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EFFECT OF LIGHT ON BUFFALO HEIFERS AND COWS

L Vanajah* and M.M.Mahusoon

Department of Animal Science, Faculty of Agriculture, Eastern University, Sri Lanka.
Email: lvanajahthuraisingham@gmail.com*

ABSTRACT

The Asian buffalo (*Bubalusbubalis*) is capable of breeding throughout the year. In many countries a seasonal pattern of ovarian activity occurs. Longer days and stronger light-to-dark ratio during the non-breeding seasons reduce estrus activity and ovulation. Large ruminants benefit from sunlight and ultraviolet radiation in terms of their health and productivity, provided that there are no exceptionally high ambient temperatures present. Increased photoperiod enhanced growth until the onset of sexual maturity. At the age, animals utilised ration more efficiently due to a lower protein recovery rate.In the dairy, a long photoperiod speeds up growth and sexual maturity. The Photoperiod length is directly related to the development of calves and heifers. It has been demonstrated that the long day photo periodstimulates mammary parenchymal growth both before and after puberty.The wintertime photoperiod of Murrah buffalo calves was prolonged by artificial light for 4 hours, which resulted in earlier puberty and faster growth.The hormone melatonin, which is secreted by the pineal gland at night, serves as the body's internal signal for the rhythm of light and dark. Buffaloes are substantially more likely to be in oestrus when the days are shorter than when they are longer. The periodicity of the oestrous cycle is significantly influenced by the species' sensitivity to photoperiod as well as environmental influences. As their ovarian activity resumes at the start of the short day-length phase, buffaloes giving birth in the autumn exhibit shorter postpartum anoestrus.

Keywords: Photoperiod, Artificial light, Melatonin, Pineal gland

INTRODUCTION

The Asian buffalo *(Bubalusbubalis)* has two types of this species; the river type, which has an adult male weight range of 450–1000 kg, and produces 1000–3000 kg of milk annually; and the swamp type, which has an adult male weight range of 325–450 kg, and produces up to 600 kg of milk annually. The swamp buffalo is raised mostly for draught, whereas the river buffalo is raised primarily for milk.Buffalo are capable of breeding throughout the year, but in many countries a seasonal pattern of ovarian activity occurs. Perera 2011 stated this is attributed in tropical regions to changes in rainfall resulting in feed availability or to temperature stress resulting in elevated prolactin secretion, and in temperate regions to changes in photoperiod and melatonin secretion.In the buffalo (*Bubalusbubalis*), reproductive seasonality is characterized by behavioral, endocrine, and reproductive changes that take place across specific seasons of the year. Longer days and a stronger light-to-dark ratio during the non-breeding seasons reduce estrus activity and ovulationde Carvalho *et al.*, 2016. The well-known problems leading to low production in buffalos include late maturity, silent heat coupled with inadequate expression of estrus, irregular estrous cycle, seasonality in breeding, anoestrus, low conception rate, long postpartum interval, and recurrent breeding Prakash *et al.,* 2005.The

release of a hormone called gonadotropin releasing hormone (GnRH) from the hypothalamus is a critical prerequisite for the onset of puberty. When the photoperiod was extended by artificial light for 4 hours during the winter, Murrah buffalo heifers grew faster and experienced early puberty Roy *et al*., 2016. Therefore, a review study was carried out to gather information related to the effect of light on Buffalo heifers and cows which would lead to improve the performance of this species. The information was collected from research articles, books, proceedings, abstracts and journals to fulfil this study.

Effect of light on feed intake

Large ruminants benefit from sunlight and ultraviolet radiation in terms of their health and productivity, provided that there are no exceptionally high ambient temperatures present Hussein 2013. Hansen *et al*., 1983 stated that increased photoperiod enhanced growth until the onset of sexual maturity. At the age, animals utilised ration more efficiently due to a lower protein recovery rate because of the higher growth Varlyakov 1999. An increase in feed efficiency by extending photoperiod during winter in crossbred beef heifers corroborates the result of this study. They also observed a non-significant difference in DMI between the natural and extended photoperiod Roy *et al.,* 2016. In general, buffalo heifers with extended photoperiods had higher weights at first ovulation, younger ages at first ovulation, and higher feed intake Kassim *et al*., 2008. Compared to buffalo heifers exposed to natural photoperiods, those subjected to lengthy photoperiods such as 16 hours of light slightly increased their feed intake and body weight Kassim *et al*., 2008. Roy *et al*., stated in winter, extending the natural photoperiod by 4 hours of artificial light (160 Lux) led to faster growth and an earlier onset of puberty in Murrah buffalo heifers. The change in ambient temperature and background natural light at sunrise and sunset and during feeding times had a significant influence on eating behavior than the artificial lighting schedule Somparn *et al*., 2007.

Effect of light on growth

In the dairy, a long photoperiod speeds up growth and sexual maturityGupta*et al*., 2016.The Photoperiod length is directly related to the development of calves and heifers as well as the development of the mammary tissue in heifers Wankhade *et al*., 2019. It has been demonstrated that the long day photo period stimulates mammary parenchymal growth both before and after puberty Petitclerc *et al.,* 1985. When long day photo periodis altered throughout the pre-pubertal growing period, first lactation milk production is increased compared to short day photo period Rius and Dahl 2006. The underlying mechanism of these growth-promoting actions of long day photo periodis in line with the observed effects of long day photo periodon Insulin-like growth factor I and prolactin, which have a favourable impact on the development of lean tissue and the mammary gland Dahl *et al.,* 2012. As a result, photoperiod manipulation provides a management tool that potentially hasten the beginning of puberty and expedite the animals' growth.

Effect on puberty

Age at puberty, which is correlated with diet, is a key factor in the lifetime reproductive efficiency of buffalo heifers Kassim *et al*., 2008. The level of nutrition and feed intake had an impact on the timing of prepubertal development, an increase in luteinizing hormonesecretion, and it appears that the luteinizing hormonegenerating system in the hypothalamus. Luteinizing hormone secretion was elevated by a long photoperiod, reflecting metabolic state. Changes in the photoperiod are accompanied by a variety of behavioral and metabolic changes in addition to adjustments in the reproductive system and sexual behavior. Some species' feed consumption does not change concurrently, which shows that the shift in day duration has altered their metabolic processes Kassim *et al*., 2008. The release of a hormone called

gonadotropin releasing hormone (GnRH) from the hypothalamus, which induces the release of luteinizing hormone, is a critical prerequisite for the onset of puberty. GnRH is crucial in controlling the release of luteinizing hormone, the growth of follicles, and the secretion of steroid hormones. When the photoperiod was extended by artificial light for 4 hours during the winter, Murrah buffalo heifers grew faster and experienced early puberty Roy *et al.*, 2016. In beef heifers kept outside, photoperiod management affects when they reach puberty and how much prolactin they secrete. Feed intake, feed quality, and body weight increase all have a significant impact on when calves begin to go through puberty Roy *et al.*, 2016.

Effect of light on hormones

A circadian rhythmicity was noticed in buffaloes during the summer, and the findings show that excessive prolactin secretion affects fertility by reducing gonadal hormone (progesterone) release. Roy and Prakash 2007 study results of the current investigation led to the conclusion that prolactin and progesterone levels in the summer and winter are closely associated to buffaloes' ability to reproduce. The hormone melatonin, which is secreted by the pineal gland at night, serves as the body's internal signal for the rhythm of light and dark. In seasonal species like sheep, goats, and mares, the importance of melatonin in controlling ovarian cyclicity is well established. However, there have been few studies done to fully understand this hormone's function in buffalo reproduction Barile 2005. The melatonin profile in the more seasonal buffalo reflected changes in photoperiod, with hormone levels falling below 20 pg/ml during daylight hours and rising steadily after sunset (on average to 60 pg/ml) Terzano *et al*., 2012. To determine whether melatonin may function as a transductional signal of photoperiod in buffalo, Presicce *et al.*, 2004 conducted research Italian-raised Mediterranean buffalo cows served as the subjects of the experiments.Buffaloes are substantially more likely to be in oestrus when the days are shorter than when they are longer, proving that the duration of the day has a considerable impact on when ovarian activity resumes. In fact, Presicce *et al.*, 2004 found high levels of melatonin during the night in a study of buffaloes raised in farms with a clear seasonal reproductive trend.

Effect of light on seasonality

Barile 2005 stated that diet, food availability, or metabolic status have no direct effect on the buffalo's reproductive seasonality, whereas climate, in particular photoperiod, which is dependent on melatonin secretion, is crucial. The result that the period of higher reproductive efficiency is reversed in the two opposite hemispheres appears to provide additional evidence of the considerable influence of photoperiod Zicarelli 1997. According to a 13-year study by Pires *et al*., 2002 on Brazilian buffaloes, the majority of births (86.73 percent) took place in the first six months of the year, with only 0.65 percent occurring in October and November. Furthermore, near the equator, where the ratio of light to dark is constant throughout the year, the reproductive period is longer.The periodicity of the oestrous cycle is significantly influenced by the species' sensitivity to photoperiod as well as environmental influences. As their ovarian activity resumes at the start of the short day-length phase, buffaloes giving birth in the autumn exhibit shorter postpartum anoestrus than those giving birth in the spring andsummer discovered a mean postpartum anoestrus interval of 5.8 months in Australian Swamp buffalo cows, with variations depending on the calving season Barile 2005.

Effect of light on oestrous cycle

The length of the oestrous cycle and the level of heat expression have been demonstrated to be influenced by a number of factors including climate, temperature, photoperiod, and diet. Oestrous behavior in buffalo is harder to identify since it is less intense than it is in cows Barile2005. The estrous cycle lasts anywhere from 17 to 26 days, with a mean of around 21

days. However, the duration of the estrous cycle is more irregular in buffalo, and both abnormally short and long estrous cycles occur more frequently. This is attributed to a number of factors, including an unfavorable environment, poor nutrition, and irregularities in the secretion of ovarian steroid hormones Marai *et al.*, 2010. Numerous studies have found that a variety of factors influence how estrous behavior manifests in various cattle species. Environmental elements (such as temperature, season, and light), age and body weight, hormone imbalances, nutrition, and degree of production are among these elements. The effects of temperature, season, and light are all part of the environment. It also influences the duration of estrous Suthar and Dhami 2010. Apart from temperature and season, light also affects the estrous cycle that is the duration and intensity of light to which the animal is exposed Imran*et al*., 2014.

CONCLUSION

The Asian buffalo (Bubalusbubalis) has a year-round reproductive cycle. During the non-breeding seasons, estrus activity and ovulation are decreased by longer days and a stronger light-to-dark ratio. The growth of calves and heifers is directly correlated with the photoperiod length. A lengthy photoperiod in the dairy hastens the development of sexual maturity. The growth of calves and heifers is directly correlated with the photoperiod length. When the days are shorter than when they are longer, buffaloes are far more likely to be in oestrus.

REFERENCES

Barile, V. L. (2005). Reproductive efficiency in female buffaloes. Buffalo production and research. REU Technical Series (67) Rome: FAO, 77-107.

Dahl, G. E., Tao, S., & Thompson, I. M. (2012). Lactation Biology Symposium: Effects of photoperiod on mammary gland development and lactation. Journal of Animal Science, 90(3), 755-760.

de Carvalho, N. A. T., Soares, J. G., & Baruselli, P. S. (2016). Strategies to overcome seasonal anestrus in water buffalo. Theriogenology, 86(1), 200-206.

Gupta, S. K., Singh, P., Shinde, K. P., Lone, S. A., Kumar, N., & Kumar, A. (2016). Strategies for attaining early puberty in cattle and buffalo: A review. Agricultural Reviews, 37(2).

Hussein, H. A., & Abdel-Raheem, S. M. (2013). Effect of feed intake restriction on reproductive performance and pregnancy rate in Egyptian buffalo heifers. Tropical animal health and production, 45(4), 1001-1006.

Imran, S., Javed, M., Yaqub, T., Iqbal, M., Nadeem, A., Mukhtar, N., & Maccee, F. (2014). Genetic basis of estrous in bovine: A Review. Int. J. Adv. Res, 2, 962-966.

Kassim, N. S., Afify, A. A., & Hassan, H. Z. (2008). Effect of photoperiod length on some reproductive traits and hormonal profiles in buffalo heifers. Am. Euras. J. Agric. Environ. Sci, 3(4), 646-655.

Marai, I. F. M., Habeeb, A. A., Gad, A. E., & Mahrose, K. M. (2010). Rabbits productive, reproductive and physiological traits as affected by drinking saline water: a review. In The 6 th International Conference on Rabbit Production in Hot Climate, Assuit, Egypt (pp. 177-189).

Perera, B. M. A. O. (2011). Reproductive cycles of buffalo. Animal reproduction science, 124(3-4), 194-199.

Petitclerc, D., Kineman, R. D., Zinn, S. A., & Tucker, H. A. (1985). Mammary growth response of Holstein heifers to photoperiod. Journal of Dairy Science, 68(1), 86-90.

Prakash, B. S., Sarkar, M., Paul, V., Mishra, D. P., Mishra, A., & Meyer, H. H. D. (2005). Postpartum endocrinology and prospects for fertility improvement in the lactating riverine buffalo (Bubalusbubalis) and yak (Poephagusgrunniens L.). Livestock Production Science, 98(1-2), 13-23.

Presicce, G. A., Senatore, E. M., Bella, A., De Santis, G., Barile, V. L., De Mauro, G. J., ... & Parmeggiani, A. (2004). Ovarian follicular dynamics and hormonal profiles in heifer and mixed-parity Mediterranean Italian buffaloes (Bubalusbubalis) following an estrus synchronization protocol. Theriogenology, 61(7-8), 1343-1355.

Rius, A. G., & Dahl, G. E. (2006). Exposure to long-day photoperiod prepubertally may increase milk yield in first-lactation cows. Journal of Dairy Science, 89(6), 2080-2083.

Roy, A. K., Singh, M., Kumar, P., & Kumar, B. B. (2016). Effect of extended photoperiod during winter on growth and onset of puberty in Murrah buffalo heifers. Veterinary World, 9(2), 216.

Roy, K. S., & Prakash, B. S. (2007). Seasonal variation and circadian rhythmicity of the prolactin profile during the summer months in repeat-breeding Murrah buffalo heifers. Reproduction, Fertility and Development, 19(4), 569-575.

Sisk, C. L., & Foster, D. L. (2004). The neural basis of puberty and adolescence. Nature neuroscience, 7(10), 1040-1047.

Somparn, P., Gibb, M. J., Markvichitr, K., Chaiyabutr, N., Thummabood, S., & Vajrabukka, C. (2007). Effect of supplementary lighting on eating behaviour by corralled swamp buffalo (Bubalusbubalis) heifers in Thailand. Songklanakarin J. Sci. Technol, 29(2), 399-411.

Suthar, V. S., & Dhami, A. J. (2010). Estrus Detection Methods in Buffalo. Veterinary World, 3(2).

Terzano, G. M., Barile, V. L., & Borghese, A. (2012). Overview on reproductive endocrine aspects in buffalo. Journal of Buffalo Science, 1(2).

Varlyakov, I. (1999). Cattle Behaviour. Animal Behaviour. Book of Ethology. KOTA, Stara Zagora, 59.

Wankhade, P. R., Diwakar, V. K., Talokar, A. J., Aderao, G. N., Miranda, C. D., & Gourkhede, D. P. (2019). Effect of photoperiod on the performances of Buffaloes: A review. J. Entomol. Zool. Stud, 7, 177-180.