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Comparative Studies on the Quality and Quantity of Soymilk from Different Varieties of Soybean

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Abstract: Four varieties of soybeans: TGX 196-2E, TGX 536-02D, TGX 923-2E and one designated as local were analyzed for quality and quantity of soymilk they would produce. Proximate analysis of the soymilk revealed total solid for between 3.82 and 3.74, with TGX 196-2E being the highest and the local sample having the least. TGX 196-2E and TGX 536-02D both had the highest crude protein value of 1.81. They also showed the highest value for oil content of 1.64 and 1.61 respectively. The local variety had crude protein value of 1.69 and showed a corresponding least value of oil content, being 1.52. Crude fiber value for all the three varieties ranged between 0.02 and 0.03 while ash content was between 0.18 and 0.24. Percentage carbohydrate was between 0.10 and 0.30, with the local variety having the highest value. TGX 196-2E showed the highest microbial load of 2.1×10 cfu/ml with a corresponding least shelf life of 23 hours at room temperature (23±2°C) and 120 hours at refrigeration temperature (4°C). TGX 536-02D had the longest shelf life of 32 hours at 23±2°C and 168 hours at 4°C. It also had the lowest microbial load of 1.8×10 cfu/ml. pH values of the soymilk produced, ranged between 6.7 and 6.57 with TGX 196-2E having the highest value. TGX 196-2E also had the highest milk yield of 88.9% while TGX 536-02D produced the least quantity, being 76.0%. Organoleptic assessment showed significant differences in color, texture and odor between the four varieties. There was, however, no significant difference among the varieties for sweetness.

Key words: Soymilk, varieties, soybeans, quality, quantity

Introduction

The soybean (*Glycine max*) is a plant belonging to the family leguminosae and sub family papilionaceae. Several legume based milk and milk products have been developed in attempts to extend the supply of milk-like products especially in areas where milk is in short supply. Since legumes are important sources of relatively inexpensive protein, introduction of imitation milk products from legumes may contribute to the alleviation of protein malnutrition (Caygill *et al*., 1981). This is particularly true for soy products. Soybean is an important source of high quality protein for vegetarians and non vegetarians alike worldwide (Burke, 1996). In Ethiopia, the Ethiopian National Institute use soybean to produce 'faffa' and soy wheat flours. It is used for 'kinema' (a meat substitute) in the Eastern Himalaya region (Sarka, 1996). It is used for the production of 'dawadawa', soyogi, soymilk soyflour, soycheese and soyyogurt in Nigeria.

According to Anochili (1984), soybean originated in Eastern Asia. It exists in different colors, such as yellow, green and red, but the yellow ones are the most common. Soybeans was introduce to Nigeria in 1908, some new varieties increased the collection to 60 (Ezedinma, 1964). In recent times, soybean production is gaining increasing popularity. Invariably, this will lead to production of soybeans ranging in morphological as well as physicochemical characteristics. In Nigeria, adaptable soybean varieties have been developed by the International Institute of Tropical Agriculture (IITA, 1990), Ibadan and Institute for Agricultural Research (IAR), Samaru, Zaria and farmers have adopted these new varieties.

Since the aim of the Nigerian government in providing many varieties is to make soy beans available in both quality and quantity, Kormawa (1996) reported that new varieties are now being developed by research, to suit our environment. It is thus of importance to study and know, which varieties are best suited for our purposes and requirements.

The aims of this study are, therefore, to evaluate four varieties of soybeans for:

- Soymilk yield
- Nutrient composition of soymilk
- Microbial load of soymilk
- Shelf life of soymilk
- Consumer acceptability of soymilk

Materials and Methods

A total of four varieties of soybean [confirmed as varieties, not accessions, by the Bauchi State Agricultural Company (BASAC)] were used. Three (3) of the varieties: TGX 196-2E, TGX 536-02D, TGX 923-2E were collected from BASAC, while the fourth, designated as 'local' was obtained from the open market in Bauchi metropolis.

Morphological studies: Morphological characteristics such as color of the seed, shape of seed, color of helium and the diameter of seed (measured with the aid of a vernier caliper) were determined fro each variety.

Production of soymilk (Cornell's Method): Soymilk was produced by the process described by Wei *et al.* (1978) illustrated in the chart below:

100g of soyabeans
↓
Steeped in water for 6 hours
↓
Boiled for 45 minutes
↓
Blended while still hot
↓
Sieved with 1 litre of water
↓
Extraction was boiled (20 minutes)
↓
Cooled to 40°C
↓
1g salt and 30g sugar added
↓
Packaged (In 1 litre plastic jugs)

Shelf life studies: Each of the soymilk derived from the different soybean variety was divided into two 1 litre plastic jugs having screw corks. The jugs were tightly screwed and stored under two different conditions for shelf life studies; (The volume of soymilk in each jug was half the milk yield of the variety in question). One jug of each soymilk type was stored at room temperature (23±2°C) and the other was stored at refrigeration temperature (4°C). Shelf life studies were carried out immediately after production (0 hour) and after every 12 hours thereafter, until each was determined spoilt. Bad odor, bad taste and separation of the soymilk into two distinct portions were indicative of spoilage in each sample.

Microbial load analysis: Nutrient agar was used as the growth medium. The agar was prepared according to manufacturer's specifications. The standard ten fold serial dilution technique was employed to dilute each sample up to the 10^5 level. The plates were then inoculated with 1 ml of the 10^5 dilutions and then incubated at 37°C for 24 hours after which the number of viable cells was counted using digital colony counter (Gallenkemp England). The counts were converted to microbial load using the formula:

ML = N/V X R
Where ML = Microbial load
N = Number of colonies
V = Value of Dilution
R = Dilution factor (expressed in cell/ml) Fraizer and Westhoff (1985).

Chemical analysis (pH): The pH was determined by use of a pH meter (Model Jenway). The pH value was determined at 0 hours (that is, immediately after production). It was done by taking 10ml of soymilk sample from each of the varieties into a test tube. The pH meter was then standardized using a buffer solution. The electrode of the pH meter was then washed with distilled water and dipped into each of the test tubes containing the soymilk samples (rinsing out the electrode with distilled water before introducing it into a new test tube). The pH value of each sample was read off an electrical device.

Proximate analysis: Proximate analysis of the soymilk samples was carried out, in triplicates, according to standard methods (AOAC, 1984); to determine protein, crude fiber, ash, oil and carbohydrate contents of the soymilk samples produced.

Organoleptic assessment: Soymilk samples of each variety were subjected to organoleptic assessment by a 10-member panel. Clean cups were provided for each sample; each panelist was requested to taste the samples one after the other and to indicate their degree of likeness or preference for each on the questionnaire provided. The samples were evaluated for taste, sweetness, texture and odor. They were required to score each parameter on the scale of 1-4, depending on their degrees of acceptability; with 1 indicating strong acceptance and 4 indicating least acceptance.

Determination of milk yield: Each soybean sample was subjected to exactly the same processes during the production of soy milk. The sieving of each sample with 1 litre of water resulted in the removal of the chaff. What was left was the quantity of "milk' that was extracted from blending each of the soybean samples. The quantity of soymilk obtainable at the point of packaging into plastic jugs was then measured for each sample and recorded as the percentage milk yield of that soy sample.

Statistical analysis: The scores for taste, sweetness, texture and odor of the samples were subjected to statistical analysis (Analysis of variance) following the methods described by Ihekoronye and Ngoddy (1985).

Results

Under room temperature (23±2°C) and refrigeration temperature (4°C), TGX 923-2E spoiled after 23 hours

Table 1: Seed characteristics of the Soy bean Varieties

Seed characteristics	TGX196-2E	TGX 923-2E	TGX 536-02D	Local Sample
Color of the seed	Pale yellow with some having greenish patches	Pale yellow with some having greenish patches	Very pale yellow. Homogenous	Very pale yellow. Homogenous
Shape	Oval	Oval	Spherical	Spherical
Diameter (cm)	0.36	0.32	0.41	0.51
Color of the Helium	Black	Light brown	Straw	Brown

Table 2: Yield, pH and Shelf life of Soymilk from four varieties of soybean

	Varieties			
Observation	TGX 923-2E	Local Sample	TGX196-2E	TGX 536-02D
Milk yield (%)	88.90	82.00	84.40	76.00
pH	6.68	6.57	6.77	6.61
Shelf at 23°C (hrs)	23.00	26.00	28.00	32.00
Shelf at 4°C (hrs)	120.00	144.00	144.00	168.00

Table 3: Proximate Analysis of the Milk Produced fro m the different varieties of soybeans

Components (%)	TGX196-2E	Local Sample	TGX 536-02D	TGX 923-2E
Water	96.18	96.26	96.21	96.24
Total Solids	3.82	3.74	3.79	3.76
Protein	1.81	1.69	1.81	1.75
Oil	1.64	1.52	1.61	1.56
Crude Fiber	0.02	0.02	0.03	0.03
Ash	0.21	0.20	0.24	0.18
Carbohydrate	0.14	0.30	0.10	0.14

Table 4: Microbial load counts of soy milk samples 24 hours after production

Varieties of Soya bean	No of viable Cells
TGX 536-02D	180×10^5
TGX196-2E	190×10^5
Local Sample	206×10^5
TGX 923-2E	210×10^5

and 120 hours respectively. Local sample and TGX 196-2E spoiled after 26 hours and 28 hours respectively when stored at room temperature and 144 hours at refrigeration temperature. TGX 536-02D spoiled after 32 hours at room temperature and 168 hours at refrigeration temperature (Table 2). The pH values of the "milk" samples were neutral. TGX 196-2E had pH 6.77; TGX536-02D pH 6.61 and the local sample had pH 6.57 as can be seen in Table 2. The percentage yield of the milk is as shown in Table 2. There was a little difference (4.4%) in the milk yield of TGX 923-2E and TGX 196-2E while TGX 536-02D had the lowest percent yield of 76%. The proximate analysis revealed that soymilk produced from TGX 196-2E and TGX 536-02D had the highest protein content of 1.81. The value of total solids ranged from 3.82 and crude fiber ranged from 0.02 to 0.03. The details of the results are shown on Table 3.

The organoleptic analysis (Table 5) revealed that soymilk produced from TGX 196-2E was preferred over all the others while that of TGX 536-02D was least preferred. There was no significant difference among the varieties in their sweetness while there was significant difference in their color, texture and color ($p<0.05$).

Discussion

Proximate analysis of the "milk" from each variety of soybeans shows that averagely it has a water content of 96.22, Total solid of 3.78, Protein of 1.77, Oil of 1.56, Crude fiber of 0.03, Ash content of 0.21 and Carbohydrate of 0.17 this agrees with the findings of Nelson *et al.* (1978) with the exception of protein content which is lower in their own report. This may be due to the variety of soybean used, the method of extraction and other equipments used.

The average value of pH of "milk" was 6.66. The pH values being near neutrality, which agrees with the reports of several other workers (Fraizer and Westhoff, 1985), may account for the growth of bacterial cells observed since bacteria thrive best on such media.

The microbial loads of the different varieties were 180×10^5, 190×10^5, 206×10^5 and 210×10^5 for TGX 536-02D, TGX 196-2E, Local Sample and TGX 923-2E respectively, as shown in Table 4. This suggests contamination, the possible sources of which are the raw materials used and ariel contamination. The ranges of counts place the "milk" within acceptable standards according to the report of Ihekoronye and Ngoddy (1985). They reported that milk is good if it contains approximately less than 50,000 numbers of bacteria per milliliter.

The shelf life of the milk produced at room temperature was 24 hours, this is the average shelf life reported generally for most milk and milk- based products. This is the reason why several workers are exploring the use

Table 5: Mean scores for acceptability of the soy milk samples

Parameter	TGX196-2E	TGX 923-2E	Local Sample	TGX 536-02D
Odor	3.25[a]	3.0[b]	2.25[c]	2.38[b]
Color	3.12[a]	1.75[c]	2.00[b]	1.88[c]
Texture	2.88[a]	2.25[b]	2.13[b]	1.25[c]
Sweetness	2.5[b]	3.0[a]	1.75[c]	1.5[c]

KEY: a, b and c indicate levels of acceptability, with a being the highest and c, the lowest

of chemical preservatives for prolonging the shelf life of milk products Sumati and Shalini (1986); Uriah and Iwagbe (1990).

Statistical analysis of the data on the organoleptic assay showed that there was no significant different among the variety for sweetness of their soymilk. There were significant differences, however, in the color, odor and texture of the milks.

Soymilk therefore has the potential to substitute dairy milk. From this study, it was found that TGX 923-2E yielded the highest volume of milk followed by TGX 196-2E while the local sample and TGX 536-02D produced the least quantity of the "milk".

From the results of the organoleptic assessment, TGX 196-2E had the highest mean scores and was therefore generally preferred above the others while TGX 923-2E was the least preferred since it had the lowest mean scores.

It is recommended therefore that the sample TGX 196-2E, which produced the most acceptable milk be used in milk production, while further research should be done on TGX 536-02D, which had the highest yield milk, with a view to improving the quality of its milk.

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