Scientific Research Publishing

Food and Nutrition Sciences, 2019, 10, 28-36
http://www.scirp.org/journal/fns
ISSN Online: 2157-9458
ISSN Print: 2157-944X

Physicochemical and Organoleptic Characteristics of Manufactured Buffalo Milk Yoghurt Incorporated Soy and Corn Milks

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How to cite this paper: Ibrahim, F.S., Ateteallah, A.H., Abd El-aal, H.A. and Khalil, O.S.F. (2019) Physicochemical and Organoleptic Characteristics of Manufactured Buffalo Milk Yoghurt Incorporated Soy and Corn Milks. *Food and Nutrition Sciences*, **10**, 28-36.
https://doi.org/10.4236/fns.2019.101003

Received: November 30, 2018
Accepted: January 5, 2019
Published: January 8, 2019

Abstract

Soy-corn-yoghurt is a fermented product that obtained from inoculation of yoghurt starter to soy corn milk. The present study was conducted to study the use of different ratios of soy corn milk and corn milk only with buffalo milk in the manufacture of yoghurt. Two experiments were carried out , the first experiment was 100 ml buffalo milk :soy corn milk ratios 90:10, 80:20, 70:30, 60:40 and 50:50 (w/w), the second was buffalo milk with Corn milk 90:10, 80:20, 70:30, 60:40, 50:50 and 40:60 respectively and 100% buffalo milk as control. Treatments were coded B_1, C_1, D_1, E_1 and F_1 in the first experiment, while B_2, C_2, D_2, E_2, F_2 and G_2 for the second respectively. All treatments subjected to chemical and organoleptic assessment. It was found those pH, total protein, fat content were decreased with increasing the ratio of soy corn milk in the product. Also, increasing the ratio of corn milk led to decrease all the previously mentioned characteristics. Curd firmness values for yoghurt made from (70:30) coded D_2 and (60:40) coded E_1 were higher than that of other treatments. Results indicated that mixes of (50:50) coded F_1, (60:40) coded E_1 and mixes (90:10) coded B_2, (80:20) coded C_2 and (70:30) coded D_2 had the highest sensory scores and chemical quality.

Keywords

Yoghurt, Corn Milk, Soy Milk

1. Introduction

Studies on the utilization of vegetables protein have been given considerable

attention due to the imbalance between the world food supply and the number of population. Also there is a worldwide need for more dietary protein, particularly for low income groups. Soymilk and mung bean milk are the most thoroughly plant protein studied and used in different dairy products such as ice cream [1]; yoghurt [2] [3]; yoghurt from mung bean [4], and Domiati cheese [5].

Maize (Zea Mays) is a common staple tropical crop with very low protein and poor amino acid profile [6]. For corn to be efficient in a melio rating malnutrition, it must be supplemented with high grade protein-soybean can provide a useful complement to cereals and tubers to give a balanced diet that could prevent protein energy malnutrition (PEM) [6]. Chemically corn contains sugars content (1% - 3%) (consisting of glucose, fructose and sucrose), protein (8% - 11%), Fat, vitamins and minerals [7]. Milky stage corn on the cob is the most suitable as a raw material for soy corn milk production with good quality [7]. Omueti and Ashaye [8] reported that soy corn milk produced from white corn grains that had higher acceptability and digestibility than soy milk for both adults and children.

In literature no much information was available about the using of corn milk in dairy products, so this research aimed to study the possibility of producing acceptable, low cost and highly nutritional yoghurt using various ratios of soy bean milk and corn milk added to buffalo milk.

2. Materials and Methods

2.1. Materials

Milk supply: Buffalo milk was obtained from the farm of Faculty of Agriculture, Sohag University, Egypt.

Soybean: Soybean Giza 22 was obtained from the Agriculture Administration, Minia governorate.

Corn grains: Corn cob grains (milky stage) of freshly harvested green were obtained from a private field situated of Girga, Sohag governorate.

2.2. Preparation of Soybean Milk

Whole soy beans were washed and soaked overnight in distilled water. After decanting the soaking water, the soybeans were blended with 10 times their weight of distilled water for 3 minutes. The resultant slurry was filtered through double-layered cheese cloth to obtain soy milk [2].

2.3. Preparation of Corn Milk

White cob corn grains were harvested at milky stage of maturity when grains most milky and Juicy (milky). The grains were separated from the cob and cleaned to remove hairs and other extraneous materials. Corn-grains were mixed in tap water in the ratio of 1:2 (w/w) using blender and finally the mixture was filtered through cheese cloth.

2.4. The Details of the Tow Experiment are given in the Following Sup Sections

2.4.1. The First Experiment

Yoghurt was made from buffalo's milk and mixtures of soy milk and corn milk ratios as following:

B_1 (100 ml buffalo milk + 90 ml Soy milk + 10 ml Corn milk).

C_1 (100 ml buffalo milk + 80 ml Soy milk + 20 ml Corn milk).

D_1 (100 ml buffalo milk + 70 ml Soy milk + 30 ml Corn milk).

E_1 (100 ml buffalo milk + 60 ml Soy milk + 40 ml Corn milk).

F_1 (100 ml buffalo milk + 50 ml Soy milk + 50 ml Corn milk).

2.4.2. The Second Experiment

Yoghurt was made from buffalo s milk and corn milk ratio's as following:

B_2 (90 ml buffalo milk + 10 ml Corn milk).

C_2 (80 ml buffalo milk + 20 ml Corn milk).

D_2 (70 ml buffalo milk + 30 ml Corn milk).

E_2 (60 ml buffalo milk + 40 ml Corn milk).

F_2 (50 ml buffalo milk + 50 ml Corn milk).

G_2 (40 ml buffalo milk + 60 ml corn milk).

The above mentioned mixtures were heated to 85˚C for 15 min., cooled to 40˚C and inoculated with 2% of starter (*Streptococcus thermophilus* and Lactobacillus *delbrueckii sub sp. bulgaricus* 1:1). The inoculated mixture was carefully stirred, filled in cups and then incubated at 40˚C until complete coagulation and stored at 7˚C.

2.5. Chemical Analysis

Total solids (TS), Total protein (TP), Fat content, ash content and pH values were measured according to A.O.A.C [9]. Curd firmness was carried out by method described by Ibrahim [10].

2.6. Sensory Evaluation

Twenty one trained panelists included staff members, graduated and undergraduated student of Dairy Department of Faculty of Agriculture, Sohag university were selected for evaluating the yoghurt samples using a quality rating score card the evaluation score was performed in duplicate and included different properties viz. flavor (50 points), body and texture (30 points) and appearance and color (20 points) as described by El-Sayed and El-Sayed [11].

3. Results and Discussion

Data presented in **Table 1** show some chemical composition of soy milk and corn milk compared with buffalo's milk. Data indicated that specific gravity for corn milk (1.056) was higher than that in buffalo milk and soy milk. The high value of specific gravity is related to increasing total solids content. Buffalo milk contained 17.99% TS, 4.09% Total protein, 7.30% Fat and 0.83% Ash. pH value

Table 1. Some physical and chemical properties of buffalo milk, soy milk, corn milk and mixture buffalo milk with different ratios of soy milk and corn milk (%).

Type of milk and Treatments	pH	Specific gravity	Total solids (TS) %	Total protein (TP) %	Fat %	Ash %
A (Buffalo milk)	6.80	1.031	17.99	4.09	7.30	0.83
Soy milk	7.03	1.017	6.99	2.98	2.00	0.43
Corn milk	7.04	1.056	15.62	1.58	-	0.54
B_1	7.09	1.025	12.57	4.17	5.40	0.65
C_1	7.05	1.028	12.78	4.29	5.00	0.65
D_1	7.04	1.031	13.22	3.80	4.90	0.65
E_1	7.03	1.032	13.84	3.79	4.80	0.68
F_1	7.02	1.032	14.00	3.51	4.70	0.66

A = control (100% buffalo milk), B1 = (100 ml buffalo milk + 90 ml soy milk + 10 ml corn milk), C1 = (100 ml buffalo milk + 80 ml soy milk + 20 ml corn milk), D1 = (100 ml buffalo milk + 70 ml soy milk + 30 ml corn milk), E1 = (100 ml buffalo milk + 60 ml soy milk + 40 ml corn milk), F1 = (100 ml buffalo milk + 50 ml soy milk + 50 ml corn milk).

was 6.80. Data shown that soymilk contained 6.99% TS, 2.98% Total protein, 2.00% Fat and 0.43% Ash, while corn milk contained 15.62% TS, 1.58% Total protein and 0.54% Ash.

The pH values for the two types of milk were 7.03 and 7.04 respectively. According to the results obtained by Bikheet [2] soy milk had 9.1% total solids, 4.2% total protein and 1.5% fat. The differences between obtained results and the others studies may be due to the differences of water content and the filtration method [2]. The pH values of buffalo milk with different ratios of soy milk and corn milk for all treatments were between 7.02 - 7.09 (Table 1). The specific gravity and total solids increase with increasing level of corn milk. However, increasing the level of corn milk in the mixture led to decrease the percentage of total protein and fat. Whereas, there was unclear changes were found in ash content for all treatment.

Data presented in Table 2 showed the chemical composition of different ratios of buffalo milk and different ratios of buffalo milk with corn milk. The pH values for all treatment were between 6.8 and 6.9. Specific gravity increased with increasing the level of corn milk. The treatment B_2 has the lowest values of Specific gravity (1.033), while the treatment G2 had the highest (1.046). As regarding to the% of TP, Fat and ash content decreased with increasing the level of corn milk. Also it was observed that no changes in the total solids for all treatments.

The tabulated data in Table 3 showed the physicochemical characteristics of buffalo milk with different ratio of soy corn Yoghurt. The pH value for buffalo milk (control) was 4.8. The values for all treatments were ranged from 4.80 to 4.50. The pH values obtained in the present study were in agreement with that obtained by Angelia *et al.* [12], who reported that yoghurt made from buffalo milk with soy milk: corn milk (80:20), (70:30), (60:40), and (50:50) has pH values

Table 2. Chemical composition of buffalo milk with different ratios of corn milk (%).

Type of milk (Treatment)	pH	Specific gravity	Total solids (TS)	Total protein (TP)	Fat	Ash
A	6.80	1.031	17.99	4.09	7.30	0.83
B_2	6.9	1.033	16.94	4.22	7.0	0.85
C_2	6.8	1.037	17.30	4.22	6.5	0.79
D_2	6.8	1.040	16.92	3.85	5.0	0.78
E_2	6.8	1.041	17.15	3.48	4.5	0.74
F_2	6.8	1.045	16.73	3.31	4.0	0.71
G_2	6.9	1.046	16.27	3.13	3.2	0.69

A = control (100% buffalo milk), B2 = (90% buffalo milk + 10 % corn milk), C2 = (80% buffalo milk + 20% corn milk), D2 = (70% buffalo milk + 30% corn milk), E2 = (60% buffalo milk + 40% corn milk), F2 = (50% buffalo milk + 50% corn milk), G2 = (40% buffalo milk + 60% corn milk).

Table 3. Chemical composition of yoghurt made from buffalo milk with different ratios of soy milk and corn milk.

Treatments	pH	Total solids (TS) %	Total protein (TP) %	Fat %	Ash %	Curd firmness (g)
A	4.80	21.90	4.97	7.8	0.94	21.0
B_1	4.80	16.90	4.63	5.8	0.74	21.1
C_1	4.64	21.26	4.38	5.3	0.72	20.9
D_1	4.64	19.51	4.21	5.2	0.72	21.3
E_1	4.50	20.30	3.97	5.1	0.74	21.6
F_1	4.50	21.23	3.56	5.0	0.73	23.5

A = Control Sample (100% buffalo milk), B1 = 100 ml buffalo + 90 ml soy milk + 10 ml corn milk, C1 = 100 ml buffalo + 80 ml soy milk + 20 ml corn milk, D1 = 100 ml buffalo + 70 ml soy milk + 30 ml corn milk, E1 = 100 ml buffalo + 60 ml soy milk + 40 ml corn milk, F1 = 100 ml buffalo + 50 ml soy milk + 50 ml corn milk.

4.638 , 4.582 , 4.556 , and 4.539 respectively. Higher ratio of corn milk decreased the pH value and this may be due to the fructose of sweet corn. Corn can be used as substrate converted to lactic acid. The pH of soy corn yoghurt had lower than the dairy yoghurt. This might be due to the different kind of substrate in soy corn milk such as fructose and sucrose as compared with sugar addition [12]. The total protein, fat and ash content were decreased with increasing of corn milk ratio (Table 3). There was a gradual decrease in level of protein as observed in all treatment. Sample B1 has 4.63% while samples C_1, D_1, E_1 and F_1 have 4.38%, 4.21%, 3.97% and 3.56% respectively. Comparative level of protein in sample B_1 and C_1 were nutritionally significant in terms of the potentials. These products can contribute to increase protein intake of consumers [13]. Fat content were a gradual decrease in all treatments, Sample (B1) has 5.8% and reached to 5% in sample (F_1). These results were higher than that obtained by Makanjuola [14]. Ash content in all treatments was 0.72 - 0.74. The obtained data were higher than that obtained by Makanjuola [14], who found that the ash contents

were 0.60 and 0.62% for samples contained 80% soy milk plus 20% corn milk and 70% soy milk plus 30% corn milk respectively. The curd firmness was affected by decreasing level of soy milk; the values were gradually increased with increasing corn milk. These results those obtained by Schmidt *et al.* [15] who found that isolated soy protein used to fortify yoghurt resulted a product having a weak texture. The highest value of curd firmness was observed for treatment F1 (50 soy milk: 50 corn milk) compared to other treatments. Generally, composition of milk especially its total solids and pH have a paramount influence on curd firmness and gel structure [4].

Results in **Table 4** indicate the changes in chemical composition of yoghurt made from different ratio of buffalo's milk and corn milk. It is clear that the pH values in all treatment decreased with increasing the corn milk level to buffalo's milk may be due to the effect of corn milk. Same results were reported by Magdoub *et al.* [16] for yoghurt produced by mixing soy milk. Data presented in **Table 4** indicated that the pH values were well agreement with those obtained by Hosny and Angelia *et al.* [12] [17] explained that the acidic nature of maize protein could be responsible for high titratable acidity and the lower of pH value. Total solids content in control sample (A) was 21.9%, while that for all treatments ranged from 25.01% - 15.06%. The decrease of TS for treatments was due to the lower total solids content of corn milk (15.62%) as shown in **Table 1**. It is obviously noted that total protein, fat and ash content decreased as corn milk ratios increased, this is attributed due to the lower content of protein and ash content in corn milk than buffalo milk.

The curd firmness was affected by the level of corn milk addition. It was shown that treatments C_2 (80:20), D_2 (70:30) and E_2 (60:40) resulted yoghurt have high value of curd firmness compared to the other treatments. Generally increasing level of corn milk led to increasing curd firmness.

Results obtained in **Table 5** shown that the decreasing amount of soy milk in the mixtures led to increase in the acceptability of the product. Treatments E_1 (60:40) and F_1 (50:50) have higher scores in flavor, body and texture and appearance and color than that of the other treatments. The obtained data were in full agreement with results given by Angelia *et al.* [12], who found that the different ratio of soy milk and corn milk cause high difference of the preference score of appearance, aroma, texture and taste. High corn milk ratio resulted in higher score of appearance and aroma. Soy corn yoghurt with (50:50) ratio was the most acceptable. Corn milk has some volatile substance such as acetaldehyde which can contribute to reduce beany flavor of soy milk [12]. Treatments E1 (60:40) and F1 (50:50) had higher level of curd firmness (**Table 4**) and total sensory scores **Table 5** than that the other treatments. However, addition of up to (60:40) and (50:50) of soy corn milk can be used in the manufacture of yoghurt without negative effect on the sensory properties.

Results in **Table 6** indicated that increasing the amount of corn milk in the mixtures led to decrease in the acceptability of the product. However, addition of

Table 4. Chemical composition of yoghurt made from different ratios of buffalo milk and corn milk.

Treatment	pH	Total solids (TS)	Total protein (TP)	Fat %	Ash %	Curd firmness (g)
A	4.80	21.90	4.97	7.8	0.94	21.0
B_2	4.70	24.57	4.64	7.5	0.89	21.7
C_2	4.75	25.01	4.42	6.9	0.88	39.9
D_2	4.65	21.21	4.19	5.3	0.85	39.9
E_2	4.70	25.00	3.69	4.8	0.80	36.9
F_2	4.60	24.87	3.98	4.3	0.78	22.9
G_2	4.50	15.06	3.20	3.4	0.77	20.8

A = Control (100 % buffalo milk), B_2 = (90% buffalo + 10% corn milk), C_2 = (80% buffalo + 20% corn milk), D_2 = (70% buffalo + 30% corn milk), E_2 = (60% buffalo + 40% corn milk), F_2 = (50% buffalo + 50% corn milk), G_2 = (40% buffalo + 60% corn milk).

Table 5. Organoleptic scores of yoghurt made from buffalo milk and different ratios of soy milk and corn milk.

Treatments	Flavor (50)	Body and Texture (30)	Appearance and Color (20)	Total (100)
A	35.4	23.70	16.80	75.80
B_1	21.8	17.43	13.20	52.43
C_1	24.8	17.05	14.23	56.08
D_1	21.0	18.70	14.33	54.23
E_1	23.1	18.90	14.80	56.60
F_1	24.8	23.90	17.80	66.50

A = Control Sample (100% buffalo milk), B1 = 100 ml buffalo + 90 ml soy milk + 10 ml corn milk, C1= 100 ml buffalo + 80 ml soy milk + 20 ml corn milk, D1 = 100 ml buffalo + 70 ml soy milk + 30 ml corn milk, E1 = 100 ml buffalo + 60 ml soy milk + 40 ml corn milk, F1 = 100 ml buffalo + 50 ml soy milk + 50 ml corn milk.

Table 6. Sensory Scores of yoghurt made from different ratios of buffalo milk and corn milk.

Treatment	Flavor (50)	Body and Texture (30)	Appearance and color (20)	Total (100)
Control (A)	35.4	23.7	16.80	75.80
B_2	35.19	23.90	17.90	76.99
C_2	29.80	21.28	16.33	67.41
D_2	25.33	18.30	15.00	58.63
E_2	22.60	17.60	14.00	54.20
F_2	18.90	16.14	14.20	49.24
G_2	18.60	15.00	11.60	45.20

A = Control (100 % buffalo milk), B_2 = (90% buffalo + 10% corn milk), C_2= (80% buffalo + 20% corn milk), D_2 = (70% buffalo + 30% corn milk), E_2 = (60% buffalo + 40% corn milk), F_2 = (50% buffalo + 50% corn milk), G_2 = (40% buffalo + 60% corn milk).

corn milks up to 10% - 30% can be used in the manufacture of yoghurt, which had good curd firmness and accepted to the consumers.

4. Conclusion

From the above mentioned results it could be concluded that addition of corn milk and soy milk for the production, added value to the product through increased its nutrient content and sensory properties, also, being cheap and readily available to low income families in the developing country. Corn milk was generally acceptable organoleptically than soy milk, so corn milk could be incorporated with buffalo or cow milk to manufacture of some dairy products.

Conflicts of Interest

The authors declare no conflicts of interest regarding the publication of this paper.

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