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Consumer Driven New Product Development through Lacto Fermentation of Cow Milk

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Abstract **– This study was done to develop a fermented dairy product by using typical yogurt starter culture, targeting to increase the diversity of cultured dairy products while increasing the convenience of consumption. Two methods were developed to produce the product. First method was adding all the ingredients at once and passing through the lactic acid fermentation while other method compromised adding food additives after lactic acid fermenting of cow milk. A consumer preference sensory test was conducted by using 30 untrained panelists to select the best manufacturing method after selecting the best ingredient combinations through several sensory tests. Finally, selected product was subjected to microbial tests including total plate count, yeast and mold count and coliform bacteria count, titratable acidity and pH detection. A proximate analysis was done to analyze the proximate composition. Results showed that the panelists preferred the product prepared by second method more than the product produced by first method and it contained 10% of sugar, 1% of gelatin and 1% of cornstarch. According to the microbial tests, titratable acidity and pH tests; keeping quality of the product remained in acceptable level for 21 days of storage under 4°C.**

Keywords **– Additives, Consumer Preference, Dairy, Keeping Quality, Lactic Acid Fermentation.**

I. INTRODUCTION

Importance if fermented dairy products in human nutrition have well described from the antiquity. Medicinal and nutritional benefits of cultured milk have beneficially used by number of generations from ancient civilizations. Many scientists have given number of reasons about the benefits of consumption of fermented milk in different eras. Recently positive health attributes of fermented dairy products and their therapeutic effects have taken special concerns in the community [1]. According to the [2] cultured milk products contain not less than 3.2% milk fat and not less than 8.2% milk solids-non-fat and it is produced by culturing milk products alone with appropriate characterizing bacteria.

Yogurt, curd, cheese, cultured buttermilk, kefir, dahi, koumiss, acidophilus milk and probiotic milk signify the great diversity of fermented dairy products produced all around the world. Further, they reflect the different cultural geographical regions of their origin, different techniques employed, types of milk used and different types and species of microorganisms engaged during fermentation process [3]. Emerging new processing techniques, evolving social attributes, scientific findings and experiments on health benefits have influenced on boosting consumption of fermented dairy products. This study has focused on development of a fermented dairy product by using typical yogurt starter culture that can increase the diversity of cultured dairy products while increasing the convenience of consumption.

II. METHODOLOGY

Two technical methods were carried out to determine the best manufacturing procedure for this product development.

A. *Method 1*

Cow milk was obtained from a commercial farm and standardized to 3.5% of milk fat and 8.25% of milk solid non-fat. Standardized milk was added granulated sugar, gelatin and cornstarch in different levels. Potassium sorbate (0.03% w/w) was added in to the sample as preservative to the mixture [4]. Pasteurization was done by double boiling the mixture at 90°C to 95°C for 5 - 10 minutes [5]. Final mixture was homogenized using a beater (National™, MK-H100N) and inoculation of lactic acid bacteria culture was done at 45 °C of temperature. YC 350 freeze dried (DVS) yoghurt culture was used to inoculate the mixture. Mixture was poured in to molds (Figure 1) and incubated (Jeio Tech, RH-400 Inc) at 42 ±2˚C for 4 hours. Resulted fermented milk was cooled in a refrigerator (Absocold, ARD369A) at 4 ˚C of temperature to avoid over fermentation. Chilled samples taken out from the mold by pushing the piston of the mold as shown in Fig. 1.

Preliminary trials were conducted to determine the best sugar, gelatin and cornstarch incorporation levels. Adjusting of sugar has done by changing sugar from 9%, 10% and 11% to detect the best compatible sugar level for the product. Adjusting gelatin and cornstarch levels were done at the same time by checking 0.5%, 1% and 1.5% of gelatin and cornstarch levels. Each sugar level was checked with each gelatin and each cornstarch level. Best and overall acceptable combination of sugar, gelatin and cornstarch levels were chosen by conducting a sensory test with 30 untrained panelists.

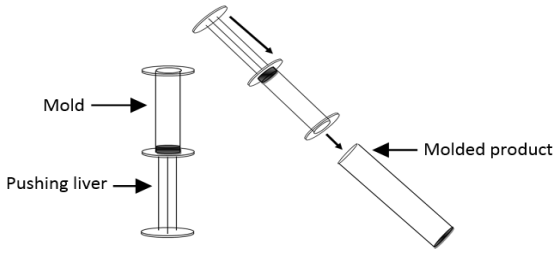

Fig. 1. Molding of Fermented Milk Product

B. *Method 2*

Standardized (3.5% of milk fat and 8.25% of milk solid non-fat) cow milk was added with 9%, 10% and 11% of granulated sugar in separate containers. Pasteurization was done by double boiling the samples separately at 90°C to 95°C for 5 - 10 minutes (Pande, 2010). Potassium sorbate (0.03% w/w) was added in to each sample as preservative to the mixture (SLS Standards, 1989). The mixture was homogenized using a beater (National™, MK-H100N) and inoculation of lactic acid bacteria culture was done at 45 °C of temperature. YC 350 freeze dried (DVS) yoghurt culture was used to inoculate the mixture. Samples were incubated (Jeio Tech, RH-400 Inc) at 42 ±2˚C for 4 hours. Resulted fermented milk was cooled in a refrigerator (Absocold, ARD369A) at 4 ˚C of temperature to avoid over fermentation.

Resulted coagulum was added with different levels of gelatin and cornstarch. Final mixture was homogenized using a beater (National™, MK-H100N). Homogenized mixture was poured in to the mold shown by Fig. 1 and stored at refrigerator for 12 hours. Chilled samples taken out from the mold by pushing the piston of the mold as shown in Figure 1 Preliminary trials were conducted to determine the best gelatin and cornstarch incorporation levels with different sugar levels. Gelatin and cornstarch were boiled with 10 mL of water and homogenized with the coagulum resulted by fermentation process. Adjusting gelatin and cornstarch levels were done at the same time by checking 0.5%, 1% and 1.5% of gelatin and cornstarch levels. Each sugar level was checked with each gelatin and each cornstarch level. Best and overall acceptable combination of sugar, gelatin and cornstarch levels were chosen by conducting a sensory test with 30 untrained panelists. Maintaining hygienic conditions were very important at each step to avoid cross contamination. Each treatment was triplicated to get results that are more accurate.

Finally, selected ingredient combinations from two manufacturing procedures were served to 30 untrained panelists to select the best manufacturing method. They were asked to evaluate taste, mouth feel, color, aroma and overall acceptability using five point hedonic scale. Results were analyzed using Friedman non-parametric test with 0.05 levels of significance in SAS 9.0 software package.

C. *Keeping Quality Tests*

The product chosen from the final sensory evaluation was subjected to microbial analysis, determination of Titratable acidity (TA) and pH. Each test was carried out in triplicates for 21 days at 2 days of intervals at storage of 5 ˚C.

Determination of total colony count (TCC) (colony forming units (CFU)/ml) was done by using plate count agar (CMO91A, Oxoid, UK) incubating at 37±1˚C for 24 hours. Yeasts and Molds was determined by means of Yeast Extraction Agar (CM0091 Oxoid, UK) medium incubating at 25±1˚C for 5 days. Coliform bacteria were determined by using Violet Red Bile Agar (CM049, Oxoid, UK) medium incubating at 37±1˚C for 24 hours.

Titratable acidity (TA) and pH of selected product was determined by titrating samples with 0.1N Sodium Hydroxide (NaOH) at the presence of phenolphthalein. pH was determined by means of calibrated pH probe (pH tester, KM903).

The proximate composition of the product was analyzed according to the methods described in Association of official Analytical Chemists methods. [6].

III. Results and Discussion

A. *Sensory Analysis*

Preliminary studies showed that 1% gelatin, 1% cornstarch and 11% sugar combination from method 1 and 1% gelatin, 1% cornstarch and 10% sugar from method 2 was preferred by the sensory panelists ($p<0.05$). Therefore, these two combinations were used for the final sensory evaluation to select the best product. Taste, odor, color, mouth feel and overall acceptability of method 2 showed higher preference compared method 1 ($p<0.05$). According to figure 2 method 2 has significant and best incorporation levels of ingredients compared to method 1.

Panelists found that method 1 was sour in taste than method 2 sample. This may due to the fermentation of glucose in cornstarch by the lactic acid bacteria in addition to fermentation of lactose in milk. This process causes increment of acidity of the product and produce sour taste. This process has not occurred in the product produced by method 2 due to addition of cornstarch was done after the fermentation take place in the system.

B. *Microbiology Tests*

The microbial analysis results of the final product are shown in Fig. 3. Total plate count of the product was slightly increased from 8±0.01 log 10/mL to 8.6±0.03 log 10/mL over 21 day of period due to the live lactic acid bacteria culture. Low level of yeast and mold growth can be seen in the product that can be due to the yeast which could available in the air during processing. Lactic acid produced by lactic acid bacteria has increased the acidity of the product which was not much desirable to the growth of many microorganisms. However, acidic conditions are preferred by yeast and mold. Therefore, it creates a desirable environment for growth of yeast and mold. Coliform bacteria were not found during the analysis.

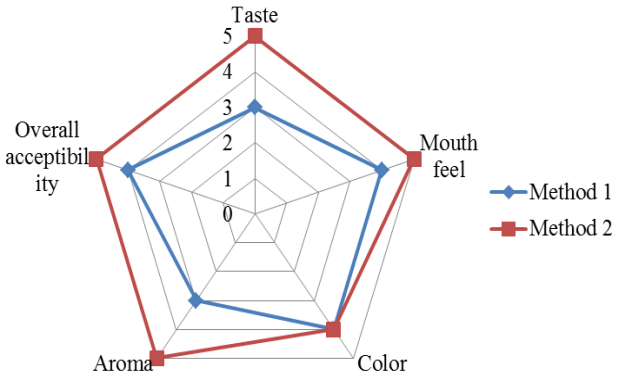

Fig. 2. Results of Sensory Analysis

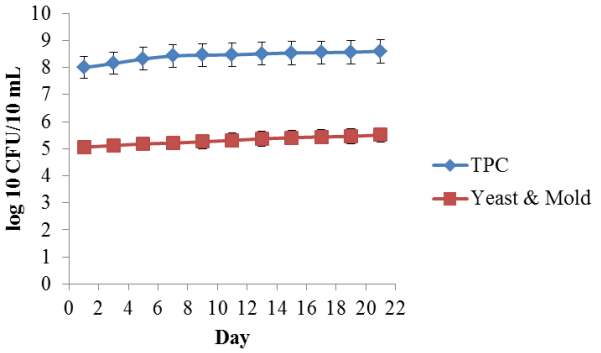

Fig. 3. Results of Microbial Analysis

C. *Titratable Acidity and pH*

Titratable acidity and pH variation of the product during 21 days of storage has shown by fig. 4 and 5. Total Titratable acidity of the product has increased from 0.16±0.03% to 0.82±0.01% during the storage. pH of the final product has dropped to 4.12±0.02 from 4.67±0.02. This was due to the lactic acid produced by the lactic acid bacteria by utilizing the lactose in milk.

Milk is a favorable substance for microorganisms to grow and cause spoilage. The most popular quality of lactic acid bacteria related to preserving is their capability to produce acid which shows antimicrobial activity by acidifying the milk and creating undesirable environment for microorganisms and proliferation of pathogens. LAB also release antimicrobial metabolites called bacteriocins. Both acids and bacteriocins are great potential to be used in food preservation, which are considered as safe natural preservatives [7].

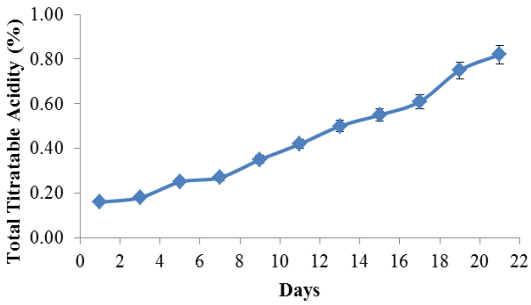

Fig. 4. Titratable Acidity of the Product during 21 Days of Storage

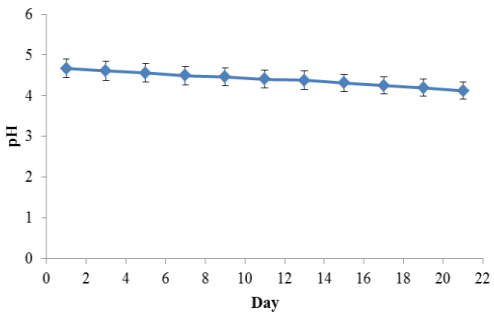

Fig. 5. pH of the Product during 21 Days of Storage

Table 1. Shows the proximate composition of the final product

Table 1: Proximate Composition of the Final Product

Component	Percentage (%)
Moisture content	85.76±0.05%
Ash content	0.7±0.01%
Crude protein content	3.4±0.07%
Crude fat content	3.5±0.02%
Crude fiber content	0.00±0.00%
Total solid content	14.24±0.0.05%

This product development has done by using the yogurt starter culture which contains *basically Lactobacillus bulgaricus* and *Streptococcus thermophiles*. These bacteria are responsible for the acidic taste generated from lactic acid elaborated by their growth [8]. Sufficient production of lactic acid is crucial for lowering the pH to a level where critical flavor compounds (acetaldehyde, diacetyl and other compounds) are formed in sufficient quantity [9].

V. Conclusion

Adding 1% gelatin and 1% cornstarch after fermentation of cow milk is appropriate to produce this new product which contains 10% of sugar. This product has produced by using typical yogurt starter culture which normally generates creamy semi solid texture. Food additives used and their levels of incorporation have given the self-standing texture to the product without affecting on the typical yogurt flavor of it.

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