



Palatability, creep feeding and fattening studies with lambs  
by Charles E Montgomery

A THESIS Submitted to the Graduate Faculty in partial fulfillment of the requirements for the degree  
of Master of Science in Animal Industry  
Montana State University  
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**Abstract:**

The purpose of these trials was to determine the palatability of feeds for suckling lambs; to determine if there was a beneficial effect in creep feeding suckling lambs and to determine the effect of two levels of protein in the ration on fattening lambs.

The results of the 1959 palatability trial indicated that lambs prefer a 70 percent concentrate, 30 percent roughage pellet to a 70 percent rough-age, 30 percent concentrate pellet. It would appear that soybean oil meal, cane sugar and high molasses beet pulp enhance the palatability of the ration. Less feed consumption was noted when wheat bran or yeast was added to the base ration.

It was found in the 1960 palatability trial that the lambs preferred a pellet containing 12.5 percent soybean oil meal during the dry lot phase. However, during the pasture phase of the trial, the lambs preferred the pellets containing 25.0 and 37.5 percent soybean oil meal. The ration containing no soybean oil meal was the least desirable of the four rations. The pellet form of all the rations was the preferred with the crumble form being second and the meal form being the least preferred.

Creep feeding twin lambs on pasture proved to be beneficial. There was no significant difference between the creep fed and the non-creep fed single lambs in dry lot.

Fattening lambs on a concentrate containing 16 percent protein resulted in faster and more efficient gains but the cost of the gain was uneconomical. While the gains and efficiency were lower for the lambs fattened on a concentrate containing 11 percent protein, cost of gains were generally lower.

PALATABILITY, CREEP FEEDING AND FATTENING  
STUDIES WITH LAMBS

by

Charles E. Montgomery

A THESIS

Submitted to the Graduate Faculty

in

partial fulfillment of the requirements

for the degree of

Master of Science in Animal Industry

at

Montana State College

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Bozeman, Montana  
August, 1960

N378  
NA766p  
Cp. 2

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#### ACKNOWLEDGEMENTS

The author takes this space to express his appreciation to the following staff members of Montana State College: to Mr. J. L. Van Horn for his assistance and invaluable guidance throughout my graduate program and in the preparation of this thesis; to Dr. O. O. Thomas for his assistance in conducting the trials and for reviewing this thesis; to Mr. G. M. Van Dyne and Dr. D. W. Blackmore for their suggestions and assistance in statistical analysis and for their suggestions during the preparation of this thesis.

Appreciation is extended to the other staff members and the graduate students for their help in collecting these data.

Sincere appreciation is expressed to my wife, Helen, for her help, understanding and encouragement during my graduate work.

144879

TABLE OF CONTENTS

	Page
ACKNOWLEDGEMENTS . . . . .	2
INDEX TO TABLES . . . . .	6
INDEX TO FIGURES . . . . .	8
ABSTRACT . . . . .	9
INTRODUCTION . . . . .	10
REVIEW OF LITERATURE . . . . .	12
Palatability . . . . .	12
Loose forms, soybean oil meal . . . . .	12
Loose forms, corn . . . . .	14
Loose forms, sweetening agents . . . . .	15
Loose forms, miscellaneous . . . . .	15
Pelleted forms . . . . .	16
Concentration of the ration . . . . .	16
Pelleting a complete ration . . . . .	18
Pelleted concentrate, loose hay . . . . .	20
Form and size . . . . .	20
Creep Feeding . . . . .	21
Pasture . . . . .	22
Dry lot . . . . .	25
Creep feeds . . . . .	26
METHODS AND PROCEDURES . . . . .	28
Palatability Trail I (1959) . . . . .	28
Experimental lambs . . . . .	28
Management of ewes and lambs . . . . .	28
Creep feeds and feeding procedure . . . . .	30
Palatability Trial II (1960) . . . . .	30
Experimental lambs . . . . .	30
Management of ewes and lambs . . . . .	30
Creep feeds and feeding procedure . . . . .	31

TABLE OF CONTENTS (Cont'd.)

	Page
Creep Feeding Trial, Twins (1959) . . . . .	34
Experimental lambs . . . . .	34
Pretreatment . . . . .	34
Management of ewes and lambs . . . . .	34
Creep feed and feeding procedure . . . . .	35
Creep Feeding Trial, Singles (1959) . . . . .	35
Experimental lambs . . . . .	35
Management of ewes and lambs . . . . .	36
Creep feed and feeding procedure . . . . .	36
Fattening Trial, Twins and Singles (1959) . . . . .	37
Experimental lambs . . . . .	37
Management of lambs . . . . .	37
Feed and feeding procedure . . . . .	38
RESULTS AND DISCUSSION . . . . .	39
Palatability Trail, 1959 . . . . .	39
Palatability Trial, 1960 . . . . .	43
Dry lot phase . . . . .	43
Pasture phase . . . . .	46
Creep Feeding 1959 . . . . .	50
Twins . . . . .	50
Singles . . . . .	52
Fattening phase, twins . . . . .	54
Fattening phase, singles . . . . .	56
SUMMARY . . . . .	60
Palatability trial, 1959 . . . . .	60
Palatability trial, 1960 . . . . .	60
Creep feeding twins, 1959 . . . . .	61
Creep feeding singles, 1959 . . . . .	62

TABLE OF CONTENTS (Cont'd.)

	Page
Fattening trial twins 1959 . . . . .	62
Fattening trial singles, 1959 . . . . .	64
LITERATURE CITED . . . . .	66

INDEX TO TABLES

Tables	Page
I. Percent composition of rations for the palatability trial, 1959. . . . .	31
II. Composition of the rations used in the palatability trial, 1960. . . . .	33
III. Analysis of variance, palatability trial, 1959 . . . . .	39
IV. Feed consumption by lambs in the palatability trial, 1959. . . . .	40
V. Preference of the rations as shown by Duncan's multiple range test . . . . .	40
VI. Test of significance of regression of consumption on percent protein in the ration. . . . .	41
VII. Gain of lambs on the 1959 palatability trial . . . . .	42
VIII. Analysis of variance of the dry lot phase of the palatability trial, 1960 . . . . .	44
IX. Table of means of feed consumption for the dry lot phase of the palatability trial, 1960. . . . .	45
X. Analysis of variance of the pasture phase of the palatability trial, 1960 . . . . .	46
XI. Table of means of feed consumption for the pasture phase of the palatability trial, 1960. . . . .	47
XII. Gains of lambs for the dry lot and pasture phase of the palatability trial, 1960 . . . . .	49
XIII. Analysis of variance of the twin creep feeding trial . . . . .	50
XIV. The effect of creep feeding on the performance of twin lambs. . . . .	51
XV. Analysis of variance of the single creep feeding trial . . . . .	52
XVI. The effect of creep feeding on the performance of single lambs. . . . .	53
XVII. The effect of two levels of protein in the rations on the fattening ability of twin lambs. . . . .	55

INDEX TO TABLES (Cont'd.)

Tables	Page
XVIII. The effect of two levels of protein in the rations on the fattening ability of single lambs. . . . .	57

INDEX TO FIGURES

Figure	Page
1. Diagram of area where palatability trial, 1959, was conducted at Fort Ellis . . . . .	.29

### ABSTRACT

The purpose of these trials was to determine the palatability of feeds for suckling lambs; to determine if there was a beneficial effect in creep feeding suckling lambs and to determine the effect of two levels of protein in the ration on fattening lambs.

The results of the 1959 palatability trial indicated that lambs prefer a 70 percent concentrate, 30 percent roughage pellet to a 70 percent roughage, 30 percent concentrate pellet. It would appear that soybean oil meal, cane sugar and high molasses beet pulp enhance the palatability of the ration. Less feed consumption was noted when wheat bran or yeast was added to the base ration.

It was found in the 1960 palatability trial that the lambs preferred a pellet containing 12.5 percent soybean oil meal during the dry lot phase. However, during the pasture phase of the trial, the lambs preferred the pellets containing 25.0 and 37.5 percent soybean oil meal. The ration containing no soybean oil meal was the least desirable of the four rations. The pellet form of all the rations was the preferred with the crumble form being second and the meal form being the least preferred.

Creep feeding twin lambs on pasture proved to be beneficial. There was no significant difference between the creep fed and the non-creep fed single lambs in dry lot.

Fattening lambs on a concentrate containing 16 percent protein resulted in faster and more efficient gains but the cost of the gain was uneconomical. While the gains and efficiency were lower for the lambs fattened on a concentrate containing 11 percent protein, cost of gains were generally lower.

## INTRODUCTION

Creep feeding is providing supplemental feed for the young lambs apart from their mothers (Miller, 1939). Creep feeding lambs has had varying degrees of success. Farm flock operators and purebred breeders often creep feed suckling lambs to get an increased growth early in life. Madsen and Matthews (1960), stated that providing additional feed to lambs during the suckling period is the most successful means of increasing lamb growth and decreasing feed required per unit of gain.

Lamb prices are usually highest in the spring months and lower through the summer and fall. To take advantage of the high lamb prices one must breed for early lambs and feed them to reach market weight and finish when prices are the highest. Providing supplemental feed to the lambs may be a partial answer to this problem.

For best results in creep feeding lambs, one must use a creep ration that is palatable, economical and one that will give efficient gains. Creep rations vary from a single grain, (corn, oats, barley, milo, etc.) to a complex ration that may contain a mixture of several grains, roughage, protein supplement sweeteners, mineral mixtures and sometimes antibiotics and hormone-like substances.

In recent years, the feeding of pelleted rations has gained in popularity. At the present time, the cost of pelleting discourages many producers from feeding a ration in this form. Feeding a pelleted ration has many advantages over feeding a loose feed. Some of these are as follows: easier to store a concentrated form, easier to feed, less labor involved, less loss from wind, animal can eat more in less time; thus less trough

space required per animal and feed efficiency is usually increased.

The purpose of this paper is to report the results of four creep feeding trials. Three trials were conducted during the spring and summer of 1959. A palatability trial with suckling lambs was designed to determine the preference of 16 different rations. The other trials were designed to study the effect of creep feeding suckling single lambs in dry lot; and creep feeding suckling twin lambs on irrigated pasture. After weaning, the lambs were fattened on two rations differing in the level of crude protein.

The fourth trial was a palatability trial with twin lambs, conducted during the spring of 1960. The lambs were fed in dry lot for 35 days and on irrigated pasture for 28 days. The trial was designed to determine if a preference was shown for different levels of soybean oil meal in the rations for twin lambs. Also, in this test the feeds were fed in three physical forms to study the effect of physical form on palatability. Palatability was determined by consumption of the ration by lambs.

REVIEW OF LITERATURE

Palatability

The palatability of a feed is one of the most important considerations in creep feeding lambs. The lambs must relish the feed to perform well. Certain ingredients such as sugar, molasses, soybean oil meal and possibly flavors have been reported to enhance the palatability of the ration when fed to lambs.

Loose form, soybean oil meal

Soybean oil meal is used as a protein supplement in most rations and recent work done in Missouri and Minnesota indicate that soybean oil meal improves the palatability of a ration. Ross and Pavey (1959a), found that soybean oil meal was the most acceptable single ingredient tested. Rations containing high percentages of soybean oil meal were consumed more readily than other mixtures when the palatability of twenty feed ingredients or mixtures was determined with lambs. A report by Jordan (1960), substantiates the Missouri work since he found that soybean oil meal was the most palatable of the common feedstuffs tested. When soybean oil meal was compared with oat groats, whole oats, ground corn, alfalfa hay, alfalfa pellets, wheat bran, linseed meal, linseed pellets and sweet pellets it was found that soybean oil meal was by far the most preferred by lambs. Jordan found that palatability of the ration has an important bearing on the amount of feed that will be consumed by lambs and that a creep ration should be relatively high in soybean oil meal (10 to 20 percent).

It was found that whole soybeans could completely replace soybean oil meal (Jordan, 1954a). The lambs fed the rations containing whole soybeans

gained slightly faster than the lambs receiving a ration containing soybean oil meal. The consumption of the two rations was the same. Carcass grade, price and yield favored the lambs fed whole soybeans in the ration. Jordan, et al. (1958), found that soybean oil meal was the most palatable supplement when compared with other high oil bearing seeds. The addition of tallow to the ration containing soybean oil meal decreased the palatability of the ration.

Jordan and Croom (1957), found that feather meal was consumed just as readily as soybean oil meal when each was added to the rations. The protein content of the rations was about the same and the lambs receiving the feather meal in the feed gained slightly faster than the lambs fed the ration containing soybean oil meal. However, the lambs had no chance to show preference since only one ration was offered each pen.

The results of a trial reported by Ross (1960), indicated that lambs preferred a creep ration made up of 60 percent corn, 30 percent soybean oil meal, and 10 percent bran over other rations offered. The other rations contained 60 percent corn and varied in the soybean oil meal and wheat bran content. One ration contained 60 percent corn, 15 percent soybean oil meal, 10 percent wheat bran and 15 percent distillers solubles. This ration was the least palatable of the meal mixes but consumption of this ration was three times greater than the corn. The lambs consumed six times as much of the preferred ration as they consumed of ground corn.

It has been shown that soybean oil meal improves the palatability of a ration and in general the rations contain from 10 to 30 percent soybean oil meal.

Loose form, corn

When comparing corn alone with mixtures of corn, wheat bran, ceretose, cane molasses and corn syrup for creep feeds in a meal form, Ross et al. (1959), found that the lambs preferred the mixtures to the corn. The most preferred ration consisted of 55 percent corn, 30 percent soybean oil meal, 10 percent wheat bran and 5 percent molasses. Willman (1935), reported that a mixture of cracked corn, whole oats, wheat bran and linseed-pea cake was more palatable than cracked corn alone. The lambs fed this mixture consumed a greater amount of feed and took less time to fatten than lambs receiving only cracked corn.

Corn proved to be more palatable than a mixture of corn and a complex milk substitute according to a report by Garrigus (1951). In a second trial, corn was compared with a commercial sweet feed containing molasses and the lambs ate 13 percent more of the sweet feed. Garrigus stated that there was no advantage of the sweet feed over the corn due to the palatability of the feeds.

It was concluded by Watson and Fenn (1942), that corn was a better fattening ration than barley since the lambs ate more, gained faster and more efficiently on corn. The lambs had access to either corn or barley, thus there was no chance for the lambs to show a preference. Brown et al. (1959), compared the preference of corn, oats, milo and wheat in the whole grain, finely ground, crimped and pelleted forms for ewes. It was found that the finely ground feed was the most preferred and whole grains the least preferred. This finding is in disagreement with Watson and Fenn.

Corn has been found to be a very good creep feed but when corn is used

in combinations with other ingredients the palatability of the ration seems to be improved.

Loose form, sweetening agents

It was reported by Perry et al. (1957), that sugar increased the palatability of the ration when fed to lambs. The lambs receiving sugar in the ration consumed 0.12 pounds more feed per day than the lambs receiving the same ration without sugar. Perry also found that soybean oil meal and sugar as supplements in the ration improved the palatability and resulted in higher quality lambs when compared to the lambs not receiving this supplement in the feed.

Work with swine has also shown that palatability is increased when sugar is added to the ration. Lewis et al. (1955), reported on nine trials involving cane sugar in pig starters. These workers found that the pigs selected starters containing sugar in all preference studies where two or more starters were offered simultaneously. Diaz et al. (1956), supported these findings and stated that unrefined cane sugar added to the ration gave equally as good results as refined cane sugar. The findings by Aldinger et al. (1957) indicated that rations containing saccharin were definitely preferred by pigs to feeds containing no saccharin. Rations varied in amount of saccharin from none to one pound per ton of feed; the ration with the highest level was the most preferred ration.

Sweetening agents usually enhance the palatability of a ration because the animals prefer rations containing sugar and saccharin.

Loose form, miscellaneous

A report from Nebraska by Weber (1930), indicates that linseed meal

increases the palatability of a ration for lambs. It was found that as the level of linseed meal was increased in the ration, feed consumption by the lambs increased.

Briggs (1938), found indications that a mixture of equal parts of whole oats and cracked barley may have an advantage over whole oats or cracked barley fed alone when used as a creep feed for fattening nursing lambs. From the results of two years work, it was shown that the mixture was more palatable and resulted in an advantage in rate and economy of gain. The lambs did not care for the barley at all when it was fed alone.

#### Pelleted forms

Pelleting seems to enhance the palatability of the ration. Feeding a pelleted ration usually results in increased consumption, improved efficiency and faster gains by lambs. It has been reported by Blaxter and Graham (1956), that pelleted and chopped hay differ in their rate of passage through the digestive tract of the ruminant. Pelleted hay passed through the digestive system faster, had a lower digestability and metabolizable energy content but was equal to chopped hay in net energy due to the lower heat increment in digesting the pelleted hay.

#### Concentration of the ration

Cox (1946), indicated that as bulky rations are increased in concentration by pelleting, the gains made and the efficiency of feed utilization increase up to a certain level. An increase in concentrates above 45 percent, when the ration is pelleted causes the gains and feed efficiency to decrease according to Cox. The optimum physical balance of the ration is 45 percent concentrates and 55 percent roughage. Other reports by Kansas

workers, Bell et al. (1955), agree with Cox and his report on physical balance. Lambs fed an unpelleted ration of 55 percent dehydrated alfalfa and 45 percent cracked corn grew faster and more efficiently than lambs fed the same ration in pelleted forms. This was due partly to the fact that lambs receiving the pellets went off feed several times during the trial. The Kansas workers found that the most desirable balance for a pelleted ration was 65 percent dehydrated alfalfa and 35 percent corn since the lambs fed this ration gained faster and more efficiently than lambs fed the unpelleted rations.

The results of a trial reported on by Ross and Pavey (1959b), disagree with Cox (1946) and Bell et al. (1955). The Missouri workers stated that a comparison of a ration of 60 percent concentrate and 40 percent roughage fed in a pellet and meal form to lambs resulted in no differences in gain or pounds of feed per pound of gain.

It would appear from the results of trials reported on by Bell et al. (1954a) that lambs receiving a pelleted ration containing 55 percent roughage and 45 percent concentrates produced greater and more efficient gains than lambs getting a 65:35 ratio of roughage and concentrate in both pelleted and unpelleted forms. A highly statistical significant interaction was found by Illinois workers between the gains of lambs receiving the meal and pelleted forms of the two rations (Hartman et al., 1959), thus disagreeing with the work of Bell et al. Also Hartman et al. found that pelleting increased the gain of the lambs on the high roughage ration and decreased the gains made by the lambs fed the low roughage ration.

It would appear that the optimum physical balance of the ration is

between 55 and 65 percent roughage and 35 to 45 percent concentrate but from the contradictory evidence reported here, this may not be true.

#### Pelleting a complete ration

Work by Thomas et al. (1954) indicated that lambs fed a complete pellet went on feed faster, had less digestive trouble and were more efficient than either group of lambs fed loose grain and hay or pelleted concentrate and loose hay. The latter two groups of lambs consumed more feed per day and made the most economical gains, due to the high cost of pelleting the complete mixture. Lambs fed the pellets sold for the highest price, graded higher but the gains were not as economical. A report by Thomas et al. (1959) showed that pelleted rations for lambs are probably more palatable since the lambs receiving the completely pelleted ration ate more, had a higher daily gain and required less feed per unit of gain.

Jordan (1954b), supports the findings of Thomas et al. (1954) since it was found that pelleting the ration increased feed efficiency and rate of gain of lambs while feed consumption was less than lambs fed the same ration unpelleted. The cost of 100 pounds of gain was almost a dollar less for the lambs fed the loose ration, this being due to the cost of pelleting.

It was reported by Thompson et al. (1957), that lambs fed a complete pellet had a greater daily gain on less feed, compared to lambs receiving long hay-whole grain; coarse, chopped hay-ground grain; pelleted hay-whole grain and mash. It was noted at the time of slaughter that the lambs fed pellets had larger, thinner-walled rumens. Results of a second trial supported the first since the lambs receiving the pellets were again more efficient and faster gainers.

Perry et al. (1957), found in one trial that pelleted feed containing 98 percent alfalfa had a 100 percent corn-replacement value and the alfalfa did not have an adverse effect on palatability. A pelleted ration of sugar, soybean oil meal, corn and alfalfa fed to lambs in the second trial resulted in faster gaining more efficient lambs when compared to the lambs fed the 98 percent alfalfa pellet. The lambs receiving the alfalfa pellet did not consume as much feed or grade as high as the lambs receiving the concentrate pellet.

A comparison of gains and feed efficiency was made by Bell et al. (1954b) when two groups of lambs were fed a ration in a pellet or meal form. The lambs receiving the pellet form of the ration consistently performed more desirably than the lambs fed the same ration in a meal form. However, it was found that cost of pelleting caused the cost of gain of the lambs fed pellets to be higher than the cost for the lambs fed meal. Contradictory evidence was found in later work when the unpelleted ration containing 55 percent dehydrated alfalfa and 45 percent cracked corn was fed to lambs (Bell et al., 1955). The group of lambs receiving this unpelleted ration made larger and more efficient gains than the lambs receiving the same ration in a pelleted form.

In the palatability trial conducted by Esplin et al. (1957), the ration was mixed and one-half pelleted and sacked and the other half was sacked with no further processing. Ten lambs ate 164.5 pounds of the pellets and 50 pounds of the unpelleted feed the first week. During the second week, the lambs ate 213 pounds of the pellet and 92 pounds of unpelleted feed or a 4:1 ratio for total consumption. The lambs had free access to the

self-feeder at all times and the feeds were changed to the other bunk at the end of the first week.

In general, pelleting a complete ration has resulted in lambs performing more desirably than lambs fed a loose ration or a ration that is part pelleted and part loose.

#### Pelleted concentrate, loose hay

In three trials reported by Jordan et al. (1959b), the suckling lambs had free access to good quality alfalfa hay and a pelleted or ground creep ration. The results of two of the trials showed that the lambs receiving the pelleted rations gained faster and more efficiently than the lambs receiving the same rations in a ground form. In the third trial, it was found that the lambs fed the meal gained faster on less feed.

It was reported in 1960 by Ross that lambs preferred the pellet form of the ration to the meal form. The lambs consumed eight times as much of the pelleted ration, containing 60 percent corn, 30 percent soybean oil meal and 10 percent wheat bran as they consumed of ground corn. Twenty-five percent more of the preferred ration was consumed when it was in the pellet form compared to the meal form. This work confirms previous work of Ross and Pavey (1959b), and Jordan et al. (1959b), where it was shown that the same ration fed in a pellet and meal form resulted in lambs preferring the pellets.

Lambs generally prefer a pelleted concentrate to meal form of the same concentrate when the lambs have access to loose hay.

#### Form and size

It has been shown previously in this review of literature that lambs

tend to prefer a pelleted ration over a loose ration. Church et al. (1959), found that lambs would gain faster on pellets of one-half inch diameter compared to lambs fed one-fourth and three-eighths inch pellets. They also found that fineness of the feed when ground had no significant effect on daily gain.

The results of palatability trials with swine have shown that when the same ration is offered in a pellet, crumble or meal form to suckling pigs the meal was preferred at first (Lewis et al., 1955). The crumbles were preferred after a few days and after six weeks the pellets were consumed just as readily as the crumbles.

#### Creep Feeding

Creep feeding has been practiced widely through most of the United States with varying degrees of success. The late R. W. Miller of California (Weir, 1955), listed the essentials of successful creep feeding on the range as follows:

- "1. The herder must be sold on the idea.
2. Begin when lambs are two to three weeks old--"Have patience".
3. Provide ample panel and trough room.
4. Feed regularly once a day.
5. Have grain in troughs before ewes and lambs arrive at the creep.
6. Clean each trough daily with a broom, "Important".
7. Provide rails above troughs - eliminates dirt.
8. Feed preferably whole milo at the beginning - just what they will clean up daily. Later whole or rolled barley, whole oats or cracked corn may be added and the milo reduced due to

the high cost.

9. Remember the ewes should be fed hay or grain to provide milk which is so necessary for the young lamb."

Jordan (1960), stated that it is unwise to creep feed lambs born after March 15 because they cannot be fed sufficiently well to enable them to be ready for market in June and July. Lambing in January and February and not creep feeding is just as unwise as creep feeding late lambs due to the increased cost involved in lambing early according to Jordan.

#### Pasture

There are conflicting reports noted concerning the value of creep feeding lambs on pasture. Jordan et al. (1959a), states that lambs weaned at 10 to 14 weeks of age and creep fed in dry lot gave the most favorable results. If the pasture is of good quality and parasites are no problem, the lambs can be left on their mothers longer. Garrigus (1943), reports findings that are in agreement with Jordan and his findings since he found that for the first 70 days lambs on lespedeza pasture gained more than those full-fed yellow shelled corn and second cutting alfalfa hay. During the remaining 42 days, the lambs fed in dry lot maintained their rate of gain whereas those on pasture lost weight. In a report by Ross and Pavey (1959b) it was indicated that since pastures were excellent and the ewes were heavy milkers, only small quantities of the creep feed were consumed.

A comparison of creep feeding and no supplemental feed was reported by Grimes in 1930. He found that lambs fed a ration of 67 percent corn, 21 percent cottonseed meal, 11 percent wheat bran and 1 percent salt in addition to their mother's milk and pasture gained faster than the lambs that

were not fed. Also, the lambs that had access to their mother and pasture only were not as fat as the creep fed lambs when they were marketed. The returns from the fed lambs and non-fed lambs were \$6.56 and \$6.26 per lamb respectively. These returns were above the cost of feeding and marketing.

In a second report, (Grimes 1931), the ration was modified slightly to contain 75 percent corn, 12 percent wheat bran, 12 percent cotton seed meal and 1 percent salt. The gains and returns again favored the lambs that were fed by \$0.17 per head above the cost of feed and marketing. The results of a trial conducted by Ross and Dyer (1947), tend to agree with Grimes when they compared creep feeding to no grain, using suckling lambs as the experimental animals. The lambs fed grain were heavier, showed more bloom and graded higher on foot and on the rail when they were marketed. Forty-four percent of the lambs receiving grain and 35 percent of those not receiving grain were marketed by June 19. By August 13, 96 percent of the lambs fed grain had been marketed while only 58 percent of those not fed had been marketed.

From the results of three years' work, Harper (1930), reported that the lambs on pasture with their mothers made greater and cheaper gains than the lambs fed supplemental feeds when on pasture with their mothers. Cost per 100 pounds of gain was \$14.00 more for the lambs fed grain. A report by Harper (1933), supported the previous work and he stated that the lambs receiving the supplemental feed gained less than the lambs having access to their mother's milk and pasture only.

Five reports from Tennessee (1932; 1933; 1934; 1935; 1936), indicated that lambs suckling their mothers with an abundant grass supply gained

almost as fast as lambs receiving a creep ration, thus the results would agree with Harper's work. Average daily gains, slaughter grades, and carcass grades were about equal. Consequently the workers felt it was uneconomical to creep feed lambs. This was supported to some extent by the results of creep feeding trials conducted at Missouri (1934, 1935), where it was found that only slight gains were obtained from the creep fed lambs compared to the lambs receiving no creep feed.

Bohstedt and Darlow (1931), demonstrated that feeding lambs a grain supplement while on good pasture was uneconomical. It was shown that lambs made virtually the same gains on timothy-clover pasture with no grain supplement as when fed grain. The findings of Harper (1936), are in agreement with the work of Bohstedt and Darlow. He found no advantage in creep feeding lambs when pasture was available, providing ewes were good milkers and good pastures were used.

It was found by Kincaid et al. (1946), that creep feeding spring lambs on good permanent pasture failed to increase gains and fatness sufficiently to pay for the cost of the extra feed.

Litton et al. (1954), supported the findings of Bohstedt and Darlow, Harper and Kincaid, that creep feeding lambs on good pasture has no beneficial effect. The Virginia workers found that when there was enough grass for the lambs, feeding grain did not influence the daily gain significantly. Feeding resulted in no improvement in carcass grade or dressing percent of the lambs.

Creep feeding lambs in Missouri was of very little value according to Weaver and Dyer (1934). The lambs fed shelled corn in a creep in addition

to their mother's milk and grass made slightly larger gains than those fed no grain. In 1935, Weaver and Dyer repeated the creep feeding trial and found that the suckling lambs fed shelled corn in a creep gained 0.06 pounds more per day and graded slightly higher than those not fed corn. The Missouri workers concluded that supplemental feed was of very little value when fed to lambs whose mothers milked well and when both the lambs and ewes had access to good pasture. Contradicting evidence for the 1934 trial was found in 1941 by the same workers when they reported that suckling lambs receiving grain gained faster than the lambs that were not creep fed. In the 1935 and 1941 trials by Weaver and Dyer, it was found the added gain of the lambs that were fed was more than enough to pay for the grain that was consumed.

Miller (1939), reported that creep feeding twins proved most profitable when 91 percent of the twins were classed as fat lambs at market time. A return of \$9.91 per ewe was realized after a deduction of \$0.66 for supplemental feed per lamb and ewe. Since the young lambs consumed only a limited amount of grain, the high percentage of fat lambs, the favorable weight and the early finish more than paid for the feed consumed.

#### Dry lot

A report from Indiana (1936), stated that the third trial in feeding lambs grain as soon as they would eat, verified two previous trials showing that lambs receiving grain during the period before going on grass made larger and cheaper gains with a more desirable market finish. Also more profit per lamb was realized from the lambs receiving the grain than those that received no grain. In a preceding report from Indiana (1934), this

was also found to be true. Harper (1936), agreed with the Indiana workers since he found that feeding lambs before pasture was available, produces a more satisfactory market finish, more quality and larger returns than from lambs not fed a supplemental feed before pasture was available.

Hodgson et al. (1948), compared rations for creep feeding lambs turned on pasture with lambs continued on dry lot until market time. The lambs had free access to the ration they were fed at all times. The lambs on pasture failed to gain as rapidly as lambs in dry lot during the first part of the trial but gained at a comparable rate to the lambs in dry lot for the remainder of the trial. Harper (1930), found that lambs on pasture with their mothers gained faster than lambs kept in dry lot until market time.

Work conducted at the Montana station by Anderson in 1958 indicated that only a slight effect was noted when single suckling lambs were creep fed but creep feeding twin lambs that were nursing their mothers was beneficial.

#### Creep feeds

Morrison et al. (1946), reported that rations having a protein content of 10.3 percent produced the most satisfactory gains and finish within the limit of those studied. Higher protein levels did not increase gains significantly and tended to produce slightly less finish than did the low levels. Less than 10 percent protein usually resulted in lower and more expensive gains. Jordan (1960), was in disagreement with this statement since he felt the ideal creep ration should be relatively high in soybean oil meal (10-20 percent). Bush et al. (1955), agreed with Morrison. They

found that lambs receiving high levels of protein in their ration did not carry as much finish as the lambs fed a ration containing 10 and 11 percent protein.

## METHODS AND PROCEDURES

Two palatability trials and two creep feeding trials were conducted. The 1959 palatability trial was conducted at the Fort Ellis Station located four miles east of Bozeman. The palatability trial of 1960 was conducted in two phases; a dry lot phase at Fort Ellis and an irrigated pasture phase at Bozeman. The two creep feeding trials were started at Fort Ellis then the ewes and lambs were moved to Bozeman with single lambs being kept in dry lot with their mothers and the twin lambs were run on irrigated pasture with their mothers. There were two phases in each of the creep feeding trials; a creep feeding phase and a fattening phase. All weights reported for these trials were non-shrunk weights.

### Palatability Trial I (1959)

#### Experimental lambs

The 39 lambs used in this trial were from aged whiteface ewes and two-year old and mature Columbia-Hampshire cross ewes. The lambs were from single and twin births with both sexes being represented. These lambs were a miscellaneous group and the ages at the start of the trial varied from about 30 to 100 days.

#### Management of ewes and lambs

The ewes and lambs were grazed on experimental grass pastures and the lambs had access to a creep area located in a large shed. The pasture grazing was rotated to allow regrowth of grass. Water and salt were located close to the creep area. A diagram of the pastures, water, salt and shed is presented in figure 1. Each lamb was vaccinated to prevent enterotoxemia before being placed on the experiment.

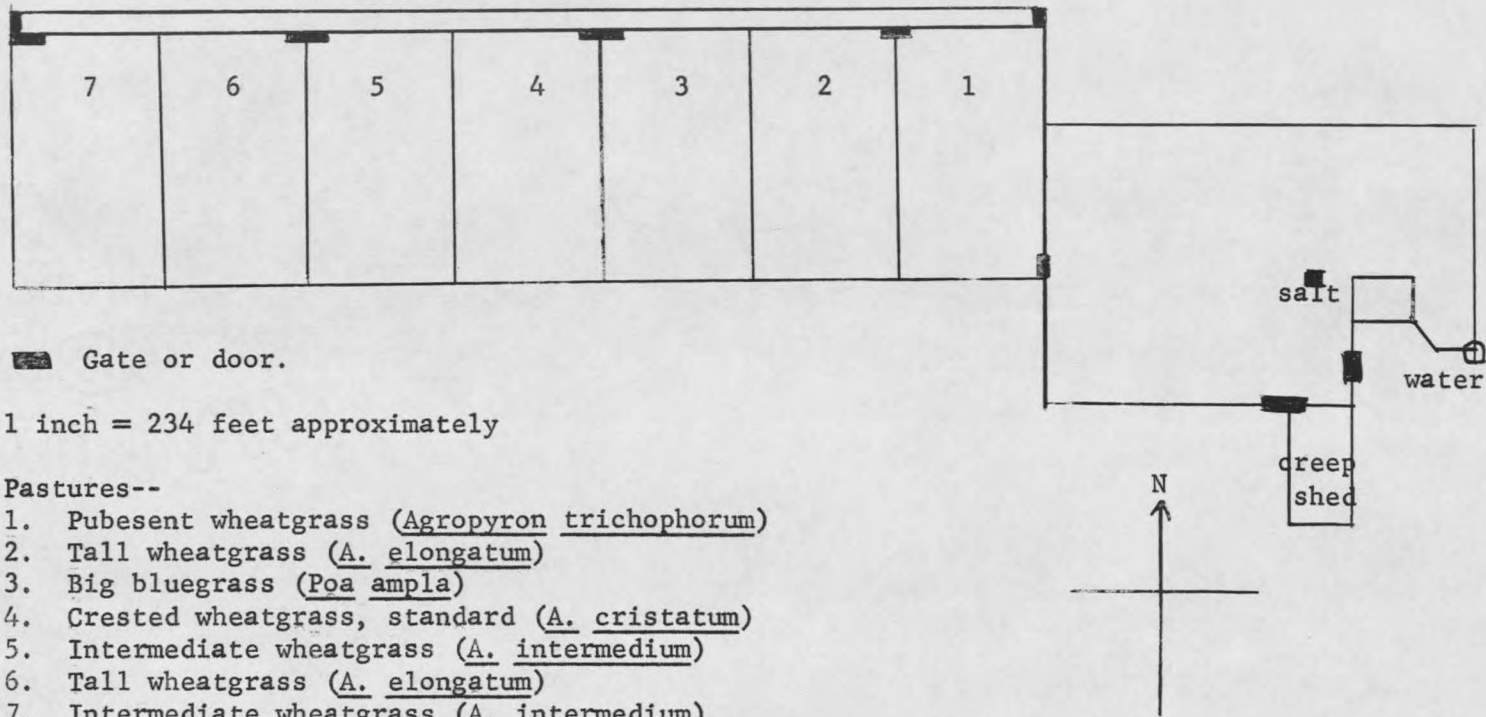


Figure 1. Diagram of area where palatability trial, 1959, was conducted at Fort Ellis.

### Creep feeds and feeding procedure

This trial began June 26 and was completed August 19. Four troughs, each eight feet long were located in the creep area with approximately six feet of space between each trough. Each trough contained four compartments each 22 inches long, 7½ inches wide and 4 inches deep. The 16 feeds used in this trial were placed in the 16 compartments at random and fresh feeds were added when necessary. The lambs were weighed every two weeks throughout the trial. At each weigh period the feeds remaining in the compartments were weighed back, feed positions were re-randomized and fresh feed was weighed and placed in the compartments. Each compartment of a trough served as an observation for a given feed for each period. The composition of the feeds used in this trial are shown in Table I. The lambs had access to the creep area at all times. On August 7, 13 lambs were removed from the trial because they were too large to enter the creep area. The remaining 26 lambs remained on trial until August 19, 1959.

### Palatability Trial II (1960)

#### Experimental lambs

Twenty sets of twins from aged whiteface ewes were used in this study. One lamb died on April 18 from peritonitis, hepatitis and pneumonia with pericarditis as reported by the Montana Veterinary Research Laboratory. The remaining 39 lambs completed the trial with no complications; however, several lambs scoured during the dry lot phase of this trial.

#### Management of ewes and lambs

The two phases of this trial were, dry lot and irrigated pasture. The dry lot phase of the trial was conducted at Fort Ellis beginning April 8

Table I. Percent composition of rations for the palatability trial, 1959.

<u>Ingredients in percent</u>		<u>Base I</u>	<u>Base II</u>	<u>1/</u>															
	Barley	50.0	50.0																
	Oats	25.0	25.0																
	Beet Pulp	25.0	12.5																
	High Molasses Pulp	0.0	12.5																
		<u>Rations</u>																	
		1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16		
<u>Ingredients in %</u>																			
	Base I	100.0	84.9	73.7	69.7	47.7	95.0	90.0	98.0	90.0									
	Base II										100.0	73.7	84.9	47.7	69.7				
	Soybean oil meal (44%)	15.1		30.3									15.1		30.3				
	Commercial Protein Supplement (33%)			26.3		52.6						26.3		52.6					
	Sugar						5.0	10.0											
	Yeast								2.0										
	Wheat bran									10.0									
	Pellet 70% concentrate																		100.0
	Pellet 70% roughage																		100.0
	Pellet 30% concentrate																		100.0
	<u>Percent</u>																		
	Protein	11.0	16.0	16.0	21.0	21.0	10.7	10.2	12.0	11.8	11.0	16.0	16.0	21.0	21.0	14.3	14.7		

1/ The base rations were mixed and the supplements were added to them on a percentage basis.

and ending May 13. The lambs varied in age from 32 to 47 days at the beginning of the trial. All the lambs were vaccinated to prevent enterotoxemia prior to the start of the trial.

Each ewe was fed an average of one and one-half pounds of a mixture of equal parts barley, beet pulp and a dehydrated alfalfa silage pellet per day. Ten pounds of good quality alfalfa hay were fed to each ewe and lamb daily. The lambs were weighed at the beginning of the trial and weekly weights were taken throughout the trial. Free access to the creep area was provided for the lambs through 32 openings  $7\frac{1}{2}$  inches wide and 30 inches high.

The pasture phase of this trial which was conducted on an irrigated pasture one mile west of the Montana State College Campus began May 13 and ended June 10. The predominant grass in the pasture was orchard grass-- (Dactylis glomerata). The creep area for the lambs was near a stream and close to a salt trough containing phenothiazine and salt. The lambs were weighed at two-week intervals during this phase of the trial; the final weight of the dry lot phase was the initial weight of the pasture phase.

The ewes lost an average of only 1.6 pounds over the five-week period, so it can be concluded that a near maintenance diet was provided for the ewes when suckling lambs. During the pasture phase, the ewes had access to grass only and gained an average of 9.7 pounds.

#### Creep feeds and feeding procedure

Four rations, each in a pellet, crumble and meal form were fed in this trial. The rations differed in the amount of soybean oil meal. As the soybean oil meal was added the amount of barley decreased. The composition

of the four rations used is presented in Table II. The rations were mixed and pelleted by a commercial feed mill in Bozeman according to specifications submitted by the Animal Industry Department. Two hundred pounds of each ration were crumbled by passing the pellets through a Burns No. 12 Coffee Mill with the crumble size varying from a meal to approximately 3/8 inch in diameter. One hundred pounds of each pellet was ground through the coffee mill to obtain a meal with particle sizes no larger than 1/8 inch in diameter.

Table II. Composition of the rations used in the palatability trial, 1960.

MSC Formula No. Ingredients	Pellets			
	130 %	131 %	132 %	133 %
Barley	53.5	41.0	28.5	16.0
Soybean oil meal	0.0	12.5	25.0	37.5
Oats	15.0	15.0	15.0	15.0
Wheat mixed feed	15.0	15.0	15.0	15.0
Alfalfa meal, dehydrated	5.0	5.0	5.0	5.0
Molasses, dried	2.5	2.5	2.5	2.5
Molasses, wet	7.5	7.5	7.5	7.5
Salt	1.0	1.0	1.0	1.0
Dicalcium phosphate	0.5	0.5	0.5	0.5
Trace minerals <u>1/</u>	X	X	X	X
Vitamin D <u>2/</u>	X	X	X	X
Percent protein <u>3/</u>	11.6	17.3	20.6	24.8

1/ One pound per ton of a trace mineral premix.

2/ Fortified to provide 500 I.U. per pound of feed.

3/ Protein was determined by chemical analysis by the Chemistry Department at Montana State College.

The troughs used in this trial were the same as in the first palatability trial except six troughs were used instead of four. By using six troughs, two observations were made on each ration in all forms. The feeds were weighed and placed in the compartment at random and were weighed back and re-randomized each week through both phases of the trial. Feed was provided as it was needed between the weigh-back periods.

#### Creep Feeding Trial, Twins (1959)

##### Experimental lambs

The 19 sets of twin lambs used in this trial were from aged whiteface ewes and two-year old and mature Columbia-Hampshire cross ewes with both sexes being represented. The lambs were allotted by stratified randomization according to age of lamb, breed and age of ewe. Ten sets of twin lambs received a supplemental feed and nine sets of twin lambs were not fed.

##### Pretreatment

As the ewes and lambs were removed from the doubling up pens following lambing, they were placed in their respective lots. All of the lambs were vaccinated to prevent enterotoxemia prior to removal from the doubling up pens. A creep area was provided for the lambs that were to be fed and as soon as all the lambs had been grouped they were weighed and placed on trial.

##### Management of ewes and lambs

The lambs were weighed on trial April 30 and at two-week intervals thereafter. The ewes and lambs were kept in dry lot until May 21 when they were moved to the irrigated pastures.

The ewes in both lots were fed five pounds of good quality alfalfa hay

and two pounds of mixture composed of equal parts barley, oats and beet pulp during the dry lot phase. The lambs in lot I had access to a creep area where feed was available and the lambs in lot II received no supplement.

On May 21, the ewes and lambs of both lots were moved to two irrigated pastures of equal acreage one mile west of the Montana State College campus and were kept there until August 28. A creep area was provided next to the gate between the two pastures for the lambs in lot I. At each weigh period the ewes and lambs of each lot were rotated to the pasture previously grazed by the other group.

#### Creep feed and feeding procedure

The lambs receiving the supplemental feed had access to the creep area at all times. The feed was weighed back and fresh feed was placed in the trough every two weeks. When dirt and manure were found in the trough, it was removed if possible and the feed was weighed back and the dirty feed was replaced with clean feed. The feed troughs were the same kind as those used in the palatability trials with a cover over the top to prevent rain from getting the feed wet.

The composition of the creep feed used in this trial was the same as ration number 10 in Table I.

#### Creep Feeding Trial, Singles (1959)

##### Experimental lambs

Forty-seven single lambs from aged whiteface ewes and two-year old and mature Columbia-Hampshire ewes were used in this trial with both sexes being represented. The lambs were allotted to lot I (creep fed) or lot II

(non-creep fed) by stratified randomization according to age of lamb, breed and age of ewe. At the start of the trial, the lambs that were to be creep fed averaged 1.8 pounds heavier than the lambs that were not to be creep fed. The ages of the lambs varied from 10 to 46 days.

#### Management of ewes and lambs

This trial was conducted in dry lot at the Montana State College sheep barns. It began on April 30, 1959 and was completed June 12. The pens were approximately 30 feet wide and 100 feet long with a stream passing through one end of the pens. The ewes were fed five pounds of good quality alfalfa hay and one and one-half pounds of a mixture composed of equal parts rolled barley, oats and beet pulp per head per day. The lambs in lot I had access to a creep area inside the barn where supplemental feed was provided. The lambs were vaccinated to prevent enterotoxemia before they were placed on trial. Individual weights were taken initially and every two weeks during this trial and the lambs were given a fatness score by a committee of three men at the end of this trial.

#### Creep feed and feeding procedure

Only lambs in lot I had access to a creep area. The feed was weighed back and fresh feed was placed in the trough every two weeks. If the uneaten feed became contaminated with dirt and manure before the normal weigh-back period, it was replaced with clean feed. An open trough 8 feet long, 7½ inches wide and 5 inches deep was used for feeding the lambs.

The composition of the creep feed used in this trial was the same as ration number 10 in Table I.

### Fattening Trial, Twins and Singles (1959)

Because these two trials were conducted in the same manner they will be discussed together. Both trials were conducted at the Montana State College sheep barn with shed space and a run provided. The pens were approximately 25 feet wide and 100 feet long with a stream running through one end.

#### Experimental lambs

These lambs were the same as those used in the two creep feeding trials outlined previously. The nine sets of twins that were not fed were divided into two lots with the pairs being separated to form twin lots I and II of nine lambs each. The 10 sets of twins that were fed were separated accordingly to form twin lots III and IV of 10 lambs each. The separation of the twins was done by stratified randomization according to breed. The single lambs that were not fed were separated by stratified randomization according to breed to form single lots I and II of 12 lambs each and the fed singles formed single lots III and IV of 12 and 11 lambs each. The fattening trial for the singles started June 12 and ended September 15, 1959. The fattening trial for the twins started September 1 and ended October 27, 1959.

#### Management of lambs

The lambs were weighed every two weeks with the final weight of the single creep feeding trial being the initial weight of the single fattening trial. The twin lambs were weighed and placed on the fattening trial September 1. The lambs were weighed and scored for fatness at the beginning of the trial and at each weigh period thereafter. The lambs that

reached the grade of better than choice when they were scored were removed from the trial. Numbers were used to designate grade with 1 (prime) through 5 (cull). Each grade was divided into its high or low form as high choice, choice and low choice.

Feed and feeding procedure

Lots I and III received ration 10 shown in Table I plus good quality alfalfa hay and lots II and IV received ration 11 shown in Table I plus good quality alfalfa hay. The feed was weighed back and fresh feed supplied at each weigh period. Dirty feed was replaced by clean feed as it became necessary. All lambs went on feed well with very little scouring. Some of the singles foundered toward the end of the fattening trial. Lots II and IV were affected more than lots I and III.

RESULTS AND DISCUSSION

Palatability Trial, 1959

Data from the first two week period of this trial were not used in the statistical analysis because several of the rations were not consumed by the lambs and comparatively little was eaten of any ration. The last two week period was not used due to the removal of 13 lambs from the trial. Zero consumption for any ration during the periods used for the statistical analysis, (Table III) were treated as real numbers.

Table III. Analysis of variance, palatability trial, 1959.

Variation due to:	Degrees of Freedom	Sum of Squares	Mean Squares	Calculated F Value
Treatment	15	7,287.33	485.82	5.14**
Period	2	1,514.00	757.00	8.00**
Error	30	2,836.67		
Total	47	11,638.00		

\*\* Highly significant ( $P < 0.01$ )

Table IV shows the feed consumption by periods and mean consumption for the three periods used for statistical analysis. Consumption of the individual rations varied greatly; the difference being highly significant ( $P < 0.01$ ). There was also a statistical highly significant difference between periods.

When the Duncan's test (Snedecor, 1956) was applied to the results of this trial, no significant difference was found at the five percent level in consumption between rations 16, 14, 7 and 4. These rations were significantly ( $P < 0.05$ ) more palatable than the other rations when measured by



consumption. The preference of the rations is indicated by the mean consumption presented in Table V, on the preceding page..

There was no significant regression of feed consumption on protein content of the rations, the results are presented in Table VI.

Table VI. Test of significance of regression of consumption on percent protein in the ration.

Variation due to:	Degrees of Freedom	Sum of Products	Mean Products	Calculated F Values
Regression Period 2 <u>1/</u>	1	79.95	79.95	1.71
Deviation from Regression	14	654.05	46.71	
Total	15	734.00		
-----				
Regression Period 3	1	12.77	12.77	0.09
Deviation from Regression	14	1,944.23	138.87	
Total	15	1,957.00		
-----				
Regression Period 4	1	108.07	108.07	0.21
Deviation from Regression	14	7,323.93	523.14	
Total	15	7,432.00		
-----				
Regression all periods	1	509.85	509.85	0.64
Deviation from Regression	14	11,128.15	749.87	
Total	15	11,638.00		

1/ Data from period one was not used due to a lack of feed consumption.

The general trend was for the lambs to consume the rations containing

the higher percentages of protein; however, other physical and/or chemical considerations which were not analyzed were responsible for the difference in consumption.

While there was not a significant difference between the pelleted ration 16 and other most preferred rations it is noted (Table IV) the lambs consumed more of the 70 percent concentrate and 30 percent roughage pellet. These results are in partial disagreement with Cox (1946) and Bell et al. (1955), who found the optimum physical balance to be 55 percent roughage and 45 percent concentrate for an unpelleted ration for lambs. Bell et al. (1955), stated that a pelleted ration of 65 percent dehydrated alfalfa and 35 percent corn fed to lambs gave the best results. The lambs on this trial ate twice as much of ration 16 as of ration 15, thus showing further that the lambs preferred the high concentrate pellet to the high roughage pellet.

Gains of the lambs used in this trial are presented in Table VII.

Table VII. Gains of lambs on the 1959 palatability trial.

Period	Days	No. of Lambs	Gain Lbs.	Average Daily Gain Lbs.
2	14	39	293.0	0.54
3	14	39	241.0	0.44
4	14	39	132.0	0.24
Total	42	39	666.0	0.41

Daily gain decreased and feed consumption increased during each period. It is postulated that this was due to the maturing of the pastures and a decrease in milk production of the ewes. The milk production of the ewes

was probably decreasing when the trial started and continued downward throughout the trial. This postulation is supported by the work of Burris and Baugus (1955), who found that the ewes' milk production was highest during the first four weeks of lactation, declined rapidly during the next four weeks and declined less rapidly thereafter.

The conclusions to be drawn from this trial might be that soybean oil meal and sugar from sugar cane or high molasses pulp enhance the palatability of the rations. Also, a high concentrate pellet is more palatable than a high roughage pellet.

#### Palatability Trial, 1960

##### Dry lot phase

The consumption records for the first week of this phase of the trial were not used in the analysis of variance. Zero consumption for any of the observations for the remainder of the trial were treated as real numbers and used in the analysis of variance. In the dry lot phase of the trial, ration, form, period and interactions of ration, form and periods were highly significant ( $P < 0.01$ ) as shown in Table VIII.

The lambs preferred the pellets to crumbles or meal and the lambs preferred the ration containing 12.5 percent soybean oil meal, (Table IX). This ration was the most palatable of the four rations and the crumbles and meal consumption of ration 131 was comparable to, or better than the pellets of the other rations. The ration that contained no soybean oil meal was found to be the least palatable ration in this phase of the trial.

Table VIII. Analysis of variance of the dry lot phase of the palatability trial, 1960.

Variation due to:	Degrees of Freedom	Sum of Squares	Mean Squares	Calculated F Values
Ration (R)	3	2,786.54	928.85	50.62**
Form (F)	2	2,532.43	1,266.22	69.00**
Period (P)	3	1,039.45	346.48	18.88**
R F	6	771.07	128.51	7.00**
R P	9	705.63	78.40	4.27**
F P	6	1,141.24	190.21	10.36**
R F P	18	914.93	50.83	2.77**
Error	48	880.96	18.35	
-----				
Total	95	10,771.62		

\*\* Highly significant ( $P < 0.01$ )

The rations containing the higher levels of soybean oil meal, 25.0 and 37.5 percent were consumed more readily as this phase of the trial progressed. This might be a result of a decreased intake of protein through the milk due to the milk production of the ewe decreasing as supported by Burris and Baugus (1955). In general, the feed consumption increased for the rations throughout the trial with fluctuations of the various rations. This increased feed consumption may be explained because of the growth of the lambs.

For all rations, the mean consumption of the pellets was twice as great as the crumbles and the consumption of the crumbles was almost twice as great as the meal. Although the consumption of all rations containing soybean oil meal increased in succeeding periods, the rate of increase varied from one period to another.

The results of this trial are in disagreement with some other reports

Table IX. Table of means of feed consumption for the dry lot phase of the palatability trial, 1960.

Periods	1	2	3	4	Average all Periods
<u>Rations Forms 1/</u>	<u>Pounds</u>				
130 1	3.5	6.0	17.0	8.5	8.8
(0% 2	2.5	5.0	4.0	5.0	4.1
SBOM) <u>2/</u> 3	1.0	1.0	0.5	1.0	0.9
All Forms, Avg.	2.3	4.0	7.2	4.8	4.6
131 1	15.0	35.5	40.5	32.5	32.1
(12.5% 2	3.5	14.5	13.5	15.5	11.8
SBOM) 3	14.0	15.5	8.0	5.0	10.6
All Forms, Avg.	10.8	21.8	22.3	17.7	18.2
132 1	1.0	4.5	11.5	29.0	11.5
(25.0% 2	4.0	2.5	11.0	9.0	6.6
SBOM) 3	2.0	0.5	1.5	4.0	2.0
All Forms, Avg.	2.3	2.5	8.0	14.0	6.7
133 1	2.0	3.5	8.5	32.0	11.5
(37.5% 2	0.5	3.0	9.5	9.0	5.5
SBOM) 3	1.0	1.5	2.5	2.5	1.9
All Forms, Avg.	1.2	2.7	6.8	14.5	6.3
Average all Rations for each Form	1	2	3	4	
	5.4	12.4	20.6	25.5	15.9
	2.6	6.2	9.5	9.6	7.0
	4.5	4.6	3.1	3.1	3.8
Average all Forms	4.2	7.8	11.1	12.8	8.9

1/ Form 1 = Pellet, Form 2 = Crumble and Form 3 = Meal.

2/ SBOM = Soybean oil meal.

since the ration containing 12.5 percent soybean oil meal proved to be more palatable than the rations containing the two higher levels. Ross and Pavey (1959) and Jordan (1960), found that rations containing high levels of soybean oil meal proved to be more palatable than the lower levels or no soybean oil meal in the ration.

Pasture phase

When the lambs were moved to pasture, consumption of the rations decreased; however, it was found that ration, form and interactions of ration times form and form times period were highly significant ( $P < 0.01$ ). The interaction of ration, form and period approached a significant ( $P < 0.05$ ) difference, with the tabular F value being 1.83. The analysis of variance for this trial is shown in Table X with the mean consumption presented in Table XI.

Table X. Analysis of variance of the pasture phase of the palatability trial, 1960.

Variation due to:	Degrees of Freedom	Sum of Squares	Mean Square	Calculated F Values
Ration (R)	3	167.00	55.67	30.09**
Form (F)	2	246.64	123.32	66.66**
Period (P)	3	12.00	4.00	2.16
R F	6	56.69	9.45	5.11**
R P	9	27.83	3.09	1.67
F P	6	47.94	7.99	4.32**
R F P	18	60.73	3.30	1.78 <u>1/</u>
Error	48	89.00	1.85	
-----				
Total	95	707.83		

1/ Approached significance (1.82)

\*\* Highly significant ( $P < 0.01$ )

Table XI. Table of means of feed consumption for the pasture phase of the Palatability Trial, 1960.

Periods	1	2	3	4	Average all Periods
<u>Rations Forms</u> 1/	<u>Pounds</u>				
130 1	1.5	3.0	2.5	2.0	2.2
(0% 2	3.0	1.0	1.0	1.0	1.5
SBOM)2/ 3	1.0	0.5	0.5	0.5	0.6
All Forms, Avg.	1.8	1.5	1.3	1.2	1.5
131 1	5.5	10.0	4.5	2.5	5.6
(12.5% 2	4.0	5.0	7.5	6.0	5.6
SBOM) 3	1.5	0.5	2.0	1.5	1.4
All Forms, Avg.	3.7	5.2	4.7	3.3	4.2
132 1	6.5	6.5	8.5	7.0	7.1
(25.0% 2	5.0	2.0	5.0	3.5	3.9
SBOM) 3	2.5	1.5	1.5	2.5	2.0
All Forms, Avg.	4.7	3.3	5.0	4.3	4.3
133 1	7.5	7.0	7.5	3.5	6.4
(37.5% 2	8.0	3.5	6.0	6.5	6.0
SBOM) 3	2.5	2.0	2.0	2.0	2.1
All Forms, Avg.	6.0	4.2	5.2	4.0	4.8
Average 1	5.2	6.6	5.8	3.8	5.3
all Rations 2	5.0	2.9	4.9	4.2	4.2
for each Form 3	1.9	1.1	1.5	1.6	1.5
Average all Forms	4.0	3.5	4.0	3.2	3.7

1/ Form 1 = Pellet, Form 2 = Crumble and Form 3 = Meal.

2/ SBOM = Soybean oil meal.

It is shown in Table XI, preceding page, that the lambs preferred, in order, the rations 132, 133, 131 and 130 containing 25.0, 37.5, 12.5 and 0 percent soybean oil meal, respectively. Thus the preference of the lambs changed from the 12.5 percent level of soybean oil meal in the ration in the dry lot phase to the rations containing the higher levels of soybean oil meal in the pasture phase. The lambs tended to prefer the pellets when the mean average of all the rations was considered; the crumble forms were intermediate in palatability and the meal forms of the rations were the least palatable. The consumption of the crumble form of rations 131 and 133 was comparable to the pellet form of these rations. As in the dry lot phase of this trial, the ration containing no soybean oil meal was the least palatable of the four rations, indicating that soybean oil meal enhanced the palatability of the rations. This is in agreement with Ross and Pavey (1959) and Jordan (1960).

The lack of feed consumption by the lambs during the pasture phase of this trial was probably due to the excellent pasture. This lack of feed consumption would be in agreement with Ross and Pavey (1959b), who reported that due to the excellent pastures and heavy milking ewes, only small quantities of the creep feeds were consumed.

The reduced gain in period five shown in Table XII was probably due to a large number of lambs scouring. The scouring may have been a result of the increased consumption of the rations containing the higher levels of soybean oil meal shown in Table IX. No scouring was noted during the pasture phase of this trial.

The gains of the lambs are shown in Table XII.

Table XII. Gains of lambs for the dry lot and pasture phase of the palatability trial, 1960.

	Days	No. of Lambs	Gain	Average Daily Gain
Period			lbs.	lbs.
<u>Dry Lot 1/</u>				
2	7	39	173.0	0.63
3	7	39	207.0	0.76
4	7	39	235.0	0.86
5	7	39	82.0	0.30
Total	28	39	697.0	0.64
-----				
<u>Pasture 2/</u>				
1	14	39	367.0	0.67
2	14	39	357.0	0.65
Total	28	39	724.0	0.66
-----				
Grand Total	56	39	1,421.0	0.65

1/ During the dry lot phase the lambs were weighed each week.

2/ During the pasture phase the lambs were weighed every two weeks.

It is concluded from this trial that soybean oil meal increased the palatability of the ration. The palatability of the feed seems to be enhanced when the feed is in a pellet form. The young lambs in this trial ate the pelleted form of the ration more readily than the crumbles or meal. As the lambs grew older they definitely preferred the pellet form of the ration. The lambs grazing on pasture tended to prefer the rations containing higher levels of soybean oil meal (25 and 37.5 percent).

Creep Feeding, 1959

Twins

In this trial, creep feeding twins proved beneficial since the lambs gained faster and graded higher than lambs not having access to creep feed. The fatness scores were 2.39 for the fed lambs and 2.85 for the lambs that were not fed. Statistical analysis of gains for the lambs showed that feeding the lambs resulted in a highly significant ( $P < 0.01$ ) difference (Table XIII).

Table XIII. Analysis of variance of the twin creep feeding trial.

Variation due to:	Degrees of Freedom	Sum of Squares	Mean Squares	Calculated F Values
Treatment	1	1,144.00	1,144.00	10.60**
Error	36	3,883.58	107.88	
Total	37	5,027.58		

\*\* Highly significant ( $P < 0.01$ )

Since the lambs were not sold, only postulations can be made about the economic advantage of creep feeding twin lambs. The cost of the creep feed per 100 pounds was \$2.05. This feed cost is low since there was no charge assigned for mixing or sacking the feed. The increased gains and fatness of the lambs that were fed in this trial would be more than enough to pay for the feed if they were sold for the same price per 100 pounds as compared to the lambs that had not been fed.

While the lambs on the trial probably would not have graded as high as fat lambs, the increased gains and fatness made by the lambs that were fed would be in agreement with Weaver and Dyer (1934), Miller (1939) and Dyer and Weaver (1941).

The results of the performance of the two groups of lambs in this trial are shown in Table XIV.

Table XIV. The effect of creep feeding on the performance of twin lambs.

<u>Treatment</u>	<u>Lot I (Creep Fed)</u>	<u>Lot II (Not Creep Fed)</u>
No. lambs	20	18
Days on trial	121	121
Average weights, (lbs.)		
Initial	19.8	18.7
Final	64.1	53.1
Gain	44.3	34.4
Daily gain	0.36	0.28
Average daily consumption (lbs.)	0.80	0.0
Feed/cwt. gain (lbs.)	216.0	0.0
Feed cost/cwt. gain (\$) <u>1/</u>	4.43	0.0
Average score (fatness)	2.39	2.85

1/ Cost for hay or pasture not included.

The lambs within both groups varied in size, this probably being due in part to intestinal parasite. The Veterinary Parasitologist, from the Veterinary Research Laboratory at Montana State College conducted an egg count from the feces of several lambs on July 17 which indicated an infestation of parasites and the lambs were treated with an anthelmintic drench on July 21. The intestinal parasite infestation may account for the low daily gain made by these lambs.

It is reasonable to assume that twin lambs would respond to creep feeding because twins tend to be restricted in milk consumption from their

mother when compared to single lambs. This assumption is substantiated by Burris and Baugus (1955), who found that ewes suckling twin lambs and ewes suckling single lambs produce about the same amount of milk. However, it should be noted that Wallace (1948), found that ewes suckling twin lambs produced more milk than ewes suckling single lambs.

From the results of this trial, it is concluded that creep feeding twins is beneficial and economical due to the increased gain and fatness of the creep fed lambs.

#### Singles

There were no charges made for the grain and hay that were fed to the ewes in this trial. The feed that the lambs in lot I received cost \$2.05 per hundred. The price is low because as previously stated the cost includes the ingredients only. The analysis of variance shown in Table XV, indicated no significant difference between the gains of the lambs that were fed and those that did not receive feed. It was found that the lambs receiving creep feed gained slightly faster than the lambs that were not fed. These results are in agreement with the report by Anderson (1958), and the Missouri reports (1934, 1935).

Table XV. Analysis of variance of the single creep feeding trial.

<u>Variation due to:</u>	<u>Degrees of Freedom</u>	<u>Sum of Squares</u>	<u>Mean Square</u>	<u>Calculated F Values</u>
Treatment	1	100.28	100.28	2.95
Error	45	1,562.57	33.97	
Total	46	1,662.85		

While there was no significant difference between the gains

of the two lots of lambs, it is shown in Table XVI that the lambs from lot I graded slightly higher when they were scored at the end of the trial. The results of the trials reported by Ross and Dyer (1947) substantiate these findings because they found that at marketing time, suckling lambs receiving grain were heavier and graded higher than lambs that were not fed.

Table XVI. The effect of creep feeding on the performance of single lambs.

<u>Treatment</u>	<u>Lot I (Creep)</u>	<u>Lot II (Non Creep)</u>
No. lambs	23	24
Days on trial	43	43
Average weights (lbs.)		
Initial	28.3	26.9
Final	52.0	47.1
Gain	23.7	20.2
Daily gain	0.55	0.47
Average daily consumption (lbs.)	0.43	0.0
Feed/cwt. gain (lbs.)	79.8	0.0
Feed cost/cwt. gain (\$) <u>1/</u>	1.64	0.0
Average score (fatness)	2.14	2.64

1/ Cost of hay or feed for ewe not included.

These lambs were placed on a fattening trial at the completion of the creep feeding trial, consequently postulations have to be made about the advantage of creep feeding single suckling lambs. In this trial, the additional gain made by the lambs that were fed was more than enough to pay for the feed if all the lambs were sold for the same price. Labor and cost of feed for the ewes was not taken into consideration when determining

the returns if the lambs had been sold. However, it should be noted that since there was no statistical difference at the five percent level, the postulations are not necessarily valid.

Fattening phase, twins

There was no statistical analysis conducted on the data from this phase of the trial due to the confounding of the results of the trial by removal of the lambs when they reached a grade of better than choice. The performance of the four lots of lambs are shown in Table XVII. Three lambs were removed before the trial began because of their fatness score, they had been in lot I previously. The trial was considered to be completed when all the lambs had been removed from any one lot. The lambs in lots I and III received a ration containing 11 percent protein and lots II and IV were fed a ration containing 16 percent protein.

The lambs in lot IV, fed a 16 percent protein ration, required less time to reach a grade of better than choice but were less efficient in feed conversion than lots II and III that were fed a 16 percent and 11 percent protein ration respectively. Also, cost of gain was higher for the lambs in lot IV with the lambs from lot III making the most economical gains.

The lambs in lot I fed on 11 percent protein ration, were consistently thinner and lighter than the other lots and cost of gains were similar to lot IV lambs. The most efficient gains were made by the lambs in lot II but the cost of the ration made the cost of gain \$0.32 more per hundred pounds than the lambs in lot III. If the cost of gains were figured in for the pretreatment of lot III lambs, the lambs of lot II would have made the most economical gains.

Table XVII. The effect of two levels of protein in the rations on the fattening ability of twin lambs.

Pretreatment Lot No.	Lot II Non-Creep Fed		Lot I Creep Fed	
	I	II	III	IV
Period 1 <u>1</u> / (No. lambs)	9	9	9	8
Average gain (lbs.)	6.1	8.8	9.9	10.0
Average daily gain (lbs.)	0.44	0.63	0.71	0.71
Score <u>2</u> /	3.04	2.99	2.75	2.29
Period 2 (No. lambs)	9	9	8	7
Average gain (lbs.)	7.6	8.7	8.2	11.9
Average daily gain (lbs.)	0.53	0.62	0.59	0.85
Score	2.35	2.17	2.29	2.25
Period 3 (No. lambs)	6	6	7	6
Average gain (lbs.)	9.2	9.0	5.4	7.2
Average daily gain (lbs.)	0.65	0.64	0.39	0.51
Score	2.31	2.14	2.11	1.91
Period 4 (No. lambs)	6	4	4	3
Average gain (lbs.)	2.0	4.5	7.5	4.7
Average daily gain (lbs.)	0.14	0.32	0.53	0.33
Score	2.02	2.09	1.97	1.71
Average days on trial	46.7	43.6	43.6	42.0
Average initial weight (lbs.)	67.4	68.6	74.3	80.4
Average final weight (lbs.)	88.6	94.0	99.1	107.9
Average gain (lbs.)	21.2	25.4	24.8	27.5
Average daily gain (lbs.)	0.45	0.58	0.56	0.65
Feed/cwt. gain (lbs.)				
Concentrate	611.6	486.5	535.4	525.0
Hay	123.6	76.0	101.3	124.0
Total	735.2	562.5	636.7	649.0
Feed cost/cwt. gain (\$)				
Concentrate	12.54	11.55	10.98	13.54
Hay	1.24	0.76	1.01	1.24
Total	13.78	12.31	11.99	14.78
Average score	2.43	2.35	2.28	2.04

1/ The periods were 14 days in length.

2/ Fatness, 1 prime, 2 choice, 3 good, 4 utility and 5 cull.

It would appear from the results of this trial that lambs fattened on alfalfa hay and a ration containing 16 percent protein gain faster and more efficiently than lambs fattened on alfalfa hay and a ration containing 11 percent protein.

Since the lambs in lot II made more efficient yet comparable gains to the lambs in lot III in this trial, it would be more desirable not to creep feed the lambs but to fatten them on a ration high in protein (16 percent). According to the results of this trial, it would be uneconomical to creep feed and then fatten lambs.

The conclusions drawn from this trial are that the most desirable ration for fattening lambs that have not previously been creep fed would be a ration of barley, oats, beet pulp, high molasses beet pulp, enough soybean oil meal to have a ration containing 16 percent protein and alfalfa hay.

If the lambs had been on creep feed prior to fattening, a concentrate of 11 percent protein containing barley, oats, beet pulp and high molasses pulp and alfalfa hay would be desirable.

#### Fattening phase, singles

No statistical analysis was conducted on the data from this trial. The lambs had to reach a grade of better than choice before they were removed from the trial. The performance of four lots of lambs is shown in Table XVIII.

The lambs were graded the day before the lamb sale at the local auction to allow the fat lambs to be marketed as soon as possible. The periods vary in length of time for this reason. No lambs were graded or removed from the trial before July 24 which was the end of the first period consisting

Table XVIII. The effect of two levels of protein in the rations on the fattening ability of single lambs.

Pretreatment Lot No.	Lot II Non-Creep Fed		Lot I Creep Fed	
	I	II	III	IV
Period 1 <u>1</u> / (No. lambs)	12	12	11	12
Average gain (lbs.)	19.4	22.6	22.5	25.2
Average daily gain (lbs.)	0.45	0.52	0.52	0.59
Score <u>2</u> /	3.30	2.68	2.52	2.70
Period 2 (No. lambs)	12	11	10	11
Average gain (lbs.)	5.0	5.8	3.6	5.3
Average daily gain (lbs.)	0.62	0.72	0.45	0.66
Score	2.88	2.25	2.32	2.30
Period 3 (No. lambs)	12	9	10	9
Average gain (lbs.)	7.5	10.7	5.4	9.6
Average daily gain (lbs.)	0.62	0.89	0.45	0.80
Score	2.62	2.06	2.16	2.01
Period 4 (No. lambs)	9	6	8	5
Average gain (lbs.)	4.5	2.7	6.8	3.4
Average daily gain (lbs.)	0.32	0.19	0.68	0.24
Score	2.70	2.14	2.09	2.23
Period 5 (No. lambs)	8	3	5	5
Average gain (lbs.)	5.3	0.0	8.0	7.4
Average daily gain (lbs.)	0.38	0.0	0.57	0.53
Score	2.40	2.33	1.62	2.22
Period 6 (No. lambs)	7	1	1	4
Average gain (lbs.)	1.9	1.0	-1.0	2.0
Average daily gain (lbs.)	0.26	0.14	-0.14	0.29
Score	2.49	3.00	1.67	2.33
Average days on trial	89.0	69.0	75.7	65.8
Average initial weight (lbs.)	44.6	49.2	46.5	52.7
Average final weight (lbs.)	84.6	85.2	75.7	93.3
Average gain (lbs.)	40.0	36.0	29.2	40.6
Average daily gain (lbs.)	0.45	0.52	0.42	0.62
Feed/cwt. gain (lbs.)				
Concentrate	445.4	423.1	561.7	420.1
Hay	55.6	35.2	35.1	44.7
Total	501.1	458.3	596.8	464.8
Feed cost/cwt. gain (\$)				
Concentrate	9.13	10.91	11.51	10.84
Hay	0.56	0.35	0.35	0.45
Total	9.69	11.26	11.86	11.29
Average score	2.73	2.41	2.06	2.30

1/ Period 1, 43 days long; Period 2, 7 days long; Period 3, 10 days long; Periods 4 and 5, 14 days long and Period 6, 7 days long.

2/ Fatness, 1 prime, 2 choice, 3 good, 4 utility and 5 cull.

of 43 days. Period two was seven days in length with the third period being ten days long. Periods four and five were 14 days long and period six was seven days in length. The trial was completed when all the lambs from any one lot had reached a grade of better than choice.

The lambs in lot I, fed an 11 percent protein concentrate, made the most economical gains but they remained on trial much longer and this would increase the cost of gain if labor was included. The cost of gain for the lambs in lot II, fed a 16 percent protein ration, was \$11.26 per 100 pounds of gain but they were on trial for an average of 69 days and this would reduce the cost of gain if labor was included. Cost of gain was the highest for the lot III lambs which were fed an 11 percent protein concentrate and they were the most inefficient lambs when gain was considered. The most efficient gaining lambs were in lot IV, which were fed a 16 percent protein concentrate, having a cost per 100 pounds of gain of \$11.29, which is comparable to the lambs of lot II.

To have efficient, rapid gaining lambs that require less time to fatten, a concentrate containing 16 percent protein would be the most desirable according to the results of this trial. This is in agreement with the fattening trial with twins reported previously in this thesis.

To obtain maximum gains in the least time with the most efficiency, the fattening ration should contain more than 11 percent protein. However, when cost of gains are included, the lower level of protein may be more desirable.

It would appear that early weaning is of benefit when the lambs are to be fattened. It is shown in Table XVIII that the lambs performed well

in the feed lot when they were weaned early. This is in agreement with the report by Jordan et al. (1959b), when they found that weaning the lambs at 10 to 14 weeks and fattening them resulted in the most favorable performance.

SUMMARY

Two palatability trials and two creep feeding trials were conducted using lambs as experimental animals. Following the two creep feeding trials, the lambs were weaned and fattened.

Palatability trial, 1959

Thirty-nine suckling lambs of mixed breeding were used in the 1959 palatability trial. The trial lasted 55 days and was designed to determine the palatability of sixteen rations, two of which were in a pellet form. The remaining 14 rations were fed in a mixed, loose form.

The lambs had access to all rations simultaneously and the results obtained from the trial were as follows:

1. The 70 percent concentrate, 30 percent roughage pellet was the most preferred creep ration and consumption of this pellet was twice as great as the pellet containing the 70 percent roughage and 30 percent concentrate.
2. Soybean oil meal improved the palatability of the creep ration and high levels (30%) were more palatable than low levels (15%) or no soybean oil meal in the ration.
3. High molasses pulp improved the palatability of the ration and when it was in combination with soybean oil meal the palatability was increased further.
4. Wheat bran and yeast decreased the palatability of the rations.

Palatability trial, 1960

A palatability trial was conducted in 1960 to determine the palatability of four rations in three physical forms. The rations varied in the

amount of soybean oil meal, 0, 12.5, 25.0 and 37.5 percent. The physical forms were pellets, crumbles and meal. This 63 day trial with 20 sets of twins consisted of a dry lot and pasture phase and the lambs had access to all rations simultaneously. During the dry lot phase, alfalfa hay and grain was provided for the ewes and during the pasture phase the ewes and lambs grazed a pasture that was predominately orchard grass.

The results obtained were as follows:

1. Soybean oil meal enhanced the palatability of the ration. The low level proved more palatable in the dry lot phase and the two higher levels were more palatable during the pasture phase.
2. Consumption of pellets was greater than that of crumbles and meal; however, the meal of ration 131 containing 12.5 percent soybean oil meal, was comparable to the pellets during the first period. The crumbles were more palatable during the dry lot phase of the trial. The meal was more palatable to the lambs during the first period than during the following periods.
3. Feed consumption increased during the dry lot phase of the trial and decreased during the pasture phase of the trial.

#### Creep feeding twins, 1959

A comparison was made of 10 sets of twins creep fed and 9 sets of twins which did not receive any supplemental feed. It was found that creep feeding suckling twin lambs resulted in a highly significant ( $P < 0.01$ ) difference when the gains were statistically analyzed. The trial was conducted

on an irrigated orchard grass pasture. Consumption of the creep rations increased continually from small quantities at the beginning (April 30) to comparatively large quantities at the end of the trial (August 28).

The creep ration consisted of 50 percent barley, 25 percent oats, 12.5 percent beet pulp and 12.5 percent high molasses pulp. Since the lambs were not sold, it was postulated that the increased gains made by the lambs that were fed would be more than enough to pay for the feed they consumed. The lambs receiving creep feed had an average grade of low choice and an average daily gain of 0.36 pounds at the end of the trial. The lambs not receiving creep feed had an average grade between good and high good and an average daily gain of 0.28 pounds.

#### Creep feeding singles, 1959

Creep feeding suckling single lambs resulted in no significant difference in gains. The trial began April 30 and was completed June 12 when the lambs were placed on a fattening trial. The creep ration for this trial was the same as for the twin creep feeding trial. There was no significant difference in gains at the five percent level but the lambs that were creep fed scored 2.14 and gained an average of 0.55 pounds per day. The lambs not creep fed scored 2.64 and gained an average of 0.47 pounds per day.

#### Fattening trial twins, 1959

To form the lots for the twin fattening trial each lot of lambs from the creep feeding trial, which was conducted earlier, were divided to allow one twin from each pair to be represented in each of the two lots. Lot II (not fed) lambs of the creep feeding trial formed lots I and II, of the fattening trial and lot I lambs (fed) of the creep feeding trial

formed lots III and IV.

The lambs remained on trial until they had reached a grade of better than choice at which time they were removed from the trial. The lambs from lots I and III were fed a ration of 50.0 percent barley, 25.0 percent oats, 12.5 percent beet pulp and 12.5 percent high molasses pulp and alfalfa hay. The lambs from lots II and IV received a similar ration but with 15 percent of the concentrate mixture being replaced with soybean oil meal to yield a concentrate containing 16 percent protein.

The results obtained are as follows:

1. Lot I lambs, previously not creep fed and fattened on an 11 percent protein concentrate, were the lowest in daily gain, the least efficient in feed use per unit of gain and the second most expensive per unit of gain.
2. The lambs in lot II, previously not creep fed and fattened on a 16 percent protein concentrate, were second in daily gain, the most efficient in feed use per unit of gain and second in cost per unit of gain.
3. Lot III lambs, previously creep fed and fattened on an 11 percent protein concentrate, were third in daily gain, second in efficiency in feed use per unit of gain and the most economical to fatten in cost per unit of gain.
4. The lambs in lot IV, previously creep fed and fattened on a 16 percent protein concentrate, were the most rapid gaining lambs, third in efficiency in feed use per unit of gain and the most expensive to fatten in cost per unit of gain.

Fattening trial singles, 1959

Each lot of single lambs on the creep feeding trial were divided into two lots. The lambs in lot II (not fed) in the creep feeding trial formed lots I and II and the lambs in lot I (fed) in the creep feeding trial formed lots III and IV. Lots I and III were fed a ration of 50 percent barley, 25 percent oats, 12.5 percent beet pulp and 12.5 percent high molasses pulp. Lots II and IV were fed a similar ration but with soybean oil meal replacing 15 percent of the mixture.

The lambs were scored and removed from this trial in the same manner as was done in the twin fattening trial. The results obtained are as follows:

1. The lambs in lot I, previously not creep fed and fattened on an 11 percent protein concentrate, were third in daily gain, third in efficiency in feed use per unit of gain and the most economical in cost per unit of gain.
2. Lot II lambs, previously not creep fed and fattened on a 16 percent protein concentrate, were second in daily gain, second in efficiency in feed use per unit of gain and third in cost per unit of gain.
3. The lambs in lot III, previously creep fed and fattened on an 11 percent protein concentrate, were the slowest gaining, the least efficient in feed use per unit of gain and the most expensive in cost per unit of gain.
4. Lot IV lambs, previously creep fed and fattened on a 16 percent protein concentrate, were the fastest gaining, the most efficient

in feed use per unit of gain and second in cost per unit of gain.

The conclusion drawn from these trials is that more work should be conducted concerning the palatability of feeds, including a variety of feeds and forms, for lambs, creep feeding and fattening lambs.

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Lambs	NAME AND ADDRESS
5-14-61	Tom Wiley
5-14-61	3 4th Cr Cr
5-20-61	Tom Wiley
12-18-64	Bruce Daughton 210W
LIB USE	John <sup>Head</sup> Coane
4-12-68	Sam Under
4-30-68	Sam I'
5-16-72	
lib w	

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