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THE NUTRITIVE VALUES OF SOME FORAGE CROPS OF PUERTO RICO [1, 2, 3]

1. Grasses

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Introduction

The importance of the knowledge of the feeding value of forage crops in relation to the modern livestock and dairy industries is recognized.

Metabolic experiments carried out with lambs have proved to be an acceptable and practical method of determining nutritional indexes of feeds, such as the biological value, coefficient of apparent digestibility, etc., these serving to give the relative nutritive values of different forage crops when fed to ruminants.

Since no work of this kind has been undertaken before in Puerto Rico, we have had up to the present time no exact knowledge concerning the nutritive values of the different pastures used in our dairy and livestock industry.

The data presented here has been collected from experiments carried out during the years 1936 and 1937. We have tried to obtain information (similar to that collected in studies on forage crops in the United States) concerning the nutritive values of those pastures most commonly used on our Island, but in no way should this initial investigation be taken as a final dictum on the matter. In addition to the work which has been done to determine the nutritional indexes of the different grasses studied, we have also tried to obtain information regarding the influence such factors as the stage of maturity at the time of cutting, the cutting and the kind of fertilizer used, may have on the nutritive values of these grasses.

[1] Cooperative project between the Agricultural Experiment Station of the University of Puerto Rico and the School of Tropical Medicine.

[2] Field work was conducted by the Experiment Station at Río Piedras.

[3] Study made possible from grant-in-aid of the Bankhead Jones Act of U. S. A. Congress 1936.

These factors are of enough importance to be the subject of a special investigation. Therefore, justification for presenting the present study lies in the hope that the data given here shall serve to indicate the problems to be solved in a systematic study of the nutritive indexes of the forage crops of our Island.

Review of the Literature

Although literature on the present subject is non-existent in Puerto Rico, it is so extensive in the States that it seems unnecessary for us to present more than a review of those studies from which we have taken our method. Sotola points out that the most accurate method of evaluating proteins at the present time appears to be that employed by Thomas and later modified by Mitchell (1). Mitchell performed a rigorous and extensive investigation of his method and came to the conclusion that it possessed a high degree of accuracy. It will be interesting to note that Mitchell used white rats as experimental animals. The method followed by Sotola (2) in his investigation on the biological value of the forage crops of the United States is similar to that recommended by Mitchell, being modified only in that Sotola used sheep instead of rats. The advisability of using sheep is clear, as results obtained in nutritive experiments with these animals have been shown to apply to cattle (3), and they are easier to work with.

The methods we followed in the determination of apparent coefficients of digestibility were the ones used by Sotola (4).

Material and Methods

The animals used in our experiment were native sheep whose ages ranged from six to eighteen months when purchased. We scarched the Island in the hope of finding a pure breed of sheep, but could not find a single farm where the breeding or care of sheep were carried out under controlled conditions. The animals had been allowed to roam about the farms and could not be used during the first two or three weeks after they were brought to the laboratory because they were practically unmanageable.

The grasses studied were grown at the Experiment Station Farm of the University of Puerto Rico at Río Piedras. A field of approximately 2 acres was divided into seventy-two 1/40 acre plots, each treatment of the soil being replicated twelve times. One half of the replication was fertilized with a mixture of 400 pounds of

ammonium sulphate and 200 pounds of double superphosphate per acre, and the other half was fertilized with 400 pounds of ammonium sulphate alone per acre.

The stages of maturation at which these grasses were cut were just before or during the flowering periods.

The cutting was done early in the morning, the grasses being chopped into pieces ranging from 2 to 4 inches in length, put into jute bags and sent to us by truck, arriving usually at about 8 or 9 o'clock in the morning.

The detailed field conditions under which the grasses were grown are given in table A.

Experimental

Metabolism cages, 3½ feet long, 2 feet wide, and 3 feet high, similar to those used by Sotola (4) were constructed at the School shop. Each cage was provided with a double bottom for the collection of the urine and feces separately.

The animals, before beginning an experimental period, were kept during a preliminary period of 10 days on the ration to be tested. At the termination of this preliminary period, the animals were placed in the metabolism cages and the collection of the data for the experiment was begun. Each experiment lasted ten days.

The following data were collected during these ten-day experimental periods: 1. Initial and final weights of the animals at the start and the end of the experimental periods. 2. Weights of the feed consumed per day. 3. Weights of the feed refused per day. 4. Weights of the feces eliminated per day. 5. Volumes of the water consumed per day. 6. Volumes of the urine eliminated per day.

These data were collected practically at the same time every day, from 9 to 10 a. m., and aliquot samples of the feeds given, the refuse left, and the feces and urine eliminated, were taken for analysis.

All the solid samples collected were dried in an air oven at 100°C. The composite aliquot samples of the feces and urine were kept in the ice box. Xylol was added to the urine as preservative. The samples of the grasses were kept in paper bags after having been dried. All the solid samples were ground in a Willy mill at the end of each experimental period; the powder obtained was mixed, and large enough portions of it were put into amber bottles provided with tight stoppers to be preserved for analysis. All the analyses reported in this study have been performed according to the methods of the Association of Official Agricultural Chemists. In the case of the nitrogen determinations, we used a solution consisting of ten

TABLE A

FIELD CONDITIONS OF THE GRASSES USED IN THE TRIALS PERFORMED

Trial No.	Common name of the grass	Scientific name of the grass	Fertilized with*	Dates on which samples were collected	Cutting	Stage of maturation when cut	Rain in inches
2.....	Corn fodder.....	*Zea Mays L.*.....	N and P..	August 27 to Sept. 5, 1936	1st....	In flower.....	8.37 to 8.92
4....	Elephant grass.....	*Pennisetum purpureum* Schum.	N.....	Sept. 22 to Oct. 2/36....	1st....	Just before flowering.....	8.92 to 6.85
13....	Elephant grass.....	*Pennisetum purpureum* Schum.	N.....	Jan. 6 to Jan. 16/37.....	1st....	Just before flowering.....	17.39
6....	Elephant grass.....	*Pennisetum purpureum* Schum.	N and P..	Oct. 13 to Oct. 23/36....	1st....	Just before flowering.....	6.85
11....	Elephant grass.....	*Pennisetum purpureum* Schum.	N.....	Dec. 16 to Dec. 26/36...	1st....	Just before flowering.....	8.61
5....	Guinea grass.....	*Panicum maximum* Jacq.	N.....	Oct. 13 to Oct. 23/36....	1st....	In flower.....	6.85
12....	Guinea grass.....	*Panicum maximum* Jacq.	N.....	Dec. 16 to Dec. 26/36...	1st....	In flower.....	8.61
7....	Guinea grass.....	*Panicum maximum* Jacq.	N and P..	Nov. 4 to Nov. 14/36...	1st....	In flower.....	2.38
14....	Guinea grass.....	*Panicum maximum* Jacq.	N and P..	Jan. 6 to Jan. 16/37.....	1st....	In flower.....	17.39
8....	Malojillo or Para grass.....	*Panicum barbinode* Trin.	N.....	Nov. 4 to Nov. 14/36...	1st....	Just before flowering.....	2.38
27....	Malojillo or Para grass.....	*Panicum barbinode* Trin.	N.....	April 28 to May 8/37...	2nd...	In flower.....	1.54
20....	Malojillo or Para grass.....	*Panicum barbinode* Trin.	N and P..	March 15 to 25/37.....	2nd...	In flower.....	0.45
25....	Malojillo or Para grass.....	*Panicum barbinode* Trin.	N and P..	April 17 to 27/37.....	2nd...	In flower.....	1.54
9....	Guatemala grass.....	*Tripsacum laxum* Nash.	N.....	Nov. 25 to Dec. 5/36....	1st....	Just before flowering.....	2.38
23....	Guatemala grass.....	*Tripsacum laxum* Nash.	N.....	March 26 to April 5/37.	2nd...	Just before flowering.....	0.47 to 1.54
10....	Guatemala grass.....	*Tripsacum laxum* Nash.	N and P..	Nov. 25 to Dec. 5/36....	1st....	Just before flowering.....	2.38 to 8.61
22....	Guatemala grass.....	*Tripsacum laxum* Nash.	N and P..	March 26 to April 5/37.	2nd...	Just before flowering.....	0.47 to 1.54
24....	Yaragua or molasses grass..	*Melinis minutiflora* Beuv.	N.....	April 6 to April 16/37...	2nd...	Just before flowering.....	1.54
17....	Yaragua or molasses grass..	*Melinis minutiflora* Beuv.	N and P..	Feb. 20 to March 2/37..	2nd...	Just before flowering.....	1.08 to 0.47
26....	Yaragua or molasses grass..	*Melinis minutiflora* Beuv.	N and P..	April 17 to April 27/37..	2nd...	Just before flowering.....	1.54

*N means those fertilized with ammonium sulphate alone. N and P means those fertilized with ammonium sulphate and superphosphate.

parts of a saturated solution of methyl red in 50 per cent alcohol and one part of a 0.25 per cent methylene blue solution in water as an indicator to titrate the standard acid in which the ammonia was collected against the standard base. A freshly prepared solution was used whenever titrations were performed. This indicator mixture has the advantage of giving a very sharp end point, changing from violet on the acid side to green on the alkaline side.

An artificial ration having the following composition was given to the animals during the trials performed for determining the minimum protein required for maintenance:

Para grass straw (no leaves)	10.00 per cent
Sugar	21.43 per cent
Starch	21.43 per cent
Cellu flour	43.90 per cent
Bone meal	2.00 per cent
Oil	1.24 per cent

Group A and Group B of our animals became used in this diet after a short time and ate an average of about 400 grams of it per day. The animals of Group D and Group E never became used to it, preferring rather to starve. Due to this, we ran only four trials on this low protein diet; three with animals in Group A and one with animals in Group B. We have calculated the body nitrogen in the feces per gram of dry matter ingested and the body nitrogen in the urine per kilogram of body weight from the data obtained from these trials. The average value obtained from these four trials was applied to all our animals.

Existing data indicates that the body nitrogen in the feces per gram of the dry matter ingested and the body nitrogen in the urine per kilogram of the body weight for sheep receiving a low nitrogen ration is quite uniform. We include the results obtained by other investigators as well as by ourselves for the low protein trials, in table 3. These results are quite close if we consider the different breeds of animals used.

Results

Table no. 1 records the percentage content of nitrogen in the feed consumed, the refuse left, and the feces and urine eliminated. These values are later used in the determination of the biological values of the grasses.

Table no. 2 gives the data gathered during the four ten-day metabolism experiments in which the nearly nitrogen-free rations were fed. The average values obtained for the body nitrogen in

the feces per gram of dry matter ingested and the body nitrogen in the urine per kilogram of body weight are 0.043 grams and 0.526 grams of nitrogen respectively. We have applied these average values in computing all our calculations for the biological values of the proteins.

Table 3 reports the values for body nitrogen in the feces per gram of dry matter ingested and body nitrogen in the urine per kilogram of body weight obtained by other investigators as well as by us.

Table 4 gives a summary of the metabolism experiments upon which the determinations of the biological values of the protein in the grasses are based. "Body Nitrogen Feces" is obtained by multiplying the weight of the total dry feed intake by the body nitrogen in feces per gram of dry matter ingested; while the "Body Nitrogen in Urine" is obtained by multiplying the average body weight of the animal in kilograms by the body nitrogen in urine per kilogram of body weight. The percentage of the total protein absorbed through the intestine and retained in the body is called the "Biological Value" of the protein. This value is computed from the following equation:

$$\text{Biological value} = \frac{100 \text{ Food N} - (\text{Total N in feces} - \text{Body N in feces}) - (\text{Total N in urine} - \text{Body N in urin}}{\text{Food N} - (\text{Total N in feces-Body N in feces})}$$

$$100 \frac{\text{Food N retained}}{\text{Food N absorbed}}$$

Table 5 contains all the proximate analyses of the offered and refused portions of the rations used in the different experiments. These analyses are all reported on a dry basis. Protein throughout this work is understood to be the nitrogen value multiplied by the factor 6.25.

Table 6 gives the proximate analyses of the feces eliminated during the different trials. These analyses are also given on a dry basis.

The coefficients of apparent digestibilty are given in table 7. By this coefficient we mean the percentage of the substances in the feed eaten that is absorbed in the intestinal tract. Coefficients of apparent digestibility of dry matter, fat, carbohydrate, ash and organic matter have been calculated. These coefficients are computed with the following equation:

$$\text{Coefficient of apparent digestibility} = \frac{100 \text{ Substance in the feed fed} - \text{Substance in the feces eliminated}}{\text{Substance in the feed fed}}$$

Table 8 gives the digestible nutrient in 100 pounds of feedstuff on the wet basis in addition to the nutritive ratio of each ration (5). The digestible fats, carbohydrates and proteins are obtained by multiplying the total amount of each nutrient in 100 pounds of the feed by the apparent coefficient of digestibility for that nutrient, as given in table 7.

The second term of the nutritive ratio is calculated by means of the following formula:

$$\text{The second term of the nutritive ratio} = \frac{(\text{Digestible fat} \times \text{heat equivalent} = 2.25) + \text{Digestible carbohydrates}}{\text{Digestible crude protein}}$$

A feed or ration having much crude protein in proportion to the carbohydrate and fat combined is said to have a narrow nutritive ratio. If the opposite is true it is said to have a wide nutritive ratio.

Table 9 gives the proximate and ash analyses of the grasses investigated, these determinations being reported on the wet basis, while table 10 contains the same data after having been calculated on the dry basis.

Table 11 is a summary of all the coefficients calculated from the data obtained in this investigation.

The vitamin A activity determinations are recorded in table 12.

Discussion

The biological values of the grasses studied do not show great differences if we are to judge these from the results obtained and indicated in the tables.

The proteins of all these grasses seem to be utilized by the lambs with the same efficiency. A significant low result was obtained in Trial No. 6 when elephant grass of the first cutting, fertilized with nitrogen and phosphorus, was fed. The biological value computed for this grass is 69. In the other three trials performed with this grass, much higher results were obtained, viz., 81, 80 and 80; nevertheless, these four samples of elephant grass recorded the lowest biological values obtained in all of the grasses investigated. Two rations of the grass fed to the animals had been fertilized with nitrogen and phosphorus. All of them were from the first cuttings. On the other hand, the malojillo or Para grass has given the highest biological value, viz., 88, 97, 89 and 91. The first value corresponds to a grass from a first cutting fertilized with nitrogen only; the other three were grasses from the second cuttings, one fertilized with nitrogen only and the other two with nitrogen and phosphorus.

The other four grasses investigated gave values which fall within the range of those obtained for elephant and Para grasses.

The data obtained in these experiments seem to indicate that the biological value is not greatly influenced by the addition of phosphorus as fertilizer or by the cutting. We can conclude, on the basis of the results obtained, that the quality of the protein is inherent in the type of grass, since very similar results were obtained for the same grass in first or second cuttings, and when fertilized with nitrogen or nitrogen and phosphorus.

The trials in which Guatemala grass was fed yielded the highest values obtained for the average coefficients of apparent digestibility for the dry matter, the lowest values obtained corresponded to the Yaragua grass. In the case of the coefficients for crude protein, Para grass trials of first cutting grass recorded the highest value, while the three trials with Yaragua grass yielded the lowest results. The other three trials with Para grass of second cuttings were significantly low, running second to the Yaragua grass trial results. The results obtained with second cutting Para grass seem to indicate that the cuttings exert a significant influence upon the digestibility of the protein. It is interesting to note that all the samples of Yaragua grass tested were from second cuttings and that they contained the least digestible proteins of all the grasses studied. Whether this low index of digestibility is inherent to the grass or is due to the cutting cannot be stated with certainty, since only second cuttings of this grass were tested. This grass also recorded very low coefficients of apparent digestibility for ash. These low values may be due either to the fact that the mineral constituents are not as readily absorbed as in the case of the other grasses or to a lack of palatability of the Yaragua grass, which is the least palatable of all the grasses investigated. Consequently, the animals consumed less of this grass during the ten-day experimental periods than the average weights eaten during similar trials with the other grasses. The total intake of mineral matter then was not enough to supply the output. This second explanation seems to us to be the most plausible one. Palatability is unquestionably an important factor which also has to be considered, as it may greatly influence the nutritive indexes. It is quite apparent that the addition of phosphorus to the fertilizer does not seem to influence the apparent coefficients of digestibility to any great extent.

The nutritive ratios show wide variations. Yaragua grass gives a very wide nutritive ratio, as is to be expected, for it has a low protein coefficient of apparent digestibility. As a matter of fact,

the nutritive ratio obtained in Trial No. 24 for this grass is extremely wide due to the very low digestibility of the protein. The values for the other two trials with this grass, although wide, are within reasonable limits. The nutritive ratio for corn fodder shows the narrowest value of all. The other grasses give values a little wider than those obtained for fresh green roughage in the United States.

Second cutting grasses recorded nutritive ratios which were always wider than those of the first cutting grasses. This is most probably due to the fact that the second cutting grasses yield, on a wet basis, lower percentages of protein than first cutting grasses. The fat and carbohydrate contents of second cutting grasses are higher than those for the first cutting grasses.

The chemical analyses of the grasses show some interesting facts. The protein contents vary, when the analyses are calculated on the dry basis, from 9.50 per cent for corn fodder, first cutting fertilized with nitrogen and prosphorus, to 2.61 per cent for Yaragua grass, second cutting, fertilized with nitrogen only. All second cutting grasses show lower protein contents than first cutting grasses. The same is true of the fat The nitrogen-free extract, on the contrary, is always greater in second cutting than in first cutting grasses. Guinea grass shows a higher calcium content than the other grasses; Guatemala grass gives the lowest result. Yaragua grass shows the highest per cent of crude fiber. The phosphorus contents of these grasses seem to be quite constant. The addition of phosphorus to the fertilizer has not shown any appreciable effect on the phosphorus contents of the grasses.

No conclusive results can be obtained from these series of experiments. We have considered only the two factors, fertilizer and cutting, in this discussion, but there is still a third which we have not touched on. This factor is the stage of maturity at which the grasses were cut and eaten by the experimental animals. As will be seen from the table of field conditions presented under the heading "Materials and Methods" at the beginning of this paper, some of the grasses sent to us were cut before the flowering stage and others, during the flowering stage. The stage of maturity at which the grasses are cut affects their nutritive values; therefore, this factor has to be studied separately, and will be, in further experiments.

Summary

1. Twenty metabolic experiments with grasses cut at different periods, between August 1936 and May 1937, are reported.

2. The biological values were determined for these grasses; the

highest recorded values belonging to Para grass and the lowest values to elephant grass.

3. The coefficients of apparent digestibility for Yaragua and malojillo grasses of second cutting are quite low.

4. All the grasses tend to give wide nutritive ratios, but Yaragua and malojillo, second cutting grasses, give exceptionally wide ones.

5. Yaragua grasses show a higher fiber content than any of the other grasses investigated.

6. Guinea grass yields, on analysis, significantly high values for calcium; Guatemala grass yielding the lowest values for this element in all the grasses studied.

7. First cuttings of grasses usually yield higher percentages of protein than second cuttings. The same is true of the fat. The nitrogen-free extract, on the contrary, is lower in first cutting than in second cutting grasses.

8. The addition of phosphorus to the fertilizer does not seem to influence to any great extent the nutritive indexes of the grasses studied.

9. The vitamin A activity of the leaves of the grasses has been determined.

Bibliography

1. **Mitchell, H. H.** A Method of Determining the Biological Value of Protein. Jour. Biol. Chem. **58**: 873–922. 1924.

2. **Sotola, J.** Biological Values and Supplementary Relations of the Proteins in Alfalfa Hay and in Corn and Sunflower Silage. Jour. Agric. Res. **40**: 70–96. 1930.

3. **Armsey, H. P.** The Nutrition of Farm Animals (1917). Quoted from Sotola, Jour. Agric. Res. **35**: 366. 1927.

4. **Sotola, J.** Relation of Maturity to the Nutritive Value of First, Second and Third Cuttings of Irrigated Alfalfa. Jour. Agric. Res. **35**: 361–383. 1927.

5. **Henry, W. H.** and **Morrison, F. B.** Feeds and Feedings. Eighteenth Edition, p. 40. The Henry–Morrison Co., Madison, Wisconsin.

6. **Turk, K. L., Morrison, F. B. & Maynard, L. A.** The Nutritive Value of the Proteins of Alfalfa Hay and Clover Hay when Fed Alone and in Combination with the Proteins of Corn. Joun. Agric. Res. **48**: 555–570. 1934.

7. **Miller, J. I., Morrison, F. B.** and **Maynard, L. A.** Relative Efficiency for Growing Lambs of the Protein in Rations Supplemented by Soybena-Oil Meal, Linseed Meal or Corn-Gluten Meal. Jour. Agric. Res. **54**: 437–448. 1937.

TABLE 1

PER CENT NITROGEN IN FEED FED, REFUSE LEFT, FECES & URINE

(FEED, REFUSE AND FECES ANALYSES, PER CENT ON DRY BASIS.)

(URINE ANALYSES, PER CENT BY VOLUME.)

Trial No.	Ration	Nitrogen in Feed Fed %	Nitrogen in Refuse Left %	Animal	Nitrogen in Feces %	Nitrogen in Urine %
1.....	Low protein diet Formula I..	0.17	.....	1A.... 2A.... 3A....	0.69 0.99 0.91	0.14 0.18 0.20
2.....	Corn fodder (N and P) first.	1.52	1.30	1A.... 2A.... 3A....	1.51 1.47 1.38	0.24 0.30 0.28
3.....	Low protein diet Formula I..	0.23	.....	1B.... 2B.... 3B....	0.84 0.92 1.05	0.60 0.37 0.17
4.....	Elephant grass (N only) first.	0.81	0.34	1A.... 2A.... 3A....	1.06 1.07 1.03	0.26 0.34 0.23
13.....	Elephant grass (N only) first..	0.87	0.40	1B....	1.01	0.18
6.....	Elephant grass (N and P)... first	0.72	0.37	1A.... 2A.... 3A....	1.09 1.17 1.07	0.28 0.43 0.32
11.....	Elephant grass (N and P)... first	1.20	0.52	1B.... 2B.... 3B....	1.14 1.19 1.08	0.13 0.13 0.15
5.....	Guinea grass (N only)..... first	0.94	0.62	1B.... 2B.... 3B....	0.95 0.92 0.93	0.35 0.47 0.42
12.....	Guinea grass (N only)..... first	0.87	0.40	1A.... 2A.... 3A....	0.97 1.08 1.08	0.23 0.27 0.30
7.....	Guinea grass (N and P)..... first	0.96	0.73	1B.... 2B.... 3B....	0.99 0.99 0.96	0.35 0.36 0.45
14.....	Guinea grass (N and P)..... first	0.83	0.46	1A.... 2A.... 3A....	1.01 1.02 0.99	0.18 0.34 0.25
8.....	Malojillo grass (N only)..... first cutting	1.06	0.52	1A.... 2A.... 3A....	1.28 1.37 1.21	0.21 0.29 0.24
27.....	Malojillo grass (N only)..... second cutting	0.50	0.38	1A.... 2A.... 3A....	1.02 0.89 0.81	0.48 0.52 0.38
20.....	Malojillo grass (N and P).... second cutting	0.62	0.30	1A.... 2A.... 3A....	1.00 1.01 1.05	0.19 0.40 0.37
25.....	Malojillo grass (N and P).... second cutting	0.44	0.34	1D.... 3D....	0.87 0.95	0.27 0.51
.....	Guatemala grass (N only).... first cutting	0.80	0.54	1B.... 2B.... 3B....	1.12 1.18 1.15	0.22 0.19 0.16
23.....	Guatemala grass (N only).... second cutting	0.69	0.55	1E.... 2E.... 3E....	1.00 1.05 1.15	0.19 0.38 0.22
10.....	Guatemala grass (N and P).. first cutting	0.83	0.43	1A.... 2A.... 3A....	1.34 1.15 1.24	0.19 0.17 0.16

TABLE 1—Contiuued

PER CENT NITROGEN IN FEED FED, REFUSE LEFT, FECES & URINE

(FEED, REFUSE AND FECES ANALYSES, PER CENT ON DRY BASIS.)

(URINE ANALYSES, PER CENT BY VOLUME.)

Trial No.	Ration	Nitrogen in Feed Fed %	Nitrogen in Refuse Left %	Animal	Nitrogen in Feces %	Nitrogen in Urine %
22.....	Guatemala grass (N and P).. second cutting	0.74	0.58	1D.... 3D....	1.14 1.12	0.22 0.21
24.....	Yaragua grass (N only)..... second cutting	0.42	0.37	1A.... 2A.... 3A....	1.29 0.95 0.97	0.33 0.23 0.29
17.....	Yaragua grass (N and P).... second cutting	0.54	0.32	1A.... 2A.... 3A....	0.98 0.86 0.95	0.12 0.21 0.21
26.....	Yaragua grass (N and P).... second cutting	0.49	0.33	1E.... 2E.... 3E....	0.98 1.10 1.16	0.22 0.34 0.24
15A....	Low protein diet.....	0.12	.....	1A.... 2A.... 3A....	0.62 0.90 0.94	0.10 0.33 0.84
30.....	Low protein diet..... Formula I	0.08	.....	1A.... 2A.... 3A....	0.92 0.82 0.80	0.11 0.19 0.12

TABLE 2

MAINTENANCE REQUIREMENT OF LAMBS AVERAGING 17.84 KILOGRAMS IN WEIGHT, BODY NITROGEN IN FECES PER GRAM OF DRY MATTER INGESTED AND BODY NITROGEN IN URINE PER 100 GRAMS OF BODY WEIGHT, BASED ON TEN-DAY TRIALS DURING WHICH NEARLY NITROGEN-FREE RATIONS WERE FED.

Trial No.	Animal No.	Average Weight Kg.	Dry Matter Ingested Gm.	Nitrogen in Feed Consumed %	Total Fecal Nitrogen Gm.	Total Urinary Nitrogen Gm.	Total Urinary & Fecal Nitrogen %	Fecal Nitrogen Per Gm. of Dry Matter Ingested	Urinary Nitrogen Per 100 Gm. Body Weight
1....	1-A...	18.35	4,245	0.17	13.80	12.71	26.51	0.0033	0.694
	2-A...	22.30	4,225	0.17	18.15	12.40	30.55	0.0043	0.556
	3-A...	18.00	3,660	0.17	15.48	8.92	24.40	0.0042	0.495
15....	1-A...	17.25	3,640	0.12	11.30	7.37	18.67	0.0048	0.427
	2-A...	15.85	2,830	0.12	16.71	6.35	23.06	0.0059	0.400
	3-A...	15.25	1,686	0.12	6.70	9.15	15.85	0.0040	0.600
30....	1-A...	20.48	2,920	0.08	11.98	9.90	21.88	0.0041	0.483
	2-A...	22.70	3,180	0.08	16.08	3.62	19.70	0.0051	0.159
	3-A...	20.83	2,800	0.08	10.15	4.75	14.90	0.0036	0.228
3....	1-B...	11.77	2,427	0.23	9.25	9.76	19.01	0.0038	0.830
	2-B...	16.55	3,089	0.23	14.22	10.38	24.60	0.0046	0.626
	3-B...	14.78	3,401	0.23	15.65	8.35	24.00	0.0046	0.565

TABLE 3

VALUES FOR BODY NITROGEN IN FECES PER GRAM OF DRY MATTER INGESTED AND BODY NITROGEN IN URINE PER KILOGRAM OF BODY WEIGHT AS OBTAINED BY DIFFERENT INVESTIGATORS WHEN NEARLY NITROGEN-FREE RATIONS ARE FED TO LAMBS

Remarks	Lamb No.	Body Nitrogen in Feces Per Gram of Dry Matter Ingested	Average Body Nitrogen in Feces Per Gram of Dry Matter Ingested	Body Nitrogen in Urine Per Kilogram of Body Weight	Average Body Nitrogen in Urine Per Kilogram of Body Weight
	1	0.0075	.....	0.428	.....
Sotola (2) performed two	2	0.0068	.....	0.236	.....
trials on each one of six	3	0.0059	.....	0.306	.....
lambs. Values given are	4	0.0064	.....	0.330	.....
average of the two trials	5	0.0070	.....	0.350	.....
(Black face lambs)	6	0.0058	0.0066	0.337	0.331
Turk Morrison & Maynard					
(6). These investigators	1	0.0061	.....	0.556	.....
used five animals and	2	0.0044	.....	0.480	.....
performed two trials on	3	0.0062	.....	0.360	.....
each animal. Values given	4	0.0065	.....	0.552	.....
are average of the two	5	0.0046	0.0056	0.393	0.468
trials. (Young growing wether lambs)					
Miller, Morrison and Maynard (7) report the following values obtained in 14 comparable experiments at the Cornell Station (Pure-bred and high-grade wether lambs of excellent mutton type used)	.....	0.0055	0.0055	0.370	0.370
The results obtained at the School of Tropical Medicine using six animals are given. Three trials					
were run on three of these	1A	0.0041	.....	0.801	.....
animals and only one trial					
on the other three. The	2A	0.0051	.....	0.335	.....
three trials in group A					
were run with a lapse of	3A	0.0035	.....	0.441	.....
about five months between each trial; the average					
value obtained for the three	1B	0.0038	.....	0.830	.....
trials is given. For animals					
of group B, the values	2B	0.0046	.....	0.626	.....
obtained from the only trial					
run is given	3B	0.0046	0.0043	0.565	0.526
(Wild Puerto Rican lambs ranging from six to eighteen months of age)					

TABLE 4

SUMMARY OF METABOLISM EXPERIMENTS UPON WHICH THE DETERMINATIONS OF BIOLOGICAL VALUES OF PROTEINS IN THE GRASSES IS BASED

Trial Number and Ration	Animal No.	Body Weight			Feed Intake Wet Gm.	Feed Intake Dry Gm.	N Intake Gm.	Total Fecal N Gm.	Body N in Feces Gm.	Food N in Feces Gm.	Absorbed N Gm.	Total N in Urine Gm.	Body N in Urine Gm.	Food N in Urine Gm.	Food N Retained Gm.	Biological Value	Ave. Biological Value
		Initial Kg.	Final Kg.	Ave. Kg.													
Trial 1	1-A...	19.10	17.70	18.35	4,280	4,245	7.22	13.80	13.80	.....	.....	12.71	12.71	.....	.....	.....	.....
Low Protein	2-A...	23.20	22.00	22.30	4,260	4,225	7.16	18.15	18.15	.....	.....	12.40	12.40	.....	.....	.....	.....
Diet	3-A...	18.50	17.50	18.00	3,690	3,660	6.23	15.48	15.48	.....	.....	8.92	8.92	.....	.....	.....	.....
Trial 2	1-A...	17.80	21.20	19.50	25,385	5,915	98.30	35.00	25.41	9.59	88.71	22.10	10.25	11.85	76.86	87	.....
Corn Fodder	2-A...	21.60	23.40	22.50	24,791	5,811	97.20	32.80	25.00	7.80	89.40	22.55	11.82	10.73	78.67	88	86
(N and P)	3-A...	16.55	18.40	17.48	20,305	4,659	81.60	27.00	20.02	6.98	74.62	22.41	9.20	13.11	61.51	83	.....
Trial 3.....	1-B...	12.08	11.45	11.77	2,561	2,427	5.61	9.25	9.25	.....	.....	9.76	9.76	.....	.....	.....	.....
Low Protein	2-B...	16.90	16.20	16.55	3,259	3,089	7.16	14.22	14.22	.....	.....	10.38	10.38	.....	.....	.....	.....
Diet.....	3-B...	15.05	14.50	14.78	3,588	3,401	7.85	15.65	15.65	.....	.....	8.35	8.35	.....	.....	.....	.....
Trial 4	1-A...	20.85	22.10	21.48	22,230	5,820	71.60	27.20	25.02	2.18	69.42	24.95	11.30	13.65	55.77	80	.....
Elephant Grass	2-A...	23.40	24.20	23.80	20,557	5,367	67.60	24.50	23.10	1.40	66.20	26.90	12.74	14.16	52.04	79	80
(N only)	3-A...	17.90	19.50	18.70	19,552	5,052	67.20	24.78	21.80	2.98	64.22	22.20	9.85	12.35	51.87	81	.....
Trial 13 Elephant grass (N only)	1-B...	14.00	12.50	13.30	28,224	7,050	75.00	28.00	30.30	.....	75.00	21.60	7.00	14.60	60.40	81	81
Trial 6	1-A...	21.58	22.39	21.99	20,781	5,590	60.80	30.90	24.00	6.90	53.90	29.00	11.55	17.45	36.45	68	.....
Elephant grass	2-A...	23.23	23.70	23.47	19,391	5,150	59.20	31.20	22.18	9.02	50.18	29.10	12.35	16.75	33.43	67	69
(N and P)	3-A...	20.25	19.30	19.78	21,393	5,810	61.60	31.95	25.00	6.95	54.65	25.12	10.40	14.72	39.93	73	.....
Trial 11	1-B...	14.30	14.30	14.30	31,660	6,432	88.80	28.60	27.61	0.99	87.81	21.80	7.55	14.25	73.56	84	.....
Elephant grass	2-B...	20.40	20.70	20.55	35,107	6,850	89.10	39.70	29.40	10.30	78.80	27.24	10.80	16.44	62.36	79	80
(N and P)	3-B...	16.10	16.55	16.33	33,878	6,648	87.95	31.50	28.60	3.90	84.05	27.60	8.60	19.00	65.05	77	.....
Trial 5	1-B...	12.49	13.90	13.20	19,635	5,990	71.10	29.60	25.79	3.81	67.29	16.55	6.95	9.60	57.69	86	.....
Guinea grass	2-B...	18.10	20.20	19.15	21,785	6,590	74.50	28.90	28.30	0.60	73.90	27.50	10.09	17.41	56.49	77	80
(N only)	3-B...	16.55	15.33	15.99	20,108	6,110	71.70	27.95	26.21	1.74	69.96	24.80	8.43	16.37	53.59	77	.....
Trial 12	1-A...	23.80	24.20	24.00	27,903	8,050	89.50	34.80	34.60	0.20	89.30	28.39	12.60	15.79	73.51	82	.....
Guinea grass	2-A...	23.40	28.10	25.25	26,960	8,170	90.00	43.90	35.10	8.80	81.20	21.50	13.30	8.20	73.00	90	86
(N only)	3-A...	19.40	21.5	20.45	26,078	7,820	74.70	31.00	33.60	3.40	71.30	21.50	10.74	10.76	60.54	85	.....
Trial 7	1-B...	13.40	14.21	13.81	21,680	6,570	75.00	31.00	28.21	2.79	72.21	23.80	7.27	16.53	55.68	77	.....
Guinea grass	2-B...	18.95	20.00	19.48	22,293	6,750	76.40	28.22	29.00	.....	76.40	29.60	10.23	16.67	59.73	78	77
(N and P)	3-B...	16.35	15.90	16.13	19,554	5,960	65.50	28.00	25.60	2.40	63.10	23.75	8.50	15.25	47.85	76	.....

Trial 14	1-A...	23.50	23.70	23.60	27,264	8,180	83.30	37.40	35.35	2.05	81.25	21.35	12.50	8.85	72.40	89	.....
Guinea grass.....	2-A...	23.60	23.30	23.45	27,986	8,390	84.28	40.60	36.05	4.55	79.73	21.60	12.30	9.30	70.43	88	89
(N and P)	3-A...	20.00	20.09	20.05	24,761	7,430	79.90	36.00	32.00	4.00	75.90	17.55	10.57	6.98	68.92	91	.....
Trial 8	1-A...	21.60	23.18	22.39	26,102	6,260	90.20	32.80	26.90	5.90	84.30	25.35	11.75	13.60	70.70	84	.....
Malojillo grass	2-A...	23.95	23.80	23.88	25,183	5,990	88.80	30.00	25.75	4.25	84.55	21.00	12.50	8.50	76.05	90	88
(N only)	3-A...	18.85	21.20	20.03	26,480	6,380	90.80	28.22	27.41	0.81	89.99	18.75	10.56	8.19	81.80	91	.....
Trial 27	1-A...	20.80	21.20	21.00	19,104	8,550	51.20	30.90	36.80	.....	51.20	9.66	11.07	.....	.....	.....	.....
Malojillo grass	2-A...	20.50	20.80	20.65	21,034	9,160	53.55	30.20	39.40	.....	53.55	12.40	10.88	1.52	52.03	97	97
(N only)	3-A...	19.10	19.40	19.25	19,968	8,820	52.20	28.95	38.20	.....	52.20	8.76	10.10	.....	.....	.....	.....
Trial 20	1-A...	21.20	23.40	22.30	26,231	7,240	59.75	36.16	31.10	5.06	54.69	18.40	11.72	6.68	48.01	88	.....
Malojillo grass	2-A...	20.70	21.70	21.20	26,216	7,240	59.75	38.02	31.10	6.92	52.83	19.30	11.17	8.13	44.70	85	89
(N and P)	3-A...	18.50	20.40	19.45	23,696	6,430	57.30	33.18	27.61	5.57	51.73	12.78	10.22	2.56	49.17	95	.....
Trial 25																	
Malojillo grass	1-D...	20.20	21.20	20.70	19,923	6,500	34.30	28.75	28.00	0.75	33.55	14.40	10.90	3.50	39.05	91	.....
(N and P)	3-D...	13.01	14.85	13.93	15,757	4,780	28.50	23.50	20.59	2.91	25.59	9.57	7.35	2.22	23.37	91	91
Trial 9	1-B...	14.28	17.00	15.64	26,971	7,120	67.00	26.20	30.60	.....	67.00	21.50	8.25	13.25	53.75	80	.....
Guatemala grass	2-B...	20.50	21.50	21.00	29,073	7,740	70.40	29.99	33.25	.....	70.40	21.80	11.08	10.72	59.68	85	84
(N only)	3-B...	17.00	16.30	16.65	28,026	7,450	68.00	26.55	32.00	.....	68.00	17.70	8.76	8.94	59.06	87	.....
Trial 23	1-E...	14.43	16.05	15.24	19,370	6,720	48.80	23.22	28.85	.....	48.80	17.90	8.02	9.88	38.92	80	.....
Guatemala grass	2-E...	12.68	14.85	13.77	14,273	4,130	40.00	16.95	17.75	.....	40.00	14.90	7.25	7.65	32.35	81	81
(N only)	3-E...	12.42	14.84	13.63	13,814	4,000	39.50	18.71	17.20	.....	39.50	14.70	7.19	7.51	31.99	81	.....
Trial 10	1-A...	22.80	22.70	22.75	26,969	6,380	67.42	31.80	27.41	4.39	63.03	23.15	11.96	11.19	51.84	82	.....
Guatemala grass	2-A...	24.80	23.60	24.20	28,285	6,755	69.00	28.50	29.00	.....	69.00	22.50	11.83	10.67	58.33	85	85
(N and P)	3-A...	18.95	20.60	19.78	28,690	6,860	69.50	31.40	29.50	1.90	67.60	19.10	10.40	8.70	58.90	87	.....
Trial 22																	
Guatemala grass	1-D...	18.70	21.20	19.95	23,023	7,100	61.20	25.40	30.50	.....	61.20	21.92	10.50	11.42	49.78	81	.....
(N and P)	3-D...	12.81	12.88	12.88	15,019	4,730	47.50	20.00	20.03	.....	47.50	11.61	6.77	4.84	42.66	90	86
Trial 24	1-A...	21.00	18.27	19.64	16,325	4,660	24.40	29.00	20.00	9.00	15.40	14.30	10.33	3.97	11.43	75	.....
Yaragua grass	2-A...	21.02	20.55	20.79	19,754	6,100	29.97	28.00	26.20	1.80	28.17	12.00	10.90	1.10	27.07	96	88
(N only)	3-A...	18.87	19.80	19.34	19,323	5,900	29.10	31.50	25.40	6.10	23.00	12.00	10.19	1.81	21.19	92	.....
Trial 17	1-A...	20.85	21.95	20.98	16,932	4,930	35.10	27.50	21.20	6.30	28.80	12.70	11.00	1.70	27.10	94	.....
Yaragua grass	2-A...	18.60	22.25	20.43	18,636	5,655	36.61	27.15	24.35	2.80	33.81	14.40	10.79	3.61	30.20	89	90
(N and P)	3-A...	18.50	18.50	18.50	16,106	4,580	33.30	26.50	19.70	6.80	26.50	13.35	9.75	3.60	22.90	87	.....
Trial 26	1-E...	15.25	14.70	14.98	15,776	4,670	34.20	25.58	20.10	5.48	28.72	15.30	7.98	7.32	21.40	75	85
Yaragua grass	2-E...	14.44	14.70	14.75	11,657	3,110	18.20	20.50	13.35	7.15	21.05	9.50	7.77	1.73	19.32	92	85
(N and P)	3-E...	14.03	14.30	14.17	13,790	4,000	31.10	27.10	17.20	9.90	21.20	10.10	7.45	2.65	18.55	88	.....
Trial 15-A.....	1-A...	17.90	16.60	17.25	4,000	3,640	4.37	11.29	11.29	.....	.....	7.37	7.37	.....	.....	.....	.....
Low Protein	2-A...	16.60	15.10	15.85	3,106	2,830	3.40	16.72	16.72	.....	.....	6.35	6.35	.....	.....	.....	.....
Diet	3-A...	15.40	15.10	15.25	1,855	1,686	2.02	6.76	6.76	.....	.....	9.15	9.15	.....	.....	.....	.....
Trial 30	1-A...	21.30	19.65	20.48	3,183	2,920	2.34	11.91	11.91	.....	.....	9.90	9.90	.....	.....	.....	.....
Low Protein	2-A...	24.20	21.20	22.70	3,463	3,180	2.55	16.10	16.10	.....	.....	3.62	3.62	.....	.....	.....	.....
Diet	3-A...	21.40	20.25	20.83	3,072	2,800	2.24	10.20	10.20	.....	.....	4.75	4.75	.....	.....	.....	.....

TABLE 5

PROXIMATE ANALYSES, REPORTED ON DRY BASIS, OF THE FED AND REFUSED PORTIONS OF THE RATIONS USED IN THE DIFFERENT METABOLISM EXPERIMENTS

Ration	Crude Protein (N x 6.25) %		Fat %		Crude Fiber %		Nitrogen-free Extract %		Ash %	
	Feed fed	Feed refused	Feed fed	Feed refused	Feed fed	Feed refused	Feed fed	Feed refused	Feed fed	Feed refused
TRIAL No. 2: Corn fodder (fert. N and P) first cutting	9.50	8.12	4.31	2.87	30.90	27.20	49.30	55.83	5.99	5.98
TRIAL No. 4: Elephant grass (fert. N only) first cutting	5.06	2.12	3.60	2.28	36.35	41.45	47.63	49.45	7.36	4.70
TRIAL No. 13: Elephant grass (fert. N only) first cutting	5.44	2.50	2.61	2.12	37.25	39.60	44.10	46.92	10.60	8.86
TRIAL No. 6: Elephant grass (fert. N and P) first cutting	4.50	2.31	2.96	1.96	35.80	43.70	49.84	47.78	6.90	4.25
TRIAL No. 11: Elephant grass (fert. N and P) first cutting	7.50	3.26	3.24	2.53	32.88	37.00	45.98	48.16	10.40	9.05
TRIAL No. 5: Guinea grass (fert. N only) first cutting	5.87	3.88	2.76	1.69	38.20	39.40	43.52	46.15	9.65	8.88
TRIAL No. 12: Guinea grass (fert. N only) first cutting	5.44	2.50	2.14	1.48	34.05	39.75	46.57	46.92	11.80	9.35
TRIAL No. 7: Guinea grass (fert. N and P) first cutting	6.00	4.56	2.43	1.74	35.43	38.25	46.56	46.51	9.58	8.94
TRIAL No. 14: Guinea grass (fert. N and P) first cutting	5.18	2.78	2.60	1.86	33.80	35.93	46.27	46.25	12.15	13.18
TRIAL No. 8: Malojillo grass (fert. N only) first cutting	6.64	3.25	2.52	1.42	31.00	36.05	50.77	51.92	9.07	7.36
TRIAL No. 27: Malojillo grass (fert. N only) second cutting	3.11	2.39	1.79	1.32	33.05	32.90	56.35	58.85	5.70	4.54
TRIAL No. 20: Malojillo grass (fert. N and P) second cutting	3.88	1.88	1.97	1.43	32.50	34.88	53.39	55.62	8.26	6.19

TRIAL No. 25: Malojillo grass (fert. N and P) second cutting	2.75	2.12	1.74	1.61	32.50	35.95	55.79	54.06	7.22	6.26
TRIAL No. 9: Guatemala grass (fert. N only) first cutting	5.00	3.38	2.98	1.72	37.03	42.21	47.54	45.82	7.45	6.87
TRIAL No. 23: Guatemala grass (fert. N only) second cutting	4.31	3.44	2.47	1.75	33.40	34.96	51.79	52.72	8.03	7.13
TRIAL No. 10: Guatemala grass (fert. N and P) first cutting	5.19	2.69	2.89	1.97	35.55	38.15	47.71	48.67	8.66	8.52
TRIAL No. 22: Guatemala grass (fert. N and P) second cutting	4.62	3.65	2.68	2.32	31.25	35.25	53.20	50.90	8.25	7.88
TRIAL No. 24: Yaragua grass (fert. N only) second cutting	2.61	2.30	2.23	2.14	38.60	40.20	49.12	48.41	7.44	6.95
TRIAL No. 17: Yaragua grass (fert. N and P) second cutting	3.40	1.97	2.40	1.33	42.15	48.10	44.60	43.26	7.45	5.34
TRIAL No. 26: Yaragua grass (fert. N and P) second cutting	3.06	2.06	2.63	1.92	39.90	42.90	48.21	47.42	6.20	5.70

TABLE 6

PROXIMATE ANALYSES OF THE FECES, REPORTED ON DRY BASIS, AVERAGE COMPOSITE SAMPLE OF TEN-DAY METABOLISM EXPERIMENTS

Trial No.	Animal No.	Ration	Crude Protein (N x 6.25) %	Fat %	Crude Fiber %	Nitrogen-free Extract %	Ash %
1.....	1-A...	Low protein diet form I.....	4.30	.....	.....	.....	.....
	2-A...	Low protein diet form I.....	6.18	.....	.....	.....	.....
	3-A...	Low protein diet form I.....	5.68	.....	.....	.....	.....
2.....	1-A...	Corn fodder (fert. N and P) firts cutting.....	9.44	2.53	23.55	52.78	11.70
	2-A...	Corn fodder (fert. N and P) first cutting.....	9.19	2.31	24.34	53.35	10.81
	3-A...	Corn fodder (fert. N and P) first cutting.....	8.60	2.69	24.45	51.68	12.58
3.....	1-B...	Low protein diet form I.....	5.25	.....	.....	.....	.....
	2-B...	Low protein diet form I.....	5.75	.....	.....	.....	.....
	3-B...	Low protein diet form I.....	6.55	.....	.....	.....	.....
4.....	1-A...	Elephant grass (fert. N only) first cutting.....	6.67	3.06	24.80	50.02	15.45
	2-A...	Elephant grass (fert. N only) first cutting.....	6.67	3.04	27.55	46.93	15.81
	3-A...	Elephant grass (fert. N only) first cutting.....	6.44	3.06	30.00	46.30	14.20
13.....	1-B...	Elephant grass (fert. N only) first cutting.....	6.30	2.79	29.90	45.11	15.90
6.....	1-A...	Elephant grass (fert. N and P) first cutting.....	6.81	3.23	31.37	42.86	15.73
	2-A...	Elephant grass (fert. N and P) first cutting.....	7.30	3.37	26.35	47.40	15.58
	3-A...	Elephant grass (fert. N and P) first cutting.....	6.68	3.18	29.90	46.17	14.07
11.....	1-B...	Elephant grass (first N and P) first cutting.....	7.14	2.62	29.10	45.34	15.80
	2-B...	Elephant grass (fert. N and P) first cutting.....	7.45	3.04	30.50	43.20	15.81
	3-B...	Elephant grass (fert. N and P) first cutting.....	6.75	2.76	31.51	43.28	15.70
5.....	1-B...	Guinea grass (fert. N only) first cutting.....	5.94	2.48	32.14	43.63	15.81
	2-B...	Guinea grass (fert. N only) first cutting.....	5.75	2.39	32.28	43.78	15.80
	3-B...	Guinea grass (fert. N only) first cutting.....	5.81	2.26	32.97	42.31	16.65
12.....	1-A...	Guinea grass (fert. N only) first cutting.....	6.06	3.04	31.05	40.15	19.70
	2-A...	Guinea grass (fert. N only) first cutting.....	6.75	2.89	29.04	39.92	21.40
	3-A...	Guinea grass (fert. N only) first cutting.....	6.75	2.74	26.09	43.42	21.00
7.....	1-B...	Guinea grass (fert. N and P) first cutting.....	6.19	2.94	32.86	42.10	15.91
	2-B...	Guinea grass (fert. N and P) first cutting.....	6.19	2.81	33.15	41.40	16.45
	3-B...	Guinea grass (fert. N and P) first cutting.....	6.00	2.93	30.40	43.47	17.20
14.....	1-A...	Guinea grass (fert. N and P) first cutting.....	6.30	2.56	28.47	41.29	21.38
	2-A...	Guinea grass (fert. N and P) first cutting.....	6.37	2.34	28.55	40.33	22.41
	3-A...	Guinea grass (fert. N and P) first cutting.....	6.19	2.36	27.20	42.45	21.80
8.....	1-A...	Malojillo grass (fert. N only) first cutting.....	8.00	3.57	28.35	44.48	15.60
	2-A...	Malojillo grass (fert. N only) first cutting.....	8.55	3.55	22.50	47.90	17.50
	8-A...	Malojillo grass (fert. N only) first cutting.....	7.56	3.10	26.70	48.24	14.40

TABLE 6—Continued

PROXIMATE ANALYSES OF THE FECES, REPORTED ON DRY BASIS, AVERAGE COMPOSITE SAMPLE OF TEN-DAY METABOLISM EXPERIMENTS

Trial No.	Animal No.	Ration	Crude Protein (N x 6.25) %	Fat %	Crude Fiber %	Nitrogen-free Extract %	Ash %
27.....	1-A...	Malojillo grass (fert. N only) second cutting.....	6.38	1.69	33.50	48.13	10.30
	2-A...	Malojillo grass (fert. N only) second cutting.....	5.56	1.89	31.85	50.08	10.62
	3-A...	Malojillo grass (fert. N only) second cutting.....	5.06	1.72	33.85	48.47	10.90
20.....	1-A...	Malojillo grass (fert. N and P) second cutting.....	6.25	1.92	30.66	46.57	14.60
	2-A...	Malojillo grass (fert. N and P) second cutting.....	6.31	1.22	32.70	46.27	13.50
	3-A...	Malojillo grass (fert. N and P) second cutting.....	6.56	1.36	30.10	47.13	14.85
25.....	1-D...	Malojillo grass (fert. N and P) second cutting.....	5.45	1.90	35.35	43.80	13.50
	3-D...	Malojillo grass (fert. N and P) second cutting.....	5.94	1.82	35.30	44.04	12.90
9.....	1-B...	Guatemala grass (fert. N only) first cutting.....	7.00	2.46	31.35	47.24	11.95
	2-B...	Guatemala grass (fert. N only) first cutting.....	7.37	2.28	32.08	45.58	12.70
	3-B...	Guatemala grass (fert. N only) first cutting.....	7.19	2.31	30.23	47.87	12.40
23.....	1-E...	Guatemala grass (fert. N only) second cutting.....	6.25	2.07	30.12	47.96	13.60
	2-E...	Guatemala grass (fert. N only) second cutting.....	6.56	2.24	31.21	45.69	14.30
	3-E...	Guatemala grass (fert. N only) second cutting.....	7.20	2.30	30.05	45.20	15.25
16.....	1-A...	Guatemala grass (fert. N and P) first cutting.....	8.38	2.49	32.30	43.53	13.30
	2-A...	Guatemala grass (fert. N and P) first cutting.....	7.19	2.34	30.95	45.92	13.60
	3-A...	Guatemala grass (fert. N and P) first cutting.....	7.75	2.35	31.81	45.09	13.00
22.....	1-D...	Guatemala grass (fert. N and P) second cutting.....	7.13	2.19	30.45	45.63	14.60
	3-D...	Guatemala grass (fert. N and P) second cutting.....	7.00	2.32	29.35	46.13	15.20
24.....	1-A...	Yaregua grass (fert. N only) second cutting.....	8.05	2.99	28.73	44.58	15.65
	2-A...	Yaregua grass (fert. N only) second cutting.....	5.94	2.88	30.60	46.18	14.40
	3-A...	Yaregua grass (fert. N only) second cutting.....	6.05	3.22	30.90	45.33	14.50
17.....	1A....	Yaregua grass (fert. N and P). second cutting.....	6.13	2.56	29.20	45.81	16.30
	2-A...	Yaregua grass (fert. Nand P) second cutting.....	5.37	2.19	31.45	46.29	14.70
	3-A...	Yaregua grass (fert. N and P) second cutting.....	5.94	2.98	29.09	45.89	16.10
26.....	1-E...	Yaregua grass (fert. N and P) second cutting.....	6.13	3.93	30.50	44.64	14.80
	2-E...	Yaregua grass (fert. N and P) second cutting.....	6.87	3.92	31.00	44.81	13.40
	3-E...	Yaregua grass (fert. N and P) second cutting.....	7.25	4.10	29.25	45.19	14.21
15-A...	1-A...	Low protein diet form I.....	3.88	.....	.....	.....	.....
	2-A...	Low protein diet form I.....	5.62	.....	.....	.....	.....
	3-A...	Low protein diet form I.....	5.87	.....	.....	.....	.....
30.....	1-A...	Low protein diet form II.....	5.75	.....	.....	.....	.....
	2-A...	Low protein diet form II.....	5.11	.....	.....	.....	.....
	3-A...	Low protein diet form II.....	4.97	.....	.....	.....	.....

TABLE 7

COEFFICIENTS OF APPARENT DIGESTIBILITY

Trial No.	Ration	Animal No.	Dry Matter %	Crude Protein (N x 6.25)%	Fat %	Crude Fiber %	Nitrogen-free Extract %	Ash %	Organic Matter %
2.....	Corn fodder (N and P) first cutting in flower.....	1-A.....	62	66	82	73	56	27	66
		2-A.....	63	67	84	73	56	33	65
		3-A.....	59	68	81	71	50	14	62
	AVERAGE.....	.....	61	67	82	72	54	24	64
4.....	Elephant grass (N only) first cutting before flowering..	1-A.....	57	63	72	66	53	31	66
		2-A.....	58	65	74	63	57	33	61
		3-A.....	53	64	72	54	53	36	54
	AVERAGE.....	.....	56	64	73	61	54	33	60
13.....	Elephant grass (N only) first cutting before flowering.	1-B.....	61	63	61	68	59	45	63
	AVERAGE.....	.....	61	63	61	68	59	45	63
6.....	Elephant grass (N and P) first cutting before flowering	1-A.....	49	49	59	43	58	17	53
		2-A.....	48	47	58	48	53	20	51
		3-A.....	49	48	58	46	54	24	51
	AVERAGE.....	.....	49	48	58	46	54	20	52
11.....	Elephant grasss (N and P) first cutting before flowering	1-B.....	61	67	70	65	61	42	64
		2-B.....	51	56	56	54	54	27	54
		3-B.....	55	63	63	56	57	33	57
	AVERAGE.....	.....	56	62	63	58	57	34	58
5.....	Guinea grass (N only) first cutting in flower.....	1-B.....	48	58	64	56	46	19	59
		2-B.....	52	62	67	59	51	26	55
		3-B.....	50	60	68	57	50	19	55
	AVERAGE.....	.....	50	60	66	57	49	21	56
12.....	Guinea grass (N only) first cutting in flower.....	1-A.....	53	59	42	53	60	29	58
		2-A.....	50	51	41	54	58	18	51
		3-A.....	56	58	52	63	59	30	60
	AVERAGE.....	.....	53	56	45	57	59	28	56

7.....	Guinea grass (N and P) first cutting in flower.....	1-B.....	52	59	53	53	57	25	55
		2-B.....	58	64	60	58	63	31	60
		3-B.....	51	60	54	55	54	17	55
	AVERAGE.....	.....	53	61	56	55	58	24	63
14.....	Guinea grass (N and P) first cutting in flower.....	1-A.....	55	55	60	61	60	17	60
		2-A.....	53	52	62	59	59	9	58
		3-A.....	51	55	63	59	55	7	57
	AVERAGE.....	.....	53	54	62	60	58	11	58
8.....	Malojillo grass (N and P) first cutting before flowering.	1-A.....	59	64	56	58	64	38	67
		2-A.....	64	66	62	70	65	38	73
		3-A.....	63	69	65	65	65	49	70
	AVERAGE.....	.....	62	66	61	64	64	42	71
27.....	Malojillo grass (N only) second cutting in flower.....	1-A.....	65	39	73	65	69	46	66
		2-A.....	63	43	62	65	66	39	65
		3-A.....	61	46	68	60	65	35	63
	AVERAGE.....	.....	63	42	68	63	67	40	65
20.....	Malojillo grass (N and P) second cutting in flower....	1-A.....	50	39	59	51	55	24	53
		2-A.....	48	36	73	45	54	31	50
		3-A.....	51	42	73	52	55	27	54
	AVERAGE.....	.....	50	39	68	49	55	27	52
25.....	Malojillo grass (N and P) second cutting in flower	1-D.....	49	16	57	40	61	16	52
		3-D.....	48	17	51	.....	60	22	50
	AVERAGE.....	.....	32	17	54	40	61	19	51
9.....	Guatemala grass (N only) first cutting before flowering..	1-B.....	67	61	78	70	68	50	69
		2-B.....	67	58	79	70	69	46	69
		3-B.....	69	61	81	73	70	50	71
	AVERAGE.....	.....	68	60	79	71	69	49	70
23.....	Guatemala grass (N only) second cutting before flowering	1-E.....	59	52	75	62	62	39	58
		2-E.....	61	58	78	60	64	43	63
		3-E.....	59	53	77	59	63	38	61
	AVERAGE.....	.....	60	54	77	60	63	40	61

TABLE 7—Continued

COEFFICIENTS OF APPARENT DIGESTIBILITY

Trial No.	Ration	Animal No.	Dry Matter %	Crude Protein (N x 6.25) %	Fat %	Crude Fiber %	Nitrogen-free Extract %	Ash %	Organic Matter %
10.....	Guatemala grass (N & P) first cutting before flowering.	1-A.....	63	53	73	65	66	44	65
		2-A.....	63	59	74	67	64	43	65
		3-A.....	63	55	74	67	65	45	65
	AVERAGE.....	.....	63	56	74	66	65	44	65
22.....	Guatemala grass (N & P) second cutting before flowering.	1-D.....	69	58	77	66	74	47	71
		3-D.....	62	57	73	54	70	35	65
	AVERAGE.....	.....	66	58	75	60	72	41	68
24.....	Yaragua grass (N only) second cutting before flowering..	1-A.....	52	.....	41	61	57	11	56
		2-A.....	52	5	41	60	56	14	55
		3-A.....	45	.....	25	54	51	2	49
	AVERAGE.....	.....	50	5	36	58	50	9	53
17.....	Yaragua grass (N & P) second cutting before flowering...	1-A.....	43	23	55	56	43	.....	48
		2-A.....	44	27	58	55	43	3	48
		3-A.....	39	21	45	52	39	.....	44
	AVERAGE.....	.....	42	24	53	54	42	3	47
26.....	Yaragua grass (N & P) second cutting before flowering..	1-E.....	44	25	41	45	50	.....	59
		2-E.....	40	29	49	40	46	.....	44
		3-E.....	42	13	38	51	47	.....	46
	AVERAGE.....	.....	42	22	43	45	48	.....	50

TABLE 8

DIGESTIBLE NUTRIENTS IN 100 LBS. OF PUERTO RICAN FEEDING STUFFS AS CUT

Feeding stuff	Total dry matter	Digestible Nutrients				Nutritive ratio
		Crude Protein	Fat	Carbo-hydrates	Total (inc. fat x 2.25)	
1 Corn fodder (fert. N and P) first cutting	23.79	1.51	0.84	11.71	13.60	1:9.0
4 Elephant grass (fert. N only) first cutting	27.68	0.90	0.73	13.06	14.75	1:16.4
13 Elephant grass (fert. N only) first cutting	24.60	0.85	0.39	12.64	13.52	1:16.0
6 Elephant grass (fert. N and P) first cutting	30.08	0.63	0.52	13.05	14.22	1:22.5
11 Elephant grass (fert. N and P) first cutting	19.23	0.90	0.39	8.70	9.58	1:10.6
5 Guinea grass (fert. N only) first cutting	29.44	1.05	0.54	12.20	13.42	1:12.8
12 Guinea grass (fert. N only) first cutting	29.84	0.91	0.29	14.00	14.66	1:16.1
7 Guinea grass (fert. N and P) first cutting	29.64	1.08	0.40	13.81	14.71	1:13.6
14 Guinea grass (fert. N and P) first cutting	30.00	0.84	0.48	14.05	15.13	1:18.0
8 Malojillo grass (fert. N only) first cutting	26.18	1.15	0.40	13.70	14.60	1:12.7
27 Malojillo grass (fert. N only) second cutting	37.90	0.50	0.46	22.33	23.37	1:46.7
20 Malojillo grass (fert. N and P) second cutting	29.10	0.44	0.39	12.27	13.15	1:30.0
25 Malojillo grass (fert. N and P) second cutting	34.00	0.21	0.32	17.57	18.29	1:87.0
9 Guatemala grass (fert. N only) first cutting	27.00	0.81	0.64	15.20	16.64	1:20.6
28 Guatemala grass (fert. N only) second cutting	30.50	0.70	0.57	16.40	17.68	1:25.2
10 Guatemala grass (fert. N and P) first cutting	24.60	0.72	0.53	13.42	14.62	1:20.4
22 Guatemala grass (fert. N and P) second cutting	30.40	0.81	0.62	17.30	18.70	1:23.1
24 Yaragua grass (fert. N only) second cutting	36.30	0.05	0.29	17.08	17.74	1:35.4
17 Yaragua grass (fert. N and P) second cutting	34.00	0.28	0.44	14.13	15.12	1:54.0
26 Yaragua grass (fert. N and P) second cutting	34.80	0.23	0.40	14.30	15.20	1:66.2

Note: "N and P" stands for nitrogen and phosphorus in the fertilizer.
"N" stands for nitrogen only in the fertilizer.

TABLE 9

PROXIMATE ANALYSES OF THE GRASSES USED IN THE NUTRITIONAL EXPERIMENTS AS CUT (WET BASIS)

Trial No.	Dates on which the grasses were collected at Río Piedras	Name of the grass	Total moisture as fed %	Crude protein (N x 6.25) %	Fat %	Crude fiber %	N-free extract %	Ash %	Calcium %	Phosphorus %
2.	August 27 to September 5, 1936	Corn fodder (N and P) first cutting in flower	76.21	2.26	1.02	7.35	11.74	1.42	0.0621	0.0415
4.	September 22 to October 2, 1936	Elephant grass (N only) first cutting before flowering	72.32	1.40	1.00	10.10	12.78	2.40	0.0582	0.0393
13.	January 6 to January 16, 1937	Elephant grass (N only) first cutting before flowering	75.40	1.34	0.64	9.18	10.83	2.61	0.0825	0.0430
6.	October 3 to October 23, 1936	Elephant grass (N and P) first cutting before flowering	69.92	1.31	0.89	10.79	15.01	2.08	0.0866	0.0425
11.	December 16 to December 26, 1936	Elephant grass (N and P) first cutting before flowering	80.77	1.44	0.62	6.34	8.83	2.00	0.0640	0.0420
5.	October 3 to October 23, 1936	Guinea grass (N only) first cutting in flower	70.56	1.73	0.81	11.21	11.85	3.84	0.0983	0.0347
12.	December 16 to December 26, 1936	Guinea grass (N only) first cutting in flower	70.16	1.62	0.64	10.18	13.88	3.52	0.1330	0.0630
7.	November 4 to November 14, 1936	Guinea grass (N and P) first cutting in flower	70.36	1.78	0.72	10.50	13.80	2.84	0.1050	0.0456
14.	January 6 to January 16, 1937	Guinea grass (N and P) first cutting in flower	70.16	1.56	0.78	10.15	13.70	3.65	0.1430	0.0741
8.	November 4 to November 14, 1936	Malojillo grass (N only) first cutting before flowering	73.82	1.74	0.66	8.11	13.30	2.37	0.0772	0.0374
27.	April 28 to May 8, 1937	Malojillo grass (N only) second cutting in flower	62.10	1.18	0.68	12.50	15.53	2.41	0.0718	0.0383
20.	March 15 to March 25, 1937	Malojillo grass (N and P) second cutting in flower	70.90	1.13	0.57	9.46	19.12	2.45	0.0854	0.0500
25.	April 17 to April 27, 1937	Malojillo grass (N and P) second cutting in flower	66.00	0.94	0.59	10.90	12.83	2.01	0.0485	0.0335
9.	November 25 to December 5, 1936	Guatemala grass (N only) first cutting before flowering	73.00	1.35	0.81	10.00	16.03	2.42	0.0546	0.0450

23.....	March 26 to April 5, 1937.....	Guatemala grass (N only) second cutting before flowering	69. 50	1. 30	0. 74	10. 01	11. 73	2. 13	0. 0448	0. 0335
10.....	November 25 to December 5, 1936.....	Guatemala grass (N and P) first cutting before flowering ..	75. 40	1. 28	0. 71	8. 75	16. 18	2. 50	0. 0523	0. 0441
22.....	March 26 to April 5, 1937.....	Guatemala grass (N and P) second cutting before flowering	69. 60	1. 40	0. 82	9. 50	16. 18	2. 50	0. 0523	0. 0441
24.....	April 6 to April 16, 1937.....	Yaragua grass (N only) second cutting before flowering	63. 70	0. 95	0. 81	14. 00	17. 84	2. 70	0. 1248	0. 0581
17.....	February 20 to March 2, 1937.....	Yaragua grass (N and P) second cutting before flowering	66. 00	1. 16	0. 82	14. 30	15. 20	2. 52	0. 0950	0. 0443
26.....	April 17 to April 27, 1937	Yaragua grass (N and P) second cutting before flowering	65. 20	1. 06	0. 92	13. 90	16. 76	2. 16	0. 0973	0. 0613

TABLE 10

ANALYSES OF THE GRASSES ON DRY BASIS

Name of the Grass	Total Solids %	Crude Protein (N x 6. 25) %	Fat %	Crude Fiber %	Nitrogen Free Extract %	Ash %	Ca %	P %	P. Ca %
Corn fodder (N and P) first cutting.....	23. 79	9. 50	4. 31	30. 90	49. 30	5. 99	0. 262	0. 180	1:1. 45
Elephant grass (N only) first cutting.....	27. 68	5. 06	3. 60	36. 35	47. 63	7. 36	0. 210	0. 142	1:1. 48
Elephant grass (N only) first cutting.....	24. 60	5. 44	2. 61	37. 25	44. 10	10. 60	0. 335	0. 175	1:1. 90
Elephant grass (N and P) first cutting.....	30. 08	4. 50	2. 96	35. 80	49. 84	6. 90	0. 288	0. 138	1:2. 08
Elephant grass (N and P) first cutting.....	19. 23	7. 50	3. 24	32. 88	45. 98	10. 40	0. 323	0. 218	1:1. 48
Guinea grass (N only) first cutting.....	29. 44	5. 87	2. 76	38. 20	43. 52	9. 65	0. 334	0. 117	1 2. 86
Guinea grass (N only) first cutting.....	29. 84	5. 44	2. 14	34. 05	46. 57	11. 80	0. 445	0. 214	1:2. 08
Guinea grass (N and P) first cutting.....	29. 64	6. 00	2. 43	35. 43	46. 56	9. 58	0. 346	0. 154	1:2. 24
Guinea grass (N and P) first cutting.....	30. 00	5. 18	2. 60	33. 80	46. 27	12. 15	0. 477	0. 247	1:1. 93
Malojillo grass (N only) first cutting.....	26. 18	6. 64	2. 52	31. 00	50. 77	9. 07	0. 295	0. 143	1:2. 06
Malojillo grass (N only) second cutting.....	37. 90	3. 11	1. 79	33. 05	56. 35	5. 70	0. 212	0. 108	1:2. 05
Malojillo grass (N and P) second cutting.....	29. 10	3. 88	1. 97	32. 50	53. 39	8. 26	0. 246	0. 132	1:1. 86
Malojillo grass (N and P) second cutting.....	34. 00	2. 75	1. 74	32. 50	55. 79	7. 22	0. 251	0. 147	1:1. 70
Guatemala grass (N only) first cutting.....	27. 00	5. 00	2. 98	37. 03	47. 54	7. 45	0. 180	0. 124	1:1. 45
Guatemala grass (N only) second cutting.....	30. 50	4. 31	2. 47	33. 40	51. 79	8. 03	0. 182	0. 147	1:1. 24
Guatemala grass (N and P) first cutting.....	24. 60	5. 19	2. 89	35. 55	47. 71	8. 66	0. 182	0. 136	1:1. 34
Guatemala grass (N and P) second cutting.....	30. 40	4. 62	2. 68	31. 25	53. 20	8. 25	0. 183	0. 145	1:1. 30
Yaragua grass (N only) second cutting.....	36. 30	2. 61	2. 23	38. 60	49. 12	7. 44	0. 343	0. 160	1:2. 14
Yaragua grass (N and P) second cutting.....	34. 00	3. 40	2. 40	42. 15	44. 60	7. 45	0. 279	0. 130	1:2. 14
Yaragua grass (N and P) second cutting.....	34. 80	3. 06	2. 63	39. 90	48. 21	6. 20	0. 279	0. 176	1:1. 59

N and P stand for nitrogen and phosphorus in the fertilizer.
N stand for nitrogen only in the fertilizer.

TABLE 11

SUMMARY OF THE NUTRITIVE INDEXES DETERMINED IN THE EXPERIMENTS PERFORMED DURING THE YEAR OF 1936-37

Ration	Dates on which Samples were collected	Coefficients of apparent digestibility							Biological Value of Protein	Nutritive Ratio 1 to	P: Ca Ratio 1 to
		Dry Matter	Crude Protein	Fat	Crude Fiber	N free Extract	Ash	Organic Matter			
TRIAL No. 2: Corn fodder fert. N and P first cutting	August 27 to Sept. 5, 1935	61	67	82	72	54	24	64	86	9	1.45
TRIAL No. 4: Elephant grass fert. N only first cutting	September 22 to October 2, 1936	56	64	73	61	54	33	60	80	16.4	1.48
TRIAL No. 13: Elephant grass fert. N only first cutting	January 6 to January 16, 1937	61	63	61	68	59	45	63	81	16.0	1.90
TRIAL No. 6: Elephant grass fert. N and P first cutting	October 13 to October 23, 1936	49	48	58	46	54	20	52	69	22.5	2.08
TRIAL No. 11: Elephant grass fert. N only first cutting	December 16 to Dec. 26, 1936	56	62	63	58	57	34	58	80	10.6	1.48
TRIAL No. 5: Guinea grass fert. N only first cutting	October 13 to October 23, 1936	50	60	66	57	49	21	56	80	12.8	2.86
TRIAL No. 12: Guinea grass fert. N only first cutting	December 16 to Dec. 26, 19236	53	56	45	57	59	28	56	86	16.1	2.08
TRIAL No. 7: Guinea grass fert. N and P first cutting	November 4 to Nov. 14, 1936	53	61	56	55	58	24	63	77	13.6	2.24
TRIAL No. 14: Guinea grass fert. N and P first cutting	January 6 to Jan. 16, 1937	53	54	62	60	58	11	58	89	18.0	1.93
TRIAL No. 8: Malojillo or Para grass fert. N only first cutting	November 4 to Nov. 14, 1936	62	66	61	64	64	42	71	88	12.7	2.06
TRIAL No. 27: Malojillo or Para grass fert. N only 2nd. cutting	April 28 to May 8, 1937	63	42	68	63	67	40	65	97	46.7	1.205
TRIAL No. 20: Malojillo or Para grass fert. N & P 2nd. cutting	March 15 to March 25, 1937	50	39	68	49	55	27	52	89	30.0	1.86
TRIAL No. 25: Malojillo or Para grass fert. N & P 2nd. cutting	April 17 to April 27, 1937	32	17	54	40	61	19	51	91	87.0	1.70

TRIAL No. 9: Guatemala grass fert. N only first cutting	November 25 to Dec. 5, 1936	68	60	79	71	69	49	70	84	20.6	1.45
TRIAL No. 23: Guatemala grass fert. N only second cutting	March 26 to April 5, 1937	60	54	77	60	63	40	61	81	25.2	1.24
TRIAL No. 23: Guatemala grass fert. N and P first cutting	November 25 to Dec. 5, 1936	63	56	74	66	65	44	65	85	20.4	1.34
TRIAL No. 10: Guatemala grass fert. N and P second cutting	March 26 to April 5, 1937	66	58	74	60	72	41	68	86	23.1	1.30
TRIAL No. 24: Yaragua grass fert. N only second cutting	April 6 to April 16, 1937	50	5	36	58	50	9	53	88	354.0	2.14
TRIAL No. 17: Yaragua grass fert. N and P second cutting	February 20 to March 2, 1937	42	24	53	54	42	3	47	90	54.0	2.14
TRIAL No. 26: Yaragua grass fert. N and P second cutting	April 17 to April 27, 1937	42	22	43	45	48	Neg. bal.	50	85	66.2	1.59

Note: "N and P" stands for nitrogen and phosphorus in the fertilizer.
"N" stands for nitrogen only in the fertilizer.

TABLE 12

VITAMIN A ACTIVITY OF CROPS

Crops	Vitamin A Units per gram (Sherman)
Para grass leaves	200
Guinea grass leaves	200
Guatemala grass leaves	270
Elephant grass leaves	200
Yaragua grass leaves	100
White pigeon peas, (flowers, stems, leaves, air-dry)	333
Velvet Beans (pods, leaves and stems, air-dry)	135