

# 学 位 論 文 の 要 旨

論文題目 Digestive Physiological Studies on Nitrogen Utilization of Steers Fed Home-grown Feeds  
(去勢牛への国産飼料給与に伴う窒素利用の消化生理学的研究)

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In Japan, intensive animal production has been expanding in recent decades, and a huge amount of animal feed including forages is being imported from all over the world. Domestic production of feed for domestically raised animals is an obvious way to improve the country's low food self-sufficiency rate and to prevent an excess of animal waste. Overall objectives of this study were to evaluate domestic forage and grain based diets for steers in digestive physiological perspective of nitrogen (N) and amino acid (AA) based on digestion, absorption and metabolism.

The first experiment was to evaluate the effects of concentrate levels supplemented to a high grass silage based diet on the digestion extent of nutrients in the rumen and intestine of steers, and to compare N balance with or without duodenal Met infusion. Ratios of supplemental concentrate were 0.35 (IsCl) and 0.85% (IsCh) of body weight on dry matter (DM) basis, respectively. Organic matter (OM) intake was greater for IsCh diet by 24% than for IsCl diet. The digestible non-fiber carbohydrate (NFC) in the total tracts also tended to be greater for IsCh diet. Duodenal flows of microbial N and non-ammonia N, and digestible N in the intestine were greater for IsCh than IsCl diet. Retention of N was improved by 85% for IsCh diet compared with for IsCl diet, but duodenal Met infusion significantly did not affect the N retention of steers consumed both levels of supplemental concentrate. These results suggest that additional Met delivery to the lower gut of steers fed high Italian ryegrass silage diets could not increase N retention, but a small increase of concentrate supplement is useful feeding management to improve N utilization through an increase in available energy supply for rumen microbial yield and host animal.

In the second experiment, the objective was to evaluate the combination effects of 38% of whole crop corn (Cs) or rice (Rs) silage with 35% of steam-flaked corn (Cg) or rice (Rg) grain in dietary DM basis on ruminal carbohydrate digestion, duodenal N flow and plasma essential amino acid (EAA) concentration. The ruminal digestibility of starch and NFC for Rs and Rg diets compared with Cs and Cg diets was greater, but that of neutral detergent fiber excluded ash (NDFom) was less. Because the ruminal disappearance of NFC plus NDFom was similar across treatments, microbial N flow was not affected by the dietary treatments. There was an interaction of Met flow by silage and grain sources: greatest for CsRg and least for RsRg diet, and blood plasma concentration of Met after feeding was lower for Rg than Cg diets. Postprandial reduction degree of plasma EAA varied with the diets and individual EAA. The Cs diets compared with the Rs diets tended to be greater in N retention because of greater digestible OM intake. These results suggest that silage source combined with corn or rice grain affects N use in steers through the digestible OM intake, and the kind of limiting AA may differ among the combinations of silage and grain sources.

The third experiment was carried out to investigate the effects of Met supplementation (10 g/d) on AA metabolism by visceral tissues in steers fed the diets consisting of 38% corn silage with 35% of corn or rice grain in DM. Net output or uptake of AA were measured

across portal-drained viscera (PDV), liver and total splanchnic (TSP: PDV plus liver) tissues. Blood and plasma flows across PDV and TSP and net fluxes of AA by PDV, liver and TSP were unaffected by the grain sources, indicating that replacement corn grain with rice grain did not affect postprandial absorption of available AA. The postprandial infusion of Met for both grain diets resulted in a significant increase in Met absorption across PDV and arterial plasma concentration of Met, although the amount of total AA release from TSP did not increase compared with the both grain diets without Met infusion. Greater supply of Met to the duodenum may not affect AA metabolism by the splanchnic tissues of growing ruminants consuming corn silage-based diets including corn or rice grain.

Overall, these studies indicate that it is important to evaluate dietary nutrient value and supplements for ruminants in digestive physiological perspective of N and AA based on digestion, absorption and metabolism. A small increase of concentrate supplement is useful feeding management to improve N utilization in growing steers fed high grass silage diets. The whole rice crop silage compared with corn crop silage may reduce N utilization in steers through less digestible OM intake, and the kind of limiting amino acid may differ among the combinations of silage and grain sources. Replacing corn grain with rice grain does not affect postprandial absorption of available AA. Provision of greater duodenal flow of Met couldn't seem to affect AA release from the splanchnic tissues to the peripheral tissues for growing ruminants consuming corn silage-based diets. When rice silage or rice grain are used as a substitution of corn silage or corn grain, the limiting amino acid for each dietary combination of silage and grain sources should be taken into consideration and clarified.