Vol. 12(8) pp. 204-209, August 2018
DOI: 10.5897/AJFS2017.1607
Article Number: 1F414C557786
ISSN: 1996-0794

http://www.academicjournals.org/AJFS

African Journal of Food Science

Full Length Research Paper

Physicochemical, microbiological and sensory characteristics of cashew milk formulated yoghurt

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Received 27 April, 2017; Accepted 2 October, 2017

Cashew yoghurt was formulated using cashew kernel milk. The physicochemical, microbiological and organoleptic assessment of the resulting product was examined and compared with commercial yoghurts. Results indicated that crude protein of 16.8% for cashew milk yoghurt compared favorably with 14.82% of commercial yoghurt. Caloric value of cashew yoghurt (133.06 kJ) was higher than that obtained for commercial yoghurts (112.01 kJ). Microbiological study revealed a total count of $1x10^6$ CFU/g, which was attributed to the culture used in the fermentation process. The cashew milk yoghurt was generally accepted by the panelist as there were no differences in the sensory characteristics examined; however, there was a difference at p> 0.05 for mouth feel for the sample studied. It can be concluded that cashew milk serves as a potential recipe for acceptable yoghurt formulation.

Key words: Cashew kernel, yoghurt, sensory, protein, organoleptic.

INTRODUCTION

Cashew plant, *Anacaduim occidentale* L. is native to Brazil. The plant is widely grown in the continents of Asia, Europe as well as Africa. In most of the African countries, especially Nigeria, the tree is grown mainly for its pseudo apple and the nuts, which are mainly consumed raw, that is, unprocessed (Ohler, 1979; Nambiar et al., 1980). Cashew is a climacteric crop, and harvesting of the nuts often takes place between January and April or May. When the cashew apples are ripe, they fall down from the tree, and the nuts are collected after detaching from the rotten apples, sun-dried on concrete floor for two days to attain moisture content of 12%, and this is to avoid spoilage. Nigeria's annual cashew nut production from 466,000 MT in the year 2000 to 836,500 MT in year 2012 representing 45% of cashew nuts produced in African (FAOSTAT, 2013).

The fruit of cashew tree consists mainly of the cashew nut, an embryo shaped shelled nut and the false fruit cashew apple. The composition of the shelled nut consists of 20 to 25% kernel, 20 to 25% cashew nut shell liquid (CNSL), 20% testa and 48 to 55% shell. The cashew nuts are majorly sold as export crop and few of

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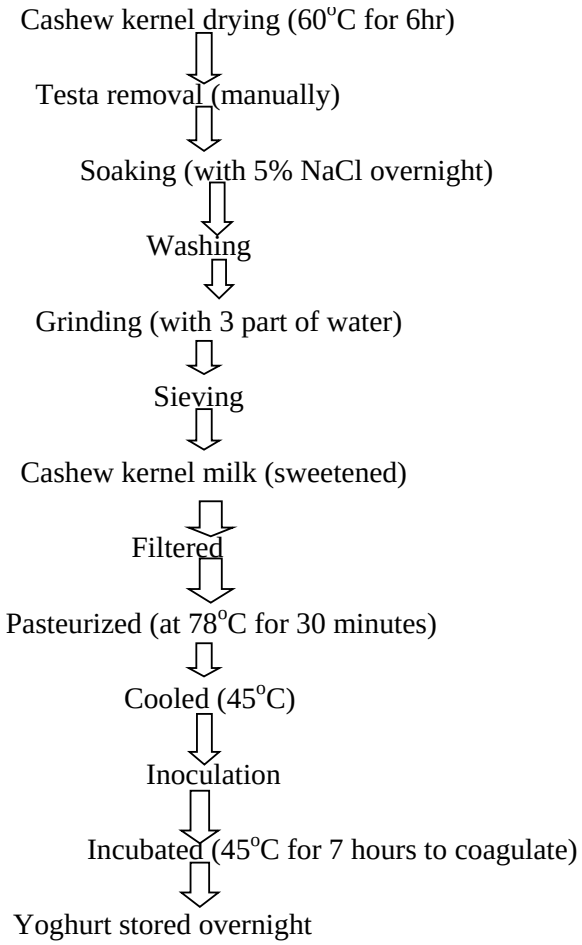

Figure 1. Flow chart for cashew kernel formulated yoghurt processing.

the nuts are roasted, flavored, and sold for local consumption in different packaging materials. Embedded in the honeycomb pericarp of the nut is a viscous brown liquid- cashew nut shell liquid, CNSL, that is, phenolic in nature. It is a by-product of the cashew nut industry. The components of this liquid have been found to be Anacardic acid (71.7%), cardol (18.7%), cardanol (4.7%), novel phenol (2.7%) and an unknown minor ingredient (2.2%) (Tyman and Morris, 1967). The liquid has been identified as an important industrial raw material (Ghatge and Maldar, 1981). For example, CNSL has been recognized as a good source of unsaturated phenol, an excellent monomer for polymer production. It is a good natural alternative to petrochemically derived phenol.

The sensory and nutritional qualities of cashew kernels cannot be overemphasized. For example, cashew kernels are excellent source of proteins (20 to 24 g/100 g), carbohydrates (23 to 25 g/100 g) and fats (40 to 57 g/100 g) (Nascimento et al., 2010; Ogunwolu et al., 2009; Yang, 2009). Moreover, studies have shown that cashew kernels have beneficial effects on health, particularly on chronic diseases such as hypertension and obesity, coronary heart disease and diabetes. However, the high content of unsaturated fatty acids of most nut kernels is one of the most determinant factor against cardiovascular disease and obesity (Mexis and Kontominas, 2009; Oliete et al., 2008; Yang, 2009; Yang et al., 2009; Aswal et al, 2012; Horáčková et al., 2015).

Formulation of value added products from cashew kernel had received much attention from various workers over the years (Sofu and Ekinci, 2007; do Espirito Santo et al., 2010; Chen et al., 2010). There is dearth of information on the use of cashew kernel milk in yoghurt formulation, and this work seeks to be addressed.

MATERIALS AND METHODS

Cashew nut kernel

Cashew nuts were obtained from Ochaja Station of Cocoa Research Institute of Nigeria. The nuts were sun dried until ready for use. The proximate composition of the kernel was carried out according to standard methods of analysis (AOAC, 1990).

Cashew kernel milk preparation

Cashew kernels were removed from nuts using manual cashew kernel breaker. The kernels were dried at oven temperature of 60°C for 6 h for easy removal of testa. Cashew kernels (250 g) were soaked in 5% NaCl solution overnight. The soaked kernel was cleaned and ground to a smooth paste. The cashew kernel 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 78°C for 30 min and refrigerated.

Formulation of cashew milk yoghurt

To obtain cashew kernel yoghurt, the produced milk was inoculated with S*treptococcus thermophilus* and incubated at 45°C for 7 h to coagulate. The resulting yoghurt (Figure 1) was then stored overnight in a bath of cold water.

Physicochemical analyses of formulated yoghurt

The pH of the formulated product was measured using a standard pH meter (pH meter kent EK 7020). Titratable acidity (TA %) was determined by titration of sample against 0.1 N NaOH (Speck, 1984). Moisture content, crude fat, protein and total ash content of the formulated yoghurt were determined according to the AOAC (1990) and Pearson (1976). The refractometric method as described by Akinsaye (1998) was used to determine the sugar content of the yoghurt. In a typical experiment, 20 ml of yoghurt was mixed with 10 ml of lead acetate (10%) in a beaker and filtered through Whatman's filter paper (No. 4) into 100-ml volumetric flask. Two spoonful of sodium hydrogen carbonate was added to the filtrate to precipitate excess lead and then filtered. The filtrate was used for the refractometric determination of the sugar content using Abbe 60 Refractometer. The viscosity was measured using viscometer.

Table 1. Chemical composition of cashew kernel.

Parameters	Value (dry wt)
Water	6.92%
Protein	21.52%
Ether extract	47.00%
Carbohydrate	29.30%
Crude fiber	1.13%
Ash	3.3.2%
Food energy	2602.9 kJ/100 g

Values are percentage mean of triplicate determinations.

Microbiological analysis

Formulated cashew kernels yoghurt samples were analyzed for total *Escherichia coli*, *Staphylococcus aureus*, *Salmonella* spp. and *Clostridium* spp., according to the American Public Health Association (Downes and Ito, 2001) guidelines.

Sensory analyses

A 9-point hedonic scale was used to measure the sensory qualities, that is, colour, aroma, mouth feel/texture, taste and overall acceptability of the product (Larmand, 1977). Ten member in-trained panelists that are used to yoghurt taste were employed to ascertain or detect any difference between the cashew milk yoghurt and the locally purchased commercialized products. These samples were coded differently and served to the panelists with a glass of water and were instructed to rinse their mouth in between the tasting period. The scale of preference ranges from 9 representing like extremely to 1 representing dislike extremely.

Statistical analysis

The results obtained were subjected to analysis of variance (ANOVA). Mean comparisons were carried out between the two yoghurt samples by Turkeys multiple range test and by Statistical Programs for Social Sciences (SPSS, 1992).

RESULTS AND DISCUSSION

Physicochemical analysis

Table 1 presents results of the proximate composition of cashew nut flour. The mean moisture value of cashew kernel was 6.92 ± 0.2%, dry weight. This is a little below the value for some legumes ranging between 7 and 11%. The low moisture content helps to reduce microbiological deterioration. The ash content obtained for this study indicates that it is low and may not be suitable for animal feed. Results from the study shows that cashew kernel contains appreciable amount of crude fat (47%) and this makes it a potential and economically viable vegetable oil. Fat is important in diet because it promotes fat soluble vitamin absorption (Bogert et al., 1994; Champagne et al, 2010; Lee and Lucey, 2010; Shahnawaz et al., 2013). It is a high energy nutrient and does not add to the bulk of the diet.

Proximate composition of yoghurt

Table 2 shows the nutritional composition of commercially sold yoghurt as compared to that of cashew kernel milk. A pH value of 4.10 was obtained for commercial yoghurt as compared to 4.20 for cashew kernel yoghurt. This obtained result could be a reflection of the souring activity of lactic and this also explain the high titratable acidity (%), 0.5 to 0.55 obtained. Reed (1982) noted in his work that good quality yoghurt should have pH of 4.15 and TA (% lactic acid) of 0.5. The values obtained in this work are similar to these stated values. From the result, the calorific value of the cashew kernel yoghurt (133.06 KJ) was higher than that of the commercial yoghurt (112.01KJ). This means that cashew yoghurt can be taken as both proteinous and energy food.

The crude ash content of commercial samples, 0.76%, is lower than that of cashew kernel yoghurt (0.84%). Crude protein (%) results showed that cashew kernel yoghurt of 16.88 was higher than the commercial yoghurt (14.82). The use of cashew kernel in yoghurt production improves the crude protein value remarkably. Similarly, the crude fat content (%) ranges from 36.01 of commercialized yoghurt to 40.32 of cashew kernel yoghurt. Egan et al. (1981), Reeds (1982) and Terna and Musa (1998) stated in their work that commercial yoghurt should have the following minimum proximate compositions, which are 3.5% for protein, 3.25 fat and 87.7% moisture. This result is higher than recommended values obtained by these authors. The coagulation time of the cashew kernel yoghurt sample was 6 h. It has been reported that the duration of fermentation at 40 to 45°C is 3 to 6 h (Ebing and Rutgers, 1996) and 3 to 5 h at 45°C (Kosikowski, 1982). The fermentation time for this

Table 2. Proximate composition of cashew yoghurt.

Analyses	Yoghurt commercial	Cashew yoghurt
pH	4.1	4.20
TA (%)	0.50	0.55
Moisture content (%)	69.0	64.52
Crude protein (%)	14.8	16.88
Crude fat (%)	36.09	40.32
Total soluble solids	59.20	56.22
Ash (%)	0.76	0.84
Specific gravity	1.0212	1.0320
Viscosity (sec.)	205.7	203.4
Caloric value (KJ)	112.01	133.06
Dry matter (%)	14.47	14.65

Table 3. Mean values of bacteriological analyses of cashew kernel yoghurt and commercialized yoghurt.

Identity	Test	Result
Cashew kernel yoghurt	Total count (37°C)	1×10^6 Cfu/g*
	E. coli/coliforms	Nil
	Staphylococcus aureus	Nil
	Salmonella spp.	Nil
	Clostridium spp.	Nil
Commercialized yoghurt	Total count	1×10^6 cfu/g
	E. coli	Nil
	Staphylococcus aureus	Nil
	Salmonella spp.	Nil
	Clostridium spp.	Nil

*Cfu/g– Colony forming unit per gram.

experiment (7 h) is in agreement with the above authors. Lactose is the fermentable sugar generally preferred by lactic acid bacteria despite non addition to the formulated milk, the product was able to exhibit the souring ability of the lactics.

Milk pasteurization (75°C) was done to modify milk protein to enhance proper viscosity and gelatinization of the product. This is in agreement with the work of Reed (1982). This also resulted in uniformity and smoothness in body texture of the yoghurt samples as indicated in Table 2.

Microbiological assay

The bacteriological quality of cashew kernel yoghurt samples and that of the commercial yoghurt samples is depicted in Table 3. Results revealed that total count of the samples is 1×10^6 cfu/g, while specific count of *E. coli, S. aureus*, *Salmonella* spp. and *Clostridium* spp. were negative for both samples. This showed that the total counts as shown in table were because of the cultures used to ferment the yoghurt, thereby resulting in the production of lactic acid, which is lethal to some organisms. Lactic acid bacteria also produce hydrogen peroxide, diacetyl and bacteriosis as antimicrobial substances which create hostile environment for food-borne pathogen and spoilage organisms, and therefore are able to suppress the multiplication of pathogenic and putrefying bacteria. It is believed that pasteurization temperature of 75°C for 30 min would have effectively destroyed any microbes present in the milk samples coupled with the low pH values (Chumchuere and Robinson, 1999; Rodriguez et al., 2010). In addition, the traditional starter cultures used in cashew kernel yoghurt production contain substantial quantities of beta-D-galactosidase enzyme and consumption of cashew kernel yoghurt may assist in alleviating the symptoms of

Table 4. Mean comparison of sensory evaluation scores of cashew kernel yoghurt and locally commercialized yoghurt.

Yoghurt	Aroma	Colour	Taste	Mouth feel	Overall acceptability
Cashew kernel yoghurt	8.1NS	7.2NS	7.4NS	8.8a	8.0NS
Commercial yoghurt 1	7.8	7.0	7.4	7.0b	7.8
Commercial yoghurt 2	7.3	7.0	7.0	7.5ab	8.0
Skimmed milk yoghurt	8.0	6.6	6.9	8.2a	7.5

Letters with the same column are significantly different (P < 0.05); NS- not significant.

lactose maladsorption. The cashew kernel yoghurt was therefore considered safe microbiologically.

Sensory characteristics

The results of the organoleptic appraisal performed on all the yoghurts are shown in Table 4. The results indicates that panelist find it difficult to differentiate them from one another. The products have milky color with semi-solid texture and the taste was slightly sour. However, there was a significant difference at P> 0.05 for mouth feel. The overall acceptability showed that the yoghurt samples were acceptable but does not show any significant difference at P< 0.05.

Conclusion

This study shows that yoghurt can be produced from a vegetable source especially for the vegetarians. This indicates that it is possible to produce good quality yoghurt that is well acceptable for human consumption using cashew kernel. It was also shown that there were no differences in the taste and flavor of yoghurts studied and this makes the product more enjoyable and pleasurable. Thus, cashew kernel yoghurt due to its content and viscosity can delay gastric emptying and can be of an immense benefit for people who are lactose intolerant.

CONFLICT OF INTERESTS

The authors have not declared any conflict of interests.

REFERENCES

Akinsaye OP (1998). Sugar laboratory. National Cereal Research Institute Badeggi Niger State (Personal communication).

Espirito Santo AP, Silva RC, Soares FA, Anjos D, Gioielli LA, Oliveira MN (2010). Açai pulp addition improves fatty acid profile and probiotic viability in yoghurt. International Dairy Journal 20(6):415-422.

Aswal P, Shukla A, Priyadarshi S (2012). Yoghurt: Preparation, characteristics and recent advancements. Cibtech Journal of Bio-Protocols 1(2):32-44.

Bogert JL, Briggs GM, Galloway DH (1994). Nutrition and physical fitness. International Journal of Food Science and Nutrition 45:223-230.

Champagne CP, Tompkins TA, Buckley ND, Green- Johnson JN (2010). Effect of fermentation by pure and mixed cultures of *Streptococcus thermophiles* and *Lactobacillus helveticus* on isoflavone and B-vitamin content of a fermented soy beverage. Food Microbiology 27:968-972.

Chen TR, Su RQ, Wei QK (2010). Hydrolysis of isoflavone phytoestrogens in soymilk fermented by *Lactobacillus* and *Bifidobacterium* cocultures. Journal of Food Biochemistry 34:1-12.

Chumchuere S, Robinson RK (1999). Selection of starter cultures for the fermentation of soya milk. Food Microbiology 16:129-137.

Downes FP, Ito H (2001). Compendium of methods for the microbiological examination of foods (4th. ed.). Washington: American Public Health Association.

Ebing P, Rutgers K (1996). Preparation of dairy products 3rd Ed. Agrodok – Series No. 36 CTA, pp. 45-46.

FAOSTAT (2013). Food and Agriculture Organization Statistics.

Ghatge D, Malder NN (1981). Cashew nut shell liquid and its use in Rubber. National Communication Laboratories, Pune 411(X) 8. India.

Horáčková S, Mühlhansová A, Sluková M, Schulzová V, Plockova M (2015). Fermentation of Soymilk by Yoghurt and Bifidobacteria Strains. Czechlovaskia Journal of Food Science 33(4):313-319.

Kosikowski FV (1982). Cheese and fermented milk foods. 2nd Ed. New York: F.V. Kosikowski and Association.

Larmand E (1977). Laboratory method for sensory Evaluation of food. Publication No. 1637, Ottawa, Canada; Canadian Department of Agriculture pp. 12-16.

Lee WJ, Lucey JA (2010). Formation and Physical Properties of Yogurt. Asian-Australasian Journal of Animal Sciences 23(9):1127-1136.

Mexis SF, Kontominas MG (2009). Effect of g-irradiation on the physicochemical and sensory properties of cashew nuts (*Anacardium occidentale* L.). Lebensmittel-Wissenschaft und Technologie 42:1501 -1507.

Nascimento AN, Naozuka J, Oliveira PV (2010). In vitro evaluation of Cu and Fe bioavailability in cashew nuts by off-line coupled SEC-UV and SIMAAS. Microchemical Journal 96(1):58-63.

Nambiar MC, Nambiar KKN, Kunhikrishna S (1980). Cashew in India. World Crops 32(1):20-23

Ohler JG (1979). Cashew. Commination 71. Department of Agriculture Research. Koninklik Institute voor de Tropen Amstardam.

Ogunwolu SO, Henshaw FO, Mock HP, Santros A, Awonorin SO (2009). Functional properties of protein concentrates and isolates produced from cashew (*Anacardium occidentale* L.) nut. Food Chemistry 115:852-858.

Oliete B, Gómez M, Pando V, Fernández-Fernández E, Caballero PA, Ronda F (2008). Effect of nut paste enrichment on physical characteristics and consumer acceptability of bread. Food Science and Technology International 14(3):259-269.

Pearson D (1976). The Chemical Analysis of Food. 6th Edn. Chemical Publishers Co. New York.

Rodriguez LA, Ortolani MBT, Nero LA (2010). Microbiological quality of yoghurt commercialized in Viçosa, Minas Gerais, Brazil. African Journal of Microbiology Research 4(3):210-213.

Shahnawaz M, Sheikh SA, Akbar ZA (2013). Physicochemical analysis of desi yoghurts produced by the local community in Gilgit District. African Journal of Food Science 7(7):183-185.
Sofu A, Ekinci FY (2007). Estimation of storage time of yogurt with artificial neural network modeling. Journal of Dairy Science 90(7):3118-3125.
Tyman JHP, Morris LJ (1967). The composition of cashew nut-shell liquid (CNSL) and the detection of a novel phenolic ingredient. Journal of Chromatography A 27:287-288.
Terna G, Musa A (1998). Soybeans yoghurt production using starter culture from 'nono' Nigerian. Nigerian Journal of Biotechnology 9(1):17-23.
Yang J (2009). Brazil nuts and associated health benefits: A review. Lebensmittel- Wissenschaft und Technologie 42:1573-1580.
Yang J, Liu RH, Halim L (2009). Antioxidant and antiproliferative activities of common edible nuts. Lebensmittel-Wissenschaft und Technologie 42:1-8.