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Does adding water to dry calf starter improve performance during summer?

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ABSTRACT

The objective of this study was to determine whether addition of water to starter would improve performance, rumen fermentation parameters, blood metabolites, and behavior in dairy calves. For this purpose, 30 Holstein male calves (3 d of age; 42.0 ± 4.2 kg of body weight) were randomly assigned to 1 of the following 3 starter diets differing in moisture content: (1) 90% dry matter (DM), (2) 75% DM, and (3) 50% DM. Weaning and final body weight values were found to increase linearly with increasing dietary water. Moreover, starter intake increased linearly during the preweaning and overall periods. Average daily gain also increased linearly in calves receiving the 75% and 50% DM diets compared with those receiving the 90% DM diet. However, treatments had no effects on gain-to-feed ratio. Adding water to a starter with 50% DM led to linear increases in both total volatile fatty acids and molar proportions of acetate and propionate in the rumen but it had no effect on the molar proportions of butyrate, isovalerate, or valerate, nor did it have any effect on acetate-to-propionate ratio. Similarly, times spent on eating, ruminating, standing, lying, and nonnutritive oral behavior exhibited no differences across treatments. Finally, addition of water to the starter diet led to no significant changes in the concentrations of selected blood metabolites, respiration rate, or rectal temperature. Results indicate that calves readily accept wetter feeds with a DM content of 50% and that adding water to starter diets improves calf performance during the hot months of summer.
Key words: moisture level, performance, dairy calf

INTRODUCTION

During heat stress periods, dairy calves exhibit poor growth and higher susceptibility to diseases due to reduced feed intake (West, 2003) and increased maintenance energy needs coupled with lowered immunity (Tao and Dahl, 2013). Previous studies have shown significantly decreased ADG in calves during the summer months (Place et al., 1998; Bateman and Hill, 2012). Studies have shown that consumption of solid feed in starter diets can contribute to optimized development of the rumen in calves, thereby leading to greater potential for early weaning (Coverdale et al., 2004; Beiranvand et al., 2014). Adding water to a TMR is often suggested as a method to improve feed palatability and reduce preferential feed sorting (Leonardi et al., 2005); however, no study has reported the effects of adding water to starter diets on the performance and behavior of dairy calves. Increased moisture content has been reported to reduce dust associated with feeding a TMR (Arzola-Álvarez et al., 2010), and to increase palatability as a result of improved texture or dilution of undesirable flavors (Lahr et al., 1983). Traditionally, adding water to a dry TMR has been considered a beneficial management practice to decrease the degree of feed sorting (Shaver, 2002). Leonardi et al. (2005) demonstrated that adding water to TMR (reducing the DM content from 81 to 64%) diminished feed sorting against longer particles by adult cows. Moreover, Miller-Cushon and DeVries (2009) reported that adding water to reduce DM concentration in a TMR from 57.6 to 47.9% decreased DMI, and Khan et al. (2014) maintained that a DM less than 65% tended to decrease DMI in dairy heifers (175 ± 12 d of age). Other studies have, however, reported increases in DMI as DM content in the diet of dairy cattle (e.g., Lahret al., 1983). From a different aspect, TMR with higher moisture levels are thought to be more susceptible to spoilage in hot and humid conditions (Eastridge, 2006), and feed consumption will be reduced if feed is spoiled or not fresh.

The present study was designed to determine the effects of adding water to a starter on feed intake, ADG, feed efficiency, rumen fermentation parameters, blood metabolites, and nutritional behavior of dairy calves during the hot months of summer. Our hypothesis was

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that adding water to a dry starter will enhance ration adhesiveness, making it harder for calves to sort out smaller particles, which, in turn, will lead to increased solid feed consumption and improved calf performance.

MATERIALS AND METHODS

Calves, Treatments, and Management

The study was conducted from June 22 to September 22, 2014, at the FKA Agri-Animal Production Co. (Isfahan, Iran). Calves were cared for according to the guidelines of the Iranian Council of Animal Care (1995). Air temperature and relative humidity data were obtained from the daily reports released by the Meteorological Network Station at Najaf-Abad (Isfahan, Iran). The temperature-humidity index (**THI**) was calculated using the following equation (García-Ispierto et al., 2006):

$$\text{THI} = 0.8 \times \text{maximum T} + (\text{minimum RH}/100) \times (\text{maximum T} - 14.4) + 46.4,$$

where T is air temperature (°C) and RH is relative humidity (%).

Thirty Holstein male calves (3 d of age; 42.0 ± 4.2 kg of BW) were separated from their dams immediately after birth, weighed, and randomly transferred to individual pens (1.5 × 2.5 m). The pens were cleaned every 3 d by removing all bedding and replacing it with fresh sawdust bedding. All calves were fed 3 to 4 L of colostrum within 2 to 6 h after birth. The animals were fed starter diets with identical ingredients and nutrient compositions but differing in moisture content: (1) 90% DM (dry diet), (2) 75% DM (wet diet), and (3) 50% DM (wetter diet). Calves were fed pasteurized waste milk containing 3.40 ± 0.11% fat, 2.70 ± 0.07% CP, and 4.92 ± 0.05% lactose at an approximate rate of 10% of their initial BW (4 kg/animal per day) in steel buckets twice daily at 0800 and 1600 h until weaning. Before milk feeding, the milk was warmed in a water bath to raise its temperature to 38 ± 0.5°C. The calves were provided ad libitum access to water and starter throughout the study period to permit at least 10% orts (i.e., the portion of the starter not consumed over a 24-h period). Starter feed refusal from each individual calf was collected at 0800 h. The animals were weaned on d 50 and the study was terminated on d 70.

Basal diet was formulated to meet NRC (2001) requirements for calf nutrients. The ingredients and nutrient composition of the basal diet are shown in Table 1. The health criteria of the calves were monitored using the procedure described in Heinrichs et al. (2003), and calves with mild scours were treated according to the standard operating procedure of the farm (Beiranvand et al., 2014).

Data Collection and Sampling

To calculate feed intake, the offered and refused amounts of starter were recorded daily on an individual basis. All the calves were weighed at birth and subsequently every 10 d until the end of the experimental period (d 70). Gain-to-feed ratio (feed efficiency = kg of BW gain/kg of total DMI) was also calculated. In addition, heart girth and hip width measurements were made on d 3, at weaning (d 50), and at the end of the study period (d 70).

On d 70 of the study, rumen samples were collected with a stomach tube approximately 3 h after the morning feeding and strained through 4 layers of cheesecloth to obtain rumen fluid. Ruminal pH was immediately measured using a mobile pH meter (HI 8314 membrane pH meter, Hanna Instruments, Villafranca, Italy). Ten milliliters of rumen fluid was acidified with 2 mL of 25% meta-phosphoric acid, placed on ice, and transferred to the laboratory where the sample was stored (−20°C) until analysis for VFA.

Table 1. Ingredients and chemical composition (% of DM unless otherwise noted) of the basal diet

Composition	% of DM
Ingredient	
Chopped alfalfa hay	10
Barley grain ground	20
Barley grain rolled	10
Whole corn grain	21.9
Soybean meal, 45% CP	30.1
Corn gluten meal	5
Calcium carbonate	0.9
Dicalcium phosphate	0.6
Salt	0.5
Sodium bicarbonate	0.5
Vitamin and mineral mix[1]	0.5
Nutrient composition	
ME,[2] Mcal/kg	3.03
NE_G,[2] Mcal/kg	1.73
DM	90
CP	22.7
NDF	16.4
ADF	8.4
Lipid	2.8
Ash	8.0
Ca[2]	0.78
P[2]	0.55

[1]Contained per kilogram of supplement: 250,000 IU of vitamin A, 50,000 IU of vitamin D, 1,500 IU of vitamin E, 2.25 g of Mn, 120 g of Ca, 7.7 g of Zn, 20 g of P, 20.5 g of Mg, 186 g of Na, 1.25 g of Fe, 3 g of S, 14 mg of Co, 1.25 g of Cu, 56 mg of I, and 10 mg of Se.

[2]Calculated from NRC (2001).