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Comparative Physico-Chemical Evaluation of Tiger-nut, Soybean and Coconut Milk Sources

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ABSTRACT

Milk of tiger nut (A), coconut (B) and soybean (C) were evaluated for their nutritional quality potentials and for possible inclusion in the preparation of various confectionary products. The milk were analyzed for the total solids, pH, protein, fat, titrable acidity, calcium and phosphorus contents. The results revealed a crude protein content of 8.07, 7.87 and 8.90% for the milk of tiger-nut, coconut and soybean respectively. The fat content was highest in coconut milk and tiger-nut while soymilk had the least. The dry matter was highest for coconut milk while soymilk and tiger-nut milk had similar ($P > 0.05$) percentage. The calcium content was 8.75% (A), 3.01% (B) and 9.25% (C). The phosphorus was greatest for C followed closely by A and the least for B. The total energy (k.cal 100^{-1}g) was estimated as 388.30 (A), 332 (B) and 100.52 (C). The study also revealed highest oleic acid (68.83%) in tiger-nut while lauric acid and capric acids were highest in coconut milk compared with other sources. It was concluded that all the milk samples are potentially good source of dietary protein and energy supplement for human consumption.

Key Words: coconut milk; Soymilk; Tiger-nut milk.

INTRODUCTION

Milk is one of the main products in most pastoral system in Africa, yet the contribution of dairying to pastoral economics often overlooked (Kerven, 1986). In Africa, milk will not only meet 30% of the pastoral family caloric requirements but, also has a vital exchange value, while bartering dairy products enables pastoralists to grow less crop and concentrate on herd management. The cash generated through dairy sales is partly used to purchase food grains.

It is noteworthy, that the dairy sub sector in Africa is thus relegated to the category of subsistence system of production due to minor and peripheral status accorded the sector by various government policies. Allied with the above, are poor nutrition and genetic constitution of the Africa breeds of ruminants. The above problems lead to insufficient milk available to the people with average per capita daily consumption of 15 L of milk. This dramatic decrease in the consumption of milk and milk products stimulated in part the processing of milk from different seeds and nuts.

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 worthy repeating that milk sources from plants are seen as a radiating hope as well as an ally in the fight against hidden hunger. All the nuts and the seeds of interest in the present study are found on the tropical environment including Nigeria for various purposes.

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} (Menesses *et al.*, 1996). Its seed has a close protein content and fairly close amino-acids with cow milk. The beans can be utilized in the liquid, powdery and curd forms for human consumption. The oil could be converted to margarine and salad oil. The meal is used as animal feed (Pfizer, 2002). Soybean was used to fortify maize custard while soft cheese and yoghurt could be prepared from soybeans. Recently, Belewu *et al.* (2005) documented the combination of soymilk (50%) and coconut milk (50%) in the preparation of soy-coconut yoghurt.

Coconut (*Cocos nucifer*a) milk is being used by confectionaries, bakeries, biscuits and ice cream industries worldwide to enhance flavour and taste of various products (Persley, 1992). Coconut juice was found to be rich in calcium (800 mg) while the protein and fat contents were 50 and 65 g respectively. The energy content was 61.0 kilocalories and the total available carbohydrate was 300 g. The milk was reported to be high in minerals and vitamin content (Nieuwentus & Nieuwelink, 2002) while total saturated fat was 10% of the total energy (Thai Food Composition, 2004). Percentage energy distribution from protein, total fat and carbohydrate was 10:30:60.

Tiger-nut (*Cyperus esculentus L.)* belongs to the division–*Magnoliophyta,* class*liliopsida,* order – *cyperales an*d family–*cyperaceae* (family) was found to be a cosmopolitan perennial crop of the same genus as the papyrus plant. Other names of the plant are earth almond as well as yellow nut grass (The Columbia Electronic

Encyclopedia, 2004). Tiger-nut has been cultivated since early times (chiefly in south Europe & 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. Non-drying oil (usually called chufa) is equally obtained from the rhizome. In West Africa, the plant is gathered from the wild while it is a troublesome weed in planted field in S. United States (The Columbia Electronic Encyclopedia, 2004). The nut was found to be rich in myristic acid, oleic acid, linoleic acid (Eteshola & Oraedu, 1996). Tiger-nut was reported as very healthy and it helps in preventing heart attacks, thrombosis and activates blood circulation. It helps in preventing cancer, due to high content of soluble glucose. It was also found to assist in reducing the risk of colon cancer (Anonymous, 2005). A very high fiber content combined with a delicious taste makes tiger-nut ideal for healthy eating (Anonymous, 2005). The nut is rich in energy content (starch, fat, sugars & protein) mineral (phosphorus, potassium) and vitamins E and C (Anonymous, 2005). Tiger-nut reduces the risk of colon cancer and it is suitable for diabetic persons and also helps in loosing weight (Anonymous, 2005). Tiger-nut was equally reported to have high content of oleic acid with positive effect on cholesterol level due to high content of vitamin E). The nut was found to be ideal for children, older persons and sportsmen (Martinez, 2003). The inclusion of 33.33% of tiger-nut in the diet of cockerel starters was reported by Bamgbose *et al.* (2003). The thrust of this study was to evaluate the nutritional qualities of kunnu prepared from three different plant milk sources (Tiger-nut, Coconut & Soybean).

MATERIALS AND METHODS

Milk was carefully extracted from two nuts (tiger-nut and coconut) and a seed (soybeans).

Preparation of Coconut Milk. Coconut milk was prepared by shelling the nut and the meat was separated from the shell using a dull knife. The brown skin was removed from the coconut meat with a razor blade and the meat was thoroughly washed and later grated. The grated meat was put in a bowl and a little warm water was added and left for a few minutes to extract the oil, milk and the aromatic compounds. The extract was later filtered with 0.18mm sieve and squeezed, so as to obtain a milky-white opaque emulsion with a sweet coconut flavour while the chaff was discarded.

Preparation of Soymilk. Soymilk was prepared by the method described by Mital *et al.* (1974) and Belewu *et al.* (2005). Briefly 1 kg of soybeans was soaked for 6 h in a 3 L of warm distilled water, it was later drained and another 6 L of boiled distilled water was added for about 5 minutes so as to inactive lipoxygenase and other anti-nutritional factors. The soaked bean was later blended several times with a blender (Model SHE, 505) and then centrifuged to separate the soymilk from the insoluble residue.

Preparation of Tiger-nut milk. The tiger-nut used was properly picked, washed and rinsed in distilled water. While, 6 L of distilled water was added to 1 kg of the tiger-nut and later blended several times with a blender and hence centrifuged to separate the milk from the insoluble residue. The three different milk sources formed treatments A (Tiger-nut milk), treatment B (Coconut milk) and treatment C (Soymilk).

Chemical and Statistical Analyses. Twenty replicate samples of the respective milk sources were analyzed for protein, ash, total solids, pH, titrable acidity, calcium and phosphorus contents. (AOAC, 1990). Fat was determined by the method of Gerber (BSH 1955). The fatty acid profile was obtained from the lipids by methylation and analysed on a Gas-liquid chromatograh. The separation was carried out on a chromatograph model PYE 104 filled with a column of 10% DEGS on chromosorb WHP 100-120. Methyl esters were separated at 250^0C using nitrogen at 35 *psi* pressure and flame ionization detector. The total energy was estimated using the modified Atwater factors, thus: (protein(g) x4) + (fat (g) x9) + (CHO(g) x 1.1 x 3.75) (Hunt *et al.*, 1987). Digestible crude protein (g) = Protein (g) x 0.96 – 4.21 (Barret and Larkin, 1977).

All data were subjected to statistical analysis of a completely randomized design model (Steel & Torrie, 1980) and means were separated by multiple range test (Duncan, 1955).

RESULTS AND DISCUSSION

Results of the proximate composition (Table I) revealed that with the exception of pH and titrable acidity, the different milk sources varied significantly ($p<0.05$) in their nutrient contents and the estimated digestible crude protein. The protein content was greatest for treatment C (Soymilk), greater for treatment B (Coconut milk) and great for treatment C (Tiger-nut milk). However, no marked variation in protein content existed between coconut milk and soymilk, but, they were superior to tiger-nut milk (6.07%). The digestible crude protein content of tiger-nut and soymilk were similar but varied significantly from that of coconut ($P < 0.05$).

The three milk sources analyzed in this study contained appreciable amount of fat ranging from 4.30% in treatment C (Soymilk) to 26.18% in Tiger-nut milk, whereas no marked variation between treatment A (Tiger-nut milk) and treatment B (coconut milk). In addition, treatments A (Tiger-nut) and B (Coconut milk) contained about 8-9 times the mean fat content of cow, goat or sheep milk. The fat content falls within the range reported by Belewu *et al.* (2005). Numerically, the fat content of soymilk was similar to the fat content of the milk of cow, sheep and goat in percentage.

High fat content of coconut milk and tiger-nut milk further enhances their utilization for the extraction of edible oil thereby enhancing their nutrient densities as well as boosting their value as alternative feed supplement in

Table I. Proximate composition and digestible crude protein contents of three different milk sources:

Content (%)	Treatments			±SEM
	A	B	C	
Dry matter	7.73[a]	10.20[b]	8.37[a]	3.12*
Crude protein	8.07[a]	7.87[b]	8.90[b]	2.51*
Digestible crude protein	4.02[a]	3.35[b]	4.33[a]	1.75*
Total ash	0.47	0.51	0.66	0.03NS
Fat	26.18[a]	24.10[b]	4.30[a]	1.80
pH	6.12	6.23	6.20	2.03 NS
Titrable acidity	0.16	0.15	0.17	0.02 NS
Calcium	8.75[a]	9.40[b]	9.50	1.95*
Phosphorus	10.57[a]	2.14[b]	12.65[a]	2.17*
Total Energy (Kcal. 100^{-1}g)	388.30[a]	332.20[b]	100.52[c]	8.53

Mean followed by different superscripts along the same row are significant ($P<0.05$) different.
NS = Not significant different ($P>0.05$)
* Means of 20 determinations.

Table II. Principal fatty acid composition (%) in the milk sources of tiger nut, coconut and soybean

Fatty acids	Tiger nut	Coconut	Soybean	±SEM
Myristic acid	0.08[a]	18.30[b]	Trace	1.32*
Oleic acid	68.38[a]	7.30[b]	23.15[c]	3.10*
Linoleic acid	11.70[a]	1.60[b]	51.20[c]	1.13*
Lauric acid	Trace	56.23	Trace	-
Palmitic acid	13.19[a]	8.95[b]	12.30[a]	3.75*
Capric acid	-	8.90	-	-

human and livestock diets.

On the other hand, the calcium content which ranged from 800 to 950 mg was found to be adequate per day for human being (WHO/FAO, 2002) thereby preventing fracture risk. However, phosphorus content was lowest for treatment B while treatments A and C are similar ($p>0.05$). The caloric value was highest for treatment A (tiger-nut) closely followed by treatment B (coconut milk) and least for soy milk. The highest oleic acid content of treatment A (tiger-nut milk) prevents chemical decomposition, improves digestive secretion, and was recommended for the prevention of nutritional therapy. The content of the linoleic acid of treatment A (tiger-nut milk) covers the daily minimum needs of human being.

The implication of using the three different milk sources in the diet is the 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. The highest oleic and lauric acid content of coconut milk were noted for their unique properties in feed as it help in preventing arteriosclerosis and related illness (Ukwuoma & Muanya, 2003).

CONCLUSION

High price of imported milk and milk products coupled with poor milk production in Nigeria in particular and Africa in general seem to have made consumers more ready to accept milk produced from plant sources hence it is suggested that milk from tiger-nut, soybean and coconut should be encouraged so as to solve the problem of protein – calorie malnutrition in Africa. However, there is the need to further investigate the sensory quality and consumer acceptability of tiger-nut in making various confectionaries.

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