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Effects of supplementary inosine on nutrient digestibility, ruminal fermentation and nitrogen balance in goats fed high amount of concentrate

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ABSTRACT

A study was conducted to compare responses of nutrient intake, digestibility, ruminal fermentation, and N balance in goats fed high amounts of concentrate supplemented with inosine or urea. Four Japanese Saneen goats (49.2 ± 5 kg), housed in individual metabolic cages, were blocked by weight into two pairs, and assigned inosine or urea as non-protein N (NPN) supplements to their basal diet at 0.15 g per kg body weight on a urea basis, in a 2 × 2 switch back experimental design. The basal diet consisted of 0.4 timothy hay, and 0.6 concentrates, and was fed to the goats as a total mixed ration (TMR). The experimental period was 13 days, including 7 days of adaptation, 5 days of sampling of feces, urine and orts, and 1 day of sampling of rumen fluid. Intake of dry matter (DM), organic matter (OM), neutral detergent fiber (NDF) and crude protein (CP) and digestibility in the total tract, as well as N balance, were assessed by total fecal collection. Rumen fluid was sampled at 0, 1, 4 and 7 h after feeding, and analyzed for pH, ammonia and volatile fatty acids (VFA). Additionally, samples collected at 0 and 4 h after feeding were assessed for protozoal counts. Daily intakes of DM, OM, NDF and CP did not differ among treatments. Digestibility in the total tract tended (P=0.07) to be lower for NDF and was numerically lower for DM (P=0.11), OM (P=0.11), and NDF (P=0.12) in

Abbreviations: ADF, acid detergent fiber; BUN, blood urea N; CP, crude protein; DM, dry matter; EE, ether extract; GLM, general linear model; NDF, neutral detergent fiber; NEFA, non-esterified fatty acids; NPN, non-protein N; OM, organic matter; RDP, ruminally degradable CP; TMR, total mixed ration; VFA, volatile fatty acids.

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goats supplemented with inosine *versus* urea. Ammonia concentration and ruminal pH were similar among treatments, and protozoal counts 4 h after feeding was lower (P=0.02) in goats supplemented with inosine compared to those on urea. No differences between treatments occurred in concentrations of rumen VFA (i.e., acetate, propionate, valerate, *iso*-acids, and total VFA) except for butyrate, which was higher (P=0.03) in goats supplemented with inosine *versus* urea 4 h after feeding. There were no differences in intake, absorption and retention of N between treatments. Thus, responses in nutrient intake, digestibility, ruminal fermentation and N balance in goats fed high amounts of concentrate with supplementary inosine and urea were similar.

1. Introduction

Animal nutritionists have evaluated many non protein N (NPN) compounds as ruminant feeds in order to identify those with a slower release in the rumen in order to optimize efficiency of their utilization by rumen microorganisms. These have included isobutylidene diurea, methenamine, acetylurea, starea, tung- and linseed coated urea, biuret, polymer-coated urea and formaldehyde treated urea (Löest et al., 2001; Galo et al., 2003; Golombeski et al., 2006). However, not all of these compounds have been as advantageous as urea because the NPN in many of them leaves the rumen without being completely converted to ammonia, thereby reducing their incorporation into microbial protein. Additionally, the ammonia formation in the rumen from these compounds, though slower than urea, is often still too fast for high capture as microbial protein (Henning et al., 1993).

According to McAllan (1982), the ribose ring of a nucleic acid compound is degraded in the rumen, yielding mainly hypoxanthine that is further hydrolyzed to ammonia and carbon dioxide. That the heterocyclic purine in inosine molecule, which is a nucleic acid compound, can be hydrolyzed to ammonia suggests its potential to supply ammonia-N required by rumen microorganisms. However, because use of ammonia-N produced in the rumen is also dependent on energy availability, inclusion of readily fermentable energy sources to forage diets supplemented with an NPN source is essential to increase the efficiency with which rumen microorganism capture its ammonia-N and stimulate their growth and adherence to feed particles (Caton and Dhuyvetter, 1997; Jetana et al., 2000). Additionally, some studies (Herrera-Saldana et al., 1990; Matras et al., 1991) have demonstrated increased ruminal microbial protein passage from the rumen and improved N balance when readily fermentable energy sources are supplied to the rumen. In this study, we hypothesized that use of inosine as a supplement to forages fed with readily fermentable energy sources would improve ruminal fermentation, forage utilization and N balance in goats.

The objective was to compare responses of nutrient intake, digestibility, ruminal fermentation and N balance in goats fed high amounts of concentrate to supplementary inosine and urea.

2. Materials and Methods

2.1. Animals, Diets and Design

Goats used in this study were managed according to guidelines of the Kyoto University Animal Ethics Committee. Four Japanese Saanen male castrated goats with an average body weight (BW) of 49.2 ± 5 kg, and housed in individual metabolic cages, were blocked by weight into two pairs, and assigned inosine (Ajinomoto Inc., Tokyo, Japan) or urea as NPN supplement, in a 2×2 switch back experimental design. The basal diet, which consisted of 0.4 timothy hay and 0.6 concentrates, was fed as a total mixed ration (TMR). The determined chemical composition of the components of the TMR is in Table 1. The ration was fed to the goats twice daily, at 09:00 and 16:00 h, with *ad libitum* supply of clean drinking water.