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Neutralized Direct-Acid-Set Whey as an Extender for a Chocolate-Flavored Dairy Drink[1]

L. C. BLACKBURN and R. BASSETTE*

Department of Animal Sciences and Industry, Kansas State University, Manhattan, Kansas 66506

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ABSTRACT

A chocolate-flavored dairy drink was prepared in which four parts of neutralized direct-acid-set whey and six parts of whole milk were combined with 1.44% chocolate flavoring, 4.5% sugar and 0.2% nonfat-dry milk. The extended chocolate-flavored drink was compared with a conventional chocolate-flavored low-fat milk made with the same formulation except skimmilk replaced neutralized whey and no nonfat-dry milk was added. Both products were heated to 80 C and mixed 2 min in an institutional Waring blender to disburse salts from neutralized whey, pasteurized at 80 C for 35 min and cooled immediately to 5 C. Sedimentation, viscosity, pH and consumer acceptability were determined. No sedimentation occurred after 7 days of storage, but after 10 days about 5.3% sediment by volume was observed in both drinks upon centrifugation. After 7 days at 4 C, the whey-extended chocolate drink had a 4% by volume watery layer that increased to 4.5% after 10 days. Maximum viscosities of 47 and 49 centipoise, respectively, were obtained after 5 days at 4 C for the extended and conventional chocolate-flavored low-fat milk. Viscosities declined to 26-27 centipoise after 10 days. Twenty-two of a consumer panel of 37 preferred the whey drink over the conventional, and seven expressed no preference, judging by a combined preference/triangle test. When data from the triangle taste test were subjected to a statistical analyses, the probability for preference was .47 for the whey drink, .30 control and .21 no preference. There was no difference in acceptability ($p > 0.05$).

With about 20% of the cottage cheese manufactured in the U. S. made by the direct-acid-set (DAS) method (*4*), DAS whey currently dumped into municipal sewers contributes significantly to dairy plant waste-disposal problems. This will become even more acute as dairy plants are forced to comply with the 1972 Amendment to the Water Pollution Act by 1985, the target date for extreme restrictions on sewage loads. Whey, which adds 30,000 - 60,000 ppm BOD, contains over half of the milk solids, so it is particularly unfortunate that DAS whey is being wasted. Neutralized, it is bland enough to be used in various food products. For example, Chen et al. (*2*) prepared an imitation milk from 40% neutralized DAS whey that was not significantly different in flavor from commercial fresh fluid milk. Blackburn et al. (*1*), with 30% DAS whey, prepared an extended buttermilk that was indistinguishable from a control buttermilk.

Described here is our attempt to use neutralized DAS whey to formulate an extended chocolate dairy drink. The developed product contained neutralized DAS whey, raw whole milk, chocolate flavoring, NFDM and sugar. This mix and a conventional chocolate low-fat milk with the same formulation except for a milk-skimmilk base were heated to 80 C, mixed in an institutional Waring blender and pasteurized at 80 C for 35 min. Sedimentation, pH, viscosity and consumer acceptability of both products were measured. The authors recognize that this is an atypical processing treatment employed with the small volume of product available.

MATERIALS AND METHODS

DAS whey neutralized to pH 6.8 with laboratory grade magnesium oxide, was blended at a 4:6 ratio with whole milk. Chocolate flavoring[2] at 1.44%, 4.5% sugar and 0.2% NFDM powder were added. The DAS-milk base formulation and a conventional chocolate-flavored low-fat milk, 2% milkfat, were heated to 80 C in a steam-flowing sterilizer, mixed in an institutional Waring blender for 2 min, then reheated to 80 C for 35 min and cooled. The blender was used in an attempt to disburse a small amount of residual salts in the neutralized whey. The conventional product was prepared by blending 1.44% chocolate flavoring and 4.5% sugar with four parts of skimmilk and six parts of whole milk and processed as previously described.

Fifty-milliliter samples of each were examined for sedimentation by observing the sediment in a graduated glass cylinder after 5 and 10 days of storage at 4 C. Additional 15-ml samples were centrifuged for 10 min in graduated tubes and the sediment volumes measured.

[1]*Contribution No. 81-275-j Department of Animal Sciences and Industry and Kansas Agricultural Experiment Station, Kansas State University, Manhattan 66506.*

[2]*Bowey/Krim-ko, Inc. Granex Agglomerated Press Instant Chocolate Flavored Dairy Preparation No. 315. Ingredients-cocoa (processed with alkali), sugar, salt, carrageenan and vanillin.*

Viscosities of both the extended and conventional chocolate-flavored drinks were measured with a Brookfield Viscosimeter, Model LVF, with a number 2 spindle and 60 rep after 1, 5, 7 and 10 days.

A consumer panel scored the two chocolate drinks in a combined triangle/preference test. The drinks were packaged in 8-oz. yogurt cups for a consumer sensory test, with each panel member receiving two cups of conventional drinks and one of the whey-chocolate drink. The cups, with lids slit and taped so straws could be inserted, were placed in brown bags with straws for distribution to KSU-Dairy Bar customers. Cups were taped closed to prevent tasters from seeing a slight color difference between the two drinks. Results from the consumer evaluation were analyzed statistically, with confidence intervals for a difference of two multinominal proportions (*6*), and the probability for preference calculated (*7*).

RESULTS AND DISCUSSION

The chocolate-flavored drink prepared with the DAS-milk base formulation appeared to be highly acceptable. After 7 days at 4 C, the whey drink, but not the conventional chocolate-flavored low-fat milk, had a slight watery layer, (viewed in the graduated cylinder), about 4% by volume, which increased to 4.5% after 10 days. Undoubtedly, the destabilizing effect of the blender on the carrageenan contributed to the body defects. Neither had a cocoa sediment at 7 days, but after 10 days the conventional drink had a 7% cocoa sediment and the whey-extended drink had a 4% sediment volume, as observed in the graduated cylinder. Edmonson et al. (*3*), using a sweet whey concentrate, fresh cream, carrageenan and chocolate flavoring, produced a concentrated sterile milk product with 35% total solids. After centrifuging to enhance sedimentation, their substituted chocolate drink had a 5% sediment volume compared with 3% for their control. Centrifuging increased sedimentation of both of our drinks to 5.3% after 10 days. The control's flocculum was compact but the whey's was fluffy.

Viscosities after 10 days of storage at 4 C were 26-27 centipoise (cps) for the two products, but measurements showed maximum viscosities of 47 cps for the whey drink and 49 for the conventional product at 5 days. Thus sedimentation increased slightly and viscosity decreased while the whey drink's watery layer increased with extended storage.

Meltesen (*5*) reported that for the Bowey/Krim-ko chocolate mix, viscosity maximized at 24-36 h after processing, and remains constant until bacteria begin to lower the pH, which later lowers gel strength. Viscosity of the drinks stems mostly from carrageenan and alkalization of the cocoa. The pH of both our conventional and whey-milk chocolate drinks fluctuated little during 10 days of storage.

Table 1 presents the results of the triangle taste test on the whey-extended chocolate-flavored drink and the chocolate-flavored low-fat milk. It also shows the method employed to calculate the probability of preference.

The probability for acceptance of the chocolate flavored-whey extended dairy drink was .47; the control, low-fat chocolate milk was .30; and no preference .23. Differences in acceptability were not significant ($p > .05$).

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TABLE 1. *Responses from the triangle taste test and calculation*[a] *of probability of preference* (*6*).

Response	Whey drink (A)	Control (B)	No preference (NP)	Total
Number correct (selected odd sample)	11(n_1)	8(n_2)	5(n_3)	24(n_c)
Number incorrect (didn't select odd sample)	11(n_4)		2(n_5)	13
Total evaluations				37(n_t)

[a] *Calculation of probable preference*

Probability of preference for A:

$$P_A = \frac{4(n_1) - (n_4)}{2(3n_c - n_t)} = \frac{4(11) - 11}{2(72 - 37)} = .47$$

Probability of preference for B:

$$P_B = \frac{4(n_2) - (n_4)}{2(3n_c - n_t)} = \frac{4(8) - 11}{2(72 - 37)} = .30$$

$$P_{NP} = \frac{2(n_3) - (n_5)}{(3n_c - n_t)} = \frac{2(5) - 2}{(72 - 37)} = .23$$