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Study of microbial changes in whey potato fermented product during storage

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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 per cent 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. The lactic acid bacteria count was sufficient (9.26 log cfu/g) to exert nutritional and therapeutic benefits to the consumers. The shelf life studies indicated that product had shelf life of 5 days in respect of sensory quality. However, the lactic acid bacteria count was sufficient and that was 8.54 log cfu/g. at the end of storage period.

Keywords: Whey, microbial analysis, storage period

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 per cent of total whey (Gupta, 2008) ^[3] 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 vegetable3s 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) ^[4]. 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 30g 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 per cent, mixed properly and incubated at 30±1 °C temperature for 12 hrs. for fermentation to have approximately 0.75 per cent acidity. On fermentation, sugar at the rate of 5 per cent 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]. All the treatment samples were evaluated for microbial status i.e. TVB, LAB Yeast and moulds and coli form count by the pour plate technique described in IS: 1479 (Part-III) 1962. The microbial count was determined at 0 hr. (means immediately after inoculation), 12 hr. (means completion of fermentation period). After fermentation all the samples were stored under refrigerator temperature (5-7 °C) and count was determined at 24, 36 and 48 hrs after inoculation i.e. 0 hr. The sensorily best treatment (T₂) *channa* whey potato fermented product was considered for shelf life studies. The product prepared was stored under refrigerator temperature (5-7 °C) upto 7 days and evaluated for sensory and microbial qualities, periodically. The combined effect of treatments was assessed by Completed Randomized Design (CRD) Panse and Sukhatmme.

Result and Discussion

Assessment of microbial quality of whey potato fermented products and plain *lassi*

Table 1: TVC of whey potato fermented products and plain *lassi* over the period (log cfu/g) (Mean of 4 replications)

Treatment	Hours				
	0	12	24	36	48
T ₀	6.64	8.54	9.26	9.12	9.17
T ₁	6.63	8.70	9.31	9.14	9.10
T ₂	6.65	8.68	9.37	9.11	9.11
T ₃	6.65	8.53	9.27	9.07	9.13
T ₄	6.65	8.68	9.37	9.12	9.18
Result	NS	NS	NS	NS	NS
SE (±)	0.04	0.05	0.05	0.03	0.04

Form table 1 it is revealed that, Non significant variation was observed in TVC due to treatments. The initial count recorded was 6.63 to 6.65 log cfu/g. About two log cycles increase in count was observed at 12 hr of incubation. It remained almost constant (≥ 9 log cfu/g) during storage of products under refrigerated condition (5-7 °C).

Lactic acid bacteria count

It is observed from the table 2 that, the initial count was approximately 6.60 log cfu/g, which increased by two log cycles at 12 hr of incubation, indicating that the products contained required LAB population to exert its beneficial impact on consumers health. The maximum LAB count recorded at 24 hr thereafter, it was decreased but at slower rate and reached to about 9 log cfu/g. at end of 48 hrs. Non significant variation of LAB count was observed over the period of time at 0, 12, 24 and 36 hr, while the LAB count was differed significantly ($p < 0.05$) at 48 hr of storage. The product (T₁) showed lowest count (8.99 log cfu/g). The maximum LAB count observed in treatment T₄ and it was at

par with T₀ (Plain *lassi*). The counts of treatment T₀, T₁, T₂ and T₃ were at par with each other.

Table 2: LAB count of whey potato fermented products and plain *lassi* over the Period (log cfu/g) (Mean of 4 replications)

Treatment	Hours				
	0	12	24	36	48
T ₀	6.57	8.48	9.14	9.01	9.05 ^{ah}
T ₁	6.57	8.60	9.26	9.05	8.99 ^a
T ₂	6.57	8.52	9.22	9.02	8.99 ^a
T ₃	6.57	8.45	9.14	9.03	9.01 ^a
T ₄	6.58	8.55	9.26	9.06	9.15 ^b
Result	NS	NS	NS	NS	*
SE (±)	0.042	0.064	0.051	0.043	0.036
CD at (5%)	-	-	-	-	0.103

Note: Means with different superscript differed significantly from each other

*=Significant at $p < 0.05$

This indicates that sample of whey potato fermented product has sufficient LAB to exert benefits from nutritional and therapeutic point of view.

Table 3: Yeast & mould count of whey potato fermented products and plain *lassi* over the period (log cfu/g) (Mean of 4 replications)

Treatment	Hours				
	0	12	24	36	48
T ₀	1.25	1.35	1.29	0.50	1.53 ^b
T ₁	0.75	0.54	0.66	1.40	1.88 ^b
T ₂	0.50	0.50	0.88	1.14	1.46 ^b
T ₃	0.38	0.79	0.54	0.25	0.25 ^a
T ₄	0.72	0.79	1.61	1.22	1.61 ^b
Result	NS	NS	NS	NS	*
SE (±)	0.37	0.37	0.36	0.38	0.34
CD at (5%)	-	-	-	-	0.992

Note: Means with different superscript differed significantly from each other

*= Significant at $p < 0.05$

From the data given in Table 3 it is seen that, yeast & mould count remained within the limit, as indicated by BIS. (Maximum, limit in *Dahi*-100, *Chakka*- 20 and *Shrikhand* – 50 cfu/g.)

Coliforms count

The status of coliforms are the indicator of cleanliness. Therefore, the Samples were subjected to determine the coliform count. The coliform count determined are presented in Table 4.

Table 4: Coliform count of whey potato fermented products and plain *lassi* over the period (log cfu/g) (Mean of 4 replications)

Treatment	Hours				
	0	12	24	36	48
T ₀	0.00	0.25	0.00 a	0.00	0.25
T ₁	0.20	0.56	0.43 ^{ab}	0.38	1.22
T ₂	0.92	0.00	0.80 ^b	0.49	0.29
T ₃	0.22	0.29	0.00 ^a	0.00	0.25
T ₄	0.69	0.20	0.93 ^b	0.85	0.38
Result	NS	NS	*	NS	NS
SE (±)	0.25	0.23	0.25	0.22	0.32
CD at (5%)	-	-	0.74	-	-

Note: Means with different superscript differ significantly from each other

*= Significant at $p < 0.05$

From the counts recorded in Table 4 revealed that, the number of coliform detected in the samples were very negligible. Coliform count in the products was in the range of 0 to 0.92 log cfu/g. This was because highly sanitary conditions were observed during the process of manufacture of whey potato

fermented product and plain *lassi*, which kept the product almost free and safe from harmful microflora.

Storage Study

Table 5: Sensory qualities of *channa* whey potato fermented product on storage (Mean of 4 replications)

Colour & appearance

Hours	12	36	60	84	108	132	156	180
Mean (score)	7.94	7.33	6.28	6.56	6.22	6.22	6.11	5.78
SE (\pm)	0.06	0.25	0.05	0.06	0.05	0.05	0.05	0.22
SD	0.09	0.44	0.09	0.09	0.09	0.09	0.09	0.39

Body & texture

Hours	12	36	60	84	108	132	156	180
Mean (score)	7.89	7.39	6.94	6.56	6.22	6.22	6.05	5.55
SE (\pm)	0.05	0.22	0.06	0.06	0.05	0.05	0.20	0.30
SD	0.09	0.38	0.09	0.09	0.09	0.09	0.34	0.53

Flavour

Hours	12	36	60	84	108	132	156	180
Mean (score)	7.72	7.72	6.72	6.61	6.22	6.05	5.55	4.78
SE (\pm)	0.15	0.05	0.15	0.05	0.05	0.06	0.15	0.11
SD	0.25	0.09	0.25	0.09	0.09	0.09	0.25	0.04

Acidity

Hours	12	36	60	84	108	132	156	180
Mean (score)	7.72	7.61	7.11	6.67	6.44	6.22	5.61	5.16
SE (\pm)	0.15	0.05	0.11	0.17	0.05	0.05	0.22	0.09
SD	0.25	0.09	0.19	0.29	0.09	0.09	0.39	0.16

Overall acceptability

Hours	12	36	60	84	108	132	156	180
Mean (score)	7.72	7.61	6.72	6.44	6.39	6.28	5.61	5.22
SE (\pm)	0.15	0.11	0.15	0.06	0.06	0.05	0.15	0.06
SD	0.25	0.19	0.25	0.09	0.09	0.09	0.25	0.09

The maximum sensory score (7.72 ± 0.15) obtained at 12 hr of fermentation, thereafter continuous decreasing trend was noticed till the end of storage of 7 days. The most affected sensory attribute was the flavor, but no much change was noticed up to day 3rd but product became unacceptable on day 5th. With regards to other attributes, it remained at acceptable level. However except flavor the score of all other sensory attributes were above the desired minimum limit (6.0) of acceptability. The decreased trend in score correlated with change in colour from pale yellow to faded yellow, slight whey separation, slight rancid and increased acidity.

Microbial Study

From Table 6 it is revealed that, the Microbial status of the product was determined periodically during storage. The initially total plate count determined as 6.76 log cfu/g and that of LAB was 6.72 log cfu/g. Both counts, raised by two log cycles at 12 hrs of fermentation and it remained exceptionally same throughout the storage period. Practically no yeast and mould and coliforms were detected in the Products, (except yeast & mould detected on day 7).

Table 6: Microbial status of *channa* whey potato fermented products on storage (logcfu/g) (Mean of 4 replications)

	Hours								
	0	12	36	60	84	108	132	156	180
SPC									
Mean	6.76	8.75	8.98	9.07	8.97	8.68	8.68	8.63	8.72
SE (\pm)	0.02	0.01	0.07	0.03	0.03	0.03	0.01	0.01	0.02
SD	0.05	0.02	0.23	0.11	0.10	0.06	0.03	0.03	0.04
LAB									
Mean	6.72	8.61	8.89	8.91	8.98	8.57	8.54	8.47	8.37
SE (\pm)	0.01	0.03	0.06	0.07	0.07	0.04	0.02	0.03	0.04
SD	0.03	0.07	0.20	0.23	0.25	0.10	0.05	0.08	0.09
Yeast									
Mean	--	--	--	--	--	--	--	--	1.93

SE (\pm)	--	--	--	--	--	--	--	--	0.20
SD	--	--	--	--	--	--	--	--	0.48
Coliform									
Mean	--	--	--	--	--	--	--	--	--
SE (\pm)	--	--	--	--	--	--	--	--	--
SD	--	--	--	--	--	--	--	--	--

Conclusion

It is concluded though the sensory qualities of whey potato fermented product decreased to some extent on storage but, LAB count was still acceptable to exert the beneficial effect on consumers as evidenced in this study.

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