Journal of Food Protection Vol. 42, No. 4, Pages 299-301 (April, 1979)

A Milk-Like Beverage from Neutralized Direct-Acid-Set Cottage Cheese Whey[1]

F. H. CHEN, R. BASSETTE*, and J. T. MARSHALL

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

(Received for publication July 21, 1978)

ABSTRACT

An imitation milk was formulated by combining 4 parts of neutralized, direct-acid-set, cottage cheese whey with 6 parts of whole milk, and fortifying with .5% nonfat dry milk solids (NFDM). Whey collected from a commercial plant was neutralized, clarified, blended with milk, fortified with NFDM, pasteurized, homogenized, and packaged in ½-gal. paper cartons in the Kansas State University (KSU) dairy processing plant. Calculated raw material costs were compared for 2.0% low fat milk, 3.25% milk, and for imitation milks with those same milkfat concentrations. The 2.0 and 3.25% imitation milk could be formulated with savings of 35 and 25 cents per gallon, respectively. Coded samples of the product were compared with regular KSU whole milk by 112 persons. Of these, 45% identified the KSU milk samples, 35% thought the experimental product was the KSU milk, and 20% could tell no difference. The milk sample was preferred for flavor by 42% of the consumers, 32% had no preference, and 26% preferred the imitation milk. The imitation milk, containing 11.5% total solids and 2.4% protein, was .5% lower in total solids and 1.0% lower in protein than KSU whole milk.

An excellent review on whey beverages by Holsinger et al. in 1974 (*5*) covers uses in beverages of whey from cheeses made with bacterial cultures. However, they did not mention direct-acid-set (DAS) whey, a relatively new product. The clean flavor of DAS whey makes it a promising substance for further study.

Neutralized DAS cottage cheese whey is bland and does not have the characteristic flavor of cultured wheys. Its blandness should make it adaptable for use in food products. Since the DAS method for making cottage cheese is increasing substantially in the United States (*3*), the need to find uses for DAS whey is important.

With more stringent pollution regulations, milk processing plants that manufacture cottage cheese will have to consider alternatives to dumping large amounts of whey into city sewers. Unfiltered cottage cheese whey adds about 54,000 ppm to the biochemical oxygen demand (BOD) (*4*). Thus small processing plants, which often dump whey into municipal sewage systems, are facing whey disposal problems (*6*).

This paper describes development and formulation of an imitation milk fabricated from neutralized DAS whey and milk.

[1]*Contribution No. 78-416-j, Kansas Agricultural Experiment Station.*

MATERIALS AND METHODS

Preparing direct-acid-set (DAS) cottage cheese whey

Laboratory scale batches of DAS cottage cheese were made in 8-liter stainless steel tanks with Corbin's patented method (*2,9*). After the cheese was cooked, the whey was strained through a colander and the curd discarded. The collected whey was cooled to 4 C and stored in stoppered Erlenmeyer flasks.

Immediately before formulating experimental products, the whey was neutralized with 50% aqueous KOH (ca. 8 g/l of whey), vigorously mixed, then clarified by centrifuging in 100-ml plastic tubes in a Precision Universal centrifuge at 1200 RPM for 5 min to produce a clear, sweet whey.

Formulation of an acceptable whey-milk (imitation milk)

Preliminary studies were designed to establish the optimum: (*a*) type of neutralizer, (*b*) amount of milkfat, (*c*) blend of neutralized whey, and (*d*) concentration of lactose to make a milk-like beverage with acceptable flavor.

Triangle taste tests were employed to compare these milks and results analyzed according to methods described by Larmond (*7*). Results from a consumer panel were analyzed statistically to determine if customers could distinguish milk from whey-milk and if they had a preference of one over the other.

Fat, protein and ash of both KSU milk and whey-milk were analyzed by A.O.A.C. methods (*1*). Fat was determined by the Babcock method and protein by dye binding. Total solids were measured by the Mojonnier procedure and lactose was determined colorimetrically by the phenol-sulfuric acid method of Marier and Boulet (*8*).

RESULTS AND DISCUSSION

Sensory evaluation of the whey-milk formulations

A mixture of 50% neutralized-pasteurized whey and 50% commercial pasteurized homogenized milk was evaluated on a nine-point hedonic scale by five experienced judges. Four whey-milk samples were standardized, two to 2.0% milkfat and two to approximately 3.25% milkfat and neutralized with either $Ca(OH)_2$ or KOH and compared with 3.25% milk (commercial pasteurized-homogenized milk obtained from the KSU dairy plant was used throughout the study). As indicated in Table 1, results showed no difference ($P < .01$) in flavors of the whey-milks as a result of neutralizer or concentration of fat. Furthermore, the whey-milk flavors were judged not different from those of the KSU milk.

A panel consisting of both experienced and inexperienced judges, using a triangle taste test, judged threshold levels for added whey and lactose. In the first trial, whey

was added to milk at concentrations of 30, 40, and 50% and evaluated by an 11-member taste panel. At the 50% whey level, 8 of 11 correctly identified the difference. At 30 and 40% whey concentrations, the panelists could not distinguish the whey-milk from regular milk ($P < .05$; see Table 2). In a second trial with 12 taste panelists, the results were almost identical.

As a result of the first two triangle taste tests, whey-milk (40% whey) was considered to be similar in flavor to that of milk. Therefore, in a final series of triangle taste tests a 40:60 blend of whey with milk was evaluated with, 0, .5, 1.0, and 1.5% added lactose. Results in Table 3 show that the panelists distinguished samples when the lactose concentration was 1.5% or more ($P < .01$).

Consumer evaluation of whey-milk

Based on results of the triangle taste tests, a paired comparison consumer taste test was designed to compare the 40:60 whey-milk containing .5% added NFDM with milk. The .5% solids were added to approximate the solids in milk. Whey for this milk was collected from a commercial dairy plant that uses the DAS method for making cottage cheese. After being neutralized, the whey was clarified at the KSU processing plant in a motor-driven farm separator. The blended mixture of raw milk, neutralized whey, cream (to standardize milkfat to 3.25%), and NFDM (.5%) was pasteurized, homogenized, and packaged into ½-gal. cartons. These cartons were paired with cartons of KSU whole milk, coded, and sold to consumers willing to evaluate the milks. (As an incentive, the pairs were sold for the normal price of a single half-gallon carton.) Customers were asked to identify which of the two cartons contained regular milk and which they preferred.

Eighty-nine of 112 customers distinguished between the two samples. However, only 56% (50 of 89) correctly identified the milk sample. Therefore we accept the hypothesis that the customers could not distinguish between the samples (*10*).

Of the 112 consumers, 45% correctly selected the milk, 35% thought the whey-milk was regular milk, and 20% could not tell the difference between the two. The flavor of the milk sample was preferred by 42% of the consumers; 26% preferred the whey-milk, and 32% had no preference.

Composition of the whey-milk and KSU milk are presented in Table 4. The whey-milk formulated with

TABLE 2. *Triangle test results comparing regular KSU whole milk with 30%, 40%, and 50% whey-milk blends (7).*

	Sample group[1,2]		
Judgment	A	B	C
Correct	5	5	8*
Wrong	6	6	3*
Degree of difference[3]			
Slight	4	4	6
Moderate	1	1	1
Much	0	0	1
Extreme	0	0	0
Preference			
KSU milk	4	2	5
Whey-milk	1	3	3

[1]All samples contained 3.25% fat.
[2]A = KSU milk vs whey-milk containing 30% whey.
B = KSU milk vs whey-milk containing 40% whey.
C = KSU milk vs. whey-milk containing 50% whey.
[3]Degree of difference and acceptability were recorded only for those making correct judgements.
*Significantly different ($P < .05$).

TABLE 3. *Triangle test results comparing judgements on regular KSU whole milk with whey-milk containing 40% whey and .0, .5, 1.0, and 1.5% additional lactose (7).*

	Sample group[1]			
Judgment	A[2]	B[2]	C[2]	D[2]
Correct	7	8	9	11**
Wrong	6	5	4	2**
Degree of difference[3]				
Slight	3	7	5	7
Moderate	1	1	2	3
Much	3	0	2	1
Extreme	0	0	0	0
Preference				
KSU milk	4	4	3	7
Whey-milk	2	3	6	4

[1]All samples contained 3.25% fat.
[2]A = KSU milk vs whey-milk without additional lactose.
B = KSU milk vs whey-milk with 0.5% additional lactose.
C = KSU milk vs whey-milk with 1.0% additional lactose.
D = KSU milk vs whey-milk with 1.5% additional lactose.
[3]Degrees of difference and acceptability were recorded only for those making correct judgments.
**Significant at ($P < .01$).

TABLE 1. *Hedonic scores[1] of KSU milk compared with whey-milks made from cottage cheese whey.*

	Samples[2,3]					
Panelist	A	B	C	D	E	Total
1	8	6	7	8	6	35
2	6	6	6	5	6	29
3	7	7	8	7	3	32
4	4	4	4	7	7	26
5	4	5	5	6	7	27
Total	29	28	30	33	29	149
Avg score	5.8	5.6	6.0	6.6	5.8	

[1]Scoring range: 9 for "like extremely" — 1 for "dislike extremely".
[2]All whey-milks consisted of a 50:50 blend of whey and KSU milk.
[3]A = Whey-milk of 3.25 fat, whey neutralized with KOH + $Ca(OH)_2$.
B = Whey-milk of 3.25% fat, whey neutralized with KOH.
C = Whey-milk of 2.00% fat, whey neutralized with KOH + $Ca(OH)_2$.
D = Whey-milk of 2.00% fat, whey neutralized with KOH.
E = KSU milk of 3.25% fat.

TABLE 4. *Composition of regular KSU whole milk and plant-processed 40% whey-milk.*

Sample	Percent				
	T.S.	Fat	Protein	Lactose	Ash
KSU whole milk	12.42	3.30	3.45	4.90	.77
40:60 whey-milk	11.50	3.15	2.43	5.01	.91

.5% NFDM solids was still .5% lower in total solids than regular milk. An additional .5% NFDM could be added to adjust the solids to that of regular milk. A 2.0% (low-fat) whey-milk also could be made economically with acceptable flavor properties (see Table 1).

The calculated savings in raw material of the 40:60 whey-milk, based on Grade A raw milk at $10.83/cwt, NFDM at $.71/lb, and milkfat at $1.00/lb, were 25 cents/gal. with .5% NFDM and 3.25% milkfat, and 35 cents/gal. with .5% NFDM and 1.95% milkfat.

ACKNOWLEDGMENT

The authors thank Dr. Richard M. Rubison, Department of Statistics at KSU, for his assistance with the statistical analyses.

REFERENCES

1. Association of Official Analytical Chemists. 1975. Official methods of analysis, 12th ed. Washington, D.C.
2. Corbin, E. A., Jr. 1971. Cheese manufacture. U.S. Patent 3,620,768.
3. Gerson, M. F. 1977. Trends in direct acidification of cottage cheese. Cultured Dairy Prod. J. 12(2):20.
4. Harper, W. J., J. L. Blaisdell, and J. Grosshopf. 1971. Dairy food plant wastes and waste treatment practices. PB-231 372. National Technical Information Service, U.S. Department of Commerce, Springfield, VA 22151.
5. Holsinger, V. H., L. P. Posati, and E. D. DeVilbiss. 1974. Whey beverages: A review. J. Dairy Sci. 57:849.
6. Jelen, P., and M. LeMaguer. 1976. Feasibility evaluation of cheese whey processing in small plants. J. Dairy Sci. 59-1347.
7. Larmond, E. 1970. Methods for sensory evaluation of food. Publ. 1284. Food Res. Inst., Canada Dept. of Agric., Ottawa KIAOC7
8. Marier, J. R., and M. Boulet. 1959. Direct analysis of lactose in milk and serum. J. Dairy Sci. 42:1390.
9. Silverman, A. 1976. Personal communication. In-line cottage cheese acidification system. Diamond Shamrock, Food Div., St. Louis, MO.
10. Snedecor, G. W., and W. G. Cochran. 1974. Statistical methods, 6th ed. Iowa State Univ. Press.