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REVIEW ARTICLE

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Factors influencing seasonal anestrus in buffaloes and strategies to overcome the summer anestrus in buffaloes

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ABSTRACT

Reproductive managements of buffalo during the summer season a challenging task livestock's owner. There are different factors contributes to this condition; the most important are consequence of increased temperature and humidity that result in a decreased expression of overt sings of estrus and reduction in appetite and dry matter intake. The failure to express the overt signs of estrus is due to aberration in endocrine profile. Heat stress during the summer causes hyper-prolactinaemia, suppressing the secretion of gonadotropins, which alters the ovarian steroidogenesis. It also affects folliculogenesis, follicular fluid microenvironment and oocyte quality. A large number of hormonal regimens have been used with varying degree of efficacy in terms of estrus induction and conception rate. A combined strategy of improvement in environment, nutrition and management is pre-requisite for hormonal manipulation in order to improve productivity of buffaloes during the summer season.

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Introduction

Buffaloes are designated as the "Black Gold" in Indian sub-continent due to their high productive potential. The species is distributed over more than 40 countries of the world (Gordon 1996) and the population increased from 159 million (FAOSTAT 1997) to 177 million (FAOSTAT 2007). Buffaloes are raised in India mainly because of milk with higher fat percentage and meat. The species has been traditionally regarded as poor breeder having low fertility in the majority of conditions under which they are raised (Barile 2005). They suffer from some inherent reproductive problems characterized by delayed puberty and sexual maturity, seasonality in reproduction, silent estrus, poor estrus signs and prolonged postpartum service period, etc.. Domestic buffalo exhibits suspension of sexual activity during summer in almost all parts of the world (Shah 1990), manifests late maturity, long postpartum anestrous intervals, poor expression of estrus,

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poor conception rates (CRs) and long calving intervals. This condition is popularly known as summer anestrus and incidence generally varies between 36.6% and 59.5%. Buffaloes with summer anestrus fail to exhibit estrus as a result of aberration in the endocrine profile leading to ovarian inactivity. Increased day length with high environmental temperature causes hyper-prolactinaemia, suppressing secretion of gonadotropins which leads to an alteration in ovarian steroidogenesis. Heat stress also affects folliculogenesis, follicular fluid microenvironment and oocyte quality. Summer anestrus is a multifactorial condition, caused by environmental, nutritional, hormonal and managemental factors. Alleviating these etiological factors, the reproductive efficiency can be improved in this species. In the present manuscript, a brief description of the factors causing summer anestrus and available management and therapeutic practices are discussed.

Seasonality in the reproductive pattern

Buffaloes are polyestrus species and show estrus year around. However, a distinct seasonal pattern has been reported from different countries of the world including India, Pakistan and many other parts of the world (Gangwar 1980; Barile 2005). This has been attributed to environmental factors especially ambient temperature, photoperiod and feed supply, more than the genetic factors (Zicarelli 1994). More accurately, the species is seasonally polyestrus with distinct seasonal variation in the display of estrus, conception and calving. The expression of estrus is limited during colder months of winter, while sex vigour declines during the hot summer (Misra and Sengupta 1965). The indirect effect of climate on the vegetation pattern seems to be most influential in buffalo's natural reproductive pattern during the summer season. The photoperiod has a marked influence on the reproductive pattern through the pineal gland secretion that controls the shift. In contrast, buffaloes breed throughout the year in some areas of the world, but more in the spring and a little less in autumn.

Factors causing summer anestrus

Summer anestrus in buffaloes is a multi-factorial condition. The main contributing factors are kind of environmental, nutritional, endocrine and managemental.

Environmental factors

Ambient temperature, humidity and photoperiod play important role causing anestrus in buffaloes during the summer. It was reported that ambient temperature and relative humidity exert a direct effect on breeding efficiency (Roy et al. 1968). Unlike favourable environment, the high temperature and humidity causes aberration in the cycle length and shorter duration of estrus. Heat stress has a direct effect on neuro-endocrine setup in buffalo (Razdan 1988) because of their susceptibility to thermal stress (Pandey and Roy 1966) during the 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 black skin and scanty hair coat (Cockrill 1993). High relative humidity further accentuates the condition (Misra et al. 1963). The duration and intensity of light exposure to animals also influence the onset of the oestrous cycle (Zicarelli 1997).

Nutritional factors

Elevated temperature depresses feed consumption during the summer in tropical and sub-tropical conditions (Marai et al. 2002). The quantity of consumed nutrients, dry matter (DM) intake including crude protein declines and a negative nitrogen balance may occur (West 1999) during the summer due to heat stress. DM digestibility and protein/energy ratio is also reported to be decreased in heat stressed animals (Moss 1993). Further, the digestibility coefficient for each of DM and crude protein is also found significantly lower in the summer than winter in lactating Murrah buffaloes (Verma et al. 2000). Digestion and metabolism of non-pregnant buffaloes declined with exposure to 2–3 h solar radiation at an air temperature of 42°C (Zhengkang et al. 1994) and nitrogen retention decreased significantly under heat stress.

Buffaloes are generally reared under low input–output management system (Jainudeen 1989). In cattle, the nutritional stress alters the feedback mechanism between oestradiol and LH surge which reduces the sensitivity of follicles to gonadotropins (De Rensis and Scaramuzzi 2003), the mechanism perhaps similar in buffalo, but allied information is lacking in the said species. Several macro and micronutrients are found to be in a lower order in various types of anestrus buffaloes Abou-Zeina et al. (2009). The serum levels of Zn, Cu and Co are also documented to be lower than the normal level in anestrus buffaloes (Singh et al. 2006). Iron and copper are used routinely as an indicator for FSH, LH and oestrogen activity (Desai et al. 1982) and are found in decreased level in anestrus buffaloes than cycling animals (Yessein et al. 1994). Phosphorous deficiency Abou-Zeina et al. (2009), and hypocuprosis due to low copper–molybdenum ratio was reported to cause anestrus during the summer (Randhawa et al. 2004). Although, a large number of studies have been documented in relation to mineral profile in anestrus buffaloes but are inconclusive.

Endocrine factors

Heat stress is a major contributing factor to the low fertility of buffalo in the late summer months. Effects of heat stress on reproductive hormones and other physiological functions are a direct consequence of the increase in body temperature (De Rensis and Scaramuzzi 2003; Khodaei Motlagh 2003). Prolactin is directly associated with the ambient temperature (Wettemann and Tucker 1974) and may mediate the seasonal effects on reproduction in buffalo (Singh and Chaudhry 1992). During hot summer months, buffaloes show hyperprolactinaemia (Singh and Chaudhry 1992), which is attributed to the seasonal changes in pineal metabolism (Paraneswaran et al. 1983) and proposed to be a possible cause of summer anestrus in the species (Singh and Madan 1989). Prolactin may block the hypothalamic mechanism responsible for episodic release of LH or inhibit the positive feedback of estrogen on LH secretion, thus interferes with estrus cycle and fertility. At the ovarian level, it alters the number of LH receptors for ovarian steroidogenesis and ovaries become refractory to the influence of FSH and LH (Sheth et al. 1978). Further, the optimal LH surge is also reported to be absent in anestrus buffaloes in the summer. 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). Anestrus associated with low thyroid function is common in buffaloes during the 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 (Roy et al. 1968).

The low reproductive efficiency of buffaloes in the summer has also been attributed to low luteal activity (Madan 1984) which is characterized by lower mean progesterone level as well as the lower peak of progesterone level during the summer (Harjit and Arora 1982; Qureshi et al. 2000), perhaps the reason for poor conception. Estradiol concentration is reported to be low in anestrus rural buffaloes during the summer (Jain 1988; Sarvaiya et al. 1993). A high level of serum corticoids was reported in anestrus buffaloes exposed to thermal stress during the summer and a higher level of serum corticoids leads to an altered gonadotropin secretion, which ultimately triggers the state of anestrus Singhal et al. (1984).

Management factors

Management plays an important role in rearing of buffalo during the summer season. It is well-known that buffaloes are weak in estrus exhibition (Jainudeen 1988) which is further exacerbated during the hot season (De Rensis and Lopez-Gatius 2007). Majority of the buffalo during the summer shows silent estrus (Chaudhry 1988), characterized by less intense signs of estrus with shorter duration (Jainudeen and Hafez 2000). It was found that buffaloes tend to exhibit estrus mostly during the night or morning hours, which remain unnoticed by most of the farmers. So routine observation does not help much in the detection of estrus in buffaloes (Beg and Totey 1999) leading to prolonged service period during warmer months, Bughio et al. (2000).

Strategies for summer anestrus

Various strategies like environmental modification, improved nutrition, breeding, suckling management and hormonal therapy can be employed to improve the reproductive efficiency in buffaloes (Gupta and Das 1999).

Management practices

Summer breeding of buffaloes can be successfully carried out by changing farm management practices, Roy et al. (1968) to improve the efficiency of rural buffaloes reared under field conditions (Pant et al. 2002). Protection from direct solar radiation is the principle of real management in the species during hot summer months which includes provision of shade, loose housing system and application of water to the body surface by sprinkling or washing or providing wallowing (Razdan 1988). It has been shown that showers in addition to wallowing facilities increase the CR reported by Di Palo et al. (2009). Proper and extensive housing system and a shift from day to night grazing practices help in reducing the adverse effects on fertility and productive efficiency in buffalo during the summer (Razdan 1988; Neglia et al. 2009).

Improving estrus detection methods

Poor estrus detection is one of the factors that increase the calving conception interval of buffalo. The routine heat detection measures used traditionally in buffalo are inadequate to detect estrus during the summer season (Jainudeen and Hafez 2000) and thus use of an entire male during the cooler part of the day or night hours may improve the efficiency of estrus detection (Acharya 1988). In the field condition, observing the animal in the night and early morning for the signs of estrus would be beneficial to detect buffaloes in estrus. It is also to be kept in mind that estrus behaviour in buffalo has a lower intensity than in cows, hence requires critical watch to the animal and differently than the cows. Bellowing and homosexual mount is less pronounced in buffalo. Further, buffalo heifers show in frequent bellowing, differently than the buffalo cows showing continuous. Quantity of cervical discharge is less and may vary between 5 and 25 ml in buffalo heifers, requires closer look in the morning hour's detection.

Hormonal treatments

Various hormonal treatment regimens are followed to alleviate anestrus and stimulate ovarian activity, to induce or synchronize behavioural estrus or control ovulation (Barile 2005; De Rensis and Lopez-Gatius 2007). Different hormones were used either alone or in combinations producing varied degrees of success. Progesterone-based treatment regimens (PRID, CIDR, CRESTAR, Progesterone injections) either alone observed by Singh et al. (1983) or in combination with gonadotropins and $PGF_{2\alpha}$ reported by Neglia et al. (2003) proved to be very effective in inducing ovarian activity in the summer anestrus buffaloes.

Nutritional management

Feeding strategy for buffaloes during hot climate is imperative in reducing infertility problems especially summer anestrus. Provision for night feeding, grazing only in the morning and late in the afternoon can reduce the heat stress in buffaloes. Moreover, feeding green fodder or silage or hay, ad-libitum water and mineral mixture supplementation improve the efficiency of reproduction during the summer. Buffaloes if well fed can be detected in estrus during the night in the summer for regular breeding (Harjit and Arora 1982). Grazing animals have to be supplemented with minerals particularly with those which are deficient in forages or fodders and the energy balance also has to be maintained in the ration. Feeding buffaloes on roughage during the night will reduce the heat load on the animal (Acharya 1988).

There are several key areas of nutritional management which should be considered during hot weather. These include formulation for reduced DM intake, greater nutrient requirements during hot weather, dietary heat increment and avoiding nutrient excess.

Indigenous Technical Knowledge (ITK)/herbal treatments

The majority of the farmers use ITK to overcome the anestrus problems in buffaloes during the summer by offering locally available resources in different combinations. Perhaps in many cases, there are inadequate veterinary facilities at the village level; hence there is no alternative to accept the adoption of ITK/herbals for the treatment of their buffaloes, due to low costs of ITKs and availability. It was observed that the majority of animals (53.33%) overcome anestrus by keeping male with the female in practice; 45.00% by using boiled Maithi (*Trigonella foenum graecum*L.) with Wheat bran for three days; 38.84% by feeding 0.5–1 kg boiled Bajara (*Pennisetum typhoides*L.) mixed with Gur (Jaggery) for a week, and 30.24% by feeding 0.5–1 kg Masurdaal (*Lens esculentamoench*) in evening time. Furthermore, 20.46% of animals solved anestrus by using pigeon faeces (10–20 mg.) with flour (Kartikiyanand 1996; Sah 1999). To maintain the estrus cycle regular, six Fowl's egg for one week were provided to the animals and 12.67% of these overcome the problem. Also, this technique was previously suggested from, Mandal (1999) and Sah (1999) by using raw eggs. Finally, 16.30% of buffaloes solved anestrus following exercise and 3.84% by feeding 5–7 kg Maili (sugarcane juice supernatant) for three days during the winter season to induce the estrus in buffalo cows.

Conclusions

Summer anestrus is one among the major obstacles hindering the reproductive efficiency in buffalo and causing huge economic losses to the buffalo breeders as well as dairy industry. Buffaloes, during the summer show poor reproductive performance characterized by silent estrus and conception failure. Various environmental, nutritional endocrine and management factors are responsible for triggering this condition. High temperature and humidity together with increase day length alters the endocrine milieu resulting in poor estrus signs and failure of conception. A good and sound management is the best approach to tackle the summer infertility while other interventions like hormonal treatments can be employed with varying success. Attempts should be made to identify effective hormonal regimes for good CR rather than better induction of estrus in the summer affected buffaloes.

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