

UTILIZATION OF CHHANA WHEY FOR THE MANUFACTURE OF SOFT DRINKS

CHHANA PEYNİRALTI SUYUNUN MEŞRUBAT YAPIMINDA KULLANIMI

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SUMMARY: This research was taken up to investigate the feasibility of utilization of chhana whey for the manufacture of soft drinks.

In the study, four experiments including variations in (a) fruit juice base, (b) sugar level, (c) fruit juice/chhana whey ratio and (d) centrifuged and uncentrifuged whey were carried out. All products were analyzed chemically, microbiologically and organoleptically.

Based on this study, it is concluded that highly nutritive drinks can be obtained from whey, a waste product.

ÖZET: Bu araştırma, chhana peyniraltı suyunun meşrubat yapımında kullanılma olanaklarını incelemek amacıyla yapıldı.

Araştırmada, (a) meyve suyu çeşidi, (b) şeker miktarı, (c) meyve suyu/chhana peyniraltı suyu oranı ve (d) santrifüj edilmiş ve santrifüj edilmemiş peyniraltı suyundaki değişimleri içeren dört deneme düzenlendi. Bütün ürünler kimyasal, mikrobiyolojik ve organoleptik yönlerden incelendi.

Araştırma sonucunda, atık bir ürün olan peyniraltı suyundan oldukça besleyici içeceklerin elde edilebileceği kanısına varılmıştır.

INTRODUCTION

Chhana is a solid milk product manufactured from cow's milk by a combination of heat and acid coagulation. It is used very extensively in the Far East as base for preparation of various sweetmeat delicacies like "rasogolla". Although chhana whey contains valuable nutrients (YALÇIN et al., 1993), it is not utilized very widely as a food ingredient and, indeed, could be a severe environmental hazard in commercial plant manufacturing tonnage quantities.

Several authors (GAGRANI et al., 1987; HAMAD et al., 1987; JAYAPRAKASHA et al., 1986; REDDY et al., 1987; TUOHY et al., 1988) have investigated the possibility of utilizing whey alone or in combination with other ingredients to produce certain drinks. The use of citric acid or lemon juice for small-scale processing confers an advantage to chhana whey in the subsequent manufacture of whey/fruit drinks. Citric acid is a common ingredient in soft drinks and is, hence, widely accepted sensorially by consumers of this type of drink. The process for manufacturing the chhana whey/fruit drink was devised so that it could be readily developed in an intermediate technology processing environment. A further criterion required that the shelf-life of the product should be several weeks in the absence of refrigeration in order to provide for a worst-case scenario in a village environment. There is, however, nothing in the principle of the process developed which would prevent it from being used for high capacity processing lines.

The purpose of this research was to study the feasibility of utilization of chhana whey to develop a fruit drink.

MATERIALS AND METHODS

Raw Materials

Supplies of fresh raw whole cow milk were obtained from the farm of The Scottish Agricultural College, Auchincruive. Each experimental run used approximately 40 l of whole milk.

Citric acid was obtained from BDH Ltd and solutions of this compound were made up freshly prior to use. The orange and pineapple juice and mango drink were obtained by arrangement with a local supermarket (TESCO Ltd, Ayr). Stabiliser (Hamulsion GDL) was supplied by G.C. Hahn and Co Ltd, Wrexham, CLWYD.

Preparation and Processing of The Drink

The method adopted YALÇIN et al. (1993) was used to obtain chhana whey. The procedure for making chhana whey fruit drink is summarized in Figure 1. Half of the finished product was stored at 25°C and half at 5°C. At each storage temperature, half of the drinks were exposed to fluorescent light and half protected from light by black polythene. Storage was continued for two months.

In this research, four experiments were carried out. The ingredients and the amounts used in preparing of whey based fruit drinks are shown in Table 1. In the first experiment, three different drinks based on orange, pineapple and mango juice were prepared. In the other experiments, only orange juice was used for making whey based drinks. Secondly, sugar was reduced to 4 % and 0 % and these were replaced by water. Thirdly, different orange fruit juice levels (15, 20, 25 and 30 %) were tried and these were replaced by whey. Sugar percentage was 4 per cent (w/w) for all the groups. Finally centrifuged whey was used for the drinks but the proportions of ingredients were the same as the first experiment.

Evaluation of the Drink

Chemical evaluation: Total solids and ash contents were obtained by the gravimetric method (ANONYMOUS, 1984). Total protein (nitrogen x 6.38) was determined using the micro-Kjeldahl method (ANONYMOUS, 1984). Fat content was obtained according to the Rose-Gottlieb method (ANONYMOUS, 1966). The pH value was measured using a PYE 290 model pH meter. For the mineral analyses, an adapted inductively coupled plasma atomic emission spectra method (ALEXANDER and DIXON, 1985) was used. Vitamin C was determined titrimetrically (PEARSON, 1975).

Microbiological evaluation: Total bacterial count was determined at 30±1°C for 3 days by the plate count method using plate count agar (ANONYMOUS, 1974; HARRIGAN and McCANCE, 1976). Violet red bile agar was used for coliform organisms. Plates were incubated at 30±1°C for 24 hours (ANONYMOUS, 1974; HARRIGAN and McCANCE, 1976). Yeast and mould counts were made by the plate count method at 25-26°C for 4-5 days using malt extract agar with the pH adjusted to 3.5±0.1 with 10 % lactic acid (ANONYMOUS, 1974; HARRIGAN and McCANCE, 1976). M.R.S. agar

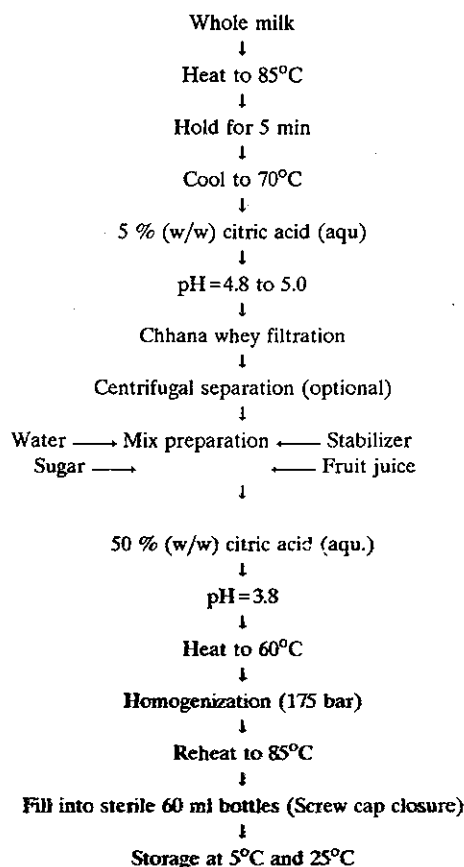


Figure 1. Process diagram of chhana whey/fruit drink manufacture

Table 1. The Ingredients And The Amounts Used In Preparing Of Whey Based Fruit Drinks

Experiment No.	Product	Ingredient content (%)						
		Whey	Fruit juice			Sugar	Water	Stabilizer
			Orange	Pineapple	Mango			
I	A	50	20	-	-	8	21.75	0.25
	B	50	-	20	-	8	21.75	0.25
	C	50	-	-	20	8	21.75	0.25
II	D	50	20	-	-	0	29.75	0.25
	E	50	20	-	-	4	25.75	0.25
	F	50	20	-	-	8	21.75	0.25
III	C	55	15	-	-	4	25.75	0.25
	H	50	20	-	-	4	25.75	0.25
	I	45	25	-	-	4	25.75	0.25
	J	40	30	-	-	4	25.75	0.25
IV	K	50	20	-	-	8	21.75	0.25
	L	50*	20	-	-	8	21.75	0.25

* Centrifuged

was used for lactobacilli. Plates were incubated at $37 \pm 1^\circ\text{C}$ for 3 days (ANONYMOUS, 1974; DeMAN et al., 1960; HARRIGAN and McCANCE, 1976).

All chemical and microbiological analyses were carried out in duplicate.

Organoleptic evaluation: Organoleptic evaluation was carried out the following day by a 17 member panel on the basis of colour, mouthfeel, flavour and overall acceptability. Panellists were familiar with dairy products. Scoring and ranking preference tests were used (LARMOND, 1977). Scoring test was carried out on the basis of a five-point hedonic scale (1-5), ranging from "dislike very much" to "like very much".

Statistical evaluation: Differences between groups on organoleptic analyses were tested for significance by analyses of variance following the methods of SNEDECOR (1956).

RESULTS AND DISCUSSION

Chemical Evaluation

Results of chemical analyses of whey-based fruit drinks are shown in Table 2. The first set of chhana whey/fruit drinks ranged in total solids from 12.92 to 14.87 per cent by weight. Protein levels across the series were in the range 0.21 to 0.32 per cent by weight with the exception of the mango-based drink. This was expected since it was made from a mango drink rather than fresh juice which was not readily available. The uncentrifuged whey drinks had a fat content ranging from 0.4 to 0.96 per cent by weight. The presence of milk fat was the main cause of a small quality problem. Despite the use of a lecithin based emulsifier (Hamulsion GDL) and homogenisation a small amount of fat separation was observed after a few weeks storage at both temperatures. This problem was obviated by using centrifuged whey which gave a product that was preferred by the taste panel and one which did not suffer from any fat separation.

Table 2. Proximate Composition and Other Analytical Data for Whey Based Fruit Drinks

	Product											
	A	B	C	D	E	F	G	H	I	J	K	L
Total solids (%)	14.66	14.87	12.92	6.54	10.68	14.68	9.88	10.13	10.86	10.65	14.31	14.19
Fat (%)	0.73	0.83	0.82	0.91	0.95	0.96	0.48	0.47	0.44	0.40	0.41	0.02
Protein (%)	0.31	0.21	0.19	0.30	0.32	0.30	0.29	0.29	0.32	0.32	0.23	0.31
Ash (%)	0.37	0.34	0.33	0.39	0.39	0.38	0.40	0.37	0.37	0.34	0.37	0.39
pH	3.68	3.54	3.55	3.80	3.77	3.76	3.75	3.75	3.76	3.72	3.67	3.62
Mineral matter (g/kg)												
Sodium				0.25	0.28	0.30					0.23	0.23
Calcium				0.49	0.49	0.49					0.40	0.40
Potassium				1.09	1.07	1.07					1.15	1.15
Magnesium				0.07	0.07	0.07					0.07	0.07
Phosphorus				0.33	0.33	0.34					0.30	0.30
Vitamin C (mg/100 ml)				0.59	0.59	0.59	0.29	0.29	0.59	0.89	0.29	0.29

Microbiological Evaluation

The microbiological quality of all products was excellent. Even after 2 month's storage at 5°C and 25°C , microbiological examination revealed no detectable growth of organisms. These results are in agreement with the findings of JAYAPRAKASHA et al. (1986).

Organoleptic Evaluation

The use of black polytene gave a general improvement in subjective colour quality of the drinks but this was not very marked. Future work could use a quantitative method to determine colour changes in the chhana whey/fruit juice drinks.

Experiment 1 (Fruit drink type): Organoleptic evaluation was carried out on the basis of colour, mouthfeel, flavour, sweetness, appearance and overall acceptability. The results for different fruit juice/whey drinks are shown in Table 3. The mango/whey drink was preferred by the panel with an overall acceptability score of 4.06 compared with 3.91-3.97 for the pineapple and orange juice/whey drink formulations. The mango/whey drink was clearly preferred for the organoleptic quality of flavour (4.12). Although it scored (4.24) distinctly better for appearance than the pineapple juice blend (3.65), it was similar in this respect to the orange juice/whey drink formulation (4.13). Mouthfeel scores were very similar (4.11 to 4.24) for all three blends. The pineapple blend was least preferred for colour with a score of 3.29 and orange blend was on the borderlines of acceptability for sweetness with a score of 2.93. Acceptability of the product was most highly correlated ($r=0.86$) with flavour.

Table 3. Organoleptic Scores for Different Fruit Juice/Whey Drinks

Fruit drink type	Colour	Mouthfeel	Flavour	Sweetness	Appearance	Overall acceptability
Orange	3.84	4.11	3.81	2.93	4.13	3.97
Pineapple	3.29	4.12	3.94	3.71	3.65	3.91
Mango	3.94	4.24	4.12	3.41	4.24	4.06

Table 4. Percentage of Ranked Placings for Variable Sweetness

Preferred sweetness level	Percentage added sugar (w/w)		
	0	4	8
First	0	65.2	34.8
Second	17.4	34.8	47.8
Third	82.6	0	17.4

place in 82.6 per cent of the tastings. This could be due to the need to balance the sharpness resulting from the citric acid added during processing. The results were significant at the 0.1 per cent level.

Experiment 3 (Variable fruit juice to whey ratio): The trends shown in Figure 2 clearly indicate that the tasters responded positively to increases in the proportion of orange juice in the blends. Colour scores appear to show a maximum at a juice/whey ratio of approximately 0.6. These results were significant at the 0.1 per cent level. This peak might be a taste response triggered by the perception that the blend should be distinctly different in colour from either the whey itself or an orange juice. Perhaps, when the colour of the blend approaches that of the juice, tasters may react negatively. This supposition could be explored by further experimental work.

Flavour and overall acceptability were influenced in a similar manner by increases in the proportion of orange juice in the blend. This assertion is confirmed by a correlation coefficient of 0.92 between flavour and acceptability scores—the highest correlation coefficient in the matrix.

The abrupt increase in the mouthfeel scores between fruit juice/whey ratios of about 0.4 to 0.55 is interesting. No observable features of the dispersed blend appeared to change between these fruit juice/whey ratios, but there might have been some change in the physical state of the emulsion. This phenomenon should possibly be investigated further. The total results of the variable fruit juice/whey tasting trial were significant at the 0.1 per cent level.

Experiment 4 (Centrifuged whey drink): The effect of centrifuging the whey before blending with the fruit juice was very noticeable as indicated in Table 5.

The mean colour responses improved very significantly from 3.64 for the uncentrifuged drink to 4.07 with milk fat removal before blending. The colour difference between the two types of drink was very noticeable and many panelists commented favourably and used descriptors such as "clean" and "bright" to describe the centrifuged orange juice/whey drink. As before, flavour and overall acceptability were most

There were differences among the findings of some researchers (GAGRANI et al., 1987; JAYAPRAKASHA et al., 1986) in preferred fruit juice flavour of drinks. This was due to the use of variable amounts of whey, sugar, water and fruit juice components and also production methods of drinks.

Experiment 2 (Variable sugar concentration): The percentage of 1st, 2nd and 3rd place rankings are given in Table 4 for the three sugar concentrations.

The 4 % added sugar gives the best overall result having scored 65.2 % of the first place rankings and never having been placed third. The panel clearly required some added sugar to the juice and whey drink as indicated by 0 % added sugar formulation being placed in third

closely linked with a correlation coefficient of 0.85.

CONCLUSION

A process for manufacturing nutritious chhana whey/fruit juice drinks has been developed. The processing procedures materials and equipment employed are such that process could be adopted in sub-tropical to tropical climates provided a milk supply was available and the basic expertise to operate the process. It is conceivable that the drinks could be made from reconstituted and recombined milks. Hot filling the product does not impair the flavour acceptability of the final product and has the great advantage that the chhana whey/fruit drinks will store satisfactorily for at least 1 month at 25°C without refrigeration. These drinks have great potential for providing a valuable source of nutrition from a waste product that could, otherwise, be a pollutant.

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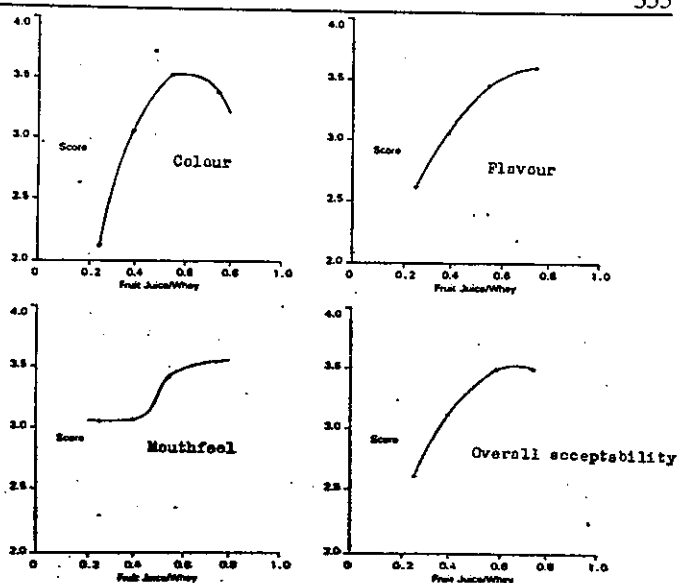


Figure 2. The effect of the weight ratio of orange juice to whey on organoleptic properties

Table 5. Organoleptic Scores for Uncentrifuged and Centrifuged Orange Juice/Whey Drinks

Type	Colour	Mouthfeel	Flavour	Overall acceptability
Uncentrifuged	3.64	3.92	3.86	3.79
Centrifuged	4.07	3.20	3.92	4.29