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Formulation and Assessment of Cashew Kernel Milk as an Alternative to Cow's Milk

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ABSTRACT

Dairy free milk alternative was produced from tree nuts and legumes with high nutritional value, lactose free, cholesterol free and unsaturated fats unlike the mammalian milk. Dairy free milk alternative was obtained from cashew nut, coconut while skimmed milk from cow was used as reference standard. The prepared milk samples were analyzed for proximate, minerals and sensory attributes. The result revealed a reasonable amount of protein (12.26%) and coconut milk for cashew milk, 11.17% for soymilk, 8.52% for coconut milk while the standard cows skimmed milk, values obtained for cashew milk of 72.67%, soymilk and coconut milk was 64.22% contain the highest of 0.69 for ash while the plant milk also contain appreciable quantity which is directly related to the mineral content of the milk alternative. Cashew nut milk had the lowest pH values of 6. 10 and the lowest specific gravity of 1.010 g/cm^3. Fat content was high for cashew nut milk compared with the other milk samples. Sensory evaluation performed indicated that cashew milk was most preferred for the attributes of colour, mouthfeel while it ranked next to skimmed milk in taste and flavor. Cashew milk was ranked highest with values of 8.33 for overall acceptability compares well with skimmed milk with the value of 8.46 while the other milk alternatives had the values of 6.22 and 6.44 for soy milk and coconut milk respectively. The results therefore indicate that cashew milk can be used as alternative to dairy milk.

KEYWORDS

Cashew nut milk; Dairy free milk alternative; Plant based milk; Sensory

1. INTRODUCTION

Milk is one of the most commonly consumed food item enjoyed by human population since ages due to its nutritional value and its ability to satisfy appetite. Milk is a nutrient-rich, white liquid food produced by the mammary glands of mammals. Consumption of cow's milk has been from generation to generation in the developed countries. Milk, a scarce and costly commodity amongst the developing countries of the world occupies a significant position in the nutrition of infants and children due mainly to the nature expert

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balancing of various nutrients that are commonly found in food [1]. The nutritional importance of milk in food has led to increase in demand and its inadequate supply for various uses. In recent years, plants sources have been accepted as functional foods and nutraceuticals as they are rich source of health beneficial bioactive components like minerals, vitamins, dietary fibres and antioxidants. Also, consumers have tended towards obtaining milk from cheaper sources rather than from animal sources for economic reasons. Legumes and nuts have those characteristics that make them suitable to produce dairy-free nutritious, health promoting, economical and palatable plant based milk alternative [2].

Plant milk is known as food product that obtained from plant source, have similar appearance like milk but does not contain milk fat and other components [3]. But plant milks are used as a substitute for animal milk due their nutritive, functional and sensory characteristics. Milk obtained from seeds, grains and nuts are used as animal milk replacer [4]. These milk substitutes are described by healthy carbohydrates (low glycemic index), fatty acids, vitamins B and E, dietary fiber and antioxidants. They are good sources of mineral such as low sodium and potassium, also good promoters of electrolytes balance.

Plant-based milk alternatives are fluids that results from breakdown (size reduction) of plant material (cereals, pseudo-cereals, legumes oilseeds, nuts) extracted in water and further homogenization of such fluids, results in particle size distribution in range of 5 μm - 20 μm which imitates cow's milk in appearance and consistency [5]. Plant milks have been consumed for centuries in various cultures, both as regular drinks and as a substitute for milk, such as by some Christian denominations during Lent. The most popular varieties substituted for cow's milk internationally are soy milk, almond milk, rice milk and coconut milk, since its consumption has raised concerns among the health conscious and risk prone population. Clinical studies have demonstrated that some constituents of milk are associated with deleterious health effects such as cow milk allergy (CMA), lactose intolerance (LI), and coronary heart diseases.

Over the past decade, major research emphasis in all sections of food product development is to address the changing needs and to meet the present demand of consumer by creating newer alternative of health foods which has led to concerted research effort in functional and specialty beverage for newer products. One such major functional requirement is milk alternatives to answer problems of cow milk allergy, lactose intolerance, calorie concern and prevalence of hypercholesterolemia [6]. Many programmes have been initiated for the best methods of producing milk analogues from vegetable sources [7]. Milk has been successfully produced from soybeans, melon seeds, groundnuts and coconuts. These has led to the declined in cow milk consumption for decades while consumption of nondairy alternatives has increased.

Plant-based milks essentially lack certain components normally associated with mammalian milk such as cholesterol, saturated fatty acids, antigens and lactose while on the same time being the good source of minerals, non-allergic proteins essential fatty acids etc., making it well suited to serve as dairy free alternative. In recent years, plants sources have been accepted as functional foods and nutraceuticals as they are rich source of health beneficial bioactive components like minerals, vitamins, dietary fibers and antioxidants. Legumes and nuts have those characteristics that make them convenient to combine them to produce dairy-free nutritious, health promoting, economical and palatable plant based milk alternative. All plant-based milks are preferred over cow's milk by consumers who are lactose intolerant or are allergic to milk proteins because of their common benefits of being lactose free, cholesterol free and low in calories [8]. There have been few research activities in the area of preparing milk alternatives other

than soy milk which includes peanut milk, rice milk, oat milk, sesame milk, coconut milk, almond milk, cashew nut milk, hazelnut milk, tiger nut, lupin milk and quinoa milk etc., [5].

Cashew nuts are actually the kidney-shaped seeds that adhere to the bottom of the cashew apple, the fruit of the cashew tree, which is native to the coastal areas of northeastern Brazil. Cashew is presently been grown in various states of Nigeria. Cashew is a highly nutritious and concentrated form of food, providing a substantial amount of energy. The cashew nut kernel has a pleasant taste and flavor and can be eaten raw, fried and sometimes salted or sweetened with sugar [9]. It also contributes as an important source of invisible fat in the diet, being widely used in a variety of ways. There has been a growing demand for cashew in many temperate countries where the demand is increasing [10]. It is rich and creamy and has a sweet and subtle nutty flavor. It is great for thickening smoothies and as a creamer in coffee. It has no saturated fat or cholesterol and it is often considered a good option for those looking for a creamier alternative [11]. The low carbohydrate and sugar content of cashew also makes it a suitable option for people who need to cut down their carbohydrate intakes, such as people with diabetes.

Other plant-based milk, such as quinoa, hemp, cow pea, hazelnut, sunflower, melon seed milk [12] including cashew nut milk are prepared and/or commercially available in some western countries but scientific literature on these milks is hardly available. Therefore, the aim of this work is to develop a milk substitute that is similar to cow's milk from cashew kernel.

2. MATERIALS AND METHODS

Jumbo size cashew nuts, *Anarcadium occidential* were obtained from the Cocoa Research Institute of Nigeria, CRIN, headquarters, Ibadan. Coconuts were purchased from Oje market in Ibadan while soybeans and milk were bought at Oja- Oba also in Ibadan.

Cashew milk preparation

The kernels were removed from nuts using manual cashew kernel breaker. The kernels were dried at oven temperature of 60°C for 6 hours for easy removal of testa. 250 g of cashew kernels were soaked in alkaline solution of 5% NaCl overnight. The soaked nut was cleaned and ground to a smooth paste. The cashew nut paste was diluted with 3 parts of water, sieved and the supernatant was sweetened with 16 g of sugar, 0.6 g of vanilla flavor, bottled and pasteurized at 75°C for 15 minutes.

Soy milk preparation

Soy milk was prepared by soaking soybeans for 12 hours in 0.5% $NaHCO_3$ solution followed by draining of the soak water. The beans was then boiled in fresh 0.5% $NaHCO_3$ solution for 30 minutes, it was drained again. The swollen beans were grinded in water at room temperature. The soy-slurry was then heated to 90°C and filtered to remove okara (i.e. the resultant chaff after squeezing out the milk). Soy milk was squeezed out using double layered cheese cloth. The same quantity of additives was added and pasteurization condition as in cashew milk was observed.

Coconut milk Preparation

Coconut milk was prepared by dehusking, dewatering and deshelling of whole coconut fruit and then grating the white inner flesh of mature coconuts and mixing the shredded coconut pulp with a small quantity of water. The grating process was done using kitchen blender, it was squeezed through cheese cloth. The same quantity of additives was added and pasteurization condition as in cashew milk was observed.

Proximate analysis

Proximate composition was determined as described in AOAC [13], WPACDS740 standard pH meter with a

glass electrode was used for measuring the pH of the different milk samples. 10 ml of the beverages was used for the pH measurement. Moisture content was determined by drying 10 g of the beverage at 105°C in a force draught oven to constant weight. The total nitrogen content of the beverage was determined by standard Kjeldahl procedure and the protein content was obtained by multiplying the total nitrogen by the factor 6.25. The fat content was determined by using Tecators Soxhlet HT2, 1045 extraction unit. Minerals such as calcium, sodium, iron, phosphorus, magnesium and potassium were determined using absorption spectrophotometer (Perkin Elmer, model 306). Vitamins like vitamin A, B, C and D content were determined using the methods of Pearson. The specific gravity of the cashew kernel milk was determined as described by AOAC [14].

Sensory evaluation

A team of ten-member panel was employed to assess the different milk samples as compared to cashew kernel milk. The four different milk samples were served in cups for tasters with a glass cup of water to rinse their mouth at intervals i.e. after each sampling. Evaluation was based on colour, taste, flavor, smoothness and overall acceptability. Each panelist scores were reflected on a hedonic scale of 1 to 9 where 1 = dislike extremely and 9 = like extremely [15]. The data were analyzed using analysis of variance (ANOVA) and the means were compared using Duncan's multiple range test.

3. RESULTS AND DISCUSSION

Physicochemical analysis

Table 1 [16] shows the chemical composition of cashew kernel from which the milk was extracted. The mean moisture value of cashew kernel was 6.92 ± 0.2%, dry weight. This is a little below the value for some legumes which ranges between 7% and 11%. Protein fat and carbohydrate content of 6.92%, 21.52%, 47.00% and 29.30% respectively. It also shows the crude fiber, ash and total metabolizable energy of 1.13%, 3.32% and 561 calorie/100 g respectively.

Water	6.92%
Protein	21.52%
Fat	47.00%
Carbohydrate	29.30%
Crude fiber	1.13%
Ash	3.3.2%
Food Energy	561 calorie/100 g

Table 1: Chemical composition of cashew kernel.

The result of proximate composition of cashew nut milk and the three different milk samples namely skimmed milk, soy milk and coconut milk is shown in Table 1 [16]. Crude protein for cow's milk recorded the highest value compared with the plant based milk but for the milk analogue, cashew milk contains appreciable value higher than the other two plant based milk.

The obtained results for the proximate analysis of all milk samples are presented in Table 2. The moisture content of the cashew milk and soy milk beverage were 64.22% and 62.40%which are lower than the value of 82.66% reported by Emelike et al. [17] for cashew milk. Also, Muhammad et al. [18] reported moisture content of 87.12% for cashew milk and 88.12% milk for soy milk. Moisture content of 67.6% was obtained from USDA database for coconut milk. The difference in the moisture content of the milk beverages could be due to the volume of water used in the extraction process as it is reflected in the study of Hagenmaier [19] who reported the moisture content of 52.0% for coconut milk from single stage extraction without added water. Moisture level has also been reported to affect the specific gravity and other nutrients concentration of milk samples [20]. The protein content of cashew milk was significantly lower than that of cow milk (12.26% and 27.97%) but slightly higher than both soy milk and coconut milk (11.17% and 8.52%).This is in contrast to the result of the study

conducted by Muhammad et al. [18] which reported that soy milk and cashew nut milk contains 2.36 ± 0.24 and 2.05 ± 0.20 respectively. The pH values for the entire milk sample tended towards acidity. The acidity of the produced cashew nut milk which is 6.10 was higher than that of cow milk, soy milk and coconut milk with the values of 6.30, 6.20 and 6.20 respectively this is not in consonant with the report of Kundu et al. [2], of pH of 7.395 and 6.920 for soy milk and almond milk respectively. Crude protein obtained from this study reveals that aside of cow's milk which contains the highest value of 27.97%, cashew nut milk contains the highest value of protein 12.26% when considering the remaining two plant milk alternatives with 11.17% and 8.52%.This is in contrast to the findings of Muhammad et al. [18], who reported a higher value of 2.36% for soy milk and 2.05% for cashew milk. Also, cashew nut milk was found to contain the highest percentage fat of 15.21 while soy milk and coconut milk has the values of 14.42% and 14.48% respectively. Ash content of the produced milk samples are 0.59%milk for soy milk, 0.54% for coconut and 0.57% for cashew nut milk. Cow's skimmed milk has the highest percentage ash content of 0.69 and it's higher when compared with the findings of Rehman et al. [21] for soymilk (0.58%) and Alyaquobi et al. [22] for fresh coconut milk (0.71% - 0.90%).

The specific gravity of the milk samples were not significantly ($p<0.05$) different from each other with values that ranged from 1.010 g/cm^3 to 1.030 g/cm^3. All the milk samples met range of acceptable specific gravity of 1.03 g/cm^3 - 1.034 g/cm^3 fixed by the New York Department of Agriculture [23].

Parameters	Skimmed Milk	Soy Milk	Coconut Milk	Cashew Nut Milk
Ash (%)	0.69	0.59	0.54	0.57
Moisture (%)	72.6	62.4	61.33	64.22
pH Values	6.3	6.2	6.2	6.1
Fat (%)	9.54	14.42	14.48	15.21
Crude Protein (%)	27.97	11.17	8.52	12.26
Specific Gravity (g/cm3)	1.018	1.03	1.016	1.01

Table 2: Proximate composition of the different milk samples.

Results are mean values of duplicate determinations

Table 3 above shows the result of mineral and vitamins analysis performed on cashew nut milk, it contains 52.5 mg/100 g of calcium, 53.2 mg/100 g of phosphorus while the iron content was 5.2 mg/100 g. Values obtained for calcium and phosphorus were higher than 4.75 mg/100 g and 2.00 mg/100 g reported by Emelike et al. [17]. Also, the iron content in this report was higher than the results of Muhammad et al. [18], who reported a value of 0.8 mg/100 g for iron. The table also shows that cashew nut milk contain appreciable quantity of vitamins like thiamin, riboflavin, niacin, beta-carotene and vitamin K. The mineral composition in cashew milk was high due to the high ash content recorded for the dairy milk alternative. Due to the presence of these minerals in appreciable amount in cashew milk, it has been reported that it aids the flow of blood, nutrients and oxygen due to less resistance of veins and arteries [24]. Consumption of cashew nut milk is also expected to reduce mineral and vitamin deficiency in developing countries.

Parameter	Composition (mg/100 g)
Ca	52.5
P	53.2
Fe	5.2
Thiamin	0.65
Riboflavin	0.18
Niacin	2.6
Beta-carotene	60
Retinol Equivalent	33 IU; 10 mcg
Vitamin K	650

Table 3: Minerals and vitamins composition of cashew nut milk.

The results of the sensory properties of the different milk samples are shown in Table 4. Attributes such as colour, taste, flavor, mouthfeel and overall acceptability were evaluated by judges. Judging from the mean values, it can be deduced that of all the plant based milk samples evaluated, cashew nut milk is the most acceptable in all the attributes tested as it ranked very close to 9 (like - extremely) in the scale used. It was also observed that cashew milk had higher score than skimmed or cow's milk in terms of taste and mouthfeel which means that it was the most preferred milk of all the samples tested for these attributes. For mean sensory scores of mouthfeel soymilk and coconut milk samples were comparable since similarity was found in mouthfeel due to the similar fat contents present in both milk samples, however, cashew milk is better ranked for this attribute because of its higher fat content. Fat was said to be well known to be related with better mouthfeel Muhammad et al. [18].

Attributes		Samples		
	SKM	SOM	COM	CAM
Colour	8.21	6.24	7.24	8.16
Taste	7.40	6.44	6.46	7.66
Flavor	8.44	6.12	7.14	8.24
Mouthfeel	8.22	5.52	5.68	8.36
Overall Acceptability	8.46	6.22	6.44	8.33

Values represent means ± standard deviation of duplicate determinations; Mean values of scores from judges; SKM: Skimmed Milk; SOM: Soy Milk; COM: Coconut Milk and CAM: Cashew Nut Milk

Table 4: Sensory Evaluation of the different milk samples.

For overall acceptability, cashew nut milk ranked close to skimmed milk which signifies that it compares favorably with cow's milk generally. However, in this research both milk samples were acceptable because the mean sensory scores for all characteristic were above the average score (5.0).

4. CONCLUSION

Overall, the results obtained in this study indicate that it is feasible to substitute cow's milk with cashew milk based on analysis of control milk (skimmed milk) and the diary free plant milk alternatives used in this study, it can be concluded that cashew milk can be a good alternative of cow milk due to absence of lactose and allergens and with better nutritional as well as sensory profile. The incorporation of sweeteners in cashew kernel milk should be encouraged and the milk utilized by health conscious individual so as to stabilize the cost of cow's milk. Therefore, it can be concluded that cashew milk can be a good alternative of cow milk due to absence of lactose and allergens and with better nutritional as well as sensory profile. Studies proves that cashew nut milk can be utilize as substitute to alleviates the cost of dairy milk and for its high nutrient content

Further work should be carried out on how to extend the shelf life of the product stored at room temperature using chemical preservatives. Since it was a pilot scale study for the nondairy milk alternative, further modifications with respect to addition of emulsifiers, sweeteners and other additives may be employed for the commercialization of the product. Since cashew nut is highly consumed by Nigerians because of its availability in commercial quantity is another way of adding food value to the crop.

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