Summer Anoestrous in Buffaloes-A Review

Anjali Kumari*, Meesamraza and Ramadevi Pampana

Indian Veterinary research Institute, Bareilly, Izzatnagar-243 122 (UP), India.

Abstract
Buffalo is an important contributor to milk, meat, draught power and leather production in many developing countries. Heat stress is a well-known problem causing huge economic losses to the buffalo breeders as well as dairy industry, since decades. The thermal stress primarily affects the hypothalamic–hypophyseal–ovarian axis. It is well-accepted that hyper-prolactinaemia as a result of thermal stress inhibits the secretion of both FSH and LH at hypophyseal level, which affects various reproductive functions and leads to decrease in reproductive efficiency. Hence heat stress needs to be alleviated by effective management to maintain the reproductive efficiency in buffaloes and prevent economic losses.

Keywords: Summer, Heat stress, Anoestrus, Buffalo.

1. Introduction
Buffalo (Bubalus bubalis) is known as the world’s second most important milk animal because it shares more than 95% of the milk produced in South Asia (Javaid et al., 2009). Buffaloes have immense agricultural importance by virtue of their high production potential through meat and milk for mankind besides being a source of sustenance to the poor and marginal farmers as well as landless laborers in the developing world (Gupta and Das, 1994; Abdolghafour and Sahgir, 2014). It alone contributes approximately 96.8% of the total milk to the dairy industry in Asia (Cockrill, 1981), and approximately 12.8% of the total world milk production in spite of being only 11.6% of the total bovine population in the world (FAOSTAT, 2007). Buffaloes can efficiently convert poor quality and fibrous feeds into high quality protein like meat, milk and valuable by-products (Kaneepan et al., 2013). Agarwal et al. (2009) demonstrated a better digestive ability of buffaloes than cattle to utilize poor quality roughage. Climatic factors such as air temperature, solar radiation, relative humidity, air flow and their interactions, often limit animal performance (Sharma et al., 1983a, b; Mishra et al., 2015a), of which air temperature is the most important. Heat stress is a well-known problem causing huge economic losses to the buffalo breeders as well as dairy industry. Heat stress is the state at which the mechanisms activate to maintain animal’s body thermal balance, when exposure to elevated temperature. Elevated body temperatures result due to elevated surrounding temperature causing reduction in gradient between the body and the environment. The environmental factors associated with heat stress which affect the physiological systems governing thermal regulation and the maintenance of positive heat loss, are primarily ambient temperature, relative humidity (RH) and radiant energy. In tropical and subtropical areas, high ambient temperature is the major constraint on animal productivity (Marai et al., 2008; Shelton, 2000). The effect of heat stress is aggravated when heat stress is accompanied with high ambient humidity (Marai et al., 2008). Exposure of buffaloes and other animals to the hot conditions evokes a series of drastic changes in the biological functions that include depression in feed intake, efficiency and utilization, disturbances in metabolism of water, protein, energy and mineral balances, enzymatic reactions, hormonal secretions and blood metabolites (Mishra et al., 2015b). Such changes result in impairment of reproduction and production performances. Heat stress directly affects the breeding efficiency of female buffalo and reduces the intensity and duration of oestrus.

2. The Effect of Heat Stress on the Females Reproductive Traits

2.1 Oestrus
Heat stress directly affects oestrus. Maximum display of sexual activity occurs in the morning and midnight, when the ambient temperature is low as compared to noon when the lowest activity is seen. El-Wardani (1995), and El-Wardani and El-Asheeri (2000) observed that the buffaloes exhibited the signs of oestrus in the early morning (3.00 to 9.00 h) and in the evening (15.00 to 21.00 h) with a peak in early
morning (about 37%), while the lower percentage was at noon (about 12% of oestrous cases started during the period from 9.00 to 15.00 h). Ovarian activity decreases in hot summer and increases during winter and spring (Williamson and Payne, 1971), as well as, anoestrus is produced (Bond et al., 1960) due to heat stress. The decline in feed intake and in the quantity and quality of feed may, aggravate the negative influence on the adrenocortical function during summer and spring (Palta et al., 1997) leading to reduced pregnancy rate in females are shown on the ova, their fertilization and consequent development of embryos (Neville and Neathery, 1974).

3. Effect of Summer Stress on Ovarian Function

Some early studies reported no quiescence of reproductive rhythm (Pandey and Raizada, 1979) evident by the presence of follicular growth followed by atresia (Takkar et al., 1983). Razdan et al. (1981) found the presence of smooth quiescent ovaries during summer without any corpus luteum. Further a recent report on this line indicated the presence of quiescent ovaries in most buffaloes in summer months (Nanda et al., 2003). Morphological and histochemical studies revealed both normal as well as atretic follicles of variable sizes in atretic buffalo ovaries (Guraya, 1979). The histological studies reported a reduced follicular growth and plenty of follicular atresia of primary to tertiary follicles in ovariain hypofunction (Ribeiro et al., 1987). Neglia et al. (2003) reported that buffalo oocytes are more sensitive to heat stress than cattle oocytes. Most of the reports suggest that season has a significant effect on buffalo oocyte yield and quality. (Zoheir et al., 2007).

4. The Effect of Heat Stress on the Hypothalamic-Hypophyseal Ovarian Axis

Heat stress has a direct effect on the neuroendocrine setup in buffalo (Razdan, 1988). They are very susceptible to thermal stress (Pandey and Roy, 1966) during summer, especially when exposed to the direct sun rays as they have poor cutaneous evaporative cooling mechanism owing to low density of sweat glands. Buffaloes get little protection by virtue of their scant hair coat (Cockrill, 1981) and high relative humidity further accentuates the condition (Misra et al., 1963). The heat stress causes hyper-prolactinemia, reduced luteinizing hormone (LH) frequency, poor follicle maturation and decreased oestradiol production in anoestrus buffaloes (Palta et al., 1997) leading to ovarian inactivity. Another important factor determining the reproductive seasonality of buffalo is the photoperiod and information regarding photoperiod is conveyed to the neuroendocrine system by the circadian secretion of melatonin from the pineal gland (Morgan and Williams, 1989). The following factors are influencing seasonal reproduction in female buffalo:

4.1 Melatonin

The role of melatonin in the regulation of reproductive seasonality is fairly well established in seasonal breeders such as sheep and mare, while a few investigations have been made to clarify the role of this hormone in buffalo reproduction. Seasonal trend in melatonin production has been reported in Italian Mediterranean buffaloes with highest (Seren et al., 1995).

4.2 Prolactin
Prolactin is directly associated with the ambient temperature and may mediate the seasonal effects on reproduction in buffalo (Singh and Chaudhry, 1992). Buffaloes show hyperprolactinaemia during hot summer months (Singh and Chaudhry, 1992), which is attributed to the seasonal changes in pineal metabolism (Paraneswaran et al., 1983) and hyper-prolactinaemia has been proposed to be a possible cause of summer anoestrus in the species (Singh and Madan, 1989). Prolactin may block the hypothalamic mechanism responsible for episodic release or inhibit the positive feedback of oestrogen on LH secretion. So it interferes with oestrous cycle and fertility by exerting its effect both at hypothalamus (Sheth et al., 1978) as well as at ovarian level and it also affects ovarian steroidogenesis by altering the number of LH receptors (Sheth et al., 1978). A higher plasma concentration of PRL makes the ovaries refractory to the influence of FSH and LH resulting in anoestrus and this leads to an ovulatory oestrous cycle and consequent poor breeding performance in summer (Paraneswaran et al., 1983). The mean serum prolactin levels are reported to be higher in anoestrus buffaloes than the basal levels in normal cycling buffaloes (Heranjal et al., 1979b).

4.3 Luteinizing Hormone and FSH
Luteinizing hormone plays an important role in contributing ovarian inactivity in buffaloes during summer months (Razdan et al., 1981) and secretion was lower during summer compared to winter (Aboul-Ela and Barkawi, 1988). Further, the optimal LH surge was also reported to be absent in anoestrus buffaloes in summer and the decreased in LH level is attributed to the inhibitory action of progesterone and PRL (Singh and Chaudhry, 1992). Buffalo heifers show seasonal changes in the level of circulating FSH which coincide with the pattern of breeding (Janakiraman et al., 1980) and the lowest value during hot months. It was reported that the ratio of FSH to LH is lower in hot summer months compared with peak breeding season (Janakiraman et al., 1980).

4.4 Thyroid Hormones
Anoestrus associated with low thyroid function is common in buffaloes during summer season (Gupta and Dhoble, 1988) and had been postulated that high ambient temperature leads to hypothyroidism, which results in the reduced responsiveness of ovary to pituitary gonadotropins causing summer infertility in buffaloes (Roy et al., 1968). A seasonal pattern of thyroid function was documented in Indian buffaloes with low thyroid secretion rate and plasma T4 level during hot dry compared to cold season (Khurana and Madan, 1985).

4.5 Ovarian Hormones
The low reproductive efficiency of buffaloes in summer has been attributed to low luteal activity (Madan, 1984) with low level of progesterone in low breeding season compared to normal breeding season (Qureshi et al., 2000). The peak P4 concentration was found much lower during summer months than winter (Kaur and Arora, 1982). Concerning oestradiol concentration it was low in anoestrus rural buffaloes during summer and under organized herd, anoestrus buffaloes did not show any distinct pattern (Kaur and Arora, 1982). In contrary, Sarvaiya et al. (1993) observed two distinct patterns of oestradiol secretion in anoestrus buffaloes both under organized as well as village condition. The peripheral levels showed distinct climatic variation in buffaloes, being lower during summer compared to winter, which is attributed to environmental stress (Palta et al., 1997).

4.6 Corticosteroids
A high level of serum corticoids was reported in anoestrus buffaloes exposed to thermal stress during summer that leads to an altered gonadotropin secretion, which ultimately triggers the state of anoestrus (Singhal et al., 1984).

5. Conclusions
Buffaloes are perfectly suited to the summer season and muddy terrain, although they exhibit signs of great distress when exposed to direct solar radiation or when working in the sun during summer. Elevation of environmental temperature during summer affects male and female reproductive functions deleteriously. Heat stress causes summer anoestrus in buffalo which is one among the major obstacles hindering the reproductive efficiency in buffalo. It is a well-known problem since decades causing huge economic losses to the buffalo breeders as well as dairy industry. The thermal stress primarily affects the hypothalamic–hypophyseal–ovarian axis and it is well-accepted that hyperprolactinaemia as a result of thermal stress inhibits the secretion of both FSH and LH at hypophyseal level. Thermal stress exerts adverse effects on the conceptus and dam’s subsequent post-partum performance traits, are pronounced during initial, as well as, late stages of gestation.
References


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