THE EFFECTS OF BRANCHED CHAIN VOLATILE FATTY ACIDS AND ENCAPSULATED LYSINE AND THREONINE SUPPLEMENTS ON PROTEIN NUTRITION OF GROWING HOLSTEIN

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ABSTRACT

Protein nutrition in ruminants is frequently limited by inadequate bacterial growth in the rumen and the lack of amino acids supplies for postruminal absorption. This study tried to stimulate bacterial growth through supplementation of isoacids and enrichment of postruminal supply of lysine, threonine, and essential fatty acids.

Trial 1 was a 5x5 Latin Square experiment in young Holstein bulls, 348 ± 29 kg, where treatments were A: basal diet, B: A + 139 mg urea/kg W^0.75, C: B + 28 mg CaSO_4/kg W^0.75, D: C + 0.05 mmol isobutyrate + 0.05 mmol β-methylbutyrate, and E: D + 0.05 mmol α-methylbutyrate. The basal diet composed of 55% forage and 45% concentrate containing 10.5 MJ ME/kg and 15% crude protein (CP). Dry matter intake was not affected by the treatments but significant changes were noted in the rumen fermentation parameters. Urea addition (treatment B) increased cultivable rumen bacteria from 6.44 x 10^11 to 8.50 x 10^11 colonies/ml (p<0.05). Addition of CaSO_4 (treatment C) reduced rumen bacteria to the similar level as that of treatment A (p<0.05). The reduction might be due to an excess of Ca that resulted in mineral imbalance. Addition of isobutyrate and β-methylbutyrate (treatment D) increased rumen bacteria from 5.93 x 10^11 to 7.54 x 10^11 colonies/ml, suggesting that the isoacids stimulated bacterial growth. The failure of α-methylbutyrate to stimulate further bacterial growth indicated that the best proportion of the isoacids was not equimolar. The number of bacterial colonies was in a good agreement with the quantity of allantoin excreted in urine. Regression of urinary allantoin excretion (A, mg/day) on the square root of bacterial colonies (B) was A = (2.6.B^{0.445})/(2.62 + B^{0.445}) with an R^2 = 0.551 and Sb = 0.0817.

Trial 2 was a 5x5 Latin Square experiment in Holstein heifers, 160 ± 43 kg, where treatments were A: treatment E as in Trial 1 + 1.5% corn oil, B: A + 1.5 ml corn oil enclosed in formaldehyde treated gelatin capsule, C: B + encapsulated lysine, 28 mg/kg W^0.75, D: C + 100 mg encapsulated threonine, and E: D + 1.5% cod liver oil. Addition of encapsulated corn oil (treatment B) increased dry matter digestibility from 73.9 to 77.5% (p<0.05) and crude protein digestibility from 87.8 to 92.0% (p<0.05). Addition of encapsulated lysine (treatment C) and threonine (treatment D) increased the corresponding amino acid concentration in the blood plasma, indicating an increase in the absorption. However, comparisons of plasma amino acid ratio prior to and 3-4 hr after feeding showed that lysine was not the first limiting amino acids. Threonine appeared as the first limiting amino acid only in the E treatment. Addition of encapsulated lysine and threonine then did not change nitrogen retention as well as liveweight gain. Good agreement between bacterial colonies and urinary allantoin excretion was also apparent in Trial 2. Regression of A on B was A = (2.9.B^{0.550})/(1.77 + B^{0.550}) with an R^2 = 0.905 and Sb = 0.0663.