

Production and Quality Evaluation of Soy-Corn Yoghurt

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Abstract: In the recent years, research efforts in the developing countries have been geared towards the improvement of protein quality foods using blends of legume and cereal which is considered a nutritionally balanced product. Therefore, this present study is aimed at finding local substitute for milk based product with high protein content of a well balancing amino acid composition and high digestibility; determining the proximate composition, microbial analysis as well as sensory evaluation of soy-corn yoghurt with a view of knowing the consumer acceptability of the product. Yoghurt samples were produced from blends of soymilk and corn milk (yellow maize corn) using *Streptococcus thermophilus* and *Lactobacillus bulgaricus* as starter cultures. Ratio of soy milk to corn milk were 80%:20%; 70%:30% and 100% soymilk as control. The yoghurt samples produced were coded A, B and C representing 100% soy yoghurt, 80%:20% soy corn yoghurt and 70%:30% soy corn yoghurt respectively. Yoghurt samples were subjected to chemical, microbiological and organoleptic assessment. The results of chemical analysis revealed protein contents of 4.30, 4.00 and 3.70% respectively for the samples. Fat contents varied between 2.10 and 2.60%, while ash contents of 0.50, 0.60 and 0.62% were obtained for the samples respectively. Total solids of between 10.98 and 8.80% were obtained with titratable acidity of 0.03, 0.05 and 0.06%, respectively. The carbohydrate contents of the samples ranged from 1.40 to 4.50% while all the samples showed fairly acidic levels. Water contents of between 89.00 and 91.20% were obtained. The microbiological examination revealed a tolerable level for all the samples.

Keywords: Corn milk, soy-corn yoghurt, soy milk

INTRODUCTION

The immense benefits of soya beans must have stipulated lot of research on incorporating soya beans (*Glycine max*) into indigenous diets such as soy bean fortified gari and tapioca (Sanni and Sobamiwa, 1994; Kolapo and Sanni, 2005); Soy dadawa (Popoola and Akuweshi, 1985; Popoola *et al.*, 2007), Soy wara (Omojasola, 2000) and Soy-yoghurt (Nsofor *et al.*, 1992; Olubamiwa *et al.*, 2006). Soy milk is an aqueous extract of soya beans (*Glycine max*) (Agure-Dam, 1997; Dashiel, 1995) and is quiet similar in appearance to cow milk. Soy milk is of considerable interest to nutritionist as possible substitute for cow milk and human milk. Over the years, it has been developed into a food for infants suffering from various forms of malnutrition and for individual with food allergies and diseases associated with cow milk diets (Considine and Considine, 1997).

Yoghurt is a Turkish name for a fermented milk product. It is originated by early nomadic herdsman, especially in Asia, Southern and Eastern Europe. Yoghurt is made by adding a culture of acid forming bacteria to milk that is usually homogenized, pasteurized and fermented. Soy corn yoghurt can be made from soy corn milk. The micro organisms that have been implicated in the fermentation of soy corn yoghurt include *Streptococcus thermophilus* and *Lactobacillus bulgaricus*

(Salje *et al.*, 2006; Popoola *et al.*, 2007). The beverage being a blend of legume and cereal is considered a nutritionally balanced product. This beverage was found to be highly digestible and widely acceptable by both adults and children (Omueti *et al.*, 2000). The objectives of the study were; to find local substitute for milk based product with high protein content of a well balancing amino acid composition and high digestibility; to determine the proximate, microbial analysis and sensory evaluation of soy corn yoghurt with a view of knowing the consumer acceptability of the product.

MATERIALS AND METHODS

Collection of materials: Soya bean seeds (variety TX 1440-1E) and grains of freshly harvested green field maize (variety DMR SLR-yellow) were obtained from the Institute of Agriculture Research and Training, Moore Plantation, Ibadan, South West, Nigeria. Commercially available yoghurt starter cultures (*Streptococcus thermophilus* and *Lactobacillus bulgaricus*) and sugar were purchased from a local store at Lagos. This study was conducted for a period spanning 6 months (March-August, 2011) in the laboratories of the department of Food Technology, The Federal Polytechnic, Ilaro, Ogun State, Nigeria.

Preparaton of soy milk: Milk extract of soy beans was prepared following the traditional Chinese method

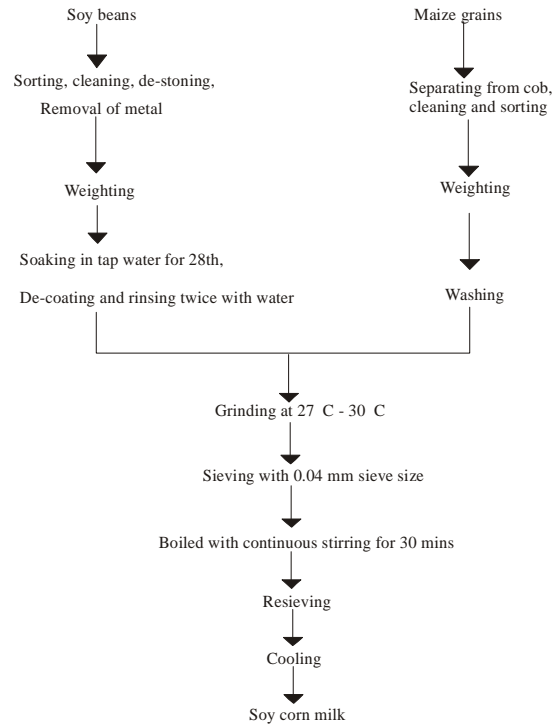


Fig. 1: Flow chart for the production of soy corn milk (Omueti and Ajomale, 2005)

described by Johnson and Synder (1978) as reported by Onuorah *et al.* (2007). The soybeans were cleaned to remove stones and any other contaminants. Two hundred grams of healthy and unbroken soy bean seeds were soaked in 2 L of water for 28 h and then decoated and rinsed with tap water. The soybean seeds were wet milled with 14 L of water. The soy milk slurry was mixed with water while breaking lumps to allow for fast sieving. Enough water was added to the slurry and the soy milk was obtained by passing the slurry through 0.04 mm sieve and filtrate collected into a clean container. The filtrate was boiled for 30 min with continuous stirring and resieved and then cooled at room temperature of 22°C.

Preparation of soy corn milk: Maize variety DMR SLR-yellow was harvested at eating stage of maturity when the grains were most milky and juicy. The grains were separated from the cob and cleaned to remove hairs and other extraneous materials (Floyed and Brandon, 1995; Ihekoronye and Ngoddy, 1985). Corn grain and dehulled soy bean cotyledons were weighed separately and combined in the proportion of 20% corn to 80% soybean and 30% corn to 70% soy bean respectively according to the process chart in Fig. 1.

Preparation of soy yoghurt: Two hundred and fifty mL of prepared soy milk was pasteurized at 88°C for 30 min and allowed to cool to 45°C. Two table spoon of mixed starter culture (*Streptococcus thermophilus* and

Lactobacillus bulgaricus) was added with sterile spoon and then incubated at 45°C for 6 h. The mixture was placed in the refrigerator for 3 h to stop fermentation at the end of the incubation period. Twelve g of sugar was added to the coagulum, stirred and filled into clean PET bottles, corked and stored (Jimoh and Kolapo, 2007; Miral and Steinkraus, 1999).

Preparation of soy corn yoghurt: Two hundred and fifty mL of the prepared soy corn milk at different proportion of soy and corn, were fermented using the mixed starter cultures as described above to obtain soy corn yoghurt.

Chemical analysis: The moisture, ash and total solid contents of the yoghurt were determined using the methods of AOAC (1990). Fat content was determined following the method described by Werner-Schmid. Protein was evaluated using formol titration method. The pH of the samples were determine using Dye unicon pH meter (model, 290 MK2) while the titratable acidity was determined using the method described by Olubamiwa *et al.* (2006). Carbohydrate was calculated by difference (AOAC, 1990)

Microbial examination: Total viable count of soy yoghurt and soy corn yoghurt were determined using pour plate technique. (0.1 mL) of the appropriate dilution was placed on nutrient agar plates. The plates were incubated at 35°C for 48 h and colony forming units per g sample (cfu/g)

Table 1: Proximate composition of yoghurt samples in percentage

| Sample | Moisture (%) | Ash (%) | Protein (%) | Fat (%) | Total solid (%) | Titrateable acidity (%) | Carbohydrate (%) | pH |
|--------|--------------|---------|-------------|---------|-----------------|-------------------------|------------------|------|
| A | 91.20 | 0.50 | 4.30 | 2.60 | 8.80 | 0.03 | 1.40 | 4.50 |
| B | 89.00 | 0.60 | 4.00 | 2.30 | 11.00 | 0.05 | 4.10 | 4.10 |
| C | 89.08 | 0.62 | 3.70 | 2.10 | 10.98 | 0.06 | 4.50 | 4.00 |

was estimated. For mold and yeast count; the above procedure was repeated using potato dextrose agar and incubation was done at 25°C for 72 h.

Sensory evaluation: The prepared yoghurt samples were presented to an untrained 10-member panel of judges who were familiar with the consumption of yoghurt. The samples were assessed for colour, flavor, viscosity, taste and overall acceptability using a nine-point hedonic scale, where 9 indicated “like extremely” and 1 indicated “dislike extremely”. Each panelist was provided with enough privacy to avoid biased assessment.

Statistical analysis: Data obtained were analysed statistically using Analysis of variance (ANOVA) and means were separated using the Least Significant Difference (LSD) according to Obi (1995)

RESULTS AND DISCUSSION

Proximate composition/chemical analysis: Table 1 shows the result of proximate composition of the samples. The total solids ranged from 8.80 to 11.00 for all the samples. Sample A has 8.80 total solid (100% soy yoghurt), Sample B has 11.00 total solids (80%:20% soy-corn yoghurt) while Sample C has 10.98% total solids (70%:30% soy corn yoghurt). Higher values recorded for samples B and C could be attributed to higher levels of suspended particles occasioned by particles in soy-corn milk than in soy milk (Nelson *et al.*, 1997). Moisture content of 91.20% obtained for sample A is higher than other samples (89.00% for B and 89.08% for C). This may be due the fact that addition of corn starch in form of milk slurry has thickened the soy yoghurt (Smoothie Recipes, 2006). The acidic nature of maize protein (zein) could be responsible for high titrateable acidities recorded for both samples B and C respectively (0.05 and 0.06%) when compared with sample A (0.03%). However as titrateable acidity increased, the pH decreased as a function of fermentation time. Acid production in the medium depends on the growth of microorganisms and their ability to ferment the available carbohydrates. The presence of high level of acidic amino acid in corn based beverage (Hosney, 1994) accounts for the lower pH of samples B and C than that of sample A.

There was a gradual decrease in level of protein as observed in all the samples. Sample A has 4.30% while samples B and C have 4.00 and 3.70% respectively. Comparative level of protein in sample B and C are nutritionally significant in terms of the potentials of these beverages to contribute to the increased protein intake of

Table 2: Microbial examination in log (cfu/g)

| Sample | Coliform bacteria | Aerobic mesophilic -bacteria | Yeast and mold |
|--------|-------------------|------------------------------|----------------|
| A | <1 | 5.29 | 2.21 |
| B | <1 | 5.47 | 2.29 |
| C | <1 | 5.7 | 2.25 |

Table 3: Sensory evaluation of samples

| Sensory attributes | Sample code | | |
|-----------------------|------------------|------------------|------------------|
| | A | B | C |
| Colour | 7.9 ^a | 6.3 ^b | 5.5 ^b |
| Flavor | 5.0 ^b | 6.6 ^a | 4.0 ^b |
| Viscosity | 5.4 ^b | 7.1 ^a | 6.2 ^b |
| Taste | 6.2 ^b | 6.8 ^b | 5.8 ^b |
| Overall acceptability | 3.5 ^b | 5.4 ^a | 2.8 ^b |

Mean sample in the column with the same superscript has no significant difference

consumers (Omueti and Ajomale, 2005). The low fat contents recorded for samples B and C may contribute to increased shelf life by decreasing the chances of rancidity. The fat content in sample A which is slightly higher than other samples may easily contribute to the production of off flavor during storage (Salunkhe *et al.*, 1992). There was a gradual increase in ash contents of the samples. Sample A has 0.50% while sample B and C have 0.60 and 0.62% respectively. The increase in ash contents observed in samples B and C is due to the mineral contents caused by the addition of corn as reported by Omueti and Ajomale (2005). Addition of corn to sample B and C led to increase in carbohydrate contents of these samples when compared with sample A. However, most of the studies on soya bean carbohydrates are mainly restricted to sugars such as sucrose, raffinose and starchyose (Fukushina, 1997; Katz, 1998)

As shown in Table 2, samples A, B, C have <1.0cfu/g coliform bacteria. According to Turkish Standard Institute (TSI330), a maximum count of 10.0 cfu/g coliform is allowed in yoghurt. The presence of coliform in yoghurt is generally regarded as direct contamination of the food with faecal materials. The aerobic mesophilic bacteria count was insignificant since it was present in count range of 5.29-5.72 log cfu/g which is an acceptable standard in yoghurt (Dayisoğlu *et al.*, 2006). All the samples showed low levels of yeast and mold counts. Levels above 10.0 cfu/g yeast and mold (Salje *et al.*, 2006) are capable of producing toxic metabolites (mycotoxin e.g aflatoxin) leading to food poisoning and can cause cancer of the liver in humans.

The results of the sensory properties of the yoghurt samples are shown in Table 3. Attributes such as colour, flavor, viscosity, taste and overall acceptability were

evaluated by judges. Samples B and C were rated low in terms of colour. This is due to the yellow colour induced by xanthophyll pigments (carotenoids) of yellow corn. Sample B was most preferred in terms of viscosity with Sample A having the least viscosity. According to Smoothie Recipes (2006) corn starch act as a thickener. There were no significant differences in terms of tastes for the three samples while sample A was rated low in terms of flavor and this is due to the beany flavor associated with soybeans. However, there are no observed differences in terms of overall acceptability for the samples except for the fact that there is high level of deterioration in soy milk based products during storage than maize based beverages (Omueti and Ajomale, 2005).

CONCLUSION

It is evident from this study that yoghurt can be produced from blends of soy milk and corn milk at various substitutional levels. Therefore, production of soy beverages which are highly consumed by Nigerians because of the availability of soy beans in commercial quantity is another way of increasing the food value of the crop.

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