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Development of technology for whey potato fermented product

Rohini Darade, Kavita Kadu and Kalyani Sarap

Abstract

The three different types of whey viz; *Paneer*, *Chakka* and *channa* were utilized as base material for preparation of whey-potato fermented product. This product was prepared by adjustment of pH of whey at 6.4, addition of potato (nearly 30%) to the level of milk solids (12.69%) fermentation with LF-40 starter culture (2%), by incubating at 30±1 °C for 12 hr, sweetening with 5 percent sugar, packaging in cups and store at 5-7 °C, be adopted. *Channa* whey system (T₂) Produced organoleptically superior product but samples T₄ (Equal quantity of three whey) and T₀ (Plain *lassi*) were also comparable to them. Chemical composition of whey potato fermented products was in the range of fat 0.34 - 0.41 percent, protein 0.95 - 1.06 percent, lactose 4.12 - 4.29 percent, ash 0.56 - 0.65 percent, total solids 15.08 - 15.72 percent, moisture 84.28 - 84.92 percent. The running cost of production of whey potato fermented product calculated as 10.98/lit. (Utilizing whey) to 15.45/lit. (Utilizing whole milk).

Keywords: Whey, fermentation, organoleptic quality, chemical composition, cost of production

Introduction

Whey is the watery part of milk that remains after separation of curd / coagulated products that result from acid or proteolytic enzyme mediated coagulation of milk. It is major by-product of dairy industry, during manufacture of products like *paneer*, *channa*, *chakka*, cheese, casein, etc. Whey is considered as an important food medium. It is rich source of carbohydrates (lactose 4-5%), minerals (0.60% Ca, P, Na, Mg etc.) and whey protein (0.3-1%). (Nair and Thompkinson, 2007) [5]. In India nearly 5 million tones whey is produced of which *channa* and *paneer* whey contribute around 80 percent of total whey (Gupta, 2008) and majority of it is disposed off as a waste. Most of whey drained off causing pollution to environment and increased urination if fed to animal. Processing of whey is one of the means to tackle these problems, but it is cost effective. Therefore systematic efforts are needed for best utilization of whey. Nowadays whey could be processed and used in various types of beverages. i.e. fermented or non fermented with or without addition of fruit Juice / pulp / flavours. Plain whey carbonation and soups by using vegetables has been successfully developed and marketed all over the world. Also whey can be utilized in production of ethanol, acetic acid, wine and in the production of crackers, filled dairy gels, lactose, beer, chewing gum and caramel (Mann, 1986). Potato (*Solanum tuberosum*) is the rich source of carbohydrates and fiber. Manufacture of beverages through lactic or alcoholic fermentation that can provide desirable sensory properties have been considered an option to add value to whey. Considering the nutritional qualities of whey, LAB and potato, the present study was conducted in department of Animal Husbandry and Dairy Science, M.P.K.V., Rahuri.

Material and Methods

The composite whole milk of cow was procured from RCDP on cattle M.P.K.V., Rahuri. The whey was obtained by manufacturing of *panner*, *channa* and *chakka*. The pH of whey systems was adjusted at par of fresh whole milk pH (6.4) by using (2% aqueous solution of sodium bicarbonate (NaHCO₃)). Simultaneously, boiled potato paste was prepared. The total solids of whey potato systems were adjusted at par with milk solids (12.69%) by adding nearly 30 g boiled potato paste per 100 ml of whey and blended properly. The blended mixture was heated at 85 °C for 5 min. and cooled to room temperature (30±1 °C). Active starter culture (LF-40) was inoculated under aseptic condition, @ 2 percent, mixed properly and incubated at 30±1 °C temperature for 12 hrs. for fermentation to have approximately 0.75 percent acidity. On fermentation, sugar at the rate of 5 percent was incorporated and mixed thoroughly. A food grade polyethylene cups (100 ml) were used for packaging the finished product. The filled

cups were preserved at refrigerator temperature i.e. 5-7 °C till evaluation. The experimental trials were conducting with five treatments viz; T₀ (plain *lassi*) T₁ (*Paneer* whey +Potato +Sugar), T₂ (*Channa* whey + Potato + Sugar), T₃ (*Chakka* whey + Potato + Sugar) and T₄ (Equal quantity of *paneer* + *Channa* + *Chakka* whey + Potato + Sugar) with four replications. The sensory evaluation of whey potato fermented products and plain *lassi* was carried out by the panel of six semi trained judges by adopting 9 point Hedonic scale, given in IS:1971 and referred by Gupta (1976) [2]. The chemical analysis was done by adopting A.O.A.C. procedures. The cost

of production of whey potato fermented product was calculated considering running cost of material used and expenses on labour, electricity product was calculated considering running cost of material used and expenses on labour, electricity, LPG, packaging etc. The prices were as per the prevailing market rates during study period. The combined effect of treatments were assessed by Complete Randomized Design (CRD).

Result and Discussion

A) Sensory Evaluation

Table 1: Sensory evaluation of whey potato fermented products and plain *lassi* (Mean of 4 replications)

Treatment	Hours				
	Colour & Appearance	Body & Texture	Flavour	Acidity	Overall acceptability
T ₀	7.71 ^b	7.50	7.21 ^{bc}	7.42 ^{bc}	7.54 ^b
T ₁	7.42 ^{ab}	7.29	6.92 ^{ab}	7.00 ^{ab}	6.96 ^a
T ₂	7.79 ^b	7.54	7.63 ^c	7.71 ^c	7.50 ^b
T ₃	6.96 ^a	6.79	6.46 ^a	6.79 ^a	6.75 ^a
T ₄	7.46 ^b	7.21	7.21 ^{bc}	7.25 ^{abc}	7.25 ^{ab}
Result	*	NS	*	*	*
SE (±)	0.16	0.23	0.17	0.19	0.17
CD at (5%)	0.47	-	0.51	0.57	0.52

Note: Means with different superscript differed significantly from each other

*=Significant at $p < 0.05$

Colour and Appearances: From table 1, it is observed that in respect of colour and appearances the highest, (7.79±0.16) score recorded for treatment T₂ but it was at par with treatment T₀, T₁ and T₄. The fermented product prepared from *channa* whey + potato (T₂), was appreciated highly, followed by T₀, T₁ and T₄. This indicates that either of whey system (*paneer*, *channa* and *chakka*) could be used for preparation of whey potato fermented product without affecting much of colour and appearance of product.

Body and texture: In respect of Body and texture from table 1 it is found that Non significant variation was observed in the values of sensory scores allotted for the body and texture attribute of whey potato fermented products and *lassi*. The whey potato fermented product under treatments T₂ secured maximum score i.e. 7.54 While, all other samples ranged in between 6.79 to 7.50 and were acceptable with varying degree.

Flavour: It is revealed from the mean values of sensory scores (Table 1), That the whey systems had significant ($p < 0.05$) effect on flavor of whey potato fermented product. This indicates that flavor of the whey potato fermented products changed as the whey system changes. The maximum score was allotted to the sample T₂ (7.63±0.17) but it was at

par with treatment T₀ and T₄. Sample T₂ (*channa* whey + potato) showed maximum liking as compared to the rest of the treatments.

Acidity: It is observed that, the treatment T₂ (*channa* whey) appears to be obtained significantly higher score (7.71±0.19) however, it was at par with T₀ and T₄ i.e. plain *lassi* and equal quantity whey, respectively.

Overall Acceptability: The overall acceptability is the consensus on the overall quality of the products. Overall acceptability of the product influenced significantly ($p < 0.05$) by whey system. The overall acceptability score of sample T₀ was at higher side (7.54±0.17) of all treatments, whereas the Treatment T₃ scored the least (6.75). Further, it is revealed that scores of samples T₀, T₂ and T₄ were at par indicating that samples were comparable from sensory point of view and rated as “liked moderately”. The good quality whey potato fermented product has the characteristic light lemon yellow colour and pleasant flavor.

B) Chemical Composition

The chemical composition of samples of whey potato fermented product and *lassi* was as follows:

Table 2: Chemical composition of whey potato fermented products and plain *lassi* (Mean of 4 replications)

Treatments	Composition (%)								pH
	Fat	Protein	Lactose	Ash	Total Solids	Moisture	Carbohydrates	Acidity	
T ₀	3.54 ^c	3.48 ^c	4.31 ^b	0.67 ^c	19.06 ^b	80.95 ^a	11.36 ^a	0.74 ^a	4.41 ^b
T ₁	0.41 ^b	0.95 ^a	4.29 ^b	0.56 ^a	15.65 ^a	84.35 ^b	13.73 ^c	0.78 ^b	4.23 ^a
T ₂	0.34 ^a	1.06 ^b	4.19 ^a	0.65 ^{bc}	15.72 ^a	84.28 ^b	13.67 ^{bc}	0.74 ^a	4.38 ^b
T ₃	0.38 ^{ab}	1.05 ^b	4.12 ^a	0.58 ^{ab}	15.08 ^a	84.92 ^b	13.08 ^b	0.74 ^a	4.41 ^b
T ₄	0.40 ^b	1.06 ^b	4.17 ^a	0.60 ^{ab}	15.46 ^a	84.54 ^b	13.41 ^{bc}	0.74 ^a	4.35 ^b
Result	*	*	*	*	*	*	*	*	*
SE (±)	0.01	0.03	0.03	0.02	0.21	0.21	0.21	0.008	0.04
CD at (5%)	0.04	0.09	0.08	0.06	0.64	0.64	0.64	0.0025	0.11

Note: Means with different superscript differed significantly from each other

*= Significant at $p < 0.05$

From table 2 it is observed that, Treatment wise fat content recorded as T₀-3.54, T₁-0.41, T₂-0.34, T₃-0.38, and T₄-0.40 percent, differed significantly ($p < 0.05$). Sample T₀ had significantly higher fat over the rest of the treatments. The protein content determined were in between 0.95 to 1.06±0.03 percent in case of whey potato fermented product, whereas it was 3.48 percent for plain *lassi* sample.

The lactose content of different samples of whey potato fermented products and *lassi* were in the range of 4.12±0.03 (T₄) to 4.31±0.03 (T₀) percent, wherein whey system had shown significant ($p < 0.05$) influence on ash content of whey potato fermented product.

Acidity of the sample of fermented products and *lassi* were in the normal range of 0.74±0.008 to 0.78±0.008 percent, which were within acceptable limit.

Treatment wise total solid content of whey potato fermented product were T₀- 19.06, T₁- 15.65, T₂ - 15.72, T₃-15.08 and T₄- 15.46 percent. The values differed significantly ($p < 0.05$). The treatment T₀ contained more total solids (19.06±0.21%),

this might be due to increased amount of sugar in plain *lassi*. Plain *lassi* had 80.95±0.21 percent water and that of whey potato fermented product contained 84.35, 84.28, 84.91 and 84.54 percent in treatment T₁, T₂ T₃ and T₄, respectively.

The average values of carbohydrates in plain *lassi* and whey potato fermented product determined were T₀ - 11.36, T₁ - 13.73, T₂ - 13.67, T₃ - 13.08 and T₄ - 13.41 percent which differed significantly ($p < 0.05$). The increased level of carbohydrates in whey potato fermented product might be due to addition of potato which might have remained undigested by starter organisms. The pH values were in between 4.23 to 4.40.

B) Cost of Production

Cost of production of whey potato fermented product

The list of items of expenditure and their contribution for calculating per unit cost of whey potato fermented product is tabulated in Table 3 and Table 4

Table 3: Running cost of production of 100 lit of whey potato fermented product by using whole cow milk as a raw material

Sr. No.	Components	Unit Price (Rs)	Quantity Required	Amount (Rs)
1	Cow milk	18	138	2484.00
2	Citric acid	716/kg	1.38 kg	988.00
3	Potato	15/kg	30 kg	450.00
4	Sugar	30/kg	5 kg	150.00
5	Culture	250/vial	1 vial	250.00
6	Electricity	2.35/unit	20 unit	47.00
7	Fuel / Gas	25.42/kg	1 kg	26.00
8	Labour	120/day	1 day	120.00
Total cost				4515.00
Main product obtained from whey manufacture		110	27 kg	2970.00
Cost of WFPF = Total cost – cost of main product obtained				1545.00
				15.45/lit

The cost of production of whey potato fermented product, worked out by taking into account prevailing markets rates of various inputs. The depreciation cost of building, packaging and equipments have not considered as the production was on laboratory scale. The cost of production of whey potato fermented product was calculated considering the running

cost of ingredients / supplies.

The cost of production of per litre of whey potato fermented product calculated and the details of cost structure given in the Table 3 and Table 4.

- Using cow milk as raw material.
- Utilizing the whey as a waste material.

Table 4: Running cost of production of 100 lit of whey potato fermented product by using whey as a raw material

Sr. No.	Components	Unit price (Rs)	Quantity Required	Amount (Rs)
1	Whey	0.50/lit	110 lit	55.00
2	Potato	15/kg	30 kg	450.00
3	Sugar	30/kg	5 kg	150.00
4	Culture	250/vial	1 vial	250.00
5	Electricity	2.35/unit	20 unit	47.00
6	Fuel / Gas	25.42/kg	1 kg	26.00
7	Labour	120/day	1 day	120.00
Total Cost				1098.00
				10.98 / lit

It is learned from the figures from Table 3 and 4 that the running cost of production of whey potato fermented product was Rs 15.45 and 10.98 / lit., for (i) milk based (ii) whey based products, respectively. The main items contributed to the cost of whey potato fermented product were sugar and milk. Considering the cost calculated by two ways as above, it can be stated that the whey available within the dairy plant will be more profitable than the procurement of the whey from outside dairies.

Conclusions

Channa whey system (T₂) produced organoleptically superior product but samples T₄ (Equal quantity of three whey) and T₀ (Plain *lassi*) were also comparable to them. Chemical composition of lactose 4.12 – 4.29 percent, ash 0.56 – 0.65 percent, total solids 15.08 – 15.72 percent. The running cost of production of whey potato fermented product calculated as 10.98 / lit. (Utilizing whey) to 15.45/lit. (Utilizing whole milk).

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