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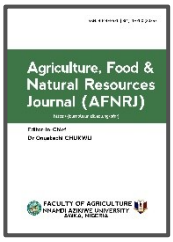

Original Article

Proximate composition of cashew nut spread complemented with date palm and ripe banana

OPEN ACCESS

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ABSTRACT

This study evaluated the proximate composition of cashew nut spread supplemented with date palm and ripe banana to develop a nutritionally enriched product from locally available raw materials. Cashew nuts, dried dates, and ripe bananas were processed into pastes and combined in different proportions using an extreme vertices mixture design. Seven formulations were prepared in varying ratios of cashew nut, date palm, and banana, mixed thoroughly and pasteurized. The spreads were subjected to proximate analysis using standard methods, and significant variations were observed. Moisture content ranged from 5.15–9.02%, protein 10.22–16.36%, fat 10.38–15.27%, ash 4.12–5.45%, fiber 4.34–6.24%, and carbohydrate 51.74–59.63%. The formulation with 70% cashew, 20% date, and 10% banana recorded the highest protein and fat contents, while the blend with 60% cashew, 20% date, and 20% banana had the highest ash content. Increased cashew nut levels contributed to higher protein and fat, whereas dates and bananas enhanced fiber and carbohydrate levels. The findings demonstrate that cashew nut significantly improves protein and fat composition in spreads, while the addition of dates and bananas enhances dietary fiber and carbohydrates. Therefore, cashew nut–based spreads enriched with date palm and ripe banana can serve as nutritious alternatives to conventional spreads, providing consumers with plant-based protein and energy from locally sourced ingredients.

KEYWORDS: *Banana, Cashew, Nut, Protein,*

INTRODUCTION

Nut-based spreads are attractive carriers of unsaturated fatty acids, phytosterols, tocopherols, and proteins, while offering a creamy matrix amenable to fortification with natural sweeteners and fruit-derived bioactives (Tonetto, 2025).). These spreads are created by finely grinding nuts until a smooth, butter-like consistency is achieved. A wide variety of nuts, including almonds, peanuts, and cashews, can be used in their preparation. Their culinary versatility allows them to be enjoyed in sandwiches, as dips, or as toppings for crackers. Additionally, nut spreads are commonly incorporated into baked goods and various recipes due to their rich taste and nutritional value (Matos et al., 2024).

The cashew tree (*Anacardium occidentale*), native to Brazil, is now cultivated extensively across tropical regions, particularly in African and Asian countries like Nigeria, Kenya, Madagascar, India, and Sri Lanka (Gbèwommindéa Dotonhoué et al., 2025). Cashew nuts are nutritionally dense, containing around 47% fats, 20% protein, and smaller amounts of ash, fiber, and oil. Their oil profile is rich in oleic and linoleic acids, which may contribute to cholesterol regulation (Leal et al., 2023). Cashew kernels also provide essential minerals like magnesium, copper, manganese, phosphorus, and zinc, along

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with B vitamins including thiamine and riboflavin (Olatunde et al., 2023).

The date palm (*Phoenix dactylifera* L.) is prized for its nutrient-dense fruit and cost-effectiveness. Dates primarily consist of carbohydrates, particularly natural sugars and fiber, with minimal fat and protein (Al-Harrasi et al., 2022). They are rich in antioxidants and compounds with anti-inflammatory, antimicrobial, and anti-cancer effects, supporting liver, immune, and gastrointestinal health (Al-Okbi, 2022). Dates are widely used as natural sweeteners and flavor enhancers in food formulations. Bananas (*Musa spp*.) are globally appreciated for their high nutritional value and abundance of beneficial phytochemicals (Payal et al., 2023). Their health-promoting qualities are linked to their high fiber and phenolic content, which provide antioxidant, antimicrobial, and anti-cancer benefits (Kumari et al., 2022). The objective of this study was to produce cashew nut spread complemented with date palm and ripe banana and evaluate its proximate composition.

MATERIALS AND METHODS

Sources of Raw Materials

Roasted Cashew nuts, dried Dates, and ripe Bananas were from Eke-Awka Market in Awka South, Anambra State.

Cashew Nut Processing

The procedure outlined by Orisa *et al.* (2023) was adopted with little modifications. The roasted cashew nuts were sorted and milled into a smooth paste using a silver crest multi-function blender with the model number: Sc-1589. The cashew nut paste was allowed to cool and packed in a container.

Date Palm Processing

The procedure outlined by Mahdi *et al*. (2022) was adopted with little modifications. Dried date palms were sorted, washed and the seeds were removed manually. The date palm flesh was ground into a paste using a silver crest multi-function blender of the model number: Sc-1589. The date palm paste was packed in a plastic air-tight container.

Banana Processing

Ripe banana fruits were washed and peeled manually to remove the banana peel. The banana fruits were ground into slurry using a silver crest multi-function blender of the model number: Sc-1589. The ripe banana fruit slurry was also packed in a container and used immediately.

Experimental Design

Extreme vertices mixture design from Minitab software version 18 was used for this research as shown in Table 1 below.

Table 1: Extreme Vertices Mixture Design

Sample code	Std order	Run Order	Pt Type	Cashew nut	Date palm	Ripe Banana
CADB1	6	1	-1	63.3333	18.3333	18.3333
CADB2	1	2	1	70.0000	10.0000	20.0000
CADB3	3	3	1	70.0000	20.0000	10.0000
CADB4	2	4	1	60.0000	20.0000	20.0000
CADB5	4	5	0	66.6667	16.6667	16.6667
CADB6	7	6	-1	68.3333	18.3333	13.3333
CADB7	5	7	-1	68.3333	13.3333	18.3333

Formulation of Cashew Nut Spread Complemented with Date Palm and Ripe Banana

The procedure outlined by Olalekan-Adeniran *et al.* (2021) was adopted for the production of the spread with little modifications. The roasted cashew nut paste, date palm paste, and ripe banana slurry were weighed and mixed at different ratios as indicated in the experimental design (Table 1.) The spread was then pasteurized at 60°C for 3 minutes. It was allowed to cool, filled into airtight small plastic jars, and stored at room temperature (29 ± 2°C).

Proximate Analysis

Moisture content

The moisture content of the flour sample was determined using AOAC (2023). Firstly, the weight of the cleaned and dried aluminum dish was measured (W_1) and 5 g of sample flour was transferred and weighed with its content (W_2). The dish and its contents were then heated in a 105°C oven for 3 h (Gallenkamp 300 plus series, Widnes, Cheshire, U.K.). After drying, the sample was cooled in a desiccator (CSN-SIMAX) for 30 min and re-weighed until a constant weight was achieved (W_3). The moisture content was then calculated using the weight loss by difference, as shown in equation (1).

$$\% \text{ Moisture} = \frac{W_2 - W_3}{W_2 - W_1} \times \frac{100}{1} \qquad (1)$$

where; W1 - the weight of the dish, W2 - the weight of the dish and sample before drying, and W3 - weight of the dish and sample after drying.

Crude protein content

The crude protein content of the sample flour was determined using an automatic Kjeldahl analyzer instrument (UDK 159)

following AOAC (2023). Before digestion, 1.0 g of sample flour was treated with catalysts ($CuSO_4.5H_2O$ and K_2SO_4). Ammonia was distilled off during 60 min of digestion of ammonium sulfate at 420°C in 12 ml concentrated sulfuric acid and reagents 50 ml NaOH, 30 ml H_3BO_3, and 50 ml distilled water, which was then automatically titrated with standard hydrochloric acid (0.2 N). Equation (2) was used to determine the total nitrogen content.

$$\% N_2 = \frac{(V_s - V_b)_{HCL} \times N_{HCL} \times 14.01}{\text{Weight of initial sample}} \times \frac{100}{1} \quad (2)$$

where; Vs - the volume of the acid consumed by the sample, Vb - the volume of the acid consumed by the blank, NHCl - the normality of the HCl, 14.01- molecular weight of nitrogen. Crude protein percentage was determined by multiplying the percentage of nitrogen using a conversion factor of 6.25.

The crude protein percentage was calculated as shown in equation (3).

$$\% \text{ crude protein} = \% N_2 \times 6.25 \quad (3)$$

Crude fat content

The amount of crude fat was determined using the Soxhlet extraction method, as described in AOAC (2023) official method 920.39. Briefly, 2 g of sample (W_1) was transferred into a thimble and covered with fat-free cotton, and then fitted into the Soxhlet extraction apparatus. A weight of pre-cleaned and dried extraction cylinder was measured (W_2) and 50 ml of petroleum ether (Loba Chemie, Mumbai, India) was added to extract the crude fat. The extraction continued for 4 h and then dried in an oven (Gallenkamp 300 plus series, Widnes, Cheshire, U.K.) at 70°C for 30 min. It was cooled in desiccators for 30 min. The combined weight of the extraction cylinder and extract was measured (W_3), and crude fat content was determined according to equation (4).

$$\% \text{ Crude fat} = \frac{W_3 - W_2}{W_1} \times \frac{100}{1} \quad (4)$$

where; W_3 - the weight of the extraction cylinder and crude fat, W_2 - the weight of the extraction cylinder, and W_1 - the weight of the sample.

Crude fiber content

Crude fiber content was determined based on AOAC (2023) official method 962.09. One gram of sample (W_1) was boiled for 40 min in 50 ml dilute sulfuric acid (2.5 %) and then, the acid was drained using a vacuum pump. After washing with distilled water, the residue was boiled for 40 min in 50 ml of 2.5 % sodium hydroxide. After that, it was washed with once 20 ml of 99.8 % ethanol, twice with 20 ml of diethyl ether, and three times with 20 ml of acetone. The insoluble residue (crude fiber and ash) was dried in an oven (Blast Air Oven, DHG-9240A, China) and weighed (W_2). This residue was burned at 550ºC for 3 h (W_3) in a furnace (Nabertherm, D-6072 Dreieich, Germany), and the crude fiber percentage was calculated using equation (5).

$$\% \text{ Crude fibre} = \frac{W_2 - W_3}{W_1} \times \frac{100}{1} \quad (5)$$

where; W_1 - the weight of the sample, W_2 - the weight of dried insoluble residue (crude fiber + ash), and W_3 - the weight of burned residue (ash).

Ash content

The ash content was determined after the removal of organic matter by dry ashing according to AOAC (2023) official method 923.03. Initially, the weight of clean and dried crucible was measured (W_1) and a 5 g of sample (W_2) was added and charred in the hot plate under the hood. The charred sample was placed in a muffle furnace ((Hasthas, Servell Engineers, Chennai, India) and ignited at 550°C for 5 h until the sample became white/gray. The crucibles and their content were cooled in a desiccator and weighed (W_3) to determine ash content using equation (6).

$$\% \text{ Ash} = \frac{W_3 - W_1}{W_2} \times \frac{100}{1} \quad (6)$$

where; W_1 - the weight of the crucible, W_2 - the weight of the sample, and W_3 - weight of the crucible and sample after ashing.

Carbohydrate

Percentage Carbohydrate value was calculated through the difference approach as follows: (100 – the sum of % moisture, % ash, % fat, % crude fibre and % crude protein). Triplicate determinations were done.

Statistical Analysis

The values obtained from the experiment were analyzed using analysis of variance (ANOVA) in the Statistical Package for Social Sciences. Significant differences between the samples were tested at $p < 0.05$ using Duncan's multiple range test.

RESULTS AND DISCUSSION

Proximate Composition

The proximate composition of cashew nut spread supplemented with date palm and ripe banana showed significant variation across samples (Table 2).

Proximate composition refers to the main nutritional components of food products, typically including moisture, protein, fat, ash, fiber, and carbohydrates. This composition is crucial for understanding the nutritional value and overall quality of food items.

Moisture content ranged from 5.15 % in CADB2 (70 % Cashew: 10 % Date: 20 % Banana) to 9.02 % in CADB4 (60 % Cashew: 20 % Date: 20 % Banana). The low moisture content gives an insight that the spread will likely be more shelf-stable. This difference can be explained by the varying proportions of moisture-rich ingredients such as bananas and dates. As noted by Sefrienda *et al.* (2022), high moisture levels can affect the

shelf life and stability of spreads, making moisture control critical in the formulation.

Protein levels significantly ($p<0.05$) varied from 10.22% in CADB4 (60 % Cashew: 20 % Date: 20 % Banana) to 16.36% in CADB3 (70 % Cashew: 20 % Date: 10 % Banana), which reflects the higher cashew content in CADB3 (70 % Cashew: 20 % Date: 10 % Banana), as cashew nuts are known for their protein richness. According to Liu *et al*. (2023), nuts typically have higher protein levels compared to fruits, which explains the significant protein content observed in the higher cashew formulations. This finding aligns with studies by Tonetto *et al.* (2025), which reported that nut-based spreads tend to exhibit enhanced protein profiles compared to fruit-based alternatives.

Fat content also significantly ($p<0.05$) varied, ranging from 10.38% in CADB4 (60 % Cashew: 20 % Date: 20 % Banana) to 15.27 % in CADB3 (70 % Cashew: 20 % Date: 10 % Banana). Increase in cashew nut inclusion also significantly increased the fat content of the spreads. The higher fat content in CADB3 (70 % Cashew: 20 % Date: 10 % Banana) can be attributed to the higher proportion of cashews, which has a high fat content and are known for their healthy fat content, primarily the mono-unsaturated fats (Meneguelli, et al., 2024). This is consistent with the findings of Tonetto *et al.* (2025), who noted that spreads with higher nut content exhibit increased fat levels, contributing to creaminess and mouthfeel.

Ash content, which reflects mineral composition, ranged from 4.12 % in CADB1 (63.3 % Cashew: 18.3 % Date: 18.3 % Banana) to 5.45% in CADB4 (60 % Cashew: 20 % Date: 20 % Banana). The observed significant ($p<0.05$) variations in ash content can be attributed to differences in the mineral density of the ingredients used; for instance, bananas and dates provide essential minerals like potassium and magnesium (Aljaloud, *et al.*, 2020). Recent studies confirm that these fruits contribute essential minerals such as potassium and magnesium (Al-Harrasi et al., 2022).

Fiber content significantly ($p<0.05$) varied from 4.34% in CADB2 (70 % Cashew: 10 % Date: 20 % Banana) to 6.24% in CADB4 (60 % Cashew: 20 % Date: 20 % Banana). The higher fiber content in CADB4 may be due to the inclusion of more fibrous ingredients like bananas, which are rich in dietary fiber (Phillips *et al.,* 2021). This observation is in line with research by Phillips *et al.* (2021), which indicated that increasing the proportion of fibrous fruits in formulations leads to higher overall fiber content.

Lastly, carbohydrate content ranged from 51.74% in CADB3 (70 % Cashew: 20 % Date: 10 % Banana) to 59.63% in CADB1 (63.3 % Cashew: 18.3 % Date: 18.3 % Banana), with CADB1 (63.3 % Cashew: 18.3 % Date: 18.3 % Banana) containing a higher proportion of carbohydrates from the bananas and dates. The carbohydrates primarily come from the sugars and starches present in these fruits, as noted by (Ibrahim *et al.,* (2021). The higher levels were associated with sugar-rich fruits (dates and bananas), consistent with recent reports on fruit-based formulations (Al-Okbi, 2022).

Table 2: Proximate Composition of Cashew Nut Spread Supplemented with Date Palm and Ripe Bananas

Sample	Moisture (%)	Protein (%)	Fat (%)	Ash (%)	Fibre (%)	CHO (%)
CADB1	$8.03^{b}\pm0.02$	$11.15^{f}\pm0.01$	$11.07^{f}\pm0.02$	$4.12^{g}\pm0.02$	$6.02^{b}\pm0.03$	$59.63^{a}\pm0.06$
CADB2	$5.15^{g}\pm0.03$	$15.98^{b}\pm0.11$	$15.10^{b}\pm0.01$	$4.27^{f}\pm0.01$	$4.34^{g}\pm0.04$	$55.17^{e}\pm0.11$
CADB3	$6.45^{f}\pm0.02$	$16.36^{a}\pm0.02$	$15.27^{a}\pm0.02$	$4.74^{c}\pm0.03$	$5.46^{e}\pm0.04$	$51.74^{g}\pm0.03$
CADB4	$9.02^{a}\pm0.01$	$10.22^{g}\pm0.01$	$10.38^{g}\pm0.03$	$5.45^{a}\pm0.01$	$6.24^{a}\pm0.04$	$58.69^{b}\pm0.06$
CADB5	$7.69^{d}\pm0.05$	$12.16^{e}\pm0.03$	$12.44^{e}\pm0.06$	$5.21^{b}\pm0.01$	$5.62^{d}\pm0.06$	$56.89^{c}\pm0.07$
CADB6	$6.77^{e}\pm0.01$	$12.87^{d}\pm0.21$	$13.99^{d}\pm0.10$	$4.47^{e}\pm0.03$	$5.73^{c}\pm0.01$	$56.17^{d}\pm0.17$
CADB7	$7.87^{c}\pm0.01$	$14.39^{c}\pm0.01$	$14.39^{c}\pm0.01$	$4.63^{d}\pm0.04$	$5.07^{f}\pm0.04$	$53.70^{f}\pm0.04$

Means with different superscripts along the same column are significantly different ($p<0.05$)

Key: *CHO = Carbohydrate, CADB1 = 63.3 % Cashew: 18.3 % Date: 18.3 % Banana. CADB2 = 70 % Cashew: 10 % Date: 20 % Banana, CADB3 = 70 % Cashew: 20 % Date: 10 % Banana. CADB4 = 60 % Cashew: 20 % Date: 20 % Banana, CADB5 = 66.6 % Cashew: 16.6 % Date: 16.6 % Banana. CADB6 = 68.3 % Cashew: 18.3 % Date: 13.3 % Banana, CADB7 = 68.3 % Cashew: 13.3 % Date: 18.3 % Banana*

CONCLUSION AND RECOMMENDATIONS

This research indicates that spreads can be produced from cashew nuts, date palm and ripe banana. The use of cashew nut complemented with date palm and ripe bananas in spread production significantly improves the protein and fat contents, indicating improved nutritional quality. Cashew nut-based spreads have relatively low carbohydrate content which may be suitable for persons planning on calorie cut down. The study therefore recommends the formulation that involved the use of 70 Cashew: 20 Date: 10 Banana (CADB3) is recommended for commercial production due to its superior protein and fat content, which are desirable for nutrient-dense spreads. Further studies on sensory evaluation, shelf stability, and consumer acceptance are suggested to optimize product development and marketability.

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Authors' Contributions

CCE conceptualized the study. CCE & JG designed the experiment, collected data, performed data analysis, and wrote the first draft of the manuscript. JG & FO performed literature searches and reviewed the first draft of the manuscript. FO & MCE reviewed, edited and formatted the second draft. All authors read and approved the final draft of the manuscript.

Ethical Statement

Not applicable

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