

# Unraveling the causes of summer anestrus in buffaloes: effective strategies for mitigation

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## Abstract

Summer anestrus refers to a temporary cessation of reproductive activity and the absence of estrous cycles in female buffaloes during the hot summer months. It is a common phenomenon that affects buffalo herds worldwide, leading to reduced fertility rates and economic losses in the dairy and livestock industry. This article explores the causes underlying summer anestrus in buffaloes and provides potential strategies to ameliorate its impact.

## Introduction

Buffaloes in the Indian sub-continent is highly valued for their productive potential and are often referred to as the "Black Gold." They are primarily raised in India for their milk, which has a higher fat content, as well as for their meat. However, they face certain reproductive issues such as delayed puberty and sexual maturity, seasonal reproduction patterns, lack of observable estrus signs, and extended periods of non-breeding after giving birth. This phenomenon, commonly known as summer anestrus, is prevalent in buffalo populations worldwide. Anestrus is characterized by the absence of regular estrus behavior, lack of discernible follicular or luteal structures in the ovaries. An inactive or non-functional ovary is a significant factor contributing to anestrus in buffaloes. Anestrus is a frequently occurring reproductive problem in buffalo populations. Buffaloes experiencing summer anestrus do not display estrus due to disruptions in their endocrine profile, leading to inactive ovaries. The combination of longer daylight hours and high ambient temperatures results in elevated prolactin levels, which suppress the secretion of gonadotropins and disrupt ovarian steroid production. Heat stress also has detrimental effects on follicle development, the microenvironment of the follicular fluid, and the quality of oocytes.

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## **Seasonality in the reproductive pattern**

Buffaloes are a polyestrous species, meaning they exhibit estrous throughout the year. However, different countries, including India, Pakistan, and various regions worldwide, have reported a distinct seasonal pattern in buffalo reproductive behavior. Environmental factors, particularly ambient temperature, photoperiod (day length), and feed availability, have been identified as key influences on this seasonal variation, rather than genetic factors. Estrus expression is limited during the colder winter months, while sexual activity decreases during the hot summer. The indirect impact of climate on vegetation patterns appears to be the primary cause of buffalo's natural reproductive patterns during the summer season. Photoperiod, through its influence on pineal gland secretion, plays a significant role in controlling these reproductive shifts. In some regions of the world, buffaloes breed consistently throughout the year, with a slightly higher frequency in spring and a slightly lower frequency in autumn.

### **Environmental factors**

Ambient temperature, humidity, and photoperiod significantly contribute to the occurrence of anestrus in buffaloes during the summer. Research has shown that ambient temperature and relative humidity directly impact breeding efficiency. Unfavorable environmental conditions, such as high temperatures and humidity, disrupt the length of the estrous cycle and reduce the duration of estrus. Buffaloes are particularly vulnerable to heat stress during the summer, especially when exposed to direct sunlight, as they have a limited capacity for cutaneous evaporative cooling due to their low density of sweat glands. Their black skin and sparse hair coat provide minimal protection. High levels of relative humidity further exacerbate these conditions. Additionally, the duration and intensity of light exposure have an influence on the initiation of the estrous cycle in buffaloes.

### **Endocrine factors**

Hormones play a crucial role in the development of summer anestrus in buffaloes, primarily due to the suboptimal functioning of the hypothalamo-hypophyseal-gonadal axis. The low reproductive efficiency of buffaloes during the summer has also been attributed to decreased luteal activity, characterized by lower average progesterone levels and reduced peak progesterone levels, which may explain the poor conception rates. Anestrus buffaloes during the summer exhibit low estradiol concentrations. Anestrus buffaloes exposed to thermal stress during the summer show higher levels of serum corticoids, which in turn lead to alterations in gonadotropin secretion and ultimately trigger the state of anestrus.

The role of melatonin in regulating reproductive seasonality has been extensively studied in seasonal breeders like sheep and mares, but its role in buffalo reproduction has received less



attention. Melatonin is produced by the pineal gland and its secretion follows a circadian rhythm, with significant levels observed only during the dark period. Research has shown a clear seasonal variation in melatonin production in Italian Mediterranean buffaloes, with the highest concentrations occurring during periods of shorter day length.

Prolactin (PRL), a hormone associated with ambient temperature, is believed to mediate the seasonal effects on buffalo reproduction. During the hot summer months, buffaloes exhibit hyperprolactinemia, which is thought to be influenced by seasonal changes in pineal metabolism and considered a potential cause of summer anestrus in the species. Prolactin may interfere with the hypothalamic mechanism responsible for the episodic release of luteinizing hormone (LH) or inhibit the positive feedback of estrogen on LH secretion, thereby affecting the estrous cycle and fertility.

Buffalo heifers exhibit seasonal fluctuations in circulating follicle-stimulating hormone (FSH) levels that align with the breeding pattern. The lowest FSH values are observed during the non-breeding season (March to June), which coincides with the hot months. Generally, the FSH levels in anestrus buffaloes remain lower compared to the baseline levels seen in normally cycling buffaloes. Furthermore, the pre-ovulatory FSH peaks that typically coincide with LH peaks are reported to be absent in non-cycling buffaloes during the hot months. The ratio of FSH to LH is also lower during the hot summer months compared to the peak breeding season.

Luteinizing hormone plays a significant role in contributing to ovarian inactivity in buffaloes during the summer months. Compared to the winter season, LH secretion is lower during the summer. Additionally, optimal LH surges are often absent in anestrus buffaloes during the summer, although some animals may experience an increase in LH levels from 3.06 to 8.67 ng/ml on certain days. The decrease in LH levels is attributed to the inhibitory effects of progesterone and PRL.

Anestrus associated with low thyroid function is common in buffaloes during the summer season. It has been postulated that high ambient temperatures lead to hypothyroidism, resulting in reduced ovarian responsiveness to pituitary gonadotropins, which contributes to summer infertility.

### **Management factors**

Management practices play a crucial role in the rearing of buffaloes during the summer season. It is widely recognized that buffaloes exhibit weak estrus behaviour, which becomes more pronounced in hot weather conditions. A significant number of buffaloes experience silent estrus during the summer, characterized by less noticeable estrus signs with shorter durations. It has been observed that buffaloes tend to exhibit estrus mostly during the night-time or early morning hours, which often goes unnoticed by many farmers. Therefore, routine observations alone are not sufficient for detecting estrus in buffaloes, resulting in prolonged service periods during the warmer months.



## **Strategies to ameliorate summer anestrus**

To enhance the reproductive efficiency of buffaloes, a range of strategies can be implemented, including environmental modifications, enhanced nutrition, optimized breeding practices, improved suckling management, and the use of hormonal therapy.

### **Managerial practices**

To improve the reproductive efficiency of buffaloes during the summer breeding period, altering farm management practices has been found to be a more favorable option than relying solely on hormonal treatments, particularly for rural buffaloes reared in field conditions. Implementing measures to protect buffaloes from direct solar radiation is considered a fundamental aspect of effective management during the hot summer months. Additionally, a modern management approach has been recommended to optimize reproductive efficiency and production in buffaloes during the summer, focusing on stress reduction and improving the nutritional status of the animals. Implementing measures to mitigate heat stress, such as providing shade, adopting a loose housing system, and utilizing water-based cooling methods like sprinkling, washing, or wallowing facilities during the hottest part of the day in summer, can significantly reduce the negative impact on buffalo fertility. Research has shown that buffaloes exposed to showers in addition to wallowing facilities achieved higher conception rates, possibly due to the prevention of early embryonic mortality through body cooling. In hot and humid areas, practices like showering, splashing, or spraying water on the body, along with appropriate housing and a shift from daytime to night-time grazing, are recommended to enhance the reproductive and productive efficiency of the animals. The conventional heat detection methods traditionally used in buffaloes are insufficient for detecting estrus during the summer season. Since buffaloes exhibit estrus predominantly during the nocturnal hours, implementing a system of heat detection during the cooler parts of the day or night-time, using a teaser bull, may enhance the efficiency of estrus detection.

### **Hormonal treatments**

Various hormonal treatment regimens are employed to address anestrus, stimulate ovarian activity, induce or synchronize behavioral estrus, or control ovulation in buffaloes. Different hormone combinations or single hormone treatments have been utilized with varying degrees of success. Progesterone-based treatments such as PRID, CIDR, and progesterone injections, either alone or in combination with gonadotropins and PGF2 $\alpha$ , have been reported to be highly effective in inducing ovarian activity during summer anestrus in buffaloes. Additionally, the combination of PRID and PMSG has shown superior results compared to PRID alone in terms of estrus induction, conception, and pregnancy rates. The ovsynch protocol, either alone or in combination with other

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hormones, has also proven to be beneficial in inducing estrus and improving conception rates in buffaloes. Attempts were made to utilize GnRH and its analogues for inducing the resumption of the estrous cycle in buffaloes during summer. However, these treatments did not yield the desired results due to their limited half-life and varying response depending on the size and stage of the follicles at the time of treatment. Additionally, it was observed that pre-treatment with insulin promotes follicular development, making the ovary more responsive. In cattle, insulin has been reported to increase the production of estradiol, leading to a feedback increase in LH release from the pituitary gland. Clomiphene citrate has been widely studied for the treatment of summer anestrus in buffaloes, with varying success rates in inducing estrus and conception. It has also been used in combination with progesterone, showing favourable outcomes. In addition to these conventional approaches, melatonin implants have been investigated as a treatment for seasonally anestrus buffaloes. A more recent advancement in this area is the utilization of antioxidants such as selenium, vitamin E, and zinc-methionine to improve fertility during the summer season.

### **Nutritional management**

Implementing an appropriate feeding strategy for buffaloes during hot climates is crucial to mitigate infertility issues, particularly summer anestrus. Strategies such as providing night feeding, allowing grazing only in the cooler morning and late afternoon periods, can help alleviate heat stress in buffaloes. This helps minimize heat stress and allows them to digest their food more efficiently. Additionally, offering green fodder, silage, or hay, along with ad-libitum water and mineral supplementation, can enhance reproductive efficiency during the summer. Well-fed buffaloes are more likely to exhibit estrus during the night, facilitating regular breeding. Provide access to salt blocks or mineral supplements formulated for buffaloes. This helps to replenish essential minerals lost through sweating and promotes overall health. Feeding buffaloes roughage during the night can help reduce the animal's heat load.

### **Conclusion**

Summer anestrus in buffaloes is a multifactorial issue influenced by heat stress, photoperiod, nutrition, and management practices. By implementing appropriate strategies to manage heat stress, optimize nutrition, manipulate photoperiod, and improve overall breeding and management practices, the adverse effects of summer anestrus can be minimized, leading to improved reproductive efficiency and productivity in buffalo herds.

