Journal of Agriculture and Food Science
Volume 3, Number 1, April 2005. pp 33-39

ISSN 1597 - 1074

PRODUCTION AND EVALUATION OF YOGHURT FROM COW-SOY MILK BLENDS

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ABSTRACT

A study was carried out to evaluate the quality of Yoghurt produced from blends of cowmilk and soymilk. Yoghurt was produced at 10%, 20%, 30% 40% and 50% soymilk substitution. One hundred percent (100%) cowmilk yoghurt served as control. The chemical composition of the yoghurt samples such as crude protein, fat, moisture, ash, pH, titrable acidity and total solids were determined. The microbial status of the yoghurt samples was also investigated. An organoleptic assessment of the products was equally carried out. Results of the chemical composition showed that addition of soymilk decreased protein, ash, total solid and titrable acidity while fat content increased. Significant differences existed among the samples in all the sensory attributes of taste, consistency, aroma, mouthfeel and general acceptability except color ($P< 0.05$). Results of microbial analyses showed that there were no coliforms found in the yoghurt samples.

INTRODUCTION

Yoghurt is one of the staple dairy products in Nigeria, and as such most of the milk consumed on Nigeria is used in the production of Yoghurt. In recent times, there has been increasing demand and consumption of yoghurt especially among the young people. Con *et al* (1996) reported that the world- wide production and consumption of yoghurt has dramatically increased during the last few year due to the introduction of different types of yoghurt. Due to the rising cost of cowmilk, yoghurts like other dairy products are becoming too exhorbitant and unaffordable. Over the years, researchers have been experimenting to find cheaper substitutes for cowmilk. Kanda *et al* (1976) reported that development of soy-based milk is a cheap substitute for traditional cow-milk yoghurt.

Soymilk is one of the several products, from soybean and is the most popular milk of plant origin. It is a creamy white liquid extracted from soybean and used as a dairy substitute. Soybean has less incidences of cardiovascular diseases and lactose intolerance thus enhancing its use in various products. The major limiting factor in the use of soymilk has been its characteristic intrinsic beany flavour (Iwe and Agu 1993). However it has been reported that a reduction in the objectionable flavour and flatulent sugars (raffinse and stachyose) occur after fermentation by lactic acid bacteria (Jood *et al* 1985).

In this research, yoghurt is produced from blends of cowmilk and soymilk. The aim of the study is to partly replace cowmilk with a cheaper substitute so as to produce acceptable quality yoghurt at an affordable cost.

Material and Methods

Materials

Soybean seeds were purchased from the Owerri main market. Powdered peak milk, granulated sugar, gelatin and sachets of dry yoghurt culture, were purchased from a supermarket in Owerri.

Methods

Soymilk was produced by the method of Ihekoronye (1991). The flow diagram for the production of soymilk is shown in Fig 1. One kilogram of soybean seeds was sorted, washed with liberal quantities of water, and then subjected to hot water blanching for 25 minutes. The seeds were manually dehulled and ground into a slurry using high speed kenwood Blender (Model 907A). A muslin cloth was used to press the milk leaving behind the cake. Four litres of water was used to extract one kilogram of soyabeans.

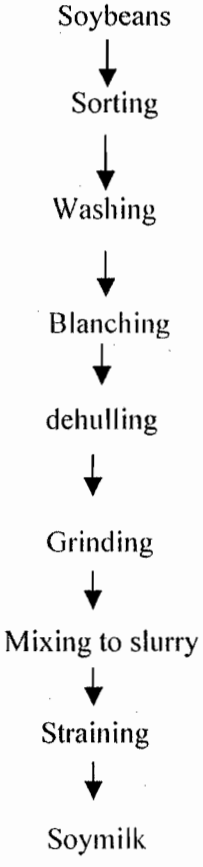

Fig 2 flowchart for soymilk production

Sample preparation

Six yoghurt samples were produced by varying the amounts of soymilk and cowmilk. Sample A contained 90% cowmilk and 10% soymilk; sample B contained 80% cowmilk and 20% soymilk, sample C had 70% cowmilk and 30% soymilk, sample D contained 60% cowmilk and 40% soymilk while sample E was blended in the ratio of 50% cowmilk to 50% soymilk. Sample F containing 100% cowmilk served as the control.

Yoghurt Production

One hundred grams of the powdered milk was reconstituted with 1,000ml of water. The soymilk and soymilk were blended at various levels. Ten percent sugar and 2½% gelatin were added and thoroughly mixed until they were dissolved. The blend was pasteurized at 80°C for 15minutes, cooled to 42°C and inoculated with 2% mixed culture of *lactobacillus bulgaricus* and *streptococcus thermophilus*. The yogburt was incubated at 42-44^{0}C for 10 hours in a water bath until the desired flavour was developed. (Hamilton 1999). The fermentation was stopped by placing the yoghurt in a refrigerator at 5^{0}C for 12 hours (overnight) prior to analysis.

Chemical analysis

The crude protein was determined by the Kjedhal procedure of AOAC (1990). The total lipid was extracted with petroleum ether according to the method of Pearson (1976). Moisture content was calculated as the weight encountered after drying 2g of the sample in an air oven at 105^{0}C for 6 hours AOAC (1990). Ash was determined by incinerating 2g samples at 575^{0}c in an ashing (muffle) oven overnight. Carbohydrate content was calculated as the difference between total weight and the mean moisture, crude protein, fat and ash contents.

The pH value of each sample was measured using a pH meter (PT model 712). The tip of the electrode was dipped into the sample and allowed to stand for about five minutes before reading. Tittrable acidity (TA) was evaluated by diluting 2g sample in distilled deionized water and making up to 25ml with the water. Then 10ml of the diluted sample was titrated against 0.1M NaOH solution in the presence of phenolphthalein indicator (Ariahu *et al* 1999). The T.A was expressed as lactic acid using the formula.

$$\text{Lactic acid (g/100g)} = \frac{\text{ml of NaoH)}}{\text{ml of sample}} \times \frac{0.9}{1}$$

Microbial Analysis

Each sample was serially diluted in sterile, distilled water to obtain the inoculums. Aliquot of each dilution was cultured on Nutrient Agar (NA) for bacteria, and onto MacConkey Agar (MA) for coliforms, while Sabourad Dextrose Agar (SDA) was used for the isolation of fungi. Plates for bacteria and fungi were incubated at room temperature (30± 2.^{0}C) for 36 hours, and at 34±2.^{0}C for 48 hours for coliforms (Ogbulie *et al* 1998). At the end of the incubation, colonies, that were observed on plates were counted and multiplied by the reciprocal of dilution power and reported as colony forming unit per ml (cfu/ml).

Sensory Evaluation

The yoghurt samples were subjected to sensory analysis, using twenty panelists selected from the Department of Food Science and Technology, Imo State University, based on product familiarity. The aroma, taste, color, consistency, mouthfeel and overall acceptability of the samples were evaluated, adopting the nine-point hedonic scale (9 = like extremely, 5 = neither like nor dislike; 1= dislike extremely) as described by Ihekoronye and Ngoddy 1985.

Statistical Analysis

All data were subjected to analysis Table 1 of variance (ANOVA) and significant means discriminated using Tukey's test (Onuh and Igwemma 1998). The level of significance was set at 5%.

Result and Discussion

Table 1: Chemical and Proximate Composition of Yoghurt Samples.

Sample	Moisture	Protein	Fat	Ash	CHO	TS	TA	pH
A	84.50±1.47	4.15±0.81	2.50±0.6	0.81±1.02	8.01±1.02	15.50±2.01	1.02	4.4
B	85.75±1.58	3.71±0.73	2.70±0.4	0.76±0.01	7.04±1.24	14.25±1.89	1.00	6.5
C	86.74±1.25	2.93±0.54	2.90±0.9	0.56±0.09	6.87±0.48	13.96±1.57	0.95	4.5
D	86.80±2.20	2.63±0.23	3.00±0.5	0.47±0.01	7.10±1.06	13.20±1.62	0.94	4.6
E	86.88±1.46	2.33±0.19	3.40±0.2	0.45±0.03	6.94±0.99	13.12±1.48	0.81	4.6
F	82.62±1.04	2.4±0.28	2.40±0.4	0.87±0.04	9.50±1.05	17.38±2.72	1.04	4.2

Mean of triplicate determinations ± standard deviation

A = 90cm: 10 sm B = 80 cm: 20 sm C = 70 cm: 80 sm D = 60 cm: 40sm

E = 50cm: 50cm F = 100 cowmilk cm = Cowmilk sm = Sogmilk

The result of proximate analysis is shown in Table 1. As the level of incorporation of soymilk increased, the protein content of the samples progressively decreased with a significant difference at 50% soymilk incorporation. However all the protein values fell within the value of 2.5% - 5.0% recommended for commercial yoghurt (Pirie 1975). The fat content increased from 2.4% in the control to 3.4% in sample E (50% cowmilk: 50% soymilk) showing a steady decrease as soymilk content increased. Tamine and Robinson (1981) stated that yoghurt containing below 3.4% are classified as medium fat yoghurt, while the ones containing above 3.4% are full-fat yoghurt. This shows that the yoghurt can be consumed by obesity prone individuals, and persons with degenerative heart diseases due to their low fat content, and the unsaturated nature of plant lipids. It has earlier be noted that yoghurt has antitumor and anti-cholesterol attributes. (Ayebo *et al* 1981: Deeth and Tamine 1981) The ash content of the blended samples steadily decreased with soymilk incorporation, reflecting lower ash value of the soybean. There was no remarkable change in the total solids (TS) of the yoghurt. All the total solid contents were in agreement with the values of 12%-15% reported for yoghurts by Tamine and Robinson (1985). The pH values decreased with increase in lactic acid. The trend was in harmony with lee *et al* (1990) who observed similar pH reductions as acidity increased.

Table 2: Microbiological characteristics of yoghurt samples

Sample	Bacteria	Fungi	Coliform
A	1.2×10^1	2.2×10^2	Nil
B	1.3×10^1	2.4×10^2	Nil
C	2.0×10^2	3.2×10^2	Nil
D	2.0×10^2	3.3×10^2	Nil
E	2.3×10^2	3.3×10^2	Nil
F	1.1×10^1	2.2×10^2	Nil

A = 90cm: 10 sm B = 80 cm: 20 sm C = 70 cm: 80 sm D = 60 cm: 40sm

E = 50cm: 50cm F = 100 cowmilk cm = Cowmilk sm = Sogmilk

The microbiological characteristics of the samples are shown in Table 2. The coliform results of all the samples were negative. This indicates absence of faecal contamination which is attributed to the strict hygienic environment under which the samples were prepared. Con *et al* (1996) reported that a maximum count of 10cfu/g of coliform group bacteria are allowable in Yoghurt. Ibraham *et al* (1989) found coliform group bacteria to be present in 80% of all yoghut sold commercially in Cario. Also Duru and Azgunes (1981) found coliform bacteria in 35% of the yoghurt sold commercially in Ankara Turkey. The total bacteria count of the samples ranged from 1.2 x 10 to 2.3 x 10^2. These values did not exceed the limits stated by Adams and Moss (1995) for processed yoghurt. This may be attributed to the micro-organisms in the starter culture. Today, in worldwide production of yoghut, *L bulgaricus* and *S thermophilus* bacteria are routinely used as the starter culture. However, all the yoghurt samples contained yeast and mold expressed as fungi count. Amott *et al* (1974) showed that 26% of the yoghurt produced and sold commercially in Ontario, Canada, contained >1,000 cfu/g of mold. Again, Duru and Ozgunes (1981) presented in their findings that 35% of commercial sold yoghurt in Ankara, Turkey, contained >100,000cfu/g of yeast and mold.

Table 3: Sensory characteristics of yoghurt samples

Sample	Color	Consistency	Taste	Aroma	Mouthfeel	Overall Accept
A	7.8_a	6.9_a	7.1_a	7.4_a	6.6_b	7.1_a
B	7.1_a	5.9_a	6.6_a	7.0_a	5.9_b	6.3_b
C	7.0_a	5.9_a	6.4_a	7.0_a	5.5_b	6.3_b
D	6.9_a	5.6_a	6.0_a	6.5_b	5.3_b	5.7_b
E	6.7_a	5.4_a	6.2_a	6.3_b	5.4_b	5.3_b
F	8.6_a	7.2_a	8.4_a	8.4_a	8.2_a	8.4_a

Values having different subscripts are significantly different (P<0.05).
A = 90cm: 10 sm B = 80 cm: 20 sm C = 70 cm: 80 sm D = 60 cm: 40sm
E = 50cm: 50cm F = 100 cowmilk cm = Cowmilk sm = Soymilk

The parelists scores are summarized in Table 3. No significant difference was observed between the color of the control sample and the blended sample at all levels of soymilk incorporation (P<0.05). However, significant difference existed in the mean scores for consistency, taste, aroma, mouthfeel and overall acceptability (P<0.05). There was gradual decrease in the scores for aroma and taste, with significant values observed beyond 40% soymilk incorporation for both attributes. This decrease in aroma and taste is not unconnected with the objectionable taste associated with plant milk (Enwere 1998, Iwe 2003). Addition of soymilk also affected the mouthfeel and consistency of the yoghurt blends, decreasing steadily as soymilk increased. The overall acceptance of the samples progressively decreased with increased soymilk addition, being significant at 20% soymilk addition. This may not be unconnected with the "beany" flavor associated with soymilk (Iwe and Agu 1993).

CONCLUSION

It is shown from study that soymilk utilization can further be enhanced by blending with cowmilk in yoghurt production. Good quality and affordable yoghurt can be produced at 20% soymilk incorporation. This can compare favorably with whole cowmilk yoghurt in terms of sensory, microbial and nutrient qualities.

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