

THE FEED REPLACEMENT VALUES OF SUGAR BEET BY-PRODUCTS

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Sugar beet by-products, and especially beet tops, have a livestock fattening value that is well recognized by many beet growers but that is not fully understood or appreciated by many others who have either, not conserved or fed their by-products to best advantage or else have never fully recognized the important part that these by-products have played in the success of their feeding operations.

While there are several factors that often make the proper conservation of tops a difficult matter, a clearer conception of their potential feeding value and how best to secure it will not only cause the grower to value his entire beet crop more highly but will also teach him to build his farm feeding operation more closely around it.

The purpose of this paper is to discuss briefly a table prepared last spring showing feed replacement values of sugar beet by-products in terms of corn or alfalfa for fattening livestock. This table summarizes data secured directly from six western State or Federal Experiment Stations and represents a resume of all fattening tests conducted at these Stations which show a direct comparison of grain and hay rations with identical rations to which one of the beet by-products has been added.

The results reported herewith, most of which have been published in station bulletins or elsewhere, include 35 trials with beet tops, 29 trials with wet beet pulp, and 42 trials with dried beet pulp. Controlled fattening tests in which the amount of grain and alfalfa actually saved or replaced by a specific amount of beet by-products could be determined on the basis of the gains produced on the animals fed. Beet by-products used were given reasonable care and were fed in well balanced rations but in no case were special conditions imposed in their harvesting, conservation or feeding that would be impractical on the ordinary beet farm.

As the object was to arrive at the carbohydrate equivalent or fattening value only of the beet by-product considered and to transpose this value into terms of either corn or alfalfa, all feed replaced by the by-product was reduced to a common standard denominator, namely total digestible nutrients using standard values for each feed as reported in Morrison's feeding tables. These figures were then recorded by Station to indicate the pounds of total digestible nutrients in grain and hay that were actually replaced by the by-product from an average ton of beets. From information available it was assumed that a conservative estimate of the average by-products derived from a top of beets would constitute 10% of beet tonnage or 200 pounds of dry matter in beet tops; 28 percent of beet tonnage or 560 pounds of wet pulp (11 percent dry matter)

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or $4\frac{1}{2}$ percent of beet tonnage or 90 pounds of dried pulp (90 percent dry matter).

It is important to note that this study is made on the total energy or net fattening value of the beet by-products when they are properly fed in conjunction with grain and alfalfa and that no consideration is given to their protein content as it might influence growth. In all rations used there was sufficient protein available to satisfy growth requirements and any protein saved by the by-products is only considered on the basis of its carbohydrate equivalent or fattening value. It is a well established fact that digestible protein in excess of the amount required for growth is converted on digestion into an equal value of digestible carbohydrate equivalent. These average feed replacement values from each Experiment Station have been listed as they were reported by those who are at present in charge of experimental feeding work at the various Stations concerned.

Feed replacement values in pounds of total digestible nutrients contained in the grain and hay actually saved or replaced by the beet by-product fed with them are first shown on the basis of the by-product secured from an average ton of beets. These pounds of total digestible nutrients are then shown, first as equivalent amounts of No. 2 yellow corn and then, as equivalent amounts of alfalfa hay, first on the basis of the by-product from a ton of beets and then on the basis of the by-product produced from a $13\frac{1}{2}$ ton average acre yield of beets.

Beet Tops

Nearly all of the trials were conducted with tops that were dried and cured in piles and fed with corn, barley or oats and alfalfa hay. The data available indicate that the dry matter content of the tops used varied from 10% of the beet tonnage in Nebraska and 11 percent in California to slightly over 13 percent in Colorado.

Tops uncared for and lying out in the field exposed to the weather for any considerable length of time or tops fed wastefully could not of course be expected to show the high feed replacement values secured in most of these experiments.

The relatively low values shown by the tops used in the Nebraska trials which were fed to lambs in experiments conducted from 1917 to 1922 may very probably have been due to considerable wastage of these tops when fed through panels to the lambs. Unless lambs are forced to clean up tops fed each day they will pull a considerable portion through the panels and trample them.

The average figure of 115.5 pounds of total digestible nutrients replaced by the estimated 200 pounds of dry matter in tops per ton of beets indicates a coefficient of digestibility of 57.7 percent for dry matter in tops. This is somewhat lower than the 64.9 percent figure reported by Morrison for t.d.n. in fresh green tops but it coincides closely with the 59 percent figure reported by the California Station in recent digestibility tests and studies made with dried tops.

The average figures reported in the table indicate that carefully cured tops from a ton of beets when fed with grain and hay have a potential fattening value equivalent in round numbers to 143 pounds of corn or to 229 pounds of alfalfa hay and that these tops from a 13½ ton acre yield of beets will replace feed with a fattening value equal to 34.7 bushels of corn or 1.54 tons of alfalfa. This means that with corn valued at \$2.00 per cwt. or \$1.12 per bushel tops have shown an average replacement value in these feeding tests equal to \$2.86 per ton of beets or of \$38.86 per acre.

While there may be tops in the field that through deterioration from lack of proper care are worth no more than the low market price for which they sell, these studies should induce many beet growers to give the best possible care to this valuable by-product and to feed it to best advantage in their own rations.

Dried Beet Pulp

The very uniform results secured in the 42 feeding tests conducted with dried pulp at four Experiment Stations seem quite significant. These feeding experiments actually show that dried pulp when fed with grain and alfalfa has a higher feed replacement value than grain. An average of all tests indicates that 90 pounds of dried pulp, the amount produced from a ton of beets, replaced a feed supply equivalent to 104.2 pounds of corn, or that a ton of dried pulp when fed properly replaced enough feed to equal the fattening value of 2316 pounds of corn.

These results are not surprising to those who have made a careful study of the feeding value of dried pulp for it has consistently shown a much higher feeding value when mixed with grain than when fed alone with hay. Early fattening experiments conducted with lambs at the Colorado Station indicated definitely that dried beet pulp used as a "lone" carbohydrate feed with alfalfa hay had only about 75 percent the feeding value of corn but that when it was fed in equal parts mixed with corn it showed a higher feeding value than corn.

A practical example of this enhanced feeding value of dried pulp when mixed with grain is indicated by a recent cattle feeding test conducted at the Montana Station. Feeder calves fattened for 224 days on a ration of steam rolled barley and alfalfa hay gained only 379 pounds while similar calves

fattened on a mixture of equal parts of ground barley and dried pulp fed with alfalfa hay gained 477 pounds. In this experiment each ton of dried pulp fed saved or replaced 2032.5 pounds of barley plus 473.1 pounds of alfalfa hay in producing gains on the calves.

Practical livestock feeders and dairymen are well aware of this high feed replacement value of dried beet pulp. They know that when dried pulp is included in the grain ration livestock gains are heavier and more uniform though they also realize that dried pulp has a much lower feeding value when used without grain.

Coefficients of digestibility reported by Morrison for dried pulp range from 71.8 percent to 74.3 percent. Its coefficient of digestibility measured by grain and hay that it saved in the Montana test would be 91.9 percent; its average coefficient of digestibility for the 42 tests reported in which it was fed with grain and hay is 93.3 percent. If this value were reduced approximately 25 percent by feeding it as a "lone" carbohydrate it would then closely approximate Morrison's coefficient of digestibility for dried pulp.

No doubt some of this value is due to the bulky nature of dried pulp and its tendency to eliminate indigestion and bloat.

While other bulky feeds such as wheat bran or corn and cob meal can also help to eliminate indigestion and bloat when used with grain and hay rations, none of these has a fiber content as highly digestible as dried pulp and none has shown the physiological value which is so clearly demonstrated in the 42 tests reported herewith:

Wet Beet Pulp

Wet beet pulp was fed in rations with grain and alfalfa hay. It was hauled from factory to feed lot and fed in bunks. Its feed replacement value was naturally influenced to greater extent by weather conditions than that of dried pulp. Feed replacement values reported for wet beet pulp show a much wider variation than values reported for dried pulp. The high replacement values reported by Montana and Wyoming Experiment Stations were secured in 22 lamb fattening tests conducted at the Huntley Station in Montana and at branch Stations at Torrington and Worland, Wyoming. The relatively low feed replacement values indicated by the Nebraska Station were secured in 3 lamb feeding tests conducted at the Scottsbluff Experiment Station at Mitchell, Nebraska. Intermediate values reported by the Colorado Station were secured in 4 tests with cattle and lambs.

An average of all reports by Stations shows a ton of wet beet pulp replacing digestible nutrients equivalent in round

numbers to 317 pounds of No. 2 yellow corn or 508 pounds of alfalfa.

Summary

Feed replacement values of sugar beet by-products when fed with grain and alfalfa hay in 106 livestock fattening experiments are reported from 6 Western Agricultural Experiment Stations.

These fattening tests with beef cattle and lambs include 35 separate trials with beet tops, 29 trials with wet beet pulp and 42 trials with dried beet pulp. They represent all available comparisons of grain and alfalfa rations that were fed with and without beet by-products at these Stations.

The average feed replacement value of the amount of each by-product secured from a ton of beets is shown as reported by each Experiment Station; first, as pounds of digestible nutrients contained in the feeds replaced, Then as pounds of either corn or alfalfa hay equivalent to digestible nutrients replaced.

Feed replacement values are then shown in terms of bushels of corn or tons of alfalfa for by-products from a $13\frac{1}{2}$ ton average acre yield of beets.

An average of results reported by Stations indicates that when the beet by-products from a ton of beets are carefully preserved and properly fed with grain and alfalfa hay for fattening purposes the 200 pounds of dry matter in the tops has a feed replacement value equal to 143.2 pounds of corn or 228.8 pounds of alfalfa hay; the 560 pounds of wet pulp replaces 88.7 pounds of corn or 142.2 pounds of alfalfa and the 90 pounds of dried pulp replaces 104.2 pounds of corn or 167 pounds of alfalfa.

On the basis then of a $13\frac{1}{2}$ ton average acre yield of beets the tops would have a replacement value equal to 34.7 bushels of corn or 1.54 tons of alfalfa; the 3.78 tons of wet pulp would be equal to 21.4 bushels of corn or .96 tons of alfalfa and the 1215 pounds of dried pulp would replace 1406 pounds or 25.1 bushels of corn or 1.13 tons of alfalfa.

With a definite shortage of sugar beet by-products due to the reduction of approximately 4,442,000 short tons of beets harvested in 1943 as compared with 1942 and with sharply increased prices for grain and hay many farmers and feeders are getting a clearer conception of the value of beet by-products.

For instance today with corn prices at \$2.50 per cwt. (\$1.40 per bu.) and beet tops at 60¢ per ton of beets the net fattening units in corn are costing fully 6 times as much as in tops. In other words those tops have a potential feeding value

of \$3.58 per ton of beets. In like manner tops and dried pulp from a ton of beets have a combined value of \$6.18. At present prices they can practically cut a fattening bill in two.

The substance of this work--the need for a clearer understanding of the value of by-products is to induce better care for them and their use on the farm. "Potential" value is a good word to use. Beet by-products can lose this value as quickly as any feed that is neglected and left unduly exposed to the elements.

FEED REPLACEMENT VALUE OF SUGAR BEET BY-PRODUCTS IN TERMS OF CORN OR ALFALFA HAY

State or Federal Agricultural Experiment Station	By-Product Replacement per Ton of Beets Produced*									Per 13½ Ton Acre Yield of Beets						Number of Experiments Reported		
	Total Digestible Nutrients** in Grain & Hay Replaced by			No. 2 Yellow Corn			Alfalfa Hay			No. 2 Yellow Corn			Alfalfa Hay					
	Wet Dried			Pounds in			Wet Dried			Bushels in			Wet Dried					
	Tops	Pulp	Pulp	Tops	Pulp	Pulp	Tops	Pulp	Pulp	Tops	Pulp	Pulp	Tops	Pulp	Pulp	Tops	Pulp	Pulp
Lbs.	Lbs.	Lbs.	Lbs.	Lbs.	Lbs.	Lbs.	Lbs.	Lbs.	Bu.	Bu.	Bu.	Tons	Tons	Tons	Tops	Pulp	Pulp	
Colorado	125	64	84	155.1	79.4	104.2	248.5	127.2	167	37.4	19.1	25.1	1.68	.86	1.13	2	4	5
Wyoming	124	87	86	153.8	107.9	106.3	246.5	173.0	171	37.1	26.0	25.6	1.66	1.17	1.15	7	10	6
Nebraska	81	36	83	100.1	44.7	103.0	161.0	71.6	165	24.1	10.8	24.8	1.09	.48	1.11	6	3	16
Montana	108	99	83	134.0	122.8	103.0	214.7	196.8	165	32.3	29.6	24.8	1.45	1.33	1.11	8	12	15
S. Dakota	137			170.0			272.4			42.0			1.84			6		
California	118			146.4			230.0			35.3			1.55			6		
Average	115.5	71.5	84	143.2	88.7	104.2	228.8	142.2	167	34.7	21.4	25.1	1.54	.96	1.13			

*Estimated 28% return of wet pulp (11% dry matter) on beet tonnage
 Estimated 4½% return of dried pulp (90% dry matter) on beet tonnage

**% Coefficient used (Morrison) Corn .806 Alfalfa .503

FEED REPLACEMENT VALUE
 Per Ton of Product (Lbs.)

Wet Pulp	Dried Pulp
Corn or Alf.	Corn or Alf.
316.8	507.9
2315.6	3711.2

References:

- Colorado Station Bulls. 379 - 422
- Wyoming " " 191 - 227 - 257
- Nebraska " " 194
- Montana Complete Summary (as yet unpublished)
- South Dakota - U. S. Belle Fourche Station
- California Experiment Station Publication March 1943