Nutritive Requirements of Breeding Ewes for Maintenance, Lactation and Growth

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NUTRITIVE REQUIREMENTS OF BREEDING EWES FOR MAINTENANCE, LACTATION AND GROWTH[1]

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IN PREVIOUS experiments (Shrewsbury *et al.*, 1942, 1943), it was found that protein, vitamin A, and factors contained in the press juice of alfalfa constituted some of the main deficiencies of a ration of corn, silage, and oat straw for breeding ewes. Breeding ewes have been maintained in satisfactory condition and have produced healthy, rapidly growing lambs when fed approximately 2.5 pounds of artificially dehydrated alfalfa hay daily with grain and silage. The substitution of artificially dehydrated oat or rye grass for alfalfa has resulted in superior maintenance of the ewes and significantly increased rate of growth of their lambs.

The experiments reported herein include additional observations on the deficiencies of the oat straw basal ration and on the nutritive value of cereal grass fractions.

Two series of experiments are described. One was conducted in 1942–43 and included twelve lots each of 15 two-year old ewes. The second was run in 1943–44 and consisted of five lots each of 10 three-year old ewes and four lots each of 15 three-year old ewes. These ewes were employed in a similar experiment in 1941–42. The ewes were assigned to the various lots by random selection (Shrewsbury *et al.*, 1943) and were fed the rations listed in table 1. All lots were equalized as closely as possible with respect to consumption of protein and energy although the failure of some to consume their feed allotments introduced some deviation from the calculated amounts.

The ewes were weighed at the beginning of the experiment, just before lambing, and at the end of lactation. The lambs were weighed at birth and at eight weeks. Wool clip was obtained on all of the ewes.

The dehydrated cereal grasses, oat straw and fractions of cereal grass were supplied by a commercial laboratory.[4] The first, second, and third cutting alfalfa hays were all harvested in Indiana from the same farm and dehydrated by a local plant.

In order to improve their physical properties the roughages were finely ground through a hammer mill and cane molasses mixed in at a level of 20 percent. Crystalline vitamins were purchased from Merck and Company; all other feeds and supplements were obtained locally.

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TABLE 1. FEED CONSUMPTION OF EWES (AVERAGE DAILY FEED IS IN POUNDS)

INGREDIENT	Lot number																
	1	1A	2	2A	3	4	5	6	7	8	9	10	11	12	13	14	15
Yellow corn	1.75	1.64	.63	.68	1.24	.72	.68	.68	.68	.68	.92	.68	1.22	1.23	.50	.68	.71
Corn silage	1.17	1.0	1.16	1.00	1.13	1.16	1.00	1.00	1.00	1.00	1.00	1.0	1.21	1.13	1.16	1.15	1.17
Rye grass			2.28	2.0	.99												
Oat grass						2.24											
Oat straw	.89	1.00								1.00			.90	1.33			
Water solubles of rye grass										.58		.58					
Residue of rye grass											1.6	1.6					
1st cutting alfalfa hay							2.4										
2nd cutting alfalfa hay								2.4									
3rd cutting alfalfa hay									2.4								
Alfalfa hay															3.28	1.97	2.00
Soybeans																.49	.50
Vitamins													Carotene[1]	Mixture[2]			Mixture[2]
Casein										.50			.50	.50			
Salt	.03	.03	.03	.03	.03	.03	.03	.03	.03	.03	.03	.03	.03	.03	.03	.03	.03
Molasses	.22	.25	.57	.5	.20	.51	.5	.5	.5	.25	.40	.40	.23	.33	.00	.00	.00
Steamed bone meal										.10			.04	.04			
Total feed, pounds	4.03	3.92	4.64	4.21	3.56	4.63	4.61	4.61	4.61	4.14	3.95	4.29	4.06	4.52	4.94	4.29	4.38
Daily energy, therms	1.93	1.86	2.04	1.84	1.74	2.06	2.0	2.0	2.0	1.84	1.61	1.93	1.99	2.14	1.78	1.87	1.92
Daily protein, pounds	.24	.22	.70	.66	.37	.48	.42	.57	.54	.54	.58	.58	.57	.60	.47	.51	.52
Year	1943	1944	1943	1944	1943	1943	1944	1944	1944	1944	1944	1944	1943	1943	1943	1943	1943

[1] See text for carotene amount

[2] See text for vitamin mixture amount.

The average daily feed, the total feed, the average daily protein intake and the average daily energy content of the rations are shown in table 1. The protein and energy calculations were based on analyses and values from Morrison's 1938 tables.

In order to overcome the difficulties of comparing the growth weights of single and twin lambs the smaller of each set of twins was removed from the experiment within the first four days after birth.

The data were treated statistically by analysis of variance according to Snedecor (1938).

Results

The results obtained when artificially dehydrated cereal grasses and oat straw were fed are summarized in table 2. The dehydrated rye grass was fed at about 2.25 pounds daily and one pound daily (lots 2 and 3). The dehydrated oat grass was fed at about 2.25 pounds daily (lot 4). The gains of the ewes during pregnancy were much greater when either dehydrated oats or rye grass was fed at the 2.25 pound level than when the dehydrated rye grass was fed at the one pound level, and all three lots gained more than the control lot (No. 1) receiving oat straw. Conversely, the loss in weight of the ewes during the lactation period was small when dehydrated rye or oat grass was fed. Death losses in the ewes and lambs were not appreciably affected by the type or amount of roughage fed. There was no apparent relationship between the roughage fed and the birth weight of the lambs. The wool clip was significantly greater in the lot receiving the high level of dehydrated rye grass (lot 2). The growth rate of the lambs during the first eight weeks was significantly greater in all lots receiving dehydrated cereal grasses. Since it has been previously shown (Shrewsbury *et al.*, 1942) that there is a high correlation ($r=0.89$) between milk production of the ewe and growth of the lamb, it is evident that a basal oat straw ration is not conducive to maximum lactation in sheep.

The effects of feeding 2.4 lbs. of various cuttings of artificially dehydrated alfalfa as compared with oat straw are shown in table 2. The second and third cuttings produced significant increases in rate of gain during pregnancy and in wool clip. In the 1943 experiments more single than twin lambs were born but the reverse was true in 1944. For this reason the statistical analysis was performed on the single lamb birth weights in 1943 and on the twins in 1944. (The data on twin lambs birth weights are not shown in the table.) In all previous experiments in this project analyses have been made on single lambs and no relationship was found between the ration fed and the birth weight of the lambs. However, a significant difference was found in birth weight between lambs from ewes fed second and third cut-

TABLE 2. DATA ON EWES AND LAMBS FED DEHYDRATED GRASSES, 1ST, 2ND AND 3RD CUTTING DEHYDRATED ALFALFA HAY

Lot No.	Ration	Av. gain of ewes during pregnancy	Death losses				Av. birth wt. of single lambs	Av. birth wt. of all lambs[2]	Av. wt. of wool clip ewes	Av. wt. of lambs at 8 weeks	Av. gain of lambs 8 weeks
			Ewes		Lambs						
			Tot. ewes	Tot. deaths	Lambs born[1]	Deaths 1st 8 weeks					
		lbs.					*lbs.*	*lbs.*	*lbs.*	*lbs.*	*lbs.*
1943 Experiments											
1	Oat straw, control	16.0	15	0	17	5	9.6	8.4	8.6	31.2	21.6
2	Dehyd. rye grass, 2¼# daily	31.5**	15	2	14	4	9.9	9.2	9.6*	46.2	36.8**
3	Dehyd. rye grass, 1# daily	21.3	15	1	18	1	10.4	9.6	8.9	41.3	31.6**
4	Dehyd. oat grass, 2¼# daily	35.5**	15	2	18	2	9.7	9.0	9.0	46.6	36.9**
1944 Experiments											
1A	Oat straw, control	19.9	10	1	11	1	11.8	9.2	8.5	30.6	20.4
5	1st cutting dehyd. alfalfa hay	25.6	15	2	24	2	11.1	8.8	8.8	32.7	23.1
6	2nd cutting dehyd. alfalfa hay	38.1**	15	0	22	1	11.0	9.9	10.4**	40.1	29.6
7	3rd cutting dehyd. alfalfa hay	38.7**	15	0	27	1	9.6	9.5	10.1**	43.9	34.0

* Significantly different from control lot at 5 percent level of t.

** Significantly different from control lot at 1 percent level of t.

[1] One lamb of twin sets discarded.

[2] Statistical analysis determined on single lambs in 1943 experiments, on twins in 1944 experiments.

ting alfalfa and those fed oat straw. The importance of this finding is questionable. Death losses of ewes and lambs were not related to the ration fed. No significant differences in rate of gain of the lambs were observed. The lambs of the ewes receiving the third cutting of alfalfa grew faster than those in any other lot but the difference in gain from the lambs in the oat straw basal lot was slightly less than the 14.6 pounds required for significance at the 5 percent level. It is likely that if a larger number of lambs had been available for study the difference in gain would have been statistically significant. The lambs in the third cutting alfalfa hay lot (No. 7), the dehydrated cereal grass lot (No. 2A) gained 13.6 and 14.4 pounds more, respectively, than did those in the oat straw lot (No. 1A).

Attempts were made to concentrate the active constituents of the cereal grasses. In previous experiments (Shrewsbury *et al.*, 1943) it was shown that the press juice of alfalfa contained a considerable amount of the potency. This indicated the presence of a water soluble factor. In the present experiments the nutritive properties of the water soluble and the residue fractions of rye grass were tested. The data which are summarized in table 3 show that the water soluble fraction (lot 8) had little or no supplemental value. The residue from the rye grass (lot 9) was about equal to whole rye grass (lot 2A) in the maintenance of ewes during pregnancy and nearly equal to it in producing growth of the lambs. It was superior with respect to wool production. The fractionation process apparently had not caused any destruction of the active constituents since the recombined fractions (lot 10) were comparable to the original rye grass. Accordingly, no conclusions regarding solubility can be drawn at this time.

Another approach was made by adding proteins and vitamins to the basal oat straw ration. Commercial casein was used as the protein and the following vitamins were administered: Carotene 10 milligrams, calcium pantothenate 2 mg., thiamin 2 mg., riboflavin 2 mg., pyridoxine 2 mg., choline 12 mg., niacin 28 mg., ascorbic acid 30 mg., and alpha-tocopherol 2 mg., per head daily. The results of these studies are presented in table 3.

The addition of vitamin A and casein (lot 11) or mixed vitamins and casein (lot 12) to the oat straw ration brought about a definite improvement in its nutritive value. However, the results were not nearly so good as those produced by cereal grass (table 2, lots 2 and 4). Besides the added vitamins and protein, other factors which are present in cereal grass evidently are needed for optimum results with breeding ewes. The identification of these factors must await future work.

In the 1943 experiments (table 3) the field cured alfalfa hay was poor in quality. It produced results only slightly better than did the oat straw ration. However, it was thought that improvement brought about in the

TABLE 3. DATA OF EWES AND LAMBS FED DIFFERENT FRACTIONS OF CEREAL GRASSES, AND ON THE VALUE OF VITAMIN AND PROTEIN ADDITIONS TO THE OAT STRAW AND ALFALFA RATIONS ON EWES AND LAMBS

Lot No.	Ration	Av. gain of ewes during pregnancy	Death losses				Av. birth wt. of single lambs	Av. birth wt. of all lambs[2]	Av. wt. of wool clip ewes	Av. wt. of lambs at 8 weeks	Av. gain of lambs 8 weeks
			Ewes		Lambs						
			Tot. ewes	Tot. deaths	Lambs born[1]	Deaths 1st 8 weeks					
		1944 Experiments									
		lbs.					lbs.	lbs.	lbs.	lbs.	lbs.
1A	Oat straw control	19.9	10	1	11	1	11.8	9.2	8.5	30.6	20.4
8	Water solubles of rye grass	17.4	10	1	13	0	11.8	9.9	8.1	34.9	24.0
9	Residue of rye grass	35.1**	10	0	18	0	—	8.6	10.6**	41.6	31.9
10	Water solubles and residue of rye grass recombined	34.1**	10	0	17	0	11.5	9.7	9.6*	46.0	35.7*
2A	Rye grass	37.4*	10	0	16	0	9.4	8.6	9.8*	43.8	34.8*
		1943 Experiments									
1	Oat straw, control	16.0	15	0	17	5	9.6	8.4	8.6	31.2	21.6
11	Oat straw-casein-vitamin A	26.4*	15	3	16	3	10.3	9.1	8.1	37.0	27.2
12	Oat straw-casein-mixed vitamins	21.1	15	3	20	2	9.5	9.2	9.4	38.8	29.5*
13	Field cured alfalfa	17.2	15	1	18	2	8.8	8.3	8.3	37.6	26.3
14	Field cured alfalfa-soybeans	19.7	15	1	19	4	9.3	8.3	8.7	40.7	30.9**
15	Field cured alfalfa-soybeans mixed vitamins	24.2	15	0	17	4	10.4	9.9	8.2	40.6	31.3**

* Significantly different from control lot at 5 percent level of t.

** Significantly different from control lot at 1 percent level of t.

[1] One lamb of twin sets discarded.

[2] Statistical analysis determined on single lambs in 1943 experiments, on twins in 1944 experiments.

performance of the breeding ewes by additions to this poor quality alfalfa hay ration might be of value in determining the factors which are lacking in the oat straw basal ration. The addition of a protein supplement (soybeans) and vitamins to the oat straw ration (table 3, lots 13, 14 and 15) resulted in some improvement over the alfalfa alone, but the response was not nearly equal to that obtained with dehydrated cereal grass.

The data were treated by analysis of multiple regression in an effort to evaluate the effects of the different amounts of protein and energy in the rations. In the case of gains of ewes during pregnancy, 64 percent of the variation between lots was due to multiple regression of gain on protein and energy. With gain of lambs it was 56 percent. Differences in the quality of protein as regards the amounts of essential amino acids probably explains most of the variation. However, significant deviations from multiple regression exist. This indicates that factors other than protein and energy were operative. Since the addition of crystalline vitamins and high quality protein (casein) to the basal oat-straw ration did not bring about results comparable to those produced by dehydrated cereal grasses, it appears that other unknown factors are necessary to supplement oat-straw as a roughage for the optimum performance of breeding ewes. However, since the precise vitamin requirements of sheep have not been determined, it is possible that variations in quantity and in combinations of vitamins might result in further improvement in the results.

Summary

Dehydrated cereal grasses (rye and oats) were found to have a high nutritive value with corn and silage for breeding ewes.

Dehydrated third-cutting alfalfa hay was comparable to dehydrated cereal grass in nutritive value for breeding ewes. First-cutting alfalfa hay was only slightly better than oat straw and the second cutting approached the third cutting alfalfa in nutritive value.

The water soluble fraction of rye grass used in these experiments did not contain the supplementing factors necessary for optimum performance of breeding ewes. The residue after water extraction retained these factors in concentration approximating the original cereal grass.

The addition of protein (casein) and crystalline vitamins to the oat straw ration or a protein supplement (soybeans) and vitamins to a poor quality alfalfa hay ration improved the rations, but did not make them equal in nutritive value to rations containing dehydrated cereal grass.

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