Effect of concentrate type (starch vs. fiber) and bicarbonate addition in grass silage-based diets on performance, diet digestibility and enteric methane emissions in lactating dairy cows

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Abstract Text:

Cereals and corn silage diets are extensively used for high yielding dairy cows and it is well established that altering dietary starch and fiber proportion results in methane (CH_4) emissions mitigation. With grass silage-based diets, quantitative evidence of CH_4 emissions reduction with high-starch concentrate is lacking. Therefore, the objective was to compare the effects of fiber-rich (F) or starch-rich (S) diets based on grass silage, supplemented or not with bicarbonate (Fb and Sb) on CH_4 emissions, diet digestibility and performance in dairy cows. Four multiparous lactating Holstein cows were used in a 4x4 Latin-square design experiment of 4 periods of 4 weeks each. Four dietary treatments were assigned based on grass silage 42%, hay 8%, and F or S concentrate 50% (DM basis), supplemented or not with sodium bicarbonate (1% DMI). Bicarbonate was used as a digestive regulator to lower the risk of ruminal acidosis appearance. Intake and milk production were measured daily and milk composition weekly during the experiment. Methane production and diet digestibility were measured simultaneously for the last 5-d of each period when cows were in open respiration chambers. Feed efficiency (fat and protein corrected milk/DMI) was calculated using data from week-4. Data were analyzed using mixed-effect models with cows as random-effect, period and treatments as fixed-effects. Orthogonal contrasts were used to evaluate diet type or bicarbonate supplementation effects. The S and Sb diets induced less daily CH_4 emissions (417.5 and 393.9 $g.d^{-1}$, respectively) than F and Fb diets (487.9 and 506.4 $g.d^{-1}$, respectively) as well as a significant decrease in CH_4 intensity (-14% in $g.DMI^{-1}$; -20% in $g.FPCM^{-1}$). DMI was reduced by 3.5% with the starch-diets compared to fiber-diets ($P < 0.05$). Total tract digestibility of nutrients (DM, OM, Starch) and gross energy were lower ($P < 0.05$) for F and Fb than for S and Sb diets. Feed efficiency, milk yield and fat content were not different between starch- and fiber-diets ($P > 0.05$) but milk protein content was greater for the starch-diets (+3%, $P < 0.05$). Bicarbonate had no effect on diet digestibility and CH_4 emissions ($P > 0.05$). However, milk fat content was higher ($P = 0.05$) with Sb than S, F and Fb diets. Feeding 50% starch-rich concentrate with grass-silage diets, with or without bicarbonate, is an effective dietary approach for reducing methane emissions without altering diet digestibility and milk performance of dairy cows.

Keywords: concentrate type, dairy cow, methane emissions