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a source of protein
for sheep

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By

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Series I

THE COMPARATIVE FEEDING VALUE OF AUSTRIAN AND ALASKA PEAS WITH AND WITHOUT METHIONINE FOR SHEEP

Legume seeds have been shown to contain many factors that influence their nutritive value. Apparently, legumes differ in the number and combination of these factors (1). Legume seeds vary greatly in their content of methionine, a sulphur-bearing amino acid. Block and Mitchell (2) have constructed a table of amino acid composition of the proteins of various legume seeds, in which they have shown that methionine is a limiting amino acid in the proteins of soybeans and peas.

Data have been presented to support the hypothesis that methionine cannot be synthesized within the tissues of the animal body from ordinary constituents of the diet (6) (18). However, the lamb has a mechanism whereby a portion of the amino acid requirements can be synthesized in the digestive system (11).

A review of the literature indicates that a major portion of the amino acid methionine must be supplied in the diet of the sheep. Loosli and Harris (12) fed five rations to lambs in a series of digestion trials. Each lamb received each ration in the course of the test. The basal ration consisted of alfalfa meal, 5 parts, timothy hay 29 parts, cane molasses 5 parts, yellow corn 12 parts, brewers' yeast 0.7 part, irra-

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diated yeast 0.1 part, corn oil 1.3 parts and minerals 0.66 part. They added four different sources of protein: (1) linseed oil meal, 9.54 parts; (2) urea, 1.25 parts; (3) urea, 1.25 parts plus NaSO_4 , 1.06 parts; and (4) urea, 1.02 parts plus methionine, 1.11 parts. The urea increased the rate of gain and the quantity of nitrogen stored. The inorganic sulphur had no apparent effect on rate of gain and nitrogen retention. The methionine plus urea increased the rate of gain and nitrogen retention to the same level as the basal ration plus linseed oil meal. The workers concluded that these findings indicate that the protein formed in the rumen by bacterial action was deficient in methionine.

Lofgreen, Loosli and Maynard (10) found that the addition of 0.2 percent methionine to a ration containing 10 percent protein significantly increased the nitrogen retained by the lamb, when 40 percent of the total nitrogen was supplied by urea.

Garrigus, Mitchell, Hale and Albin (5) conducted 10 trials on 30 black-face lambs using three rations: (1) a basal ration low in a sulphur-bearing amino acid; (2) the basal ration plus 0.5 percent elemental sulphur; and (3) the basal ration plus 0.5 percent methionine. The basal ration plus 0.5 percent methionine increased weight gains, fleece weights and fleece lengths.

Klosterman, Bolin, Lesley and Dinusson (8) found that when field peas make up 16.62 percent of a pregnant ewe's ration, the addition of 0.15 percent methionine resulted in increased nitrogen retention and utilization. However, the addition of 0.15 percent methionine to a ration containing 30.61 percent peas did not increase nitrogen retention.

Studies on the protein value of Alaska peas for growth in relation to their methionine content for the chick and the rat have been reported by Bolin and associates (3) (4), Peterson and co-workers (16), Woods *et al* (19), and Lehrer and associates (9).

Objectives

The objectives of this investigation were to: (1) compare the nutritive value of the Austrian pea with the Alaska pea for sheep when fed in a ration containing barley, oats, and a low protein roughage; (2) determine the need for methionine supplementation of Austrian and Alaska peas for sheep; and (3) compare the nutritive value of these sources of protein with that of soybean oil meal for sheep.

Experimental Procedure

Thirty-six purebred Suffolk and nine purebred Hampshire ewe lambs were selected as experimental subjects. The lambs ranged in age from 120 to 150 days and weighed from 65 to 100 pounds. These lambs had been on good grass pasture since birth and all appeared to be in good health, showing no sign of parasitism, disease, or other abnormalities. The test was conducted between the dates of August 2 and October 4, 1951.

The lambs were divided into five lots, using only weight and breed as selection criteria. Lambs of comparable weight and of each breed were represented in every lot. Weekly weights of individual lambs were taken just previous to the morning feeding. Initial and final weights

were taken after the lambs had been withheld from water for a period of 12 hours and previous to the morning feeding.

The lambs were given single 12.5 gram doses of phenothiazine orally at the outset of the experiment to reduce any intestinal parasitic population.

Five concentrate mixtures were prepared and then pelleted with a 1/2-inch die in a California Master pellet mill. The composition of the various mixtures is given in Table I. In the discussion, these mixtures are referred to as indicated: Lot I, Austrian peas; Lot 2, Alaska peas; Lot 3, Austrian peas plus DL-methionine; Lot 4, Alaska peas plus DL-methionine; and Lot 5, Soybean oil meal.

The lambs were fed according to appetite at all stages of the trial. Coarsely chopped brome hay (*Bromus inermis*) was used as a roughage. This hay had been frosted before maturity, but was very palatable and was readily consumed by the majority of the lambs. The brome hay was used in the study to reduce the protein content of the total ration for a more accurate comparison of the nutritive value of Alaska and Austrian peas and to determine the value of these peas as a supplement to grass hays. The ratio of 1 : 1 of concentrate to hay was employed for the first 28 days of the experiment at which time the ratio was changed to 3 : 2 so that more of the grain portion would be eaten. The lambs were fed twice daily at 12-hour intervals in individual stalls. The concentrate and hay were weighed individually, placed in the same container, and were fed together.

The calculated protein content of each of the five rations was approximately 11 percent with an estimated digestible protein content of 7.5 percent. These values are in line with the minimum requirements of protein for sheep recommended by the National Research Council (13).

Table 1. Concentrate Mixtures

| <u>Lot No.</u> | <u>Components</u> | <u>Parts Per 100</u> |
|----------------|--|----------------------|
| 1 | Barley..... | 33 |
| | Oats..... | 33 |
| | Austrian Peas (<i>Pisum arvense</i>)..... | 33 |
| | Salt..... | 1 |
| TOTAL..... | | 100 |
| 2 | Barley..... | 33 |
| | Oats..... | 33 |
| | Alaska peas (<i>Pisum sativum</i>)..... | 33 |
| | Salt..... | 1 |
| TOTAL..... | | 100 |
| 3 | Barley..... | 33 |
| | Oats..... | 33 |
| | Austrian Peas (<i>Pisum arvense</i>)..... | 33 |
| | Salt..... | 1 |
| | DL-methionine..... | 0.3 |
| TOTAL..... | | 100.3 |

Table 1. Concentrate Mixtures (Continued)

| Lot No. | Components | Parts Per 100 |
|---------|---|---------------|
| 4 | Barley..... | 33 |
| | Oats..... | 33 |
| | Alaska Peas (<i>Pisum sativum</i>)..... | 33 |
| | Salt..... | 1 |
| | DL-methionine..... | 0.3 |
| | TOTAL..... | 100.3 |
| 5 | Barley..... | 42 |
| | Oats..... | 42 |
| | Soybean oil meal..... | 15 |
| | Salt..... | 1 |
| | TOTAL..... | 100 |

Table 2. Individual weights, gains, feed intakes, and feed requirements of lambs fed the Austrian pea mixture for a period of 63 days (pounds).

(Lot I)

| Lamb Number | Initial Weight | Final Weight | Total Gain | Av. Daily Gain | Total Feed | Av. Daily Ration | Feed per 100 Lb. Gain |
|-------------|----------------|--------------|------------|----------------|------------|------------------|-----------------------|
| 1..... | 89 | 113 | 24 | .38 | 187 | 2.98 | 780 |
| 2..... | 89 | 118 | 29 | .46 | 200 | 3.18 | 691 |
| 3..... | 85 | 109 | 24 | .38 | 201 | 3.18 | 837 |
| 4..... | 82 | 106 | 24 | .38 | 202 | 3.21 | 842 |
| 5..... | 86 | 114 | 28 | .44 | 211 | 3.35 | 753 |
| 6..... | 75 | 102 | 27 | .43 | 188 | 2.98 | 694 |
| 7..... | 77 | 95 | 18 | .28 | 160 | 2.55 | 889 |
| 8..... | 67 | 91 | 24 | .38 | 170 | 2.70 | 708 |
| 9..... | 80 | 99 | 19 | .30 | 183 | 2.90 | 963 |
| Average.. | 81 | 105 | 24 | .38 | 189 | 3.00 | 784 |

Table 3. Individual weights, gains, feed intakes and feed requirements of lambs fed the Alaska pea mixture for a period of 63 days (pounds).

(Lot II)

| Lamb Number | Initial Weight | Final Weight | Total Gain | Av. Daily Gain | Total Feed | Av. Daily Ration | Feed per 100 Lb. Gain |
|-------------|----------------|--------------|------------|----------------|------------|------------------|-----------------------|
| 10..... | 96 | 111 | 15 | .24 | 182 | 2.89 | 1215 |
| 11..... | 85 | 107 | 22 | .35 | 195 | 3.09 | 884 |
| 12..... | 75 | 91 | 16 | .25 | 170 | 2.69 | 1059 |
| 13..... | 83 | 95 | 12 | .19 | 150 | 2.39 | 1254 |
| 14..... | 78 | 86 | 8 | .13 | 124 | 1.96 | 1546 |
| 15..... | 75 | 102 | 27 | .43 | 197 | 3.13 | 729 |
| 16..... | 75 | 98 | 23 | .36 | 195 | 3.10 | 849 |
| 17..... | 67 | 91 | 24 | .38 | 169 | 2.69 | 706 |
| 18..... | 61 | 83 | 22 | .35 | 152 | 2.41 | 690 |
| Average.. | 77 | 96 | 19 | .30 | 170 | 2.70 | 907 |

Table 4. Individual weights, gains, feed intakes, and feed requirements of lambs fed the Austrian peas plus DL-methionine mixture for a period of 63 days (pounds). (Lot III)

| Lamb Number | Initial Weight | Final Weight | Total Gain | Av. Daily Gain | Total Feed | Av. Daily Ration | Feed per 100 Lb. Gain |
|-------------|----------------|--------------|------------|----------------|------------|------------------|-----------------------|
| 19 | 95 | 121 | 26 | .41 | 212 | 3.36 | 815 |
| 20 | 90 | 115 | 25 | .40 | 200 | 3.17 | 799 |
| 21 | 85 | 109 | 24 | .38 | 201 | 3.19 | 838 |
| 22 | 86 | 108 | 22 | .35 | 191 | 3.03 | 868 |
| 23 | 78 | 104 | 26 | .41 | 196 | 3.11 | 753 |
| 24 | 79 | 97 | 18 | .28 | 168 | 2.66 | 933 |
| 25 | 77 | 97 | 20 | .32 | 171 | 2.71 | 854 |
| 26 | 70 | 97 | 27 | .43 | 142 | 2.26 | 527 |
| 27 | 67 | 93 | 26 | .41 | 185 | 2.94 | 713 |
| Average.. | 81 | 104 | 24 | .38 | 185 | 2.94 | 778 |

Table 5. Individual weights, gains, feed intakes, and feed requirements of lambs fed the Alaska peas plus DL-methionine mixture for a period of 63 days (pounds). (Lot IV)

| Lamb Number | Initial Weight | Final Weight | Total Gain | Av. Daily Gain | Total Feed | Av. Daily Ration | Feed per 100 Lb. Gain |
|-------------|----------------|--------------|------------|----------------|------------|------------------|-----------------------|
| 28 | 88 | 115 | 27 | .43 | 194 | 3.07 | 718 |
| 29 | 88 | 113 | 25 | .40 | 199 | 3.15 | 795 |
| 30 | 84 | 103 | 19 | .30 | 184 | 2.92 | 968 |
| 31 | 85 | 111 | 26 | .41 | 216 | 3.43 | 831 |
| 32 | 77 | 104 | 27 | .43 | 204 | 3.24 | 757 |
| 33 | 68 | 86 | 18 | .28 | 166 | 2.63 | 921 |
| 34 | 75 | 101 | 26 | .41 | 179 | 2.84 | 688 |
| 35 | 69 | 102 | 33 | .52 | 202 | 3.20 | 612 |
| 36 | 69 | 95 | 26 | .41 | 187 | 2.97 | 720 |
| Average.. | 78 | 103 | 25 | .40 | 192 | 3.05 | 762 |

Table 6. Individual weights, gains, feed intakes, and feed requirements of lambs fed the soybean oil meal mixture for a period of 63 days (pounds). (Lot V)

| Lamb Number | Initial Weight | Final Weight | Total Gain | Av. Daily Gain | Total Feed | Av. Daily Ration | Feed per 100 Lb. Gain |
|-------------|----------------|--------------|------------|----------------|------------|------------------|-----------------------|
| 37 | 88 | 114 | 26 | .41 | 191 | 3.03 | 735 |
| 38 | 86 | 108 | 22 | .35 | 180 | 2.84 | 818 |
| 39 | 80 | 93 | 13 | .21 | 143 | 2.27 | 1102 |
| 40 | 85 | 105 | 20 | .32 | 177 | 2.80 | 882 |
| 41 | 76 | 101 | 25 | .40 | 201 | 3.19 | 803 |
| 42 | 78 | 105 | 27 | .43 | 198 | 3.14 | 732 |
| 43 | 76 | 93 | 17 | .27 | 157 | 2.50 | 926 |
| 44 | 76 | 96 | 20 | .32 | 191 | 3.04 | 956 |
| 45 | 68 | 90 | 22 | .35 | 177 | 2.81 | 804 |
| Average.. | 79 | 101 | 21 | .34 | 179 | 2.85 | 841 |

Table 7. A summary of the average weights, gains, and feed requirements of lambs fed the five mixtures for a period of 63 days (pounds).

| Lot No. | Mixtures | Weight | | Total Gain | Daily Gain | Daily Ration | Total Feed Per Lamb | Feed Per 100 Lb. Gain |
|---------|---|---------|-------|------------|------------|--------------|---------------------|-----------------------|
| | | Initial | Final | | | | | |
| 1 | Austrian peas, 33%..... | 81 | 105 | 24 | .38 | 3.0 | 189 | 784 |
| 2 | Alaska Peas, 33%..... | 77 | 96 | 19 | .30 | 2.7 | 170 | 907 |
| 3 | Austrian peas, 33% plus DL-methionine 0.3%..... | 81 | 104 | 24 | .38 | 2.9 | 185 | 778 |
| 4 | Alaska peas, 33% plus DL-methionine 0.3%..... | 78 | 103 | 25 | .40 | 3.1 | 192 | 762 |
| 5 | Soybean oil meal, 15%.. | 79 | 101 | 21 | .34 | 2.8 | 179 | 841 |

* Average of total feed consumed of the group divided by total gain \times 100.

Table 8. Coefficient of variation of average daily gain and the feed required for a 100-lb. gain and the coefficient of correlation between gain and feed consumption each group.

| Lot No..... | Austrian | Alaska | Austrian + DL-methionine | Alaska + DL-methionine | Soybean Oil Meal |
|---|----------|--------|--------------------------|------------------------|------------------|
| | I | II | III | IV | V |
| Variation in gain, percent... | 17 | 27 | 13 | 15 | 19 |
| Variation in feed requirement, percent..... | 9 | 28 | 14 | 14 | 13 |
| Coefficient of correlation between gain and feed consumption..... | 0.17 | 0.24 | 0.21 | 0.20 | 0.4 |

Table 9. Analysis of variance of average daily gains and feed required for each 100 pounds gain. Snedecor (17).

| | Average Daily Gains ¹ | | |
|----------------|----------------------------------|----------------|-------------|
| | D/F | Sum of Squares | Mean Square |
| Total..... | 44 | .2666 | |
| Lots..... | 4 | .0585 | .0146 |
| Remainder..... | 40 | .2081 | .0052 |

¹The least significant difference required for 0.05 level of probability is .069 lb.

¹The least significant difference required for 0.01 level of probability is .091 lb.

| | Feed for Each 100 Pounds Gain ² | | |
|----------------|--|----------------|-------------|
| | D/F | Sum of Squares | Mean Square |
| Total..... | 44 | 1,387,649 | |
| Lots..... | 4 | 288,023 | 72,006 |
| Remainder..... | 40 | 1,099,626 | 27,490 |

²The least significant difference required for 0.05 level of probability is 111 lbs.

²The least significant difference required for 0.01 level of probability is 149 lbs.

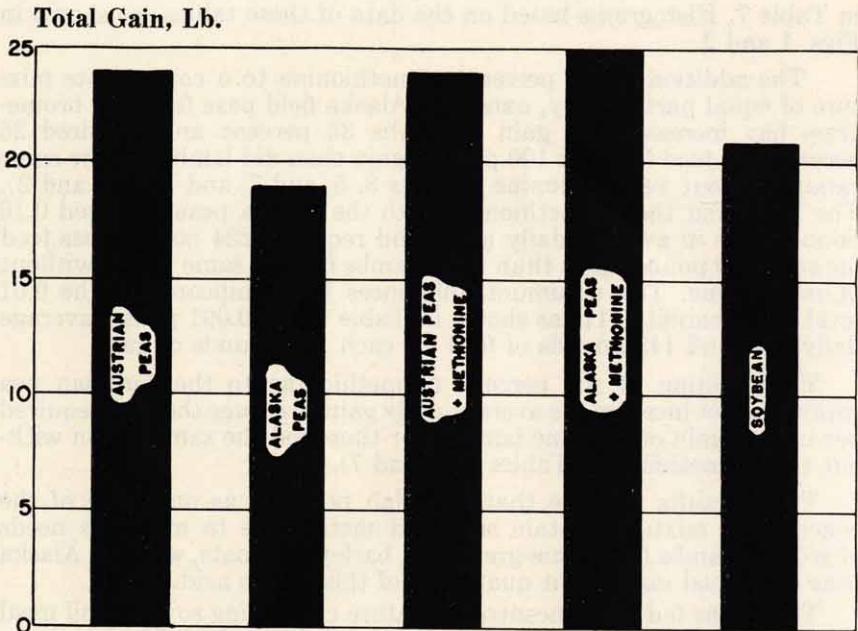


Fig. 1. Total average gain of each of the groups of lambs fed the five rations.

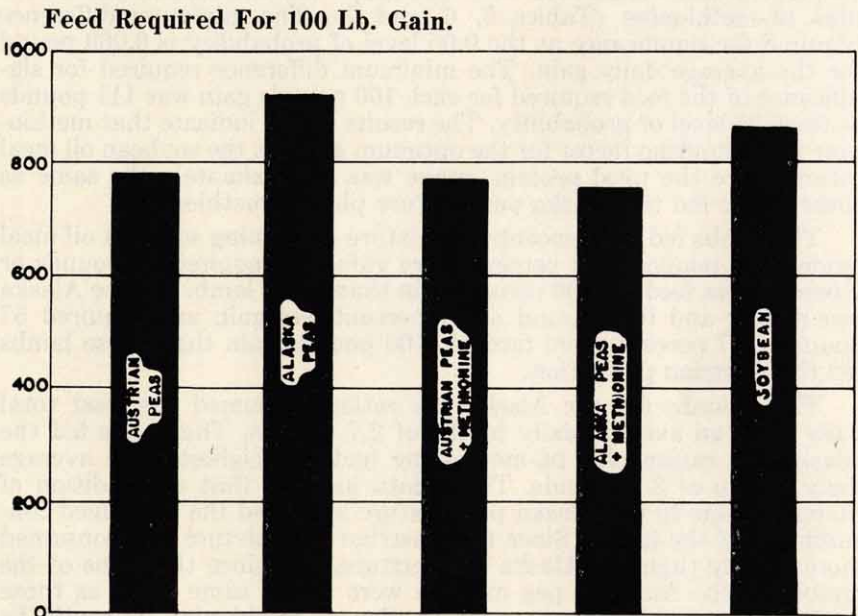


Fig. 2. Average feed required for each 100 lb. of gain of the groups of lambs fed the five rations.

Experimental Results

Data showing individual performance are shown in Tables 2 to 6 inclusive. A summary of the lamb gains and feed requirements is shown

in Table 7. Histograms based on the data of these tables are shown in Figs. 1 and 2.

The addition of 0.3 percent DL-methionine to a concentrate mixture of equal parts barley, oats, and Alaska field peas fed with brome-grass hay increased the gain of lambs 33 percent and required 25 percent less feed for each 100 pounds gain than did lambs fed the same ration without DL-methionine (Tables 3, 5, and 7, and Figs. 1 and 2). The lambs fed the DL-methionine with the Alaska peas averaged 0.10 pound more in average daily gains and required 224 pounds less feed for each 100 pounds gain than those lambs fed the same ration without DL-methionine. The minimum differences for significance at the 0.01 level of probability (17) as shown in Table 9, are 0.091 pound average daily gain and 149 pounds of feed for each 100 pounds of gain.

The addition of 0.3 percent DL-methionine to the Austrian pea ration did not increase the average daily gain or reduce the feed required per unit of gain of the nine lambs over those fed the same ration without the DL-methionine (Tables 2, 4, and 7).

These results indicate that Austrian peas fed as one-third of the concentrate mixture contain sufficient methionine to meet the needs of growing lambs fed brome-grass hay, barley, and oats, whereas Alaska peas contained insufficient quantities of this amino acid.

The lambs fed the concentrate mixture containing soybean oil meal had 0.06 pound or 15 percent less gain and required 79 pounds or 14 percent more total feed than the lambs fed the Alaska pea ration plus DL-methionine (Tables 5, 6, and 7). The minimum difference required for significance at the 0.05 level of probability is 0.069 pound for the average daily gain. The minimum difference required for significance of the feed required for each 100 pounds gain was 111 pounds at the 0.05 level of probability. The results would indicate that methionine is the limiting factor for the optimum gains in the soybean oil meal ration, since the total protein intake was approximately the same as those lambs fed the Alaska pea mixture plus DL-methionine.

The lambs fed the concentrate mixture containing soybean oil meal made: 0.04 pound or 13 percent more gain and required 66 pounds or 7 percent less feed for 100 pounds gain than those lambs fed the Alaska pea ration; and 0.04 pound or 11 percent less gain and required 57 pounds or 7 percent more feed for 100 pounds gain than those lambs fed the Austrian pea ration.

Those lambs fed the Alaska pea ration consumed the least total daily feed, an average daily intake of 2.7 pounds. The lambs fed the Alaska pea ration plus DL-methionine had the highest total average daily intake of 3.1 pounds. These data indicate that the addition of DL-methionine to the Alaska pea mixture increased the daily feed consumption of the lambs. Since the Austrian pea mixture was consumed more readily than the Alaska pea mixture, and since the gains of the lambs fed the Austrian pea mixture were of the same order as those lambs fed the Alaska pea mixture plus DL-methionine, it would be logical to conclude that these differences in feed consumption are due to the additional methionine content of the Austrian peas. The differences in gains of the various groups cannot be credited to the differences in feed intake, as there was no significant correlation between gain and feed consumption (Table 8).

Summary

The addition of DL-methionine to a mixture containing Alaska peas increased the rate of gain of lambs 33 percent over those lambs fed the same ration without DL-methionine.

Lambs fed Austrian peas without DL-methionine made the same rate and economy of gains as those fed the Austrian peas with DL-methionine.

The lambs fed the soybean oil meal mixture made a greater rate and economy of gain than those fed the Alaska pea without DL-methionine and less gain than those groups of lambs fed the Austrian pea and the Alaska pea plus DL-methionine mixtures.

Observations made during feeding indicate that the Austrian pea mixture and the Alaska pea plus DL-methionine mixture were more palatable than the Alaska pea mixture without DL-methionine.

Series II

THE PAIRED-FEEDING METHOD AND ITS APPLICATION TO A STUDY OF METHIONINE DEFICIENCY OF PEAS FED TO SHEEP

Since the results of the previous tests of Series I with lambs fed individually all they would consume showed a significant increase of 33 percent in gains of lambs fed DL-methionine in the mixture containing Alaska peas over those lambs fed the same mixture without DL-methionine, and there was an average increase of 15 percent in total daily feed intake (the coefficient of correlation of gains with feed intake was too low to be significant, Table 8, and no difference in gains were observed when DL-methionine was added to the Austrian pea mixture), an experiment was designed, using the paired method of feed control (7) (5). This method would eliminate the effect of increased feed intake on gains, since each member of each pair receives the same total quantity of feed.

Sixteen pairs of Suffolk and 2 pairs of Hampshire ewe lambs were selected. The lambs were fed in pairs matched according to breed and initial weight with each member of each pair receiving the same total quantity of feed daily. Nine pairs of lambs were used to study the effect of rate and economy of gain in body weight when one member of each pair was fed a concentrate mixture of barley 33 parts, oats 33 parts, Austrian peas 33 parts, and sodium chloride 1 part, with brome-grass hay. The other member of the pair was fed a concentrate mixture of barley 33 parts, oats 33 parts, Alaska peas 33 parts, and sodium chloride 1 part with brome-grass hay.

The Alaska pea mixture composed of barley 33 parts, oats 33 parts, Alaska peas 33 parts and sodium chloride 1 part, fed with brome-grass hay was compared with the same mixture with the DL-methionine added as measured by rate and economy of gains.

In the study of the comparative value of the Austrian pea mixture with the Alaska pea mixture, nine pairs finished the test (Table 10). In the study on the comparative value of the Alaska pea mixture with the Alaska pea mixture plus DL-methionine, nine pairs of lambs began the test, but only seven finished. One member each of two pairs went off feed during the third week and refused to eat during the remainder of the test. The data of both pairs were omitted from the calculation of results (Table 11).

All pairs of lambs started the feeding period with a concentrate-to-hay ratio of 2 to 3 for the first 28 days and were fed equal parts concentrate and hay the remaining 42 days. The total feeding period was 70 days. The tests were started August 1, 1952 and completed October 10, 1952.

A limited total feed intake was used for the purpose of determining the value of the DL-methionine on a low level of energy intake. The total average daily intake of the matched pairs was 2.2 pounds as compared to a range of an average of 2.7 to 3.1 pounds daily for the groups of individually fed lambs of Series I.

Individual data are shown in Tables 10 and 11. A summary is shown in Table 12. The lambs fed the Austrian pea mixture gained an average of 0.04 pound more per day and required 226 pounds less feed for each 100 pounds gain than the paired mates fed the Alaska peas. According to Students' method (14) of determining significance of differences, the odds were 79 to 1 for the difference of 0.04 being significant.

The lambs fed the Alaska peas plus DL-methionine had a greater average daily gain of 0.03 pound with 269 pounds less feed for each 100 pounds gain than the paired mates fed the Alaska peas without DL-methionine. The odds were 9999 to 1 for the difference in an average daily gain of 0.03 pound being significant.

Table 10. Gains and feed requirements of 9 pairs of lambs, with one member of each pair receiving Austrian peas in the concentrate mixture and the other Alaska peas—for a period of 70 days (pounds).

| <u>Pair and Mixture</u> | <u>Initial Weight</u> | <u>Average Daily</u> | | <u>Feed for 100 Lb. Gain</u> |
|-------------------------|-----------------------|----------------------|---------------|------------------------------|
| | | <u>Gain</u> | <u>Ration</u> | |
| No. 1 | | | | |
| Austrian peas | 81 | .21 | 2.6 | 1188 |
| Alaska peas | 83 | .14 | 2.6 | 1795 |
| No. 2 | | | | |
| Austrian peas | 83 | .16 | 2.5 | 1596 |
| Alaska peas | 84 | .21 | 2.6 | 1233 |
| No. 3 | | | | |
| Austrian peas | 90 | .24 | 2.6 | 1069 |
| Alaska peas | 81 | .21 | 2.5 | 1150 |
| No. 4 | | | | |
| Austrian peas | 79 | .19 | 2.1 | 1125 |
| Alaska peas | 81 | .13 | 2.2 | 1741 |
| No. 5 | | | | |
| Austrian peas | 69 | .16 | 2.1 | 1352 |
| Alaska peas | 74 | .10 | 2.1 | 2133 |

| | | | | |
|--------------------|----|-----|-----|------|
| No. 6 | | | | |
| Austrian peas..... | 63 | .27 | 2.2 | 796 |
| Alaska peas..... | 63 | .20 | 2.3 | 1130 |
| No. 7 | | | | |
| Austrian peas..... | 77 | .13 | 2.1 | 1656 |
| Alaska peas..... | 79 | .17 | 2.2 | 1268 |
| No. 8 | | | | |
| Austrian peas..... | 57 | .21 | 2.0 | 917 |
| Alaska peas..... | 63 | .20 | 2.2 | 1089 |
| No. 9 | | | | |
| Austrian peas..... | 69 | .16 | 2.2 | 1381 |
| Alaska peas..... | 66 | .11 | 2.1 | 1875 |
| Average | | | | |
| Austrian peas..... | 74 | .19 | 2.2 | 1174 |
| Alaska peas..... | 76 | .15 | 2.3 | 1400 |

Table 11. Gains and feed requirements of 7 pairs of lambs with one member of each pair receiving Alaska peas in the concentrate mixture, and the other Alaska peas plus 0.3 percent DL-methionine—for a period of 70 days (pounds).

| <u>Pair and Mixture</u> | <u>Initial Weight</u> | <u>Average Daily</u> | | <u>Feed for 100 Lb. Gain</u> |
|----------------------------|-----------------------|----------------------|---------------|------------------------------|
| | | <u>Gain</u> | <u>Ration</u> | |
| No. 10 | | | | |
| Alaska..... | 86 | .14 | 2.5 | 1761 |
| Alaska plus DL-methionine. | 82 | .15 | 2.4 | 1114 |
| No. 11 | | | | |
| Alaska..... | 77 | .13 | 2.2 | 1752 |
| Alaska plus DL-methionine. | 75 | .17 | 2.2 | 1301 |
| No. 12 | | | | |
| Alaska..... | 55 | .14 | 2.1 | 1448 |
| Alaska plus DL-methionine. | 60 | .13 | 2.2 | 1674 |
| No. 13 | | | | |
| Alaska..... | 62 | .21 | 1.9 | 907 |
| Alaska plus DL-methionine. | 60 | .19 | 2.0 | 1052 |
| No. 14 | | | | |
| Alaska..... | 66 | .16 | 2.2 | 1416 |
| Alaska plus DL-methionine. | 63 | .23 | 2.2 | 980 |
| No. 15 | | | | |
| Alaska..... | 72 | .10 | 2.1 | 2145 |
| Alaska plus DL-methionine. | 68 | .17 | 2.1 | 1251 |
| No. 16 | | | | |
| Alaska..... | 82 | .21 | 2.5 | 1177 |
| Alaska plus DL-methionine. | 80 | .24 | 2.4 | 986 |
| Average | | | | |
| Alaska..... | 71 | .16 | 2.2 | 1424 |
| Alaska plus DL-methionine. | 70 | .19 | 2.2 | 1155 |

Table 12. Summary—A comparison of the average weights, gains and feed requirements of lambs fed in matched pairs, 1 member of a pair receiving Austrian peas, the other receiving Alaska peas—1 member receiving Alaska, the other receiving Alaska plus DL-methionine—for periods of 70 days (pounds).

| <u>Mixture</u> | <u>Initial Weight</u> | <u>Final Weight</u> | <u>Total Gain</u> | <u>Average Daily Gain</u> | <u>Average Daily Ration</u> | <u>Feed for 100 Lb. Gain</u> |
|-------------------------------|-----------------------|---------------------|-------------------|---------------------------|-----------------------------|------------------------------|
| Austrian..... | 74 | 88 | 14 | .19 | 2.2 | 1174 |
| Alaska..... | 76 | 87 | 11 | .15 | 2.3 | 1400 |
| Alaska..... | 71 | 82 | 11 | .16 | 2.2 | 1424 |
| Alaska plus DL-methionine.... | 70 | 83 | 13 | .19 | 2.2 | 1155 |

Summary

The paired-feeding method of feed control was used to evaluate the difference in the nutritive value of Austrian peas and Alaska peas as a feed for sheep when each was fed a ration containing brome-grass with barley and oats. The lambs fed the rations containing Austrian peas and containing Alaska peas plus DL-methionine gave the most rapid and economical gains. These results are in close agreement with the results obtained in the experiments of the individually fed lambs, Series I. As measured by feed refusals, the rations containing the Austrian peas and those containing Alaska peas plus DL-methionine were more palatable.

Conclusions

A study has been made of the effect of the addition of DL-methionine to Alaska peas and Austrian peas on rate and economy of gains of growing lambs. Two methods were used: (1) The individual feeding method, and (2) the paired method of feed control.

The addition of DL-methionine to a ration containing a concentrate mixture of barley, oats and Alaska peas with brome-grass hay increased the average daily gain 33 percent, and required 25 percent less feed for each 100 pounds gain for lambs than the same rations without DL-methionine, when the individual feeding method was used. A difference of 19 per cent in average daily gain in favor of the addition of DL-methionine to the Alaska peas over those fed the Alaska peas without DL-methionine was obtained with the lambs fed with the paired method of feed control.

The addition of DL-methionine to the ration containing Austrian peas, barley, oats and brome-grass hay did not increase the rate and economy of gains of lambs over those fed the same ration without DL-methionine.

Lambs fed individually all the Austrian pea ration they would consume, made 27 percent greater average daily gains than the group fed the Alaska pea ration. Lambs fed the Austrian pea ration, using the paired-method of feed control, made 20 percent more rapid gains than their paired mates fed the same quantity of the Alaska pea ration.

The lambs fed the concentrate mixture containing soybean oil meal made greater and more economical gains than those fed Alaska peas without DL-methionine but less gains than those lambs fed Austrian peas or Alaska peas plus DL-methionine.

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