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RESEARCH ARTICLE

Effects of different feeding methods and space allowance on the growth performance, individual and social behaviors of Holstein calves



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Abstract

The importance of nutrient provisions and weaning methods for calves has been well established over the past few years, while as increasing interest has focused on contribution of animal behavior and their overall performance in production regimes. The present study investigated the effects of feeding methods and space allowance on growth performance, individual and social behaviors in Holstein calves. Twenty-four Chinese Holstein male and female calves were allocated to either an individual or group of 6 and fed either with a bucket or a teat. Milk replacer, calf starter, and Chinese wildrye were offered during the experiment. A fecal index used in the present study was defined as the total fecal scores/total number of calves in each treatment. The results showed that there was no significant difference among the 4 treatments in terms of feed intake, body weight, average daily gain, and fecal index. For the feeding behaviors, the ingesting milk time and ingesting milk rate were significantly affected by space allowance, while the feeding methods showed a significant influence on the bunting behavior of the calves. There was no significant difference among the 4 treatments in terms of licking fixtures, self-grooming, and lying down behaviors, irrespective of the feeding method or space allowance. However, sucking an empty bucket or the teat was significantly affected by the feeding method. Several selected group behaviors were examined in the present study, and similar values for sniffing the other calves, social grooming, and cross-sucking behaviors were observed. Overall, the present study demonstrated that different feeding methods and space allowances had a significant effect on the feeding behavior of calves, while the feed intake, growth performance, health condition, individual and group social behaviors were not significantly influenced. Furthermore, under intensified production systems, Holstein calves raised in a group may obtain a similar production performance, thus reducing management input and profitability compared with those kept individually. However, there may be competition during the feeding period.

Keywords: dairy calves, feeding approach, space allowance, growth performance, animal behavior

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1. Introduction

Intensified production systems have been increasingly adopted for rearing dairy calves in recent years partially due to the intense demand for dairy products and the need to reduce labor requirements. Research suggests that nutrition provisions, weaning methods, fatty acids, or probiotic

supplementation will significantly enhance the growth performance and health conditions of calves (Terré *et al.* 2007; Roth *et al.* 2009; Frizzo *et al.* 2010). Meanwhile, the feeding contribution, individual and social behaviors of calves for overall performance are receiving considerable attention, because housing and management practices can influence the production, health, and welfare of dairy calves (Jensen and Kyhn 2000; Keyserlingk *et al.* 2004).

Previous studies showed that housing milk-fed calves in a group can improve animal welfare benefits because it allowed calves to possess more space and perform social behaviors (Færevik *et al.* 2006; Jensen *et al.* 1997). Individually reared calves exhibited little interest in contacting other calves, or they forcefully push other calves once social interaction is initiated (Duve and Jensen 2012; de Paula Vieira *et al.* 2012). This inability to regulate social interactions among individually housed calves may be attributed to a limited social experience. However, inconsistent results were observed in previous literature as individual housing may vary in regard to the level of social contact possible. For example, in some types of individual housing, tactile contact between neighboring calves is observed for individually housed calves, whereas some show few incentives to touch each other (Jensen and Larsen 2014). Currently, there are no guidelines regarding the space allowance when rearing calves in China. However, European Union (EU) regulations have established that each calf (body weight (BW) < 150 kg) should have access to a comfortable lying area with a minimum space of 1.5 m². Moreover, research conducted to date is based on calves housed individually or in relatively small groups of 2 to 3 (Jensen and Budde 2006). However, under the current production regimes, there are often more calves per group. Therefore, it is necessary to compare and identify appropriate space allowances for calves in a typical production system in China. Additionally, when calves are reared in a group, they often compete for milk (Jensen and Budde 2006). Keyserlingk *et al.* (2004) found that teat-fed calves exhibit increased competition, providing that limited teats are accessible or one teat is accessible per calf. Unlike the traditional feeding approach using a bucket, feeding calves with teats may reduce the rate of milk ingestion (Haley *et al.* 1998). However, limited information is available on the growth performance, health condition, and behaviors of calves fed from a bucket or a teat for different space allowances. Thus, the objective of this study was to investigate the different feeding methods and determine if space allowance enhances the performance and behaviors of Holstein calves.

2. Materials and methods

This study was conducted at the Experimental Station of

the Chinese Academy of Agricultural Sciences (CAAS) in Beijing, China, and it was approved by the Animal Ethics Committee of CAAS. Humane animal care and handling procedures were followed throughout the experiment. The environmental conditions were continuously recorded, and the air temperature (°C) and relative humidity (%) were collected every day from the local weather station (Daxing District, Beijing). The weekly mean air temperature was (11.4±6.26)°C, and the relative humidity was (53.7±14.55)% (mean±SD).

2.1. Animals and feeding

Twenty-four Holstein dairy calves (12 males and 12 females) were used in this study. The animals were tagged and separated from their dams into a large straw-bedded pen after birth. They were simultaneously weighed (40.0±0.31) kg of BW and offered 2 L of colostrum, ensuring a total intake of 5 L within the first 12 h. After the colostrum provision was provided to the calves for the first 3 d, all calves were fed whole milk on day 4 and until the commencement of the experiment. Colostrum and whole milk qualities were determined to ensure adequate nutrient intake for the calves.

After the initial colostrum and whole milk feeding during the first week after birth, a milk replacer (Table 1) manufactured by the Beijing Precision Animal Nutrition Research Center in China (Patent No. 02128844.5) was offered to the calves during a 7-d adaptation period (from 7 to 14 d of age) and throughout the whole experiment (from 14 to 70 d). Then, calf feed starter and Chinese wildrye (Table 1) were added to the diet beginning on day 42. The milk replacer was dissolved in hot water at a rate of 143 g to 1 L of 39°C water and was provided 3 times during the day at 0930, 1630, and 2230 h. The calf feed starter was also produced by the same manufacturer at the Feed Research Institute, and it was offered *ad libitum* after the completion of the milk replacer at each meal. The fresh Chinese wildrye was chopped into lengths of approximately 3–5 cm, and was freely accessible at all times. Clean water was also provided during the whole study. Milk replacer allowance was offered gradually according to the body weight of the calves (11% of BW), and the amount was adjusted as their BW increased.

2.2. Treatment and housing

For the experimental period (from 14 to 70 d), 24 Holstein calves were assigned to 1 of 4 groups (*n*=6): 1) individually housed and fed with a bucket (individual bucket, IB); 2) individually housed and fed with a teat bottle (individual teat, IT); 3) group housed and fed with a bucket (group bucket, GB); or 4) group housed and fed with a teat bottle (group teat, GT). At the commencement of the study, an equal

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