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Effects of sodium bicarbonate and yeast on nutrient intake, digestibility, and ruminal fermentation of light-weight lambs fed finishing diets

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Abstract

This study was conducted to determine the effects of adding yeast culture and sodium bicarbonate to the finishing diets for lambs on intake, digestibility, rumina1 parameters and nitrogen retention. Twenty Pelibuey male lambs, weighing an average of 23 kg, were assigned to one of four treatment groups according to a completely randomized design with a 2×2 factorial arrangement. Treatments were: (1) no additive (NA); (2) 0.12% yeast culture (YC); (3) 0.5% sodium bicarbonate (SB); and (4) 0.12% YC and 0.5% SB. During the 7-day collection period, SB increased DM intake ($P < 0.05$), while YC had no effect ($P > 0.05$) on intake. Intake of non-fibrous carbohydrates (NFC) was increased ($P < 0.05$) with SB in the ration, but not by supplementing YC ($P > 0.05$). The YC had no effect ($P > 0.05$) on dry matter (DM), neutral detergent fiber (NDF) or non-fibrous carbohydrates digestibility. A higher intake of NFC with the SB treatments was associated with a lower ($P < 0.05$) digestibility. SB increased excretion of NDF ($P < 0.05$), which reduced its digestibility ($P < 0.05$) by more than 9 percentage units. Lambs consuming diets with SB had 27% more N retained, in contrast with those fed the basal diet without additives. Rumen pH was greater than the minimum considered to cause acidosis (≤pH 5.5). The SB reduced ($P < 0.05$) percent molar acetate and increased ($P < 0.05$) percent molar propionate, which is in contrast to what has been normally observed with dairy cattle research. A lower acetate to propionate ratio with the SB rations may be a result of a lower digestibility and a higher intake of NDF, which may have increased the rate of passage of fiber particles through the gastrointestinal tract.

Keywords: Lambs; Intake; Digestibility; Sodium bicarbonate; Yeast culture

1. Introduction

Acidosis is one of the most common nutritional related diseases in feedlots ruminants. Lactic acidosis occurs frequently in feedlots animals that consume high

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energy or low fiber diets. Ruminal acidosis is defined as a drastic reduction in rumen pH. Acidosis is caused by an excessive ingestion and fermentation of soluble carbohydrates such as sugars and starch, consumed in a relatively short period of time. This results in the production of more lactic acid that can actually be buffered by the rumen, attracting water from the circulatory system into the rumen, which causes dehydration of the animal and a drastic change in blood pH (Owens et al., 1998).

Acidosis in ruminants is frequently classified as acute, chronic (or subclinical) or subacute. After consumption of rapidly fermentable carbohydrates, in sufficient quantities to reduce the pH of ingesta, an acute acidosis will occur. With a chronic acidosis, feed intake and weight gain are reduced, although the animal may not appear to be sick. A clinical diagnosis of acidosis depends on the acidity of the rumen or blood. Rumen acidosis may be acute if rumen pH is <5.2, or chronic if pH is between 5.2 and 5.6 (Church, 1991).

A reduction in the absorption of VFA from the rumen may limit energy availability when acidosis occurs (Bergman, 1990). With steers and lambs, Adams et al. (1981) found that yeast culture (YC) and sodium bicarbonate (SB) supplementation could stimulate feed intake of animals on a high grain diets, at least for a short period of time. Although a change in rumen liquid flow patterns occurred, the addition of SB did not alter fermentation products, digestibility or performance in steers. The addition of yeast culture to the basal diet may alleviate the effect of acidosis that normally resulted in the depression in feed intake. Live yeast (*Saccharomyces cerevisiae*) and other bacterial cell species adhere to feed particles to support ruminal fermentation. Although these do not survive in the rumen, a small population may be maintained with continuous feeding (Van Soest, 1994). Production responses are highly variable and are influenced by ration composition (Wallace and Newbold, 1993). Adams et al. (1981) observed a small effect of yeast supplementation on ruminal pH, volatile fatty acid production and fiber digestion. However, other researchers (Wiedmeier et al., 1987) have also observed an increase in rumen fermentation and fiber digestion. Apparently, live yeast stabilize rumen environment by reducing the pH of rumen fluid (Williams and Newbold, 1990). The purpose of this study was to evaluate the effect of yeast culture and sodium bicarbonate supplementation in the finishing diets of light-weight Pelibuey lambs, on intake and digestibility of dry matter (DM) and other nutrient components, nitrogen retention, mastication, and ruminal fermentation.

2. Experimental procedures

Twenty male Pelibuey lambs, with an average weight of 23.4 kg, were randomly assigned to one of the four groups according to a completely randomized design, with a 2×2 factorial arrangement of treatments. Treatments were: (1) no additives (NA); (2) 0.12% yeast culture (YC; Yea Sacc® 1026; All-Tech, Lexington, Kentucky; containing 2.8×10^4 cfu of yeast/g); (3) 0.5% sodium bicarbonate (SB); and (4) 0.12% YC and 0.5% SB.

Lambs were confined individually in metabolic cages (1.5 m^2), with water and feed available at all time. Lambs were weighed at the beginning and end of the sampling period, before being offered their first meal. Experimental diets are presented in Table 1. Total daily feed was offered in three equal portions during the day (08:00, 13:00 and 17:00 h). Feed offered was based on the intake of the previous day plus an additional 10%, in order to reduce the selection of feed components by lambs.

The experiment consisted of a 14-day adjustment phase during which lambs were adapted to the experimental rations, and a 7-day collection phase, plus a 24 h eating behavior study. During the collection phase, total volume of feces and urine were collected, weighted and frozen. At the end of the 7-day collection period, all

Table 1
Feed composition of lamb finishing diets with or without yeast culture or sodium bicarbonate[a]

Item	Without $NaHCO_3$		With $NaHCO_3$	
	No[b]	Yes[b]	No[b]	Yes[b]
Ingredient (%)				
Soybean hulls	10.0	10.0	10.0	10.0
Sorghum grain[c]	68.1	68.0	68.0	67.9
Soybean meal	13.3	13.3	13.3	13.3
Molasses	6.0	6.0	6.0	6.0
Calcium carbonate	1.3	1.3	1.3	1.3
Urea	0.6	0.6	0.6	0.6
Premix[d]	0.2	0.2	0.2	0.2
Sodium bicarbonate	–	–	0.5	0.5
Salt	0.5	0.5	0.13	0.13
Yeast culture	–	0.12	–	0.12

[a] Nutrient composition of the basal diet: NEm (Mcal/kg),1.872; NEg (Mcal/kg), 1.257; crude protein (%), 17.0; bypass protein (%), 9.0; calcium (%), 0.75; phosphorous (%), 0.36; potassium (%), 0.91; crude fiber (%); 7.0.

[b] Yeast culture.

[c] Sorghum: 50% whole and 50% ground.

[d] Premix: containing 5.6% Mg; 15,000 ppm Zn; 12,000 ppm Mn; 7500 ppm Fe; 400 ppm I; 50 ppm Co; 50 ppm Se; 3,500,000 IU Vitamin A/kg; 862,500 IU Vitamin D_3/kg; 4000 IU Vitamin E/kg; 30 g/ton of sodium alkaloid (Bovatec; Alpharma, Fort Lee, NJ), and 20.9% urea.