through the use of AI and more recently embryo transfer. Globally, there has been minimal genetic selection for fertility in buffalo, which are generally regarded as poor breeders [2]. Poor breeding is attributed to late maturity, poor estrus expression, prolonged calving intervals, and seasonal reproductive patterns.

2. Reproductive anatomy

The reproductive tract of the water buffalo (*Bubalus bubalis*) is quite similar to that of domestic cattle (*Bos taurus* and *Bos indicus*). The tubular genitalia of the buffalo are generally more muscular and firmer, and the uterine horns are more coiled than those of the cow. The body of the uterus is much shorter (1–2 cm) than that of the cow (2–4 cm). The cervix of the water buffalo is smaller than that of the cow (length 3–10 cm, diameter 1.5–6.0 cm) and its canal is more tortuous, which probably accounts for less dilation of the external os during estrus. The average number of cervical folds in water buffalo is three [3].

The inactive ovaries of the mature water buffalo [4] are smaller (3.0 cm × 1.4 cm × 1.0 cm; 2.9–6.1 g) versus (3.7 cm × 2.5 cm × 1.5 cm; 5–15 g) in the cow [5]. There are differences due to variations in breed, environmental conditions, season, and management practices.

3. Puberty

The onset of puberty occurs later than in cattle. The age at first estrus is difficult to determine, due to the difficulty of estrus detection. First estrus occurs at 15–18 and 21–24 months in river buffalo and swamp buffalo, respectively; it varies considerably with the level of nutrition and body condition score [6].

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4. Estrous cycle

Water buffalo are seasonally polyestrous with an average cycle length of 21 days (range 18–24 days), and an average duration of estrus of 18 h (range 5–36 h). Compared to cattle, estrous behavior in water buffalo is much more subtle, and homosexual behavior, i.e. females mounting females, is rare. Secondary signs such as swollen vulva, reddening of the vulvar mucosa, mucous vaginal discharge, and frequent urination are not reliable indicators of estrus. Ovulation occurs ~30 h after the onset of estrus (range 18–45 h). Twin ovulations are rare. The diameter of an ovulatory follicle is ~10 mm. The diameter of the mature CL ranges from 10 to 15 mm versus 12.5 to 25.0 mm in the bovine. The ovulation papilla, or crown, of the CL does not protrude much beyond the surface of the ovary, making it more difficult to identify by palpation per rectum (Fig. 1). The CL of pregnancy is invariably located ipsilateral to the gravid horn. The growth, selection, regression and ovulation of follicles were monitored by ultrasound in 30 river buffaloes throughout a spontaneous estrous cycle during the breeding season (autumn in Brazil) [7]. As in cattle, follicular growth occurred in waves in buffaloes. Two-wave cycles were most common (63.3%) followed by three-wave cycles (33.3%) and a single wave cycle (3.3%). The number of waves influenced the length of the luteal phase and the estrous cycle.

5. Estrus detection

Covert or silent estrus is the single largest factor responsible for poor reproductive efficiency in buffalo [8]. Estrus detection is a prerequisite for efficient reproductive management. Accurate estrus detection is essential when hand-mating to selected sires is practiced. To compensate for the lack of overt estrous behavior among females, estrus can be detected with the aid of teaser animals, or pedometers, or it can be induced with hormonal treatments. Teaser animals can be bulls with a lateral deviation of the penis [9] and an epididymectomy, or androgenized females [10]. Vasectomized bulls per se are less desirable due to the risk of spreading venereal diseases. Teaser animals should be fitted with a chin-ball marking device to identify the animals in estrus.

Fig. 1. The corpus luteum of the water buffalo (left) is more deeply embedded in the stroma than the corpus luteum of *Bos indicus* (right). The ovulation papilla is also less prominent in the water buffalo, hence more difficult to palpate per rectum. Scale bar = 6 mm.

6. AI

Successful AI depends on the quality of the semen, the skill of the inseminator, the accurate timing of the insemination, and the health and condition of the female. The optimal time for insemination is 8–12 h after onset of estrus. The bio-stimulatory effect of the teaser bull allows for a general increase in reproductive efficiency in a herd by improving the percentage of animals cycling, and by improving the pregnancy rate from 19 to 43% [11]. Although buffalo are polyestrous, fertility is reduced during the off-breeding season (spring and summer) during the period of increasing daylight and summer heat.

7. Synchronized insemination

Results of single or double injection regimens with $PGF_{2\alpha}$ are comparable with those obtained in cattle [12]. Synchronized ovulation and timed AI (OvSynch: GnRH, Day 0; $PGF_{2\alpha}$, Day 7; GnRH, Day 9; AI, Day 10) is a well-established reproductive management technique in cattle, especially in dairy cows. In Brazil, two OvSynch protocols (GnRH versus LH) for timed AI were evaluated in 335 buffaloes [13]. Follicular dynamics were monitored by ultrasonography every 12 h on Days 0–2, on Day 7, and then every 6 h from the time of the second GnRH or LH injection on Day 9 until the time of ovulation. The interval from treatment to time of ovulation (26.5 h versus 24.4 h) did not differ between the two treatments (GnRH versus LH, $P > 0.05$). Conception rates of the buffaloes artificially inseminated in the field were 64.2%. Pluriparous buffaloes had higher conception rates than primiparous buffaloes ($P < 0.05$).

In a separate study of the OvSynch protocol, an intravaginal progesterone releasing device (CIDR-B) was inserted at the time of the first GnRH injection (Day

0). The CIDR device was removed 7 days later, at the time of $PGF_{2\alpha}$ treatment (Day 7). Pregnancy diagnosis was made by ultrasonography 30 days after AI. Conception rates in the control group, which did not receive progesterone, were 55.4% (36/65), and 57.5% (61/106) in the treated group which did receive progesterone ($P > 0.05$).

Different protocols were evaluated to determine the efficiency of synchronization of ovulation and timed AI in buffaloes during the non-breeding season (spring and summer) [14]. In Group 1 ($n = 96$) buffaloes received a CIDR plus 2.0 mg of estradiol benzoate i.m. (Day 0). On Day 9, the CIDR was removed and $PGF_{2\alpha}$ and 500 IU eCG were administered. On Day 11, the buffaloes received 1500 IU hCG i.m., with AI 14 h later. In Group 2, buffaloes were treated according to the standard OvSynch protocol, and were inseminated 16 h after the second GnRH injection. Group 1 had higher ($P < 0.01$) conception rates than Group 2 [53.5% (46/86) versus 28.2% (11/39)].

8. Conclusions

Reproductive management and selection for fertility have been used less for water buffalo than for cattle. Poor expression of estrous behavior is the primary factor responsible for low reproductive efficiency. Difficulties in estrus detection can be ameliorated by the use of teaser animals. In addition, artificial control of the estrous cycle has provided an efficient means of increasing reproductive efficiency.

9. Illustrations

Go to the Visual Guide to Theriogenology (http://drostproject.vetmed.ufl.edu), select the Bubaline Guide and/or the Bovine Guide.

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