COMPARISON OF CONCENTRATED SEPARATOR BY-PRODUCT TO MOLASSES AS AN ANIMAL FEED SOURCE

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Section F

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Molasses and molasses dried beet pulp are important feed sources in todays' animal feed industry. The installation of chromatographic separators into todays sugar factories will result in the replacement of molasses with concentrated separator by-product (CSB). Because todays' animal feeder is very cognizant of nutritional values in animal feed stuffs, The Amalgamated Sugar Company gave priority to evaluating this new sugar industry by-product.

The Amalgamated Sugar Company in conjunction with the Department of Animal, Dairy, and Veterinary Sciences of Utah State University[1] began a study to provide nutritional data for the animal nutritionists and animal feeders who would ultimately become involved with using CSB. The objective of these studies were to (1) determine the comparative worth of CSB, and to (2) provide the end user with a sense of confidence in using CSB in place of molasses.

The following studies, carried out by Utah State University for The Amalgamated Sugar Company, will be briefly discussed.

(1) Determination of the total digestible nutrient (TDN) content of CSB.

(2) Comparison of CSB to molasses as a liquid supplement for cattle fed alfalfa-grass hay diets.

(3) Cattle preference for beet pulp containing varied amounts of molasses or CSB.

Additional studies currently being performed by Utah State include:

(4) Comparison of CSB to molasses as a liquid supplement for cattle fed high energy grain diets, and

(5) Affects of CSB on nutrient digestibility, milk production and cattle preference[2]

The Total Digestible Nutrient (TDN) Content of CSB

The use of chromatography results in the removal of sugar from molasses. The resultant by-product, CSB, has elevated levels of crude protein and ash and reduced levels of total digestible nutrients (TDN).

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[2]M. J. Arambel, C. W. Arave, R. D. Wiedmeier and B. H. Kent; Animal, Dairy and Veterinary Sciences Department, Utah State University, Logan, UT.

The TDN content of CSB was determined for Amalgamated by Utah State University on actual feeding trials using a substitution method. The TDN of an alfalfa-grass hay basal diet and the TDN of a test alfalfa-grass hay diet with 10% added CSB was determined using four ruminally cannulated cows in a replicated 2x2 latin square design. The difference in digestibility between the basil and test diet was used to calculate the digestibility of CSB. The TDN content of CSB determined in this manner was 59.34 percent. This is 20 percent lower than molasses with a reported TDN content of 75 percent which is what would be expected because of the reduced sugar and elevated ash content of CSB.

Comparison of CSB and Molasses as Liquid Supplements For Cattle Fed Alfalfa-Grass Hay Diets[3]

The objective of this portion of the study was to compare the effects of molasses and CSB supplementation of forage diets on:

(1) Nutrient Digestibility

(2) Ruminal Fermentation Characteristics

(3) Blood Electrolytes

Two diets were prepared using a grass-alfalfa hay base supplemented with one of two liquid supplements, 7.3 percent molasses or CSB. The supplements were of approximately equal refractometer dissolved solids concentration. These diets were fed to four ruminally cannulated cows in individual pens in a replicated 2x2 latin square design. Samples were collected twice daily during a five-day collection period. The data was analyzed using analysis of variance techniques.

As can be seen in Table 1, the digestibility of dry matter, acid detergent fiber, and neutral detergent fiber was not affected by type of liquid supplement. Crude protein digestibility was however lower with CSB, but since the crude protein content of CSB is higher then molasses (19.0% vs. 10.0%), the actual crude protein digested was similar in both diets at 6 percent.

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[3] *"Comparison of CSB by-products to molasses as liquid supplements for cattle fed alfalfa-grass hay diets"*, Proceedings, Western Section, American Society of Animal Science, Vol. 41, 1990, J. R. Bair, B. H. Tanner, R. D. Wiedmeier, M. J. Arambel and J. L. Walters, Utah State University, Logan, UT

TABLE 1

Comparison of Forage Diets Supplemented With Molasses or CSB on Nutrient Digestibility

NUTRIENT	MOL, %	CSB, %	SE, %	P>F, %
Dry Matter	69.03	68.58	0.45	0.45
Crude Protein	67.63	64.07	0.95	0.02
Acid Detergent Fiber	57.48	55.77	0.70	0.11
Neutral Detergent Fiber	65.62	64.75	0.58	0.32

Table 2 shows that no significant differences between liquid treatments were observed on ruminal pH, NH_3, volatile fatty acids, or viable bacteria concentrations. The portion of total bacteria that were cellulolytic was also unaffected. Molar proportions of individual volatile fatty acids were not affected and in the expected range.

TABLE 2

Comparison of Forage Diets Supplemented* With Molasses or CSB on Ruminal Fermentation Characteristics

ITEM	MOL	CSB	SE	P>F
pH	6.97	6.93	0.03	0.31
Ammonia, mg/dl	14.21	16.71	1.25	0.17
Volatile Fatty Acids (total mmol/ml)	74.3	74.78	--	--
Volatile Fatty Acids (proportions, molar %)				
Acetate	70.80	71.14	0.92	0.64
Propionate	16.96	16.48	0.39	0.62
Butyrate	9.34	9.47	0.23	0.68
Isobutyrate	0.87	0.87	0.01	0.90
Isovalerate	1.02	1.16	0.09	0.42
Valerate	0.99	0.87	0.04	0.16
Protozoa, x 1000/ml	13.9	7.8	4.5	0.32
Total Bacteria, 10^9/ml	26.79	27.36	1.23	0.58
Cellulolytic Bacteria, %	21.72	21.37	0.86	0.86

*Fed at 7.3 percent of diet

Since CSB has an elevated ash content compared to molasses, the effects on blood mineral balance is of practical importance. Table 3 show that supplementation with either molasses or CSB resulted in similar blood electrolyte concentrations.

TABLE 3

Comparison of Forage Diets Supplemented* With Molasses or CSB on Blood Electrolyte Concentrations

ITEM, mg/dl	MOL	CSB	SE	P>F
Calcium	11.62	12.01	0.41	0.53
Phosphorus	6.21	7.32	0.83	0.72
Potassium	5.70	6.20	0.47	0.28
Sodium	142.34	143.29	0.58	0.62
Magnesium	2.63	2.71	0.32	0.57
Chloride	101.21	102.02	0.46	0.62

*Fed at 7.3 percent of diet

Cattle Preference for Beet Pulp Containing Varied Amounts of Molasses or CSB

One of the most economical ways to market CSB is to dry it on pulp. Molasses dried beet pulp is considered as a highly palatable feed and is of paramount importance to both the sugar industry and the animal feed industry. Therefore extreme concern was placed on the effect replacing molasses with CSB would have on the palatability of beet pulp.

A study was conducted by Utah State University for The Amalgamated Sugar Company to determine cattle preference for beet pulp containing varied amounts of molasses or CSB. Six pregnant two-year old heifers were fed a diet of alfalfa-grass hay and rolled corn designed to satisfy physical and chemical appetance factors. Once each day the heifers were offered free choice access to each of six beet pulp treatments containing, 10, 15, or 25 % molasses solids or CSB solids for 15 minutes. Treatments were administered in a 6x6 latin square experimental design.

Results shown in Table 4 indicate that there was no significant difference in the intake of the six beet pulp treatments.

TABLE 4

ITEM	% Mol Solids/Pulp			% CSB Solids/Pulp			SE
	10	15	25	10	15	25	
Intake, lbs	4.51	4.64	4.92	4.51	4.69	4.72	0.15

Experiences of The Amalgamated Sugar Company in Marketing Concentrated Separator By-Product

Table 5 compares nutritional characteristics of beet molasses with that of CSB.

TABLE 5

	MOLASSES (%)	CSB (%)
Moisture (minimum)	25*	30*
Ash (maximum)	9*	25*
Total Sugars (minimum)	38*	15*
Crude Protein (minimum)	10	15*(typical>20%)
TDN (typical)	75	59.34

* Guaranteed analysis

The Amalgamated Sugar Company applied the information given in Table 5 in conjunction with the local market requirements to come up with the relative worth of CSB as compared to molasses for use as a liquid supplement.

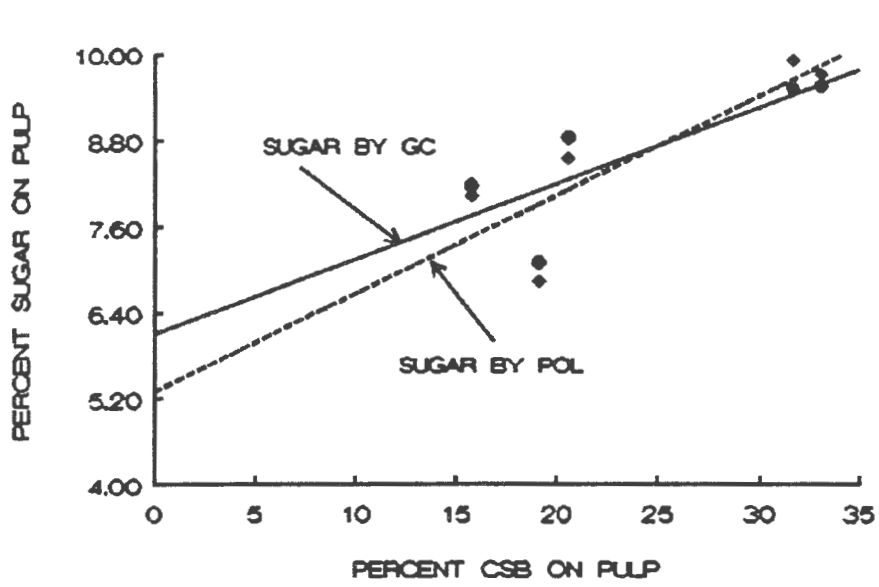
The majority of the CSB produced by The Amalgamated Sugar Company, however, is dried on pulp. This is done for reasons of economics and because of the logistic problems associated with disposing of large quantities of liquid supplements to a limited local market.

As was previously indicated, CSB can be added up to 25% solids on pulp without effecting palatability. In practice however, 20% is the practical limit because of pelletizing limitations. Excessive CSB can reduce the life of pellet mill main shafts and reduce pellet mill capacity. Pellets produced from high concentrations of pure CSB also tend to be harder than molasses pellets and thus less durable.

These problems can be minimized to a large extent by blending CSB with discard molasses before drying on pulp. Blending of CSB with molasses before drying has the added advantage of providing nutritional consistency of pulp produced between factories.

CSB may be dried on pulp at levels approaching 15 percent solids on pulp and still remain under the 8 percent maximum allowable sugar content for Japanese sales. The relationship between CSB solids on pulp and the sugar content of dried pulp taken from actual factory production runs is shown graphically in Figure 1.

FIGURE 1
CSB ON PULP VERSUS SUGAR CONTENT



Nitrate Concern

An occasional topic of concern with respect of CSB is the concentration of nitrates. Nitrates are changed into nitrites in the digestive tract of animals. When this is absorbed into the blood it changes the hemoglobin into a form that cannot transport oxygen. Animals may become asphyxiated in rare cases[4].

The nitrate levels in CSB are directly related to the level of nitrates in the molasses separator feed material. Nitrate levels in molasses vary widely and depends on the beet growing area and beet agronomic practices. The analysis of various Amalgamated molasses samples over the last two years shows nitrates range from 0.24 to 0.63 percent on molasses.

Essentially 100 percent of the nitrates in separator feed molasses remain with the CSB. The nitrates are concentrated in the CSB because of the separation of molasses solids to extract (the sucrose rich fraction). A rough approximation is that the concentration of nitrates in CSB will be twice the concentration of nitrates in molasses.

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[4]*Feeds and Feeding*, Frank B. Morrison, 21st Edition, Ithach, New York, The Morrison Publishing Company, 1951, p. 46.

The potential lethal level of nitrates in feed rations is 0.9 percent or higher[5]. Nitrate problems from CSB therefore are highly unlikely because, whether CSB is fed as a supplement or dried on pulp, it will always make up a relatively small portion of the total ration. Concern over the nitrate level in CSB is only relevant when the remaining components of the ration contain nitrate levels approaching the 0.9 percent level.

Registration Status

CSB is currently registered as a commercial feed stuff in states which The Amalgamated Sugar Company markets CSB. CSB is currently beings considered by the Association of American Feed Control Officials (AAFCO) for registration as an animal feed source.

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[5]Ensminger and Olentine, Feeds and Nutrition, 1st Edition, 3rd Printing, 1980, Clovis, CA, p. 183.