FEEDING VALUE OF MILO STUBBLE FOR SHEEP

by

LESLIE JUNIOR CHYBA

B. S., Kansas State University, 1969

A MASTER'S THESIS

submitted in partial fulfillment of the

requirements for the degree

MASTER OF SCIENCE

Department of Animal Science

KANSAS STATE UNIVERSITY
Manhattan, Kansas

1972

Approved by:

B. E. Brent
Major Professor

TABLE OF CONTENTS

INTRODUCTION

Kansas farmers produce nearly two million acres of corn and five million acres of grain sorghum annually. The majority of these crops are harvested for the grain leaving approximately 50 percent of the total dry weight in the field.

Stover is a necessary by-product of grain production that contains considerable amounts of energy in the form of simple sugars and polysaccharides. Cellulose is its primary complex carbohydrate. Because of the 1,4 glycoside linkage of the cellulose, utilization of it by monogastrics is limited. Ruminant animals, however, possess the ability to convert this fibrous roughage into energy via cellulytic microorganisms in the rumen.

Traditional attempts to use stovers have been "pasturing out" stubble fields but this is inefficient due to animal selectivity and weathering. A more complete method of harvest would be to ensile stover and feed it as silage. Grain sorghum would be well suited for ensiling because of its relatively high moisture content at harvest.

The experiments reported herein were designed to study the feeding value of milo stubble silage for sheep.

REVIEW OF LITERATURE

Forage Composition, Digestibility and Voluntary Intake

During growth and maturation of most plants several notable changes occur. The most striking of these in forages is a decrease in protein and, in some cases, soluble carbohydrate content, while structural carbohydrates and lignin increase (Blaser, 1964). Johnson *et al*. (1971) noted similar trends in grain sorghum vegetation.

Van Soest (1967) divided forage dry matter into two fractions: cell contents, composed of lipids, carbohydrates, protein and water soluble compounds; and cell wall constituents, consisting mainly of cellulose, followed by hemicellulose and lignin. The first fraction was considered almost completely available while cell wall digestibility was governed by the lignin concentration.

Noller *et al*. (1963) indicated that corn silage cut at three stages of maturity decreased in dry matter digestibility. Johnson and McClure (1968), reporting on a two-year study with corn silage, point out that maximum dry matter digestibility was reached at about the dent stage and decreased thereafter. Similar results were reported with sorghum silage by Ramsey *et al*. (1961), but dry matter digestibility decreased after the milk stage. Apparent dry matter digestibility of Atlas sorghum silage declined from 55 to 46 percent with advancing maturity, while silage made from Rox, another variety, was not appreciably affected by maturity. (Owen and Kuhlman, 1967).

Van Soest (1965a) points out that the principal factors governing forage dry matter digestibility are the proportion of completely available cell contents and the concentration of lignin (which controls the digestibility of cell wall constituents).

Certain portions of the plant such as fibrous roots, stems and leaves accumulate lignin through the natural process of "lignification". The structure or the manner in which lignin affects digestibility has not been completely explained. It has been suggested that lignin may act as a physical barrier to cellulytic microorganisms (Baker and Harris, 1947).

Sullivan (1955) reported increased cellulose and lignin with advancing maturity. As lignin increased, cellulose digestibility decreased. Tomlin et al. (1965) found lignin content negatively correlated with 12-hour in vitro cellulose digestibility. In addition, lignification was linearly related to in vitro cellulose digestibility as grass matured. Mowat et al. (1969) reported a linear relationship existing between lignin and cell wall digestibility.

Kamstra et al. (1958) isolated the cellulose fraction at different stages of maturity by delignification. This resulted in improved in vitro cellulose digestibility. Sullivan and Hershberger (1959) reported similar results in vivo. Dehority et al. (1962) used timothy, alfalfa and orchard grass cut at several stages of maturity as in vitro substrates. In all cases, hemicellulose fermentation decreased with maturity. Reducing particle size by ball milling to remove the inhibitory influence of lignin reversed this trend.

The relationship of lignin and digestibility depends on plant species. Quicke and Bentley (1958) observed differing digestibility of cellulose in mature brome and orchard grass hays although proximate composition and lignin content were similar. Later, Quicke and Bentley (1959) suggested differences in lignin content of mature forages were too small to account for the observed differences in cellulose digestibility. Although lignin was apparently the major component affecting cellulose digestibility, it did not follow that the most lignified plant had the poorest cellulose digestibility.

Tomlin *et al*. (1965) concluded that lignin content in legumes had less effect on cellulose digestibility than it did in grasses. Gaillard (1962) reported a high correlation between digestibility of organic matter and percent crude fiber, lignin, and cellulose plus lignin. Differences in grass and legume digestibility were also noted. Mowat *et al*. (1969) reported similar differences. Van Soest (1964) explained that legumes contain a smaller, more highly lignified holocellulose fraction than grasses. Thus, a greater portion of the dry matter was free of lignin influence.

There may be non-lignin factors influencing forage digestibility. Van Soest and Jones (1968) reported that silica content of forages was related to a reduction in digestibility of cell wall constituents. Smith *et al*. (1971) has shown the extent of depression on organic matter digestibility to be approximately one percent for each percent increase in the silica content of the forage.

Hemicellulose may influence holocellulose digestibility. Digestibility of hemicellulose was different from that of cellulose (Lyford *et al*., 1963). Waite *et al*. (1964) reported that during plant growth, hemicellulose, especially the xylan fraction, becomes less digestible. Gaillard (1966) indicated hemicellulose, particularly the xylan uronic acid fraction, had a lower apparent digestibility than cellulose.

Van Soest and Marcus (1964) reported a negative correlation between cell wall constituents and voluntary intake by sheep. When cell wall constituents made up 60% or more of the dry matter, voluntary intake was depressed. Later, Van Soest (1965b) suggested that voluntary intake was depressed when cell wall constituents exceeded 55% of the dry matter with intake restricted by fibrous mass in the rumen.

Conrad et al. (1964) and Blaxter et al. (1961) observed increased voluntary intake with increased forage digestibility. Crampton (1957) found a positive relationship between voluntary intake and forage digestible nutrient content.

Other workers found intake more closely related to rate of digestion rather than total digestibility (Donefer et al., 1960 and Johnson et al., 1962). Conrad et al. (1964) reported voluntary intake was directly related to body weight and rate of passage when rations were low in digestibility. At higher digestibility, intake was related to metabolic size, production and digestibility.

Montgomery and Baumgardt (1965) concluded that factors regulating voluntary intake may shift from physical to physiological factors as digestibility increases. These results are in general agreement with those of Conrad (1966).

Rate of removal of undigested residue from the digestive tract influences intake, and this may be influenced by particle size (Balch and Campling, 1962). Lloyd et al. (1960) and O'Dell et al. (1963) reported increased consumption when forage particle size was reduced by chopping, grinding or pelleting. Murdock (1965) and Owen and Kuhlman (1967) indicated dry matter intake was increased by increasing the fineness of silage. Minson (1963), Moore (1964), and Beardsley (1964) concluded that reduction of particle size may increase voluntary intake and decrease crude fiber digestibility. Increased rate of passage may, at least in part, explain these observations (Johnson et al., 1964 and Moore, 1964).

Feeding Value of Stover

The idea of ensiling stover is not new. Becker and Galup (1927) suggested that if it were economically feasible, sorghum heads should be harvested for the grain before ensiling the plant.

Sherman et al. (1918) reported that corn stover fermented to a product quite similar to normal corn silage. Cattle readily consumed this silage and preferred it to any dry roughages. Nevens and Harshbarger (1940) produced good quality silage by ensiling broomcorn stover with molasses. Milk production of dairy cows was only slightly reduced when compared to corn silage.

Colenbrander et al. (1971a) reported corn stover and corn silage fermentation patterns were similar. However, stover silage had a higher pH and lower lactic acid concentration. Colenbrander et al. (1971b) added four levels of urea and ammonium polyphosphate (APP) to improve certain desirable characteristics of corn stover silage. Addition of urea tended to improve *in vitro* dry matter disappearance. As the level of urea was increased, cell wall constituents, acid detergent fiber and acid detergent lignin decreased.

Recent work indicates that grain content may not be a good indication of silage quality. Balwani et al. (1969) compared corn, corn stover, high-grain forage sorghum and forage-type sorghum silages in digestion and metabolism trials with sheep. Apparent dry matter digestibility was 68% for corn and 50% for stover silage. Dry matter digestibility for the grain and forage-type sorghum silages was 51% and 55%, respectively. Thurman et al. (1961) presented voluntary intake and digestion coefficients with dairy steers for different ensiled portions of Atlas sorghum plants. Intake was lower for stalk silage than whole plant (4.61 vs 7.62 lbs. daily). Digestion coefficients for Atlas whole plant, stover and stalk silage were 55.11, 56.55 and 53.44 percent, respectively. Garrett and Worker (1965) found that certain varieties of sorghum made into silage were at least as valuable a feed for growing cattle as sorghum containing a higher ratio of grain to forage. Owen et al. (1962) tested forage sorghum and sterile sorghum varieties. They concluded that sterile sorghum silages were not inferior to the forage sorghum silage. In contrast maximum digestibility of corn silage depends on the quantity of ears (Johnson et al., 1966).

Russell and Morrison (1920) estimated the feeding value of corn stover silage was 61% of corn silage. Kuhlman et al. (1932-34) valued Darso stover silage at 87% of Darso silage. Galye and Lloyd (1917) stated that corn stover silage was "little more than a maintenance ration" for beef cattle. However, Baker (1943) found that stover silage from two varieties of grain sorghum equaled steer gains from prairie hay. All steers gained less than those fed grain sorghum silage.

Cox (1929) used cane and corn stover supplemented with cottonseed meal and produced daily gains of 0.274 and 0.199 lb., with lambs. Oh et al. (1971) fed sheep pelleted corn stalks fortified with sulfur and phosphorus. Pelleted stover had a lower apparent dry matter digestibility than alfalfa but calculated digestible energy values were in the N.R.C. (1968) recommended range for maintenance of mature sheep.

Colenbrander _et al_. (1971a) fed corn stover silage ensiled with and without urea to yearling Holstein heifers. Average daily gain was 0.89 kg for corn silage, 0.45 kg for stover silage and 0.50 kg for stover ensiled with urea. In another trial, addition of ammonium polyphosphate (APP), urea, or both, to corn stover silage increased _in vitro_ dry matter disappearance and animal performance.

Albert _et al_. (1967a) reported pregnant beef heifers gained 0.73, 0.11 and 1.24 lbs. per day when fed husklage (ensiled husk and cobs), stalklage and corn silage supplemented with soybean meal and Vitamin A. Dry matter digestibilities of the three silages were 60.0, 55.4 and 65.0 percent, respectively.

Corn stalks ensiled with urea, biuret and soybean meal supplements were fed to gestating ewes (Albert _et al_., 1967b). Ewes fed the urea and biuret silage maintained their weight. Those fed stover ensiled with soybean meal gained an average of five lbs. during the 80-day trial. Dry matter digestibilities averaged 48.6, 48.4 and 50.3 percent, respectively, for the urea, biuret and soybean meal silages. All ewes were in positive nitrogen balance.

Beef cows fed stalklage ensiled with urea consumed 13.3 lbs. of dry matter daily and gained 11.2 lbs. in a 50-day trial (Albert _et al_., 1967c). Those fed stalklage and biuret consumed 12 lbs. of dry matter daily and gained 10 lbs.

Ward (1972) reported gestating heifers gained an average of 41 lbs. in 60 days on stalklage supplemented with corn, natural protein, Vitamin A and phosphorus. Calf birth weights were equal (67 lbs.) for stalklage and hay-fed heifers. Heifers grazing corn stalks had average calf weights of 65.4 lbs.

Colenbrander et al. (1971c) fed 0.81, 0.92, 1.03 and 1.14 Mcal estimated net energy (ENE) per kg of complete feed to Holstein heifers. The addition of ENE produced a significant linear increase of daily weight gains (0.34, 0.43, 0.58 and 0.68 kg for the four rations, respectively). They concluded that, if properly supplemented, stover can satisfactorily produce 100% of the N.R.C. recommended growth response.

EXPERIMENTAL PROCEDURES

Experiment I.

This experiment was designed to determine the feeding value of milo stubble for growing lambs. Crossbred Rambouillet wethers averaging 30.1 kg were randomly allotted by weight to five replicated lots of four lambs each. Two lots were randomly assigned to each of the five forage treatments.

The growth trial ran from December 30, 1971 to February 8, 1972. The initial and final weights of the lambs were taken following 15 hours without food and water. Fourteen-day interim weights were also taken.

The five forage treatments are presented in table 1. The mature milo stubble harvested for silage was harvested from a single field near Manhattan, Kansas, using a row-crop forage chopper equipped with a 5.05 cm screen. Chopped stubble and additives were mixed mechanically[1] before packing into 208-liter plastic lined metal drums. As barrels were filled, the polyethelene liner was tied off to insure a good seal. Barrels were stored in open buildings, and opened only as needed. Forage sorghum was ensiled in an upright concrete stave silo (3.7 x 17.4 m). The milo stubble pellets were purchased from a commercial dehydrator in Fremont, Nebraska.

[1]Harsh Mobil Mixer, Eaton, Colorado.

Table 1. FORAGE TREATMENTS USED IN LAMB GROWTH TRIAL

Forage Treatment No.	Date of Harvest	Description
1	Sept. 17, 1971	Forage sorghum silage.
2	Nov. 5, 1971	Milo stubble silage, no additives.
3	Nov. 5, 1971	Milo stubble silage plus 9.1% rolled milo added on a dry matter basis at ensiling time.
4	Nov. 12, 1971	Milo stubble silage plus 1.5% organic acid mixture[a] added on "as is" basis at ensiling time.
5	--	Milo stubble pellets (0.65 cm).

[a]60% acetic, 40% propionic acid.

On a dry matter basis, the rations for treatments 1, 2, 4 and 5 included 70.9% of the respective forage, 22% supplement and 7.1% rolled milo. The ration for forage treatment 3 contained 78% silage and 22% supplement. All rations were formulated to be isonitrogenous; the four milo stubble rations (rations 2-5) were formulated to contain equal amounts of grain. Composition of the supplements is shown in table 2. Supplement A was fed with rations 1 through 4 and supplement B was fed with ration 5. There was no attempt to compensate for the additional energy from the organic acids added to treatment 4. (Forage treatment and corresponding rations are designated by the same numbers.)

Lambs were fed _ad libitum_ once daily. Water was available free choice. Major ration components and feed refusals were collected bi-weekly and frozen for analysis.

At the conclusion of the trial, two lambs were randomly selected from each lot and rumen fluid was drawn at two, four and six hours post feeding via stomach tube (Raun and Burroughs, 1962). pH was determined immediately with a Beckman pH meter. Two ml of 5% mercuric chloride was added to each 40 ml sample. Rumen fluid was stored at 5°C until it was centrifuged at 42,000 g for seven minutes and acidified with 0.5 ml of 50% H_2SO_4. Aliquots were analyzed for total and individual volatile fatty acids by gas chromatography (Parks, 1970).

Table 2. SUPPLEMENT COMPOSITION FOR LAMB GROWTH TRIAL

Ingredient	Supplement A	Supplement B
	%	%
Soybean meal	73.71	60.50
Milo, rolled	19.75	32.67
Dicalcium phosphate	3.34	3.63
Fat	1.00	1.00
Salt	1.50	1.50
Trace minerals	0.25	0.25
Aureomycin[a]	0.45	0.45
Vitamin premix[b]	+	+
Composition (dry matter basis)		
Crude protein	39.9	33.0

[a]22 mg/kg

[b]Added to provide 3,000 IU of Vitamin A, 300 IU of Vitamin D and 3 IU of Vitamin E/animal/day.

Ration samples were composited, mixed and sub-sampled. Aliquots were dried to a constant weight at 70°C and ground to pass a two mm screen. Proximate analysis was carried out on ration components (A.O.A.C., 1960). Cell wall constituents (CWC), acid detergent fiber (ADF) and acid detergent lignin (ADL) were determined for the forage samples using the technique of Goering and Van Soest (1970). Silage pH was established by extraction with distilled water (Barnett, 1954).

Forage _in vitro_ dry matter disappearance (IVDMD) was determined by the two-stage method of Barnes (1969), with the following modifications: Frozen forage was mixed with dry ice and ground to pass a 1 mm screen. Urea (1 g/l) was added to McDougalls artificial saliva prior to saturating with CO_2. At the end of the pepsin digestion phase, tubes were centrifuged and the pepsin-HCl solution decanted. Twenty ml of distilled water was added, and after mixing, tubes were recentrifuged at 2,000 g. After decanting the supernatant, tubes and undigested residue were dried to a constant weight at 65°C. Three _in vitro_ runs were conducted. In each run, forage treatments were layed down in triplicate at hours 6, 12 and 48 for IVDMD determination.

Experiment II.

Silage refusals presented a problem in Experiment I. From visual observation, it was apparent that the larger silage particles (especially the milo stalks greater than 2.5 cm in length) accounted for most of the refusal. Experiment II was designed to test the effect of particle size on silage intake.

Silage made from forage treatment 2 (table 1) was fed in two physical forms: (1) the original silage as chopped from the field and (2) the original silage ground through a hammermill using no screen.

Silages were fed ad libitum but rolled milo grain and supplement A (table 2) were held constant (table 3).

Twelve wethers averaging 31 kg were allotted to the two treatments. Individually penned lambs were fed twice daily during the ten-day pre-trial and subsequent five-day intake trial. Refusals were collected each morning; samples of both rations and refused feed were obtained. Composite samples were dried at 70°C for dry matter determination.

Table 3. RATIONS FOR FIVE-DAY SILAGE INTAKE TRIAL

	Ration No.	
Ingredient	2	2A
Forage treatment 2, original chop	ad lib.	--
Forage treatment 2, hammermilled	--	ad lib.
Supplement A	208 g	208 g
Milo, rolled	70 g	70 g

Experiment III.

Perhaps the most practical method of utilizing milo stubble is in maintenance feeding. Experiment III was conducted to determine if ensiled milo stubble could maintain gestating ewes. The trial ran from December 12, 1971 to May 6, 1972.

Seventy gestating Hampshire and Western ewes averaging 71.8 kg were allotted to the two treatments (table 4). Final weights were determined just before the first ewe lambed (51 days). Ewes received no feed or water 15 hours before weighing. Immediately after parturition ewes were removed from the trial.

Table 4. SILAGE TREATMENTS USED IN GESTATING EWE TRIAL

Item	Date of Harvest	Description
Corn silage[a]	Sept. 17, 1971	Grain in glaze stage of maturity.
Milo stubble silage[a]	Oct. 16, 1971	Milo stubble + 9.1% rolled milo grain added on a dry matter basis.

[a]Both forages were harvested with a forage chopper and ensiled in upright concrete silos (3.6 x 10.6 m).

Rations were formulated to be equal in energy, protein, calcium and phosphorus. Composition of the supplements is shown in table 5.

Total digestible nutrient (TDN) values for the corn silage and milo stubble silage were estimated to be 70 and 59 percent, respectively. Rations were limit fed (table 6) according to energy levels set for gestating ewes (N.R.C., 1968).

Sampling procedures and analysis of the rations were the same as in Experiment I.

Table 5. SUPPLEMENTS FOR GESTATING EWE TRIAL

Ingredient	Corn Silage	Milo Stubble Silage
	% (DM Basis)	%
Fat	1.0	1.0
Dehydrated Alfalfa Meal	10.0	10.0
Soybean Meal	5.4	63.65
Milo	82.95	24.15
Dicalcium Phosphate	0.35	1.15
Limestone	0.25	--
Vitamin Premix[a]	0.05	0.05

[a]Added to provide 3,000 IU of Vitamin A, 300 IU of Vitamin D and 3 IU of Vitamin E/animal/day.

Table 6. DAILY RATIONS FED TO GESTATING EWES

Item	DM	Corn Silage	Milo Stubble Silage
	%	g (DM Basis)	g
Corn Silage	36.56	1144	--
Milo Stubble Silage	30.71	--	1208
Rolled Milo Grain[a]	85.96	82	82
Supplement	89.10	222	222

[a]Fed three weeks prior to the first lambing date.

RESULTS AND DISCUSSION

Experiment I.

Milo stubble silage (forage treatments 2-4) was of low quality as indicated by percent crude protein, ADL, and CWC (table 7). Silage made from forage treatment 3 was lower in fiber, ADL and CWC than the other two stubble silages, due to dilution by the added grain. Forage sorghum silage (forage treatment 1) had the lowest percent CF, ADL and CWC, followed by the milo stubble pellets (forage treatment 5).

The only indication of ensiling characteristics was pH. Silages 3 and 4 had high, but still acceptable, pH values; while pH of forage treatment 2 indicates very little fermentation occurred. The high pH values for the barrel silages could be the result of low environmental temperatures during the ensiling period.

Lamb performance is shown in table 8. Values in the table represent the pooled average of two lots for each of the respective rations. There were no differences in daily gain or feed efficiency among lambs receiving rations 2, 3 and 4. Because of negative and zero weight changes by lambs fed rations 2 and 3, a gain-to-feed ratio was substituted for the more customary feed-to-gain ratio. Lambs receiving ration 4 all gained weight, resulting in a slightly higher, nonsignificant gain-to-feed ratio than lambs receiving rations 2 and 3. Lambs fed ration 4 consumed more feed ($P < .05$) than those fed ration 3.

Lambs fed rations 1 and 5 gained faster ($P < .05$), consumed more feed ($P < .05$) and were more efficient ($P < .05$) than lambs fed rations 2, 3 and 4. Ration 5 was consumed in greater amounts ($P < .05$) than any

Table 7. COMPOSITION OF THE FIVE FORAGE TREATMENTS FED IN LAMB GROWTH TRIAL

Forage Treatment No.	Dry Matter	% Crude Protein	% Crude Fiber	% Ether Extract	% Ash	CWC	ADF	ADL	pH%
		(Dry matter basis)							
1	29.79	4.19	25.58	1.93	7.51	53.88	34.87	5.43	4.07
2	40.26	3.86	39.06	1.32	10.02	73.62	51.66	8.86	5.03
3	40.10	5.07	36.27	1.42	9.71	67.72	47.61	7.65	4.42
4	42.17	4.17	37.23	1.36	9.88	70.04	49.92	8.16	4.60
5	89.74	5.67	34.70	1.72	8.87	63.28	43.31	6.42	--

Table 8. LAMB PERFORMANCE FOR 40-DAY GROWTH TRIAL WITH FIVE DIFFERENT FORAGE TREATMENTS

Item	Ration 1	Ration 2	Ration 3	Ration 4	Ration 5
No. lambs	8	8	8	8	7[a]
Avg. initial wt., kg	31.22	31.13	30.49	30.58	31.08
Avg. final wt., kg	36.92	31.71	31.03	32.92	38.88
Avg. wt. gain, kg	5.70	0.58	0.54	2.34	7.80
Avg. daily gain, kg	0.143[b]	0.015[c]	0.014[c]	0.059[c]	0.195[b]
Avg. ration dry matter consumed per head/day kg	1.10[c]	0.93[d,e]	0.88[e]	0.96[d]	1.53[b]
Kg gain/kg feed	0.130[b]	0.016[c]	0.016[c]	0.061[c]	0.127[b]

[a] One lamb removed for failure to consume the ration.

[b,c,d,e] Means on the same line bearing different superscripts differ significantly ($P < .05$).

of the other four rations.

Forage sorghum silage (ration 1) produced lamb gains consistant with results of Bell and Erhart (1956). Lamb gains for ration 4 agreed closely with average daily gains reported by Cox (1929) but were far lower than gains reported by Menzies et al. (1956). Higher concentrate levels could account for the latter differences.

Feed refusals for the three milo stubble silages were in excess of five percent of the total dry matter offered. Coarseness of the silage chop contributed to excessive sorting and rejection. Albert (1967) reported similar problems when corn stover was fed to heifers. He concluded that fine chopping would increase intake and minimize sorting.

The milo stubble used in ration 5 was not of the same origin as the milo stubble silages. While a direct comparison of the pelleted and ensiled milo stubbles' ability to support lamb growth is questionable, both physical form and forage quality were probably responsible for the observed differences. These conclusions agree with Minson (1963), Moore (1964) and O'Dell et al. (1963).

Rumen fluid total volatile fatty acid (TVFA) concentrations and pH is shown in table 9. TVFA levels and rumen pH remained relatively constant for the three sampling times. However, TVFA differences ($P < .05$) were noted between treatments within two of the sampling times. Rumen fluid from lambs fed ration 4 contained more ($P < .05$) TVFA at two hours post feeding than that from lambs fed ration 1. At four hours post feeding TVFA concentration in lambs fed ration 4 was higher ($P < .05$) than in lambs fed the other four rations. The addition of organic acids to the forage prior to ensiling may account for some of the increase in TVFA's concentration.

Table 9. TOTAL VOLATILE FATTY ACID CONCENTRATION AND pH

	Hours Post Feeding					
	2		4		6	
Ration	TVFA	pH	TVFA	pH	TVFA	pH
1	79.79^{b}	6.63	85.33^{b}	6.79	88.35	6.64
2	85.18^{a,b}	6.78	84.43^{b}	6.84	84.40	6.84
3	88.30^{a,b}	6.84	83.33^{b}	6.89	86.26	6.87
4	95.53^{a}	6.70	100.93^{a}	6.79	94.73	6.79
5	84.78^{a,b}	6.52	88.60^{b}	6.85	90.28	6.85

^{a,b}Means in the same column bearing different superscripts differ significantly ($P < .05$).

Table 10. MOLAR PERCENT VOLATILE FATTY ACIDS

Item	Ration				
	1	2	3	4	5
Volatile Fatty Acids, molar %					
Acetic	62.55^{d}	69.97^{a}	66.33^{b,c}	67.37^{b}	64.84^{c}
Propionic	24.96^{a}	19.80^{c}	24.23^{a,b}	22.71^{c}	23.76^{b}
Butyric	12.45	10.55	9.42	9.89	11.36
Acetate:propionate ratio	2.50	3.54^{a}	2.74	2.97	2.73

^{a,b,c,d}Means in the same line bearing different superscripts differ significantly ($P < .05$).

Since time effect was nonsignificant, the molar percent VFA's shown in table 10 represent a pooled average for replicated lots over the three sampling times.

In general, rations 2 and 4 produced higher molar percents of acetic acid and lower ($P < .05$) molar percents of propionic acid than the other three rations. No significant differences were found among the five rations for molar percent butyric acid. Rumen fluid from lambs fed ration 2 had the highest ($P < .05$) acetate:propionate ratio.

The IVDMD of the five forage treatments is shown in table 11. A run X treatment interaction ($P < .05$) was obtained and forage treatment differences were noted at all time periods. Forage treatment 4 was more digestible ($P < .05$) than the other four forages at hours 6 and 12. Dry matter disappearance at 48 hours was highest for forage treatment 1 f lowed in order by forage treatments 4, 5, 3 and 2 ($P < .05$). Forage treatment 3 was more digestible ($P < .05$) than forage treatment 2 at all three time periods. This was expected since grain was added at ensiling time. The unusually high IVDMD of the acid-treated silage (forage treatment 4) at hours 6 and 12 was inconsistant with results of the other forage treatments in this trial.

Improved lamb performance appeared to be associated primarily with level of voluntary intake (i.e., forage treatment 5), degree of dry matter digestibility (i.e., forage treatment 1) and acetate to propionate ratios in the rumen fluid (i.e., forage treatments 1, 4 and 5).

Table 11. PERCENT IN VITRO DRY MATTER DISAPPEARANCE FOR THE FIVE FORAGE TREATMENTS IN THE LAMB GROWTH TRIAL[a]

Item	Forage Treatments				
	1	2	3	4	5
6 hr.	11.9[e]	12.6[e]	16.9[d]	34.6[b]	18.4[c]
12 hr.	36.4[c]	20.8[e]	23.9[f]	41.2[b]	27.4[d]
48 hr.	61.9[b]	45.1[f]	47.5[e]	59.6[c]	52.7[d]

[a]Each value represents the mean of nine *in vitro* observations.

[b,c,d,e,f]Means on the same line bearing different superscripts differ significantly ($P < .05$).

Experiment II.

Results of the intake trial are shown in table 12. Lambs fed the hammermilled silage (ration 2A) consumed more silage dry matter ($P < .01$) than lambs fed the original chopped silage (ration 2). This agrees with reports by Murdock (1965) and Owen and Kuhlman (1967) and supports the concept that a reduction in silage particle size will increase intake and limit the opportunity for animals to select certain portions of the forage for consumption.

Experiment III.

Chemical composition of the silages fed gestating ewes is shown in table 13. Visual appraisal and pH values indicated that both silages were satisfactorily preserved. As expected, the corn silage had more crude protein and less crude fiber, CWC, ADF and ADL than the milo stubble silage. Forty-eight hour IVDMD was higher ($P < .01$) for the corn silage than the milo stubble silage (68.4% vs 51.4%).

Performance of the ewes is shown in table 14. The results indicate that the ewes consumed enough milo stubble silage to meet their energy requirements during gestation. Feed refusals were minimal for both silage rations; less than 5% of the total silage offered during the first 51 days of the experiment. Average daily gain of ewes fed milo stubble silage (0.14 kg) was in close agreement with the N.R.C. (1968) recommendation of 0.17 kg for ewes in the last six weeks of gestation. Ewes receiving corn silage gained faster ($P < .05$) than ewes receiving milo stubble silage (0.25 vs 0.14 kg per day). Ewes

Table 12. INFLUENCE OF PARTICLE SIZE ON SILAGE INTAKE[a]

Item	Day				
	1	2	3	4	5
Ration 2					
Avg. silage dry matter intake (g)	351.3	418.9	435.7	425.1	433.3
Intake, g/wt. $kg^{0.75}$	48.1	54.6	55.9	55.0	55.7
Ration 2A					
Avg. silage dry matter intake (g)	455.8	532.9	514.2	540.6	540.0
Intake, g/wt. $kg^{0.75}$	57.6	62.8	61.4	63.4	63.3

[a]Each value represents the mean of six lamb observations.

Table 13. COMPOSITION OF SILAGE FED IN THE GESTATING EWE TRIAL

Item	% Dry Matter	% Crude Protein	% Crude Fiber	% Ether Extract	% Ash	CWC	ADF	ADL	pH
	(Dry matter basis)								
Corn Silage	36.56	8.25	21.16	2.59	6.10	46.27	26.91	2.54	4.01
Milo Stubble Silage	30.71	4.85	31.52	1.51	12.36	60.20	42.87	7.20	3.92

Table 14. PERFORMANCE OF EWES IN GESTATING EWE TRIAL

	Silage	
Item	Corn	Milo Stubble
No. of ewes	34	36
Initial wt., kg	71.9	71.8
Final wt., kg	84.9	79.0
Avg. wt. gain, kg	13.0	7.2
Avg. daily gain, kg	0.25[a]	0.14[b]
Avg. Daily Intake		
Silage, g	1103	1162
Supplement, g	222	222
Rolled milo, g	82	82
Lambing Performance		
No. ewes lambed	28	29
No. lambs born	40	40
No. single lambs born	16	18
Avg. birth wt. of single lambs, kg	5.51	5.13
No. twin lambs born	24	22
Avg. birth wt. of twin lambs, kg	3.89	3.54
Kg lamb born/ewe	6.62	6.31

[a,b]Means in the same line bearing different superscripts differ significantly ($P<.05$).

fed corn silage gained 34% more than the predicted weight gain (0.25 vs 0.17 kg per day). Apparently the corn silage contained more TDN than the 70% assumed for ration formulation.

Corn silage-fed ewes produced slightly more lamb weight per ewe than those fed milo stubble silage. Both single and twin lambs were slightly heavier at birth in the corn silage group. Many lambs appeared to lack vigor and death losses were relatively high. Seventeen and thirteen lambs from the corn silage and milo stubble silage groups, respectively, were either stillborn or died shortly after parturition. Lamb health at birth was probably the result of pre-experimental planes of nutrition and/or breeding regimes and not the silage treatments.

SUMMARY

Two experiments studied the feeding value of milo stubble for sheep in growing and maintenance feeding programs. A third studied the influence of particle size on silage voluntary intake.

In experiment I, 40 crossbred wethers were allotted to five forage treatments: 1. forage sorghum silage, 2. milo stubble silage, 3. milo stubble silage plus 9.1% rolled milo grain added at ensiling, 4. milo stubble silage plus 1.5% organic acid mixture added at ensiling, 5. milo stubble pellets. On a dry matter basis, rations for forage treatments 1, 2, 4 and 5 included 70.9% of the respective forage, 22% soybean meal-based supplement and 7.1% rolled milo. The ration for forage treatment 3 contained 78% silage and 22% supplement. Average daily gain (kg) and gain-to-feed ratios for the five rations, respectively, were: 0.143, 0.130; 0.015, 0.016; 0.014, 0.016; 0.059, 0.061; and 0.195, 0.127. Lambs fed rations 1 and 5 gained faster ($P<.05$), consumed more feed ($P<.05$) and were more efficient ($P<.05$) than lambs fed the other 3 rations. There were no differences in ADG or gain-to-feed ratio among lambs receiving rations 2, 3 and 4. Feed refusals for the three milo stubble silages were in excess of 5% of the total dry matter offered. Rumen liquor samples taken at 2, 4 and 6 hours post feeding revealed little change in rumen pH or total volatile fatty acid (TVFA) concentrations. At 4 hours post feeding, TVFA concentration in lambs fed ration 4 was higher ($P<.05$) than in lambs fed the other four rations. Rumen fluid from lambs fed rations 2 and 4 contained higher molar percents of acetic acid and lower molar percents of propionic acid than rumen fluid from

lambs fed the other three rations. Rumen fluid from lambs fed ration 2 had the highest ($P<.05$) acetate:propionate ratio. Forty-eight hour *in vitro* dry matter disappearance was highest ($P<.05$) for forage treatment 1 followed in order by forage treatments 4, 5, 3 and 2.

In experiment II, 12 wether lambs were fed milo stubble silage in two physical forms; original chopped and hammermilled before feeding. Milo grain and supplement were limit fed while silage was fed *ad libitum*. Lambs fed hammermilled silage consumed more silage dry matter ($P<.01$) than lambs fed the original chopped silage.

In experiment III, 70 ewes of Hampshire and Western breeding were allotted to corn or milo stubble silage-based rations. Rations were formulated to supply equal amounts of energy, protein, calcium and phosphorus. Intake was restricted to N.R.C. (1968) recommended allowances. Ewes consumed enough milo stubble silage to meet their energy requirements during gestation. Daily gains of ewes fed milo stubble silage and corn silage were 0.14 and 0.25 kg, respectively. Corn silage fed ewes produced slightly more lamb weight per ewe than ewes fed milo stubble silage (6.62 vs 6.31 kg). Both single and twin lambs were slightly heavier at birth in the corn silage group.

ACKNOWLEDGMENTS

I would like to take this opportunity to thank the members of my committee: Dr. Benny E. Brent, Dr. Keith Bolsen and Dr. C. W. Deyoe, for their suggestions and guidance during the course of this study.

I am especially grateful to Dr. Bolsen for his encouragement, guidance and time during the planning of the experiments, conduct of the trials and preparation of the manuscript. I would also like to thank Dr. Brent, my major professor, for his counsel and support during my studies at Kansas State University.

Appreciation is also extended to Dr. Don L. Good, Head of the Department of Animal Science, for the use of facilities and equipment in the department. I would also like to thank the faculty and staff of the Animal Science Department for their helpfulness and friendship during my studies at K.S.U.

This manuscript is dedicated to my wife, Marcia; son, Todd; and my parents, Mr. and Mrs. Frank Chyba, for their encouragement and patience during the course of this study.

LITERATURE CITED

Albert, W. W., D. L. Cox and E. E. Hatfield. 1967a. Stalklage ensiled with urea or biuret for wintering beef cows. Ill. Beef Cattle Day, p. 24.

Albert, W. W., D. L. Cox and E. E. Hatfield. 1967b. Urea, biuret and soybean meal ensiled with cornstalk forage for wintering pregnant ewes. Ill. Beef Cattle Day, p. 25.

Albert, W. W., L. D. Ferrell and U. S. Garrigus. 1967. Husklage, stalklage and corn silage for wintering pregnant beef heifers. Ill. Beef Cattle Day, p. 13.

A.O.A.C. 1960. Official methods of analysis (9th Ed.). Association of official agricultural chemists. Washington, D. C.

Baker, F. and S. T. Harris. 1947. The role of the microflora of the alimentary tract of herbivora with special reference to ruminants. II. Microbial digestion in the rumen (and caesum), with special reference to the decomposition of structural cellulose. Nutr. Abstr. Rev., 17:3.

Baker, M. L. 1943. Wintering steer calves. Nebr. Agr. Exp. Sta. Bull. 350.

Balch, C. C. and R. C. Campling. 1962. Regulation of voluntary food intake in ruminants. Nutr. Abstr. Rev., 32:669.

Balwani, T. L., R. R. Johnson, K. E. McClure and B. A. Dehority. 1969. Evaluation of green chop and ensiled sorghums, corn silage and perennial forages using digestion trials and VFA production in sheep. J. Animal Sci. 28:90.

Barnes, R. F. 1969. Collaborative research with the two-stage in vitro rumen fermentation technique. Proc. Nat. Conf. on forage quality evaluation and utilization, Lincoln, Nebraska.

Barnett, A. J. G. 1954. Silage fermentation. Academic Press, London.

Beardsley, D. W. 1964. Symposium on forage utilization: Nutritive value of forage as affected by physical form. Part II. Beef cattle and sheep studies. J. Animal Sci. 23:239.

Becker, R. B. and W. D. Galup. 1927. Utilization of grain in Kafir and cane silage by dairy cows. Okla. Agr. Exp. Sta. Bull. 164.

Bell, T. D. and A. B. Erhart. 1956. Lamb feeding experiments. 43rd annual livestock feeder day. Circ. 335.

Blaser, R. E. 1964. Symposium on forage utilization: Effect of fertility levels and stage of maturity on forage nutritive value. J. Animal Sci. 23:264.

Blaxter, K. L., F. W. Wainman and R. S. Wilson. 1961. The regulation of food intake by sheep. Animal Prod. 3:51.

Colenbrander, V. F., L. D. Muller and M. D. Cunningham. 1971b. Effects of added urea and ammonium polyphosphate on fermentation of corn stover silages. J. Animal Sci. 33:1097.

Colenbrander, V. F., L. D. Muller, J. A. Wasson and M. D. Cunningham. 1971a. Effects of added urea and ammonium polyphosphate to corn stover silages on animal performance. J. Animal Sci. 33:1091.

Colenbrander, V. F., L. D. Muller, J. A. Wasson and M. D. Cunningham. 1971c. Corn stover silage supplemented with varying increments of energy for growing dairy heifers. J. Animal Sci. 33:1306.

Conrad, H. R. 1966. Symposium of factors influencing the voluntary intake of herbage by ruminants: Physiological and physical factors limiting feed intake. J. Animal Sci. 25:227.

Conrad, H. R., A. D. Pratt and J. W. Hibbs. 1964. Regulation of feed intake in dairy cows. I. Change in importance of physical and physiological factors with increasing digestibility. J. Animal Sci. 47:54.

Cox, R. 1929. Cottonseed meal with various rations for lambs. New Mexico Agr. Exp. Sta. Bull. 179.

Crampton, E. W. 1957. Interrelations between digestible nutrients and energy content, voluntary dry matter intake and the overall feeding value of forages. J. Animal Sci. 16:546.

Dehority, B. A., R. R. Johnson and H. R. Conrad. 1962. Digestibility of forage hemicellulose and pectin by rumen bacteria _in vitro_ and the effect of lignification thereon. J. Dairy Sci. 45:508.

Donefer, E., E. W. Crampton and L. E. Lloyd. 1960. Prediction of the nutritive value index of a forage from _in vitro_ rumen fermentation data. J. Animal Sci. 19:545.

Gaillard, Blanche D. E. 1962. The relationship between the cell wall constituents of roughages and the digestibility of the organic matter. J. Agric. Sci. 59:369.

Gaillard, Blanche D. E. 1966. Calculation of the digestibility for ruminants of roughages from the contents of cell wall constituents. Neth. J. Agric. Sci. 14:215.

Galye, H. K. and E. R. Lloyd. 1917. Silages for fattening steers. Miss. Agr. Exp. Sta. Bull. 182.

Garrett, W. N. and G. F. Worker. 1965. Comparative feeding value of silage made from sweet and dual purpose varieties of sorghum. J. Animal Sci. 24:782.

Goering, H. K. and P. J. Van Soest. 1970. Forage fiber analyses. (Apparatus, reagents, procedures and some applications.) Agr. Handbook No. 379.

Johnson, R. R., T. L. Balwani, L. J. Johnson, D. E. McClure and B. A. Dehority. 1966. Corn plant maturity II. Effect on in vitro cellulose digestibility and soluble carbohydrate content. J. Animal Sci. 25:617.

Johnson, R. R., V. P. DeFaria and K. E. McClure. 1971. Effects of maturity on chemical composition and digestibility of bird resistant sorghum plants when fed to sheep as silages. J. Animal Sci. 33:1102.

Johnson, R. R., B. A. Dehority, J. L. Parsons and H. W. Scott. 1962. Descrepancies between grasses and alfalfa when estimating nutritive value from in vitro cellulose digestibility by rumen microorganisms. J. Animal Sci. 21:892.

Johnson, R. R. and K. E. McClure. 1968. Corn plant maturity IV. Effects on digestibility of corn silage in sheep. J. Animal Sci. 27:535.

Johnson, R. R., G. E. Ricketts, E. W. Klosterman and A. L. Moxon. 1964. Studies on the utilization and digestion of long, ground and pelleted alfalfa and mixed hay. J. Animal Sci. 23:94.

Kamstra, L. D., A. L. Moxon and O. G. Bentley. 1958. The effect of stage of maturity and lignification on the digestion of cellulose in forage plants by rumen microorganisms in vitro. J. Animal Sci. 17:199.

Kuhlman, A. H., P. G. McGillard and E. Weaver. 1932-34. Darso heads have low feeding value when used in silage. Okla. Agr. Exp. Sta. Rpt. 169.

Lloyd, L. E., E. W. Crampton, E. Donefer and S. E. Beacon. 1960. The effect of chopping versus grinding on the nutritive value index of early versus late cut Red Clover and Timothy hays. J. Animal Sci. 19:859.

Lyford, S. J. Jr., W. W. G. Smart, Jr. and G. Matrone. 1963. Digestibility of alpha cellulose and pentosan components of cellulosic micelle of fescue and alfalfa. J. Nutr. 79:105.

Menzies, Carl, T. D. Bell and A. B. Erhart. 1956. Lamb feeding experiments. 23rd annual lamb feeder day.

Minson, D. J. 1963. The effect of pelleting and wafering on feeding value of roughage -- a review. J. Brit. Grassl. Soc. 18:39.

Montgomery, M. J. and B. R. Baumgardt. 1965. 1. Pelleted rations varying in energy concentration. J. Dairy Sci. 48:569.

Moore, L. A. 1964. Symposium on forage utilization: Nutritive value of forage as affected by physical form. Part 1. General principles involved with ruminants and effect of feeding pelleted or wafered forage to dairy cattle. J. Animal Sci. 23:230.

Mowat, D. N., M. L. Kwain and J. E. Winch. 1969. Lignification and in vitro cell wall digestibility of plant parts. Can. J. Plant Sci. 49:499.

Murdock, J. C. 1965. The effects of length of silage on its voluntary intake by cattle. J. Brit. Grassl. Soc. 20:54.

Nevens, W. B. and K. E. Harshbarger. 1940. Broomcorn silage for dairy cattle. J. Dairy Sci. 23:1023.

Noller, C. H., J. E. Warner, T. S. Ramsey and D. L. Hill. 1963. Comparative digestibilities and intake of green corn and corn silages with advancing maturity. J. Animal Sci. 22:1135.

N.R.C. 1968. Nutrient requirements of domestic animals. No. 5. Nutrient requirements of sheep. National Research Council, Washington, D. C.

O'Dell, G. D., W. A. King, W. C. Cook and S. L. Moore. 1963. Effect of physical state of coastal bermuda grass hay on passage through digestive tract of dairy heifers. J. Dairy Sci. 46:38.

Oh, J. H., W. C. Weir and W. M. Longhurst. 1971. Feed value for sheep of corn stalks, rice straw and barley straw as compared with alfalfa. J. Animal Sci. 32:343.

Owen, F. G. and J. W. Kuhlman. 1967. Effect of maturity on digestibility of forage sorghum silages. J. Dairy Sci. 50:527.

Owen, F. G., J. R. Kuiken and O. J. Webster. 1962. Value of sterile forage sorghums and corn as silages for lactating cows. J. Dairy Sci. 45:55.

Parks, J. 1970. Control of feed intake in ruminants: A semipurified liquid diet for continuous intraruminal infusion. MS thesis, Kansas State University, Manhattan, Kansas.

Quicke, G. V. and O. G. Bentley. 1958. Lignin and methoxyl groups as related to the decreased digestibility of mature forages. J. Animal Sci. 17:1206.

Quicke, G. V. and O. G. Bentley. 1959. Lignin and methoxyl groups as related to the decreased digestibility of mature forages. J. Animal Sci. 18:365.

Ramsey, D. S., J. W. Lusk and J. T. Miles. 1961. Observation on the digestibility of sweet sorghum silage ensiled at four stages of maturity. J. Dairy Sci. 44:975.

Raun, N. S. and W. Burroughs. 1962. Suction strainer technique in obtaining rumen samples from intact lamb. J. Animal Sci. 21:454.

Russell, H. L. and E. B. Morrison. 1920. Corn stover silage for milk production. Wisconsin Agr. Exp. Sta. Bull. 323.

Sherman, J. M. and S. I. Beckdel. 1918. Corn stover silage. J. Agr. Res. 12:589.

Smith, G. S., A. B. Nelson and Eloy J. A. Boggino. 1971. Digestibility of forages in vitro as affected by content of "silica". J. Animal Sci. 33:466.

Sullivan, J. T. 1955. Cellulose and lignin in forage grasses and their digestion coefficients. J. Animal Sci. 14:710.

Sullivan, J. T. and T. V. Hershberger. 1959. Effects of chlorine dioxide on lignin content and cellulose digestibility of forages. Science 130:1252.

Thurman, R. L., O. T. Stallcup and C. E. Reames. 1961. Quality factors of Sorgo as a silage crop. Ark. Agr. Exp. Sta. Bull. 632.

Tomlin, D. C., R. R. Johnson and B. A. Dehority. 1965. Relationship of lignification to an in vitro cellulose digestibility of grasses and legumes. J. Animal Sci. 24:161.

Van Soest, P. J. 1964. Symposium on nutrition and forage and pastures: New chemical procedures for evaluating forages. J. Animal Sci. 23:838.

Van Soest, P. J. 1965a. Comparison of two different equations for the prediction of digestibility from cell contents, cell wall constituents and lignin content of acid-detergent fiber. J. Dairy Sci. 48:815.

Van Soest, P. J. 1965b. Symposium on factors influencing the voluntary intake of herbage by ruminants: Voluntary intake in relation to chemical composition and digestibility. J. Animal Sci. 24:834.

Van Soest, P. J. 1967. Development of a comprehensive system of feed analysis and its application to forages. J. Animal Sci. 26:119.

Van Soest, P. J. and L. H. P. Jones. 1968. Effects of silica in forages upon digestibility. J. Dairy Sci. 51:1644.

Van Soest, P. J. and W. C. Marcus. 1964. Method for the determination of cell wall constituents in forages using detergent and the relationship between this fraction and voluntary intake and digestibility. J. Dairy Sci. 47:704.

Waite, R., M. J. Johnston and D. G. Armstrong. 1964. The evaluation of artificially dried grass as a source of energy for sheep. The effect of maturity on the apparent digestibility of rye-grass, cooksfoot and Timothy. J. Agr. Sci. 62:391.

Ward, J. 1972. Feeding value of crop residues. Nebr. Beef Cattle Rpt., p. 30.

FEEDING VALUE OF MILO STUBBLE FOR SHEEP

by

LESLIE JUNIOR CHYBA

B.S., Kansas State University, 1969

AN ABSTRACT OF A MASTER'S THESIS

submitted in partial fulfillment of the

requirements for the degree

MASTER OF SCIENCE

Department of Animal Science

KANSAS STATE UNIVERSITY

Manhattan, Kansas

1972

ABSTRACT

Two experiments studied the feeding value of milo stubble for sheep in growing and maintenance feeding programs. A third studied the influence of particle size on silage voluntary intake.

In experiment I, 40 crossbred wethers were allotted to five forage treatments: 1. forage sorghum silage, 2. milo stubble silage, 3. milo stubble silage plus 9.1% rolled milo grain added at ensiling, 4. milo stubble silage plus 1.5% organic acid mixture added at ensiling, 5. milo stubble pellets. On a dry matter basis, rations for forage treatments 1, 2, 4 and 5 included 70.9% of the respective forage, 22% soybean meal-based supplement and 7.1% rolled milo. The ration for forage treatment 3 contained 78% silage and 22% supplement. Average daily gain (kg) and gain-to-feed ratios for the five rations, respectively, were: 0.143, 0.130; 0.015, 0.016; 0.014, 0.016; 0.059, 0.061; and 0.195, 0.127. Lambs fed rations 1 and 5 gained faster ($P < .05$), consumed more feed ($P < .05$) and were more efficient ($P < .05$) than lambs fed the other 3 rations. There were no differences in ADG or gain-to-feed ratio among lambs receiving rations 2, 3 and 4. Feed refusals for the three milo stubble silages were in excess of 5% of the total dry matter offered. Rumen liquor samples taken at 2, 4 and 6 hours post feeding revealed little change in rumen pH or total volatile fatty acid (TVFA) concentrations. At 4 hours post feeding, TVFA concentration in lambs fed ration 4 was higher ($P < .05$) than in lambs fed the other four rations. Rumen fluid from lambs fed rations 2 and 4 contained higher molar percents of acetic acid and lower molar percents of propionic acid than rumen fluid from

lambs fed the other three rations. Rumen fluid from lambs fed ration 2 had the highest ($P < .05$) acetate:propionate ratio. Forty-eight hour *in vitro* dry matter disappearance was highest ($P < .05$) for forage treatment 1 followed in order by forage treatments 4, 5, 3 and 2.

In experiment II, 12 wether lambs were fed milo stubble silage in two physical forms; original chopped and hammermilled before feeding. Milo grain and supplement were limit fed while silage was fed *ad libitum*. Lambs fed hammermilled silage consumed more silage dry matter ($P < .01$) than lambs fed the original chopped silage.

In experiment III, 70 ewes of Hampshire and Western breeding were allotted to corn or milo stubble silage-based rations. Rations were formulated to supply equal amounts of energy, protein, calcium and phosphorus. Intake was restricted to N.R.C. (1968) recommended allowances. Ewes consumed enough milo stubble silage to meet their energy requirements during gestation. Daily gains of ewes fed milo stubble silage and corn silage were 0.14 and 0.25 kg, respectively. Corn silage fed ewes produced slightly more lamb weight per ewe than ewes fed milo stubble silage (6.62 vs 6.31 kg). Both single and twin lambs were slightly heavier at birth in the corn silage group.

Approved By:________________

ARTS AND SCIENCES COPY CENTER

Copy Order

Date________________________

Time Received________________

Time Wanted_________________

Charge To:

_______ Dean's Office
_______ Aerospace Studies
_______ Art
_______ Athletics
_______ Biochemistry
_______ Division of Biology
_______ Chemistry
_______ Computer Science
_______ Economics
_______ English
_______ Geography
_______ Geology
_______ History
_______ Journalism & Mass Communications
_______ Mathematics
_______ Military Science
_______ Modern Languages
_______ Music
_______ Philosophy
_______ Physical Education
_______ Physics
_______ Political Science
_______ Psychology
_______ Sociology & Anthropology
_______ Speech
_______ Statistics
_______ Auditorium
_______ Military Affairs
_______ South Asia Center
_______ Student Publications
_______ Other________________________________

For____

By____

Special Instructions___________________________

____

____

____

____

Bind _______

Collate _______

Staple _______

Fold _______

Pick up _______

Deliver _______

Call _______

FOR USE IN DEAN'S OFFICE ONLY

Copies		Charge
_________	@ 5	- ________
_________	@ 3	_________
_________	@ 1	_________
TOTAL		_________

Completed work received by___________________________

Job Breakdown

No. of Pages	No. of Copies	Total Copies