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Research

Environmental enrichment and social rank affects the fear and stress response to regular handling of dairy goats

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ABSTRACT

Human–animal interactions can have result in fear and stress for the animals and can affect negatively their welfare and productivity. Environmental enrichment techniques can be a tool to reduce this fear response to handlers. The aim of this study was to analyze the effects of environmental enrichment and social rank on fear and stress response to handling of dairy goats. Thirty Saanen dairy goats (3.5-5 years of age) were observed 6 hours daily for 16 consecutive days. Behavior sampling was used to record all events of agonistic interactions, and index of success was calculated for each goat. Two groups, control (CO) and enriched (EN), of 12 goats each (6 high rank [HR] and 6 low rank [LR]), were then observed during a 4-phase handling test. Reactivity behaviors were recorded using focal sampling, and plasma cortisol was assessed in all goats. An analysis of variance (ANOVA) was used to assess the effect of treatment (EN and CO) and social rank (HR and LR) on behavior, and a multivariate ANOVA for repeated measures was used to assess the effect of treatment and social rank on cortisol levels in response to handling. The EN group and HR goats had a longer distance to the handler ($P < 0.01$ and $P < 0.05$, respectively); however, it took longer for the goats in the CO group to be caught ($P < 0.01$). LR goats in the EN group showed higher levels of aggression to the handler than HR goats in the EN and CO groups as well as LR goats in the CO group ($P < 0.01$). On average, EN goats had higher cortisol values than in the CO ($P < 0.05$), and the HR goats had significantly higher cortisol values than the LR animals ($P < 0.05$). In general, goats in the EN group had a more excited reaction than the CO group that could be related to a cognitive state derived from the effect of the enrichment. These results have important implications for animal husbandry and help to broaden the literature on the effects of environmental enrichment and dominance rank on goat handling.

Introduction

The process of domestication relates to a development of adaptation to different production environments and to a reduction in animal fear to humans (Price, 1999). However, interaction with humans still has a great effect on the physiology and behavior of domestic animals (Hemsworth, 2003). This interaction, when constant, can increase reactivity and fear to humans (Mateo et al., 1991). In routine husbandry procedures involving human–animal interactions, such as disbudding, rectal palpation, drug administration, artificial insemination, or blood extraction, high levels of fear, pain, and stress can be inflicted on the animals (Solano et al., 2004; Álvarez et al., 2009). As a consequence, these procedures can increase costs in

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terms of reduced productivity, health, animal welfare, and handler safety (Waiblinger et al., 2002; Hawson et al., 2010).

In ruminants, dominance relationships determine unequal access to resources, such as food, water, lying space, shade, or individuals from the other sex (Ungerfeld, 2012). Goats under intensive dairy production systems are often housed in barns, in conditions that differ substantially from the natural habitat of this species in terms of limitation of space and resources, such as resting or feeding places, as well as the composition and size of the herd (Miranda-de la Lama and Mattiello, 2010). Under these conditions, social relationships also involve competition and conflicts of interests (Aureli et al., 2002). Particularly in groups with stable social structures, an increase in conflicts of interest may cause more aggression and social instability (Miranda-de la Lama et al., 2011). The ability to perceive this environment as benign and to modulate fear responses accordingly is important as fear is generally considered an undesirable emotional state that is related to a reduced welfare (Minch et al., 2008). Consequently, the development of methods for reducing animal fear to humans is a necessity (Vandenheede and Bouissou, 1998). The goal of human–animal interaction is to prevent fearful responses that could adversely affect future unavoidable interactions with human personnel (Poggiagliolmi et al., 2011). In this context, environmental enrichment techniques can be a useful tool to reduce the animal's fear response to handlers (Meehan and Mench, 2002).

Environmental enrichment is defined as the addition of biologically relevant features to the captive animals' physical and social environments to foster natural behaviors, providing them with greater behavioral opportunities (Newberry, 1995). Enrichment techniques are considered beneficial for the welfare of animals but can also be very helpful to address certain management problems observed in animal production settings, therefore positively affecting farm profitability (Newberry and Estévez, 1997). Designs to enrich the environment are crucial in the effort to fully address the biological needs of domestic animals (Wells, 2009). Traditionally, the evaluation of environmental enrichment programs has been focused on broad effects, such as frequency of aggressions, stereotypes and affiliation behaviors, and preference test (van de Weerd and Day, 2009). However, less is known about the effect of environmental enrichment programs on social rank and animal reactivity to humans during handling procedures. Consequently, it is necessary to analyze the possible effects of enrichment programs on handling reactivity and the stress response to be able to recommend the right modifications in housing and management to minimize the biological cost for animals during regular handling. The study that follows is based on the hypothesis that the goats living at barren environment may compromise habituation to a regular handling, which may affect their fear and stress response. The aim of this study was to analyze the effects of environmental enrichment and social rank on the fear and stress response to regular handling of dairy goats.

Materials and methods

The study was carried out on a commercial farm, located in Huamantla, Tlaxcala state (latitude 18°19'N), central Mexico plateau, at 2153 m above sea level, with a mean temperature of 15.5°C and a mean annual rainfall of 670 mm. The experimental protocol was first approved by the Internal Animal Ethics Committee of the Faculty of Veterinary Medicine (National Autonomous University of Mexico).

Social dominance measurements

Thirty Saanen dairy goats (3.5-5 years of age, multiparous, dehorned) were used. The group was housed in a 25 × 17 m outside pen (stocking density of 14 m^2 per goat) 80 days before the observations were carried out. The goats were fed twice a day, between 08.00 and 09.00 hours and in the afternoon between 14.00 and 15.00 hours. Corn silage was offered in a lateral feeding passageway with a layout of the feeding trough that allowed individual feeding places (35 cm per animal) for all the goats in the group. The pen was equipped with a metallic water trough (1 × 2 m) and a mineral lick stone. The goats were milked at 15:00 hours and were fed a standard concentrate pellet diet (approximately 0.3 kg per goat). Goats were individually identified and marked with 30-cm-high numbers and letters painted on the sides and rump with washable spray for animal marking.

The goats were observed 6 hours daily, from 8:00 to 10:00, 12:00 to 14:00, and 16:00 to 18:00 p.m., for 16 consecutive days, making a total of 96 hours of observations, and always observed by the same trained observer from a platform with a seat height of 2.5 m. The observer was 6 m away from the goats. Behavior sampling was used to record all events of agonistic interaction including butts, when the goat used the front of her head to make contact with another goat; threats, when a goat turned toward or approached another individual with head down and then lunged without making contact; chases, when a goat actively moved toward another individual, causing the latter to walk or run away; and avoidance, when a goat actively moved away from another individual whether previous interaction had occurred between the 2 individuals. From the data collected on these interactive behaviors and their consequences, indices of success were calculated to reflect social status of each goat according to her experiences in agonistic interactions with any other member of the herd (Álvarez et al., 2003).

The index of each goat could therefore range from 0 to 1 and was calculated according to Mendl et al. (1992). Index of success = number of individual goats she is able to displace/(number of individual goats she is able to displace + number of individual goats able to displace her). The goats were then considered as in the studies by Barroso et al. (2000) and Álvarez et al. (2003) dividing them into 3 ranking categories according to their index of success (IS): low (IS = 0.0-0.33), medium (IS = 0.34-0.66), and high hierarchy (IS = 0.67-1.0). With this ranking, 24 goats were chosen: 12 with high rank (HR) and 12 with low rank (LR).