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Full Length Research Paper

Effect of stabilizers on the quality of carbonated flavoured whey drink

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Carbonated Flavoured Whey Dink (CFWD) was prepared by blending sugar (8%), stabilizers (that is, carboxy methyl cellulose, carrageenan), colour and flavor (orange red) to liquid whey. The whey drink was subjected to carbonation. The whey drink was evaluated for their physico-chemical and sensory properties till 30 days of refrigerated (4°C) storage. The storage study revealed that fat, lactose, SNF, total solids, acidity and viscosity decreased while pH and total plate count increased with storage period. The significant changes were observed only for fat, lactose, solids-not-fat (SNF), total solids and viscosity. The sensory quality of CFWD containing carragenan was found to be highly acceptable.

Key words: Whey, stabilizer, carbonated drink.

INTRODUCTION

Whey was discovered accidentally about 3000 years back when enzyme chymosin in native to calf stomach coagulated the milk that was contained in a bag made of calf skin, resulting in formation of 'curd and whey' (FAO, 2006). Whey can be obtained from any type of milk. However, whey from cow's milk is quite popular in western countries, while in some regions of the world, goats, sheep and even camel's milk are being used in the manufacture of dairy products that results in the production of whey (Zadow, 1994).

Previously, whey was treated as an insignificant by-product of cheese making, used mainly in animal feed or surplus. With advances in technology and recent discoveries of functional and bioactive roles of whey proteins, whey and whey components are now viewed as precious ingredients. The recognition of whey as a source of unique physiological and functional attributes provides opportunity for the food industry to incorporate whey and whey components into a variety of foods (National Dairy Council, 2003).

De Wit and Moulin (2001) estimated that 700,000 tons of whey produced globally is used as ingredients in food.

The current world production of whey is about 125 million tones, in which about 64% is produced in European countries and 24% in North America. In the absence of systematic surveys/statistics, the predicted value of whey production in India is estimated at 4.84 million tones per annum (Raju et al., 2005).

Whey contains about 50% of the milk solids together with 100% of the lactose and 20% of the protein. The lactose makes up about 75% of the total whey solids (Siso, 1996). Whey comprises about 80 to 90% of the volume of milk from which it is obtained (Khamrui and Rajorhia, 1998).

Whey protein is a complete, high quality protein with a rich amino acid profile. It contains the full range of amino acids including essential amino acids (EAAs) and branched-chain amino acids (BCAAs – *viz.,* leucine, isoleucine, valine) which are important for tissue growth and repair. Leucine is a key BCAA in protein synthesis and plays a critical role in insulin and glucose metabolism. The BCAA comprises > 20% of total amino acids in whey. The EAAs and BCAAs in whey protein are not only present in higher concentrations than in other protein sources (that is, soy, corn, wheat), but they are more efficiently absorbed and utilized (Harper, 2000).

A growing acceptance of milk-based beverages has been reported in Brazil, where lactic beverages formulated with whey (made by mixing yoghurt and cheese whey) represented about one-third of the market

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Table 1. Particulars of mozzarella whey**.**

Parameter	Results
Fat (%)	0.40
Protein (%)	0.67
Lactose (%)	5.40
Ash (%)	1.0
MSNF (%)	7.30
Total solids (%)	7.66
Acidity (% LA)	0.50
pH	4.6

for yoghurt and other dairy-based lactic beverages (Penna et al., 2003). Whey based lactic beverages constitute an emerging segment of non-conventional dairy products that require sensory, physical and chemical characterization for quality control and product development. From consumer point of view, lactic beverages should be as viscous as milk. In this type of product, texture and mouthfeel are often matched to those found in traditional products (Jack et al., 1995). Whey drinks are formulated for kids, adults and enthusiast with the combination of yogurt, milk, fruit juices and soya solids (Kacvinsky, 2005).

The market demand for beverages is growing all over the world and Pakistan is no exception to it. Whey beverages have been recognized as a genuine thirst quencher, light, refreshing, healthful and nutritious (Prendergast, 1986).

Many attempts have been made on utilization of whey in the formulation of various dairy products but, still there is a scope to explore the possibilities for its utilization in beverage industries. Now-a-days, different dairy industries are looking for new product ideas and technologies to meet the consumer's requirement and to increase the profitability of the products. Product diversification is quite feasible using whey in formulated foods, especially beverages (Patel et al., 2007).

In Pakistan, 2500 tons of cheese is being produced per annum (PDDC, 2006). Hence, sufficient amount of whey is being produced. The development of technology has opened up new and cost effective ways of utilizing the whey constituents that are finding its place in newer applications, both in dairy and food industries.The project is planned with two main objectives: To develop a whey-based carbonated flavoured drink and to evaluate the storage changes.

MATERIALS AND METHODS

Liquid mozzarella whey was obtained from a local cheese industry. It was analyzed for fat, protein, lactose, total soluble solids, SNF, ash, acidity and pH. Fresh liquid whey was heated at 65°C for 30 min and divided into three equal portions. Additives like citric acid (0.07%), sugar (8%) and sodium benzoate (0.03%) were incorporated in whey. Carboxyl methyl cellulose (CMC), Carragenan and mixture of both (50:50) were used at 0.5% by weight of final whey beverage, after dissolving in hot water (specify temperature; proportion of stabilizer: water too) and added to the whey drink. The drink was made homogenous by subjecting the drink at 7000 rpm/min to reduce the size of the particles with the help of lab scale blender. Whey drink was filled into transparent 500 ml plastic bottles for carbonation. Carbonation was carried out at 50 kg/cm^2 (HUASHENG, DCGF14/12/5) and the whey drink cooled and finally stored in a refrigerator (4±1°C) for further analysis. The carbonated flavoured whey drink (CFWD) was evaluated for pH (pH meter 720, WTW 823362), acidity, lactose and total solids as per standard method (AOAC, 1990) while fat was analyzed by Gerber method and protein by Kjeldhal method (Kirk and Sawyer, 1991). Viscosity was measured by viscometer (Expotech USA model 35) The CFWD were evaluated organoleptically and rated for colour, odour, sediment, flavor, appearance and overall acceptability by a panel of five judges (Djuric et al., 2004). The data obtained was subjected to statistical analysis (Koffi et al., 2005).

RESULTS AND DISCUSSION

The particulars related to sweet whey is given in Table 1. The whey had 0.67% protein, 5.40% lactose and 7.66% total solids.

The influence of storage period on lactose and SNF content of carbonated flavoured whey drink (CFWD) was significant; the influence on acidity and viscosity of CFWD was highly significant. Rest of the constituents (*viz.,* protein, fat, ash, total solids) of CFWD remained unaffected by the storage period.

The highest pH value was recorded in sample S_2 (4.31) at 30th day of storage (Table 1). The pH of CFWD is in agreement with that reported by Girsh (2001) for whey drink. The acidity of the product was in decreasing order for S_1 (0.407), S_2 (0.433) and S_3 (0.437), when fresh (0 day) (Table 2). The protein content of CFWD of this present study is in accordance with that observed by Niketic and Marinkovic (1984) for cheese whey beverage. They found no change in the protein content of cheese whey beverage packaged in Tetrapak cartons during 6 weeks of storage at room temperature. The lactose content of CFWD did not vary within treatments but it tended to decrease during storage up to 30 days. The initial lactose content was 5.40% lactose at 0 day which decreased to 4.73% at 30th day of storage (Table 3). The decrease in lactose content during storage was due to its conversion into lactic acid (Goodnaught and Kleyn, 1976). The mean total solids content was 10.53% when fresh (0 day) which decreased to 9.15% at 30th day (Table 3). Ash represents the inorganic matter in the product (Ranhotra, 1985). The ash content remained almost constant throughout this study. Viscosity is directly related to thickness of whey drink. Polysaccharides contribute to the structural and textural properties of milk products (Kumar and Mishra, 2003). The initial mean value of viscosity was 3.88 poise which decreased to 3.57 poise at 30th day of storage (Table 3). Finally micro-structure showed the classical appearance of an acidic gel with the presence of polysaccharide appendages

Table 2. Influence of stabilizer on the physico-chemical characteristics of whey drink

Treatments	Fat (%)	Protein (%)	Lactose (%)	Ash (%)	SNF (%)	Total solids (%)	Acidity (% LA)	pH	Viscosity (poise)
S_1 (Carragenan)	0.24	0.67	4.98	1.38	9.52	9.87	0.407	4.23	3.82[a]
S_2 (CMC)	0.24	0.67	4.98	1.38	9.52	9.87	0.433	4.27	3.72[b]
S_3 (Carragenan + CMC)	0.24	0.67	4.98	1.38	9.52	9.87	0.435	4.20	3.62[c]

[abcd], Different superscripts indicates significant difference between the means at $P \leq 0.05$ probability level.

Table 3. Effect of storage on physico-chemical characteristics of whey drink (S_1, S_2, S_3).

Storage period (days)	pH	Acidity (%)	Protein (%)	Fat (%)	Lactose (%)	Ash (%)	Total solids (%)	Viscosity (poise)	SNF (%)
0	4.18[d]	0.463[a]	0.67	0.30[a]	5.40[a]	1.39[a]	10.53[a]	3.88[a]	9.54[a]
10	4.23[c]	0.435[b]	0.67	0.25[b]	5.04[b]	1.38[b]	10.13[b]	3.77[b]	9.52[b]
20	4.25[b]	0.419[c]	0.67	0.21[c]	4.74[c]	1.38[b]	9.68[c]	3.65[c]	9.51[c]
30	4.27[a]	0.383[d]	0.67	0.20[d]	4.73[d]	1.38[b]	9.15[d]	3.57[d]	9.51[d]

Storage temperature = 4°C. [abcd], Different superscripts indicates significant difference between the means at $P \leq 0.05$ probability level.

Table 4. Influence of stabilizer on sensory quality of whey drink.

Treatments	Colour (2)	Appearance (1)	Flavour (10)	Odour (2)	Sediment (5)	Total sensory score (20)
S_1 (Carragenan)	2.00	0.88[a]	8.66[a]	1.23[a]	2.75	15.52[a]
S_2 (CMC)	2.00	0.69[b]	7.25[b]	0.74[b]	2.37	13.05[b]
S_3 (Both)	2.00	0.69[b]	5.50[c]	0.75[b]	2.37	11.31[c]

[abcd], Different superscripts indicates significant difference between the means at $P \leq 0.05$ probability level.

Table 5. Effect of storage on sensory characteristics of whey drinks (S_1, S_2, S_3).

Storage period	Flavour	Odour	Colour	Sediment	Appearance	Total sensory quality
Day 0	7.66[a]	1.16[a]	2.00	3.00	1[a]	14.82[a]
Day 10	7.66[a]	0.91[b]	2.00	3.00	1[a]	14.57[a]
Day 20	6.88[ab]	0.89[b]	2.00	2.33	0.58[b]	12.70[b]
Day 30	6.33[b]	0.67[c]	2.00	1.66	0.42[b]	11.08[c]

Different superscripts a b c indicates significant difference between the means at the level of probability: $P \leq 0.05$

(Oliveira et al., 2002). The initial mean value of SNF was 9.54% which decreased to 9.51% at 30th day of storage (Table 3 and 4). The investigated values of SNF for CFWD are in line with the findings of Djuric et al. (2004) for whey beverage.

Sensory evaluation of carbonated flavoured whey drink

The sensory evaluation was conducted at ≤ 1 day and thereafter at an interval of 10 days up to 30 days (that is, at 10, 20 and 30th day). Organoleptic evaluation of CFWD showed that storage period had a significant effect on all of the sensory parameters evaluated. During storage the scores for flavour, odour, sediment, appearance and total quality varied from 7.66 to 6.33, 1.16 to 0.67, 3.00 to 1.66, 1.00 to 1.42 and 14.82 to 11.08 respectively (Table 5). At 0 day, maximum and minimum total sensory score (16.47) was associated with samples S_1 (16.47) and S_3 (13.00) respectively (Table 5). After 10, 20 and 30 days of storage, the judges observed a slight decline in the total sensory score in all of the CFWD samples. Hence it was found that CFWD sample S_1 obtained maximum scores regarding the organoleptic evaluation and remained the best. Incorporation of stabilizer exceeding 0.3% adversely affected the sensory properties of milk products. The sensory score of CFWD increased with level of stabilizer up to 0.35%; use of 0.5% resulted in undesirable flavor (Mehanna and Mehanna, 1989).

Conclusion

Carrageenan is the best choice as a stabilizer when compared to carboxymethyl cellulose during 30 days of refrigerated storage of carbonated flavoured whey drink. Carbonation increased the palatability of the whey drink and extended its shelf-life.

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