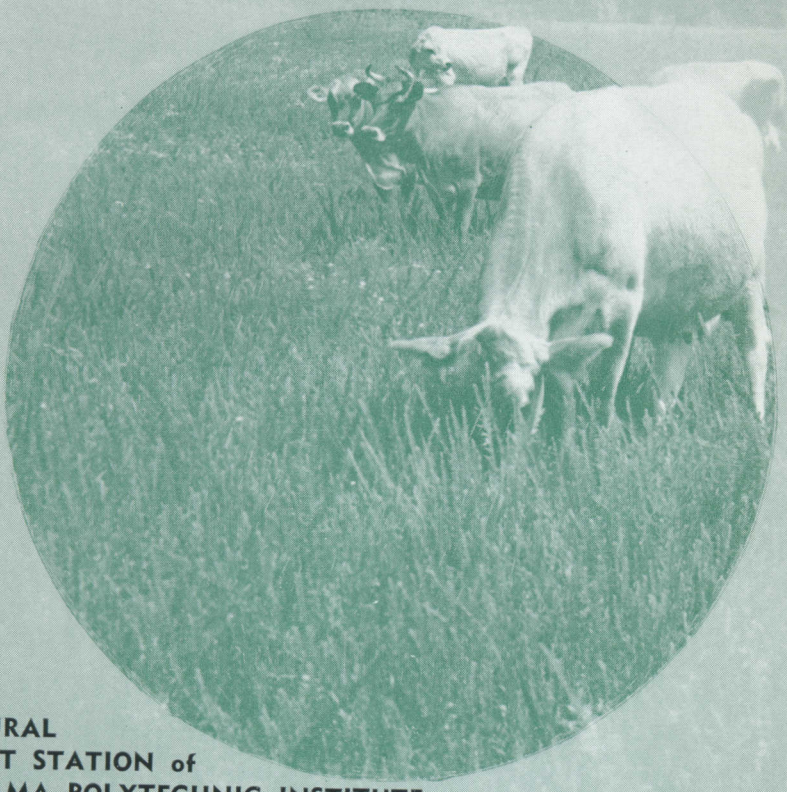
BULLETIN 318
OCTOBER 1959

Nutritive Qualities of SERICEA FORAGE



AGRICULTURAL
EXPERIMENT STATION of
THE ALABAMA POLYTECHNIC INSTITUTE
E. V. Smith, Director, Auburn, Alabama

CONTENTS

	Page
Chemical Composition and Digestibility	3
Forage Dry Matter Intake	5
Sericea for Growing Calves	7
Sericea for Milk and Butterfat Production	9
General Discussion	13
Summary and Conclusions	15
Literature Cited	18
Appendix	19

First Printing 3M, October 1959

Nutritive Qualities of Sericea Forage

GEORGE E. HAWKINS, *Associate Dairy Husbandman*

In 1952, at the beginning of this study, sericea was grown and fed on many Alabama dairy farms. In recent years, however, use of sericea in dairy rations has declined.

Most studies at other stations before 1952 had shown that the nutritive quality of sericea forage was inferior to that of crops such as alfalfa. Since sericea was so widely used, however, it seemed desirable to obtain additional information on the nutritive qualities of this forage. Thus, several tests were conducted to further characterize the feed value of sericea as a hay and as a grazing crop.

After the first two tests, it was clear that it would be necessary to add other feeds to sericea to get satisfactory growth or milk yields. Therefore, most of the feeding tests reported here compared sericea forage alone with sericea forage plus a supplement of energy, protein, or protein substitute. In addition, U.S. No. 2 quality alfalfa hay was used as a standard to indicate when good animal performance was obtained.

Results of the series of tests are reported under the following headings: (1) chemical composition and digestibility, (2) forage dry matter intake, (3) sericea for growing calves, and (4) sericea for milk and butterfat production.

CHEMICAL COMPOSITION and DIGESTIBILITY

The sericea hays studied were first and second cuttings. They were grown on a wide range of soils from central to northern Alabama and were cut at heights of 12 to 18 inches.

Average percentages of crude protein, ether extract, crude

TABLE 1. CHEMICAL COMPOSITION OF SERICEA HAYS, DRY MATTER BASIS

Chemical component	Composition	
	Average	Range
	Per cent	*Per cent*
Crude protein	13.1	10.5-16.6
Ether extract	2.6	1.6- 3.8
Crude fiber	32.5	27.1-36.8
Nitrogen-free extract	45.9	40.8-50.5
Ash	5.3	4.3- 8.2
Lignin, apparent	20.6	16.8-23.7
Cellulose	37.8	31.5-39.7
Tannin	3.5	1.7- 4.4

fiber, nitrogen-free extract, ash, apparent lignin, cellulose, and tannin of 14 sericea hays are given in Table 1. The range in crude protein content of the hays was from 10.5 to 16.6 per cent and that of lignin was 16.8 to 23.7 per cent. Crude fiber and cellulose contents ranged from 27.1 to 36.8 and from 31.5 to 39.7 per cent, respectively. Ash, nitrogen-free extract, and tannin contents of the hays were highly variable.

On the basis of chemical characteristics alone, the sericea hay with the highest crude protein, lowest crude fiber and cellulose, and highest ash content would be expected to be a high quality forage. However, the lignin content of sericea hays averaged 20.6 per cent, which is approximately twice as high as that of alfalfa hay *(9)* and is indicative of a low quality forage.

Digestibility of some of the hays was determined by total collection and that of other hays was determined by the lignin ratio method *(3)*. The two methods of determining digestibility were compared and found to give similar results.

Digestibility of dry matter and apparent digestibility of protein of the sericea hays, sericea leaves, sericea stems, sericea stems and alfalfa leaves, and sericea leaves and alfalfa stems are presented in Table 2. The digestibility of dry matter and apparent digestibility of protein in sericea hay was highly variable. Sericea leaves and stems were fed separately and in combination with alfalfa leaves and stems to determine whether proportion of leaves and stems in the hays affected digestibility.

As shown in Table 2, dry matter in sericea leaves was less digestible than that in sericea stems. Crude protein in sericea stems was digested more completely than that in sericea leaves. However, because of the high protein content of the leaves, the

TABLE 2. DIGESTIBILITY OF SERICEA FORAGE

Forage[1]	Digestible dry matter		Apparent digestible protein	
	Average	Range	Average	Range
	Pct.	*Pct.*	*Pct.*	*Pct.*
Sericea hays (14)	48.0	34.8-58.0	4.2	1.9-6.7
Sericea leaves (2)	44.3	44.1-44.5	6.2	5.8-6.6
Sericea stems (2)	57.2	56.8-57.6	4.2	3.8-4.6
Sericea stems-alfalfa leaves (1)	56.6		9.5	
Sericea leaves-alfalfa stems (1)	47.8		8.0	

[1] Numbers in parentheses represent the number of hays or forages studied.

apparent digestible protein content of sericea leaves was higher than that of sericea stems.

The finding that sericea stems were more digestible than sericea leaves reveals an unusual relationship. Normally leaves are more digestible than stems. However, the sericea hays that were highest in cellulose and crude fiber were highest in digestibility. Yet, as would be expected, digestibility of the hays decreased as the apparent lignin content increased. This indicates that the apparent lignin content of sericea leaves was greater than that of sericea stems. Analysis of leaves and stems from one lot of sericea hay revealed that leaves contained 26.7 per cent apparent lignin and stems contained only 21.7 per cent. This high apparent lignin content of the leaves probably accounts for the negative relationship found between lignin and cellulose contents and lignin and crude fiber contents of sericea forage.

FORAGE DRY MATTER INTAKE

Thirteen sericea hays were fed to cows, steers, or calves. They were given all of the hay they would eat and amounts fed and refused were measured. Each hay was fed to three or more test animals. Results of these tests, expressed as pounds of hay eaten per 100 pounds of body weight, are given in Table 3. In the first test 6-month-old calves that received no other feed consumed an average of 1.5 pounds of sericea hay as compared to 3.3 pounds of alfalfa hay per 100 pounds of body weight. Addition of crystalline tannin to the alfalfa had no effect on the amount of hay eaten. However, the crystalline tannin probably was different from the tannin in sericea.

TABLE 3. AVERAGE DAILY INTAKE OF SERICEA HAY PER 100 POUNDS OF BODY WEIGHT BY DAIRY CATTLE

Hay	Intake per 100 pounds body weight
	Pounds
First test (calves)	
Sericea, first cutting	1.5
Alfalfa, first cutting	3.3
Alfalfa, first cutting + 5 per cent tannin	3.6
Second test (steers)	
5 sericea hays, first cuttings	3.0(2.3-3.5)[1]
5 sericea hays, second cuttings	3.0(2.6-3.2)[1]
Third test (steers)	
Sericea hay	2.8
Sericea leaves	2.9
Sericea stems	2.4
Alfalfa leaves and sericea stems	3.3
Sericea leaves and alfalfa stems	3.3
Alfalfa hay	3.2
Fourth test (milking cows)	
Sericea, second cutting[2]	2.1
Sericea, second cutting[3]	2.0
Alfalfa, second cutting[2]	2.9

[1] Values in parentheses are ranges for five hays grown at different locations.
[2] Concentrates fed at rate of 1 pound per 3 pounds 4 per cent FCM.
[3] Concentrates fed at rate of 1 pound per 2 pounds 4 per cent FCM.

Jersey and Holstein steers weighing between 470 and 595 pounds were fed 10 sericea hays (second test) that were grown at five locations over the State. The amount of hay eaten per 100 pounds of body weight ranged from a low of 2.3 pounds for first cut hay grown at Auburn to a high of 3.5 pounds for first cut hay grown in northern Alabama. However, the intake of second cut hay from northern Alabama was only 2.6 pounds as compared to 2.9 pounds for second cut hay grown at Auburn. Results of this test showed that the amount of sericea hay eaten was not affected by the geographic location at which it was grown. Also, it was found that, on the average, first and second cuttings were equally acceptable.

Tannin content of the forage that averaged 3.5 per cent (range 1.7 to 4.4) had no significant effect on the amount of forage eaten by the steers. However, the steers ate more of hays that were high in cellulose and crude fiber than of hays that were low in those chemical components. This probably means that some soluble component of sericea restricts intake before crude fiber becomes the limiting factor.

In the third test, intake of sericea hay was compared with that of sericea leaves, sericea stems, alfalfa hay, and combinations of alfalfa leaves with sericea stems and sericea leaves with alfalfa stems. Intakes of all these forages were satisfactory. Nevertheless, the data reveal that the amount of forage eaten was consistently less when sericea hay, sericea stems, or sericea leaves were fed alone than when the rations included alfalfa. The relatively low intake of sericea stems as compared to sericea leaves indicates that the stem contributes much to the low intake of sericea forage. However, sericea stems did not reduce total forage intake when they were mixed with alfalfa leaves. All forages fed in this test were ground, thus the effect of physical characteristics of the leaves and stems was minimized.

Cows fed 1 pound of concentrate to each 3 pounds of 4 per cent FCM (fat corrected milk) and given all of the hay they would eat consumed 2.1 pounds of sericea as compared to 2.9 pounds of alfalfa per 100 pounds of body weight. When the rate of concentrate feeding was 1 pound to each 2 pounds of 4 per cent FCM, the cows ate 2.0 pounds of sericea hay per 100 pounds of body weight.

This series of tests showed that cows will consume variable amounts of sericea hay. Also, in the three tests in which sericea and alfalfa were compared, dairy cattle ate more of the alfalfa hays than of the sericea hays.

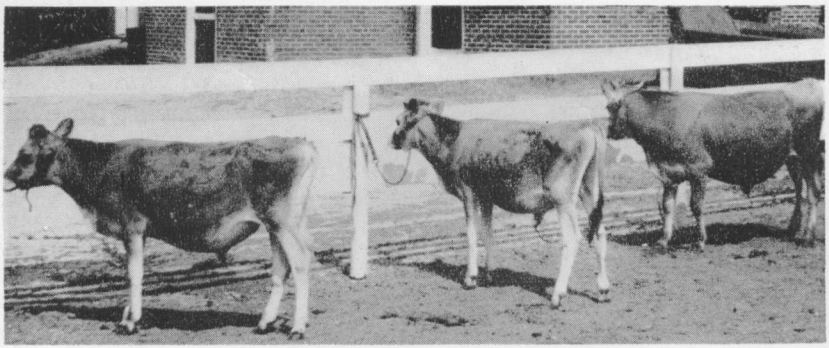
SERICEA for GROWING CALVES

Weight gains of growing calves within the age range of 29 to 185 days were determined in four tests in which sericea was fed. Results are given in Table 4.

During the tests the calves were fed 2 to 3 pounds of concentrates (approximately 16 per cent protein) daily. All hays were chopped to aid in mixing with the urea and with the cottonseed

TABLE 4. AVERAGE DAILY WEIGHT GAINS OF CALVES FED DIFFERENT RATIONS

Hay fed	Daily weight gains
	Pounds
Sericea	0.8
Sericea (3 parts) + cottonseed meal (1 part)	1.1
Sericea (97.4 per cent) + urea (2.6 per cent)	0.8
Alfalfa	1.1
Peanut	0.7



These calves show differences in growth on three of the test rations. Calf at left received sericea hay supplemented with urea, one in center was fed sericea hay alone, and larger calf at right was on alfalfa hay.

meal supplements. Calves fed sericea and sericea plus urea made similar gains, 0.8 pounds per calf daily, but their gains were less than those of calves fed alfalfa, Table 4 (see photo). However, gains of calves fed a sericea hay-cottonseed meal mixture were equal to that of calves fed alfalfa, and 0.3 pounds greater than that of calves fed sericea without cottonseed meal. Nevertheless, the daily gain of calves fed sericea hay was 0.1 pound greater than that of calves fed peanut hay.

The average TDN (total digestible nutrient) intake per pound of gain in body weight for calves fed sericea hay was 2.8 pounds as compared with 2.7 pounds for calves fed the sericea hay-cottonseed meal mixture. The proportion of total TDN consumed as hay during this test, which extended from 58 to 148 days of age, was approximately 40 per cent for both groups. In another test, beginning at 29 and extending through 185 days of age, calves fed sericea and those fed sericea supplemented with urea required 3.2 pounds of TDN per pound of gain in weight. In contrast, calves fed alfalfa required only 2.8 pounds of TDN per pound of gain.

Levels of calcium, magnesium, and inorganic phosphorus in blood serum from calves on some of the test diets were measured. Results of these analyses are given in Table 5. The inorganic phosphorus in blood serum from calves fed sericea, sericea supplemented with urea, sericea and cottonseed meal mixture, and alfalfa were within the "normal range" for calves of their age. However, the serum inorganic phosphorus levels of calves fed sericea with urea were significantly lower than those of calves

TABLE 5. AVERAGE CONCENTRATION OF INORGANIC PHOSPHORUS, CALCIUM, AND MAGNESIUM IN BLOOD SERUM FROM CALVES FED TEST RATIONS

Hay	Concentrations in mg. per 100 ml. serum		
	Inorganic-phosphorus	Calcium	Magnesium
Sericea	7.9	9.3	2.4
Sericea-CSM	8.0	--	--
Sericea-urea	7.1	10.3	2.2
Alfalfa	8.9	9.8	2.0
Peanut	4.6	--	--

fed sericea without urea. Also, calves fed sericea hay maintained significantly higher levels of serum inorganic phosphorus than calves fed peanut hay. The low blood serum inorganic phosphorus levels of calves fed the peanut hay suggest that the phosphorus intake of calves on this hay was too low to support normal growth.

Blood serum calcium values of calves on sericea with and without the urea supplement differed significantly from those of calves on alfalfa. However, the small differences probably have no practical importance.

Magnesium content of blood serum from calves fed sericea with and without urea and of calves fed alfalfa were within the "normal range."

SERICEA for MILK and BUTTERFAT PRODUCTION

Four sericea hays were fed to milking cows with and without supplements to form 10 rations. In addition, nonirrigated sericea pasture with part-time supplemental grazing on a temporary summer pasture, nonirrigated sericea pasture with a supplement of oat hay, and irrigated sericea pasture were compared with alfalfa pasture.

Prior to going on rations 1 through 7, the cows were fed alfalfa hay. This procedure was followed to establish the level of milk production that could be expected under good feeding conditions. During the test periods cows were fed the same quantity of TDN as they had received while on alfalfa. The difference between the rations fed during the pre-test and test periods was that sericea hay was substituted for alfalfa hay during the test periods.

When the cows refused sericea hay, they were fed extra concentrates above their regular allowance to supply the recom-

TABLE 6. RELATIVE MILK PRODUCTION OF COWS FED SERICEA HAY WITH SUPPLEMENTS AND OF COWS FED ALFALFA HAY

Ration number	Roughage and supplement	Relative milk production compared with	
		Alfalfa[1]	Sericea alone[2]
		Per cent	*Per cent*
1	Sericea	76	100
2	Sericea (3 parts) + corn (1 part)	99	122[3]
3	Sericea (3 parts) + CSM, 41% protein grade (3 parts)	98	121[3]
4	Sericea (60% TDN) + chopped oat forage (30% TDN)	71	93
5	Sericea-urea (contained 2.6% urea)	81	99
6	Sericea (20% TDN), concentrates (80% TDN)	100	133[4]
7	Sericea (20% TDN), heated concentrates (80% TDN)	96	128[4]
8	Sericea (free choice) + lb. concentrate to 3 lb. 4% FCM	68	100
9	Sericea (free choice) + lb. concentrate to 2 lb. 4% FCM	80	117
10	Sericea (free choice) + rye-clover pasture + 1 lb. concentrate to 3 lb. 4% FCM	93	136
11	Sericea pasture + 4 lb. concentrate daily	84	100
12	Sericea pasture, irrigated + 4 lb. concentrate daily	83	98
13	Sericea pasture + millet-Sudangrass pasture + 4 lb. concentrate daily	92	109
14	Sericea pasture + oat hay + 4 lb. concentrate daily	80	95

[1] Average daily 4 per cent FCM production on sericea rations listed divided by that of cows fed alfalfa rations in the same test (production on alfalfa ration = 100 per cent). Sericea value of 76 per cent (ration 1) is average of three tests.

[2] Average daily 4 per cent FCM production on sericea supplemented rations divided by that of cows fed sericea ration without the supplement (production on non-supplemented sericea ration = 100 per cent.)

[3] Same sericea hay that was fed in ration 5.

[4] Average index of unsupplemented sericea rations used to obtain these values. See Appendix Table for information on number of cows fed each ration, length of experimental periods, and daily milk production.

mended allowance of nutrients *(10)*. This was done to keep their TDN intake at the same level as during the pre-test period. Also, in each test a group of cows was fed alfalfa hay to provide a standard comparison. The concentrates fed in each study had a crude protein content of approximately 16 per cent.

Milk production of cows on the sericea rations is expressed as a percentage of the production of cows fed alfalfa hay. In addition, milk production of cows on sericea rations that included a supplement (rations 2-7) are expressed as a percentage of production of cows fed the same sericea hay without the supplement.

Milk production of cows fed sericea hay and concentrates at the same rate as cows fed alfalfa hay produced only 76 per cent as much milk as cows fed alfalfa hay, Table 6. Cows fed rations 2, 3, 6 and 7, in which nutrients from other sources were substituted for nutrients from sericea, produced about the same amount of milk as cows fed alfalfa hay. These rations were 21 to 33 per cent superior to sericea hay without supplements.

Ration 4, in which immature oat forage replaced three-fourths of the concentrates with the amount of sericea TDN remaining constant, was inferior to sericea and the full concentrate allowance in milk production. Also, addition of urea, a protein substitute, to sericea (ration 5) to supply digestible protein equivalent to that of alfalfa hay did not increase milk production over that of cows fed sericea without urea. Cows fed ration 5 consumed 42.0 to 59.3 per cent of their TDN intake as sericea with concentrates supplying the remainder. Milk production decreased as the percentage of TDN intake from sericea hay increased.

The response of cows to sericea hay under farm feeding conditions was evaluated by rations 8, 9, and 10. Cows on rations 8 and 9 were given all of the sericea hay they would eat day and night. Those on ration 10 were fed all of the sericea hay they would eat except from 7:00 a.m. to 1:00 p.m. During this interval they were allowed to graze a dense succulent pasture mixture of abruzzi rye, rescue grass, and crimson clover. Cows on rations 8 and 10 were fed 1 pound of concentrate to each 3 pounds of 4 per cent FCM; those on ration 9 received 1 pound of concentrate to each 2 pounds of 4 per cent FCM. The extra concentrate fed to cows on ration 9 increased milk production 17 per cent over that of cows fed ration 8. Cows on ration 10, which included 6 hours of grazing each day on immature forage, pro-

duced 93 per cent as much milk as cows fed alfalfa hay plus concentrate at the rate of 1 pound to each 3 pounds of 4 per cent FCM. The immature forage in ration 10 increased milk production 36 per cent over that of cows fed ration 8.

The amount of sericea hay consumed by cows on rations 8, 9, and 10 was equal to 48, 45, and 23 per cent, respectively, of their total TDN intake. In contrast, cows on alfalfa hay in the same test ate 62 per cent of their TDN as hay. Thus, in rations 8, 9, and 10, as in rations 2, 3, 5, 6, and 7, the highest level of milk production was obtained on rations in which TDN intake from sericea hay supplied the lowest percentage of the total nutrient intake.

Rations 11, 12, 13, and 14 included sericea pasture, with that for ration 12 irrigated. Cows on ration 13 and 14 were on sericea pasture at night only. During the day those on ration 13 were on a pasture mixture of millet and Sudangrass and those on ration 14 were fed oat hay in an open shed. In addition, each cow on rations 11, 12, 13, and 14 was fed 4 pounds of a 16 per cent protein concentrate daily. Cows on nonirrigated sericea, ration 11, produced more milk than cows on irrigated sericea, ration 12. Also, sericea pasture alone, ration 11, was about equal to sericea pasture supplemented with oat hay. However, cows that were on the millet-Sudangrass pasture (ration 13) during the day and on the sericea pasture at night produced 20 per cent more milk than cows on sericea pasture day and night.

Early in this series of tests with milking cows, it was noted that the percentage of butterfat in milk increased when cows were fed sericea hay. Results of studies by Shaw *et al. (15)* indicated that feeding of heated starchy concentrate feeds decreased butterfat percentage in milk. Increases in butterfat percentage of milk frequently occur when cows drop in milk production as a result of low TDN intake. However, cows on sericea rations that dropped in milk production almost invariably gained in body weight. This indicates that the drop in production was due to some cause other than insufficient TDN intake. In order to test this idea, the change in butterfat content of milk from cows fed a concentrate containing the usual ingredients (ration 6) was compared with that of cows fed a concentrate containing 60 per cent of heat treated starchy feeds, i.e., stale bread or roasted corn (ration 7).

At end of the first 2 weeks, butterfat content of milk from cows

on ration 6 had increased to 106 per cent of the original level and that from cows fed the heat treated starchy feeds (ration 7) had decreased to 94 per cent. At the end of the 8-week test, the persistency of butterfat percentage in milk from cows fed rations 6 and 7 was 106.4 and 99.3 per cent, respectively, of that at the start of the test. In contrast, the persistency of butterfat percentage of milk from cows fed alfalfa hay in the same test was 103.9 per cent.

The increase in butterfat percentage of milk from cows fed ration 6, in which sericea hay TDN was only 20 per cent of the total, was significantly greater than that of cows eating 50 per cent of their TDN as alfalfa hay. Since the total milk production of cows on rations 6 and 7 and on alfalfa hay was similar, it appears that the increase in butterfat percentage in milk from cows fed sericea was due to some cause other than insufficient energy intake. Also, the depression in butterfat percentage of cows fed the heat treated starchy feeds was less than that observed by Shaw *et al.* when cows were fed this type of concentrate *(15)*.

Studies at the Maryland Station *(15)* had indicated a relationship between the molar percentages of volatile fatty acids in rumen liquor and the butterfat percentage of milk from cows fed experimental rations. Rumen liquor collected before the morning feeding from cows fed rations 6 and 7 was analyzed for molar percentages of volatile fatty acids. Molar percentage of acetic acid in rumen liquor from cows fed ration 6 was 3.6 per cent higher than that from cows fed ration 7. Thus, it appears that the increase in butterfat percentage in milk from cows fed ration 6 was associated with a high molar percentage of acetic acid produced in the rumen of cows fed this ration.

GENERAL DISCUSSION

Results of the series of tests reported herein confirm previous reports *(2, 4, 6, 7, 12, 14)* that sericea is a low quality roughage. Chemical tests employed are not entirely satisfactory as a means of determining or predicting the productive value of this roughage. A well-known characteristic of sericea hay is coarseness of stems. Yet the crude fiber content of the sericea fed compared favorably with that of alfalfa, a nutritious forage.

The stems of sericea hay were found to be more digestible

than the leaves, which generally make up 50 to 60 per cent of the weight of the forage. In addition, sericea hays containing the highest percentages of crude fiber were more digestible than hays containing less crude fiber. However, this does not mean that allowing sericea to reach a late stage of maturity with a high percentage of stems will increase the productive value of the forage. Another consideration worthy of note is that the digestible dry matter content of the sericea forage may vary from about 35 per cent to about 58 per cent. Yet on the forage that was highly digestible, milk yields were low.

The high content of tannin in sericea has been associated with low intakes of this forage by livestock *(1, 11, 13)*, yet crystalline tannin addition to alfalfa hay had no detectable effect on amount of forage eaten. Also, other lespedezas that have been reported to have tannin contents similar to that of sericea *(8)* seem to be palatable forages. It is possible that the tannin in sericea, which is a phlobaphene forming tannin, has a different effect on forage intake than the gallotannin added to alfalfa hay, Table 3. Nevertheless, gallotannin and the tannin extracted from sericea have several common characteristics including bitter taste.

Results of the test, which showed no pronounced effect on consumption of alfalfa when tannin was added and the absence of a significant relationship between tannin content and intake of 10 hays *(5)*, are not necessarily different from the report of Donnelly *(1)* that showed that cattle selectively grazed sericea with low tannin content. Donnelly measured preference for sericea by tannin content, but did not measure the total quantity consumed by the cows, whereas the author measured intake when other feeds were not available.

Coarseness of the stem, which was found to affect the preference of cattle for sericea *(1)*, probably is involved in the acceptability of sericea by cattle. The low intakes of ground sericea hay and ground sericea stems suggest that a chemical substance associated with coarse stems, rather than the coarseness itself, accounts in part for the low intakes of sericea forage by cattle. At least, the 2.9 and 2.4 pounds of sericea leaves and sericea stems, respectively, consumed per 100 pounds of body weight by steers show that the leaves are more palatable than the stems. Yet sericea leaves generally contain three to five times as much tannin as the stems. Results of the test with 10 hays indicate that the geographic location of growth and whether the forage

is first or second cutting has no important bearing on the palatability of sericea.

Characteristics of sericea that contribute to its low quality for growing calves and for milking cows include low net energy value, low digestibility of the crude protein, and low ash content. The low digestibility of the crude protein may be somewhat in error, however, as the costive effect of sericea frequently results in bloody feces. Since the protein content of blood is high, the amount of protein in bloody feces is not a true indication of digestibility of sericea protein. The difference between apparent and true digestibility of sericea protein, however, has not been measured.

In addition to the analytical data showing that the ash content of sericea is low, the craving for supplemental mineral salts *(12)* shows that some mineral component of sericea probably is inadequate. The calcium content of sericea is approximately two-thirds that of alfalfa, whereas the phosphorus content of the two hays are similar *(10)*; results of blood studies indicate that phosphorus in sericea is well utilized by calves. Also, addition of cottonseed meal, a good source of phosphorus, as a supplement to sericea for milking cows did not have a noticeable effect on milk production. It appears, therefore, that phosphorus is not a limiting mineral in sericea for growth or milk production.

Cows fed 40 per cent or more of their nutrients as sericea hay consistently produced less milk than cows fed alfalfa hay. Grouping the results of tests with milking cows, the data show that replacing a part of the sericea-TDN with TDN from a high quality feed partially overcame the depression in milk yield associated with feeding sericea. The depression of milk yield when cows are fed sericea is proportional to the percentage of nutrient intake supplied as sericea. This relationship, however, holds true only when sericea supplies over 20 per cent of the TDN. Practically speaking, this means that the nutritive value of sericea hay is proportional to its TDN content when the amount fed does not exceed about one-fifth of the nutrient requirements and the remaining four-fifths are supplied by a high quality feed.

SUMMARY and CONCLUSIONS

The digestion studies and chemical analyses of the sericea hays show that the composition and digestibility of sericea hay is quite variable. Substitution of sericea hay TDN for alfalfa hay TDN

on a unit basis above 40 per cent of the total intake always resulted in a decrease of milk production. Cows produced milk at a normal level when sericea supplied less than one-fifth of the nutrient intake.

During studies on intakes of forage, the intakes of sericea hays as percentages of that of alfalfa hay were: 45, 73, and 88. Mature cows fed all of the sericea hay they would eat consumed an average of 2.1 pounds of hay per 100 pounds of body weight as compared with 2.9 pounds of alfalfa hay. Yearling dairy steers receiving no other feed ate 2.8 and 3.2 pounds of forage per 100 pounds of body weight when fed sericea and alfalfa, respectively. The same steers, carrying little fat, were fed 10 sericea hays (two cuttings from each of five locations in northern to central Alabama). Intakes of these hays ranged from 2.3 to 3.5 pounds per 100 pounds of body weight.

There was a significant negative correlation between the nitrogen-free extract (less tannin) content and a significant positive correlation between the crude fiber content of the 10 sericea hays and the amounts eaten by the steers. In contrast, the correlation between tannin content and intake of the hays by the steers was nonsignificant. It appears, therefore, that the intake of sericea is limited by some component of nitrogen-free extract other than tannin before crude fiber becomes the limiting factor. In this series of studies, all sericea hays were ground or chopped. Therefore, texture of sericea stems was not a variable.

Among the sericea hays fed in the tests reported, the ranges in composition on the dry matter basis, in per cent, were: crude protein, 10.5 to 16.6; ether extract, 1.6 to 3.8; crude fiber, 27.1 to 36.8; ash, 4.3 to 8.2; nitrogen-free extract, 40.8 to 50.5; tannin, 1.7 to 4.4; and cellulose, 31.5 to 39.7. Nitrogen-free extract was the only chemical component in which there was a consistent relationship associated with geographic location of growth. The mean nitrogen-free extract content of hays grown in northern Alabama was 44.0 per cent as compared with 48.7 per cent for those grown in central Alabama.

Digestibility of 14 sericea hays was determined. The digestible dry matter content averaged 48.0 per cent and ranged from 34.8 to 58.0 on the dry matter basis. The energy value of sericea TDN for milk production was approximately 76 per cent that of alfalfa TDN when supplying over 40 per cent of the TDN intake of dairy cows. This low energy value of sericea appears to be

the result of rumen fermentation, which yields a high proportion of acetic to other volatile fatty acids.

The digestible protein content of sericea hays averaged 4.2 and varied between 1.9 and 6.7 per cent. Thus, to ensure adequate protein nutrition, another source of protein should be added when sericea is fed.

Feeding 1 part of cottonseed meal to each 3 parts of sericea and 2 pounds of concentrate daily promoted satisfactory gains in calves over 8 weeks of age, but urea supplementation of sericea did not support normal growth. The cottonseed meal supplement, however, was not satisfactory for good bone nutrition.

Urea supplementation of sericea to increase the "digestible protein equivalent" of the ration to a level similar to that of alfalfa hay did not alter the depressing effect of sericea hay on milk yield. On the other hand, 4 per cent FCM production was the same on sericea-corn and sericea-cottonseed meal mixtures, containing three parts of sericea to one of corn or cottonseed meal, as on alfalfa hay. Actual milk yields were less, however, on the sericea-corn and sericea-cottonseed meal mixtures than on alfalfa. The net energy value of the sericea-corn and cottonseed meal mixtures were similar to that of alfalfa hay. Thus, it appears that the net energy of a pound of TDN from sericea is less than that of a pound of TDN from alfalfa.

Results of these studies indicate that 8 to 10 pounds of sericea hay may be fed to dairy cows daily without having an adverse effect on milk yield provided the other nutrients needed are supplied from high quality roughages and concentrates. Under usual feeding conditions, however, sericea is not a good forage for dairy cows in milk. For this reason, except in extreme feed shortages, it is recommended that sericea be eliminated from the dairy roughage program or that it be used only for dry cows and yearling animals. Even as a forage for dry cows and yearlings, it should be supplemented with protein and minerals.

LITERATURE CITED

(1) DONNELLY, E. D. Some Factors that Affect Palatability of Sericea Lespedeza, *L. cuneata. Agron. J.* 46:96. 1954.

(2) EATON, W. H. Unpublished data. 1937-38.

(3) ELLIS, G. H., MATRONE, G., AND MAYNARD, L. A. A 72% H_2SO_4 Method for the Determination of Lignin and Its Use in Animal Nutrition Studies. *J. Animal Sci.* 5:285. 1946.

(4) GRINNELLS, C. D. A Comparison of Alfalfa and Lespedeza Sericea Hay. N.C. Agr. Expt. Sta. Ann. Rpt. 58:55. 1935.

(5) HAWKINS, GEORGE E. Relationships Between Chemical Composition and Some Nutritive Qualities of Lespedeza Sericea Hays. *J. Animal Sci.* 18:763. 1959.

(6) HINTON, S. A. AND WYLIE, C. E. Comparison of Lespedeza Sericea Silage, Alfalfa Silage and Corn Silage for Dairy Cows. *J. Dairy Sci.* 23:564. 1940.

(7) HOLDAWAY, C. W., ELLETT, W. B., EHEART, J. F., AND PRATT, A. D. Korean Lespedeza and Lespedeza Sericea Hays for Producing Milk. Va. Agr. Expt. Sta., Bull. 305, 1936.

(8) LEASE, E. J. AND MITCHELL, J. H. Study of Tannins in Lespedeza Sericea. S.C. Agr. Expt. Sta. Ann. Rpt. 53:71. 1940.

(9) MILLER, DONALD F. Composition of Cereal Grains and Forages, National Acad. Sci., National Res. Council. Pub. 585. 1958.

(10) MORRISON, F. B. *Feeds and Feeding.* 22nd ed. Morrison Publ. Co., Ithaca, N.Y. 1956.

(11) OLSON, L. C. AND ELROD, J. M. Factors Affecting the Palatability of Sericea Lespedeza to Livestock. Ga. Agr. Expt. Sta., Press Bull. 568. Rev. 1951.

(12) VOELKER, H. H. AND STALLCUP, O. T. The Nutritive Value of Lespedeza Hay for Wintering Dairy Heifers. *J. Dairy Sci.* 34:509. 1951.

(13) WILKINS, H. L., BATES, R. P., HENSON, P. R., LINDAHL, I. L., AND DAVIS, R. E. Tannin and Palatability in Sericea Lespedeza, *L. Cuneata. Agron. J.* 45:335. 1953.

(14) WYLIE, C. E. AND HINTON, S. A. Lespedeza Sericea Feeding Trials with Dairy Cows. *J. Dairy Sci.* 18:443. 1935.

(15) SHAW, J. C., ROBINSON, R. R., SENGER, M. E., LEFFEL, E. C., DOETSCH, R. E., LEWIS, T. R., AND BROWN, W. H. Ruminant Metabolism on Diets Producing a Low Fat Content Milk. Md. Agr. Expt. Sta. Misc. Pub. 291. 1957.

APPENDIX

AVERAGE DAILY FCM PRODUCTION OF COWS FED EXPERIMENTAL RATIONS

Ration fed	FCM by periods		Experimental FCM, adjusted yield[1]
	Standardization	Experimental	
	Pounds	*Pounds*	*Pounds*
Ration groups 2 and 3[2]			
Alfalfa hay	25.9	20.6	19.2
Ration 2 (Table 6)	24.3	19.3	19.0
Ration 3 (Table 6)	21.7	17.3	18.9
L.S.D.: P=0.05	----	----	1.6
Ration group 5[2]			
Alfalfa hay	30.7	28.7	27.9
Sericea hay	28.6	21.6	22.7
Ration 5 (Table 6)	30.0	22.7	22.5
L.S.D.: P=0.01	----	----	4.2
Ration group 4[3] [4]			
Alfalfa hay	22.8	23.9	23.8
Sericea hay	22.5	18.5	18.9
Ration 4 (Table 6)	22.9	17.7	17.6
L.S.D.: P=0.05	----	----	0.3
Ration groups 8, 9, and 10[5]			
Alfalfa hay	21.2	24.5	23.4
Ration 8 (Table 6)	24.2	19.8	16.0
Ration 9 (Table 6)	18.6	17.3	18.7
Ration 10 (Table 6)	18.5	20.3	21.7
Alfalfa hay + grazing	17.7	20.2	22.3
L.S.D.: P=0.05	----	----	6.0
Ration groups 6 and 7[6]			
Alfalfa hay	28.2	27.1	25.9
Ration 6 (Table 6)	25.2	24.0	26.0
Ration 7 (Table 6)	27.8	25.5	24.8
L.S.D.: P=0.05	----	----	2.3
Ration groups 11, 12, 13, and 14[7]			
Alfalfa pasture	25.7	25.8	26.2
Ration 11 (Table 6)	26.2	22.2	22.1
Ration 12 (Table 6)	26.8	22.2	21.7
Ration 13 (Table 6)	25.9	23.9	24.1
Ration 14 (Table 6)	26.1	21.0	21.0
L.S.D.: P=0.05	----	----	2.7

[1] Adjusted by covariance to take into account differences in initial levels of production.

[2] Five cows were fed each ration during a 28-day test period.

[3] Average milk production per cow by replications at start of test, in pounds, were: Replication 1, 29.2; replication 2, 26.0; replication 3, 22.4; replication 4, 19.7; and replication 5, 16.4.

[4] Five cows were fed each ration during a 14-day test period.

[5] Cows transferred to this test from rations fed in ration group 4; three cows were fed each ration during a 14-day test period.

[6] Five cows were fed each ration during a 56-day test period.

[7] Seven cows were on each ration during an 84-day test period.