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## PROTEIN SUPPLEMENTATION AS RELATED TO SOURCES OF PROTEIN FOR GROWING-FINISHING LAMBS

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### Summary

Two hundred forty crossbred ewe and wether lambs ranging from 55 to 100 lb. were allotted into five weight groups averaging 81.6, 71.9, 70.2, 70.0 and 65.6 pounds. Within each weight group (replication), the lambs were randomly allotted to six supplemental treatments (control, soybean meal, corn gluten meal, urea, urea-soybean meal and urea-corn gluten meal) to give rations varying in protein solubility and amino acid profile. Control rations contained 11% protein, while protein content for rations of supplemented lambs contained about 13% protein (dry basis). Lambs were fed from 50 days (heavier weight group) to 99 days (lighter weight group) to reach an average weight of approximately 110 lb. at which time they were marketed. Supplements were fed at a rate of 10% of the total dry matter intake with the other 90% consisting of ground ear corn as the basal feed.

Results obtained throughout the trial indicated a significantly higher ( $P < .05$ ) rate of gain for animals supplemented with soybean meal, corn gluten meal, urea-soybean meal and urea-corn gluten meal when compared to the control group. Urea-supplemented lambs gained at a lower rate, but no initial period of lowered performance during adaptation to urea was observed.

Animals fed the control diet consumed less dry matter ( $P < .05$ ) than those fed protein-supplemented diets. Feed consumption was similar for all supplemented groups. Therefore, feed efficiency was primarily a reflection of rate of gain.

Soybean meal is commonly considered to be of higher quality protein on basis of amino acid composition than corn gluten meal. It is more readily degraded in the rumen than corn gluten meal. However, as supplements to ear corn for growing and finishing lambs, the two high protein ingredients appeared about equal.

Urea as the only supplemental protein to ear corn was of questionable value in this experiment. Using urea to provide about one-half of the supplemental protein with soybean meal or corn gluten meal did not affect performance of the lambs. However, the benefits from urea under these conditions were not determined since soybean meal or corn gluten meal were not fed at these lower levels without urea.

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## Introduction

Numerous experiments have been conducted during past years to determine protein requirements of ruminants under various dietary conditions and with different types and levels of production. Requirement levels of various nutrients have been established which appear to meet needs under practical feeding conditions.

Research involving protein supplementation has shown that a large fraction of the protein available to the ruminant is of bacterial origin regardless of the dietary source. However, not all protein sources appear to be of equal value to the ruminant. Studies have indicated that amino acid composition, rate of degradation in the rumen and the availability of carbohydrates in the diet affect bacterial protein synthesis and the amount and quality of protein presented to the animal. Natural sources of proteins (soybean meal, cottonseed meal, linseed meal, corn gluten meal) have been shown to be degraded at different rates in the rumen and reported to affect utilization of protein by the ruminant.

The objective of this study was to evaluate commercially available sources of supplemental protein in diets for growing and finishing lambs. Supplements were selected to differ in protein solubility and amino acid profile and were expected to be degraded at different rates in the rumen to furnish protein post-ruinally varying in dietary and bacterial origin. If the principles concerning these parameters reported by other investigators would be applicable, the response in terms of growth and feed utilization would be a measure of the value of the supplements for productive purposes.

## Procedures

Two hundred forty crossbred ewe and wether lambs were used in this experiment. They were selected from a larger group purchased at a local livestock auction about 45 days before the beginning of the experiment. During this time, the lambs were sheared and brought to a full feed with a ground ear corn ration. The lambs ranged from 55 to 100 lb. and were divided into five weight groups (replication) averaging 81.6, 71.9, 70.2, 70.0 and 65.6 pounds.

Lambs within each weight group were randomly allotted to six experimental treatments with six wether and two ewe lambs per treatment. They were implanted with Ralgro (12 mg. zeranol) and vaccinated for prevention of overeating disease.

The finishing diet consisted of 90% ground ear corn and 10% supplement on a dry matter basis. Six different supplements (table 1) were fed as follows:

1. Control supplement (corn grain)
2. Soybean meal supplement
3. Corn gluten meal supplement
4. Urea supplement
5. Urea-soybean meal supplement
6. Urea-corn gluten meal supplement.

Table 1. Percentage Composition of the Supplements<sup>a</sup>

| Ingredients                             | Control | Soy-bean meal | Corn gluten meal | Urea | Urea-soy-bean meal | Urea-corn gluten meal |
|---|---------|---------------|------------------|------|--------------------|-----------------------|
| Ground corn                             | 81.0    | 19.4          | 38.8             | 72.6 | 45.4               | 54.7                  |
| Soybean meal<br>(44% crude protein)     | --      | 63.8          | --               | --   | 31.9               | --                    |
| Corn gluten meal<br>(60% crude protein) | --      | --            | 43.5             | --   | --                 | 21.8                  |
| Urea (46% nitrogen)                     | --      | --            | --               | 7.9  | 4.0                | 4.0                   |
| Ground limestone                        | 11.0    | 10.8          | 10.7             | 9.4  | 10.0               | 10.0                  |
| Dicalcium phosphate                     | 3.0     | 1.0           | 2.0              | 2.6  | 2.6                | 2.7                   |
| Calcium sulfate                         | --      | --            | --               | 2.1  | 1.1                | 1.1                   |
| Potassium chloride                      | --      | --            | --               | .4   | --                 | .7                    |
| Trace mineral salt                      | 5.0     | 5.0           | 5.0              | 5.0  | 5.0                | 5.0                   |
| Vitamin A <sup>b</sup>                  | --      | --            | --               | --   | --                 | --                    |
| Antibiotics <sup>c</sup>                | --      | --            | --               | --   | --                 | --                    |
| Protein content, %                      | 9.52    | 30.3          | 31.7             | 31.6 | 32.0               | 32.4                  |

<sup>a</sup> Supplements were fed at a rate of 10% of the total ration on a dry matter basis.

<sup>b</sup> Each supplement contained 330 IU of vitamin A per pound of supplement.

<sup>c</sup> Each supplement contained 11 mg. of chlortetracycline per pound of supplement.

Rations with 90% ground ear corn and 10% supplement (dry basis) resulted in protein dietary levels for the control ration of 10.8%, soybean meal, 12.9%, corn gluten meal and urea, 13.0% and urea-soybean meal and urea-corn gluten meal, 13.1%. Feed offered once daily was adjusted daily to provide a full feed with the designated ratio of ground ear corn and supplement. The ear corn was ground through a .5-inch screen in a hammer mill. The supplements were made into .25-inch diameter pellets and top-dressed to the ground ear corn.

The lambs were weighed at 3-week intervals to monitor performance. Each replication was terminated when the lambs within each replication averaged approximately 110 pounds. An entire replication of the six supplemental treatments was marketed at the same time and carcass data were not collected. All five replications were weighed together for the last time at 43 days of feeding. The first replication was marketed after 50 days of feeding, one after 78 days, two after 85 days and the last replication after 99 days.

### Results

Data collected were analyzed statistically using least squares procedures. Weight groups (replications) showed significant differences for weight gain and feed consumption. The heavier lambs consumed more feed and gained at a faster rate. However, there were no effects of weight groups on the response to the various protein supplements. Therefore, results for protein

supplementation are presented averaged across weight groups. Values presented (table 2) are averages for the five pens within supplement treatments. These values differ only slightly from weighted averages based on lamb days.

### Weight Gain

Accumulated average daily gains are presented for 21, 43 and 99 days (table 2). At the first weighing after 21 days, faster gains were obtained from all the protein supplements in comparison to the nonsupplemented control. Lower rates of gain were obtained at 43 and 99 days. Weather conditions were more favorable during the early part of the experiment, which perhaps explains in part the decreasing gain at the later dates. A reduction in rate of gain is also commonly associated with increasing fatness in finishing lambs. While there was an advantage for protein-supplemented groups at each period shown, it became less pronounced with increasing time on the experiment.

There were only small differences between lambs fed soybean meal or corn gluten meal on basis of weight gain. Using urea to furnish about one-half of the supplemental protein with soybean meal or corn gluten meal did not appear to affect weight gain. However, urea as the only supplemental protein to ear corn rations resulted in the lowest rate of gain among protein-supplemented lambs and only slightly above the nonsupplemented control group for the 99-day experiment. The results from urea did not appear attributable to reduced performance frequently observed during an initial adaptation to urea. An important factor in the early responses to protein supplementation with only small differences between urea and the other supplements could have been the ration and level of feeding at beginning of the experiment. All lambs had been adapted to a full feed of the ear corn ration but received no supplemental protein prior to this time.

### Feed Consumption

Accumulated average daily feed consumption at 21, 43 and 99 days is shown in table 2. The lambs were at a full feed at the beginning of the experiment and showed only small differences between supplement groups for the first 21 days. The improvement in weight gain noted during this time, therefore, could not be a result of differences in feed intake.

With increasing weight and time on experiment, there was an increase in feed consumption. Protein-supplemented lambs showed more increase than the control group. Differences between the various supplements, including urea, were small at 43 and 99 days.

### Feed Efficiency

The control group of lambs which gained at a lower rate had higher feed requirements than protein-supplemented lambs, even though they consumed less feed. The only exception was in comparison to the urea-supplemented group at 99 days where feed requirements were about the same as for the control group.

Table 2. Feedlot Performance of Finishing Lambs Fed Different Protein Supplements with Ground Ear Corn (December 19, 1978, to March 26, 1979)

| Item                                      | Control           | Soybean meal      | Corn gluten meal  | Urea               | Urea-soybean meal  | Urea-corn gluten meal |
|---|-------------------|-------------------|-------------------|--------------------|--------------------|-----------------------|
| No. of animals <sup>a</sup>               | 40                | 39                | 38                | 39                 | 38                 | 39                    |
| Initial wt., lb.                          | 71.7              | 71.5              | 72.2              | 72.0               | 71.7               | 72.3                  |
| Final wt., lb.                            | 105.6             | 111.8             | 111.2             | 107.0              | 111.5              | 112.5                 |
| Accumulated average daily gain, lb.       |                   |                   |                   |                    |                    |                       |
| 21 days                                   | .477              | .613              | .619              | .584               | .614               | .629                  |
| 43 days                                   | .463              | .568              | .563              | .535 <sup>bc</sup> | .571 <sup>b</sup>  | .555 <sup>b</sup>     |
| 99 days                                   | .429 <sup>b</sup> | .516 <sup>c</sup> | .505 <sup>c</sup> | .453 <sup>bc</sup> | .511 <sup>b</sup>  | .506 <sup>b</sup>     |
| Accumulated average daily feed, lb. (dry) |                   |                   |                   |                    |                    |                       |
| 21 days                                   | 2.42              | 2.47              | 2.46              | 2.49               | 2.50               | 2.46                  |
| 43 days                                   | 2.63 <sup>b</sup> | 2.74              | 2.72              | 2.67 <sup>bc</sup> | 2.73 <sup>bc</sup> | 2.72                  |
| 99 days                                   | 2.66 <sup>b</sup> | 2.87 <sup>c</sup> | 2.87 <sup>c</sup> | 2.78 <sup>bc</sup> | 2.81 <sup>bc</sup> | 2.87 <sup>c</sup>     |
| Feed/gain ratio (dry)                     |                   |                   |                   |                    |                    |                       |
| 21 days                                   | 507               | 403               | 397               | 426                | 407                | 391                   |
| 43 days                                   | 568               | 482               | 483               | 499                | 478                | 490                   |
| 99 days                                   | 620               | 556               | 568               | 614                | 550                | 567                   |

<sup>a</sup> Initially 40 lambs per treatment.

<sup>b,c</sup> Means within rows followed by different letters are significantly different (P<.05).

Since feed consumption was similar for all protein-supplemented groups, feed efficiency would be primarily a reflection of differences in rate of gain. Soybean meal and corn gluten meal were about equal on basis of feed efficiency as they were for rate of gain. Using urea to provide about one-half of the supplemental protein with these two ingredients did not appear to affect feed efficiency. Over the 99-day experiment, urea did not improve feed efficiency over the control group. The small advantage in weight gain for urea in comparison to the control group was offset by a higher feed consumption.