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Dried Poultry Waste as a Nonprotein Nitrogen Source for Ruminants

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Summary

Two trials were conducted to evaluate the use of dried poultry waste as a source of degradable intake protein in growing and finishing ruminant diets. Trial 1 utilized eighty-eight crossbred lambs (62 lb) in a 60-day growing period and subsequent 60-day finishing period. In the growing period, lambs were fed seven levels of degradable intake protein, 5.6 to 7.7% of diet DM (7.6 to 9.7% CP) from either urea or dried poultry waste. In the finishing period, lambs (71 lb) were fed a control diet containing no added N, 5.1% degradable intake protein (9.6% CP) or six levels of degradable intake protein, 5.7 to 8.5% (10.1 to 12.6% CP) from either urea or dried poultry waste. In the growing phase, no response to level of degradable intake protein was observed. Feed efficiencies for urea and dried poultry waste were equal. In the finishing phase, dried poultry waste was equal to urea as a source of degradable intake protein. In Trial 2, four ruminally-fistulated

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crossbred yearling steers (642 lb) were used to evaluate rumen ammonia concentration from feeding dried poultry waste or urea. Steers were ruminally dosed with .08 lb of nitrogen from either urea or dried poultry waste. Steers dosed with urea had greater ammonia concentrations at two and four hours compared to those dosed with dried poultry waste. Dried poultry waste was utilized as efficiently as urea in growing and finishing lamb trials and concentration of ammonia in the rumen was less for dried poultry waste.

Introduction

Waste management is a concern of the livestock and poultry industries and feeding waste products to animals is a management tool that can be used. Research has shown that consumption of poultry waste by ruminants results in a higher recovery of nutrients than use as fertilizer. Dried poultry waste (DPW) contains an average of 28% CP, of which 54% is true protein with the remainder mostly in the form of rumen degradable uric acid.

Dried poultry waste can be used in supplements for both growing and finishing diets. The value of DPW in ruminant feeding programs has not been critically evaluated. The objective of this experiment was to determine if DPW is a viable source of degradable intake protein for growing and finishing diets.

Procedure

Trial 1 — Growing-Finishing

Thirty-four ewes and fifty-four crossbred wethers (62 lb ± 1.9) were randomly assigned to one of 14 treatments for a 60-day growing period. Treatments consisted of seven levels of degradable intake protein (DIP) from either urea or DPW, 5.6% to 7.7% DIP (7.6 to 9.7% CP). Diets were a 50:50 mixture of ensiled corncobs and corn silage that made up 89% of the diet DM, the remainder of the diet was dry rolled corn and mineral supplement. Diets were balanced to be isocaloric and contain a minimum .7% calcium and .35% phosphorus. For the different treatment levels, urea and DPW supplied 40 to 60% of total dietary N (DM basis). The diets for low and high treatment levels were mixed once weekly and appropriate amounts of each diet were mixed for each lamb in order to obtain the proper treatment level. The amount of DIP consumed by each lamb was calculated based on amount of degradable protein from DPW or urea, ensiled corncobs, and corn silage. The lambs were weighed on three consecutive days at beginning and end of 60-day period. Three days before the final weights, lambs were fed 2.1% (DM basis) of BW to reduce differences in gut fill.

The same eighty-eight lambs (71 lb ± 2.6) were used in 60-day finishing period. Lambs were randomly assigned to 13 treatments, which included a diet containing no supplemental N, 5.1% DIP (9.6% CP) or six levels of DIP from either urea or DPW, 5.7 to 8.6% DIP (10.1 to 12.6% CP). Diets were based on dry rolled corn, alfalfa, ensiled corncobs, molasses, and mineral supplement and balanced to be isocaloric and contain a minimum of .7% calcium and .35% phosphorus. Urea and DPW supplied 0 to 34% of total dietary N (DM basis). The control and highest treatment level diets were mixed once weekly. Appropriate amounts of each diet were mixed for each lamb to obtain the proper treatment level. The amount of DIP consumed by each lamb was calculated based on amount of degradable protein from DPW or urea, corn, corn silage, and alfalfa consumed by each lamb. Lambs were weighed on three consecutive days at the beginning and end of the period. Beginning weights were the ending weights from the growing period.

Degradable intake protein efficiency was assessed using the slope ratio technique and determined by regression of feed efficiency on DIP. Individual slopes of DPW and urea protein efficiencies were analyzed statistically with a two tailed t-test.

Trial 2 — Metabolism

Four ruminally-fistulated crossbred yearling steers (642 lb) were used. The steers were assigned to treatments according to a 4 x 4 Latin square design. Dietary treatments were: two growing rations balanced for 7.0% DIP (9.0% CP) supplemented with either DPW or urea; two finishing rations balanced for 9.7% DIP (12% CP) supplemented with either DPW or urea. The growing rations consisted of 44% corn silage, 44% ensiled corncobs, 9% dry rolled corn, and 3% supplement. The finishing rations consisted of 79% dry rolled corn, 5% corn silage, 5% alfalfa hay, 8% molasses, and 3% supplement. All diets were balanced to contain a minimum of .70% calcium, and .30% phosphorus. The growing diet included 25 g/ton Rumensin and the finishing ration included 25 g/ton Rumensin and 10 g/ton Tylan. Each steer had a 10-day adaptation period to diets containing either urea or DPW when the percentage of body weight each steer would consume was determined. After 10 days, steers were fed, at their determined percentage of body weight, a diet that contained no urea or DPW for 36 hours before sample collection. The diet was fed at 2-hour intervals throughout the sample collection period.

After the 36-hour period, 40 grams of N (quantity of urea consumed if fed the urea supplemented diet) from urea or DPW were intraruminally dosed into each steer. Rumen fluid was collected at 0, 2, 4, 6, 8, 12, and 16 hours after dosing. Ruminal pH was measured immediately after collection.

Ammonia concentrations were statistically analyzed using the GLM procedures of SAS as repeated measures. Each steer was an experimental unit with period, steer, and treatment as sources of variation and time as the repeated measure.

Results

Treatments were formulated to contain increasing increments of DIP, therefore the calculated intakes of degradable protein were different ($P < .05$) among treatment levels for both urea and DPW treatments in the growing period. Dry matter intake was not significantly different among treatments. Data analyzed as nonlinear regression showed no response to level of DIP. Average gain/feed (.08) of the lambs consuming DPW and urea were equal.

To observe a protein response, DIP must be fed below the lamb's requirement. The 5.6% DIP treatment was apparently not below the lambs requirement when consuming this growing diet. The DIP requirement for the lambs was estimated before the trial using TDN of the diet times the efficiency of rumen microbes to convert energy to microbial crude protein (MCP). It has been estimated that the efficiency of rumen microbes to convert energy into MCP is 13%. The diet in this trial contained 61% TDN so the estimated DIP requirement was 7.9%. However, we did not observe a response to the 5.6% DIP level, indicating a lower efficiency should have been utilized or recycling of N to the rumen is greater than predicted.

During the finishing period lambs were fed a DIP level below the requirement, resulting in a numerical increase in efficiency due to level of DIP. Numerically less DIP was required from DPW to reach maximum efficiency compared to urea (Figure 1). The efficiency with which lambs utilized the N in DPW and urea are indicated by slopes of .043 and .031, respectively. These slopes were not different ($P > .10$).

The DIP requirement for finishing lambs was calculated as previously described. However, a lower rumen microbial efficiency to convert energy to MCP was used. The DIP required for lambs on the finishing diets was calculated as 85% TDN times 8.03% microbial efficiency compared to a forage diet. An efficiency of 8.03% was used because a high concentrate diet has a lower rumen pH and reduced microbial efficiency compared to a forage diet. Therefore, the DIP requirement for lambs consuming the finishing diets was 7%. The results from this trial indicate DIP requirements were 6% for DPW and 6.3% for urea.

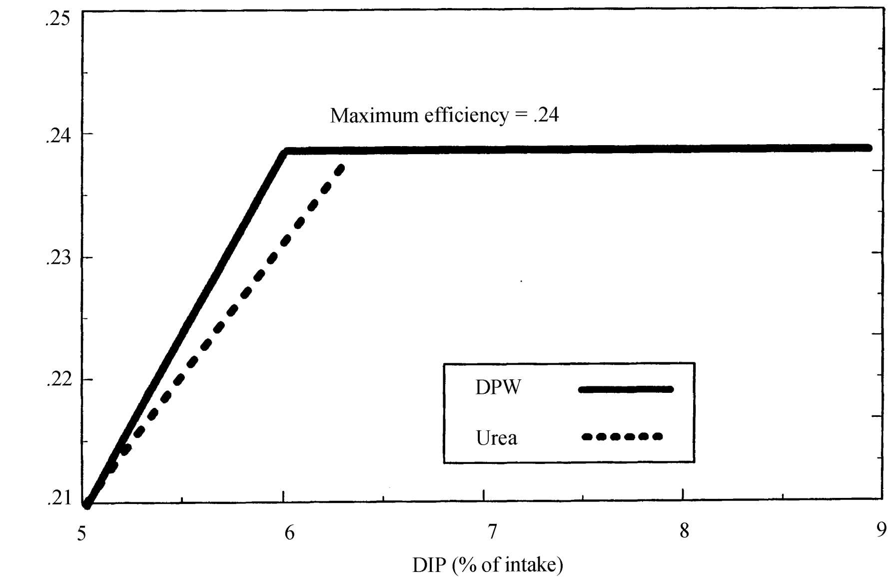

Figure 1. Nonlinear regression of feed efficiency on degradable intake protein for finishing period.

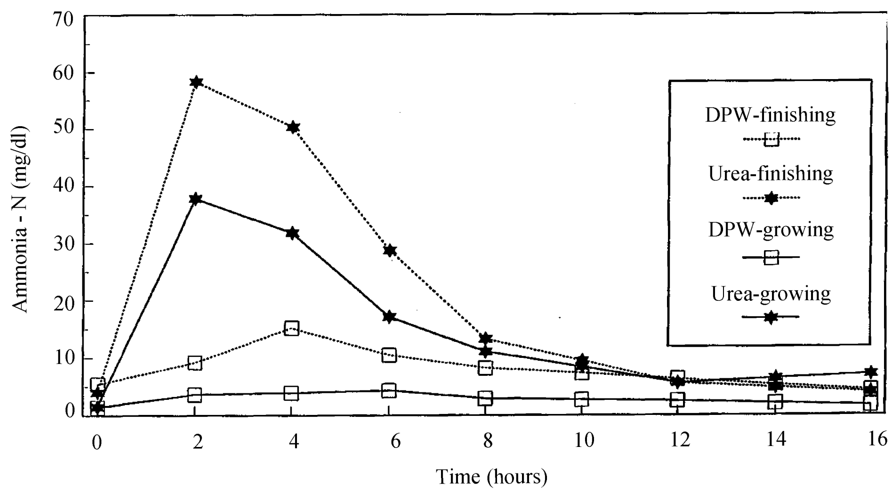

Figure 2. Ruminal ammonia concentration from dosing DPW or urea when feeding growing or finishing diets.

The feed efficiencies for lambs receiving finishing diets supplemented with DPW or urea above the DIP requirement were equal, (.24) as were daily gains (.69 lb/day). Dry matter intakes were not different among treatments.

In the metabolism trial, steers dosed with urea had higher ammonia concentrations ($P < .03$)and ruminal pH ($P < .10$) 2 and 4 hours after dosing than steers dosed with DPW (Figure 2). Thus urea provided a greater concentration of ammonia for the rumen microbes quickly, while DPW provided ammonia at a low concentration over time.

Results from these trials indicate that DPW is an acceptable source of rumen degradable protein for ruminants. The two trials indicate that DPW is efficiently utilized by rumen microbes in both growing and finishing diets, and can be used to meet the animals' degradable intake protein requirement.

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