Tigernut-Soy Milk Drink: Preparation, Proximate Composition and Sensory Qualities

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Abstract—Tigernuts (Cyperus esculentus L.) and soybeans (Glycine max M) were processed into natural fresh Tigernut-Soy Milk Drink, TSMD (50:50 %), fresh Tigernut Milk Drink, TMD (100%) and Soymilk Drink, SMD (100%). These were evaluated for their proximate and sensory quality potentials and for possible consumption as a dessert. The milk drinks were analysed for the total energy, pH, crude protein, fat, carbohydrate, ash, crude fibre and moisture contents. The results revealed a reasonable amount of protein content of 7.95, 7.10 and 4.50% for the milk of tigernut-soy, tigernut and soybean respectively. Proximate composition showed that tigernut-soy milk blend had higher protein (7.95%) and fat (27.22%) but low pH (6.1) than soymilk and tigernut milk. Soymilk had less protein (4.50%) than tigernut milk and the blend. All the samples had high moisture content which ranged from 57.34-80.34%. Significant difference (p<0.05) existed in sensory scores of mouth feel, colour and aroma, but there was no significant (p>0.05) difference in taste and overall acceptability; although all the samples were generally accepted in terms of sensory quality. It was concluded that milk from tiger-nut and soybean be encouraged due to the high nutrient contents (protein, fat, etc) so as to solve the problem of protein–calorie malnutrition.

Index Terms— processing, proximate composition, sensory qualities, soymilk, tigernut milk

I. INTRODUCTION

Milk is an excellent source of all nutrients except iron and ascorbate [1]. Milk has been recognized as an important food for infants and growing children [2]. It is one of the main products in most pastoral system in Africa, yet the contribution of dairying to pastoral economics is often overlooked [3]. In developing countries, the cost of dairy milk and their products are prohibitive. This dramatic decrease in the consumption of milk and milk products stimulated in part the processing of milk from different seeds and nuts [4]. Though undervalued in the past, milk from plant sources are key ingredient in the diet of African countries. Recently, researchers have shown strong interest in these milk sources due to their high nutritional values and economic potentials. It is worth repeating that milk sources from plants are seen as a radiating hope as well as an ally in the fight against hidden hunger [4].

In view of the scarce milk supply in various countries and the ever increasing gap between the requirement and population, efforts have been made over the years to develop alternative milk-like products from vegetable sources [5]. Soybeans, peanuts and cowpea have been accorded high attention in the investigations on milk substitutes. However, hardly any attention has been given to the use of locally available tiger-nut as such or in combination with milk to produce a palatable ready-to-serve bottled beverage, like ‘Horchata de chufas’ as done in South Europe especially in Spain [6]. Prior to the development of such phyto milk like tigernut milk which serves as a less expensive substitute for dairy milk, direct milk consumption as a beverage was not common in Nigeria [7, 8].

Development of milk substitutes extracted from legumes serves as an alternative source of producing an acceptable nutritious drink [9]. Among the sources of vegetable milk, soybean has received very high research attention and more research is still being designed to improve the quality of soy milk [10]. Little research attention has been given to bambaranut [11], baobab [2], peanut [12], melon seed [13] and tigernut milk [14] as sources of vegetable milk.
Tigernut (Cyperus esculentus L.) belongs to the Division–Magnoliophyta, Class–Liliopsida, Order–cyperales and Family–Cyperaceae and was found to be a cosmopolitan, perennial crop of the same genus as the papyrus plant [4]. The tubers are about the size of peanuts and are abundantly produced in Nigeria. It has many other names like Zulu nut, yellow nutgrass, ground almond, chufa, edible rush and rush nut. In Nigeria, the Hausas call it “Aya”, Yorubas “imumu”, the Igbo “aki Hausa”, “ofio” in southern Nigeria [15]. Tigernut has been cultivated since early times (chiefly in south Europe and West Africa) for its small tuberous rhizomes which are eaten raw or roasted, used as hog feed or pressed for its juice to make a beverage.

Tigernut, an under-utilized crop, was reported to be high in dietary fibre content, which could be effective in the treatment and prevention of many diseases including colon cancer, coronary heart diseases, obesity, diabetes and gastrointestinal diseases [16]. It has 5.8% moisture, rich in protein (7%) [17] and carbohydrate such as reducing sugar (7.4%), soluble polysaccharide (7.4%) and starch (86.4%) [18]. According to [19] the protein in tigernut is of high biological value considering the many essential amino acids it contains. These amino acids are higher than those proposed in the standard by the [20; 21] and satisfy amino acid need of adults [22].

The nuts are valued for their highly nutritious starch content, dietary fibre, carbohydrate (mono, di and polysaccharides) [23]. The nut was reported to be rich in sucrose (17.4 to 20.0%), fat (25.50%), and protein (8%) [24]. The nut is also very rich in mineral content (Sodium, Calcium, Potassium, Magnesium, Zinc and traces of Copper [25]. Research studies have shown that 100g Tigernut contain 386 kcal (1635 kJ), 7% proteins, 36% fats (oils), 31% starch, 21% glucose, and 26% fibre of which 14% is non-soluble and 12% soluble [26]. The nuts are said to be stimulant and tonic and also used in the treatment of indigestion, colic diarrhoea, dysentery and excessive thirst [27].

Tigernut milk (having Spanish name “Horchata”) is a refreshing purely natural vegetable drink and/or dessert, which is prepared with water, sugar and tigers-nuts. It is a very nutritive, energy drink both for young and old. The qualities of Tigernut (Cyperus esculentus) in this context stimulate its inclusion in the preparation of beverage so as to provide protein-energy-rich drink at affordable price in place of animal protein/fat which is scarce and expensive.

Soybean (Glycine max) was first introduced in Nigeria in 1908 and the total area cultivated was 401,000 hectares while the yield recently was put at about 1270 kg ha-1 [28]. Soybean (Glycine max M) with 40% protein and 20% fat assumes the most predominant position in solving the nutritional imbalances prevailing. It not only provides quality macronutrients but also various other micronutrients, which are otherwise required to fight against malnutrition.

Soybean is rich in protein content and can furnish protein supply to bridge up the protein deficiency gap at low-cost than any other crop [29]. Among the numerous soy food items, soymilk (extract of soybean) had been the first product ever prepared and consumed by human since long ago. Soymilk not only provides protein but also is a source of carbohydrate, lipid, vitamins and minerals [30]. Soymilk is an alternate of dairy animal milk due to its cheaper high-quality protein. Soymilk is a healthy drink and is important for people who are allergic to cow milk protein and lactose [29].

Tigernut–Soy Milk (TSMD) is a blended, processed commodity and is a source of high quality energy, protein, minerals, and vitamins. Therefore, the objective of this study was to evaluate the efficacy of Tigernut and soybean in the preparation of beverage drink.

II. MATERIALS AND METHODS

Fresh Tiger nuts and soybean seeds were purchased from the local traders in Eke-onunwa market in Owerri, Imo State, Nigeria. The chemicals and equipment used were of analytical grade and were obtained from the Plant Physiology and Biochemistry Laboratory, University of Port Harcourt, Rivers State and Department of Food Science and Technology, Federal University of Technology, Owerri.

A. Sample preparation

These nuts and seeds were sorted; foreign materials, bad/cracked nuts and seeds which may affect the taste and keeping quality of the drink were removed, washed and rinsed with portable water and used to produce milk.

B. Tigernut milk preparation

1kg of the fresh tigernuts was blended several times into slurry with water (6L) in a Q-link auto-clean blender. The slurry was pressed using muslin cloth to extract the milk. The extract was pasteurized at 72°C for 5s. It was homogenized and rapidly cooled. The flow chart for tigernut milk drink (TMD) production is shown in Figure 1.
C. Soybean milk preparation
1 kg of soybeans was soaked overnight for 18 h in a
3 L of warm portable water to give a bean: water ratio
of 1:3. The beans were then drained, rinsed with
portable water and blanched for 5 min in boiling
water. The blanched beans were drained, dehulled
and ground with 750 ml of portable water in a Q-link
auto-clean blender. The resulting slurry was filtered
through a muslin cloth and the extract (milk)
obtained was boiled for 15 min. The flow chart for
soymilk production is shown in Figure 2.

Figure 1: Flow chart for Tigernut milk drink production
Soybean seeds

Sorting and washing

Soaking (18h)

Blanching (for 5min)

Draining

Dehulling

Grinding / milling

Diluting with water (1:3)

Sieving/ filtering

Boiling (for 15min)

Cooling

Soymilk

Figure 2: Flow chart for soymilk production (SMD).

D. Tigernut-soy milk drink (TSMD) preparation
Tigernut milk (TM) and soymilk (SM) was mixed at equal proportion (TM: SM); 50:50 to obtain the final product (TSMD). This was done using a food blender operated at full speed for 10min. The resulting blend was homogenized and pasteurized at 72°C for 5s in a water bath and cooled immediately to room temperature (28±2°C) for analysis. The flow chart for tigernut-soymilk drink production is shown in Figure 3. From there samples for proximate analysis and sensory evaluation were taken. All analyses were carried out in duplicate for each sample and results obtained were computed into means. These were subjected to analysis of variance (ANOVA).
E. Proximate analysis
Moisture, ash, crude protein, crude fibre, and pH were determined according to standard methods [31], carbohydrate was determined by difference. Fat was determined by the method described by [32] and the total energy was estimated using the modified Atwater factors, thus: (protein x4) + (fat x9) + (CHO x 1.1 x 3.75) [33].

F. Sensory evaluation
Samples were subjected to sensory evaluation using twenty panelists randomly selected from the university community. Panelists rated the products for overall acceptability and sensory attributes of colour, aroma, taste and mouthfeel using 9-point hedonic scale [34].
G. Statistical analysis
Data were subjected to Analysis of Variance (ANOVA) and Turkey’s test was used for comparison of means. Statistical significance was accepted at p<0.05 [34].

III. RESULTS AND DISCUSSION
The results of the proximate composition and sensory evaluation of the samples are shown in table I and II respectively. The protein content was higher for TSMD than for TMD and SMD. The results agreed with the report of [35; 36]. High crude protein of TSMD could probably be due to high crude protein of Tigernut. [37] also found similar protein increase in tigernut. The pH value for Tigernut milk was higher than that of other samples (SMD and TSMD). This shows that Tigernut is less acidic and implies that milk prepared from Tigernut will be acceptable to patient with ulcer and other related problems since it is less acidic. This confirms the assertion of [27] that Tigernuts are regarded as stimulant and tonic and it can be used in the treatment of indigestion, colic diarrhea and dysentery. These pH values fell within the value reported by [36] who used Tigernut for the preparation of yoghurt, [38] and [39] who used Tigernut for the preparation of Kunnu. The TSMD had the highest fat content (27.22%) which may be attributed to high content of fat in the tigernut and soya bean. Tigernut, itself was reported to be rich in fat (25.50%) [39] The level in the milk samples was higher than the minimum (3%) level required by the Codex Alimentarius Standard [40]. High total energy content of TMD and TSMD could be probably due to high contents of protein and fat. The total energy value of the milk is from the fat content hence, higher fat content is an indication of more total energies available [4]. Total ash in the samples was lower than ash content of 1.5% as reported by [14] with the exception of TSMD which had ash content of 2.45% and was significantly (p<0.05) different from others. All samples had high moisture contents between 57.34- 80.34%. This could affect the stability and safety of food with respect to microbial growth and proliferation hence the products require cold storage. The milk samples had carbohydrate contents between 2.7-10% and crude fibre contents between 0.20-0.24%.

The sensory scores revealed various significant differences in all the parameters evaluated. Although the highest taste, aroma, mouth feel and overall acceptability were recorded for SMD, tigernut-soy milk blend (TSMD) was still highly acceptable to the panelists. The higher values for SMD may be due to longtime familiarity with products from soya bean. All the samples were generally acceptable to the panelists, thus there was no significant difference (p>0.05) in taste and overall acceptability. It was noted from this study that the mouth feel values for TMD and TSMD were lower than that for SMD which still remained unclear but TMD and TSMD had higher fat contents. This is contrary to the findings of [41] who reported that fat is known to promote good mouth feel.

TABLE I
MEAN VALUES FOR PROXIMATE COMPOSITION, PH AND TOTAL ENERGY OF TMD, SMD AND TSMD

<table>
<thead>
<tr>
<th>Sample</th>
<th>Protein %</th>
<th>Carbohydrate%</th>
<th>Fat %</th>
<th>Crude fibre %</th>
<th>Ash %</th>
<th>Moisture%</th>
<th>pH</th>
<th>Total energy(cal)</th>
</tr>
</thead>
<tbody>
<tr>
<td>TMD</td>
<td>7.10&lt;sup&gt;b&lt;/sup&gt;</td>
<td>2.70&lt;sup&gt;c&lt;/sup&gt;</td>
<td>24.50&lt;sup&gt;a&lt;/sup&gt;</td>
<td>0.22&lt;sup&gt;b&lt;/sup&gt;</td>
<td>0.46&lt;sup&gt;b&lt;/sup&gt;</td>
<td>65.02&lt;sup&gt;a&lt;/sup&gt;</td>
<td>6.70&lt;sup&gt;a&lt;/sup&gt;</td>
<td>259.70&lt;sup&gt;b&lt;/sup&gt;</td>
</tr>
<tr>
<td>SMD</td>
<td>4.50&lt;sup&gt;c&lt;/sup&gt;</td>
<td>10.0&lt;sup&gt;a&lt;/sup&gt;</td>
<td>4.30&lt;sup&gt;b&lt;/sup&gt;</td>
<td>0.20&lt;sup&gt;c&lt;/sup&gt;</td>
<td>0.66&lt;sup&gt;b&lt;/sup&gt;</td>
<td>80.34&lt;sup&gt;a&lt;/sup&gt;</td>
<td>6.34&lt;sup&gt;b&lt;/sup&gt;</td>
<td>96.70&lt;sup&gt;c&lt;/sup&gt;</td>
</tr>
<tr>
<td>TSMD</td>
<td>7.95&lt;sup&gt;a&lt;/sup&gt;</td>
<td>4.80&lt;sup&gt;b&lt;/sup&gt;</td>
<td>27.22&lt;sup&gt;a&lt;/sup&gt;</td>
<td>0.24&lt;sup&gt;a&lt;/sup&gt;</td>
<td>2.45&lt;sup&gt;a&lt;/sup&gt;</td>
<td>57.34&lt;sup&gt;a&lt;/sup&gt;</td>
<td>6.10&lt;sup&gt;c&lt;/sup&gt;</td>
<td>295.98&lt;sup&gt;a&lt;/sup&gt;</td>
</tr>
<tr>
<td>±SEM</td>
<td>0.17</td>
<td>0.25</td>
<td>3.65</td>
<td>0.01</td>
<td>1.29</td>
<td>66.5</td>
<td>0.06</td>
<td>13.9</td>
</tr>
</tbody>
</table>

Means with different superscript in each column are significantly different (p<0.05). SEM = Standard Error of Mean; TMD=100% tigernut milk; SMD= 100% soymilk; TSMD= 50% tigernut milk+50% soymilk.
### TABLE II

**SENSORY EVALUATION SCORES FOR TMD, SMD AND TSMD**

<table>
<thead>
<tr>
<th>Sample</th>
<th>Colour</th>
<th>Aroma</th>
<th>Taste</th>
<th>Mouth feel</th>
<th>Overall acceptability</th>
</tr>
</thead>
<tbody>
<tr>
<td>TMD</td>
<td>6.85&lt;sup&gt;b&lt;/sup&gt;</td>
<td>5.45&lt;sup&gt;b&lt;/sup&gt;</td>
<td>5.8&lt;sup&gt;a&lt;/sup&gt;</td>
<td>5.3&lt;sup&gt;b&lt;/sup&gt;</td>
<td>6.2&lt;sup&gt;a&lt;/sup&gt;</td>
</tr>
<tr>
<td>SMD</td>
<td>8.40&lt;sup&gt;a&lt;/sup&gt;</td>
<td>7.40&lt;sup&gt;a&lt;/sup&gt;</td>
<td>7.5&lt;sup&gt;a&lt;/sup&gt;</td>
<td>7.8&lt;sup&gt;a&lt;/sup&gt;</td>
<td>7.0&lt;sup&gt;a&lt;/sup&gt;</td>
</tr>
<tr>
<td>TSMD</td>
<td>7.85&lt;sup&gt;a&lt;/sup&gt;</td>
<td>6.35&lt;sup&gt;b&lt;/sup&gt;</td>
<td>6.1&lt;sup&gt;a&lt;/sup&gt;</td>
<td>5.7&lt;sup&gt;b&lt;/sup&gt;</td>
<td>6.7&lt;sup&gt;a&lt;/sup&gt;</td>
</tr>
<tr>
<td>LSD</td>
<td>0.66</td>
<td>1.0</td>
<td>1.71</td>
<td>1.22</td>
<td>2.07</td>
</tr>
</tbody>
</table>

Means with different superscript in each column are significantly different (p<0.05). LSD = Least Significant Difference; TMD=100% tigernut milk; SMD= 100% soymilk; TSMD= 50% tigernut milk+50% soymilk.
IV. CONCLUSION

The result revealed that milk prepared from Tigernut and soybean could be used as a beverage for both the young and old persons due to the high nutrient contents (protein, fat, etc.). Based on the sensory evaluation, the Tigernut-soy milk blend and Tigernut milk were also acceptable. This indicates that utilization of Tigernut will be enhanced when processed into beverage drinks. It is therefore suggested that milk from tiger-nut and soybean be encouraged so as to solve the problem of protein– calorie malnutrition in Africa in particular and the world in general; as these milk drinks also possess almost similar properties as that of cow milk.

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REFERENCES


