RESULTS OF SILAGE INVESTIGATIONS WITH HIGH PROTEIN UNWILTED FORAGE AT THE NEW YORK STATE COLLEGE Or; AGRICULTURE

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Silage is not a replacement for good pasture management, but it is a means of making the most of a sound grassland programme. It is an effective method of preserving surpluses of immature forage for use when pasture is in short supply or completely lacking. While quality silage is an excellent feed it is still a substitute for the original product-pasture herbage. The problem in making silage is to produce a nutritious and palatable feed and to keep the loss of nutrients at a minimum.

A nutritious forage must be high in digestibility ; there is little point in feeding a product which animals cannot utilise. The digestibility of a forage can be influenced slightly by fertility and moisture levels, but is primarily dependent upon stage of maturity when harvested. Immature forage is high in digestibility;' mature herbage is low in digestibility.

A nutritious forage should supply much or all of the protein requirements of animals, especially in areas where protein-rich supplements are expensive. The percentage of legume in the mixture and the nitrogen level of the soil have a marked influence upon the protein content of forages. But fortunately, for any given situation, immature forage is higher in protein than mature forage. Thus, high digestibility and high protein content tend to go together.

Cutting the forage while it is young is the first step in making quality silage; the next step is to preserve it in such a manner that a maximum of the nutrients will be conserved and that the silage'will be palatable. Prevention of all fermentation would be ideal, but since, at least for the present, this is not possible, it is desirable to adopt ensiling practices that will hold fermentation losses to a minimum and at the same time favour the type of fermentation that produces palatable silage.

Early studies with corn silage and the work of Virtanen as well as others stressed the importance of reducing the pH of the ensiled forage as rapidly as possible. A low pH supposedly assured a palatable silage and at the same time supposedly held the loss of dry matter to about 10 per cent. Numerous preservatives were evaluated and the use of the inorganic acids or fermentable carbohydrates such as molasses (which could be converted to lactic acid) became almost universal practice.

Before World War II phosphoric acid and molasses were the most common silage preservatives in the north-eastern region of the United States, but when both became unavailable many farmers found they could make silage without preservatives. Most farmers practised wilting, but a substantial number successfully used unwilted forage.

Following the war when direct-cut field choppers were in good supply many of the smaller. farmers wished to eliminate the extra equipment necessary for wilting. The use of molasses or ground grain was recommended for unwilted, high protein forages but an increasing number of farmers challenged these recommendations. At the same time investigations at Cornell University revealed that immature forage ensiled without wilting but with the addition of 70 lb of molasses per ton of green herbage lost 20 or more per cent of its dry matter in the juice and from fermentation. When normal top spoilage was included nearly $\frac{1}{4}$ of the ensiled crop was lost. The silage had a pH of 3.8 to 4.0 ; the average daily consumption of all cows, chiefly Holsteins, exceeded 100 pounds per day. The digestibility was high and milk production surpassed expectations. In other words the quality of molasses-treated silage was excellent, but the losses were excessive. Research on how to reduce the high loss of dry matter was initiated in 1950. Trench, tower, and laboratory silos were used. During the past 6 years, molasses, ground grain, chopped hay, sulphur dioxide, sodium metabisulphite and Kylage (a mixture of calcium formate and sodium nitrite) have been evaluated for their ability to reduce loss of dry matter. Several other fungicides and bactericides have been or are being tested in laboratory silos.

Sulphur dioxide usually reduced losses of dry matter from fermentation, An average of all experiments showed that 51b of sulphur dioxide per ton of green forage resulted in a saving of 14lb of dry matter in every ton of green forage (80 per cent moisture) ensiled. This saving was not great enough to offset the cost of the preservative. Palatability trials did not reveal any consistent advantage for sulphur dioxide treated silage. The application of sulphur dioxide is time-consuming and unless properly handled can be dangerous to humans, livestock, and nearby plants. Uniform distribution frequently is not obtained and pockets of untreated silage may occur. In view of these marked disadvantages extensive feeding trials with sulphur dioxide treated silage were not undertaken.

Kylage did not reduce materially the loss of dry matter. In some cases the odour of the silage was improved, but no difference in palatability was measured. No detailed feeding trials were undertaken with Kylage treated silage.

In 1952 and 1953 four large silos were filled simultaneously with a first harvest year stand of red clover, ladino clover, lucerne, and timothy. Both years the crop was about 75 per cent legume, chiefly red clover, and was cut at the bud stage; few legume flowers were showing. All silos were filled with unwilted forage. In one silo the forage received no treatment; the forage in the other silos was treated with 701b of molasses, 9lb of sodium metabisulphite, or 100lb of brewers' dried grains per ton of green material. The silos were filled in three days and all material was weighed at the time of filling and again when it was removed from each silo. In addition to these weighings, loss of dry matter was estimated by using over 100 paired bag samples in each silo each year.

Juice loss measurements were made by collecting all juice that flowed from each silo. Untreated and molasses treated silage had the highest total flow, while brewers' grains had the lowest. The total loss of dry matter as juice and fermentation was about the same for untreated, molasses treated, and bisulphite treated silage. Brewers' grains decreased the total loss of dry matter by about 3 per cent.

All silages were fed to dairy cows ; daily consumption, milk production, and change in body weight were measured. The, first year there was essentially no difference among the four silages. Consumption of all silages averaged 103 to 108lb per day, Milk production varied from 44.2 to 46.7lb per day and body weight gain was +0.19lb per day for untreated silage up to +0.66 for brewers' grains treated silage. The second year the bisulphite silage was less palatable than the other three silages and the consumption of dry matter was significantly lower. Milk production was maintained, but cows on bisulphite silage lost ¾lb per day while cows on the other three silages gained ½ to ¾lb per day. Over the two-year period, however, there were no significant differences in feeding value among the four silages. Thus any value for a preservative had to be obtained by reducing the loss of dry matter or by improving the odour of the silage. The latter is intangible and difficult to evaluate in monetary terms unless the price of milk is affected by the silage fed. No consistent differences were detected in the quality of the milk from cows receiving different silages, None of the silages had strong odours.

Treating with 9lb of sodium metabisulphite saved 2.8lb of dry matter for every ton of green material ensiled. Molasses saved 3.2lb of forage dry matter but 14.7lb of molasses dry matter was lost; treating with 100lb of brewers' grains saved 17.6lb of forage dry matter, but 23.3lb of grain dry matter was lost. It was concluded that none of the three preservatives was of any real value for treating immature 'legume-grass forage, especially when the legume was chiefly red clover. Laboratory tests with birdsfoot trefoil, lucerne, and nitrogen fertilised grass did not show any material advantage for molasses, sodium bisulphite, or ground grain as silage preservatives. Acceptable silage has been made repeatedly from high legume forage without the use of a preservative, but the juice and fermentation losses, like those in the large silos, usually approached 20 per cent.

In 1954 and 1955 three of the tower silos were filled with a red clover, ladino clover, lucerne, timothy mixture cut at the pre-bloom stage. In one silo the forage was ensiled without treatment or wilting. In another silo the forage was not wilted and 2001b of chopped hay was added to each ton of green forage. The third silo was filled with forage which had been allowed to wilt from ½ to 2 hours in the field. The addition of chopped hay was laborious and uniform distribution was not obtained. Although it reduced juice flow, the problems of handling chopped hay far outweighed the saving of dry matter.

Wilting reduced both juice loss and fermentation loss. Over the two-year period about 7 per cent more of the total dry matter ensiled was saved by wilting as compared to ensiling without wilting. Cows consumed slightly more dry matter and produced slightly more milk when fed wilted silage than when fed unwilted silage. These differences were small and cannot be considered significant. The major advantage of wilting appeared to be in reducing the amount of dry matter lost. Wilting also decreases the stench and mess associated with heavy juice flow.

The advantage of wilting depends upon how the programme fits into the silage operation. Wilting to a specific moisture content is inflexible and farmers soon give it up. However, most of the advantage from wilting can be obtained by decreasing the moisture content of the forage from 80 to 85 per cent down to 70 to 75 per cent. This requires relatively little wilting and it is not essential that every load of forage be wilted the same amount. It appears to be good farm management to wilt forage to about 70 per cent moisture when weather permits but to continue to make silage even if wilting to the desired moisture level is impossible. The advantages of wilting will not offset the cost of labour and machinery that are not utilised efficiently.

In conclusion the results obtained at the New York State College of Agriculture can be summarised as follows: Palatable silage, free of strong odours and high in digestibility has been made repeatedly in large and laboratory silos from unwilted, high protein herbage.. The loss of dry matter, however, was high, usually exceeding 20 per cent of the total dry matter ensiled. About 1-3rd of the dry matter lost was in the juice and the remainder was from fermentation. None of the preservatives tested reduced the loss of dry matter or improved the feeding value of the silage enough to offset their cost.

'Decreasing the moisture content of immature forage by 5 to 10 per cent has resulted in a saving of 7 per cent of the total dry matter ensiled. At present this appears to be the most effective way of reducing the high juice and fermentation losses associated with the ensiling of immature forage.

DISCUSSION

Q. Why do you use timothy; is it because of palatability and is it only used in silage or is it also used for grazing?

A. Timothy and smooth brome grass are our chief hay grasses. Both are palatable. The seed of timothy is cheap but the disadvantage is that it is susceptible to leaf disease, especially if cut late. For a short-term hay meadow we use timothy. Brome grass seed is dearer but for a five or six year hay meadow we prefer it to timothy or cocksfoot.

Q. Would wilting be an advantage in New Zealand where it is not possible to get good consolidation with the trench or clamp method of making silage ?

A. If you have a trench, say ten feet or eight feet, you could still do quite a bit of heavy rolling on the lower layer. In the tower silo we use unwilted material for the last three loads, or about the top one-eighth.

Q. The making of good silage should be encouraged under all conditions. Therefore we say wilt it even if making a bun. To what moisture status can you wilt safely?

A. The important thing is to reduce the moisture content by 5 or 10 per cent. We aim at getting greatest return so we prefer to wilt somewhat heavier than that. We find it difficult to overwilt young material. As soon as it gets older then it is very easy to overwilt; it will not compact as easily and we can have severe heating with high losses.

Q. Should you allow it to approach 100 degrees F. ? If you fill your silos rapidly will it heat up sufficiently or is that not necessary ?

A. We started out with the idea that controlled temperature was desirable but when filling farm silos the farmer actually has only a few-days. As we worked-we-were convinced that the faster you exclude air the better. The whole idea is to fill a silo as quickly as possible. By excluding air you will cut your dry matter losses. To get heat up to 100-110 degrees extends over several days and losses are' high.

Q. How do the high temperatures affect the actual digestibility of silage, or is it merely a matter of dry matter loss?

A. We have not worked much with the effect of temperature of silage on digestibility. The temperature apparently does not influence digestibility as long as you do not go above 120 degrees, but if temperature gets to 140 degrees to 150 degrees the digestibility is depressed a great deal.

Q. If the temperature is kept down would the silage be palatable to stock such as sheep ? My experience was with 1500 tons of silage chopped with a harvester. I worked on a temperature of 130 degrees near the top. I fed 3000 ewes for 12 weeks in the autumn which was very dry and those sheep never left one forkful of the silage. If we put the silage in too quickly and get the temperature below 100 degrees will it be palatable to sheep in particular?

A. In terms of dairy cows the answer is no. I have had no experience with sheep but have heard it said that sheep would not eat silage when the temperature was not allowed to rise to 100 to 110 degrees; it was unpalatable. Personally I do not know about sheep. If you put it in silos rapidly without heat it would have low dry-matter loss. It would be better to lose a little dry matter and ensure palatability.

J. W. Calder. Silage at 120 degrees is very palatable for sheep; silage at below 100 degrees is not palatable for sheep.