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誌物のタイトル

Journal of Integrated Field Science

巻

14

ページ

55-59

年

2017-03

URL

http://hdl.handle.net/10097/00121225
Effects of Environmental Enrichment on Welfare of Cattle

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Keywords: animal welfare, cattle, environmental enrichment

Abstract

In recent years, keeping animals indoors has become a popular rearing system in many countries where there is a high population density and lack of land to graze animals. However, this frustrates animals by depriving them of opportunities for many behaviors. To solve these problems, environmental enrichment was introduced to animal welfare science. It is thought to be an alternative means to contribute to animal welfare. It focuses on the biological functions of the animals and helps them to cope with stressors in their surroundings, prevent frustration, and express more normal behaviors. In this review, several elements of environmental enrichment and how they affect animal welfare are discussed. First, we discuss natural suckling and group rearing, both of which allow animals to perform social behaviors with other individuals. Second, we summarize behavior-stimulating tools such as brushing, scratching/rubbing arch devices, and bedding materials. Finally, space allowance as physical enrichment is discussed. Now that animal welfare science focuses on how to improve animal welfare and keep animals in a comfortable condition and prevent stress should be paid more attentions than studies on how to reduce stress after it has occurred. Duncan and Olsson (2001) argued that freedom from the state of suffering is assured by providing for environmental requirements, while the establishment of pleasurable states requires environmental enrichment. Environmental enrichment is widely used to help animals cope with stress in indoor rearing.

Introduction

In recent years, keeping animals indoors has become a leading rearing system in many countries where there is a high population density and lack of land to graze animals. Rearing animals indoors provides many advantages, such as protecting animals from extreme weather conditions and parasite infections and reducing environmental pollution. However, it also frustrates animals, resulting in a change in behavioral and physiological indicators. For example, disturbed behavior, such as repeated tail-biting (Schröder-Petersen and Simonsen, 2001) in pigs, and severe feather-pecking and vacuum nest-building in chickens (Jensen, 1993), occurs during unnatural life conditions. As to physiology, it has been reported that cortisol concentration is increased by social disruption (Adeyemo and Heath, 1982), restraint (Lefebvre et al., 1990), and transport (Palme et al., 2000). Cattle with high levels of serum cortisol spend less time ruminating and vocalize more than those with low levels of cortisol (Bristow and Holmes, 2007).

Until recently, most welfare assessments were conducted when animals were already under stressful conditions. However, studies of how to improve welfare and keep animals in a comfortable condition and prevent stress should be paid more attentions than studies on how to reduce stress after it has occurred. Duncan and Olsson (2001) argued that freedom from the state of suffering is assured by providing for environmental requirements, while the establishment of pleasurable states requires environmental enrichment. Environmental enrichment is widely used to help animals cope with stress in indoor rearing.

On the other hand, environmental enrichment is an alternative way to contribute to animal welfare. It focuses on the animals’ biological functions, helps animals to cope with stressors in their surroundings, prevents frustration, and allows animals to express more normal behaviors (Newberry, 1995). Bloomsmith et al. (1991) stated that environmental enrichment can be divided into five categories: social, occupational, physical, sensory, and nutritional. Therefore, environmental enrichment can improve animal welfare from...
many angles. For example, opportunities to engage in complex social interactions may fill the calves’ need for a companion and thus reduce stress (De et al., 2012). This increases the fitness of the animals’ biological functioning, including lifetime reproductive success.

In this review, we focus on several elements of environmental enrichment and how they play roles in cattle welfare.

Elements of environmental enrichment

Rearing systems

It is well known that in intensive production systems, calves are separated from their dams immediately or within a few hours after birth. Under these circumstances, calves may be deprived of many natural behaviors and biological functions. Social behaviors, such as contact with peers, are present from the first week of life (Wood-Gush et al., 1984).

Artificial suckling might suppress the normal suckling behavior of natural lives, contributing to the onset of stereotypies such as tongue playing in Japanese Black cattle (Sato et al., 1994). In comparison, natural suckling systems, in which calves are nursed by their dams and have social contact with other calves and cows, have a positive effect on daily weight gain and vitality in calves (Krohn, 2001). Further, calves reared with their dams struggle less when restrained for blood sampling compared with those housed singly (Duve et al., 2012), and contact with the mother has a long-term effect on behavior (Wagner et al., 2012). Natural suckling also has effects on physiology. An instantaneous increase in serum oxytocin concentrations has been reported in calves during natural suckling (Lupoli et al., 2001). In a previous study, we showed that the basal serum oxytocin concentration was higher in calves of one-month-old under the natural suckling system than under the bucket-suckling system. We concluded that natural suckling might contribute to an increase in investigative behavior via the increase of serum oxytocin concentration (Chen et al., 2015).

Group rearing also benefits the animals. Duve and Jensen (2012) reported that calves reared in groups performed more social behaviors than calves housed individually, with limited social contact, from the age of three weeks. Further, group-housed calves spent less time alone and had a higher social rank when introduced into a new group than individually housed calves (Broom and Leaver 1978).

Social interaction with dams and peers is important to calves. Wood-Gush et al. (1984) reported a higher frequency of interactions of calves and their dams until four weeks of age (0.72/30 min) than with other cows (0.18/30 min) or calves (0.68/30 min). As a consequence, natural and group rearing fulfill the need for social behaviors in cattle, and thus contribute to animal welfare.

Behavior-stimulating tools

All domestic animals are strongly motivated to explore and investigate when they face a new environment (Broom and Fraser, 2007). However, barren indoor housing deprives calves of this behavior, and so behavior-stimulating tools have been developed to improve this situation.

It has been suggested that social grooming in cows is an important behavior pattern with functional significance for the formation and maintenance of social bonds; it is regarded as a reliable indicator of friendship (Sato et al., 1991; Boissy et al., 2007). The pattern of this behavior changes with indoor housing, but brushing can fulfill this need in cows. Brushing is thought to act by a similar mechanism to that of maternal grooming, in that they both have a cleaning effect on animals (Kohari et al., 2009; Schukken and Young, 2009). Further, it has been reported that brushing is widely used by farmers in the livestock industry for various purposes, including to increase milk yield (Schukken and Young, 2009), and an effect of building a physiological bond between the stockperson and animal is expected. Ninomiya and Sato (2009) reported that brushing promoted self-grooming behavior and improved welfare in Japanese Black and Japanese Shorthorn calves. Meanwhile, brushing connects to physiological indicators. In a previous study, we found that manual brushing increased serum oxytocin concentrations in cattle (Chen et al., 2014). Since oxytocin is one of the positive indicators of livestock welfare (Broom and Fraser, 2007), this suggests a positive effect of brushing on cattle. Taking the above into consideration, brushing may be an alternative mean to provide social grooming behavior for cows housed indoors.

In outdoor rearing, cows can scratch themselves and rub on trees in the pasture. This behavior is inhibited when they are reared in tie-stalls or narrow cowsheds. An arch-shaped device for scratching and
rubbing, which allows cattle to scratch their dorsal and head areas, has been designed to let animals perform this behavior (Simonsen, 1979). In an applied study, it was reported that cows used these arches for longer durations and higher frequencies than other devices (Wilson et al., 2002). In addition, studies have investigated designs to allow cattle to express exploration behavior. It has been reported that a soil floor stimulated explorative behaviors and improved the health and welfare of Japanese Black steers (Ariga et al., 2015). Thus, it was concluded that a soil floor provides novelty and enrichment for cattle, compared to a concrete floor.

**Space allowance**

Physical enrichment is also an important enrichment for cows (Bloomsmith et al., 1991). Animals will be stressed if adequate space is not provided. In many countries, dairy cows are kept throughout the year in tie-stalls, or narrow cowsheds, which results in a lack of exercise and contact with other cows. It has been reported that calves that had greater space allowance performed higher levels of play behavior (Jensen et al., 2015). Similarly, in adult cows, when space allowance increased, agonistic behavior decreased (Kondo et al., 1989).

However, space allowance is not just about providing constant visual and physical contact between conspecifics, but also providing an opportunity to separate from other individuals on some occasions. For example, dairy cows seek isolation from calve when ill, suggesting that providing a cow with a secluded area may provide a physical enrichment benefit to it (Proudfoot et al., 2014). Even in natural life, animals need individual space. Most cows separate themselves from others when calving, and select dry and high-altitude places with tree cover and branches overhead or a shelter (Lidfors et al., 1994).

Animals need contact with others to perform social behaviors, but also private space to comfort themselves at times. These two needs should be considered when designing housing and husbandry systems.

**Conclusions**

Recently, studies on positive emotional states, rather than negative states, in animals have started to receive greater interest (Boissy et al., 2007; Mellor 2012; Proctor and Carder, 2014). Required conditions for animal welfare have been proposed as the five freedoms: freedom from hunger and thirst; freedom from discomfort; freedom from pain, injury, or disease; freedom to express normal behavior; and freedom from fear and distress (FAWC, 1992). Thus, environmental enrichment as an element of improving animal welfare has attracted interest from many scientists.

In the present review, we focused on several elements of environmental enrichment that may help cattle to cope with stressors in their surroundings, prevent frustration, and perform more normal behaviors. These methods are based on meeting the biological needs of the animals. As described above, these are natural and group rearing, behavior-stimulating tools to allow for some natural behaviors, and space allowance to perform normal behaviors. In this case, we suggest that studies on environmental enrichment should be paid further attention.

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