Effects of Higher Dietary Cation with or without Protected Fat and Niacin on the Milk Yield and Thermoregulatory Ability in Holsteins During Summer Heat Stress


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I. INTRODUCTION

Heat stress is one of the major factors that decrease milk production and fertility of dairy animals during summer. Thermal environment and the metabolic heat production are two sources of heat which can negatively affect milk production of dairy cows (Linn, 1997). For normal behavior,
physiological metabolism and milk yield, it is essential that the body temperature of cows should be maintained within narrow limits. At moderate environmental temperature (5.5 – 25°C), physiological demands for cooling or warming the body temperature are minimal and an optimal performance usually occurs (Thatcher et al., 1974). However, when environmental temperature exceeds the range mentioned above, thermoregulatory activities increased and feed intake is reduced, leading to a reduction in milk yield (Schneider et al., 1984).

Dairy cows tend to reduce their feed intake by 8 – 12% or more under heat stress (Roman-Ponce, 1977). As dairy cows reduce their feed intake under heat stress, more nutrients needed to be condensed into a smaller volume of feed to maintain the nutrient supply for normal milk yield. Optional methods to increase nutrient density in a diet include feeding high quality forage, feeding more grain, and supplementing fats (Leighton and Rupel, 1960; Knapp and Gramer, 1991; Chan et al., 1993; Huber et al., 1993). Minerals, especially Na and K, easily depleted in cows under a high environmental temperature (Jenkinson and Mabon, 1973). Higher rate of respiration and perspiration can cause an excessive loss of water, thereby reducing mineral levels in the body. Increasing the K and Na contents in the ration to compensate for both increased losses and decreased intake may improve the performance of heat stressed cows (Jenkinson and Mabon, 1973).

Fat is a cold nutrient because its hydrolysis yields less heat in the animal body thus its feeding can mitigate some of the negative effects of high environmental temperature on animal productivity. However, a depression in milk protein content often occurs when fat is supplemented in the diet of dairy cows (Homer et al., 1986). Some studies have reported a reduction in the depression of milk protein percentage when supplemental niacin was fed (Cervantes et al., 1996). However, the response to niacin might have been independent of the response to supplemental fat, because similar increases in milk protein content occurred in cows fed niacin without supplemental fat. Several studies have indicated increased milk production when either supplemental fat (Homer et al., 1986 and Kim et al., 1993) or niacin (Cervantes et al., 1996) fed to lactating Holsteins.

Thus, the present study was conducted to evaluate the effect of dietary cation-anion difference (DCAD) with or without supplemental fat and niacin as a mean of improving thermoregulatory response and milk yield of Holsteins during summer.

II. MATERIALS & METHODS

1. Animals and treatments

This study was carried out at National Livestock Research Institute, Seonghwan, Korea. Thirty mid-lactating Holstein cows (134 ± 12.6 DIM and 23.4 ± 2.3 kg/d of milk yield) were divided into three groups (10 animals/group). Cows were housed in a free-stall barn and were provided with forced-air ventilation (wind velocity = 4 m/s) using 41 cm diameter fans. Cows were assigned to one of three treatment diets for the period of 2 months from July to August. All the diets were iso-nitrogenous and were formulated according to the recommendations of NRC (2001). Diet one was formulated to contain low DCAD (+15 DCAD) while the remaining two diets were higher in DCAD (+30 DCAD). One higher DCAD diet was formulated to contain by-pass fat and the second higher DCAD diet contained the niacin along with by-pass fat (Table 1). Cows were fed TMR ad libitum twice a day (09:30 and 15:00). Feed offered was adjusted daily to ensure approximately 5% ors.