



# Nutrient Composition, Phytochemical and Sensory Properties of Nuts from Red and Yellow Varieties of Cashew Fruit

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## ABSTRACT

This study evaluated the nutrient composition, phytochemical and sensory properties of nuts from red and yellow varieties of cashew fruit. Samples of fresh cashew fruits were obtained from Ihube plantation at Okigwe in Imo state. The cashew nut samples were separated from the cashew apple and roasted at 150°C for 5 hours. The cooled nuts were dehulled and the kernels milled into flour using a milling machine (Model:100 stone mill). Proximate, minerals, vitamins, phytochemicals and sensory properties of the samples were determined using standard analytical methods. Data obtained were compared using independent samples t-test. Cashew nuts from red variety had significantly ( $p<0.05$ ) higher crude fibre (2.29%) content while the yellow variety had significantly ( $p<0.05$ ) higher crude protein (26.54%) content. Cashew nuts from red variety had significantly ( $p<0.05$ ) higher magnesium (43.87mg), phosphorus (128.62mg), zinc (1.24mg) and iron (0.85mg). Vitamin C, vitamin E, folic acid, phytate, tannin, alkaloid, flavonoid, carotenoid and phenol content of the samples were not significantly ( $p>0.05$ ) different. There were no significant ( $p>0.05$ ) differences in taste, colour, aroma, texture and overall acceptability among the samples. This study reveals that cashew nuts from both varieties of cashew are rich sources of nutrients and phytochemicals and were both generally acceptable. Therefore, the cultivation, consumption and use of nuts from the red and yellow varieties of cashew as ingredients in the formulation of food products should be encouraged.

**Keywords:** Cashew, phytochemical, nuts, nutrients

## INTRODUCTION

Nuts could be referred to as dry, hard-shelled, separated fruit that do not split on maturity to release seed (1). Cashew (*Anacardium occidentale L*) tree is a member of the *Anacardiaceae* family (1). The nut is kidney shaped with length of about 3cm (2). Cashew is a drought resistant tree and grows well in a variety of soils and tropical climatic condition (3).

Cashew nuts were introduced in Nigeria in the 15<sup>th</sup> century by the Portuguese as a form of afforestation scheme in a bid to control the high rate of erosion in the eastern Nigeria (4). Cashew cultivation became extensive in Nigeria in the early 1950's. It has cut across 27 states in the country and its rate of production has increased to about 30 folds from 1990 to 2012 (5). In 2010, Nigeria was ranked one of the largest producers of cashew in the world together with India, Tanzania, Cote d' Ivore, Vietnam, Indonesia, Philippines, Brazil, Guinea-Bissau and Benin with a total output of approximately 2,757,598 metric tonnes (6).

Cashew can be planted either by directly placing the seeds in the field or by budding, grafting or marcotting (2). There are variations in the growth pattern, quality of crop and yield of cashew fruits, colour of the apple (red, yellow and orange) and size of the nuts (7).

There are several techniques that can be employed in the processing of cashew nuts. These include cleaning, soaking, roasting, shelling, drying and peeling (2,8). Cashew nuts are roasted over open fire or hot charcoal in rural areas in Nigeria (9). Roasting enhances the flavor of the nut. After roasting, the nuts can be taken mostly as snacks or can be further processed into other products such as butter (10). Cashew nut is a good source of nutrients such as protein, copper, zinc, iron and magnesium (11). It is also a rich source of dietary fiber and health promoting phytochemicals (1).

Cashew nut is a popular snack in Nigeria (12). Previous studies (13,14 and 15) examined the chemical and physico-chemical properties of cashew nuts. Ologunde (12) evaluated the nutrient potentials of cashew nuts from three locations in Nigeria. There is limited data on the nutritional and phytochemical composition of processed cashew nuts from red and yellow varieties of cashew in Nigeria. This study will therefore evaluate the chemical, phytochemical and sensory properties of processed nuts from red and yellow varieties of cashew.

## **MATERIALS AND METHODS**

### **Processing of Cashew Nut**

Samples of fresh fruits from the yellow and red varieties of cashew were obtained from Ihube plantation at Okigwe Local Government Area, Imo state, Nigeria. The fresh nuts from the yellow and red variety of cashew were separated from the cashew apple and sorted. The nuts from each variety were placed separately in baking pans and were labeled. The nuts were roasted in an oven for approximately 5 hours at a temperature of 150°C. A wooden spoon was used to turn the nuts at an interval of 15 minutes to avoid burning. After roasting, the nuts were spread on a flat surface to cool and were cracked with a wooden spoon to separate the nuts from its shell. An electric milling machine (Mockmill 100 stone mill) was used to grind the nuts into fine flour. The milling machine was washed before and after milling the samples from each colour variety of cashew. The flour was then packaged in an air tight container for laboratory analysis.

### **Chemical Analysis**

The proximate composition of the samples was determined using the standard method of analysis described by the Association of Official Analytical Chemist (AOAC) (16). The kjeldahl method was used to determine the protein content (16), fat was determined by the Soxhlet extraction method (16), moisture was determined using hot air oven method (16). Ash was determined by weighing 1g of each sample into a tarred porcelain crucible. It was incinerated at 600°C for six hours in an ashing muffle furnace until ash was obtained (16). The carbohydrate content was determined by difference (17). Vitamin C and vitamin E were analyzed according to Maguire *et al.*, (18). Determination of Folic acid was done using AOAC (19) method. The minerals potassium, magnesium, zinc, iron and phosphorus were determined using atomic absorption spectrophotometry described by Ranjiham and Gopal (20)

Test for alkaloids, phenols and tannins were carried out using the method of Herboone (21), flavonoids was determined using Mayuri (22), phytates was determined using Lucas and Markakes (23). Phytosterols was analyzed using O'Fallon *et al.*, (24)

### **Sensory Evaluation**

The sensory properties of the cashew samples was carried out using thirty panelists which comprises of both students and staff of the Nutrition and Dietetics Department, Imo State University Owerri, Nigeria. The parameters such as colour, flavour, taste, texture and overall general acceptability of the cashew samples were analysed using a 9 point hedonic scale. Where 9 = extremely liked, 8 = liked very much, 7 = liked moderately, 6 = like much, 5 = neither like nor dislike, 4 = dislike, 3 = dislike moderately, 2 = dislike very much, 1 = disliked extremely. They samples were served simultaneously in clean white plates. Tap water was provided for rinsing of mouth between samples

### Statistical Analysis

The data obtained was analyzed using Statistical Products for Service Solutions (SPSS) version 21.0. The data obtained were presented as means and standard deviation of the samples. Independent samples t-test was used to compare the means of the samples and a  $p < 0.05$  was considered statistically significant.

### RESULTS

The proximate composition of processed cashew nuts from red and yellow varieties of cashew is presented in table 1. There was a significant difference ( $p < 0.05$ ) in the crude protein and crude fibre content of the samples. Cashew nuts from red variety had higher fat (44.27%) and crude fibre (2.29%) content while cashew nuts from the yellow variety had higher moisture (6.34%), ash (3.97%), crude protein (26.54%) and carbohydrate (21.21%) content.

**Table 1: Proximate composition of cashew nuts**

Sample	Moisture (%)	Ash (%)	Crude Protein (%)	Fat (%)	Crude Fibre (%)	Carbohydrate (%)
RCV	5.77 <sup>a</sup> ±0.04	3.87 <sup>a</sup> ±0.35	24.78 <sup>a</sup> ± 0.25	44.27 <sup>a</sup> ±2.2	2.29 <sup>b</sup> ±0.01	19.02 <sup>a</sup> ±2.1
YCV	6.34 <sup>b</sup> ±0.85	3.97 <sup>a</sup> ±0.07	26.54 <sup>b</sup> ±0.85	40.0 <sup>a</sup> ±0.35	1.87 <sup>a</sup> ±0.12	21.21 <sup>a</sup> ±0.2

Values are means ± standard deviation of triplicate determinations. Means with same superscript within the same column are not significantly different ( $p > 0.05$ )

**Key:**

RCV= Red cashew variety

YCV= Yellow cashew variety

The mineral compositions of processed cashew nuts from red and yellow varieties of cashew are presented in table 2. There was significant difference ( $p < 0.05$ ) in all the minerals tested in this study. Cashew nuts from red variety had higher magnesium (43.87mg), phosphorus (128.62mg), zinc (1.24mg) and iron (0.85mg) contents while cashew nuts from yellow variety had higher potassium (58.52mg) content.

**Table 2: Mineral composition of nuts from red and yellow varieties of cashew**

Sample	Potassium (mg)	Magnesium (mg)	Phosphorus (mg)	Zinc (mg)	Iron (mg)
RCV	56.27 <sup>a</sup> ±0.11	43.87 <sup>b</sup> ±0.04	128.62 <sup>b</sup> ±0.17	1.24 <sup>b</sup> ±0.00	0.85 <sup>b</sup> ± 0.01
YCV	58.52 <sup>a</sup> ±0.11	38.57 <sup>a</sup> ±0.18	121.525 <sup>a</sup> ±0.25	1.19 <sup>a</sup> ±0.01	0.78 <sup>a</sup> ± 0.00

Values are means ± standard deviation of triplicate determinations. Means with same superscript within the same column are not significantly different ( $p > 0.05$ )

**Key:**

RCV= Red cashew variety

YCV= Yellow cashew variety

The vitamin composition of processed cashew nuts from red and yellow varieties of cashew is presented in table 3. There was no significant difference ( $p > 0.05$ ) in the vitamin C vitamin E and folic acid content of the samples. Vitamin C (35.51mg), vitamin E (1.77mg) and folic acid (36.52µg) contents were higher in the red variety of cashew.

**Table 3: Vitamin composition of nuts from red and yellow varieties of cashew**

Sample	Vitamin C (mg)	Vitamin E (mg)	Folic acid (µg)
RCV	35.51 <sup>a</sup> ± 0.13	1.77 <sup>a</sup> ± 0.04	36.52 <sup>a</sup> ± 0.31
YCV	35.37 <sup>a</sup> ± 0.52	1.69 <sup>a</sup> ± 0.01	36.37 <sup>a</sup> ± 0.16

Values are means ± standard deviation of the triplicate determinations. Means with same superscript within the same column are not significantly different (p>0.05)

**Key:**

RCV= Red cashew variety

YCV= Yellow cashew variety

The phytochemical compositions of processed cashew nuts from red and yellow varieties of cashew are presented in table 4. There was no significant difference (p>0.05) in all the phytochemicals tested in this study. The total phytosterol (2.48mg) and phenol (1.65mg) contents were higher in the red variety while phytate (1.54mg), tannin (1.84mg), alkaloid (2.77mg), flavonoid (3.47mg) and carotenoid (8.74µg) contents were higher in the yellow variety.

**Table 4: Phytochemical composition of nuts from red and yellow varieties of cashew**

Sample	Phytate (mg)	Tannin (µg)	Alkaloid (mg)	Total phytosterol (mg)	Flavonoid (mg)	Carotenoid (µg)	Phenol (µg)
RCV	1.49 <sup>a</sup> ± 0.14	18.3 <sup>a</sup> ± 0.03	2.73 <sup>a</sup> ± 0.18	148.54 <sup>a</sup> ± 0.1	3.37 <sup>a</sup> ± 0.34	8.62 <sup>a</sup> ± 0.12	165.45 <sup>a</sup> ± 0.45
YCV	1.54 <sup>a</sup> ± 0.03	184.97 <sup>a</sup> ± 0.38	2.77 <sup>a</sup> ± 0.03	148.34 <sup>a</sup> ± 0.0	3.47 <sup>a</sup> ± 0.02	8.74 <sup>a</sup> ± 0.23	164.78 <sup>a</sup> ± 0.23

Values are means ± standard deviation of the triplicate determinations. Means with same superscript within the same column are not significantly different (p>0.05)

**Key:**

RCV= Red cashew variety

YCV= Yellow cashew variety

The sensory properties of processed cashew nuts from red and yellow varieties of cashew are presented in table 4.5 and figure 4.3. There was no significant difference (p>0.05) in taste, colour, aroma, texture and overall acceptability of processed cashew nuts from red and yellow varieties of cashew. Cashew nut from the red variety had higher taste (8.20), aroma (7.70) and overall acceptability (8.23) while the yellow variety had higher colour (7.70) and texture (7.80) values.

**Table 5: Sensory evaluation of nuts from red and yellow varieties of cashew**

Sample	Taste	Colour	Aroma	Texture	Overall acceptability
RCV	8.20 <sup>a</sup> ± 0.96	7.43 <sup>a</sup> ± 1.07	7.70 <sup>a</sup> ± 1.34	7.76 <sup>a</sup> ± 1.00	8.23 <sup>a</sup> ± 0.77
YCV	7.83 <sup>a</sup> ± 1.28	7.70 <sup>a</sup> ± 1.23	7.33 <sup>a</sup> ± 1.58	7.80 <sup>a</sup> ± 1.09	8.0 <sup>a</sup> ± 1.2

Values are means ± standard deviation of thirty panelists. Means with same superscript within the same column are not significantly different (p>0.05)

**Key:**

RCV= Red cashew variety

YCV= Yellow cashew variety

## DISCUSSION

In this study, the nutrient composition, phytochemical and sensory properties of nuts from red and yellow variety of cashew fruit were evaluated. Cashew nut from yellow variety of cashew had significantly ( $p < 0.05$ ) higher moisture (6.34%) content than that of red variety (5.77%). The low moisture content observed in the cashew nuts suggests that they could have improved shelf life. The low moisture content observed in this study is related to the low moisture content of undefatted cashew nut flour (5.7%) reported by Emelike *et al.*, (25) and roasted cashew nut flower flour (5.9%) by Ogunbenle and Afolayan (13).

In this study, no significant difference was observed in the ash content of the nuts from red and yellow variety of cashew. The range of 3.87% to 3.97% observed in the ash content of the red and yellow variety of cashew respectively is within the range of 2.74 – 4.14 reported by (26) but lower than 4.41% in (14) and higher than 2.91% and 3.38% reported by Ogunbenle (27) and Ogunbenle and Afolayan (14). Cashew nuts from the yellow variety had significantly higher protein content (26.54%) than the red variety (24.78%). The high protein values observed in this study suggests that roast cashew nuts could be important sources of protein in the diet and its consumption could contribute immensely to an individual's protein requirement Hassan *et al.*, (28). The protein content of 26.54% and 24.78% observed in the nuts from the red and yellow variety of cashew respectively is related to 26.15% observed by (13) but higher than 17.5% reported by (15) and 21.8% observed by (27) and lower than 27.31% in (14).

The fat content of the samples were not significantly different with the red variety having higher fat content (44.27%) than the yellow variety (40.05%). This is in agreement with the fat content of 39.88-47.10 reported by (26). Cashew nuts from the red variety had significantly ( $p < 0.05$ ) higher crude fibre (2.29%) than the yellow variety (1.87%). The fibre content observed in the nuts from the red (2.29%) and yellow (1.87%) variety is lower than 3.11%, 3.63% and 5.6% - 6.12% of fibre present in cashew nut reported by but (13), (27) and (12) respectively but higher than 1.42% reported by (14).

There was no significant difference in the carbohydrate content of both samples. Cashew nut from the yellow variety had higher carbohydrate content (21.21%) than the red variety (19.02%). Nuts are known to contain a reasonable amount of carbohydrate and the result obtained from this study fell within the range of carbohydrate content (18.1-22.2%) of cashew kernels from different origin reported by Rico *et al.*, (29).

Cashew nuts from red variety was significantly higher in magnesium (43.87mg), phosphorus (128.62mg), zinc (1.24mg) and iron (0.85mg) contents while cashew nuts from yellow variety was only significantly ( $p < 0.05$ ) higher in potassium (58.52mg) content. The magnesium, phosphorus, zinc, iron and potassium content of the nuts from the red and yellow varieties of cashew are in agreement with the mineral content of cashew nuts reported by (13), (15), (30), and (14) respectively.

There was no significant difference ( $p > 0.05$ ) in vitamin C content of both samples. Cashew nut from the red variety (35.51mg) had higher vitamin C content compared to nuts from the yellow variety of cashew (35.37mg). The vitamin E content of nuts from both the red and yellow variety of cashew was not significantly different ( $p > 0.05$ ) with nuts from the red variety of cashew (1.77mg) having higher vitamin E content than the nuts from the yellow variety of cashew (1.69mg). Vitamin E, a fat soluble vitamin is known to be predominant in nuts and oily foods, which possesses neuro protective, anticancer and cholesterol lowering properties (31). The vitamin E content observed in this study is higher than the vitamin E content of cashew nut flour reported by Griffin (15). There was no significant difference in folic acid content of both samples analyzed. Folic acid, a B- vitamin is known to be abundant in cereals and vegetables, which also help in the development of new cells. Folic acid content of cashew nuts from various origin, according to Rico *et al.*, (29), ranges from 33.4-45.2 $\mu$ g and this falls within the range of cashew nuts observed in this study.

Phytate, tannin, alkaloids, total phytosterol, flavonoid, carotenoid and phenols were the phytochemicals analyzed in this study. Phytochemicals are biologically active, naturally occurring chemical compounds found in plants, which provide health benefits for humans, further than those attributed to macro and micronutrients (35). The phytochemical composition of cashew nuts did not differ significantly ( $p > 0.05$ ) between the red and yellow variety.

Nuts from the red variety of cashew had phytate content of (1.49mg) while nuts from the yellow variety had phytate content of (1.54mg). The phytate values observed in this study is lower than 1.9mg in raw cashew nuts reported by Ogungbenle (27). This suggests that the phenol content could have been reduced by the heat applied during roasting.

The tannin content of nuts from the yellow variety (184.97 $\mu$ g) was higher than the tannin content of nuts from the red variety (184.3 $\mu$ g) of cashew. Tannin is a water soluble polyphenolic compound found in plants, which is known for binding protein, decrease digestion by inhibiting key enzymes involved in digestion and can also render iron and vitamin B12 unavailable, if taken in excess (32). In moderate consumption, it aids the healing of burns, increase blood clotting and protect the kidney (33). Okpanachi *et al* (34) did not observe significant difference in the tanin content of red and yellow variety of sun dried cashew pulp which is in agreement with this study. The alkaloid content of nuts from the yellow variety of cashew (2.77mg) was higher than that of the red variety (2.72mg). Alkaloid is a natural product that contains heterocyclic nitrogen atoms which have many pharmacological activites like antihypertensive effects, antimalaria effect and anticancer actions (35)

Cashew nut from the red variety (148.54mg) had higher total phytosterol content than cashew nut from the yellow variety (148.34mg). The values of phytosterol observed in this study are higher than 138mg reported by Oliver (36). The flavonoid content of nuts from the yellow variety of cashew (3.47mg) was higher than nuts from the red variety (3.37mg) of cashew. There was no significant difference in the flavonoid content of red and yellow variety of sun dried cashew pulp whereby the pulp from the yellow variety had higher flavonoid content than the pulp from the red variety reported by (34) which is in agreement with this study. The yellow variety had higher carotenoid (8.74mg) content compared to nut from the red variety (8.62mg). This study is in agreement with (15) who also observed low levels of carotenoids in roasted cashew nuts. Nuts from the red variety of cashew had higher phenol content (165.45 $\mu$ g) than nuts from the yellow variety (164.78 $\mu$ g). The values of phenols observed in this study are lower than the values of phenols observed by (36) and (15).

There was no significant difference in the sensory attributes tested in this study. Although the cashew nuts were from different varieties, there is still a similarity in colour and taste of their nuts after processing. This suggests that cashew nuts from red and yellow varieties of cashew are generally acceptable.

## CONCLUSION

This study reveals that cashew nuts from both varieties of cashew are rich sources of nutrients and phytochemicals. However cashew nuts from the red variety was considerably richer in fibre and minerals such as zinc, iron, phosphorus and magnesium while nuts from the yellow variety of cashew was significantly richer in protein and potassium. Therefore, the cultivation and consumption of cashew nuts from both varieties should be encouraged as nuts from both red and yellow varieties of cashew could contribute to an individual's daily nutrient and phytochemical levels. Since cashew nuts from both varieties are generally accepted, it can serve as a major ingredient in the formulation of food products.

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