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Proximate Composition And Physicochemical Properties Of African Breadfruit-Corn Milk

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***Abstract:** The objective of this study was to develop quality milk analogue from local plant source comparable to soymilk. Plain milk extracts were separately extracted from African breadfruit (Treculia africana var africana) and sweet corn (Golden cob F1). A portion of each extract was blended on breadfruit: corn proportion of 60:40. Plain soymilk was extracted from soybean (TGX 573-IE). The plain milks were similarly formulated except that sucrose was not added to the corn milk due to the natural sweetness of sweet corn. The milk samples were analyzed for proximate composition and physiochemical properties using soymilk as a control. There was significant difference ($p < 0.05$) in moisture content, protein, fat, ash crude fibre and carbohydrate of the milk samples. The positive contribution effect of the sweet corn and the breadfruit accounted for good proximate values of the breadfruit-corn milk. The breadfruit-corn milk exhibited better physicochemical properties than the soymilk.*

***Keywords:** Corn milk, breadfruit milk, breadfruit-corn milk and soymilk.*

I. INTRODUCTION

Milk is a pale liquid produced by the mammary glands of mammals and is the primary source of nutrition for young mammals before they are able to digest other types of food (Pehressan et al., 2000).

Humans first learned to regularly consume the milk of other mammals following the domestication of animals during the Neothlithic Revolution or the development of agriculture. This development occurred independently in several places around the world from as early as 9000 to 700BC in South West Asia (Bellwood, 2005a) to 3500 to 3000BC in the Americas (Bellwood, 2005b).

In developing countries, the cost of dairy milk and their product are prohibitive which has over the years stimulated efforts to develop alternative milk-like products from different seeds, grains and legumes (Belewu and Belewu, 2007; Udeozor, 2012). Shurtleft and Aoyagi (2013) reported that the earliest seen document that mentions non-dairy almond milk dates as far back as 1226.

Vegetable milk (alternative milk or milk analogue) can be obtained from legumes and oil seeds such as soybean (Fabiyi, 2006; Tunde-Akintunde and Souley, 2007; Odu et al., 2012), bambara nut (Obizoba and Egbuna, 1992), breadfruit seeds, (Onweluzo and Nwakalor, 2009), baobab (Obizoba and Anyika, 1995), tiger nut (Ukwuru and Ogbodo, 2011), groundnut (Odo, 2001; Adeiye et al., 2013), corn (Supavitipatana 2010), melon seeds (Akubor, 1998) among others.

To further improve and diversify the food and nutrition situation of low income families in the developing world, some legumes, cereals and nuts have been blended to obtain milk analogue as in tiger nut – soy milk (Udeozor, 2012), soy-corn milk (Omueti and Ajomale, 20005; Kolapo and Oladimeji, 2008; Trisnawati et al., 2013), bambara nut-tiger nut- coconut milk (Okorie et al., 2014; Adedokun et al., 2012).

Research work on breadfruit milk (Onweluzo and Nwakalor, 2009) and corn milk (Supavititpana et al., 2010) revealed the high nutritional values of both milks. Reports of legume – cereal milk blends by authors in the preceding paragraph provided positive contribution effects as evident on the enhanced quality of resultant products. Considering the quality attributes of breadfruit and corn it is envisioned that blending their milk extracts could result in high quality nutrient beverage. This will assist in combating protein calorie malnutrition among low income earners as well as complement protein calorie malnutrition among the low income earners, as well as add value to these agricultural materials.

II. MATERIALS AND METHOD

A. SOURCE OF RAW MATERIALS

The seeds of African breadfruit (*Treculia africana var africana*) and soybean (*TGX 573-IE*) were purchased from Oye Agu Market Abagana, Njikoka L.G.A, Anambra State, Nigeria. Green field sweet corn (*Golden cob F1*) was purchased from Songhai Farm, Heneke, Ezeagu L.G.A., Enugu State, Nigeria.

B. PRODUCTION OF DIFFERENT MILK SAMPLES

The production of milk samples followed purchasing and preparation of the raw materials.

a. PREPARATION OF BREADFRUIT MILK

The method described by Onweluzo and Nwakalor (2009) was slightly modified. Approximately 2 kg of dehulled breadfruit seeds was washed before soaking in potable water for 6 h. The water used in soaking was changed every 2 h during the 6 h duration to avoid fermentation and to eliminate foul odour and greasy substances, thereby providing fresh clean seeds. The soaked seeds were repeatedly washed before wet-milling in a variable speed blender (SB-736, Sonic, Japan) with intermittent addition of distilled water. The slurry was filtered through double layer linen cloth and the residue was wet-milled twice more to ensure optimum juice yield, while maintaining final seeds to water ratio of 1:3 (w/v). The filtrate was boiled for 20 min with continuous stirring and was subsequently re-filtered to obtain plain breadfruit milk which was subsequently formulated (see Fig.1).

b. PRODUCTION OF CORN MILK

Preparation of corn grains followed the method of Ihekoronye and Ngoddy (1985). The green field sweet corn was firstly husked, the silks removed and washed in clean water. The grains were separated from the cobs using knife, cleaned to remove hairs and other extraneous materials to obtain clean grains. Milk extraction followed the method of Supavititpatana et al. (2010) with modification. Approximately 1kg of clean grains was soaked in potable water for 6 h with soak water replaced every 2 h to avoid fermentation. This was repeatedly washed, rinsed with distilled water and wet-milled in a variable speed blender, with intermittent addition of distilled water as before. The slurry was filtered through double layer linen cloth and the residue was wet-milled twice more for maximum juice extraction, with final grain to water ratio of 1:3 (w/v). The filtrate was boiled for 15 min, re-filtered to give plain corn milk which was subsequently formulated (see Fig.2).

c. BREADFRUIT-CORN MILK

Appropriate portions of the previously produced breadfruit milk and corn milk were blended on 60:40 proportions (v/v) to obtain plain breadfruit–corn milk which was subsequently formulated (see Fig.3).

d. PRODUCTION OF SOYMILK

The cold extraction method of Udeozor (2012) was used.

About 1 kg of seeds were sorted, washed and soaked in excess volume of potable water for 8 h, decanted and boiled for 30 mm. The grains were threshed out and washed repeatedly to obtain clean cotyledons before wet-milling and filtering as before. The filtrate was boiled for 20 min, re-filtered to obtain plain soymilk for subsequent formulation.

e. MILK FORMULATION

The four plain milks were similarly formulated with emulsifier (0.02% glyceryl monosterate), stabilizer (0.02% carrageenan), milk flavor (to taste), and preservatives (0.01% sodium benzoate and 0.01% potassium sorbate). About 2% sucrose was added as sweetener to other milk samples except the corn milk due to natural sweetness of sweet corn. The milks were separately homogenized in a 5 – speed hand mixer (MC – HM 6630 Master Chef and Crown Star, China), pasteurized at 65^{0}C for 15 min, hot-filled into 250 ml screw capped plastic bottles, rapidly cooled and stored at ambient temperature.

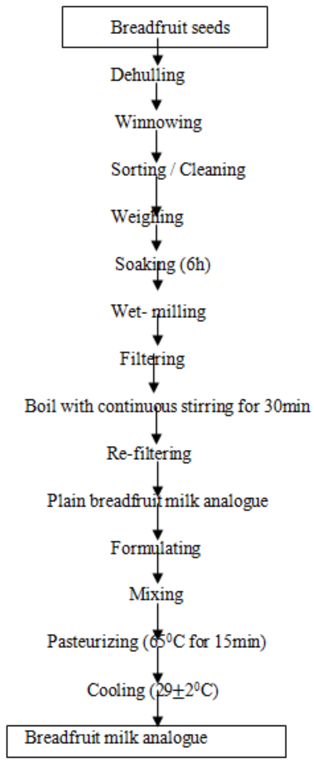

Figure 1: Flow chart for the production of breadfruit milk

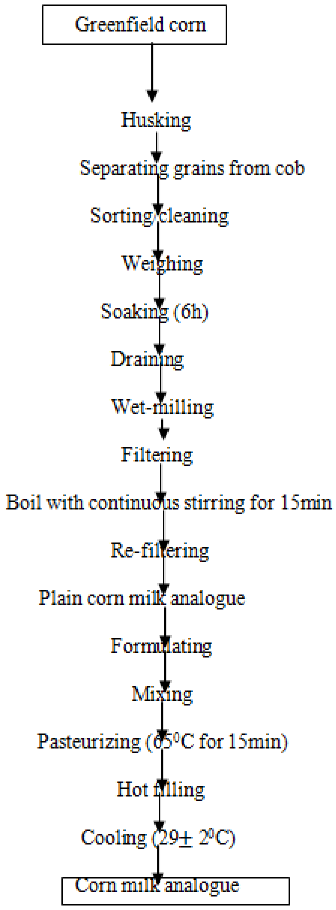

Figure 2: Flow chart for the production of corn

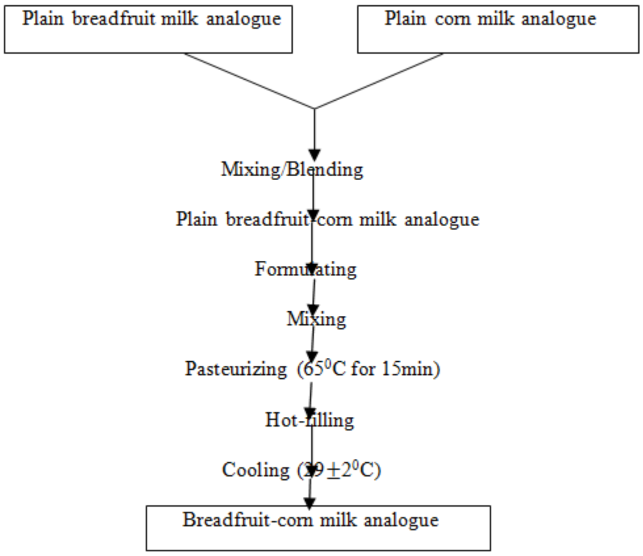

Figure 3: Flow chart for the production of breadfruit-corn milk

Proximate Analysis

The Proximate analysis was conducted using the methods of AOAC (2000).

C. MOISTURE CONTENT

About 2 g of sample was weighed into previously washed, dried and weighed Petri dish. This was dried in air oven at 103 ± 2^0C for 1 h. The result was noted and the sample was heat for another 1 h until a steady result was obtained.

$$\% \text{ Moisture content} = \frac{W_1 - W_2}{\text{weight of sample}} \text{ x } \frac{1000}{1}$$

Where W_1 = weight of Petri dish and sample before drying
W_2 = weight of Petri dish and sample after drying

a. ASH CONTENT

About 2 g of sample was weighed into previously washed, dried and weighed platinum crucibles. The sample was burnt in a muffle furnace at 500^0C for 3 h, cooled in desiccators and weighted.

$$\% \text{ Ash content} = \frac{W_3 - W_1}{W_2 - W_1} \text{ x } \frac{1000}{1}$$

Where W_1 = weight of empty platinum crucible
W_2 = weight of platinum crucible and sample before turning
W_3 = weight of platinum and ash

b. CRUDE FIBRE

About 2 g of sample was weighed in a beaker and boiled with 200 ml of a solution containing 1.25 g of carbonate free NaOH per 100 ml. The final residue was filtered through a thin but closed pad of washed and ignited asbestos in Gooche crucible. This was subsequently dried in an electric oven and weighed. It was afterwards incinerated, cooled and reweighed. The loss in weight after incineration is the weight of the fibre.

$$\% \text{ Crude fiber} = \frac{\text{weight of fibre}}{\text{weigh of sample}} \text{ x } \frac{100}{1}$$

c. CRUDE FAT

Approximately 2 g of sample was placed in an extraction thimble and was plugged lightly with cotton wool. Previously clean, dried and weighed boiling flask was filled with about 200 ml of petroleum ether (boiling point 40 to 60^0C). The soxhlet apparatus was assembled and allowed to reflux for about 6 h. The thimble was removed with care and petroleum other was recovered for re-use. When the flask was almost free of petroleum ether it was removed and dried at 105 to110^0C for 1 h. This was transferred into desiccators and allowed to cool, before weighing.

The weight so obtained was expressed as a percentage of the 2 g sample used.

d. CRUDE PROTEIN

Approximately 2 g of sample was weighed into a 300 ml kjehdal flask (gently to prevent the sample from touching the surface) and 20 ml concentrated sulphuric acid was added. The flask was stoppered and shaken. Then 0.5 g of the kjehdal catalyst mixture was added. The mixture was heated cautiously in a digestion rack under fire until a clear solution appeared. The clear solution was allowed to cool before 100 ml of distilled water was added to avoid caking and then 50 ml was transferred to the kjehdal distillation apparatus.

A 100 ml receiver flask containing 5 ml of 2% boric acid and indicator mixture containing 5 drops of bromocreasol blue and 1 drop of methylene blue was placed under a condenser of the distillation apparatus so that the tap was about 20 cm inside the solution. About 5 ml of 40% sodium hydroxide was added to the digested sample in the apparatus and distillation commenced immediately until 50 drops got into the receiver flask after which it was titrated to pink colour using 0.01N hydrochloric acid.

% Nitrogen = Titre value x 0.01 x 1 x 4

% Protein = % Nitrogen x 6.25

e. CARBOHYDRATE

The percentage carbohydrate was determined by differential method.

100 – (% Moisture + % Ash + % fiber + % fat + % protein),

D. DETERMINATION OF PHYSIOCHEMICAL PROPERTIES

a. TITRATABLE ACIDITY

Titratabe acidity was determined using the method described by Adeiye et al. (2013). Approximately 20 g of the milk sample was weighed into 250 ml conical flask and diluted with twice its volume of distilled water. 2 ml of phenolphthalein indicator was added to the mixture and this was titrated with 0.1N sodium hydroxide NaOH to a persistent pink colour. The titratable acidity was reported as % lactic acid by weight using 1 ml 0.1NaOH = 0.0090 g lactic acid (AOAC, 1990).

b. PH

The pH of sample was measured by electrometric method using laboratory PH Meter Hanna model H1991300 (APHA, 1995).

c. VISCOSITY

Approximately 30 ml of sample was filled into a 50 ml beaker. Viscosity was measured using Oswald type viscometer.

d. TOTAL SOLIDS

Total solids was obtained by differential method

% Total solids = 100 - moisture content.

e. APPARENT COLLOIDAL STABILITY

Apparent colloidal stability was measured using the method of Omueti and Ajomale (1998). Milk samples were placed in graduated tubes and held in racks in the refrigerator undisturbed at 4 ± 1^0C. Changes in apparent colloidal stability was indicated by separation into two layers. Level of visible line of demarcation between the settled and remaining portion of the milk solution was measured (height in cm) and recorded over 0 h, 24 h, 48 h and 72 h.

f. FOAM STABILITY

Foam stability was determined using the method of Onyesom et al. (2005) with slight modification. Approximately 2 ml of sample was blended with 40 ml of distilled water at high speed in a variable speed blender for 60 s. At the end of blending, the samples were transferred into 100 ml graduated cylinder. The volume of foam in the standing cylinder after whipping was recorded as foam stability at 1, 10, 30, 60 and 90 mm.

g. EMULSION STABILITY

Emulsion stability was determined using modified method of Onyesom et al. (2005). Approximately 2 ml of each sample was dispersed in 15 ml of distilled water. Then 15 ml of vegetable oil was added at a rate of 15 ml/130 s while blending in a variable speed blender at high speed for an additional 60 s before transferring into a 50 ml graduated cylinder. Volumetric changes in the foam, oil and aqueous layers were recorded after 0.5 h, 20 h and 6.0 h.

h. STATISTICAL ANALYSIS

Data obtained were subjected to one way analysis of variance (ANOVA) using SPSS version 17.0 and the differences between mean values were evaluated at p< 0.05 using Post Hoc Multiple Comparison Test.

III. RESULTS AND DISCUSSION

Parameter	CMA	BMA	BCM	SMA
Moisture (%)	$85.30^C\pm1.04$	$86.87^b\pm0.42$	$85.87^c\pm0.62$	$89.60^a\pm0.44$
Protein	$3.91^d\pm0.12$	$4.76^a\pm0.04$	$4.04^c\pm0.07$	$4.23^b\pm0.07$
Fat	$0.45^d\pm0.00$	$0.76^b\pm0.01$	$0.63^c\pm0.01$	$0.89^a\pm0.04$
Ash	$2.46^a\pm0.06$	$1.88^c\pm0.04$	$2.34^b\pm0.06$	$0.80^d\pm0.01$
Crude fibre	$3.70^c\pm0.06$	$5.07^a\pm0.04$	$4.91^b\pm0.11$	$1.76^d\pm0.38$
Carbohydrate	$4.57^a\pm1.04$	$2.54^d\pm0.42$	$3.55^b\pm0.62$	$3.14^c\pm0.51$

Means within a row followed by different superscript are significantly different (p<0.05).
CMA=Corn milk, BMA=Breadfruit milk, BCM=Breadfruit-corn milk, SMA=Soymilk

Table 1: Proximate composition of milk samples

A. PROXIMATE COMPOSITION

The proximate composition of milk samples are as shown in Table 1. The moisture content range of 85.30 to 89.60% correlated with values obtained previously for vegetable milks (Tunde-Akintunde and Souley, 2009; Onweluzo and Nwakalor, 2009; Ukwuru and Ogbodo, 2011; Adedokun et al., 2014). Moisture content is controlled by the seed to water ratio during milling and level of thermal treatment thereafter. High moisture content of product could affect the stability and safety of food with respect to microbial growth and proliferation, hence requiring cold storage (Odu et al., 2012).

The soymilk was significantly (p<0.05) higher in protein than the breadfruit-corn milk. The protein content of the BCM was however higher than the values reported for soymilk of 2.66 to 2.81% (Odu et al., 2012), 3.2% (Onweluzo and Nwakalor, 2009), 2.7% (Nnam, 2003), but lower than 5.2% reported by Yazici et al. (1997). Ukwuru and Ogbodo (2011) reported the effect of treatment process on protein content and observed that high temperature extraction led to decrease in protein yield. The high protein values in this study may be due to treatment method such as soaking which resulted to tender product with finer slurry in addition to repeated milling and filtration. Finer slurry allows increased passage of filtrate while delayed filtration help to increase solubility of the protein thereby increasing yield. Furthermore, the mild extraction temperature might have discouraged denaturing of protein cells. Of important consideration is the raw material, since seed variety greatly affects protein content of vegetable milk (Minet et al., 2005; Gesinde et al., 2008). The use of the sweet corn variety might have favoured the good protein value of the BCM. Trisnawati et al. (2013) reported that yellow corn normally produced soy-corn milk with highest protein content and invitro protein digestibility (IVPD). It is noteworthy that the protein content of all the milk samples compared favorably with the 3.5% of dairy milk reported by Passmore and Eastwood (1986).

The fat content of soymilk was significantly (p< 0.05) higher than the other milk samples. The 0.89% fat of the soymilk was however lower than 1.81 to 2.36% reported by Odu et al. (2012) and the 1.32 to 1.7% for soymilk and 3.4% for breadfruit milk reported by Onweluzo and Nwakalor (2009). The decrease might be due to increased soaking time which might have led to increased permeability of the cotyledons and hence more efficient leaching (Omueti et al., 1992). Wilkens and Hackler (1969) reported that about 6% of the soak water solid was lipid. In addition, the lower temperature employed in this study might have affected fat extractability. The high fat methods in which the seeds are cooked is because preheating treatment reduces viscosity of the oil and allows for easy break down of oil cells and release of fat. The fat content of the milk samples were lower than the minimum (3%) level required by codex Alimentarius Standard (Passmore and Eastwood, 1986). However, the low fat content of the milks may confer stability advantage. Sunny Roberts et al. (2004) reported that low fat content of groundnut milk is an advantage for the keeping quality of the product as the probability of rancidity taking place would be greatly reduced.

The ash content of the milk samples was significantly (p<0.05) different, with the corn milk recording the highest value of 2.46%. This is probably due to the high mineral and sugar content of sweet corn variety used. High mineral content in products result in high ash content (Odu et al., 2012). Ukwuru and Ogbodo (2011) reported that addition of sugar increased the ash content of milk since the ash content of sweetened tiger nut milk was higher than the sample with no addition of sugar. The ash content of the milk samples are within the standard limit of <5% of Standard Organization of Nigeria (Adedokun et al., 2014).

There was significant (p<0.05) difference in crude fibre content of the milk samples. The breadfruit milk and the corn milk blended to give a crude fibre content of 4.91% which by far exceeded the 1.76% of soymilk (control). The 1.76% obtained was higher than the 0.2% reported by Udeozor (2012) and 0% reported by Ene-Obong (2001) for soymilk, and 0% of soy-corn milk by Kolapo and Oladimeji (2003). The low crude fibre values of the soy based products as reported by these authors contradicts the high crude fibre content of soybeans, notable for relatively high amounts of glucosycermide, which may be the reason for the cancer preservative effect of eating soya foods (Symolon et al., 2004).

The high carbohydrate value of corn milk of 4.57% contributed significantly (p<0.05) to increase from 2.54% of breadfruit milk to 3.55% of breadfruit–corn milk. The 3.55% carbohydrate content of the breadfruit-corn milk was significantly (p<0.05) higher than the 3.14% of the soymilk. However, the carbohydrate value of the soymilk correlated with 1.99 to 3.40% reported previously (Kolapo and Oladimeji, 2008; Odu et al. 2012), but differed from the 10% reported by Udeozor (2012). The improved carbohydrate content of the breadfruit-corn milk was due to high carbohydrate content of sweet corn. Olakunle (2012) reported similar increase in the carbohydrate value of soy-corn milk due to addition of corn. This is expected because cereals are generally better source of carbohydrate than legumes. The milk samples had lower carbohydrate content than human and dairy milks of 6.8% and 5.0% respectively, which may be enhanced by concentrating to reduce moisture content or fortifying with carbohydrate rich concentrates.

B. PHYSICOCHEMICAL PROPERTIES

As can be seen in Table 2 the titratable acidity value of the breadfruit-corn milk of 0.423% was higher than 0.252% of soymilk. The titratable acidity value of breadfruit-corn milk was higher than the 0.23 to 0.036% of breadfruit milk reported by Onweluzo and Nwakalor, (2009). The acidic nature of maize protein (zein) as reported by Hosney, (1994) might have contributed to the higher total titratable acidity of the breadfruit-corn milk. The higher acidity of breadfruit-corn milk could provide better storage stability against acid intolerant microorganisms.

Parameter	Titratable acidity	pH	Viscosity	Total solids
BCM	0.423	4.68	0.487	14.13
SMA	0.252	6.23	0.475	10.40

BCM=Breadfruit-corn milk, SMA=Soymilk.

Table 2: Some Physicochemical properties of breadfruit-corn milk and soymilk

The pH of breadfruit-corn milk of 4.68 was lower than the 6.23 of soymilk. The pH of the breadfruit-corn milk was also lower than the 5.37 to 5.84 of breadfruit milk as reported by Onweluzo and Nwakalor (2009).The presence of high level of acetic amino acids in corn based beverage (Hosney, 1994) might have contributed to the lower pH of breadfruit-corn milk. The more acidic pH of breadfruit-corn milk could be an advantage because it may discourage the growth of pathogens that may cause gastro intestinal problems (Onweluzo and Nwakalor, 2009).

The viscosity of 0.487pa.s of the breadfruit-corn milk was higher than the 0.47pa.s of the soymilk. Viscosity of food system is usually affected by sugar and other macromolecules through their interaction with the solution or solvent (Zapsalis and Beck, 1985). Thus the high sugar content of sweet corn might have contributed to the viscosity gain of the milk blend. The higher viscosity value of breadfruit-corn milk could also be due to higher concentration of suspended solids, possibly from the addition of corn. Viscosity of milk product is important in determining the rate of creaming of the milk and the rate of mass and heat transfer (Adeiye et al., 2013).

The total solids content of the breadfruit-corn milk of 14.13% was significantly higher than the 10.40% of soymilk. The total solids of the soymilk correlated with the 9.62% of Onweluzo and Nwakalor (2009) and 9.48% of Omueti and Ajomale (2005). The high value obtained in this study may be attributed to process method. Soaking and blanching improves total solids extraction (Onweluzo and Nwakalor (2009), which were some of the treatment methods employed in this study. The higher level of total solids of breadfruit-corn milk may be attributed to the higher levels of suspended particles contributed by the corn milk (Nelson et al., 1976). Elsamni et al. (2014) reported that higher corn ratio will increase total solids of beverages. Farinde et al. (2008) suggested that the total solids of soymilk could be improved by adding soybean flour to the soymilk. Increasing the total solids increases the nutritive value of the product and improves the keeping quality (Odu et al., 2012).

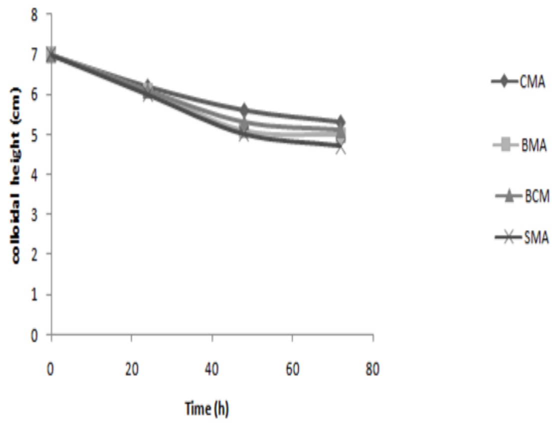

Figure 1: Effect of storage duration on apparent colloidal stability of Corn milk (CMA), Breadfruit milk (BMA), Breadfruit –Corn milk (BCM) and Soymilk (SMA).

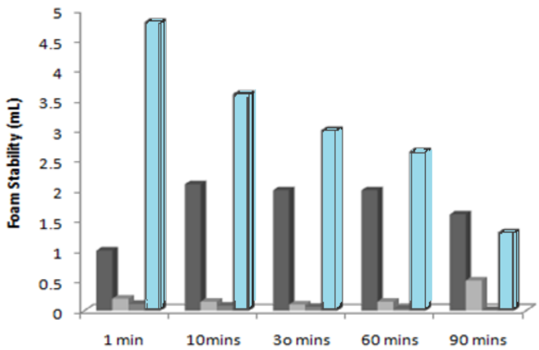

Figure 2: Foam Stability of Corn milk (CMA), milk (BMA), Breadfruit-Corn milk (BCM) and Soymilk (SMA) during 90 min observation

The apparent colloidal stability of breadfruit-corn milk was higher than that of soymilk (Fig.1) during the 72 h observation. The slower decline in apparent colloidal stability of breadfruit-corn milk as compared to the soymilk could be an indication of more uniform dispersion of solutes and gradual deterioration during storage. This could be attributed to the nature of protein complexes in the beverage types. Formation of hydrophilic protein-lipid complexes has been implicated in soymilk colloidal stability (Nelson et al., 1976). Hosney et al. (1994) associated glutamic acid with corn proteins. Since glutamic acid is hydrophilic in nature (Nelson et al., 1976), better apparent colloidal stability of corn milk and breadfruit-corn milk could be attributed to stronger hydrophilic protein-lipid complexes in the corn based beverages. Also, the higher occurrence of starch in the corn based beverages due to higher carbohydrate content, with resultant gelation of starch under heat might have contributed to their higher apparent colloidal stability. Weak colloidal stability is one setback for vegetable milk that requires consistent studies to evolve the right combinations of emulsifiers and stabilizers that most suit particular milk extract or their blends. The foam stability of milk samples after 1 min, 10 min, 60 min and 90 min after whip is as shown in Fig.2. It can be seen that all through the 90 min observation, the breadfruit-corn milk had the least stable foam of less than 0.2 ml. The soymilk had the highest foam stability, with a peak value of 4.5 ml after 1 min, maintaining the lead until 90 min when it ended at 1.3 ml behind the corn milk sample which recorded 1.6 ml. The high value of the soybean and sweet corn extracts which might be attributed to the prevalent oligosaccharides and their behavior when subjected to certain processes. Onyesom et al. (2005) stated that a process which increases soluble sugars reduces emulsion and foam stability. Parades-Lopez et al. (1991) reported that foam stability is important because whipping agents depends on its ability to maintain the whip as long as possible.

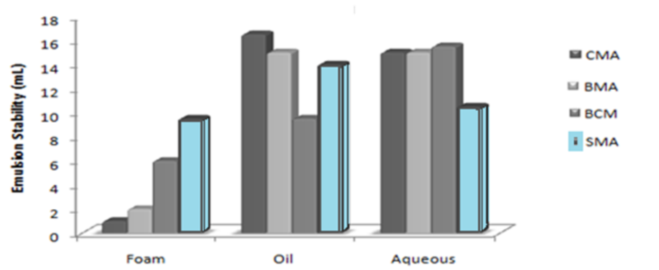

Figure 3a: Emulsion stability of CMA, BMA, BCM and SMA after 0.5 h

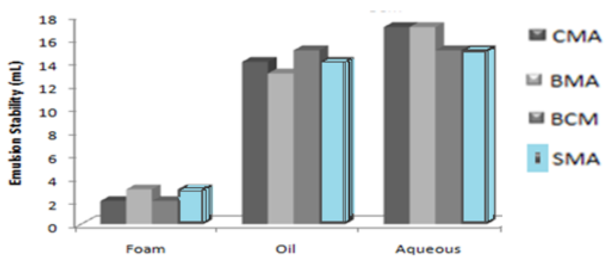

Figure 3b: Emulsion stability of CMA, BMA, BCM and SMA after 2.0 h

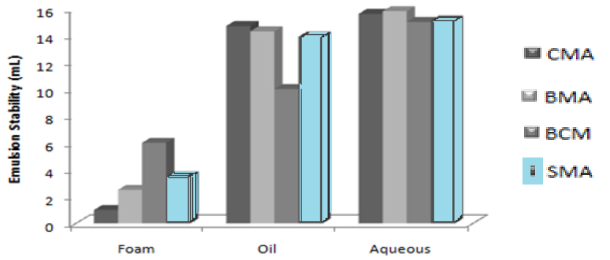

Figure 3c: Emulsion stability of CMA, BMA, BCM and SMA after 6.0 h

The emulsion stability of the milk samples after 0.5 h, 2.0 h and 6.0 h are shown in Figs. 3 a, b and c in respect of foam, oil and aqueous phase. It was observed that after 6.0 h, phase separation in the breadfruit-corn and soymilk (control) was similar, except for slightly higher foam of the latter. Blending of corn milk and breadfruit milk conferred on the resultant breadfruit-corn milk improved emulsion stability, compared to either of the milks. Sathe et al. (1982) reported that it is the globular nature of food materials that confers high emulsion stability. It is possible that agglomeration of the macromolecules in the corn milk and the breadfruit milk might have resulted in milk with better globular nature. The knowledge of emulsion stability helps in ice cream, baking and high protein food production (Onyesom et al., 2005). Odu et al. (2012) remarked that low suspension stability was inherent in vegetable milk and required more attention on selective application of emulsifiers and stabilizers to sustain homogeneity during storage.

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