



Effect of weaning on performance of dairy buffaloes in tropical conditions - A review

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ABSTRACT

Weaning is one of the important management practices, which is mostly followed at organized dairy farms in India and abroad. Generally breeding programme at buffalo farms focusses on milk production, however weaning can additionally boost the total milk production of the dairy farm, apart from increasing the reproductive potential of adults and promoting scientific rearing of young calves. There is little information on early weaning of buffalo calves and its effect on production and reproduction performances of dams during post-partum in Indian buffaloes. However, early weaning may be associated with the restriction of colostrum feeding and essential nutrients for dairy buffalo calves. Breaking the maternal bond is stressful to the calf and lactating buffaloes, which can be evaluated by biochemical indicators of stress in bovine models. Although, weaning at birth is well established in dairy cattle, in case of buffaloes, it may yield significant outcomes in terms of estimating actual milk production and increasing precious buffalo milk in the market for human consumption. On the other hand, weaning practice in dairy buffaloes has been limitedly investigated and not reviewed properly under variable conditions. Keeping in view the impact of weaning, the present paper has been aimed to review the effect of weaning on performance of dairy buffaloes under tropical conditions. The weaning practices in dairy buffaloes can reduce the feeding cost of calves and increase the reproductive potential of the dairy animals through early resumption of post-partum ovarian cyclicity. However, more trials need to be conducted in dairy buffaloes for understanding the relationship between the behaviour of weaned animals and age of weaning towards better adaptability and optimum production at dairy farms.

Keywords: Behaviour, Growth, Production, Rearing, Reproduction, Stress, Weaning

Buffaloes are considered as black gold of India, which are divided into two groups, viz. Riverine and Swamp buffaloes having chromosome number (2n) 50 and 48, respectively (Yilmaz *et al.* 2012). Most of the buffaloes found in Indian subcontinent are generally riverine type and mainly used for milk and meat purpose (Safari *et al.* 2018). As buffaloes contribute a noteworthy portion in milk production of India, the maintenance of buffalo calves is of great importance. Health management and proper nutrition are the two most important aspects for effective buffalo calf rearing programme. Generally in the Indian subcontinent, two methods of neonatal calf rearing are practised, i.e. suckling and weaning. In the former method, calves are allowed to suckle one or two teats before or after milking the dams whereas in the later method, calves are taken away from their dams just after birth or later stage and they are reared either on pail or hand feeding method. The practice of weaning is more advantageous to calves in terms of scientific feeding, less disease occurrence while other benefits include estimation of actual milk production

of dam under hygienic conditions and enhanced breeding efficiency of dams (Rashid *et al.* 2013). Moreover, if accidentally calf dies, it does not affect the let-down and milking process of weaned dams. The practice of weaning is dependent on the age and social bond between the calf and dam (lactating mother); however, early weaning immediately after birth is more suitable in most of the dairy farm which makes the calf independent of suckling. In absence of suckling stimulus, cow or buffalo also get accustomed of milking which make the milking and calf feeding easier to manage as per the desire of the dairy owner. However, it is also supposed that sometimes weaning in buffaloes may also lead to difficulty in pail/bottle feeding in calves due to strong maternal instinct (Cruz *et al.* 2019) as well as behavioural changes in lactating dams or both. Keeping in view the advantage and challenges of weaning in buffaloes, the present article has been aimed to review the effect of weaning on performance of buffalo calves and dams under tropical conditions.

Rearing calves through suckling

The management practices of buffalo calves depend largely on the rearing methods and the technical knowledge of the handler at dairy farm (Bharti *et al.* 2015a).

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Small and marginal farmers in India generally keep new born buffalo calves with dams for milk let-down from their mothers (Kumar *et al.* 2017). It is believed that the suckled calves have better daily body weight gain, lower incidences of abnormal behaviours, better immune status and health as compared to weaned calves (Kamboj and Kumar 2013). Rearing of buffalo calves through natural suckling is very common in India as the suckling instinct of calf helps in normal let-down of milk. This also avoids possibility of unusual drop in milk yield and drying off in lactating dam. However, in this method of rearing, the actual amount of milk consumed by calf as well as milk yield of dam is very difficult to estimate. In tropical dairy animals, a long post-partum anestrus is one of the main factors affecting reproduction as suckling reduces the hypothalamic release of gonadotropin releasing hormones (GnRH), which results in insufficient pulsatile leutenising hormone (LH) release ultimately lengthening post-partum anestrus.

Calf rearing through weaning

Weaning process in buffalo calves completes generally at about 9–11 months of age under natural conditions (Reinhardt and Reinhardt 1981). But in artificial rearing calves are weaned at earliest possible age for economic purposes. In case of intensive dairy farming, buffalo calves are separated from their mothers immediately after birth or a few (3–6) days after birth and from this period onwards calves are fed on milk or milk replacer until 45–90 days of age (Khan *et al.* 2007, Gudev *et al.* 2007, Bharti *et al.* 2018). The practice of early weaning has some adverse consequences (Kumar *et al.* 2017) such as high stress level and inhibition of milk ejection in buffalo cows (do Nascimento-Rangel *et al.* 2014, Bharti *et al.* 2015a, 2015b). In conventional feeding programs calves are generally weaned after 6 weeks of age. Weaning at 2–4 weeks of age using a pre-starter to stimulate dry feed consumption has no adverse effect on physical (Morrill 1984, Morrill *et al.* 1984) or immunological (Reddy *et al.* 1985) development of weaned buffalo calves. In India and other developing countries, the dairy calves are reared on traditional rearing system on whole milk feeding and separation of calf from mother is usually practiced after rumen development of calf's compound stomach mostly at the age of 3–4 months. In addition to this, calf starter and green roughages are given *ad lib.* after two weeks of age onwards to fulfil the rest of dry matter requirement of calves. With restricted milk feeding from very beginning after birth, the calf starts nibbling on calf starter, green fodder and hay from 2nd weeks of life (Ranjhan *et al.* 1972). Limited milk feeding for calf rearing programme seems to be most useful and economical under current scenario of milk production in our country. Autumn-born calves could be early weaned in early spring while their dams grazed in low quality forest pastures, which can be efficiently used by dry cows (Casasus *et al.* 2005). Compared to cattle, buffalo calves struggle to achieve a successful weaning transition (Aref *et al.* 2016), which could compromise their future

performance (Fernandez *et al.* 1977, Zicarelli *et al.* 2007).

Weaning of buffalo calves and rumen development

According to some reports, early weaning may be associated with higher vulnerability to illness, high mortality rates as well as sub-optimal growth rate in buffalo calves (Aref *et al.* 2016). The late rumen development in buffaloes as compared to cattle may be due to reduced milk intake, postponed dental eruption and requirement of more care before being able to eat on their own (Vecchio *et al.* 2013, Bharti *et al.* 2015a, 2018, Singh *et al.* 2018). In case of artificial rearing of dairy calves, the weaning phase is very crucial in relation to disease prevalence (Curtis *et al.* 1988, Svensson and Leiberg 2006). Calves at this age are mostly susceptible for enteric and respiratory diseases (Radostits 2001, Lundborg *et al.* 2005, Svensson and Leiberg 2006). The alteration from pseudo-monogastric digestion to ruminant digestion is a delicate process for the young calf and mechanisms controlling ruminal transition are not entirely understood (Baldwin *et al.* 2004). Due to early weaning of buffalo calves, it has long been established that volatile fatty acids in the rumen stimulate early development of papillae in number and size (Sander *et al.* 1959). Most of the early-weaned calves had higher volatile fatty acid and microbial nitrogen concentration in the rumen juice than late weaned calves, which resulted to rapid development of ruminal function in early weaners. Health status, weight gain, and rumen development did not differ in calves weaned by the concentrate feeding system and the conventional whole milk feeding system (Roth *et al.* 2009). It was studied that prolonged milk feeding may withhold the onset of ruminal microflora (Lengemann and Allen 1959) and can slow the rate of establishment of rumen protozoa (Singh 1972).

Effect of weaning on growth of calves

Early weaning of buffalo calves cost approximately 18% less per kg of live weight than late weaning, which is associated with lower milk consumption (Abbas *et al.* 2017, Bharti *et al.* 2018). Yadav *et al.* (1999) reported that growth rate of female buffalo calves weaned at 6–7 months in individual stall-fed was more than the calves which were grazed and group fed. Sikka *et al.* (2002) reported that there was no significant difference in the total body weight gain in suckling versus non-suckling buffalo calves. Growth improvement in dairy cattle calves due to early weaning followed by intensive feeding has been reported by several authors (Fluharty *et al.* 2000, Schoonmaker *et al.* 2001). In contrast to this, Pordomingo (2002) reported that when early weaned calves were placed on a low-quality diet without supplementation, no improvement was observed (Fluharty *et al.* 2000, Schoonmaker *et al.* 2004). Calves those were weaned at 28 days and fed 3.8 litres of whole milk once daily had no adverse health effects and had acceptable growth and average daily gain (Hopkins 1997). Suckling system expressed better growth rates as compared to weaning, which may be due to higher nutrient intake

from whole buffalo milk to suckling calves as compared to mixed milk to weaned calves (Bharti *et al.* 2015a).

Health status and mortality of buffalo calves after weaning

Management of buffalo calves varies according to the system of production. Improper feeding causes high mortality rate even up to 52% in calves less than one month of age (Pasha 2013). In well managed dairy herds, buffalo calf mortality usually should not exceed five percent from birth to 30 days of age (Smijisha and Kamboj 2012). The higher mortality rates in the first weeks of life affect the welfare and production efficiency of buffalo farms (Masucci *et al.* 2011). Under the weaning condition, total serum immunoglobulins in body were lesser as compared to post colostrum feeding in buffalo calves (Bharti *et al.* 2015c). From birth, the intestine's ability to absorb immunoglobulin (Ig) decreases, so that by 9 h of age the calf absorbs only half the IgG it would have 8 h earlier (Kumar *et al.* 2017). Therefore, it is essential to consider the time from birth to the consumption of colostrums. Shimizu and Nagatoma (1978) reported that mortality of neonatal calves was attributed to health disorder like diarrhoea and pneumonia. Frequency of occurrence of diarrhoea in non-suckling buffalo calves was significantly higher than the suckling calves (Sikka *et al.* 2002). The mortality in buffalo calves was found to be highest in the age group of 6-30 days (67.20%) and lowest in 61-90 days (5.6%). According to some studies, occurrence of health problems such as alopecia, emaciated body, lameness, fever, umbilical complications, weakness, respiratory tract infection or nasal discharge especially in weaned calves immediately after birth could be associated with weaning stress due to breakdown of mother-calf bond and transition of feed quality from liquid milk to solid concentrate feed (Bharti *et al.* 2015a, Bharti *et al.* 2018).

Effect of weaning on production performance of dam

Presence of strong maternal instinct in buffaloes is one of the reasons for not weaning buffalo calves at birth or at early stage, as it may cause milk let-down problem (Bharti *et al.* 2016). Contradictory results regarding the effect of early weaning and milk production of dam were obtained. Some researchers reported that accidental calf mortality or weaning programs at 2 to 4 weeks of age had no effect on milk let-down and milking (Bharti *et al.* 2015a). According to Kumar *et al.* (2017) about 25% of buffalo/cows do not adapt to weaning as they do not let-down milk without being suckled. Singh and Brar (2006) reported that peak yield was higher in suckled dams than in their non-suckled buffalo dams. The total actual milk yield, lactation length and corrected milk yields were higher for suckling system as compared to dams of weaned ones (Kantharaja 2011). Fence line contact between buffalo calves and mother had positive effect on milk production as compared to complete visual separation (Kumar *et al.* 2017). Contrarily, Sikka *et al.* (2002) reported that non-suckling dams had longer lactation length and higher milk yield than suckling

dams. However, not only weaning affects milk ejection, but exposure to different novel stimuli such as a new environment, milking machine noise and close human contact has a great role (Saltalamacchia *et al.* 2007, Cavallina *et al.* 2008 and Polikarpus *et al.* 2014).

Reproductive performance of dam

The inter-calving period is one of the most important parameters used to evaluate the productive and reproductive efficiencies of a farm or herd (Zicarelli *et al.* 2007). It is reported that early weaning hastens early resumption of ovarian activity and better reproductive performance in buffalo/cows (Ramirez *et al.* 1992, Abdalla 2003, Bharti *et al.* 2017). Post-partum anoestrous remains a major reproductive limitation in buffaloes. The calving interval in 48% to 66% of buffaloes is 14 months as dictated by exposure to the environment and unpredictable management. The main objective of buffalo calf operations is to obtain one calf per buffalo every year after a gestation period of approximately between 312 and 334 days (Desta 2012, Kumar *et al.* 2017). The average period of first post-partum heat and first post-partum artificial insemination are shorter in buffalo cows whose calves were weaned after birth as compared to buffalo cows whose calves were weaned at 45 days (Williams 1990, Bharti *et al.* 2017). Weaned buffaloes with dummy calves had shown improvement in post-partum reproductive performance as compared to suckled buffaloes (Singh *et al.* 2016). It has been observed that regression of the corpus luteum of pregnancy is very rapid by 10th day post-partum in case of non-suckled swamp buffaloes and the total number of follicles was greater during the first 15 days (Agrawal *et al.* 1979), whereas in suckled swamp buffaloes (Jainudeen *et al.* 1983) no follicular activity was detected by rectal palpation during the 1st month after calving but, mature follicles were palpable in the majority of animals (63%) between days 29 and 56 after parturition (Walters *et al.* 1982). The conception rate in primiparous cow was 37% higher in which calves were weaned at 6 to 8 weeks of age as compared to dams in which calves were weaned at 7 months of age (Lusby *et al.* 1981) and in consonance, the service period was reduced by 72 days in non-suckling dams than suckling dams (Hanumantha *et al.* 1988). Calving interval of suckling buffalo dams was higher in comparison to non-suckling dams (Sikka *et al.* 2002). Uterine involution occurred one week earlier in limited suckled buffaloes than in non-suckled buffaloes (Usmani *et al.* 1990) and complete involution occurred by 45th day post-partum (Agrawal *et al.* 1978). Suckling is one of the major causes for long inter-calving period in dairy buffaloes whereas weaning reduced the incidence of post-partum anestrus (Jainudeen 1988).

Milking behaviour of dam

In bubaline species, maternal behaviour during parturition and behavioural interactions of dams with their new born calves are important in respect of weaning related

problems and in cases of calf mortality in early stage of life. In general, buffaloes are known to be difficult to milk without let-down by calf. In order to overcome the problems, 65% of the farms use concentrate feeding during pre-stimulation to improve milk let-down, while 13% used injectable oxytocin to induce milk ejection according to a survey (Varma and Sastry 1994). To avoid unnecessary use of oxytocin, it is necessary to understand the factors that influence the efficient removal of milk in buffaloes, such as milk accumulation, storage of milk, and its ejection. Milk let-down time was influenced by breed, parity order, stage of lactation, let-down with or without calf whereas, the actual milking time was affected by parity order, stage of lactation, method of milking, time of fodder feeding and trend of concentrate feeding (Singh and Brar 2006). The licking of neonatal calf was one of the most striking behaviours shown by the buffalo cow immediately after parturition (Yadav *et al.* 2009). The total duration of licking was longer in heifers than multiparous cows. The buffalo requires little more stimulation towards let-down of milk than cattle (Costa and Reinemann 2004). The temperament of the cows prior to milking, during and after milking was not affected by their milk yield capacity. However, the time of milking also showed no significant effect on the temperament of cows prior and after milking (Gonzaga and Lorenzo 2007).

Suckling behaviour of calf

Generally, teat seeking behaviour by buffalo calves was most important activity soon after calving when it first stood up (Yadav *et al.* 2009). Most of the calves started teat seeking soon after their standing and sex of calves had a significant effect on first attempt to teat seeking by calves. Male calves took longer time to first teat seeking than the female calves. Mateous *et al.* (2010) recorded suckling/allo-suckling behaviour and weight gain in river buffalo calves and further suggested that bull-calves presented greater average weight gain and time spent in individual filial and in communal non-filial suckling than heifer-calves, which showed greater communal filial suckling than the former during the first four months of life.

Weaning stress in buffalo calves and dams

Stress leads to the commencement of the hypothalamo-pituitary-adrenal (HPA) axis for the stimulation of the autonomous nervous system (ANS) and to a complex cascade of events to maintain homeostasis of the animal (O'Loughlin *et al.* 2014, Gomez *et al.* 2018). Acute or chronic exposure to stressors can lead to distress with effects on the welfare of animals, ultimately compromising the future productivity (Popescu and Diugan 2017). Some studies suggested that weaning may be considered as a multi-factorial stressor as it incorporates nutritional, physical and psychological elements, causing stress, and consequently having ill effects on productive performance, and increase in the mortality rate of calves (O'Loughlin *et al.* 2014, Johnston *et al.* 2016, Moggy *et al.* 2017).

However, buffalo calves are more vulnerable to stress than cattle calves when separated from the mothers, as they are highly social animals with strong maternal instincts and developing a close bond with their mothers (Mustafa *et al.* 2010). According to a study in buffaloes, cortisol levels showed a slight increase at weaning compared to cattle (Aref *et al.* 2016). Contrary to these findings, weaning did not affect the health and immunity status of buffalo calves when negative emotional arousal caused by the interruption of mother-calf physical contact is avoided (Ahmad *et al.* 2009, Bharti *et al.* 2015c). Therefore, if animals are stressed, adrenaline is secreted and this may reduce the supply of endogenous oxytocin through vasoconstriction or by blocking the oxytocin receptors on the myoepithelial cells of udder alveoli, affecting the let-down time, rate of milk flow, milk yield and milking time (Polikarpus *et al.* 2014).

Stress related hormonal profile of dam and calf

Cows and calves, can begin to bond within 5 min of contact after birth and separating them within 24 hr of birth is thought to reduce bonding and causing stress at weaning (Hudson and Mullord 1977). Reports from previous studies (Veissier *et al.* 1990a, 1990b, Church and Hudson 1999) indicate that breaking the close maternal bond is stressful to both calf and dam. MacKenzie *et al.* (1997) found no effect of weaning on the humoral immunity of weaned calves. Attenuation of the cell mediated (Hickey *et al.* 2003) but not humoral immunity (Fisher *et al.* 1997) has been identified in situations of chronic stress. Pollock *et al.* (1991) also suggested that the cell mediated immunity may be a more reliable indicator of the physiological status of calves older than 5 months. The adrenal hormones are recognized indicators of stress in bovine models (Toates 1995) and no work has been identified which describes the long-term effect of weaning on the mediators of stress (Cruz *et al.* 2019). Gudev *et al.* (2007) reported that by avoiding negative emotional arousal, caused by the interruption of the physical contact between buffalo dam and her calf, the abrupt transition from liquid to solid feed at 90 day of age had no stress-inducing effect. Qureshi (2008) reported that abrupt weaning caused an acute rise in serum concentration of cortisol, tri-iodothyronine and thyroxine in buffalo-calves on day 1 post-weaning. Female calves presented higher values of serum cortisol and triiodothyronine as compared with pre-weaning values.

Conclusion

The practice of weaning in dairy farms could benefit the farmers by enhancing milk production which can avail more milk in the market for human consumption. The weaning practices in dairy buffaloes can reduce the rearing cost on feeding calves and increase the reproductive potential of the dairy animals through early resumption of post-partum ovarian cyclicity. However, some more trials may need to be conducted in dairy buffaloes towards understanding the behaviour and performance related to age at weaning, so

that it can be practiced smoothly across the country for optimum production.

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