

# Effect of selected spices on the proximate composition, shelf life and sensory properties of cashew nut butter

C. A. Orisa<sup>1\*</sup>, A. O. Amadi<sup>2</sup>, S. C. Achinewhu<sup>2</sup> and R. N. Owunna<sup>2</sup>

<sup>1</sup>Department of Home Science and Management, Rivers State University, Faculty of Agriculture, Nkpolu-Oroworukwo, P.M.B. 5080, Port Harcourt, Rivers State, Nigeria.

<sup>2</sup>Department of Food Science and Technology, Rivers State University, Faculty of Agriculture, Nkpolu-Oroworukwo, P.M.B. 5080, Port Harcourt, Rivers State, Nigeria.

\*Corresponding author. Email: [catherine.orisa@ust.edu.ng](mailto:catherine.orisa@ust.edu.ng); Tel: +2348063612361.

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**ABSTRACT:** The effect of selected spices on the proximate composition, shelf life and sensory properties of cashew nut butter was evaluated. Cashew kernels were milled into paste and spiced with ginger (*Zingiber officinalis*), cinnamon (*Cinnamomum verum*), garlic (*Allium sativum*) and uda (*Xylopiya aethiopica*) while unspiced cashew butter was used as control. The samples were evaluated for their proximate composition and sensory properties. These were kept at room temperature and analyzed for microbial properties. Proximate composition revealed that moisture content ranged from 25.66-36.09%, ash 4.08-5.35%, fat 40.16-55.31%, crude protein 1.64-2.35%, crude fibre 2.39-4.51%, while the carbohydrate content ranged 4.49-15.06%. The energy value was determined, and ranged from 433.15-525.16 Kcal. Ash content was significantly ( $p < 0.05$ ) higher in sample spiced with uda, fat and crude protein in ginger spiced sample, carbohydrate and crude fibre in uda and garlic spiced sample. Initial total bacterial count of the samples showed that the sample spiced with garlic had the lowest count ( $1.35 \times 10^3$  CFU/g) and after 2 weeks, cinnamon spiced butter had the lowest count ( $1.95 \times 10^4$  CFU/g). Initial total coliform count of the samples ( $1.05 \times 10^5 - 5.35 \times 10^6$  CFU/g) was lower in the control sample and after 2 weeks, uda spiced butter had the highest count ( $1.55 \times 10^2$  CFU/g). Initial total mould count showed no growth for control sample and samples spiced with ginger and garlic. After 2 weeks, only the control sample recorded no growth; however, all butter samples had total mould count within the recommended standard of  $10^3$  CFU/g for mould. Sensory analysis revealed that the control sample was highly preferred by the panelist and this was followed closely by the cinnamon spiced sample. This study recommends the use of cinnamon for shelf life extension of cashew nut butter which will result in cashew butter of improved shelf life and nutritional qualities.

**Keywords:** Cashew nut butter, sensory properties, shelf life, spices.

## INTRODUCTION

The term 'nut butter' defines a product with approximately 90% of nut ingredients (Shakerardekani *et al.*, 2013). Nut butters are widely used as a major item of diets. Nuts are rich in useful nutrients such as proteins, carbohydrates, and oils. Butters are usually produced by grinding nuts in the presence of an edible oil to form a nut paste (Shakerardekani *et al.*, 2013). Honey is added to the nut paste as a flavouring agent. Other ingredients could be

added to impart various desired textures to nut butters. Butter has a variety of uses, and the most common use is in sandwich preparation. Other uses include as toppings for edible crackers or as dips for vegetable pieces. Besides that, butter is also used in a variety of baking and cooking applications. Butter can be produced from almond, hazelnut, macadamia nut, peanut, pecan, pistachio and walnut and cashew nut.

The cashew tree (*Anacardium occidentale*) is a native of Brazil which is widely cultivated throughout the tropical climate regions, particularly in Africa and Asia such as Kenya, Madagascar, Nigeria, India, Sri Lanka and Thailand (Liaotrakoon *et al.*, 2016). The cashew fruit comprises of cashew apple, cashew nut shell and cashew nut kernel. The cashew nut kernel is an edible nut which can be considered as rich sources of lipids and proteins. It is slightly curved back on itself and forms two cotyledons, representing about 20-25% of the nuts weight (Gadani *et al.*, 2017). Cashew kernel is a rich source of fat (47.1%) and contains 4.7% ash, 1.2% fiber and 19.8% protein (Emelike *et al.*, 2015). The kernels also contain an average of 48% oil which are oleic (73.73%), linoleic (13.60%) and stearic (10.20%) acids in the ratio of 1:2:1 which can be used to lower blood serum cholesterol (Emelike and Barber, 2018). The cashew kernel is an important delicacy which is mainly used in confectionary such as cakes, pastries, candies and chocolates by enriching their taste and appearance as dessert nut. The nut can also be made into powder, paste, kuli-kuli snack, nut milk and cashew nut butter (Emelike and Akusu, 2018; Emelike and Akusu, 2019). Cashew nut butter is made by grinding dry roasted cashew kernels into a paste. According to Nwosu *et al.* (2014), cashew nut slurry butter gives a better spreadable product compared to groundnut slurry spread.

Spices refer to all of the edible parts of a plant including fruit, seed, root, rhizomes, barks, leaves, flowers and other vegetative substances used in a very small quantity as food additives to colour, flavour or preserve food (Bouba *et al.*, 2012). They are food ingredients, popular in every cuisine. They can be used in food products due to their flavouring properties, taste, aroma and colour. The popular spices are cinnamon, cardamom and ginger which are characterized by intense taste and aroma (Wilczynska *et al.*, 2017). They are widely used as seasoning or condiment and for medicinal purpose (Eke-Ejiofor *et al.*, 2016). They have been found to have antibacterial, antiviral and antifungal activity in *in vitro* studies. Spices such as cloves, garlic, ginger and pepper are good sources of nutrients and phytochemicals (Otunola *et al.*, 2016). Currently, there is a growing awareness that spices improve the oxidative stability of processed products thus marketed as antioxidants for use in the food industry (Lourenco *et al.*, 2019).

The quality of food is determined by its nutrient content. Currently, consumers are well educated and knowledgeable and are more concerned with the nutritional contents of the food they take. Alex and Eagappan (2017) in their study reported that natural spices not only provide good colour and flavour to the product but also contains antioxidants that inhibit lipid peroxidation and rancidity as well as other free radical-mediated processes that prevents the product from microbial spoilage. Therefore, it is important to improve shelf life of food products such as cashew nut butter which naturally goes

rancid easily.

The aim of this study is to evaluate the effects of ginger (*Zingiber officinals*), cinnamon (*Cinnamomum verum*), garlic (*Allium sativum*) and uda (*Xylopia aethiopica*) spices on the proximate composition, shelf life and sensory properties of cashew nut butter.

## MATERIALS AND METHODS

Roasted cashew kernels were purchased from Ogige market in Nsukka, Enugu State, Nigeria. Spices (cinnamon, ginger, garlic, and uda) were purchased from Mile 3 Market, Port Harcourt, Rivers State, Nigeria. The chemicals and equipments used for this study were obtained from the Biochemistry Laboratory, Department of Food Science and Technology, Rivers State University, Port Harcourt, Rivers State, Nigeria. The chemicals were of analytical grades.

### Preparation of spice powder

The separable part (husk) of ginger and garlic were peeled off and the spices were washed with distilled water and thereafter dried in a hot air oven at 55°C for 24 hours. All the dried spices including dried uda and cinnamon barks were milled using a dry milling machine and sieved using 0.6 mm sieve to get the spice powder as described by Sangwan *et al.* (2014) with modification.

### Formulation and production of spiced cashew nut butter

The roasted cashew nuts were sorted and milled into paste using an attrition mill. The spice powder and other ingredients were incorporated in the ratios shown in Table 1 and then homogenized using a Panasonic electric blender. The products were allowed to cool and packed in containers. The flowchart for the production of spiced cashew nut butter is as shown in Figure 1.

### Shelf life determination

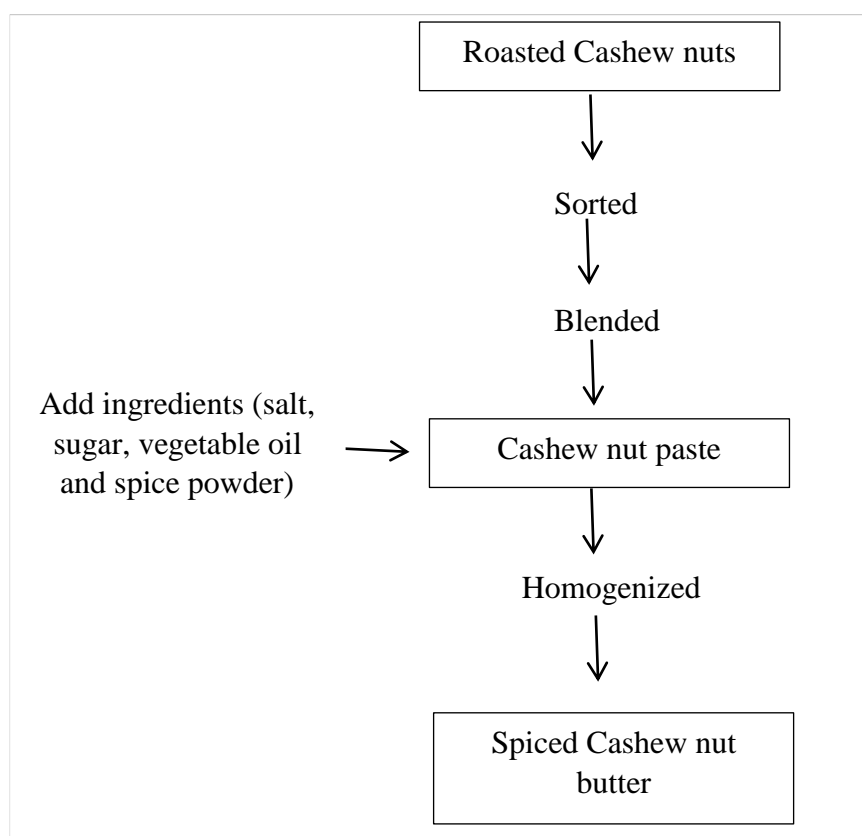
The spiced cashew nut butter samples were packaged in airtight containers and stored at room temperature (29°C) for 2 weeks. Microbial, proximate, energy value and sensory analyses were carried out on the samples on week 0 (initial), week 1 and week 2.

### Microbiological analysis

Microbial analysis was carried out using the method described by Jidean and Jideani (2006). Total bacteria

**Table 1.** Formulation of spiced cashew nut butter.

Ingredients	A	B	C	D	E
Peanut (g)	600	600	600	600	600
Ginger (g)		20	-	-	-
Cinnamon (g)	-	-	20	-	-
Garlic (g)	-	-	-	20	-
Uda (g)	-	-	-	-	20
Salt (g)	0.2	0.2	0.2	0.2	0.2
Sugar (g)	5.0	5.0	5.0	5.0	5.0
Vegetable oil (ml)	30	30	30	30	30

**Figure 1.** Production of spiced cashew nut butter.

counts were determined using nutrient agar (NA) while Saboraud dextrose agar (SDA) was used for the enumeration of total mould counts.

### Proximate analysis

The methods described by AOAC (2012) were used to determine the moisture, ash, fat, protein and crude fibre contents of the spiced and unspiced cashew nut butter

samples. Carbohydrate content was determined by difference.

### Energy value determination

The energy content (E) was calculated using Atwater factor method as described by Adegunwa *et al.* (2014). The value was obtained by multiplying the values for the crude protein, crude fat and carbohydrate by Atwater factor

4, 9, 4 respectively and the product was summed up, the value gotten was expressed in Kilocalories.

$$\text{Energy (Kcal/100g)} = (4 \times \text{Protein}) + (9 \times \text{fat}) + (4 \times \text{carbohydrate}) \dots\dots \text{Equation 1}$$

### Sensory analysis

A twenty-member semi-trained panelist consisting of students and staff of Rivers State University, Port Harcourt, Rivers State, Nigeria was used for sensory evaluation. Criteria for selection were that panelists are above 18 years of age and regular consumers of cashew kernels. They were neither sick nor allergic to nuts and spices. Spiced cashew nut butter was compared to plain cashew nut butter and evaluated for colour, taste, texture, flavour, spreadability and overall acceptability. Each attribute was rated on a 9-point hedonic scale of 1 to 9 with 1 = disliked extremely while 9 = liked extremely as described by Iwe (2010).

### Statistical analysis

The data obtained was subjected to analysis of variance (ANOVA) using (SPSS) version 20.0 software 2007. All analysis was done in duplicate. The measure of central tendencies and dispersions was determined and Duncan Multiple Range Test (DMRT) was used to separate the mean (Wahua, 1999).

## RESULTS AND DISCUSSION

### Proximate composition and energy value of samples

The proximate composition and energy value of the unspiced and cashew nut butter spiced with ginger, garlic, cinnamon and uda is shown in Table 2. Moisture content of the butter samples ranged from 25.66-33.26% with sample E (uda spiced cashew butter) recording the lowest value (25.66%) while sample C (garlic spiced cashew butter) had the highest value (33.26%). Moisture content of sample D (cinnamon spiced cashew nut butter) was significantly ( $p < 0.05$ ) different from samples E and A while samples B, C and D were not significantly ( $p > 0.05$ ) different. The result also showed that all the spices except uda increased the moisture content of the samples. Similar finding was also reported by Emelike *et al.* (2020) for ogi spiced with ginger and cinnamon. The results for moisture content were higher than the ones reported by Afolabi *et al.* (2018) for peanut butter made from peanut, crayfish and ginger whose moisture content was in the range of 6.23-6.31%. The low moisture content indicates a good shelf life for the product, since moisture content affects its stability and overall quality (Folake and Bends, 2006). The

moisture content of any food is an index of its water activity and it is used as a measure of stability and susceptibility to microbial contamination (Okerulu *et al.*, 2017).

Ash content of the samples ranged from 4.08% in sample D (cinnamon spiced butter) to 5.35% in sample E (uda spiced butter). Ash content of sample E was significantly ( $p < 0.05$ ) different from all other samples. The result also showed that treatment with ginger, garlic and cinnamon had no significant ( $p > 0.05$ ) effect on the ash content of the samples. Ash content is an overall estimate of the total mineral elements present in food. The results were higher than the values of 2.60-2.90% reported by Afolabi *et al.* (2018) for peanut butter incorporated with ginger and crayfish. It is also higher than the values of 2.20-3.56% obtained by Nwosu *et al.* (2014) for cashew nut and peanut spreads.

Fat content recorded 50.16%, 55.31%, 40.16%, 44.66% and 49.69% for control and butter samples spiced with ginger, garlic, cinnamon and uda, respectively. There was a significant ( $p < 0.05$ ) difference in the fat content of the butter samples. The result also showed that the ginger spice treatment (sample B) significantly ( $p < 0.05$ ) increased the fat content of the sample. This trend was also reported by Emelike *et al.* (2020) for ogi spiced with ginger and cinnamon. Fats (lipids) are structural components of all tissues and are indispensable for the assembly of membranes of cells and cell organelles. They are sources of essential fatty acids for the body's fat synthesis, and serve as vehicles for the absorption of fat-soluble vitamins and other precursors. Dietary fats slow gastric emptying and intestinal motility thereby prolonging the length of time food is left in the stomach – increasing the satiety values of meals. This is particularly important for infants and children due to their small stomach size (FAO, 2010). The crude fat content of the spiced cashew nut butter makes these samples contribute to meeting the daily lipid requirement of consumers. However, higher lipid content would make the product highly susceptible to rancidity (Odibo *et al.*, 2008).

Crude protein content of the butter samples ranged from 1.64% in sample C (garlic spiced butter) to 2.35% in sample B (ginger spiced butter). There was also a significant ( $p < 0.05$ ) difference in the crude protein content of the butter samples. A significant ( $p < 0.05$ ) increase was also observed upon treatment with the spices. An increase in the protein content of ogi was also reported by Emelike *et al.* (2020) following treatment with ginger and cinnamon. The result obtained are lower than the study of Boli *et al.* (2013) that peanut butter sold in retail markets in Cote d'Ivoire contains crude protein ranging from 22.92-27.42%. Also, the results were lower than those reported by Adjou *et al.* (2013) for 100% peanut butter which was 27.53%. This could be as a result of difference in raw materials. Protein serves as the major structural components of all cells in the body, and functions as enzymes, transport carriers, and some hormones. Dietary protein is an

**Table 2.** Proximate composition of spiced cashew nut butter.

Samples	Moisture (%)	Ash (%)	Fat (%)	Crude protein (%)	Crude fibre (%)	CHO (%)	Energy (Kcal)
A	26.54±3.32 <sup>bc</sup>	4.20±0.14 <sup>b</sup>	50.16±0.22 <sup>b</sup>	1.66±0.02 <sup>d</sup>	2.39±0.31 <sup>c</sup>	15.06±3.25 <sup>ab</sup>	512.28±15.09 <sup>a</sup>
B	30.21±0.12 <sup>abc</sup>	4.35±0.21 <sup>b</sup>	55.31±0.44 <sup>a</sup>	2.35±0.02 <sup>a</sup>	3.28±0.22 <sup>b</sup>	4.49±0.15 <sup>c</sup>	525.16±3.46 <sup>a</sup>
C	33.26±3.85 <sup>ab</sup>	4.28±0.18 <sup>b</sup>	40.16±0.22 <sup>d</sup>	1.64±0.03 <sup>d</sup>	4.36±0.44 <sup>a</sup>	16.30±3.48 <sup>a</sup>	433.15±11.83 <sup>b</sup>
D	36.09±3.07 <sup>a</sup>	4.08±0.11 <sup>b</sup>	44.66±0.92 <sup>c</sup>	2.14±0.03 <sup>b</sup>	3.91±0.22 <sup>ab</sup>	9.13±2.50 <sup>bc</sup>	447.01±18.23 <sup>b</sup>
E	25.66±0.46 <sup>c</sup>	5.35±0.49 <sup>a</sup>	49.69±0.44 <sup>b</sup>	2.05±0.05 <sup>c</sup>	4.51±0.26 <sup>a</sup>	12.74±0.31 <sup>ab</sup>	506.36±5.00 <sup>a</sup>

Values are means ± standard deviations by three determinations. Mean values within a column with different superscripts are significantly different ( $p < 0.05$ ). **Keys:** A = Control (unspiced cashew nut butter), B = Ginger spiced cashew nut butter, C = Garlic spiced cashew nut butter, D = Cinnamon spiced cashew nut butter, E = Uda spiced cashew nut butter.

important macronutrient in human nutrition being the source of essential amino acids for the synthesis of the body's proteins (Onyeike *et al.*, 2015).

The result of crude fibre content of the butter samples was as follows: 2.39%, 3.28%, 4.36%, 3.91% and 4.51% for control and butter samples spiced with ginger, garlic, cinnamon and uda, respectively. Crude fibre content of samples C, D and E were not significantly ( $p > 0.05$ ) different from one another. There was also a significant ( $p < 0.05$ ) increase in the crude fibre content of the samples. Crude fibre is the number of indigestible sugars present in a food sample which has the physiological role of adding bulk to stool, and thus contribute to the maintenance of internal distensions for a normal peristaltic movement. By facilitating peristalsis, dietary fibre helps to reduce many gastrointestinal diseases, serum cholesterol, risk of coronary heart disease, colon and breast cancer and hypertension (Akinyele and Oloruntoba, 2013).

Carbohydrate content of the butter samples ranged from 4.49-16.30% with the lowest value (4.49%) recorded in sample B while sample C had the highest value (16.30%). There was a decrease in the carbohydrate content upon treatment with ginger, cinnamon and uda. However, these decreases were significant ( $p < 0.05$ ) for samples treated with ginger and cinnamon. Similar decrease was also reported by Emelike *et al.* (2020) for ogi treated with cinnamon. The result was lower than the finding of Asibuo *et al.* (2008) whose carbohydrate content for peanut butter ranged from 20-32%. The result however agrees with the study of Afolabi *et al.* (2018) who reported carbohydrate values of 12.87-21.39% for peanut butter incorporated with ginger and crayfish.

Energy content of the samples ranged from 433.15 Kcal in sample C to 525.16 Kcal in sample B. There was no significant ( $p > 0.05$ ) difference in the energy values of samples A, B and E. The result also showed that treatment with garlic, cinnamon and uda led to a significant ( $p < 0.05$ ) increase in the energy values of the samples. The observed differences in the energy values of the samples could be attributed to variation in the protein, fat and carbohydrate contents of the samples.

### Microbial count of unspiced and spiced cashew nut butter during storage

#### Total bacterial count (cfu/g) of cashew nut butter stored for 2 weeks at room temperature

Table 3 shows the Total Bacterial Count (TBC) of unspiced and spiced cashew nut butter stored for 14 days at room temperature. Initial total bacterial count of the samples ranged from  $1.35 \times 10^3$  to  $7.50 \times 10^3$  cfu/g with sample C (garlic spiced cashew nut) recording the lowest and sample A (control) as the highest. There was an increase in the total bacterial count of the butter samples during storage; however, this increase was higher for the control sample. At the end of storage period of 14 days, all the treated samples had bacteria count of  $10^4$  cfu/g while the control sample had  $10^5$  cfu/g. This might be due to the spice treatment as spices have the ability to inhibit the growth of microorganisms in food products thereby potentiating their shelf life (Kawatra and Raiagopalan, 2015). The cashew nut butter after 14 days of storage was within the microbial limit of not more than  $10^5$  cfu/g for ready to eat food products (ICMSF, 2002).

#### Total coliform count (cfu/g) of cashew nut butter stored for 2 weeks at room temperature

Table 4 shows the Total Coliform Count (TCC) of cashew nut butter stored for 14 days at room temperature. Initial coliform count of the samples ranged from  $1.05 \times 10$  to  $5.35 \times 10$  cfu/g with sample A (control) recording the lowest and sample B (ginger spiced cashew nut butter) as the highest. The result also showed that there was an increase in the coliform count of the samples during storage. Samples treated with ginger (sample B), garlic (sample C) and cinnamon (sample D) recorded  $10^1$  cfu/g while sample treated with uda (sample E) had coliform count of  $10^2$  cfu/g after 14 days storage. The presence of coliforms in food no matter how insignificant is an indication of faecal contamination as a result of poor practices (ICMFS, 2002).

**Table 3.** Total Bacterial Count (Cfu/g) of cashew nut butter stored for 2 weeks at Room Temperature.

Samples	Storage period (Weeks)		
	Initial	1	2
A	$7.50 \times 10^3$	$2.15 \times 10^4$	$4.40 \times 10^5$
B	$2.60 \times 10^3$	$5.35 \times 10^3$	$2.80 \times 10^4$
C	$1.35 \times 10^3$	$4.40 \times 10^3$	$3.15 \times 10^4$
D	$1.80 \times 10^3$	$3.85 \times 10^3$	$1.95 \times 10^4$
E	$7.70 \times 10^3$	$2.40 \times 10^4$	$9.35 \times 10^4$

**Keys:** A = Control (unspiced cashew nut butter), B = Ginger spiced cashew nut butter, C = Garlic spiced cashew nut butter, D = Cinnamon spiced cashew nut butter, E = Uda spiced cashew nut butter, Cfu/g = Colony forming unit per gram.

**Table 4.** Total Coliform Count (Cfu/g) of cashew nut butter stored for 14 Days at Room Temperature.

Samples	Storage period (Weeks)		
	Initial	1	2
A	$1.05 \times 10$	$1.00 \times 10$	$2.20 \times 10$
B	$5.35 \times 10$	$1.60 \times 10$	$9.50 \times 10$
C	$2.00 \times 10$	$1.55 \times 10$	$2.45 \times 10$
D	$1.80 \times 10$	$2.80 \times 10$	$2.80 \times 10$
E	$4.20 \times 10$	$2.15 \times 10$	$1.55 \times 10^2$

**Keys:** A= Control (unspiced cashew nut butter), B = Ginger spiced cashew nut butter, C = Garlic spiced cashew nut butter, D = Cinnamon spiced cashew nut butter, E= Uda spiced cashew nut butter, Cfu/g = Colony forming unit per gram.

**Table 5.** Total Mould Count (Cfu/g) of cashew nut butter stored for 14 Days at Room Temperature.

Samples	Storage period (Weeks)		
	Initial	1	2
A	NG	NG	NG
B	NG	NG	$1.00 \times 10$
C	NG	NG	$1.00 \times 10$
D	NG	NG	$2.50 \times 10$
E	NG	$8.05 \times 10$	$1.00 \times 10$

Keys: A = Control (unspiced cashew nut butter), B = Ginger spiced cashew nut butter, C= Garlic spiced cashew nut butter, D = Cinnamon spiced cashew nut butter, E = Uda spiced cashew nut butter, Cfu/g = Colony – forming unit per gram, NG = No growth.

Enterobacteriaceae which include coliforms should not be more than  $10^4$  cfu/g in ready to eat foods. Coliform counts ranging between  $10^2$  and  $10^4$  cfu/g are considered to be at the border line while values less than  $10^2$  cfu/g are satisfactory (Adi *et al.*, 2018). Therefore, the coliform counts in all the cashew nut butter samples are at the border line of acceptable limits.

#### **Total mould count (cfu/g) of cashew nut butter stored for 14 days at room temperature**

Table 5 shows the Total Mould Count (TMC) of cashew nut butter stored for 14 days at room temperature. Initial mould count of the samples showed no growth for all samples. At the end of storage period, all the treated samples had

**Table 6.** Mean sensory scores of unspiced and spiced cashew nut butter.

Samples	Colour	Appearance	Taste	Flavour	Aroma	Overall Acceptability
A	7.95 <sup>a</sup>	7.40 <sup>a</sup>	7.65 <sup>a</sup>	7.25 <sup>a</sup>	7.30 <sup>a</sup>	7.50 <sup>a</sup>
B	5.50 <sup>bc</sup>	5.65 <sup>b</sup>	5.80 <sup>b</sup>	5.75 <sup>b</sup>	5.75 <sup>b</sup>	5.70 <sup>bc</sup>
C	6.40 <sup>bc</sup>	6.45 <sup>ab</sup>	5.60 <sup>b</sup>	5.65 <sup>b</sup>	5.65 <sup>b</sup>	5.90 <sup>bc</sup>
D	6.60 <sup>b</sup>	6.50 <sup>ab</sup>	5.25 <sup>b</sup>	6.30 <sup>b</sup>	6.30 <sup>ab</sup>	6.15 <sup>b</sup>
E	5.20 <sup>c</sup>	5.60 <sup>b</sup>	5.30 <sup>b</sup>	5.35 <sup>b</sup>	5.35 <sup>b</sup>	5.45 <sup>bc</sup>

Mean values within a column with different superscripts are significantly different at ( $p < 0.05$ ). **Keys:** A = Control (unspiced cashew nut butter), B = Ginger spiced cashew nut butter, C = Garlic spiced cashew nut butter, D = Cinnamon spiced cashew nut butter, E = Uda spiced cashew nut butter.

mould count of 10 cfu/g while the control sample had no growth. For food products, the number of moulds must not exceed  $10^3$  cfu/g (Larissa *et al.*, 2018). Thus, the finding of this study showed that all the samples were within the acceptable limit and therefore, the products are microbiologically safe. The presence of mould in the treated samples may be due to the presence of residual moisture which provides a conducive environment for their growth. Mould growth has been associated with the formation of heat stable mycotoxins which are a major concern of food safety (Dalie *et al.*, 2010).

### Sensory properties of unspiced and spiced cashew nut butter

Table 6 shows the mean sensory scores of unspiced and spiced cashew nut butter. The result of the sensory analysis of the cashew nut butter samples showed that the control sample was highly preferred by the panelist for all sensory parameter. This was followed closely by the sample spiced with cinnamon with an overall score of 6.15 as compared to the control of 7.50. Similar order of preference was also reported by Emelike *et al.* (2020) for ogi spiced with cinnamon and ginger. This result therefore indicates that cinnamon can be used to spice cashew nut butter.

### Conclusion

The result of this study showed that ginger, garlic, cinnamon and uda improved the ash, crude protein and crude fibre content of cashew nut butter. Ash content was significantly ( $p < 0.05$ ) higher in uda treated sample; ginger spiced sample had higher crude protein and fat while crude fibre was higher in garlic treated sample. Total bacterial count was higher in the control sample and lower in the cinnamon spiced sample after 14 days of storage. Mould and coliform after 14 days of storage were within the recommended standard. The control sample was highly preferred by the panelists and this was followed closely by

the cinnamon spiced cashew nut butter. This study therefore demonstrated the potential of cinnamon in the treatment of cashew nut butter with acceptable sensorial attributes comparable with the control sample.

### CONFLICT OF INTEREST

The authors declare that they have no conflict of interest.

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