Development of Soy Milk Based Functional Fruit Yogurt Fortified with Extra Virgin Olive Oil

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ABSTRACT

Cardiovascular diseases (CVD) and obesity are the most increasing world health challenge in recent days. To prevent these health problems, food researchers are intensively focusing to replace animal fat by healthy vegetable item with incorporation of different bioactive compounds. This study was conducted to develop a novel yogurt using different ratio of soy and cow milk. Blueberry pulp, extra virgin olive oil and stevia were used in the bottom portion to enhance functionality of the developed yogurt against CVD. All developed yogurt samples were analyzed for taste, texture and overall acceptability. Sensory analysis showed that, the yogurt developed from 75% soy milk and 25% cow milk had the highest overall acceptability.

Keywords: Blueberry, extra virgin olive oil, functional yogurt, soy and cow milk.

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I. INTRODUCTION

Yogurt is a widely consumed fermented dairy product in which proteins coagulated by lactic acid producing bacteria [1]. Most peoples prefer yogurt over normal milk due to its easily digestible protein, availability of probiotics and bioavailability of different minerals and vitamins [2]. Day by day, the yogurt getting different forms in relation to different health benefits. Though the dairy milk is the main ingredient of yogurt but due to its some negative health aspects vegetables based milk items are also using to produce yogurt [3]. In addition to prebiotic and probiotic ingredients, scientists now suggesting for lowering or replacing the dairy fat of the yogurt. The use of soy milk in yogurt product has increasing mainly for its lower fat and higher protein content [4]. Moreover, less saturated fatty acids, absence of lactose and high amino acid profile gives more consumer preference to the soy milk based food products [5]. A developed bioyogurt from the mixture of 25% soy milk + 75% cow and buffalo milk showed very good nutritional and health benefits [1]. Compare to dairy milk, low price of soy milk is also one of the major reasons of expanding soy based food production [6]. However, some consumers do not prefer soya based items due to its unpleasant flavor [1]. This problem can be solved adding fruit pulp or flavoring agent. The consumption of blueberries (*Vaccinium corymbosum*) in different fermented food items has increased due to rich source of bioactive compounds [7]. It has been proven that berries are considered as disease fighter food as it has anticancer,

antioxidant and anti-mutagenic power [8]. Although consumption of strawberries is more common in fruit yogurt production, use of blueberries also getting popularity with addition of some sweetening or flavoring ingredients [7]. In addition to health benefits, blueberry's distinctive color gives an extra attraction to the developed product. Incorporation of different plant or marine based oil rich in monounsaturated fatty acids (MUFA) and polyunsaturated fatty acids (PUFA) in fermented food is also getting popularity aimed to develop different functional food [9]–[11]. Strawberry yogurt with addition of microencapsulated salmon oil rich in n-3 fatty acid has shown high acceptability to health conscious consumers [11]. Five different vegetable oils were used to get PUFA rich functional yogurt to replace plain yogurt [10]. As well as other vegetable oil, extra virgin olive oil (EVOO) is extensively used for production of Nano-emulsion and new food development [9]. Regular consumption of EVOO improves the antioxidant status and reduce the LDL content of blood due to its phenolic content [12]. In addition to CVD prevention, olive oil is very effective against breast cancer and type II diabetes mellitus [9]. To fight against CVD, olive oil especially EVOO play a great role due to its higher MUFA, PUFA and other bioactive compounds [13]. In replace to sugar (sucrose), stevia (artificial sweetener) is also an excellent idea to get low calorie yogurt. Stabilizer (pectin, alginate, gelatin etc.) can be used to get a good texture. Modified starch, carrageenan or another hydrocolloid stabilizer is also used to prevent floating of any ingredient thus to get better consistent and acceptable product [6].

Therefore, based on previous discussion, the objective of this study was to develop a consumer acceptable novel functional yogurt using different combination of soy milk and cow milk with incorporation of blueberry pulp and extra virgin olive oil.

II. MATERIALS AND METHODS

A. Raw Materials

The experiments was conducted in the kitchen lab of the department of Agricultural Engineering, Sher-e-Bangla Agricultural University, Bangladesh. Soy milk, low fat cow milk, blueberry pulp, extra virgin olive oil, stevia, vanilla flavor, agar powder, Bifidobacterium starter and sugar were purchased from a local super shop.

B. Preparation of Fruit Compote

Locally purchased blueberry pulp (50%) was mixed with table sugar (25%) and stevia (2.5%). After addition of required amount of water the mixture was pasteurized at 95°C for 3 minutes. 22.5% agar powder and 2.5% (by volume) EVOO were mixed at the end of pasteurization. Finally the prepared fruit compote (bottom portion of the final yogurt) was mixed properly and poured into individual cup and kept in refrigerator after cooling.

C. Preparation of Yogurt

Five different soy and cow milk combination were used for yogurt manufacturing is shown in Table I.

TABLE I: AMOUNT OF SOY AND COW MILK FOR YOGURT PREPARATION

Sample	%Soy Milk	% Cow Milk
1	100	-
2	-	100
3	25	75
4	50	50
5	75	25

Low fat cow milk and soymilk were mixed properly following stated ratio. The mixture was pasteurized 85°C for 10 minutes. Vanilla flavor was added at the end of pasteurization and cooled to 42°C. After addition of Bifidobacterium starter, the mixture poured into glass cup which are bottom filled with previously prepared berry fruit compote. Finally the inoculated yogurt left in an incubator at 42 (±1) °C for 8 hours.

D. Measurement of pH

The incubated yogurt samples were checked for pH during 8 hour fermentation period using a digital pH meter. The initial pH of all samples was in the range of 6.9 to 7.1.

E. Sensory Analysis

Developed fruit bottom yogurt samples were used to sensory analysis by 25 semi trained panelists using a 9 point hedonic scale. The panelists comprised of both female and male members who are in 25 to 30 age range. Taste (flavor), texture (consistency) and overall acceptability were evaluated at room temperature. Yogurt was served to panelists in plastic cup coding with single digit and requested to score the samples as 1-3 (low), 4-6 (medium)

and 7-9 (high). Score 1 implies lowest quality (bad) while score 9 imply best quality (excellent). To prevent biasness in scoring the sensory evaluation was performed in individual basis.

III. RESULT AND DISCUSSION

A. Product Description

The developed fruit bottom yogurt is shown in Fig. 1. It was observed that, there was uniform mixture of yogurt in which soy milk proportion was comparatively less than cow milk. This may be due to less binding of soy protein with casein.

Fig. 1. Appearance of soy milk based fruit yogurt fortified with EVOO.

Yogurt from 25% soy with 75% cow or buffalo milk was reported to be best for uniform mixing and other point of physical judgment [1]. Uniform mixing of soy yogurt with added rice bran oil was also reported [3]. Even though the yogurt had uniform mixture but some coarse particle was observed in fruit compote in bottom portion of the yogurt cup. This may be due higher gravitational force of coarse particles which results from non-uniform pulping of berry fruit. This problem can be solved by uniform blending followed by a proper straining of fruit pulp.

B. Kinetics of Acidity during Fermentation

The pH content of yogurt samples (only upper yogurt portion, not fruit bottom) were determined at each one hour interval basis. At the same measuring time, the pH value of all samples were quite nearer while there was no significant difference was observed due to different soy milk ratio. Maximum difference was observed between yogurt from 100% cow milk and yogurt from 100% soy milk. However, in all samples, pH drops was faster during first 3 hours of fermentation then followed by a slower decrease. The fall of pH of yogurt from 25% cow milk+ 75% soy milk is shown in Fig. 2.

It can be seen that pH drops to 4.5 within first 6 hours of incubation. Similar observation was also found where a pH of 4.6 was recorded for soy yogurt with addition of inulin [14]. The pH value after 8 hours fermentation is quite nearer to range 4.4 to 4.6 and 4.3 to 4.5 for fermented soy product [15], [16].

Fig. 2. pH change of yogurt made from 25% of cow milk+ 75% of soy milk.

C. Sensory Evaluation

The sensory properties of developed yogurt samples were evaluated by the semi trained panelists. A structured 9 point hedonic scale was used to score individual parameters of each sample. The obtained result of sensory evaluation is shown in Table II.

TABLE II: SENSORY EVALUATION OF YOGURT MADE FROM DIFFERENT RATIO OF SOY AND COW MILK

Ratio of soy milk (SM) and cow milk (CM)	Taste and flavor	Texture or consistency	Overall acceptability
100% CM	3.64 ± 1.5 ^a	3.75 ± 1.87 ^a	3.42 ± 1.91 ^a
75% CM + 25% SM	4.79 ± 1.7 ^b	7.47 ± 0.88 ^c	4.85 ± 1.81 ^b
50% CM + 50% SM	5.89 ± 2.3 ^c	4.91 ± 2.52 ^b	5.56 ± 2.18 ^c
25% CM + 75% SM	7.86 ± 1.32 ^d	5.72 ± 1.45 ^c	7.36 ± 1.16 ^d
100% SM	6.71 ± 1.52 ^c	6.82 ± 2.1 ^d	6.71 ± 2.5 ^d

The data are mean ± S.D. a-d Letters indicates statistical difference at same time (p < 0.05).

It can be seen that, highest test and flavor score was secured by yogurt from 75% soy milk (rest is cow milk) where yogurt from 25% soy milk gave best texture or consistent product. However, based on sensory evaluation yogurt made from 25% cow milk + 75% soy milk was found to be best as it had highest score of overall acceptability. Interestingly, most participants preferred yogurt from 100% soy milk over 100% cow milk

IV. CONCLUSION

In addition of cherry fruit and extra virgin olive oil in bottom layer, a mixture of 75% soy milk and 25% cow milk was successfully used to produce functional fruit bottom yogurt. This produced yogurt had less dairy fat and more MUFA, PUFA as well as bioactive compounds. Fermentation of the developed product was satisfactory with probiotic Bifidobacterium starter. According to sensory evaluation, the functional yogurt made from a mixture of 75% soy and 25% cow milk with addition of gelatin found

to be most acceptable. Further research is suggested to evaluate physicochemical and storage stability before commercialization of the developed product.

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