Sugar-Beef By-Prod ucts and Their Place in Idaho Agriculture

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Your conference sections deal with a wide variety of technological problems of the sugar-beet industry such as breeding, protection from insect pests and diseases, soils, seed production, chemical problems, harvesting equipment, etc. A single topic out of one hundred or more listed deals with by-product utilization, scheduled for January 7, in Section A, under the title, "Steer and Lamb Feeding Trials With Various Forms of Sugar Beet Pulp."

Like various other American manufacturing enterprises, meat packing for example, the by-products of your industry are an important asset, their total value, when properly utilized, representing a substantial portion of the total annual increment of wealth resulting from sugar-beet production and processing, and, undoubtedly, a vital factor in determining the permanent success and profitableness of the sugar-beet industry.

We in Idaho are interested in, and appreciative of, the sugar-beet industry because we are, in the main, producers of raw agricultural materials, and there is a dearth in our state of manufacturing industries and enterprises, Our beet-sugar factories turn out a highly finished product, require a year-around maintenance force and, during certain seasons of the year, support a very substantial payroll.

Of equal, if not greater, importance to us is the functioning of sugar-beet growing as a vital factor in our agricultural economy. The production of beets requires good land and good farmers. The successful growing of beets demands a rotation system that returns to the soil both total elements of fertility and those organic elements that are conducive to moisture absorption and moisture retention, to ease of tillage and to high-producing capacity. In other words, successful sugar-beet farming is well-balanced farming, requiring efficiency in farm management and skill in maintaining at a high level the productive capacity of the land. Hence, the sugar-beet industry contributes to a region those benefits that accrue from industrial expansion, and almost inevitably brings substantial benefits to the farm economy of the area.

Fortunately for the agriculture of the beet-sugar-producing regions, the refined product is only a part of the output. The molasses, pulp, and tops are an added asset of great financial importance. Their profitable utilization, with limited exceptions, is confined to their functioning as important supplements to feeding rations, pri-

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marily for the finishing of steers and lambs for market. In addition to their content of elements of animal nutrition which can be measured by the chemist, such as proteins, carbohydrates, and fats, they bring certain other beneficial factors in animal feeding such as bulk. the addition of laxative qualities, and the stimulation of appetite. The farmer, once his beets have gone to the dump under the terms of his acreage contract, has a further interest which is consummated by the proper utilization of these highly valuable by-products.

In addition to a factory and its operating force, therefore, sugar-beet growing brings a livestock-feeding industry which raises the average productivity of the lands served by the factory and materially contributes to the permanency of farming.

Extensive experimental work has been conducted during the past few years in the utilization of these various sugar-beet by-products for the finishing of animals for market. The great volume of this work has been done by the Colorado Experiment Station, but other stations such as Wyoming, Utah, Nebraska, Washington, Montana, California, and our own Idaho Station, have conducted investigations to determine how these by-products can be most profitably utilized and to evaluate them as supplements to the livestock-feeding rations ordinarily used in the Western feed lots. The sugar companies and private organizations also have fed molasses, pulp, and beet tops, and have contributed to the total volume of information now available on sugar-beet by-products feeding.

The work of our Idaho Station has been concerned with the siloing of the tops and their utilization as supplements to alfalfa hay and grain, the feeding of the molasses in various proportions and under varying conditions, and the utilization of the pulp both in the wet and in the dried form. Dried beet pulp, in addition to the important place it has had in rations for lambs and steers, has been used for a substantial part of our ration in the feeding of our high-producing Jersey and Holstein-Friesian cows in advanced-registry testing. Because of its low phosphorus content, the dried beet pulp has been used in our Caldwell experimental feeding for the basic portion of our checklot of steers and lambs in determining the effects of low phosphorus rations. It has been the purpose in the experiments to find some measure of the place of phosphorus in the fattening ration, both for steers and lambs. The beet pulp can be used advantageously as a means of measuring the most advantageous phosphorus intake in the fleshing of both steers and lambs for market. This particular use, however, is merely incidental to the proper place this by-product of the beet industry has in animal feeding as a source of total nutrients, and as a bulky form of ration advantageous in the compounding of feeding rations.

The department of Animal Husbandry of the University of Idaho works with the Caldwell Branch Experimental Farm in conducting these sugar-beet by-products experiments as well as other experiments in livestock feeding. Professor C. W. Hickman and Dr. W. M. Beeson of the Department are in charge, and Dr. Beeson has supplied me with a summarization of the results secured from other sources as well as from our own investigations. The following summarization of recorded data indicating the important place sugar-beet by-products have in animal feeding is quoted from material assembled by Dr. Beeson:

Beet Molasses

Beet molasses is essentially a carbohydrate feed which is abundant in energy and fattening properties but is decidedly deficient in protein and minerals. Many experiments establish the fact that beet molasses may satisfactorily replace part of the concentrated feeds in rations for hogs, sheep, beef and dairy cattle.

A review of a large number of experiments shows that when beet molasses replaces a considerable portion of the grain ration it has a relative feeding value of about 80 percent of shelled corn. In Idaho, however, experiments where limited quantities of beet molasses (4 pounds per steer daily) were fed, it was found to be equal to barley as a fattening feed, provided it was properly balanced with bonemeal as a source of phosphorus.

Summary of 15 experiments conducted at various experiment stations gives beet molasses about 84 percent the value of corn when used at the rate of .38 of a pound in a lamb-fattening ration. In four trials at the Colorado Experiment Station beet molasses was worth about 86 percent of the feeding value of grain. Molasses also, has been used in wintering ewes and to furnish the concentrate for ewes just prior to and after lambing. In experimental work at the Washington Station along this line, molasses has given very good results where about one-half pound was fed per ewe daily in place of grain.

In addition to these more popular standard uses of molasses, it has certain other values and peculiarities which should be mentioned. It has been used for years as an appetizer in livestock rations, especially to increase the palatability of poor roughages and unpalatable grain mixtures. In recent years molasses has proved successful as a remedy in preventing pregnant-ewe paralysis. Very often just prior to lambing, ewes develop a condition which is caused by low blood sugar. A molasses supplement to the ration in the amount of 10 to 20 percent of the concentrated intake has been found effective both in preventing and in curing what seems to be a nutritional maladjustment.

Certain precautions must be followed in the feeding of molasses. Ordinarily it is fed along with wet beet pulp because the two products are available near sugar factories. A 5-year study at the University of Idaho Experiment Station has shown that a ration of beet molasses, alfalfa hay and wet beet pulp is deficient in phosphorus. Our data indicate that when beet molasses is fed as the only concentrated feed, and when beet pulp is fed in large quantities, it is impossible to get the steers

to eat enough alfalfa hay to meet the phosphorus requirements. Studies on the phosphorus needs for fattening steers have conclusively shown that it requires about 2 pounds of alfalfa hay daily per 100 pounds of liveweight to meet the phosphorus needs for fattening steers.

To give a concrete example, steers on a ration with the beet by-products and alfalfa hay gained only about 1 pound a day and required 30 percent more feed to make a pound of gain. When the same basal ration was supplemented with .10 pound steamed bonemeal per steer daily as a source of phosphorus, the steers gained an average of 2 pounds daily and showed no signs of phosphorus deficiency.

Therefore, it must be kept in mind that beet molasses and wet beet pulp, or dried beet pulp, are primarily carbohydrate feeds and must be supplemented with the proper amounts of protein, vitamins, and phosphorus. Since alfalfa hay supplies the proper vitamins and protein, phosphorus is the limiting factor in rations of this type.

Our studies also have included the utilization of beet by-products by sheep, but under practical feeding conditions a phosphorus supplement is not needed because the lamb is capable of consuming enough alfalfa hay to meet the phosphorus requirements even when beet molasses and wet beet pulp are fed in large quantities.

Beet molasses also is a laxative feed and must be fed with precaution and in limited quantities. In feeding molasses as the sole concentrate, our studies have indicated that 4 to 5 pounds per steer daily is the maximum amount that can be fed with safety. The feeding of larger amounts resulted in the steers going off feed. The maximum amount which can be fed safely to lambs is approximately one-third pound daily.

Wet Beet Pulp

Wet beet pulp might be classified as a carbohydrate roughage or silage which is high in moisture, low in protein, and low in phosphorus. Wet beet pulp varies considerably in its moisture content, depending on the hauling distance from the source of supply, and on the storage period. On an average, wet pulp contains about 88 percent moisture when fed to cattle several miles from the factory. In most of our sugar-beet sections wet beet pulp can be purchased by the producer of beets at a cost ranging from 50 cents to a dollar per ton, which usually makes it a very economical feed, providing the transportation costs are reasonable.

In Colorado experiments with cattle, wet beet pulp was worth on an average of $2.69 per ton when fed at the rate of 70 to 80 pounds per steer daily. Recent studies at the University of Idaho have shown that wet beet pulp was equal in value to corn silage for fattening calves.

Wet beet pulp also is used for fattening lambs. It usually is fed at a rate of from 2 to 4 pounds per head daily and when used in these proportions our results have shown that it has a feeding value ranging from $1.77 to $2.00 per ton.

Beet Tops

There are three principal methods commonly practiced in the utilization of beet tops, namely, (1) pasturing the tops with cattle or sheep; (2) curing the tops by placing them in small piles in the field, later hauling them to the feed yards; and (3) ensiling the tops. Information and estimates available indicate considerable variation in the amount of tops secured from a field of beets. The green weight of the tops usually

equals from one-half to two-thirds the weight of the beets produced. On a dry-matter basis, the tops per acre are equivalent to 10 to 15 percent of the net weight of the beets. Idaho experiments for the past few years have shown a yield of 1 ton of beet tops from every 3.2 tons of sugar beets harvested.

The moisture content of beet tops and the method of preparation causes a tremendous variation in the feed value, and for that reason it is rather difficult to arrive at any definite figures as to the relative values of beet tops as compared to other succulent roughages. In Colorado experiments, beet tops that were dried and cured in the field were worth about $4-90 per ton in fattening rations for steers. In contrast, beet tops that were stacked in layers of straw were worth only about 35 percent of the value of corn silage.

For the past 3 years we have conducted tests at the Idaho Station comparing the value of corn silage and beet-top silage. The beet-top silage used was stacked with layers of straw above the ground. Our results have shown that beet-top silage is worth about one-third less per ton than corn silage for steers, but has not proved to be very valuable for fattening lambs.

At the Colorado Station a comparison of beet tops that were pastured in the field with tops dried and fed in the lot, and beet tops put up as silage, showed some advantage in favor of the dried tops. If the weather is favorable, pasturing of tops may be done with very little waste. But the consensus of opinion seems to be that it does not pay to pasture the tops in the field if maximum use of feed is desired. However, the method of preparation, whether it be ensiling or partially drying, is primarily a question of individual preference and of facilities available.

Dried Beet Pulp

Where there is an excess of wet beet pulp and a demand for the more concentrated product, large quantities of pulp are dried and sold in competition with grain. Dried molasses beet pulp or dried beet pulp should be classified as a concentrate feed, but it is rather bulky in nature. It has the same nutritional limitations as wet pulp, being deficient in protein, vitamins, and phosphorus. We should keep in mind that dried beet pulp is merely wet beet pulp with the moisture extracted by a drying process. The relative feeding value of dried and wet pulp has been found to be in the same ratio as their dry-matter content. In Colorado; experiments, dried pulp was worth 8.4 times the feeding value of wet pulp.

At the present time nearly all pulp is mixed with molasses and sold as dried molasses beet pulp. The ratio is usually 1,600 pounds of dried pulp and 40 0 pounds of dried molasses per ton of prodfuct. In this connection it might also be interesting to know that it takes about 1 ton of sugar beets to produce 9 5 pounds of plain dried pulp or an approximate ratio of 20 to 1.

There is some variation in the experimental results as to the comparative value of dried beet pulp and grain. However, beet pulp is principally a grain substitute and must compete on the market with grain, excepting where it is used as a specialty feed to provide bulk or to serve as an appetizer. In general, dried molasses beet pulp is equal to grain

for fattening- livestock, and therefore, cannot ordinarily demand a higher price than grain unless warranted by the convenience or special reasons for feeding it.

In Colorado experiments, dried molasses beet pulp was equal to corn as a fattening feed for yearling and 3-year-old steers.

For sheep in Wyoming experiments, dried molasses beet pulp produced satisfactory gains but was found to be more expensive than wet beet pulp. A summarization of 10 experiments indicates that lambs fed a mixture of dried molasses beet pulp and shelled corn made as rapid gains on the average as lambs fed corn as the only concentrate. In these experiments, dried molasses beet pulp was worth 95 percent the value of shelled corn. In California research, dried molasses beet pulp was equal to barley. In 18 experiments conducted by the Nebraska and Wyoming Stations, dried molasses beet pulp had a value of about 80 percent of corn.

In addition to its value as a fattening feed, dried molasses beet pulp is used to provide bulk in a ration, and many times is reconstituted with water to provide a succulent feed for show cattle and for high-producing dairy cattle. Many feeders like to feed dried beet pulp as part of the ration because its bulky nature prevents digestive disorders and aids considerably in keeping the cattle or sheep on feed. It is used extensively in show-cattle rations and is popular with feeders who are trying to produce animals for the showring or sales.

Results of comprehensive feeding trials conducted in widely separated sections of the country, therefore, establish for sugar-beet by-products an important and valuable function in animal feeding. It is pertinent to this discussion to calculate the total values represented by this by-product phase of our sugar-beet industry and to determine the ratio of such totals to what the farmer receives from the processor for his beets.

The latest sugar-beet-production data, for a complete year, are for 1940, and, according to "The World Sugar Situation," Bureau of Agricultural Economics, United States Department of Agriculture, the total American production for that year was as follows: Sugar beets, 12,192,000 tons; molasses pulp, 189,000 tons; moist pulp, 1,625,000 tons; other dry pulp, 114,000 tons; molasses (in addition to that included in molasses pulp calculated on a basis of computation used by the Colorado Experiment Station), 46,200 tons. In addition to the above, the beet tops left on the field after the harvesting of the beets represented something like 40 percent of the total weight of the 1940 beet crop. Jack Maynard of the Great Western Sugar Company estimates that, on a field-cured basis, the tops represent .2 ton for each ton of beets. Applying this method to the 1940 crop, the total tonnage of field-cured tops was 2,438,400 tons.

Applying to this total 19 40 production the values heretofore set forth, in this review of experimental work, the by-products for that year had for our livestock feeders a total value of approximately $24,000,000. Comparing this with the total amount received by the farmer the same year for his beets, which, including Government benefit payments, was $8 6,010,000, establishes for the by-products listed above a value of approximately 28 percent of the payments for beets, or approximately 22

percent of the estimated total value of the beets and their by-products. Using current higher feed prices rather than the normal prices considered in the feeding experiments, and recognizing the somewhat more liberal estimates of the value of by-products made by some sugar-beet-industry authorities, one might well justify a claim that these by-products used primarily in animal feeding have a value equal to about one-third of the compensation received by the farmer for his beets.

Speaking now of Idaho, the 1940 total volume of sugar-beet production ranked fourth among the states, and we were a close second to California in average, acre yield. The Idaho harvest was from 71,000 acres which produced 1,141,000 tons of beets for which the farmers received $7,549,000. The Idaho by-products, on the basis of figures heretofore quoted, had a value to the feeding industry of approximately $2,000,000 and possibly as much as $2,500,000 when combined with other feeds for various classes of livestock.

Idaho sugar-beet production including its by-products, therefore, represents a very considerable percentage of the State's total annual increment of agricultural wealth, and brings to our farms various other substantial benefits and advantages. Through the Experiment Station and the Extension Service of the University, we have endeavored to be helpful to this industry and expect to continue to assist in every way we can toward its attainment of the greatest possible efficiency and success.

In summarization: First, the American sugar-beet Industry, the major tonnage of which is grown in our western states, each year brings to us a substantial volume of new wealth from a specialized agricultural crop and from values found inherent in its by-products.

Second, it has a direct and marked effect upon our farm economy, necessitating that we strengthen our soil resources by adding fertilizing materials, that we practice well-organized rotation systems and that we use the best of farming methods.

Third, and finally, this industry brings new values to the agricultural area in which it is located through the impetus it gives to the Introduction of livestock and the establishment of a feeding industry. This, in turn, materially contributes to the permanence and success of the farm enterprise.