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Introduction

An increase of big farms is occurring all around Europe which causes an increase in the number of animals per handler, aiming for increased working time productivity. Together with today's automatic milking and feeding systems this will cause a reduced human-animal interaction. But there are handling procedures that is still needed in a dairy cow herd, e.g. dehorning, ear-tagging, transportation, medical treatments and re-grouping (for review see Boivin *et al.*, 2003; Raussi, 2003). Therefore the interactions between animal and handler are of increasing interest and significance with regard to animal welfare and productivity within the modern dairy production.

Human-animal interaction, here cattle, can be divided in positive and negative interactions where positive interactions include touching and calm talk (Seabrook, 1994), while negative interaction include hitting or shouting (Pajor *et al.*, 2000). It is of great importance to have a positive human-animal interaction as handling of animals affects their productivity and welfare (Hemsworth *et al.*, 1993). According to Seabrook (1994), characteristics of the handler such as emotional stability, confidence and consistency as well as showing no aggression, have a positive effect on the human-animal interaction. Negative interactions might expose the animals for a series of physiological stress responses (Hemsworth *et al.*, 1993). These responses might also occur when habituation to humans is lacking (see Raussi, 2003 for review). Cattle might not only experience fear towards humans, but also towards other environmental factors. According to Rushen *et al.* (2011), introducing of new surroundings and isolation from conspecifics can cause fearfulness in the animals and because of this, a reduced milk yield.

The aim of this literature study is to learn the effects of human-animal interactions on the dairy cow. The study is limited to the direct effect of humans interacting with cattle. The question formulation of this study is: how is the milk yield and composition affected by human-animal interaction?

Literature review

Human-animal interaction in dairy production

The interaction between humans and animals is a main feature within the modern livestock production. It has been shown in research that there can be great effects on both animals and handler, depending on how the interaction is between them (Hemsworth & Coleman, 2011). Most common events of human-animal interaction are the daily handling including cleaning, milking actions and feeding (Raussi, 2003). This contact often include a close presence of humans, occasionally also with an intense handling by the humans; that is when the animal has to be physically handled by the human. A key feature determining the animal's response to the human is fear (Hemsworth *et al.*, 1993).

Fear is, according to Boissy (1995), an emotional state in the animal which is induced by the perception of any actual danger, leading to avoidance of the same. The fearfulness can thereby also be caused by factors such as presence of stray voltage, handlers' technical knowledge, genotype of animal and nutritional deficiencies (Breuer *et al.*, 2000). A study by Breuer *et al.* (2000) showed that fear of humans could have practical consequences for the productivity in dairy cows. Moreover, a reaction of fear can affect the safety of both animals and humans and reduce working time efficiency. Dairy cows being fearful do often kick during milking procedures and has higher residual milk (Rushen *et al.*, 1999; Hemsworth,

2003). Furthermore, many of the routine husbandry such as dehorning, vaccination, ear tagging and hoof care, is seen as negative stressors for the animal, even though they in the long term improves the welfare of the animal (Raussi, 2003).

Fear can be measured in different ways. Welp *et al.* (2003) for instance, investigated vigilance as a measure of fear in dairy cows. 20 cows were tested indoors with an unfamiliar, aversive or a gentle person close by. The study showed that the vigilance increased in the presence of an aversive person compared to during the presence of both the gentle and the unfamiliar person. The conclusion of the study was that the vigilance is altered by the cows depending on their degree of fear towards humans, and an estimation of the animal's fearfulness can hence be provided. Many studies have used the same method as Munksgaard *et al.* (2001) to measure fear in dairy cows, i.e. the cow's distance to handlers. Results of the study indicate that cows stayed closer to gentle handlers than to aversive handlers. This is interpreted as fearfulness of aversive handlers. A similar method to investigate fear in dairy cows is to observe the approach behaviour towards handlers, which has been done by, among others Breuer *et al.* (2000) and Waiblinger *et al.* (2003). All studies mentioned show that cows seem to be fearful of aversive handlers.

To increase the productivity of the cow Breuer *et al.* (2000) suggests an improved positive human-cattle interaction. This could for example be brushing prior to milking. Performed by a familiar person this has showed varying effects on the animal (Rushen *et al.*, 2001). According to Rushen *et al.* (2001), when the cow was brushed before milking, there was significantly less elimination of faeces and vocalization, which are clear behavioural indicators of stress in cattle. The reduction of these factors is the strongest indicators that the presence of humans can reduce fear responses in cattle. The conclusion of the study by Rushen *et al.* (2001) is, at times where humans are present, some behavioural stress indicators create less stress response in the animals. Furthermore, the results indicate that, in the presence of an aversive handler the acute stress is more distinct. The importance of the handlers' behaviour and that it affects the behaviour of the cow is also shown in a study by Waiblinger *et al.* (2002). The study also observes that cows approach the handlers which are using calm interactions more frequent, and the writers underline the importance of the handler's behaviour in order to avoid fear of humans in cattle.

An important aspect when determining the human-animal interaction is also the individual differences in the behaviour of cattle (Hanna *et al.*, 2006). In a study made by Lanier *et al.* (2000) it was shown that highly temperamental cows were more sensitive to sounds, touch and motion.

It is important to remember that there are a limited number of studies that have tried to evaluate the influence of the handler in commercial dairy farms (see Breuer *et al.*, 2000; Hemsworth *et al.*, 2000). These studies had varied herd sizes, number of handlers, and other factors that affect the behaviour and milk production making it difficult to actually notice the stockperson's effect (Hanna *et al.*, 2006).

Human-animal interaction and the physiological reactions in the cow

The animal utilizes three different biological responses to cope with unfamiliar and potentially threatening or painful stimuli: the autonomic, the neuroendocrine and the behavioural response (Hemsworth *et al.*, 1993).

The autonomic and neuroendocrine systems' roles are to prepare the body for the stressor, e.g. increase the heart rate (Hemsworth *et al.*, 1993). The sympathetic part of the autonomic nervous system function as an emergency system and releases energy rapidly, while the parasympathetic part restore energy and prepare for a sudden energy release. These "fight-and flight responses" only last for a short period of time. If a stressor continues, the response becomes a long-term or a chronic stress response, and reduces the animal's reproduction ability, immune function and nutrient uptake (Hemsworth *et al.*, 1993).

It has been shown that the heart rate of the cow during milking increases in the presence of a handler (Rushen *et al.*, 1999). Moreover, if an animal show great fear of humans, human presence will initiate responses that include release of catecholamines, for instance epinephrine or norepinephrine, from the adrenal medulla to prepare the animal for avoidance or escape responses (Hemsworth *et al.*, 1993).

The presence of humans do not always relate to physiological signs of stress (Munksgaard *et al.*, 2001). For instance, the cortisol concentration, also called stress hormone, has been examined in many studies. In a study by Hemsworth *et al.* (1989) it was showed that the group of cows with minimized human handling during five months of calving and lactation had a significant higher mean cortisol concentration in the milk, then the groups with more handling. Another study (Boissy & Bouissou, 1988) showed that a group of dairy heifers that had human contact from birth to nine months old, showed lower plasma cortisol and heart rate responses than the groups with less human contact. Both studies do also indicate that the stress response to humans can be limited by habituation or making the animals more accustomed to human interaction.

Human-animal interaction and the milk production

Human-animal interaction affects the lactation in dairy cattle in different ways. Studies referred to mainly investigate the effect on milk yield of human presence and interaction. The importance of the effects of lactation is great, since the milk production is the main income within dairy production.

Some studies have shown milk yield to be affected by type of handling. According to Rushen *et al.* (1999), the total milk yield decreased as the residual milk increased by 70 % when the cows were treated aversively. On the other hand, Munksgaard *et al.* (2001) did not find any difference in milk yield between cows treated gently or aversively. The reason for the different results could be that in the study made by Rushen *et al.* (1999) the treatment was rougher which made the cows more frightened hence affecting the milk yield (Munksgaard *et al.*, 2001). In a study by Hanna *et al.* (2006) it was investigated what effect the handler's physical and vocal interactions had on the milk yield. The result showed that a positive handling gave higher milk yield. Even though the difference was small (1%), it was consistent. The smaller difference found in this study may be due to the interactions being less extreme, which simply lead to a smaller difference in milk yield.

Studies that have examined correlation between human contact and milk yield also show different results. Rushen *et al.* (2001) did not find any correlation between human contact and milk yield while Hemsworth *et al.* (2000) showed that milk yield was reduced if the cows showed a high level of fear of humans or a high reluctance to interact with humans. In the study of Hemsworth *et al.* (2000) fear was determined by the cow's behaviour towards humans, after milking. Cows unwilling to approach a sedentary human and/or retreating when being approached by humans were concluded as frightened of humans.

A study made by Breuer *et al.* (2000) concluded that fear of humans was correlated to both milk composition and milk yield. The study showed that milk protein, fat and yield were all lower at farms where the cow showed less approach to the human. This indicates that the more willing a cow is to approach humans, the higher the milk yield and content of fat and protein (Breuer *et al.*, 2000). Probably, this suggests that a more aversive handling leads to a more aversive reaction of the cow since previous studies showed a connection between aversive handling and reduced milk yield (see e.g. Rushen *et al.*, 1999 and Hemsworth *et al.*, 2000).

Conclusion

It has been clearly shown that welfare and productivity of animals is affected by the human-animal interaction. Despite the fact that the human-animal interaction is decreasing in a modern dairy production there will always be an interaction between humans and cattle. The key feature in a high performing dairy production of today is a positive human-animal interaction and therefore avoiding fear against humans. Fear causes stress which leads to a decreased milk yield and possibly to a decreased content of fat and protein. Due to the various results in earlier studies, more work need to be done determining how the human contact affects the productivity of the dairy cows. This is important since the dairy farmer get paid, not only by the yield, but also based upon the composition of the milk.

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