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BULLETIN 465 OCTOBER 1957

EFFECTS OF PRESERVATIVES ON alfalfa silage FOR DAIRY CATTLE

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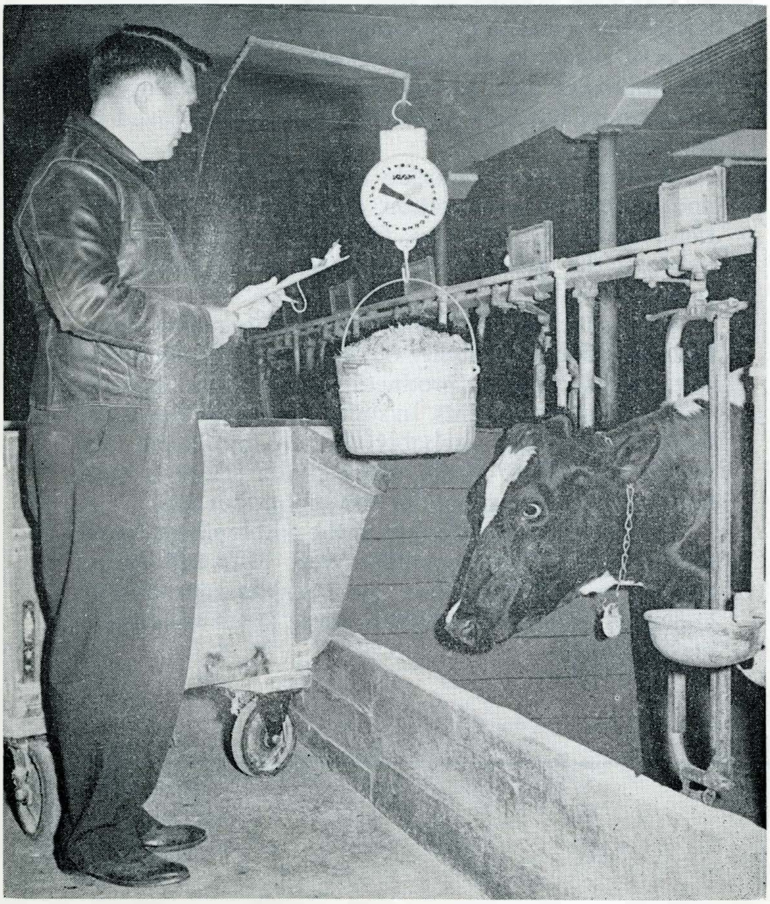

DAIRY HUSBANDRY DEPARTMENT
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summary

You are likely to have trouble preserving alfalfa as silage, especially under the rather unfavorable conditions of packing and air removal found in bunker silos.

Several factors cause this trouble. Alfalfa is relatively low in fermentable sugars and is high in protein and minerals; therefore, enough acid to properly preserve it in silos may not develop.

Carotene content of well-preserved alfalfa silage is high but seems to be lost rapidly in poorly preserved areas of silage. In our experiments sodium metabisulfite improved the carotene retention of the silage to some extent but milk production was not improved by the addition.

Iodized sodium chloride added to the alfalfa did not improve its preservation, consumption, or production response by milk cows. Corn and cob meal did not improve the palatability of silage when used as a preservative.

Characteristic of alfalfa silage was its rather objectionable odor. Palatability of this silage was relatively low, and declines in production were quite rapid in our feeding experiments. In some cows there was great body weight loss, probably due to insufficient dry matter equivalent intake when alfalfa silage is used for most of the roughage for cows in production.

Estimated dry matter loss of the edible silage, based on the changes in ash content, were 15 to 22% during storage in bunkers. When you consider top spoilage and silage refusals by animals, these losses are considerably higher.

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EFFECTS OF PRESERVATIVES ON

alfalfa silage

FOR DAIRY CATTLE

HOWARD H. VOELKER and EMERY BARTLE*

There has been considerable interest in recent years in the use of alfalfa for silage. Many times rainy weather, especially during the first cutting, may result in high losses if alfalfa is cut for hay.

Opinions as to the value of alfalfa as silage vary widely. These differences may come about because conditions are critical for making good alfalfa silage. The main reason alfalfa is preserved as silage with difficulty is that it contains a much smaller percentage of fermentable sugars than do corn and sorghum forages, which have been successfully preserved without additives for many years.

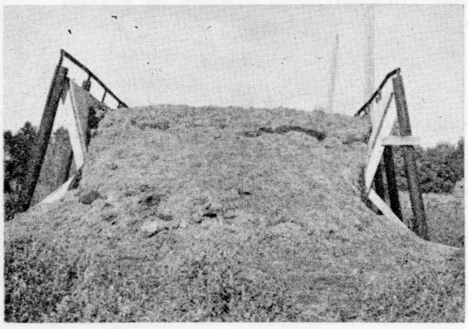
Freshly ensiled alfalfa has approximately 4.5% total protein, whereas corn and sorghums have less than half as much. Therefore the ratio of fermentable sugars to protein is not as favorable in alfalfa as it is in corn or sorghum. Alfalfa is even lower than grass forage in sugars.

Another factor of importance may be that alfalfa contains more minerals which may neutralize some of the acids produced during fermentation. Also, the high protein content of alfalfa may contribute to buffering action and thus reduce effectiveness of acid produced.

Legume silages have been fed at the South Dakota State College Agricultural Experiment Station for many years. More intensive research on preserving, feeding value, and losses under controlled conditions have been done in the past 5 years.

The following experiments were initiated to gain more information on preservation, losses, and feeding value of alfalfa when preserved as silage and fed to dairy cows.

Alfalfa silage in a bunker silo.



*Dr. Voelker is associate dairy husbandman and Mr. Bartle is assistant dairy husbandman, South Dakota State College Agricultural Experiment Station.

Experiments in Preservation

Wilting the Alfalfa

Most of the alfalfa used in these studies was wilted before ensiling. If alfalfa is not wilted, seepage losses may be high, and foul, strong-odor silage may result. By permitting the alfalfa to wilt for 2 or 3 hours on sunny days, the moisture content is usually reduced to approximately 65%.

Moisture tests were run on the silage used. In addition to moisture tests, some carotene determinations and many pH values were obtained. Table 1 shows some relationships that were found. Carotene appeared to be better preserved in the lower moisture silages. None of the pH readings were as low as is desirable; however, it did not appear that moisture content had a great deal of influence on the development of acids. In general, milk cows preferred silage made at 60 to 67% moisture. The high moisture silages, especially above 70%, resulted in poor consumption.

It was difficult to obtain proper wilting because drying conditions varied so much at different times each day. Such factors as stage of maturity of the alfalfa, rainfall, air humidity, soil moisture, and air temperature probably influenced the amount of wilting. In some cases where the alfalfa was too dry it was not cut uniformly into short lengths with the field cutter and did not pack well in the silos.

Wilting tended to result in less seepage losses, especially in upright silos. Seepage losses appeared to be less in the horizontal bunker silos, probably because of less depth of silage compared to upright silos, putting less pressure on the silage.

The moisture content of the alfalfa can be estimated by several methods. One method is to roll a good-sized handful of the freshly cut alfalfa in both hands. If moisture squeezes out, and if the material stays in a compact ball, the moisture content is too high. If it falls apart rapidly the material is too dry. Experience is most valuable in the estimation of the best amount of wilting. A second method involves drying a sample of silage by tractor or automobile exhaust. These exhaust driers can be purchased at several farm equipment companies.

Preservation with Sodium Metabisulfite

Several years ago Pennsylvania research workers developed a method of applying sulfur dioxide from cylinders to forage as it was ensiled. This method was effective in improving the odor, color, and carotene in alfalfa silage. However,

Table 1. Relationship of Moisture Content, Carotene, and Acidity of Alfalfa Silage

Amount of Wilting	Moisture %	Carotene (mcg. per gram)	pH
Well-wilted	60.2	65	4.7
Moderate	66.7	56	5.5
Moderate	69.9	36	5.2
Slight	70.3	18	5.1
Very slight	73.8	22	5.2

many difficulties were encountered. More recently, sodium metabisulfite was made available in dry form, as a powder, which is much easier to handle than the sulfur dioxide gas. It can be added to silo blowers at filling time by use of a corn planter fertilizer attachment.

Experiments in preservation using sodium metabisulfite were started at South Dakota State College to determine its effects on preservation, losses, and feeding value when used under bunker silo conditions.

In June 1955, a 200-ton horizontal bunker silo was filled with first-cutting alfalfa. This silo had slanting walls 8 feet high and 63 feet long. Its walls were 11 feet apart on the bottom and 18 feet at the top and it had a concrete floor. The alfalfa was wilted to 64 to 70% moisture before ensiling. The east half of the bunker was treated with 10 pounds of sodium metabisulfite per ton of green alfalfa and the west end served as the control. Samples were taken from each load prior to putting it in the bunker. These samples were analyzed chemically.

The bisulfite was sprinkled manually on the alfalfa and mixed into the alfalfa with forks in the bottom half of the silo. The distribution was poor in spots, resulting in some bleached areas of silage. In filling the top half of the bunker, the bisulfite was sprinkled uniformly into a blower as the silage was blown from trucks into the bunker. No bleached areas were found in this silage. The silage was packed using tractors and trucks and was covered with felt roofing which was weighted down with a small amount of green chopped alfalfa. (More recently plastic covers have been used very successfully.) It was stored for about 5 months before being fed the following fall and winter.

Sodium metabisulfite is added to silage by sprinkling the powder into the silage blower at filling time.

The silage was sampled as it was fed and these samples were used for chemical analyses. Samples were taken from the top and bottom halves of each of the untreated and the bisulfite-treated silage. These data were averaged and the ash values are presented in table 2. Changes in ash values suggest dry matter losses because ash does not disappear unless leached away. Therefore, an increase in ash suggests dry matter losses.

Table 2 shows that there was a difference in ash values of the bisulfite-treated and untreated silage when ash values of the bisulfite were accounted for. There was some apparent change in the top compared to the bottom half of the bunker, suggesting greater losses of dry matter in the top half. Also, the freshly ensiled material averaged between 8.6 and 8.8% ash (dry basis). This indicates losses of 15 to 20% of the dry matter equivalent of the alfalfa between ensiling and feeding. When top spoilage and feed refused are considered, these losses are even greater. Experimental work is in progress to check further the losses by ash value changes and total weights of silage between ensiling and feeding.

The silage was sampled as it was fed between November 1955 and January 1956. There was considerable difference in the carotene retention of the metabisulfite and control silage (table 3), with an advantage for the metabisulfite. Also, there was a greater retention of carotene in the bottom half of the bunker. It is obvious that where air is not excluded, sodium metabisulfite is of little, if any, value. If the top silage is not packed sufficiently, the air may be reincorporated, leaving essentially an untreated silage.

Some chemical analyses of treated and untreated silages are presented in table 4. The treated silage was slightly higher in ether extract than the wilted silage. The treated silage averaged lower in percent of crude fiber. This could be because of less loss in other nutrients in the treated silage. These data suggest further studies of these losses.

Preservation with Iodized Sodium Chloride

Common salt (sodium chloride) is often used in preserving foods. It also serves as a flavor improver. Therefore, it seemed to have possibilities of improving consumption

Table 2. Ash Values of Bisulfite-treated and Control Alfalfa Silages When Fed

Silage Treatment	Area in Bunker	Ash (Dry Basis) Replicate I	Ash (Dry Basis) Replicate II
		(%)	(%)
Sodium bisulfite	top half*	9.77	9.46
Sodium bisulfite	bottom half	9.07	8.22
No preservative	top half	10.79	10.31
No preservative	bottom half	9.98	[illegible]

*These analyses include just the edible silage, not the extreme top silage.

Table 3. Effect of Sodium Metabisulfite on Carotene Content of Alfalfa Silage

Storage Time	Treatment	Carotene Content, mcg./g. Top Half	Bottom Half
5 months	Preservative*	71	102
5 months	No Preservative	18	—
7 months	Preservative	17	113
7 months	No Preservative	15	36

*10 pounds per ton.

of alfalfa silage by animals. Also, many types of bacteria capable of pronounced proteolytic (protein break-down) and lipolytic (fat break-down) defects in certain food products are sensitive to moderate salt concentrations. Since many types of bacteria are sensitive to salt, it should have an effect in reducing these unfavorable reactions.

Certain food products such as sauerkraut are protected from undesirable types of bacteria by the concentration of salt, while the more resistant types bring about the desired changes. Most bacteria will not tolerate more than 6% salt and few survive concentrations as great as 15%. Studies of some types of bacteria indicate variations in tolerance to salt.

With this information in mind, alfalfa silage (approximately 125 tons) was made in a grooved wood plank bunker silo 35 feet long, 14.5 feet wide at the bottom, and 16.5 feet wide on top, with side walls 8 feet high. The bunker had a concrete floor. This bunker was filled with wilted alfalfa containing 66 to 67% moisture.

One half of the silage (east end of bunker) received iodized salt containing 0.02% potassium iodide at the rate of 1% salt to the wilted alfalfa. The other end of the bunker served as the control. Truck loads of short-chopped alfalfa were alternated with salt and no salt to obtain uniformity of silage in each end of the bunker. The salt was applied to the alfalfa through a silage blower as the trucks were unloaded, thus improving mixing of the salt and silage with the blower. After being packed in the bunker with trucks the silage was covered with felt roofing.

The silo was opened at both ends and fed starting approximately 2

Table 4. Chemical Analyses of Alfalfa Silage

Treatment	Area in Bunker	Moisture	Ether Extract	Crude Fiber	Protein	N.F.E.
		(%)	(%)*	(%)*	(%)*	(%)*
Sodium metabisulfite	top half	64.00	3.45	19.73	18.00	47.94
Sodium metabisulfite	bottom half	69.90	3.22	24.06	19.30	43.02
Sodium metabisulfite	top half	—	3.66	28.05	21.54	36.18
Sodium metabisulfite	bottom half	—	3.42	25.66	21.14	40.23
No preservative	top half	—	2.86	28.44	18.09	40.30
No preservative	bottom half	69.90	2.78	32.72	15.78	38.74

*Dry matter basis.

months after filling. The silages were sampled periodically for pH determinations and chemical analyses. The average results of these determinations are presented in table 5. There appeared to be no great differences in composition due to sodium chloride as a preservative.

Neither of the silages had as good odor and appearance as is desirable. They both had rather strong offensive odors. This seems characteristic of alfalfa silage made in bunkers. Different lots of silage in different years, even though wilted, finely cut, well packed, and covered, will vary considerably in quality. The average pH values of both control (5.5) and salt-preserved silages (5.7) were higher than are usually found in good silage.

The salt was expected to have some effect on bacterial action in the silage. Studies indicate variation in types of bacteria as to their tolerance for salt. Salt should affect the bacteria in silage by influencing the permeability of bacteria cell membranes. In the commercial manufacture of sauerkraut, for example, salt performs several important functions. It draws juices out of the plants; it favors lactic acid type fermentation, the acid which is most desirable; it checks putrefaction; and it contributes to desirable flavor. These effects should be desirable in alfalfa silage. However, high concentrations inhibit desirable fermenting bacteria to some extent. It becomes necessary, then, to select a concentration that will permit the best fermentation. Commercial sauerkraut manufacturers find about 2.5% salt is best. However, in making alfalfa silage about 1% salt may be maximum because of high consumption of silage by cows.

It could be that higher concentrations of salt may produce more desirable effects in stimulating lactic acid formation in alfalfa silage; however, higher than 1% salt may reduce feed intake of cows.

Preservation with Corn and Cob Meal

Ground ear corn has been used to some extent as a preservative for alfalfa silage. In the midwest it is a relatively low cost source of fermentable carbohydrates and is available on farms. Common recommendations are to use 150 to 200 pounds per ton of green alfalfa. The

Table 5. Chemical Analyses of Alfalfa Silages With and Without Salt

Feeds	Moisture	Ether Extract	Crude Fiber	Protein	Ash	N.F.E.	Carotene	pH
	(%)	(%)*	(%)*	(%)*	(%)*	(%)*	(Mcg./9.)*	
Alfalfa Silage (no salt)	66.66	4.16	27.85	19.71	11.01	37.27	56	5.5
Alfalfa Silage (1% salt)	67.70	3.71	27.26	17.84	13.91	37.28	49	5.7

*Dry matter basis.

Silage is sampled for chemical analyses.

grain raises the dry matter content of the silage. Also, the fermenting silage should produce more acid where corn is added. However, the question arises as to how much of the feeding value is recovered when the silage is fed. Estimates vary as to the recovery, usually ranging from 50 to at least 75% of the feeding value retained.

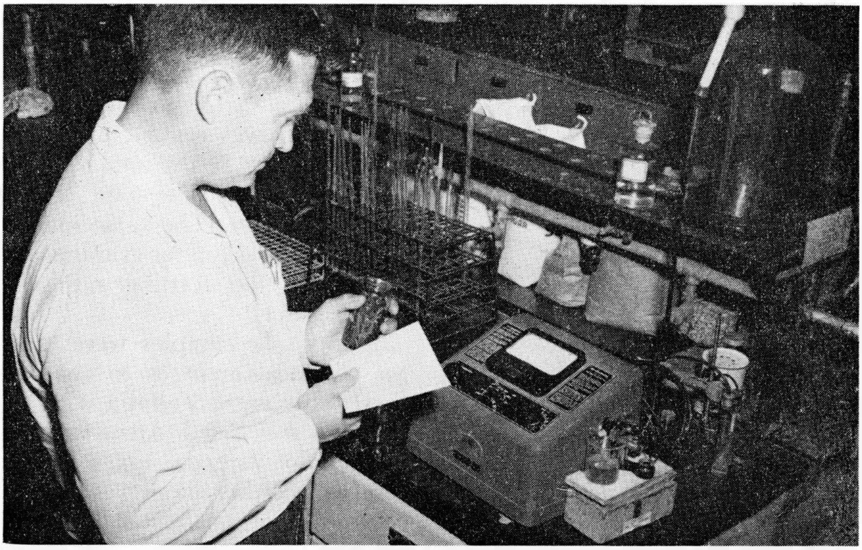
The following experiments were conducted to obtain a better estimate of the preservation and losses when corn was used. Two bunker silos with capacities of 200 and 125 tons were used. (These silos were used previously in the sodium metabisulfite and sodium chloride studies.) First-cuting alfalfa at approximately one-fourth bloom stage of maturity was used. The alfalfa was wilted to about 63% moisture. However, individual truck loads of alfalfa varied considerably in moisture content. Ground ear corn was applied manually to part of the silage at the bottom of the first bunker; however, most of the corn was applied through a silage blower. The corn was applied to one end, or to one-third of the total silage in each bunker, at the rate of 200 pounds per ton. The same kind of ear corn was saved for grinding and adding to the feeding rations 4 months later.

Eighty-nine samples were taken for chemical analyses to compare the freshly ensiled alfalfa with the silage as it was fed. Areas sampled in the silo were the top 6 inches; center of bunker about 4 feet deep; center of bottom, first 2 feet; and sidewall, 4 feet deep. The silage was well packed in the bunkers with trucks and tractors. One bunker was covered with felt roofing, the other with about 6 inches of soil.

Chemical Changes in Silage

The samples of silage were analyzed at the time of filling and upon feeding to obtain estimates of the changes which took place. The results are shown in table 6. Changes in ash or mineral values were used to estimate losses in dry-matter, non-ash (see table 7). Previous studies by the Biochemistry Department indicated a rather close relationship between changes in ash content and actual losses by weighing in and weighing out of all the silage from silos. These ash changes may lack somewhat in precision; however, other methods of measuring losses have certain inherent errors as well.

The changes in ash indicate that



Precision equipment is used in determining composition of the silage.

Table 6. Some Chemical Changes in Alfalfa Silage Between Ensiling and Feeding

Preservative per Ton Alfalfa	Area in Bunker	Time of Sampling & Analyses	Moisture	Protein	Crude Fiber	Ether Extract	Nitrogen Free Extract	Carotene per Gram	pH
			(%)	(%)*	(%)*	(%)*	(%)*	(Mcg.)*	
None	Top 6″	Feeding	72.6	19.95	39.85	1.41	23.17	4	7.4
		Ensiling	62.9	17.90	25.64	2.69	44.41	23	
None	Sidewall	Feeding	60.9	17.33	31.32	1.47	36.09	8	5.7
	4′ High	Ensiling	63.3	17.05	25.64	2.69	45.87	23	
None	Bottom	Feeding	65.3	16.00	32.27	2.02	38.97	31	5.3
	2′ Center	Ensiling	61.5	21.33	22.86	3.61	42.16	22	
None	Center	Feeding	66.7	14.46	35.31	1.74	37.58	50	4.9
	4′ High	Ensiling	65.5	13.35	25.64	2.69	48.51	82	
200 lb. corn	Top 6″	Feeding	66.3	17.45	30.73	1.82	36.54	4	7.1
and cob		Ensiling	64.5	18.63	25.23	3.54	44.37	17	
200 lb. corn	Sidewall	Feeding	65.0	17.77	27.73	2.33	38.04	48	6.3
and cob	4′ High	Ensiling	67.8	18.63	25.23	3.54	43.48		
200 lb. corn	Bottom	Feeding	58.6	16.76	27.13	3.40	42.85	40	5.7
and cob	2′ Center	Ensiling	55.3	18.63	25.23	3.54	42.84		
200 lb. corn	Center	Feeding	58.6	15.17	27.62	3.77	43.63	40	4.3
and cob	4′ High	Ensiling	62.1	18.63	25.23	3.54	42.90		
Corn and Cob									
Meal (used in preserving silage)			11.0	10.28	9.17	2.67	76.18	1	

*Dry matter basis.

there were very heavy losses in the top and sidewall areas of the bunker, with lower losses in the center and bottom areas. Since top exposure represents a relatively large proportion of the total in bunker silos compared to upright silos, this loss needs serious consideration.

Based on proportions of total silage for each sampling area, it was estimated that the total loss in the no-preservative area was approximately 18% and was approximately 22% of the edible silage where corn and cob-meal was used.

The pH readings did not indicate that development of acidity was influenced by introducing the ground ear corn. None of the areas had as much acidity as is commonly found in corn or sorgo silage.

Carotene changes indicated heavy losses in the top silage, with good carotene preservation in the center and bottom of the bunker. The increases in crude fiber percentages between ensiling and feeding suggest higher losses in non-crude fiber material than in crude fiber, which is not as easily decomposed. These increases in percentage of crude fiber were highest in the top 6 inches of silage.

Table 8. Effect on Average Roughage Consumption, Milk Production, and Weight

Preservative per Ton Alfalfa	Area in Bunker	Time of Sampling	Ash	Estimated Dry Matter Loss*
			(%)	(%)
None	Top 6″	Feeding	15.62	37
		Ensiling	9.81	—
None	Sidewall	Feeding	13.79	36
	4′ High	Ensiling	8.75	—
None	Bottom	Feeding	11.44	17
	2′ Center	Ensiling	9.52	—
None	Center	Feeding	10.91	10
	4′ High	Ensiling	9.81	—
200 lb. corn and cob	Top 6″	Feeding	13.46	48
		Ensiling	6.93	—
200 lb. corn and cob	Sidewall	Feeding	14.13	47
	4′ High	Ensiling	7.49	—
200 lb. corn and cob	Bottom,	Feeding	9.86	14
	Center	Ensiling	8.44	—
200 lb. corn and cob	Center	Feeding	9.81	17
	4′ High	Ensiling	8.16	—

$$\text{*Estimated dry matter loss} = \frac{\text{ash \% when fed} - \text{ash \% when ensiled} \times 100}{\text{Ash \% when fed}}$$

Feeding Trials

The general procedure was to feed cows on experiments alfalfa silage free choice. Alfalfa hay of good quality was fed in addition, because previous feeding trials indicated distinct craving for hay and straw when alfalfa silage was the only roughage offered to cows. The cows usually were fed concentrates at rates of 1 pound of concentrates for 3 pounds of 4% fat-corrected milk. Less grain than this resulted in rapid body weight losses.

Sodium Metabisulfite Preserved Silage

Sixteen milk cows were divided into two groups, using a single cross-over design experiment so that each cow received treated and untreated silage for 8 weeks each. The cows were fed individually. Half of the cows in the bisulfite group and half of the cows in the untreated silage group received a concentrate supplement containing 50% ground corn and cobmeal and 50% ground oats. The other half of the cows in each group received a concentrate ration composed of corn and cobmeal, ground oats, wheat bran, soybean oil meal, and linseed oil meal to make a mixture averaging 14% total protein. All concentrate mixtures were fortified with 1% steamed bone meal and 1% iodized salt. The corn-oats combination averaged 11.3% total protein.

The objective was to test milk production response of cows to preserved and unpreserved alfalfa silage at the high and low levels of protein in concentrates.

Body weights were obtained for 3 successive days and averaged at the beginning and end of each period of feeding. Milk production values were adjusted to 4% fat-corrected milk basis. Average decline in daily milk was calculated as the difference between average daily milk during the preliminary week and during the last week of each period.

Table 8. Effect on Average Roughage Consumption, Milk Production, and Weight Changes of Milk Cows When Fed Silage Preserved with Sodium Metabisulfite

Group	Roughage per Cow Daily	Daily 4% Milk*	Decline in Daily Milk	Milk Solids Not Fat	Body Wt. Change
	(lbs.)	(lbs.)	(lbs.)	(lbs.)	(lbs.)
Sodium bisulfite silage	49.6	29.4	—3.1	2.87	— 8
No preservative silage	50.1	29.9	—3.2	2.76	+ 3
Grain: (14% protein, ½ of cows in each above group)	50.2	30.2	—3.1	2.83	— 7
Corn-Oats (½ of cows in each above group)	49.5	29.0	—3.2	2.80	— 1
Corn Silage + 12 lbs. Alfalfa hay (after alfalfa silage trial completion)	57.2	30.7	—0.8	2.66	+61

*Milk production adjusted to energy equivalent of milk, 4% fat.

Table 9. Roughage Consumption, Milk Production, and Body Weight Changes of Cows Fed Salt-Preserved Alfalfa Silage

Ration	Roughage per Cow Daily	Avg. Daily 4% Fat Corrected Milk*	Period Decline in Avg. Daily Milk	Avg. Daily Milk Solids Not Fat	Avg. Body Weight Change
	(lbs.)	(lbs.)	(lbs.)	(lbs.)	(lbs.)
6 lb. alfalfa hay per cow and salt-preserved silage	52	20.9	—11.9	2.0	+30
6 lb. alfalfa hay per cow; No-salt silage	54	23.0	— 7.2	2.1	+89
Grain: High protein (15.7%, ½ of cows in each above group)	52	21.8	—10.0	2.1	+67
Corn-oats, protein (10.5%, ½ of cows in each above group)	54	22.1	— 9.1	2.0	+52

*Milk production adjusted to energy equivalent of milk, 4% fat.

The results of the feeding trial are presented in table 8.

There were no appreciable effects of the sodium metabisulfite on alfalfa silage consumption, milk production, or body weight changes. After completion of the alfalfa silage feeding periods, the cows were put on a corn silage and alfalfa hay ration (12 pounds alfalfa hay; corn silage free choice). They consumed approximately 13 pounds more dry matter equivalent daily per cow than they had when on alfalfa silage and production declines were reduced. After going off the alfalfa silage the cows gained more than 2 pounds body weight daily per head during a 30-day period.

Sodium Chloride Preserved Silage

The experimental procedure used was similar to that of the experimental feeding of sodium metabisulfite preserved silage, except that iodized salt was used in place of the metabisulfite. Again, half of the cows received a corn and oats concentrate. The other half received a higher protein mixture containing 15.7% total protein.

The results of this feeding trial are shown in table 9. The salt offered no advantages of consumption of silage. Although the cows were in the latter parts of their lactations, the decline in production appeared more rapid in the cows fed the salt-preserved silage. Also, the cows on the salt-preserved silage gained less weight compared to the control group. The cows fed salt-treated silage appeared to lose their sleekness and "bloom" compared to the controls. Both groups craved hay or straw, as was common in other trials.

Again, in this trial, there was no advantage to feeding higher protein to the cows than was provided in the corn-oats mixture. Calculations from Morrison's Feeding Standards indicated that the cows consumed more than enough protein from the alfalfa roughage and corn and oats concentrate ration.

Corn and Cob Preserved Silage

Eighteen cows in late lactation were divided into three groups to obtain an estimate of the preserving value and retention of feeding value of corn and cob meal when used in preserving alfalfa silage. One group of cows was fed the silage preserved with 10% corn. A second comparable group of cows was fed the control silage (not corn preserved) with 10% ground ear corn added at the time of feeding. The third group of cows received the control silage with ground ear corn added at 8% of the silage fed. The corn was from the same source as that used in preserving the silage.

The 12-week feeding trial was divided into three periods with crossover of cows, so that each cow received each ration. The added corn was fed on top of the silage and mixed somewhat into the alfalfa silage at feeding time.

The results of the feeding trial are listed in table 10. There was no significant difference in the daily consumption of silage whether the corn was used in preserving the silage or added at the time the silage was fed. Body weight and milk production results did not suggest significant differences between groups, indicating that the precision of the experiment was not high enough to detect differences. It should be noted that the corn added at 10 and 8% of the silage at feeding time may be considerably less than the total corn added at the time of filling the bunker silo because some of the added corn was lost in inedible silage. Therefore losses probably are higher than the data on production show.

It is interesting to note that cows in all groups lost body weight while on experiment even though the corn was added to the roughage in addition to 1 pound of concentrates for every 3 pounds of 4% fat-corrected milk produced.

Further experiments on preservation and losses of alfalfa for silage are in progress and will be published at a later date.

Table 10. Silage Consumption, Milk Production, and Body Weight Changes with Corn and Cob Meal Preserved Silage

Group	Daily Consumption	Daily 4% Milk	Decline in Daily Milk	Body Weight Change
	(lbs.)	(lbs.)	(lbs.)	(lbs.)
Alfalfa silage, corn preserved	47.4*	25.7	—4.2	—21
Alfalfa silage	42.7			
10% corn added	4.3	26.9	—3.5	—23
Total	47.0			
Alfalfa silage	43.1			
8% corn added	3.4	25.3	—4.7	—20
Total	46.5			

*Each figure represents the average of 6 cows for 3 periods.

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