A STUDY OF METABOLISM AND RATE OF GAIN WITH LAMBS USING PELLETED AND NON-PELLETED RATIONS

by

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INTRODUCTION

Commercial lamb feeders have shown an increased interest in pelleted rations in recent years. Experimental work indicates that these rations generally produce more rapid and efficient gains than similar rations in non-pelleted form. The advantage of preparing feed in pelleted form seems to be most evident when the available roughage is of poor quality. Pelleting apparently improves the palatability of the feedstuff, thereby promoting increased consumption.

In this experiment, a comparison is made between pelleted and non-pelleted rations in regard to feedlot performance, digestibility and nitrogen retention. Although lambs were used in these trials, it is thought that the results obtained can be applied to cattle as well.

Rations with two different ratios of roughage to concentrate were utilized. In addition, the source of roughage in the pelleted rations was either suncured alfalfa hay or dehydrated alfalfa hay.

This study should help provide a clearer understanding as to the relative merits of pelleted and non-pelleted rations in the feeding of ruminant animals.

REVIEW OF LITERATURE

In recent years, increasing interest has been shown in the pelleting of rations for sheep. Some of the first research work reported on the use of pellets was that conducted at New Mexico A. and M. in 1950. Neale (9) conducted trials over a three year period in which low quality alfalfa hay was combined with sorghum grain and molasses in pelleted form. A non-pelleted ration consisting of high quality alfalfa hay and sorghum grain was used as a control ration. Results from these trials revealed that the

lambs on the pelleted ration gained more rapidly and utilized their feed more efficiently than the lambs on the non-pelleted ration. It should be noted, however, that the pelleted ration contained molasses while the non-pelleted ration did not include this ingredient.

Later work by Neale (10) compared pelleted rations of varying proportions of roughage to concentrate. Pellets containing 70 percent, 60 percent and 50 percent roughage were fed to both light and heavy lambs. The light lambs exhibited a slight and the heavy lambs a marked increase in rate of gain and feed efficiency with the pellets of higher roughage level.

Recent studies at the Illinois Agricultural Experiment Station (2) indicated that little or no advantage was to be gained from pelleting rations consisting of alfalfa meal and corn. The pelleting of rations containing timothy meal and corn considerably increased both rate and efficiency of gain. The results of this work and that by Neale (9), (10) indicate that pelleting of low quality roughages provides a means of obtaining more complete and efficient utilization of those types of feed.

Evidence is also available indicating that lambs will show greater performance with pelleted rations than the same ration in non-pelleted form. Thomas, et al. (13) found that lambs on pelleted rations of hay and grain gained faster and more efficiently than lambs fed whole grain and long hay. Similar results were recorded by Jordan, et al. (5) who also reported that the lambs on all pelleted rations developed an apparent craving for roughage and began to chew on feed bunks and fence posts during the latter stages of the trial.

Work at Kansas State College (1) during the last few years is in accordance with that previously mentioned in that lambs on pelleted rations show an increase in rate of gain and feed efficiency over lambs on similar

non-pelleted rations. In these trials, rations of 55 percent roughage and 45 percent corn were compared to rations of 65 percent roughage and 35 percent corn. It was found that the 55-45 rations gave results superior to those of the 65-35 ration whether the rations were fed in natural form or as pellets.

Lindahl and Davis (6) fed rations consisting of 50 percent alfalfa hay, 45 percent corn and 5 percent blackstrap molasses, in loose form and as pellets to lambs. Lambs on the non-pelleted ration gained 0.34 pound per head per day while those receiving pellets gained 0.42 pound per head per day. Feed required per hundred pounds gain was 908 and 772 pounds respectively for the loose and pelleted ration.

John (4) found that lambs given pelleted rations made faster and more efficient gains than lambs given similar non-pelleted rations. In the work reported by John, there was one instance of a non-pelleted ration producing better results than a similar ration in pelleted form, but the lambs on the pelleted ration had gone off feed during the feeding period. John (4) reported that pelleted rations containing 65 percent alfalfa hay and 35 percent corn gave significantly better results in the feedlot than did pelleted rations containing 55 percent alfalfa hay and 45 percent corn. This is not consistent with the results reported by Bell and co-workers (1). However, non-pelleted 55-45 rations produced faster and more efficient gains than did 65-35 non-pelleted rations.

Hays (3) conducted a feeding trial with lambs using pelleted and non-pelleted rations with varying ratios of roughage to concentrate. In addition, the pelleted rations contained either suncured or dehydrated alfalfa hay as the source of roughage. Lambs gained faster and more efficiently on the pelleted rations. The pellets containing suncured alfalfa hay gave better results than those containing dehydrated alfalfa hay. A ratio of 55 percent

roughage and 45 percent concentrate was more efficient and economical than a 65-35 ratio in the non-pelleted rations. Pelleted rations, however, gave slightly larger gains with the higher proportion of roughage, but the advantage in efficiency and economy was inconsistent.

While most workers report more favorable results from feeding pelleted rations than non-pelleted rations, some trials have failed to indicate such results. In experiments conducted at Oklahoma A. and M. College (11) little or no increase in feed efficiency or rate of gain was noted from pelleted rations over similar non-pelleted rations. Schneider, et al. (12) also could detect no benefit from the pelleting of rations.

In a metabolism study by John (4), lambs fed pelleted rations had significantly higher protein and ether extract digestion coefficients than lambs fed non-pelleted rations. The digestion coefficient for crude fiber was much lower in the pelleted rations. There were no noticeable differences between the total digestible nutrient values of the pelleted and non-pelleted rations, but in the 55-45 rations, the total digestible nutrient values were significantly higher than in the 65-35 rations. The average percent nitrogen retained per lamb was much greater in the pelleted rations than in the non-pelleted rations.

Hays (3) conducted a metabolism study with lambs using pelleted and non-pelleted rations having a 60-40 roughage to concentrate ratio and pelleted rations having a 55-45 ratio. In addition, the source of roughage in the pellets was either suncured or dehydrated alfalfa hay. The digestion coefficients, total digestible nutrients, and nitrogen retention were highest in the pelleted rations containing 55 percent roughage and 45 percent corn. While there were but slight differences in the digestion coefficients and total digestible nutrients between the 60-40 pelleted and non-pelleted

rations, the non-pelleted ration had a significantly lower nitrogen retention than the pelleted rations. There were no consistent differences between the results from pellets containing suncured or dehydrated alfalfa hay.

Digestion trials were conducted by Long, et al. (7) in which wether lambs were fed identical rations in natural, ground and pelleted form. The rations consisted of 30 percent prairie hay, 20 percent alfalfa hay, 34 percent corn, 8 percent cottonseed meal, and 8 percent cane molasses. Results indicated that grinding of the feed tended to decrease digestibility while pelleting of the ground ration raised the digestibility to the original level. There was no significant difference in overall digestibility between the rations in pelleted and natural form.

The actual feeding of pelleted rations on a commercial basis has been limited due to the high cost of preparation of the pellets. At the present cost of pelleting, there appears to be little, if any, economic advantage in feeding pellets since the cost of pelleting offsets the saving in feed.

EXPERIMENTAL PROCEDURE

Feeding Trial

One hundred and twenty-six lambs were used in this trial. The lambs were purchased at the Kansas City Stock Yards on October 10, 1956, and upon arrival at the Kansas State College sheep barns, were put in dry lot. The lambs received prairie hay and water for the first two days and after that, were given long alfalfa hay, corn and oats. This ration was continued until the first day of the feeding period.

In late October, the lambs were individually weighed, ear tagged, and divided into six lots of 21 animals each. Assignment to lots was made

according to weight to insure an equal distribution of light and heavy lambs in all lots. The lambs were then placed in six separate pens, all of which were covered on the north by an open-faced shed. The lambs were started on test November 6.

Experimental rations were assigned to the various lots as follows:

Lot 1. Pelleted ration - Pellets consisted of 60 percent suncured alfalfa hay and 40 percent corn. Chopped alfalfa hay was added to the ration to achieve a ratio of 65 percent roughage to 35 percent concentrate.

Lot 2. Pelleted ration - Pellets consisted of 50 percent suncured alfalfa hay and 50 percent corn. Chopped alfalfa hay was added to the ration to achieve a ratio of 55 percent roughage to 45 percent concentrate.

Lot 3. Non-pelleted ration - Ration consisted of 65 percent chopped alfalfa hay and 35 percent corn.

Lot 4. Non-pelleted ration - Ration consisted of 55 percent chopped alfalfa hay and 45 percent corn.

Lot 5. Pelleted ration - Pellets consisted of 60 percent dehydrated alfalfa hay and 40 percent corn. Chopped alfalfa hay was added to the ration to achieve a ratio of 65 percent roughage to 35 percent concentrate.

Lot 6. Pelleted ration - Pellets consisted of 50 percent dehydrated alfalfa hay and 50 percent corn. Chopped alfalfa hay was added to the ration to achieve a ratio of 55 percent roughage to 45 percent concentrate.

The alfalfa hay used in this experiment was harvested from the same field. The hay for the dehydrated pellets was taken to the mill for dehydration as soon as it was cut. The hay for the suncured pellets was allowed to cure in the field, baled and then taken to the mill for grinding and pelleting. The hay used in the non-pelleted rations was field cured, baled, and then put through a forage chopper just prior to the start of the

feeding trial. All the corn for the trial came from the same bulk lot at the Manhattan mill.

After the lambs were started on the experimental rations, the amount fed daily was gradually increased until each lot was receiving all they would clean up. Feeding was done twice daily and any feed not consumed was weighed back and the amount recorded. Salt and water were kept before the lambs at all times. The lambs were weighed individually at the beginning and at two-week intervals throughout the trial. The feeding period lasted 88 days, terminating on February 2, 1957. Upon completion of the feeding period, the lambs were taken to the St. Joseph Stock Yards and sold. After slaughter, U.S.D.A. carcass grades were obtained for each lamb.

Average daily gain, feed intake, feed consumed per hundred pounds of gain, carcass grades, and feed cost were recorded. Representative samples of all types of pellets, corn and alfalfa hay were taken to the chemistry laboratory for analysis. Results of these analyses are found in Table 1.

Metabolism Study

The same rations were used in the metabolism study that were used in the feeding trial. The metabolism study was divided into two phases. The rations in Phase I contained 65 percent roughage and 35 percent concentrate while those in Phase II contained 55 percent roughage and 45 percent concentrate. In both phases, one ration consisted of chopped alfalfa hay and ground yellow corn, another of dehydrated alfalfa hay and yellow corn in pelleted form, and a third of sunoured alfalfa hay and yellow corn in pelleted form. The pellets in Phase I contained 60 percent alfalfa and 40 percent corn. Chopped alfalfa hay was added to the pellets in Phase I in amounts necessary to achieve the 65-35 ratio. Pellets in Phase II

Table 1. Chemical analysis of feeds used in the feeding trial and metabolism study.

Feeds	Protein	Ether Extract	Crude Fiber	Moisture	Ash	N-Free Extract	Carbo-hydrates
	%	%	%	%	%	%	%
Dehydrated Pellets (60-40)[1]	15.38	3.63	18.12	6.03	8.55	48.29	66.41
Suncured Pellets (60-40)[2]	15.38	2.81	15.15	6.58	6.43	53.65	68.80
Alfalfa Hay[3]	15.80	1.66	29.30	5.94	9.28	38.32	67.62
Yellow Corn	11.31	3.86	2.14	8.55	1.83	72.31	74.45
Alfalfa Hay[4]	18.00	1.78	25.59	5.77	10.02	38.84	64.43
Dehydrated Pellets (50-50)[5]	13.56	4.39	15.51	6.47	6.65	53.42	68.93
Suncured Pellets (50-50)[6]	14.13	3.07	13.10	6.85	5.48	57.37	70.47

[1] Pellets consisting of 60 percent dehydrated alfalfa hay and 40 percent corn used in the feeding trial and metabolism study. Chopped alfalfa hay was added to make a 65-35 ratio.

[2] Pellets consisting of 60 percent suncured alfalfa hay and 40 percent corn used in the feeding trial and metabolism study. Chopped alfalfa hay was added to make a 65-35 ratio.

[3] Alfalfa hay used in Phase I.

[4] Alfalfa hay used in Phase II.

[5] Pellets consisting of 50 percent dehydrated alfalfa hay and 50 percent corn used in the feeding trial and metabolism study. Chopped alfalfa hay was added to make a 55-45 ratio.

[6] Pellets consisting of 50 percent suncured alfalfa hay and 50 percent corn used in the feeding trial and metabolism study. Chopped alfalfa hay was added to make a 55-45 ratio.

contained 50 percent alfalfa and 50 percent corn. Chopped alfalfa hay was added to the pellets in Phase II in amounts necessary to achieve the 55-45 ratio.

Eight of the heaviest lambs from the original group purchased in Kansas City were selected for the metabolism trials. These lambs were brought to the metabolism room and placed in metabolism crates on November 10, 1956. They were immediately started on an approximate full feed of the experimental rations. Feeding was done twice daily and water was kept before the lambs at all times. A week was allowed for the lambs to become accustomed to the crates and diet. On November 17, the first collection period of Phase I began. Each collection period covered a span of seven consecutive days. Since only eight metabolism crates were available, three lambs each were on two of the rations and two lambs were on the third ration during each collection period. At the end of each collection period, the rations were rotated and a three day adjustment period was allowed before beginning the next collection period. In this manner, collections were obtained from all the lambs on each ration of the trial.

One lamb of the original eight failed to eat during the initial adjustment period and was replaced by a lamb which soon exhibited signs of illness and also had to be replaced. This accounts for the fact that only seven lambs are shown in the first collection period.

The feces from each lamb was collected every evening during the collection period. This was weighed and a 5 percent aliquot placed in a porcelainized pan which in turn was placed in an oven set at 65 degrees Centigrade. After the seventh day of collection, the oven was turned up to 95 degrees Centigrade until the feces were completely dry. The dry feces were then weighed, transferred to glass jars and taken to the chemistry

laboratory for analysis.

The urine was also collected every 24 hours, the volume recorded, and a representative sample placed in a glass jar. A few drops of toluene were added as a preservative. Upon completion of a collection period, the urine samples were taken to the chemistry laboratory for nitrogen analysis.

RESULTS AND DISCUSSION

Feeding Trial

It is pointed out that the pellets used in this experiment contained either 60 percent roughage and 40 percent concentrate or 50 percent roughage and 50 percent concentrate. Chopped alfalfa hay was added to the pellets to make a ration containing either 65 percent roughage and 35 percent concentrate or 55 percent roughage and 45 percent concentrate. In addition, the source of roughage in the pellets was either dehydrated or suncured alfalfa hay. In the following discussions, rations consisting of pellets made with 60 percent suncured alfalfa hay and 40 percent corn plus enough chopped alfalfa hay to make a ration having a 65-35 roughage to concentrate ratio, will be spoken of as 65-35 suncured pellets. Reference to the other rations will be made in a like manner.

Results of the feeding trial are given in Table 2. The lambs made more rapid gains when fed pelleted rations than when fed similar non-pelleted rations in all cases but one. This exception was with the 55-45 dehydrated pellets. The rate of gain from this ration was essentially the same as that from the 55-45 non-pelleted ration. The increased rates of gain apparently resulted from more efficient feed utilization since the total amount of feed consumed was less with the pelleted rations than with the non-pelleted

Table 2. Feed-lot performance of lambs fed pelleted and non-pelleted rations.

Lot number	1	2	3	4	5	6
Ration	60% sun. alf. hay 40% corn Pellets*	50% sun. alf. hay 50% corn Pellets*	65% chopped alf. hay 35% ground corn	55% chopped alf. hay 45% ground corn	60% dehy. alf. hay 40% corn Pellets*	50% dehy. alf. hay 50% corn Pellets*
No. lambs per lot	21	21	21	20	21	21
Days on feed	88	88	88	88	88	88
Avg. initial wt. per lamb	77.0	75.4	75.3	75.3	75.5	75.1
Avg. final wt. per lamb	117.5	115.0	108.8	106.1	110.6	106.2
Avg. total gain per lamb	40.5	39.6	33.4	31.0	35.1	31.1
Avg. daily gain per lamb	.459	.450	.380	.352	.399	.353
Lbs. feed daily per lamb						
Pellet	3.15	2.92			2.94	2.62
Chopped hay	.418	.408	2.20	1.70	.408	.408
Ground corn			1.16	1.33		
Lbs. feed per cwt. of gain						
Pellet	684.7	647.9			735.5	740.7
Chopped hay	87.6	90.6	577.9	483.7	102.1	115.4
Ground corn			304.6	377.7		
Feed cost per cwt. gain	$16.44	$16.43	$16.25	$16.89	$19.31	$20.24
Feed cost per lamb	$6.66	$6.51	$5.43	$5.24	$6.78	$6.29
No. lambs died				1		
Carcass grades						
Prime				2	1	
Choice	10	17	12	9	10	11
Good	11	4	9	9	10	10

* Each lamb received, in addition, .4 pound of chopped alfalfa hay daily.

rations. The cost of gain with pellets containing dehydrated alfalfa hay was considerably more than that with pellets containing suncured alfalfa hay or the non-pelleted rations. This can be partially attributed to the high cost of dehydration.

Pellets containing suncured alfalfa hay gave significantly better results than pellets containing dehydrated alfalfa hay. Not only did the lambs gain more rapidly on the pellets made with suncured hay, but the feed efficiency was greater and the cost per hundred pounds of gain less.

Slightly faster gains were obtained from 65-35 suncured pellets than from 55-45 suncured pellets. The same was true with the pellets containing dehydrated alfalfa hay. Another factor of interest is that the 55-45 suncured pellets produced faster gains than either of the rations containing dehydrated alfalfa. This tends to indicate that while a 65-45 roughage to concentrate ratio may be desirable, a more important factor in obtaining good results from pellets is the utilization of suncured alfalfa hay as the source of roughage. Feed efficiency and cost per hundred pounds of gain were varied and inconsistent between the pellets containing different ratios of roughage to concentrate.

In the non-pelleted rations, the 65-35 roughage to concentrate ration produced a slightly faster rate of gain and a lower cost per hundred pounds of gain than the 55-45 ration.

It is thought that the addition of a small amount of roughage to the pelleted ration, as was done in this trial, lends to more efficient utilization of the pellets.

The feed prices and processing charges used in determining the feed cost were as follows: Chopped alfalfa hay, $28.00 per ton; ground corn, $1.50 per bushel; dehydrated alfalfa hay, $37.00 per ton; grinding hay for

the pellets, $5.00 per ton, and mixing and pelleting, $5.00 per ton. On the basis of these figures, the 60-40 suncured pellets cost $44.44 per ton, the 50-50 suncured pellets cost $46.80 per ton, the 60-40 dehydrated pellets cost $48.62 per ton and the 50-50 dehydrated pellets cost $50.28 per ton.

One lamb died during the next to last week of the trial due to enterotoxemia.

Metabolism Study

The average values for the metabolism study are found in Tables 3 and 4.

Digestion Trial. With the rations containing 65 percent roughage and 35 percent concentrate, the lambs receiving suncured pellets had a higher total digestible nutrient value than the lambs on the non-pelleted ration. The non-pelleted ration, however, gave a higher total digestible nutrient value than the pelleted ration with dehydrated alfalfa hay. In the 55-45 rations, the same relationship existed. The better results obtained from suncured pellets are in agreement with results of the feeding trial. The 55-45 rations produced considerably higher total digestible nutrient values than the 65-35 rations.

There was little difference in the digestion coefficients for crude fiber in any of the pelleted rations. The fiber digestion coefficients for both of the non-pelleted rations were essentially the same and were considerably higher than those of the pelleted rations. The digestion coefficient values for crude fiber in this trial were considerably higher in the pelleted rations than those reported previously for similar trials (Hays, 3), (John, 4). The small amount of chopped alfalfa hay added to the pellets is thought to have aided in the digestion of crude fiber. Pellets alone, due to their compactness, would probably tend to move more rapidly

Table 3. Digestibility study with lambs.*

No. of Lambs	Ration	Digestion Coefficient				
		Protein	E. Extract	Fiber	N.F.E.	T.D.N.
		%	%	%	%	%
7**	65-35 DP[1]	66.71	67.75	36.79	78.94	69.71
8	65-35 SP[2]	72.38	61.82	38.17	81.94	63.72
8	65-35 AH&C[3]	69.34	61.49	44.76	79.86	62.06
8	55-45 DP[4]	65.18	81.72	35.82	80.76	64.61
8	55-45 SP[5]	71.89	72.75	36.23	83.98	67.08
8	55-45 AH&C[6]	72.63	70.98	44.92	83.10	66.78

* Individual lamb results are shown in Appendix Tables 5-10.

** One lamb was removed due to illness.

1 Represents pellets containing 60 percent dehydrated alfalfa hay and 40 percent corn plus enough chopped alfalfa hay to make a 65-35 ratio.

2 Represents pellets containing 60 percent suncured alfalfa hay and 40 percent corn plus enough chopped alfalfa hay to make a 65-35 ratio.

3 Represents a non-pelleted ration consisting of 65 percent chopped alfalfa hay and 35 percent ground yellow corn.

4 Represents pellets containing 50 percent dehydrated alfalfa hay and 50 percent corn plus enough chopped alfalfa hay to make a 55-45 ratio.

5 Represents pellets containing 50 percent suncured alfalfa hay and 50 percent corn plus enough chopped alfalfa hay to make a 55-45 ratio.

6 Represents a non-pelleted ration consisting of 55 percent chopped alfalfa hay and 45 percent ground yellow corn.

Table 4. Average results of nitrogen balance study with lambs.*

No. of Lambs	Ration	Grams N consumed	Grams dry feces	Grams N in feces	% N in feces	Total ml. of urine	Grams N in urine	% N in urine	Total N in feces and urine	% N in feces and urine	Grams N retained	% N retained by lamb
7**	65-35 DP[1]	155.53	2108	51.91	33.29	16032	84.78	54.50	136.73	87.79	18.99	12.21
8	65-35 SP[2]	158.02	1775	41.76	27.11	14928	89.99	58.42	132.00	85.53	22.27	14.47
8	65-35 AHaC[3]	139.41	1849	41.73	30.65	13146	88.45	63.44	131.18	94.09	8.23	5.91
8	55-45 DP[4]	155.52	2095	54.15	34.82	10295	73.96	47.56	115.61	82.38	27.40	17.62
8	55-45 SP[5]	151.86	1712	42.87	28.23	11521	78.35	51.59	121.22	79.82	30.63	20.18
8	55-45 AHaC[6]	160.82	1701	44.00	27.36	10640	87.11	54.16	131.11	81.52	29.70	18.48

* Individual lamb results are shown in Appendix Table 11.

** One lamb was removed due to illness.

1 Represents pellets containing 60 percent dehydrated alfalfa hay and 40 percent corn plus enough chopped alfalfa hay to make a 65-35 ratio.

2 Represents pellets containing 60 percent suncured alfalfa hay and 40 percent corn plus enough chopped alfalfa hay to make a 65-35 ratio.

3 Represents a non-pelleted ration consisting of 65 percent chopped alfalfa hay and 35 percent ground yellow corn.

4 Represents pellets containing 50 percent dehydrated alfalfa hay and 50 percent corn plus enough chopped alfalfa hay to make a 55-45 ratio.

5 Represents pellets containing 50 percent suncured alfalfa hay and 50 percent corn plus enough chopped alfalfa hay to make a 55-45 ratio.

6 Represents a non-pelleted ration consisting of 55 percent chopped alfalfa hay and 45 percent ground yellow corn.

through the digestive tract than pellets accompanied by roughage. Not only would the roughage delay the passage of the pellets through the digestive tract, but it would also add bulk to the ration. This would help to avoid the formation of a doughlike mass in the digestive tract which would not be readily attacked by the digestive juices (Maynard and Loosli, 8).

The suncured pellets produced considerably higher digestion coefficients for crude protein than did the pellets containing dehydrated alfalfa hay. The 65-35 suncured pellets gave a slightly higher value for protein than did the 65-35 non-pelleted ration, however, the values for 55-45 suncured pellets and the 55-45 non-pelleted ration were essentially the same.

The 55-45 rations gave much higher digestion coefficients for ether extract than did the 65-35 rations. Pellets containing dehydrated alfalfa hay had considerably higher values than either the suncured pellets or the non-pelleted rations.

Suncured pellets produced slightly higher digestion coefficients for nitrogen-free extract than did the non-pelleted rations. The non-pelleted rations gave higher values than did the dehydrated pellets. The rations containing 55 percent roughage produced somewhat higher digestion coefficients for nitrogen-free extract than did the rations containing 65 percent roughage.

Nitrogen Balance. The differences in nitrogen retention in the rations containing 55 percent roughage and 45 percent concentrate were slight. The 65-35 ration consisting of chopped alfalfa hay and corn, however, produced a much lower nitrogen retention than did the 65-35 pelleted rations. This difference was largely due to the failure of two of the lambs to eat properly, during which time they exhibited a negative nitrogen balance. The average percent nitrogen retained for the 55-45 rations was considerably higher than for the 65-35 rations.

GENERAL DISCUSSION

In this experiment it was found that lambs being fattened on pelleted rations consisting of suncured alfalfa hay and corn gained more rapidly and had better feed efficiency than lambs being fed pelleted rations consisting of dehydrated alfalfa hay and ground corn or non-pelleted rations consisting of chopped alfalfa hay and ground corn. The better results obtained from the pelleted rations containing suncured alfalfa hay are in agreement with other work previously reported (Hays, 3). Many of the experiments found in the literature report the use of molasses in the pellets along with the other ingredients. Even with this factor to consider, it is generally agreed that pelleted rations produce more rapid and efficient gains in lambs than similar rations in non-pelleted form. These results further confirm this observation, but only when suncured alfalfa hay was used as the source of roughage in the pellets.

Results from this experiment showed that the rate of gain and feed efficiency in the suncured pellets having different ratios of roughage to concentrate were essentially the same. Also, the cost per hundred pounds of gain was the same. This lack of variability between the different ratios of roughage to concentrate is not in agreement with the work conducted by Hays (3), who reported that his results definitely confirmed a greater feed efficiency of pelleted rations containing a 55-45 roughage to concentrate ratio over rations containing a 65-35 ratio.

Jordan, et al. (5), reported that lambs on all-pelleted rations developed an apparent craving for roughage and began chewing on feed bunks and fence posts. The lambs in this experiment received approximately .4 pound of chopped alfalfa hay along with the pellets. No signs of a craving for

roughage were noted. It is also thought that the addition of this small amount of roughage to the ration helps to effect a more complete breakdown of the crude fiber in the ration. The digestion coefficients for the crude fiber are considerably higher in this experiment than in the trial conducted by John (4) in which no additional roughage was added to the pellets.

Results from this trial comparing the rate of gain and feed efficiency between pelleted rations containing dehydrated alfalfa hay as the source of roughage and non-pelleted rations are in agreement with the work reported by Cate, et al. (2), in which they found that there was little or no advantage to be gained from pelleting rations consisting of alfalfa meal and corn. The pellets containing dehydrated alfalfa not only failed to produce an appreciable increase in rate and efficiency of gain over non-pelleted rations, but the cost of the dehydrated pellets raised the cost per hundred pounds of gain considerably above that for non-pelleted rations.

Only one other worker, Hays (3), used pelleted rations containing either suncured alfalfa hay or dehydrated alfalfa hay, so only one comparison can be drawn between the relative merits of pellets containing these two sources of roughage. The actual values for the total digestible nutrients and the various digestion coefficients varied somewhat between this experiment and the work conducted by Hays (3). However, the results of the metabolism studies of the two trials are in fairly close agreement as far as relative differences between the different rations is concerned except in the case of the crude fiber digestion coefficients. Hays reported a much lower value for the 60-40 pelleted rations than for the 55-45 pelleted rations, but this is thought to be due to the fact that Hays did not add chopped alfalfa hay to his 60-40 pellets.

Nitrogen retention was higher with the 55-45 rations, than with the

65-35 rations. There was little difference in the percent of nitrogen retained in the 55-45 rations.

In the 65-35 rations, the non-pelleted ration produced a much lower nitrogen balance than did either of the pelleted rations. This low value is largely attributed to the failure of two lambs to eat properly while on the non-pelleted ration.

The lambs used in the metabolism study were the heaviest of the group of lambs purchased for both the feeding trial and metabolism study. It is believed by some people that animals confined to crates for experimental purposes exhibit extreme states of unthriftiness and loss of weight during this confinement. A point of interest is that the lambs utilized in this metabolism study had an average weight exactly the same at the end of the trial as at the beginning although they did lose considerable muscle tone due to lack of exercise.

SUMMARY AND OBSERVATIONS

One hundred and twenty-six lambs were used in the feeding trial of this experiment. They were assigned to lots according to weight in order to insure a uniform average size of lambs in each lot. There were six lots of twenty-one lambs each. Pelleted and non-pelleted rations with two different ratios of roughage to concentrate were fed. In addition, dehydrated alfalfa hay was used for the source of roughage in one set of pellets while suncured alfalfa hay was used in the other set.

It was found that the lambs made more rapid gains on the pelleted rations than on the non-pelleted rations in all cases but one. The increased rates of gain were apparently due to more efficient feed utilization rather than increased feed intake since the lambs on the non-pelleted rations

consumed more feed than those on the pelleted rations.

Pellets containing suncured alfalfa hay as the source of roughage produced faster and more economical gains than pellets with dehydrated alfalfa hay as the source of roughage.

Where dehydrated alfalfa hay was the source of roughage, the 65-35 pelleted ration produced best results. When suncured alfalfa hay was the source of roughage, there was no significant difference in economy and rate of gain between the pellets containing the two different ratios of roughage to concentrate.

The cost per hundred pounds of gain was approximately the same for the non-pelleted rations and the pelleted rations containing suncured alfalfa hay. The cost was considerably higher with pellets containing dehydrated alfalfa hay. This can be partially attributed to the high cost of dehydration.

Eight wether lambs were used in the metabolism study of this experiment. These lambs were fed the same rations that were used in the feedlot trial. Each lamb was on each ration for one week with a three-day adjustment period in between. There was little difference in the total digestible nutrient value for any of the rations containing the same ratio of roughage to concentrate. The rations containing 55 percent roughage and 45 percent concentrate produced somewhat higher total digestible nutrient values than did the 65-35 rations. Digestion coefficients for crude fiber were significantly higher in the non-pelleted rations. Digestion coefficients for ether extract were higher in the rations containing 55 percent roughage and 45 percent concentrate, with the pelleted rations containing dehydrated alfalfa hay having considerably the highest value.

The pelleted rations containing suncured alfalfa hay and the non-pelleted

rations gave crude protein digestion coefficients that were essentially the same. The crude protein digestion coefficients for the pelleted rations containing dehydrated alfalfa hay were somewhat lower than those in the other rations. There was no significant difference in the digestion coefficients of nitrogen-free extract in any of the rations, however, the 55-45 rations held a slight edge over the 65-35 rations in this value.

There was little difference in the average amount of nitrogen retained among the 55-45 rations. Nitrogen retention from the 65-35 rations was much the lowest in the non-pelleted ration. It is thought that this low value resulted largely from the failure of two of the lambs to eat properly. The overall average for nitrogen retention was significantly higher in the rations containing 55 percent roughage and 45 percent concentrate.

The following observations were made from this experiment:

Lambs gained as fast or faster on pelleted rations than on similar rations in non-pelleted form.

Pellets containing suncured alfalfa hay produced more rapid and economical gains than pellets containing dehydrated alfalfa hay.

Pelleted rations containing suncured alfalfa hay as the source of roughage produced higher total digestible nutrient values than non-pelleted rations or pelleted rations containing dehydrated alfalfa hay. This difference was slight in the case of the non-pelleted rations.

Rations containing 55 percent roughage and 45 percent concentrate produced higher total digestible nutrient values than rations having a 65-35 roughage to concentrate ratio.

Digestion coefficients of crude fiber were higher in non-pelleted rations than in pelleted rations.

Digestion coefficients for crude protein were lower in the pelleted

rations containing dehydrated alfalfa hay than in pelleted rations containing suncured alfalfa hay or the non-pelleted rations.

Rations containing 55 percent roughage and 45 percent concentrate produced higher digestion coefficients for ether extract than rations containing 65 percent roughage and 35 percent concentrate.

Pelleted rations containing dehydrated alfalfa hay produced higher digestion coefficients for ether extract than pelleted rations containing suncured alfalfa hay or the non-pelleted rations.

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APPENDIX

Table 5. Digestibility study with lambs using a pelleted ration consisting of 60 percent dehydrated alfalfa hay and 40 percent corn plus enough chopped alfalfa hay to make a 65-35 ratio.

Lamb		Total grams fed	% Protein	Grams crude protein	% Ether extract	Grams ether extract	x2.25	% Crude fiber	Grams crude fiber	% N.F.E.	Grams N.F.E.	Total nutrients digested	% T.D.N.
21	Pellets	4848	15.38	745.62	3.63	175.98		18.12	878.45	48.29	2341.09		
	Alf. hay	712	15.50	110.36	1.66	11.81		29.30	208.61	38.32	272.83		
	Total	5560		855.98		187.79			1087.06		2613.92		
	Feces	1882	15.37	289.26	3.18	59.84		36.05	678.46	29.31	551.61		
	Am't digested			566.72		127.95	287.88		408.60		2062.31	3325.51	59.81
	Dig. coefficient			66.20		68.13			37.58		78.89		
77	Pellets	5600	15.38	861.28	3.63	203.28		18.12	1014.72	48.29	2704.24		
	Alf. hay	840	15.50	130.20	1.66	13.94		29.30	246.12	38.32	321.88		
	Total	6440		991.48		217.22			1260.84		3026.12		
	Feces	2239	15.14	338.98	3.22	72.09		36.96	827.53	28.55	639.23		
	Am't digested			652.50		145.13	326.54		433.31		2386.89	3799.24	58.99
	Dig. coefficient			65.81		66.81			34.36		78.87		
71	Pellets	5600	15.38	861.28	3.63	203.28		18.12	1014.72	48.29	2704.24		
	Alf. hay	840	15.50	130.20	1.66	13.94		29.30	246.12	38.32	321.88		
	Total	6440		991.48		217.22			1260.84		3026.12		
	Feces	1897	14.66	278.10	3.11	58.99		37.53	711.94	30.38	576.30		
	Am't digested			713.38		158.23	356.01		548.90		2449.82	4088.11	60.56
	Dig. coefficient			71.95		72.84			43.53		78.49		
103	Pellets	5600	15.38	861.28	3.63	203.28		18.12	1014.72	48.29	2704.24		
	Alf. hay	840	15.50	130.20	1.66	13.94		29.30	246.12	38.32	321.88		
	Total	6440		991.48		217.22			1260.84		3026.12		
	Feces	2174	15.99	347.62	3.35	72.82		37.70	819.59	29.10	632.63		
	Am't digested			643.86		144.40	324.90		441.25		2393.49	3803.50	59.06
	Dig. coefficient			64.93		66.47			34.99		79.09		

Table 5. (concl.)

Lamb:		Total: grams: fed	% Pro-: tein:	Grams: crude: protein:	% Ether: extract:	Grams: ether: extract:	x2.25	% :Crude: fiber:	Grams: crude: fiber	% N.F.E.:	Grams: N.F.E.:	Total: nutrients: digested	% T.D.N.
49	Pellets	5600	15.38	861.28	3.63	203.28		18.12	1014.72	48.29	2704.24		
	Alf. hay	840	15.50	130.20	1.66	13.94		29.30	246.12	38.32	321.88		
	Total	6440		991.48		217.22			1260.84		3026.12		
	Feces	2566	14.91	352.77	3.20	75.71		37.69	891.74	30.14	713.11		
	Am't digested			638.71		141.51	318.39		369.10		2313.01	3639.21	56.50
	Dig. coefficient			64.41		65.14			29.27		76.43		
120	Pellets	5600	15.38	861.28	3.63	203.28		18.12	1014.72	48.29	2704.24		
	Alf. hay	840	15.50	130.20	1.66	13.94		29.30	246.12	38.32	321.88		
	Total	6440		991.48		217.22			1260.84		3026.12		
	Feces	1972	15.45	304.67	2.97	58.56		37.19	733.38	29.94	590.41		
	Am't digested			686.81		158.66	356.98		527.46		2435.71	4006.96	62.21
	Dig. coefficient			69.27		73.04			41.83		80.48		
149	Pellets	5600	15.38	861.28	3.63	203.28		18.12	1014.72	48.29	2704.24		
	Alf. hay	840	15.50	130.20	1.66	13.94		29.30	246.12	38.32	321.88		
	Total	6440		991.48		217.22			1260.84		3026.12		
	Feces	2226	15.90	353.93	3.72	82.80		36.20	805.81	30.06	669.58		
	Am't digested			637.55		134.42	302.44		455.03		2356.54	3751.56	58.25
	Dig. coefficient			64.30		61.88			36.06		77.87		
Total fed		44,200		6804.86		1491.11			8652.10		20770.64		
Total digested				4539.53		1010.30	2273.17		3183.65		16397.77	26394.12	59.71
Dig. coefficient				66.71		67.75			36.79		78.94		

Table 6. Digestibility study with lambs using a pelleted ration consisting of 60 percent suncured alfalfa hay and 40 percent corn plus enough chopped alfalfa hay to make a 65-35 ratio.

Lamb		Total grams fed	% Protein	Grams crude protein	% Ether extract	Grams ether extract	x2.25	% Crude fiber	Grams crude fiber	% N.F.E.	Grams N.F.E.	Total nutrients digested	% T.D.N.
21	Pellets	5600	15.38	861.28	2.81	157.36		15.15	848.40	53.65	3004.40		
	Alf. hay	840	15.50	130.20	1.66	13.94		29.30	246.12	38.32	321.88		
	Total	6440		991.48		171.30			1094.52		3326.28		
	Feces	1807	14.85	268.33	2.87	51.86		36.90	666.78	33.29	601.55		
	Am't digested			723.15		119.44	268.74		427.74		2724.73	4144.36	64.35
	Dig. coefficient			72.93		69.72			39.08		81.91		
77	Pellets	5600	15.38	861.28	2.81	157.36		15.15	848.40	53.65	3004.40		
	Alf. hay	840	15.50	130.20	1.66	13.94		29.30	246.12	38.32	321.88		
	Total	6440		991.48		171.30			1094.52		3326.28		
	Feces	1871	13.26	248.09	3.42	63.98		38.33	717.15	32.45	607.13		
	Am't digested			743.39		107.32	241.47		377.37		2719.15	4081.38	63.37
	Dig. coefficient			74.97		62.65			34.47		81.74		
5626	Pellets	5600	15.38	861.28	2.81	157.36		15.15	848.40	53.65	3004.40		
	Alf. hay	840	15.50	130.20	1.66	13.94		29.30	246.12	38.32	321.88		
	Total	6440		991.48		171.30			1094.52		3326.28		
	Feces	1738	14.56	253.05	3.33	57.87		36.13	628.80	32.52	565.19		
	Am't digested			738.43		113.43	255.21		465.72		2761.09	4220.45	65.53
	Dig. coefficient			74.47		66.21			42.55		83.00		
71	Pellets	4368	15.38	671.79	2.81	122.74		15.15	661.75	53.65	2343.43		
	Alf. hay	642	15.50	99.51	1.66	10.65		29.30	188.10	38.32	246.01		
	Total	5010		761.30		133.39			849.85		2589.44		
	Feces	1293	13.84	178.95	3.65	47.19		37.56	485.65	31.86	411.94		
	Am't digested			582.35		86.20	193.95		364.20		2177.50	3318.00	66.22
	Dig. coefficient			76.49		64.62			42.85		84.09		

Table 6. (concl.)

Lamb		Total grams fed	% Protein	Grams crude protein	% Ether extract	Grams ether extract	x2.25	% Crude fiber	Grams crude fiber	% N.F.E.	Grams N.F.E.	Total nutrients digested	% T.D.N.
103	Pellets	5600	15.38	861.28	2.81	157.36		15.15	848.40	53.65	3004.40		
	Alf. hay	840	15.50	130.20	1.66	13.94		29.30	246.12	38.32	321.88		
	Total	6440		991.48		171.30			1094.52		3326.28		
	Feces	1841	15.57	286.64	4.11	75.66		36.11	664.78	31.76	584.70		
	Am't digested			704.84		95.64	215.19		429.74		2741.58	4091.35	63.53
	Dig. coefficient			71.08		55.83			39.26		82.42		
49	Pellets	5600	15.38	861.28	2.81	157.36		15.15	848.40	53.65	3004.40		
	Alf. hay	840	15.50	130.20	1.66	13.94		29.30	246.12	38.32	321.88		
	Total	6440		991.48		171.30			1094.52		3326.28		
	Feces	1700	13.78	234.26	3.31	56.27		37.79	642.43	32.35	549.95		
	Am't digested			757.22		115.03	258.81		452.09		2676.33	4144.45	64.35
	Dig. coefficient			76.37		67.15			41.30		82.95		
120	Pellets	5600	15.38	861.28	2.81	157.36		15.15	848.40	53.65	3004.40		
	Alf. hay	840	15.50	130.20	1.66	13.94		29.30	246.12	38.32	321.88		
	Total	6440		991.48		171.30			1094.52		3326.28		
	Feces	1966	14.96	294.11	3.73	73.33		37.17	730.76	31.48	618.89		
	Am't digested			697.37		97.97	220.43		363.76		2707.39	3988.95	61.94
	Dig. coefficient			70.33		57.19			33.23		81.39		
149	Pellets	5600	15.38	861.28	2.81	157.36		15.15	848.40	53.65	3004.40		
	Alf. hay	840	15.50	130.20	1.66	13.94		29.30	246.12	38.32	321.88		
	Total	6440		991.48		171.30			1094.52		3326.28		
	Feces	2019	16.10	325.05	4.09	82.57		35.94	725.62	31.32	652.35		
	Am't digested			666.43		88.73	199.64		368.90		2693.93	3928.90	61.00
	Dig. coefficient			67.21		51.79			33.70		80.98		
Total fed		50,090		7701.66		1332.49			8511.49		25873.40		
Total digested				5613.18		823.76	1853.46		3249.52		21201.70	31917.86	63.72
Dig. coefficient				72.88		61.82			38.17		81.94		

Table 7. Digestibility study with lambs using a non-pelleted ration consisting of 65 percent chopped alfalfa hay and 35 percent ground corn.

Lamb		Total grams fed	% Pro-tein	Grams crude protein	% Ether extract	Grams ether extract	x2.25	% Crude fiber	Grams crude fiber	% N.F.E.	Grams N.F.E.	Total nutrients digested	% T.D.N.
21	Alf. hay	4130	15.50	640.15	1.66	68.55		29.30	1210.09	38.32	1582.61		
	Corn	2226	11.31	251.76	3.86	85.92		2.14	47.63	72.31	1609.62		
	Total	6356		891.91		154.47			1257.72		3192.23		
	Feces	1923	14.71	282.87	3.53	67.88		38.70	744.20	31.03	596.70		
	Am't digested			609.04		86.59	194.82		513.52		2595.53	3912.91	61.56
	Dig. coefficient			68.28		56.05			40.82		81.30		
77	Alf. hay	4130	15.50	640.15	1.66	68.55		29.30	1210.09	38.32	1582.61		
	Corn	2226	11.31	251.76	3.86	85.92		2.14	47.63	72.31	1609.62		
	Total	6356		891.91		154.47			1257.72		3192.23		
	Feces	1812	13.84	250.78	3.67	66.50		37.91	686.92	31.52	571.14		
	Am't digested			641.13		87.97	197.93		570.80		2621.09	4030.95	65.41
	Dig. coefficient			71.88		56.94			45.38		82.10		
5626	Alf. hay	4130	15.50	640.15	1.66	68.55		29.30	1210.09	38.32	1582.51		
	Corn	2226	11.31	251.76	3.86	85.92		2.14	47.63	72.31	1609.62		
	Total	6356		891.91		154.47			1257.72		3192.23		
	Feces	1985	14.45	286.83	3.20	63.52		36.44	723.33	34.59	686.61		
	Am't digested			605.08		90.95	204.63		534.39		2505.62	3849.72	60.56
	Dig. coefficient			67.84		58.87			42.48		78.49		
71	Alf. hay	4130	15.50	640.15	1.66	68.55		29.30	1210.09	38.32	1582.51		
	Corn	2226	11.31	251.76	3.86	85.92		2.14	47.63	72.31	1609.62		
	Total	6356		891.91		154.47			1257.72		3192.23		
	Feces	1682	14.21	239.01	2.49	41.88		36.88	620.32	34.16	574.57		
	Am't digested			652.90		112.59	253.32		637.40		2617.66	4161.28	65.47
	Dig. coefficient			73.20		72.88			50.67		82.00		

Table 7. (concl.)

Lamb:		Total grams fed	% Protein	Grams crude protein	% Ether extract	Grams ether extract	x2.25	% Crude fiber	Grams crude fiber	% N.F.E.	Grams N.F.E.	Total nutrients digested	% T.D.N.
103	Alf. hay	4130	15.50	640.15	1.66	68.55		29.30	1210.09	38.32	1582.51		
	Corn	2226	11.31	251.76	3.86	85.92		2.14	47.63	72.31	1609.62		
	Total	6356		891.91		154.47			1257.72		3192.23		
	Feces	1932	14.68	283.61	2.81	54.28		34.55	667.50	36.27	700.73		
	Am't digested			608.30		100.19	225.42		590.22		2491.50	3915.44	61.60
	Dig. coefficient			68.20		64.86			46.92		78.04		
49	Alf. hay	4130	15.50	640.15	1.66	68.55		29.30	1210.09	38.32	1582.61		
	Corn	2226	11.31	251.76	3.86	85.92		2.14	47.63	72.31	1609.62		
	Total	6356		891.91		154.47			1257.72		3192.23		
	Feces	1836	13.85	254.28	2.34	42.96		36.50	670.14	35.27	647.55		
	Am't digested			637.63		111.51	250.89		587.58		2544.68	4020.78	63.25
	Dig. coefficient			71.49		72.18			46.71		79.71		
120	Alf. hay	3370	15.50	522.35	1.66	55.94		29.30	987.41	38.32	1582.61		
	Corn	1816	11.31	205.38	3.86	70.09		2.14	38.86	72.31	1313.14		
	Total	5186		727.73		126.03			1026.27		2604.52		
	Feces	1706	14.89	254.02	3.61	61.58		37.09	632.75	33.51	571.68		
	Am't digested			473.71		64.45	145.01		394.51		2032.84	3046.08	58.73
	Dig. coefficient			65.09		51.13			38.44		78.05		
149	Alf. hay	4130	15.50	640.15	1.66	68.55		29.30	1210.09	38.32	1582.61		
	Corn	2226	11.31	251.76	3.86	85.92		2.14	47.63	72.31	1609.62		
	Total	6356		891.91		154.47			1257.72		3192.23		
	Feces	1917	14.90	285.63	3.46	66.32		35.75	685.32	35.26	675.93		
	Am't digested			606.28		88.15	198.33		572.40		2516.30	3893.31	61.25
	Dig. coefficient			67.97		57.06			45.51		78.82		
Total fed		49,678		6971.10		1207.32			9830.31		24950.13		
Total digested				4834.07		742.40	1670.40		4400.83		19925.22	30830.52	62.06
Dig. coefficient				69.34		61.49			44.76		79.86		

Table 8. Digestibility study with lambs using a pelleted ration consisting of 50 percent dehydrated alfalfa hay and 50 percent corn plus enough chopped alfalfa hay to make a 55-45 ratio.

Lamb		Total grams fed	% Pro-tein	Grams crude protein	% Ether extract	Grams ether extract	x2.25	% Crude fiber	Grams crude fiber	% N.F.E.	Grams N.F.E.	Total nutrients digested	% T.D.N.
21	Pellets	5040	13.56	683.42	4.39	221.25		15.51	781.70	53.42	2692.36		
	Alf. hay	560	18.00	100.80	1.78	9.96		25.59	143.30	38.84	217.50		
	Total	5600		784.22		231.21			925.00		2909.86		
	Feces	1661	15.57	258.61	2.89	48.00		35.46	588.99	33.94	563.74		
	Am't digested			525.61		183.21	412.22		336.01		2346.12	3619.96	64.64
	Dig. coefficient			67.02		79.23			36.32		80.62		
77	Pellets	6664	13.56	903.63	4.39	292.54		15.51	1033.58	53.42	3559.90		
	Alf. hay	728	18.00	131.04	1.78	12.95		25.59	186.29	38.84	282.75		
	Total	7392		1034.67		305.49			1219.87		3842.65		
	Feces	2303	15.86	365.25	2.60	59.87		36.65	844.04	31.19	718.30		
	Am't digested			669.42		245.62			375.83		3124.35	4722.24	63.88
	Dig. coefficient			64.69		80.40			30.80		81.30		
5626	Pellets	6664	13.56	903.63	4.39	292.54		15.51	1033.58	53.42	3559.90		
	Alf. hay	728	18.00	131.04	1.78	12.95		25.59	186.29	38.84	282.75		
	Total	7392		1034.67		305.49			1219.87		3842.65		
	Feces	2393	15.18	363.25	2.44	58.38		36.98	884.93	31.42	715.88		
	Am't digested			671.42		247.11	555.99		334.94		3126.77	4689.12	63.42
	Dig. coefficient			64.89		80.88			27.45		81.37		
71	Pellets	5040	13.56	683.42	4.39	221.25		15.51	781.70	53.42	2692.36		
	Alf. hay	560	18.00	100.80	1.78	9.96		25.59	143.30	38.84	217.50		
	Total	5600		784.22		231.21			925.00		2909.86		
	Feces	1603	15.55	249.26	1.98	31.73		33.94	544.05	34.11	546.78		
	Am't digested			534.96		199.48	448.83		380.95		2363.08	3727.82	66.56
	Dig. coefficient			68.21		86.27			41.18		81.20		

Table 8. (concl.)

Lamb:		Total grams fed	% Pro-tein	Grams crude protein	% Ether extract	Grams ether extract	x2.25	% Crude fiber	Grams crude fiber	% N.F.E.	Grams N.F.E.	Total nutrients digested	% T.D.N.
103	Pellets	6664	13.56	903.63	4.39	292.54		15.51	1033.58	53.42	3559.90		
	Alf. hay	728	18.00	131.04	1.78	12.95		25.59	186.29	38.84	282.75		
	Total	7392		1034.67		305.49			1219.87		3842.65		
	Feces	2181	16.18	352.88	1.71	37.29		33.83	737.83	35.64	777.30		
	Am't digested			681.79		268.20	603.45		482.04		3065.35	4832.63	65.37
	Dig. coefficient			65.89		87.79			39.51		79.77		
49	Pellets	6664	13.56	903.63	4.39	292.54		15.51	1033.58	53.42	3559.90		
	Alf. hay	728	18.00	131.04	1.78	12.95		25.59	186.29	38.84	282.75		
	Total	7392		1034.67		305.49			1219.87		3842.65		
	Feces	2235	17.38	388.44	1.97	44.02		31.49	703.80	36.46	814.88		
	Am't digested			646.23		261.47	588.30		516.07		3027.77	4778.37	64.64
	Dig. coefficient			62.45		85.59			42.30		78.79		
120	Pellets	6664	13.56	903.63	4.39	292.54		15.51	1033.58	53.42	3559.90		
	Alf. hay	728	18.00	131.04	1.78	12.95		25.59	186.29	38.84	282.75		
	Total	7392		1034.67		305.49			1219.87		3842.65		
	Feces	2045	16.33	333.94	2.84	58.07		37.13	759.30	31.69	648.06		
	Am't digested			700.73		247.42	556.69		460.57		3194.59	4912.58	66.45
	Dig. coefficient			67.72		80.99			37.75		83.13		
149	Pellets	6664	13.56	903.63	4.39	292.54		15.51	1033.58	53.42	3559.90		
	Alf. hay	728	18.00	131.04	1.78	12.95		25.59	186.29	38.84	282.75		
	Total	7392		1034.67		305.49			1219.87		3842.65		
	Feces	2341	16.92	396.09	3.51	82.16		35.08	821.22	32.89	769.95		
	Am't digested			638.58		223.33	502.49		398.65		3072.70	4612.42	62.39
	Dig. coefficient			61.71		73.10			32.67		79.96		
Total fed		55,552		7776.46		2295.36			9169.22		28875.62		
Total digested				5068.74		1875.84	4220.64		3285.06		23320.75	35895.17	64.61
Dig. coefficient				65.18		81.72			35.82		80.76		

Table 9. Digestibility study with lambs using a pelleted ration consisting of 50 percent suncured alfalfa hay and 50 percent corn plus enough chopped alfalfa hay to make a 55-45 ratio.

Lamb		Total grams fed	% Pro-tein	Grams crude protein	% Ether extract	Grams ether extract	x2.25	% Crude fiber	Grams crude fiber	% N.F.E.	Grams nutrients	Total digested	% T.D.N.
21	Pellets	5814	14.13	821.51	3.07	178.48		13.10	761.63	57.37	3335.49		
	Alf. hay	638	18.00	114.84	1.78	11.35		25.59	163.26	38.84	247.79		
	Total	6452		936.35		189.83			924.89		3583.28		
	Feces	1776	14.47	256.98	4.03	71.57		36.32	645.04	34.73	616.80		
	Am't digested			679.37		118.26	266.08		279.85		2966.48	4191.78	64.96
	Dig. coefficient			72.55		62.29			30.25		82.78		
77	Pellets	6664	14.13	941.62	3.07	204.58		13.10	872.98	57.37	3823.13		
	Alf. hay	728	18.00	131.04	1.78	12.95		25.59	186.29	38.84	282.75		
	Total	7392		1072.66		217.53			1059.27		4105.88		
	Feces	1849	15.43	285.30	3.30	61.01		36.15	668.41	33.69	622.92		
	Am't digested			787.36		156.52	352.17		390.86		3482.96	5012.35	67.80
	Dig. coefficient			73.40		71.95			36.89		84.82		
5626	Pellets	6664	14.13	941.62	3.07	204.58		13.10	872.98	57.37	3823.13		
	Alf. hay	728	18.00	131.04	1.78	12.95		25.59	186.29	38.84	282.75		
	Total	7392		1072.66		217.53			1059.27		4105.88		
	Feces	1806	16.21	301.50	3.07	55.44		35.04	632.82	33.89	612.05		
	Am't digested			771.16		162.09	364.70		426.45		3493.83	5056.14	68.40
	Dig. coefficient			71.89		74.51			40.25		85.09		
71	Pellets	4590	14.13	648.56	3.07	140.91		13.10	601.29	57.37	2633.28		
	Alf. hay	510	18.00	91.80	1.78	9.07		25.59	130.50	38.84	198.08		
	Total	5100		740.36		149.98			731.79		2831.36		
	Feces	1209	14.73	178.08	3.00	36.27		35.86	433.54	33.60	406.22		
	Am't digested			562.28		113.71	255.84		298.25		2425.14	3541.51	69.44
	Dig. coefficient			75.94		75.81			40.75		85.65		

Table 9. (concl.)

Lamb:		Total: grams: fed	% Pro-: tein:	Grams: crude: protein:	% Ether: extract:	Grams: ether: extract:	x2.25	% :Crude: fiber:	Grams: crude: fiber	% N.F.E.:	Grams: N.F.E.:	Total nutrients: digested	% T.D.N.
103	Pellets	5040	14.13	712.15	3.07	154.72		13.10	660.24	53.65	2891.44		
	Alf. hay	560	18.00	100.80	1.78	9.96		25.59	143.30	38.84	217.50		
	Total	5600		812.95		164.68			803.54		3108.94		
	Feces	1396	15.55	217.07	2.63	36.71		36.29	506.60	33.78	471.56		
	Am't digested			595.88		127.97	287.93		296.94		2637.38	3818.13	68.18
	Dig. coefficient			73.29		77.70			36.95		84.83		
49	Pellets	6664	14.13	941.62	3.07	204.58		13.10	872.98	57.37	3823.13		
	Alf. hay	728	18.00	131.04	1.78	12.95		25.59	186.29	38.84	282.75		
	Total	7392		1072.66		217.53			1059.27		4105.88		
	Feces	2054	16.30	334.80	2.80	57.51		33.68	691.78	33.59	689.93		
	Am't digested			737.86		160.02	360.04		367.49		3415.95	4881.34	66.03
	Dig. coefficient			68.78		73.56			34.69		83.19		
120	Pellets	5040	14.13	712.15	3.07	154.72		13.10	660.24	53.65	2891.44		
	Alf. hay	560	18.00	100.80	1.78	9.96		25.59	143.30	38.84	217.50		
	Total	5600		812.95		164.68			803.54		3108.94		
	Feces	1504	14.87	223.64	2.79	41.96		33.87	509.40	35.70	536.92		
	Am't digested			589.31		122.72	276.12		294.14		2572.02	3731.59	66.63
	Dig. coefficient			72.49		74.52			36.60		82.72		
149	Pellets	6664	14.13	941.62	3.07	204.58		13.10	872.98	57.37	3823.13		
	Alf. hay	728	18.00	131.04	1.78	12.95		25.59	186.29	38.84	282.75		
	Total	7392		1072.66		217.53			1059.27		4105.88		
	Feces	2047	16.92	346.35	2.88	58.95		33.97	695.36	34.00	695.98		
	Am't digested			736.31		158.58	356.80		363.91		3409.90	4866.92	65.84
	Dig. coefficient			68.64		72.90			34.35		83.04		
Total fed		52,320		7593.25		1539.29			7500.84		29056.04		
Total digested				5459.53		1119.87	2519.70		2717.89		24403.66	35100.78	67.08
Dig. coefficient				71.89		72.75			36.23		83.98		

Table 10. Digestibility study with lambs using a non-pelleted ration consisting of 55 percent chopped alfalfa hay and 45 percent ground corn.

Lamb		Total grams fed	% Protein	Grams crude protein	% Ether extract	Grams ether extract	x2.25	% Crude fiber	Grams crude fiber	% N.F.E.	Grams N.F.E.	Total nutrients digested	% T.D.N.
21	Alf. hay	3080	18.00	554.40	1.78	54.82		25.59	788.17	38.84	1196.27		
	Corn	2520	11.31	285.01	3.86	97.27		2.14	53.92	72.31	1822.21		
	Total	5600		839.41		152.09			842.09		3018.48		
	Feces	1305	16.11	210.23	3.67	47.89		33.49	437.04	33.98	443.43		
	Am't digested			629.18		104.20	234.45		405.05		2575.05	3843.73	68.63
	Dig. coefficient			74.95		68.51			48.10		85.30		
77	Alf. hay	4060	18.00	730.80	1.78	72.26		25.59	1038.95	38.84	1576.90		
	Corn	3332	11.31	376.84	3.86	128.61		2.14	71.30	72.31	2409.36		
	Total	7392		1107.64		200.87			1110.25		3986.26		
	Feces	1745	15.48	270.12	3.13	54.61		33.50	584.57	35.49	619.30		
	Am't digested			837.52		146.26	329.08		525.68		3366.96	5059.24	68.44
	Dig. coefficient			75.61		72.81			47.34		84.46		
5626	Alf. hay	4060	18.00	730.80	1.78	72.26		25.59	1038.95	38.84	1576.90		
	Corn	3332	11.31	376.84	3.86	128.61		2.14	71.30	72.31	2409.36		
	Total	7392		1107.64		200.87			1110.25		3986.26		
	Feces	1851	16.68	308.74	2.22	41.09		29.01	536.97	38.61	714.67		
	Am't digested			798.90		159.78	359.50		573.28		3271.59	5003.27	67.68
	Dig. coefficient			72.12		79.54			51.63		82.07		
71	Alf. hay	3780	18.00	680.40	1.78	67.28		25.59	967.30	38.84	1468.15		
	Corn	3100	11.31	350.61	3.86	119.66		2.14	66.34	72.31	2241.61		
	Total	6880		1031.01		186.94			1033.64		3709.76		
	Feces	1712	15.37	263.13	3.54	60.60		34.70	594.06	34.44	589.61		
	Am't digested			767.88		126.34	284.26		439.58		3120.15	4611.87	67.03
	Dig. coefficient			74.47		67.58			42.52		84.10		

Table 10. (concl.)

Lamb		Total grams fed	% Pro-tein	Grams crude protein	% Ether extract	Grams ether extract	x2.25	% Crude fiber	Grams crude fiber	% N.F.E.	Grams N.F.E.	Total nutrients digested	% T.D.N.
103	Alf. hay	3165	18.00	569.70	1.78	56.33		25.59	809.92	38.84	1229.28		
	Corn	2591	11.31	293.04	3.86	100.01		2.14	55.44	72.31	1873.55		
	Total	5756		862.74		156.34			865.36		3102.83		
	Feces	1645	15.40	253.33	2.80	46.06		32.09	527.88	39.52	650.10		
	Am't digested			609.41		110.28	248.13		337.48		2452.73	3647.75	63.37
	Dig. coefficient			70.65		70.53			38.99		79.04		
49	Alf. hay	4060	18.00	730.80	1.78	72.26		25.59	1038.95	38.84	1576.90		
	Corn	3332	11.31	376.84	3.86	128.61		2.14	71.30	72.31	2409.36		
	Total	7392		1107.64		200.87			1110.25		3986.26		
	Feces	1876	16.08	301.66	3.43	64.34		33.43	627.14	35.38	663.72		
	Am't digested			805.98		136.53	307.19		483.11		3322.54	4918.82	66.54
	Dig. coefficient			72.76		67.96			43.51		83.34		
120	Alf. hay	3220	18.00	579.60	1.78	57.31		25.59	823.99	38.84	1250.64		
	Corn	2636	11.31	298.13	3.86	101.74		2.14	56.41	72.31	1906.09		
	Total	5856		877.73		159.05			880.40		3156.73		
	Feces	1507	16.24	244.73	3.14	47.31		33.82	509.66	34.37	517.95		
	Am't digested			633.00		111.74	251.41		370.74		2638.78	3893.93	66.49
	Dig. coefficient			72.11		70.25			42.11		83.59		
149	Alf. hay	4060	18.00	730.80	1.78	72.26		25.59	1038.95	38.84	1576.90		
	Corn	3332	11.31	376.84	3.86	128.61		2.14	71.30	72.31	2409.36		
	Total	7392		1107.64		200.87			1110.25		3986.26		
	Feces	1973	17.66	348.43	3.10	61.16		31.60	623.46	35.00	690.55		
	Am't digested			759.21		139.71	314.34		486.79		3295.71	4856.05	65.69
	Dig. coefficient			68.54		69.55			43.84		82.67		
Total fed		53,660		8041.45		1457.90			8062.49		28932.84		
Total digested				5841.08		1034.84	2328.39		3621.71		24043.51	35834.69	66.78
Dig. coefficient				72.63		70.98			44.92		83.10		

Table 11. Nitrogen balance study with lambs.

Lamb	Grams N consumed	Grams dry feces	Grams N in feces	% N in feces	Total ml. urine	Grams N in urine	% N in urine	Total N in feces and urine	% N in feces and urine	Grams N retained	% N retained by lamb
Dehydrated Pellets (65-35)*											
21	136.95	1882	46.28	33.79	6050	75.56	55.17	121.84	88.96	15.12	11.04
77	158.63	2239	54.23	34.18	9420	85.06	53.61	139.29	87.79	19.37	12.21
71	158.63	1897	44.49	28.04	4420	86.54	54.55	131.03	82.59	27.62	17.41
103	158.63	2174	55.61	35.05	10050	80.40	50.68	136.01	85.73	22.64	14.27
49	158.63	2366	56.44	35.57	37790	93.71	59.07	150.15	94.64	8.50	5.36
120	158.63	1972	48.74	30.72	6470	83.46	52.61	132.20	83.33	26.44	16.67
149	158.63	2226	56.62	35.69	38030	88.60	55.85	145.22	91.54	13.42	8.46
Total	1088.73	14756	382.41		112230	593.33		955.74		133.11	
Average				33.29			54.50		87.79		12.21
Suncured Pellets (65-35)*											
21	158.63	1807	42.93	27.06	9010	85.77	54.06	128.70	81.12	29.95	18.88
77	158.63	1871	39.69	25.02	12810	86.46	54.50	126.15	79.52	32.49	20.48
5626	158.63	1738	40.48	25.51	25720	105.45	66.47	145.93	91.98	12.72	8.02
71	121.80	1295	28.49	23.49	2935	81.24	66.69	109.86	90.18	11.96	9.82
103	158.63	1841	45.86	28.91	11450	90.11	56.80	135.97	85.71	22.67	14.29
49	158.63	1700	37.48	23.62	13310	104.61	65.94	142.09	89.56	16.56	10.44
120	158.63	1966	47.05	29.66	5300	83.15	52.41	130.20	82.07	28.44	17.93
149	158.63	2019	52.00	32.78	38890	85.16	53.68	137.16	86.46	21.49	13.54
Total	1232.21	14205	334.11		119425	719.95		1056.06		176.28	
Average				27.11			58.42		85.53		14.47

Table 11. (cont.)

Lamb	Grams N consumed	Grams dry feces	Grams N in feces	% N in feces	Total ml. urine	Grams N in urine	% N in urine	Total N in feces and urine	% N in feces and urine	Grams N retained	% N retained by lamb
					Chopped Alfalfa Hay and Ground Corn (65-35)						
21	142.70	1923	45.25	31.70	12250	84.03	58.88	129.28	90.58	13.44	9.42
77	142.70	1812	40.12	28.11	13390	84.49	59.20	124.61	87.31	18.11	12.69
5626	142.70	1985	45.89	32.15	16260	108.45	75.99	154.34	108.14	-11.64	-8.14
71	142.70	1682	38.24	26.79	4310	87.10	61.03	125.34	87.82	17.38	12.18
103	142.70	1932	45.37	31.79	8650	83.81	58.73	129.18	90.52	13.53	9.48
49	142.70	1836	40.68	28.50	27640	92.87	65.08	133.55	93.58	9.16	6.42
120	116.43	1706	40.64	34.90	3615	79.09	67.92	119.73	102.82	-3.30	-2.82
149	142.70	1917	45.70	32.03	20460	87.77	61.50	133.47	93.52	9.24	6.48
Total	1115.33	14793	341.89		106575	707.61		1049.50		65.92	
Average				30.65			63.44		94.09		5.91
					Dehydrated Pellets (55-45)**						
21	125.47	1661	41.37	32.97	9940	71.86	57.27	113.23	90.24	12.24	9.76
77	165.54	2303	58.44	35.30	8360	72.14	43.57	130.58	78.87	34.96	21.13
5626	165.54	2393	58.12	35.10	19600	93.88	56.71	152.00	91.81	13.54	8.19
71	125.47	1603	39.88	31.78	3370	63.62	50.62	103.40	82.41	22.07	17.59
103	165.54	2181	56.46	34.10	5270	72.38	43.72	128.84	77.83	36.70	22.17
49	165.54	2235	62.15	37.54	3740	75.77	45.77	137.92	83.31	27.62	16.69
120	165.54	2045	53.43	32.27	5290	71.46	43.16	124.89	75.43	40.65	24.57
149	165.54	2341	63.37	38.28	27090	70.70	42.70	134.07	80.98	31.47	19.02
Total	1244.18	16762	433.22		82360	591.70		924.93		219.25	
Average				34.82			47.56		82.38		17.62

Table 11. (concl.)

Lamb	Grams N consumed	Grams dry feces	Grams N in feces	% N in feces	Total ml. urine	Grams N in urine	% N in urine	Total N in feces and urine	% N in feces and urine	Grams N retained	% N retained by lamb
					Suncured Pellets (55-45)**						
21	149.81	1776	41.11	27.44	7730	89.28	59.59	130.39	87.03	19.42	12.97
77	171.62	1849	45.64	26.59	15360	83.25	48.50	128.89	75.09	42.73	24.91
5626	171.62	1860	46.24	26.10	24820	97.79	56.98	146.03	85.08	25.59	14.92
71	118.45	1209	28.49	24.05	2760	69.96	59.06	98.45	83.11	20.00	16.89
103	130.07	1396	34.73	26.70	5070	64.89	49.88	99.62	76.58	30.45	23.42
49	171.62	2054	53.56	31.20	6870	73.37	42.75	126.93	73.95	44.69	26.05
120	130.07	1504	35.78	27.50	4830	75.34	57.92	111.12	85.43	18.95	14.57
149	171.62	2047	55.41	32.28	24730	72.95	42.50	128.36	74.79	43.26	25.21
Total	1214.88	13695	342.96		92170	626.83		967.79		245.09	
Average				28.23			51.59		79.82		20.18
					Chopped Alfalfa Hay and Ground Corn (55-45)						
21	134.30	1305	33.63	25.04	8660	82.01	61.06	115.64	86.10	18.66	13.90
77	177.22	1745	43.21	24.38	6270	101.88	57.48	145.09	81.86	32.13	18.14
5626	177.22	1851	49.39	27.86	8950	85.92	48.48	135.31	76.35	41.91	23.65
71	164.96	1712	42.10	25.52	3230	86.72	52.57	128.82	78.09	36.14	21.91
103	138.03	1645	40.53	29.36	7410	74.02	53.62	114.55	82.98	23.48	17.02
49	177.22	1876	48.26	27.23	8670	89.47	50.58	137.73	77.71	39.49	22.29
120	140.43	1507	39.15	27.87	4830	86.02	61.25	125.17	89.13	15.26	10.87
149	177.22	1973	55.74	31.45	37100	90.89	51.28	146.63	82.73	30.59	17.27
Total	1286.60	13613	362.01		85120	696.93		1048.94		237.66	
Average				27.36			54.16		81.52		18.48

* Pellets contained 60 percent roughage and 40 percent concentrate. Enough chopped alfalfa hay was added to make a 65-35 ratio.

** Pellets contained 50 percent roughage and 40 percent concentrate. Enough chopped alfalfa hay was added to make a 55-45 ratio.

A STUDY OF METABOLISM AND RATE OF GAIN WITH LAMBS USING PELLETED AND NON-PELLETED RATIONS

by

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This experiment was designed to study the feedlot performance, digestibility, and nitrogen retention from pelleted and non-pelleted rations having two different ratios of roughage to concentrate. In addition, the pellets contained either dehydrated or suncured alfalfa hay as the source of roughage.

One hundred and thirty-four lambs were used, with the eight heaviest being selected for the metabolism study. The lambs used in the feeding trial were divided into six lots of 21 animals each.

The same rations were used in both the feeding trial and metabolism study. The experimental rations were as follows: (1) Pellets containing 60 percent dehydrated alfalfa hay and 40 percent corn plus enough chopped alfalfa hay to make a 65-35 ratio. (2) Pellets containing 60 percent suncured alfalfa hay and 40 percent corn plus enough chopped alfalfa hay to make a 65-35 ratio. (3) Non-pelleted ration consisting of 65 percent chopped alfalfa hay and 35 percent ground yellow corn. (4) Pellets containing 50 percent dehydrated alfalfa hay and 50 percent corn plus enough chopped alfalfa hay to make a 55-45 ratio. (5) Pellets containing 50 percent suncured alfalfa hay and 50 percent corn plus enough chopped alfalfa hay to make a 55-45 ratio. (6) Non-pelleted ration consisting of 55 percent chopped alfalfa hay and 45 percent ground yellow corn.

It was found that lambs being fattened on pelleted rations containing suncured alfalfa hay gained more rapidly and had better feed efficiency than lambs on pellets containing dehydrated alfalfa hay or on non-pelleted rations. There was little difference in rate of gain, feed efficiency and cost per hundred pounds of gain between suncured pellets having different ratios of roughage to concentrate. In the dehydrated pellets and the non-pelleted rations, rate and economy of gain were best in the rations containing the higher level of roughage. The cost of gain was about the same for the

suncured pellets and the non-pelleted rations. Cost of gain for the dehydrated pellets was considerably higher.

Total digestible nutrient values were higher in the 55-45 rations than in the 65-35 rations. Pellets containing dehydrated alfalfa hay gave the lowest total digestible nutrient values, suncured pellets gave the highest, and the values for the non-pelleted rations fell between the two. Digestion coefficients for crude protein were lowest in the dehydrated pellets. There was little difference between the protein digestion coefficients for suncured pellets and the non-pelleted rations. The two different levels of roughage to concentrate produced no significant differences in crude protein digestion coefficients. Ether extract digestion coefficients were considerably higher in the dehydrated pellets than in the other two rations. Rations containing 55 percent roughage gave a higher value for ether extract than did the rations containing 65 percent roughage. There was little difference in the digestion coefficients for crude fiber in any of the pelleted rations. Fiber digestion coefficients for both of the non-pelleted rations were essentially the same and were considerably higher than those for the pelleted rations. The 55-45 rations produced slightly higher digestion coefficients for nitrogen-free extract than did the 65-35 rations. There was little difference in the values for nitrogen-free extract within the rations containing the same ratio of roughage to concentrate.

The 55-45 rations produced higher average percents of nitrogen retention than did the 65-35 rations. There was little difference in nitrogen retention from the 55-45 rations, while in the 65-35 rations, the non-pelleted ration gave a much lower value than did the pelleted rations. It is thought that this low value was due to the failure of two of the lambs on the non-pelleted ration to eat properly.