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UTILIZATION OF CROP RESIDUES AND HIGHLY LIGNIFIED WASTE PRODUCTS IN WINTERING RATIONS FOR BEEF COWS

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Although residues and waste fiber can be fed in many types of ruminant rations at low levels as a replacement for the forage, greater usage can probably be found in maintenance or wintering rations. A crop residue or waste material is no better than its available nutrient composition. How closely this nutrient composition will meet the requirement of animals determines how the material can be used and what supplemental feeds are required. The nutrient requirement of 1,100 lb. dry pregnant mature cows in the middle third of pregnancy could be used as a basis for requirements for a maintenance or wintering ration for breeding stock. The requirements for such animals (N.R.C., 1976) are as follows:

Nutrient Concentration in Diet Dry Matter

Minimum dry matter consumption (lb)	Total protein (%)	Digestible protein (%)	NE_m (Mcal/lb)	ME (Mcal/lb)	TDN (%)	Ca (%)	P (%)
15.9	5.9	2.8	0.49	0.86	52	0.18	0.18

Daily Nutrients Per Animal

Minimum dry matter consumption (kg)	Total protein (kg)	Digestible protein (kg)	NE_m (Mcal)	ME (Mcal)	TDN (kg)	Ca (g)	P (g)	Vitamin A (thousands IU)
7.2	0.42	0.20	8.14	14.1	3.9	13	13	20

My allotted time for this presentation will not permit complete coverage of the utilization of all residues and wastes. Only the utilization of residues or fibrous wastes considered important and available in quantity in South Dakota are briefly reviewed from selected feeding experiments in various areas.

Straws and Other Fibrous Cereal Grain Residues

Straw and chaff can be considered to be another cash crop in addition to the grain if used as a feed. G. W. Mathison, University of Alberta, states that the weight of straw produced on a given land area is greater than weight of grain produced and accounts for about 50% of the gross energy, 30% of the digestible energy as well as 20% of the crude protein produced on an acre of land. The nutrient content of various straws is quite uniform but does vary somewhat from

year to year and perhaps its composition is affected by the area in which the grain is produced. Average compositions of common straws might be as follows:

Nutrient Content of Straw (Dry Basis), Percent

Straw	Crude protein	TDN	Crude fiber	Ca	P
Wheat	4.4	40.6	37.0	0.19	0.08
Barley	4.9	42.2	37.7	0.30	0.09
Oats	4.4	44.8	36.3	0.24	0.10
Mixed	5.1	--	--	0.21	0.10

Consumption - 1.5 to 2.0 lb. per 100 lb. body weight

It is apparent that straws will be too low in protein and phosphorus to meet the minimum requirement for wintering mature animals. With the realization of the deficiencies in straw of protein, energy, vitamin A, phosphorus and perhaps other minerals as well, how can straw be used in wintering rations and what would be the expected animal response?

Wintering on Straw Alone

It has been shown that cows can be wintered on straw and chaff plus supplemental salt if animals are in sufficient condition to withstand the weight losses. During one 3-year experiment in which the wintering period varied from 132 to 160 days, animals experienced an average loss in these experiments of 126 lb. per animal. The weaning weights of the calves were not greatly different from animals receiving supplemental feeds. It was suggested that wintering on straw alone does preclude that winters should be mild and animals must be in good fall condition. These experiments were performed in Montana by Arnett and McChord in the late 1920's. Wintering animals on straw alone was not too uncommon during this period.

Animals can be expected to lose weight on straw alone because the intake of 1.5 to 2.0 lb. of straw per 100 lb. of body weight does not meet the minimum energy or protein requirements.

Wintering on Supplemented Straw Rations

Supplementation with protein appears to be the most critical to increase straw intake and to increase fiber digestibility. Reports of increased intake from 14 to 25% by protein supplementation of straw have been made by various researchers. It appears that proper level of protein supplementation is more important in straw supplementation than the source of protein. Nonprotein sources were less valuable than plant protein sources in some instances. In general, it was shown that 10 lb. of hay or 1 lb. of cottonseed meal daily would substantially reduce weight losses experienced when straw alone was fed. Slow release nonprotein products appear to have merit as protein supplements with straw.

Energy addition to rations high in straw is not as clear-cut as protein supplementation and may decrease fiber utilization somewhat, depending on the level of grain added. The intake of straw does not vary greatly when additional energy is provided and energy additions should be based on condition of the animals being wintered.

Since some questions may be asked as to the value of chaff as compared to straw, mention of a comparison made by Morrison and Canadian workers might be in order. Although actual feeding data are lacking, nutrient analysis suggests that chaff has a higher protein and phosphorus level but less energy unless the grain that may be included is considered. The grain content can be from 1 to 3%, depending on harvesting machines used.

The Maryland Experiment Station suggests from their experience with straw feeding that small grain straw with adequate supplemental protein could replace up to two-thirds of the hay fed to wintering pregnant beef cows. A comparison was also made between all hay (brome and wheatgrass) wintering ration and a ration composed of 50% hay and 50% straw with no protein supplementation in either ration type. The young cows fed hay and straw lost the most weight. The straw feeding did not appear to affect the calf birth weight or livability. All animals were supplemented 1 month before calving with hay and grain and straw feeding was discontinued. Using straw to replace part of the hay in these experiments reduced costs about $1.00 in 1972, $2.25 in 1973 and $4.67 per cow month in 1975 as feed costs began to rise during this period. Even though animals may lose more weight due to winter straw feeding, the effect on birth weight and animal health was not noted in any of these experiments.

The North Dakota Experiment Station performed straw feeding experiments during the late 1960's in which a wintering ration of 20 lb. of crested-brome hay per day was compared to a ration of 7 lb. of hay, 13 lb. of wheat straw and 1 lb. of soybean oil meal daily. Animals on rations containing straw lost on the average during a 3-year experiment about 39 lb. more weight during wintering than animals fed hay. Birth weight and growth rate of the calves were not affected by the level of winter nutrition of their dams--remembering that animals did receive additional feed prior to calving. No differences were noted in the conception dates due to the two levels of nutrition. The cost of a wintering program at that time was about the same between feeding programs. Comparative costs depend on the value assigned to the straw and the cost of hay. It was concluded at this station also that two-thirds of the hay in a beef cow wintering ration can be replaced by straw plus supplemental protein without adversely affecting the cow's ability to wean a healthy calf, provided she is in good condition upon entering the winter period. It may or may not reduce the winter feed bill, but it does extend a short hay supply.

Experience with straw feeding in North Dakota suggests that animals should be watched more closely than usual. Straw feeding can cause constipation and impaction of the abomasum (true stomach) which in turn causes permanent nerve damage with animal losses. It may not be readily apparent that animals are losing condition either, since if intake of straw is high, the animals may be disintended and mistaken as being in good condition.

Conclusions for Straw Feeding (Canadian and North Dakota Experiment Stations)

1. Cereal grain by-products represent a large source of potential nutrients for wintering feed.

2. It utilizes a feed raised on the farm or ranch that might otherwise be wasted.

3. Cattle can be wintered on straw alone in an emergency if winter conditions are ideal and animals are in good condition before this time. Excessive weight losses can occur.

4. Cows will consume from 1.5 to 2.0 lb. of straw per 100 lb. of body weight and increasing this intake with well-balanced diets is difficult.

5. Protein supplementation is most critical to maximum intake and digestibility of wintering straw diets, with plant proteins being the most valuable.

6. The effectiveness of grain supplementing straw diets is open to question if used to increase intake and digestibility of the straw portion of the diet.

7. The overhead of winter feeding can be minimized when there is a hay shortage.

8. Feeding straw will release some hay for cash sale.

9. It appears that an attempt should be made to collect all grain by-products from grain harvest to improve the total value of straw.

10. Some care must be taken in straw-based rations since constipation and abomasal impactions can occur. Providing adequate salt, minerals, water and also perhaps protein supplements can assist in alleviating impactions.

Corn Stalks, Cobs and Miscellaneous Corn Residues

Of all the corn residues possible, corn stalks are the most versatile as a wintering feed since it can be left in the field after the corn harvest to be grazed in the fall and winter, ensiled or harvested as stalks in various ways. Its composition will be determined by the amount and type of other corn plant parts which accompany the stalk itself. Thus, one should consider composition of corn plant parts to make estimates of nutrient value of corn residue material.

A study made at Iowa State University considered the composition of major parts of the corn plant as follows:

Composition and Digestibility of the Corn Plant

	Dry matter	Crude protein	In vitro digestible dry matter	Ash
Grain	73	10.2	91	1.6
Leaf	76	7.0	58	13.7
Husk	55	2.8	68	3.4
Cob	58	2.8	60	1.4
Stalk	31	3.7	51	4.7
Husklage (Foster)	78	3.7	65	3.3
Stalkage (Hesston)	66	4.2	56	10.6
Stalkage (Flail)	55	3.8	51	--

A comparative study of the value of corn residues by the University of Nebraska provides a good rule of thumb for the nutritive value of corn plant residues. In essence, the study states that the digestibility of corn residues arranged in descending order would be the grain followed by husk, leaf, stalk and cob. The protein content arranged in the same fashion would be grain, husk, stalk and cob. Weather effect over time tends to decrease the value of corn residues left in the field as the winter progresses. The value of corn stalks left in the field without harvesting or grazing has been estimated by a Nebraska agricultural economist in terms of its fertilizer value in subsequent years. The stover from a 100-bushel corn crop was estimated to contain approximately 56 lb. nitrogen, 3 lb. phosphorus, 27 lb. potassium and 17 lb. calcium. This might be valued at about $1.20 per acre plus the value of organic matter that stalks will generate.

Wintering Use of Stalks or Residues Grazed in the Field

Allowing animals to graze the corn fields following the corn harvest is a common practice and has been estimated to be the cheapest method of utilization of corn residues for wintering cattle or other ruminants. This method does have its limitations, however, and must be a factor to consider when planning winter feeding. Only 30 to 35% of stover is actually utilized by grazing animals. Nutrient value decreases with the length of the grazing period since animals will select the more digestible portions first, leaving indigestible portions as the potential for selection diminishes. Snow may cover the more digestible and nutritive portions of the corn residues such as the residual grain and husks. Wind may also blow husks and leaves out of the field. As stated previously, weather may cause a decrease in digestibility of corn residues as the winter progresses. This will mean that the value of grazing residue is decreasing while the demand for energy of the animal may be increasing due to weather deterioration. Heavy snow and severe weather may cause grazing of corn residues in the field to cease altogether without warning.

It is difficult to really estimate how long a cow can be maintained when grazing under ideal conditions, but it is estimated that 1 ton of stover is available for every 30 to 35 bushels of corn harvested and, of course, not all the stover will be grazed. If a cow eats 30 lb. per day, she will have consumed at least an acre of available stover in 2 months.

Wintering Animals on Harvested Corn Residues

Harvesting corn residues, although more costly than grazing, provides more total roughage from a given field and does overcome some of the disadvantages of grazing. Harvested residues other than silage can be moved from one location to another as needed, especially since the residues can be made into stacks with various types of collecting and stacking machines developed in recent years. In general, the method of harvesting will be an individual decision as to which method is the most convenient and the least costly.

Corn Stalks

Corn stalks can now be easily chopped and stacked to be fed either in the field or in a feedlot. Stalks can be further processed from stacks or directly into silage similar to traditional silage made from the entire plant. Additional water is usually required because of maturity of the stalk. Stalk

roughage source. Since my consideration is only wintering rations, it will not be discussed. Wood materials with lower levels of lignin encrustation such as aspen wood have potential in wintering rations if properly supplemented. The most serious deficiencies would be protein, phosphorus and vitamin A. Aspen tree material has approximately 1% crude protein. Its acceptability as a feed by wild ruminants is well known but difficult to evaluate. Some experimentation is now in progress on wood wastes at South Dakota State University using the material in growing and finishing rations. Please refer to the field day bulletin for the progress summary of this work.