Review Article

Importance of Behavioral Aspects and Its Implications on Physiological Status, Relationships and Production of Dairy Animals

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Abstract

Most of the behavioural aspects of milking animals like mother-offspring bond, relationships with the stockperson, impact of shifting during lactation stage has been shown to play a major role indicating the production of animal and welfare issues. Dairy animals are highly socialized animals and are engaged in many complex interactions to communicate for dominance, subordination and bonding within the group to form linear social hierarchical structure in a herd. Feeding behavior is influenced by feed bunk, position of body, age of animals, feeding interval and displacement of feed by high and low rank animals which has significant effect on DMI and milk production. Temperament is one of the important factors of milking behaviour in dairy animals which affects the milk yield of a herd. Sudden or excessive shifting of animals between groups or herds significantly lowers the production rate in a herd by increasing the physiological biomarkers. Good maternal behaviour is the key feature of production system which enhances the suckling instinct, reduce let down time, maintain the lactation yield through lowering the stress and strong maternal-offspring bond. The stockperson's attitudes always have an effect on the welfare of the animals by improving the handling and positive attitudes. Comfort around resting for welfare of animals can be achieved by monitoring the animal's behaviour in all aspects of rearing system and management to get the profitable and sustainable livestock production.

Key words: Behaviour, Dairy Animals, Lactation, Milk Yield, Temperament

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Introduction

The linear social hierarchical structure with the most dominant animal at the top and the most subordinate animal at the bottom is found predominantly in a herd. Among the domestic animals, cattle are called as

herding species because of their high sociality to engage in many complex interactions to communicate for dominance, subordination and bonding within the group. Social rank is profoundly predicted by age, body weight and size of the animals. As older animals have more experience within the herd mates and are thus better positioned to compete whereas, the larger animals are much more capable of dominating their smaller herd mates especially physically with their strength. When individuals first meet they enter into flight and fight zone to establish rank. Once hierarchical structure is established within a herd, the negative interactions become less common except competition for a limited resource (such as feed, resting and lying areas, grooming area, milking parlour, etc.) or when closely ranked animals tries to re-establish or alter the dominance order in a particular herd. For sustainable and quality livestock production, animal behavior and welfare are the most essential criteria to balance the production as well as stress in animal's behavior. This review reports the most important behaviors implicating the part of animal's production and physiological status and its effect on animal welfare.

Role of Different Behaviours for Production in Dairy Animals

Feeding Behaviour

To maximize the yield across the whole herd, it is important to maximize the dry matter intake so that the impacts of social hierarchy can be considered at the farm level. Feeding behaviour can be described by using various measures such as the number and duration of meals, intake quantity and feeding rate (Von Keyserlingk and Weary, 2010). To get established into a new social rank with stable hierarchy within the herd, interaction and competition for limited and / or valued resources such as feed or access to feed are considered e.g. cows of lower social rank were displaced from the feed bunk more often, particularly at high stocking rates (Huzzey *et al*., 2006) whereas high ranking cows usually spend more time at the feeder following the provision of fresh food (Val-Laillet *et al*., 2008).

Competition at the feed bunk affects the feeding behavior especially for subordinate animals by increasing the feeding rate and reducing intake (Von Keyserlingk and Weary, 2010). A minimum of 0.51 m of bunk space if provide in a herd, there is unlikely measurable reduction in DMI (Grant and Albright, 2001) but if increasing the bunk space above 0.5m may not have significant effects on DMI while doubling the amount from 0.5 m to 1.0 m feeding space per cow resulted in 57% reduction in aggressive interactions and allowed cows to increase their feeding activity (DeVries *et al*., 2004). Eating with heads in the downward position produce 17% more saliva, which increase the rumen function than the cows eating with heads held horizontal. Cows exhibited year-round rooting, sorting, feed tossing behavior and feed wastage (0 to 5%) when fed in shallow and elevated bunks. Feeding at ground level or in headlocks showed little or no feed tossing behavior (Albright, 1993). Displacement has been observed in cows more frequently from a post and rail feed barrier as compared to a barrier composed of headlocks (Huzzey *et al*., 2006).

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Feeding behaviour is a dynamic process which changes in the days before calving and found at greatest among cows at greatest risk to disease in the early post partum period (Von Keyserlingk and Weary, 2010). The intersection of frequency distribution between the two peaks called as break point occurring at about 25 min is a bimodal process which used to define the within-meal intervals and between meal intervals. According to this approach an interval of less than the break point is called as meal criterion or within a meal (Tolkamp *et al*., 2000). Therefore, the feeding speed usually adapted according to the feeding system in a farm (Wierenga and Hopster, 1991). By this definition, two feeding events if separated by a break of only 10 minutes is considered as being part of the same meal but if the cow returned to the feeder after a break of 50 minutes, this event will consider to be the part of a new meal (De Vries *et al.*, 2004; 2009). Mean time for concentrate mixture intake was significantly less ($P<0.05$) in docile in comparison to nervous lactating Murrah buffaloes (Singh *et al*., 2016). When rumination begins after eating, it prompts the cow to lay down on their left side, making the rumination more effective as rumen is positioned on the left side (Grant *et al.*, 1990).

Milking Behaviour

The milking behavior of dairy animals in a herd is an essential component to know the fact of production and its welfare issues. Temperament of dairy animals is a factor which affects the milk yield of a herd. The buffalo is the second most important species in terms of milk production, after dairy cows in the world which produces the highest quality milk than any other domestic animals (Senosy and Hussein, 2013). It was found that nervous buffaloes shows significantly more ($P<0.05$) total milking time as compared to docile buffaloes; the respective values were 26.3 and 15.65 minutes (Singh *et al*., 2016). It is because the buffaloes are sensitive to milking environment than the cows for which any change in milking operation may lead to little let-down of milk (Thomas *et al.*, 2005). Milk yield significantly increases in less milking temperament of docile buffaloes (Ramasamy and Singh, 2004). The docile buffaloes show higher rate of feed intake, shorter let-down time, increases daily milk yield, higher rate of milk flow, higher milk fat and longer milking time than the other non-docile buffaloes (Nayak and Mishra, 1984; Gupta *et al.*, 1985).

Effect of Shifting on Behaviour

In a lifetime, animal passes from various physiological states such as young, adolescent, pregnant, parturition etc. and under organized herds it is shifted from one group to another and this may expose animal to a newer social environment. This can modify animal's behavior which may have potential effect on production and reproduction performance. Modifications in the behaviour of young animals induced due to early separation from the dam (Houwing *et al*., 1990; Illmann and Spinka, 1993). It has also been reported that following first day after shifting cows usually produce 23.3% less milk at the first day than last day

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prior to shifting (Broucek, 2017). Anxiety and panic reactions cause due to sudden movements by humans (Adamczyk *et al*., 2015). Social tension creates by the mixing of new cows after relocation into any new herd (Brakel and Leis, 1976). The mixing multiparous and uniparous cows was reported to reduce milk yield by 19% for 10 days, 5% for 40 days, 4% for 5 days, and 3% for 1 day (Phillips and Rind, 2001). One of the reasons for stress during shifting highlights the good or bad relationship between the milkers and the cows (Herskin *et al*., 2004; Grasso *et al*., 2007; Macuhova *et al*., 2008) which is important aspect for human and animal relationship during handling. It suggests that where possible, excessive movement of animals between groups should at least be limited or avoided to ensure stable social groups for maximizing the production level in a herd.

Effects of Housing on Dairy Animal's Behaviour

Parameters	Individual Housing	Group Housing	Authors
Approach behavior to humans	Faster, more frequent	Slower, less frequent	(Lensink *et al*., 2000a)
Separation/restraint	Easier	Can be difficult	(Boissy and Le Neindre, 1997)
Loading	Faster, less effort needed	Slower, more effort needed	(Lensink *et al*., 2000b)
Male aggressiveness towards humans	More aggressiveness (isolation rearing)	Less aggressiveness	(Price and Wallach, 1990)
Sign of disturbance towards robotic cleaning system	Greater	Minor	Doerfler *et al*., 2016

Role of Maternal Behavior for Initialization of Bond

Maternal behavior is basically facilitated by various hormonal changes. Physiological parameters related to stress, such as ACTH or corticosterone, are reduced during motherhood in different mammalian species (Neumann, 2005). Also, oxytocin has been observed to reduce fearfulness (Neumann, 2005), which may be due to induction of social bonding as well as to activate maternal behavior (Von Borell, 2007; Kendrick *et al*., 1987). Oxytocin is released during teat stimulation through suckling as well as during vaginocervical stimulation at parturition (Kendrick *et al*., 1988). There is positive correlation between oxytocin levels and maternal and/or bonding behavior as detected in various species such as cattle (Williams, 2001), sheep (Kendrick *et al*., 1987), rats (Pedersen and Prange, 1979), and primates (Boccia *et al*., 2007), including humans (Uvnas-Moberg, 1990). Newborn calves normally suckle five to ten times per day with each nursing session of duration up to ten minutes (Nordin and Jaimudeen, 1991). The rate of growth of calf with advancement of age decreases the milk yield of the buffalo cows due to decrease in number of nursing bouts (Tulloch, 1979).

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The importance of maternal ability is undisputable in intensive production systems with increasing sizes of production units and less time for observations by stockmen, (Grandinson, 2005). Factors influencing the maternal behavior include the breed of animals, parity stage (Vandenheede *et al*., 2001), sex of the new born as well as birth weight of calf (Stehulova *et al*., 2013). Due to the early separation calf from its mother after parturition, a strong long-term maternal ability is usually not required in dairy production which may be due to relaxed selection pressure as a factor during centuries of calf rearing by humans (Le Neindre, 1989). Indeed, only limited responses of multiparous dairy cows has been observed to removal of their calves (Hopster *et al*., 1995).

It has been usually seen in all conditions especially close confinement during initial suckling and development of a bond between mother and young occur (Hafez, 1992). The key features for establishment of a strong maternal bond with the calf are nursing, attention and protection from potential predators (Grandinson, 2005). In buffaloes soon after parturition, recognition of their young ones is established and adopted through the maternal grooming and licking (Fraser and Broom, 1990) which is called as critical period (Gordon, 1996) and sensitive period (Kent, 1987) during which calve accustomed to fast learning of specific cognitive ability which is termed as imprinting which results in formation of a permanent close attachment between mother and a salient environmental object, forming mother – offspring bond in a rapid manner.

A reciprocal recognition can be usually seen in between buffalo cows and their own calves during the critical period (Usmani *et al*., 1990). Mother may reject her own calf if separated or in absence of continuous contact for more than a few hours immediately after parturition (Houwing *et al*., 1990) and hostile behaviour is exhibited to the alien (Lidfors, 1989) where as in contrast, it is has been also seen in this stage where mother can quickly acquires or learns to identify her own calf and thereafter, relates to it like a partially vulnerable extension of herself (Weary and Chuo, 2000). Vocalization turns vigorously by cow to her new born calf following licking at head, neck, back, abdomen, tail, and perineal region (Sato *et al*., 1991) is important in strengthening the maternal bond (Fraser and Broom, 1990) and social bond between mother and young (Gordon, 1996).

Role of Interactions between Human and Animal

To increase the productivity of the cow there should be an improved positive behavior towards animals as human-cattle interaction (Breuer *et al*., 2000). Knowing the individual behavior of every animal in one's charge and having the ability to recognize small changes in the behavior of animal or all the animals collectively is termed as Stockmanship (Seabrook, 1977). The stockperson's attitudes always have an effect on the welfare of the animals (Hemsworth, 2008). It was stated that at times where humans are present, some behavioral stress indicators create less stress response in the animals (Rushen *et al.*, 2001). And hence,

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it also states that the handlers' behavior affects the behavior of the cow (Waiblinger *et al*., 2002). Stepping behaviour is associated with increased heart rate, increased milk cortisol concentrations and fears of novelty, whereas kicking behaviour is expressed by non-fearful cows (Wenzel *et al*., 2003). Highly temperamental cows are more sensitive to sounds, touch and motion (Lanier *et al.*, 2000).

Effect of Improved Interactions on Physiology and Animal Welfare

Through positive handling and positive attitudes of stockpersons, there is increase in fat and protein in milk (Breuer *et al.*, 2000) and milk yield by 20 % (Worthington, 1977) while the residual milk significantly decreased up to 70 % by gentle and positive handling (Rushen *et al.*, 1999) whereas non-significant effect was also reported (Munksgaard *et al.*, 2001). Fear increases significantly the cortisol level which increases the risk of accidents and decreases animal welfare (Johansson, 2012). The secretion of catecholamine under autonomous nervous system increases higher heart rate and chronic stress in negatively handled heifer (Breuer *et al*., 2000).

Positive interactions between human and cattle have great importance in the field of animal welfare, economy and safety for farmers as well as their cattle (Johansson, 2012). It is suggested that "seeing is believing", which means that farmers need to be able to see what positive handling can do both for themselves and their animals, to believe it themselves (Atkinson, 2012). By means of walking and talking calmly around the cattle, with positive feelings (such as feed) and stroking the cattle's peculiar body regions associated with social grooming reduces the animals fear and stress (Johansson, 2012). Hence, stroking region that has been used for social grooming has positive effect on welfare of the cows with improved production (Schmied *et al*., 2008). Improved productivity in beef production is found to be associated with positive behaviour of the handler, such as moving slowly, talking friendly and letting the calf suck their fingers (Lensink *et al*., 2000a). Feeding should be as a reward which can be utilized to build positive relationship (Petherick *et al*., 2009).

Calves that raise with human contact were shown to have lower cortisol levels (Grandin, 1997) and in positive situations, by experience, learn to be less fearful of people (Petherick *et al*., 2009). Handling at a young age has a substantial influence on development of interactions (Jago *et al*., 1999) and the cows which handled the first hour after first calving need less extra assistance in early lactation (Boivin *et al*., 2003). The calves exposed to gentle contact shows less nervous temperament and is easier to move (Lensink *et al*., 2000b) and the cows being treated gently by handler keep less flight distance (Munksgaard *et al*., 2011) and by habituating animals to humans, fear can be reduced which leads to decreased injury risk (Grandin, 1998; Boivin *et al*., 2003; Waiblinger *et al*., 2004). Positive and gentle handling such as feeding by hand, talking to the cattle in a calm voice and stroking the cattle on the neck, reduced cattle kicking towards humans (Waiblinger *et al*., 2004). When tested 8 months after the study, it took long time to be

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sorted from the group especially the calves that had not been handled (Boivin *et al*., 1992). Therefore, it is important to spend time with the animals daily with calm to avoid stressing the animals (Olsson, 2006). This gives a chance for a positive relationship between the humans and animals to develop.

"Welfare Quality concept" concentrates on assessing welfare using animal based criteria, interpreting how the animal performs in its environment. A cow always attempts to cope with its environment to maintain an optimal level of welfare by adjusting its behaviour according to the prevailing circumstances. When coping and adjustment fails, signs of poor welfare can occur (Broom, 1996). Many welfare criteria have been identified, such as "comfort around resting" (Plesch *et al*., 2010), decreased total lying time and number of lying bouts or prolonged standing in the lying area have been used as indicators of poor cow welfare (Cook *et al*., 2005; Fregonesi and Leaver, 2001; Haley *et al*., 2001). In addition, to indicate changes in cow welfare abnormalities in lying down and rising movements have been used (Lidfors, 1989). Cows change their weight distribution by decreasing their rear leg movements while avoiding abrasions of the rear legs and the swollen udder (Chapinal *et al*., 2013). High degree of synchronization in cattle's behaviour is performed which is contemporary to other members of the group within the herd indicating a positive welfare state, in particular for subordinate animals (Metz, 1983).

Conclusion

The animal's behaviour plays an important role in terms of physiological condition and production of the animal. Increase in production such as milk yield, body weight of calves and increase in feed intake depends on how the animals is responding to its surroundings. Housing management is closely associated with good welfare practices to decrease the stress and enhance the natural behavior of animal thereby increasing the production of the animals. Relationship of stockperson with its animals brings out the adjustability with known facts of routine and helps to maintain the sustainability of production level. Animal behaviour is always best expressed by animals in its range condition and there is more scope for welfare issues in loose housing system than tie barn system. Animal's problems can easily be identified by observing their behavior and controlling social dominance will help in better management of a dairy farm. The studies on the dairy animal behaviors can be utilized as an important tool for management of dairy farms. Hence, it can be concluded that the behavioural aspects play a great role towards the sustainable livestock production and welfare of animals.

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