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Effect of Hydrothermal Processing Period on the Chemical Composition of African Walnut (*Tertracarpidium conophorum*)

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ABSTRACT

The effect of hydrothermal processing period on the nutritional content of walnut was investigated. The nuts were cooked for 60, 80 and 105 min at a temperature of 100^{o}C. Raw walnut was the control. The following results were obtained for raw walnut; walnuts cooked for 60, 80 and 105 min as follow: moisture content 42.25, 43.85, 44.00 and 44.75%, fat 16.13,16.55, 17.13 and 16.57%, crude protein 21.45, 19.27, 19.15 and 17.85%, crude fibre 2.20, 2.99, 3.35 and 5.60%, ash 2.02, 2.52, 2.45 and 3.00%, carbohydrate 15.96, 14.83, 13.93 and 12.23%, respectively. It was evident that there were varying degrees of changes that occurred in each of the chemical composition of the nut with respect to the different cooking time. From the results obtained, it was discovered that walnut cooked for 80 min at a constant temperature of 100^{0}C gave better results in terms of nutrient retention.

Key words: Carbohydrate, Cooking Time, Moisture Content, Nutritional Content and Walnut.

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INTRODUCTION

The word walnut derives from Old English *wealhhnutu*, literally "foreign nut", *wealh* meaning "foreign" (Wikipedia, 2011). It comprises with such families as *Juglandaceae* (English walnut), *Euphorbiaceae* and *Olacaceae*. Each family has its own peculiar characteristics but they have some things in common such as the nuts. *Juglandaceae* is mostly found in Southeast Europe, Japan and more widely in the New World. *Coulaedulis* (family - *Olacaceae*) is found in Congo, Gabon and Liberia. *Tetracarpedium conophorum (*family - *Euphorbiaceae)* which is called Africa walnut is found in Nigeria, Western Cameroon and India, it is thought to originate from Nigeria, it is known in the littoral and the Western Cameroon as *Kaso* or *Ngak*. In Nigeria, it is found in the South Western part of the country. *T. conophorum* is called *Ekporo* by the *Effiks* and *Ibibios* of Cross River and Akwa-Ibom States (Oke, 1995; Petrova, 1980). Dalziel (1937) reported that the plant is known as *Ukpa* (Igbo) and *Awusa* or *Asala* (Yoruba). In Hausa it is known as *Gyadan Kurumi*. Its habitat is usually large trees. It has a long history as food grown by peasant farmers across West African rainforest. The climber bears capsules which are greenish in colour when young and greenish-yellow when fully ripe. They contain four shelled seeds (Willis, 1966). The testa of the seed is hard and the cotyledons white in colour. The fruits are edible (Enujiugha, 2003). In Nigeria they are cultivated principally for the nuts which are cooked and consumed as snacks (Oke, 1995). A bitter taste is usually observed upon drinking water immediately after eating the nuts; this could be attributed to the presence of chemical substances called alkaloids (Edem et al., 2009).

The shell, bark and leaves of the *T. conophorum* plant are antifungal, anti-parasitic and anti-dysenteric and the bark is used by people as a mild laxative. The medicinal uses of

Table 1. Proximate chemical composition of *T. Conophorum* nuts at various hydrothermal treatment periods.

	Raw	Minutes		
		60	80	105
Moisture	42.25±0.356	43.85±0.248	44.00±0.322	44.75±0.538
Fat	16.13±0.114	16.55±0.448	17.13±0.357	16.57±0.497
Crude protein	21.45±0.417	19.27±0.344	19.15±0.200	17.85±0.319
Crude fibre	2.20±0.163	2.99±0.029	3.35±0.490	5.60±0.726
Ash	2.02±0.128	2.52±0.163	2.45±0.294	3.00±0.172
Carbohydrate	15.96±0.354	14.83±0.382	13.93±0.382	12.23±0.341

the bark, leaves and roots are an ancient prehistoric practice surrounded by many superstitious beliefs (Enujiugha, 2003). It is also reported to be useful in folklore in the treatment of dysentery. This therefore justifies its ethno medical use, which refers to the cultural specific medical system not in the Western world. The nut lipase could prove useful in industrial bio catalytic hydrolysis; it could also be useful in processes that require lower cooling costs and minimal corrosion problems (Enujiugha, 2003). The nut contains between 48 to 50% dry weight of oil, which is liquid and golden yellow in colour with taste and odour resembling those of Lin seed oil. The residue after oil contains over 50% protein. Gas chromatographic analysis of the seed oil shows a high level of the Sn-3 fatty acid and Linolenicacid (Adebona and Ogunsua, 1983). Deterioration of the milky white cotyledons during storage comes by way of off-flavour development as a result of high unsaturation of the seed oil. However, refrigerated storage extends the shelf life of the nuts considerably (Adesioye, 1991). Little or no work has been done on the effect of cooking time on the chemical composition of *T. conophorum.* Also, the immense benefits and importance of the nut and its derivatives have not yet been fully utilized in Nigeria. Since the nut cannot be consumed in its raw form, they are subjected to hydrothermal treatment and sometimes even excessive heat, thus there is need to investigate the effect of these heat treatments on the chemical composition of the nut.

MATERIALS AND METHODS

Materials

The samples of African walnut (*T. conophorum*) used for this study were purchased from Okene market, Okene Local Government Area, Kogi State, Nigeria. The samples were washed three times with water to remove impurities from the nut to prevent infestation. The samples were refrigerated at a temperature of 21°C during the course of the analysis to preserve its freshness. The analysis was carried out in the laboratory of National Cereals Research Institute (NCRI) Badeggi, Niger State, Nigeria.

Methods

Sample Preparation

Walnuts weighing 972 g was used for this study. Three different samples weighing 108 g each were obtained from this; the first sample was cooked for 60 min, the second sample was cooked for 80 min while the third sample was cooked for 105 min all at a temperature of 100°C. These were done in triplicates. Each of the samples were then grated and placed in a closed container.

Chemical Analysis

Moisture, total protein, crude fat, ash and crude fiber content were determined in nut samples such as described in AOAC (2004). The carbohydrates content was determined by the difference [100- (Moisture+ total protein+ crude fat+ ash + crude fiber] method.

RESULTS AND DISCUSSION

The results of the experiments are presented in Table 1.

Moisture

There were insignificant differences in the moisture content of the raw nuts and the samples treated at the same temperature for different cooking periods of 60, 80, and 105 min as shown in Figure 1.

From Table 1, an increase of 2.5% of moisture content was observed as the raw nut was cooked for 105 min. The low moisture absorbance properties of the nut when it was subjected to hydrothermal treatment for different period may be due to its hard shell covering, which prevented flow of water to the kernel. There was continuous increase in the moisture content of the walnut as the cooking period time increases. The moisture content reached at 105 min was 44.75% while the raw nut had the lowest moisture content of 42.25%. The result for moisture content of the raw nut was comparable to the one gotten by Edem et al. (2009) whose value was 48.70%. The differences

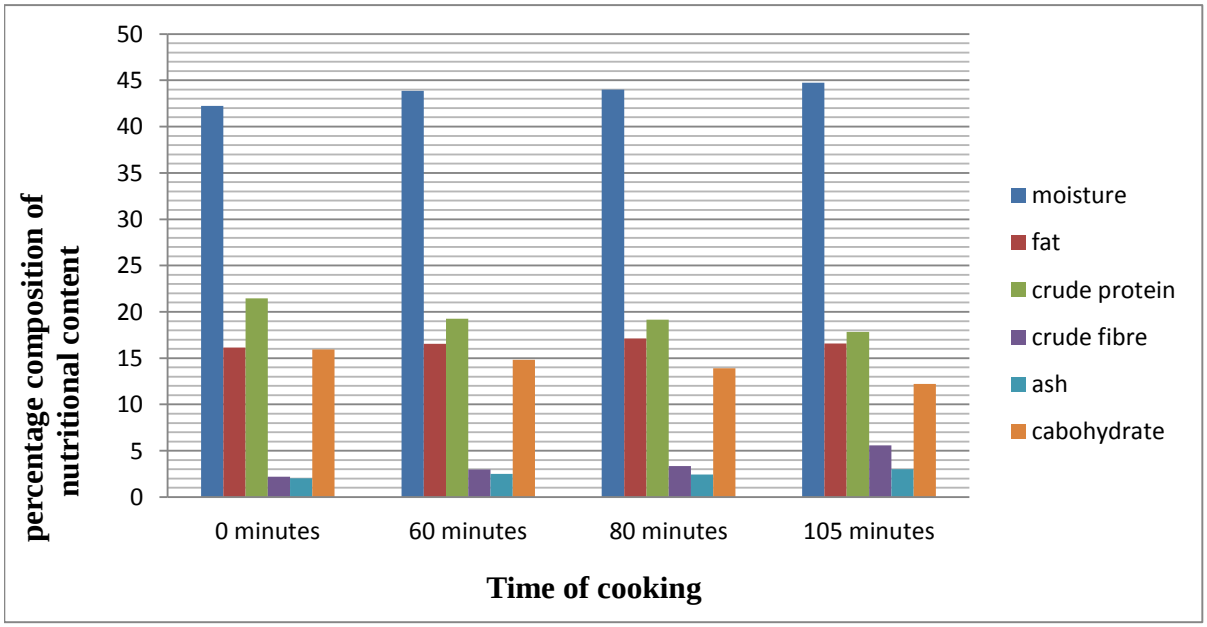

Figure 1. Chemical composition of *T. conophorum* nut at various cooking time.

observed in these values may be attributed to environmental and agronomic factors as has been suggested by Raules and Nair (1993); Parcerisa (1993). This indicates that as long as the nuts remains in water during treatment it continues to absorb more water. The low moisture content of the raw fruit shows that it could be stored for some time without going bad (Edem et al., 2009).

Crude Protein

T. conophorum nut cooked for 105 min at a temperature of 100°C showed lowest content of crude protein 17.85% than those cooked for shorter period of time. The raw, and those cooked for 60, and 80 min had protein content of 21.45, 19.27, and 19.15% of protein. Uncooked walnut had the highest protein content. This shows that as the period of cooking increases, there was a corresponding decrease in the protein content of the nut. The uncooked nut protein was comparable with that of groundnut (20.2%), cotton seed (20.4%) and those of cashew nut (21.4%) but lower than that of tropical almond (25.81%) (FAO, 2006; Ezeokonkwo and Dodson 2004). The percentage composition of the raw sample is close to the one gotten for the raw nut by Ndie et al. (2010) whose value was 21.60%. According to Agnieszka et al. (2011) reduction in protein content of nuts may be caused by solubilization of some easy hydrolyzing components and their migration to water and also by enhanced activity of enzymes for example, lipases. Figure1 shows that there were significant differences in the crude fibre content of the raw nut and between samples treated at the same temperature but different cooking period of 60, 80, 105 min.

The nut cooked at 100°C for 105 min had the highest crude fibre content of 5.60% while the raw nut had the lowest fibre content of 2.20%. An increase of 3.40% was obtained when the raw nut was cooked for 105 min. This shows that an increase in period of hydrothermal treatment of the nut increased the crude fibre content. The result gotten for the raw nut is also close to the one gotten by Ndie et al. (2010) which value was 2.90% and comparable to 3.34% gotten by Edem et al. (2009). Enujiugha (2003) cooked the nut for period of 2 h and the value gotten for the crude fibre was 6.34% which was comparable to the one gotten for 105 min 5.60%. It showed that *T. conophorum* nut is averagely a good source of crude fibre. The average crude fibre content indicates the ability of *T. conophorum* nut to maintain internal distension for a normal peristaltic movement of the intestinal tract, a physiological role which crude fibre plays.

Fat

The fat content of raw *T. conophorum* nut increased insignificantly with an increase in length of cooking period of 60, and 80 min but decreased when the duration of application of heat treatment increased to 105 min under constant temperature as shown in Figure 1. The nut cooked for a period of 105 min contained 16.57% of fat while the raw nut contained 16.13%. The values are far lower than those gotten by Enujiugha (2003) which was 48.90%, these differences may be attributed to the oven

drying which he subjected the kernels to before determining the fat content. 6.21% of fat was gotten by Edem et al. (2009). The differences observed in these values may also be attributed to environmental and agronomic factors as has been suggested by Raules and Nair (1993); Parcerisa (1993). 1.04% increase of fat content was observed as the nut was cooked for 80 min. According to Oladele and Aina (2009) the increase could be attributed to leaching of some soluble constituents of the kernel into the cooking water. Constituents such as simple sugars and some anti- nutrients for example, tannin and phytic acid are leached into water especially at above ambient temperature through the swollen and ruptured cell walls which permeate water and soluble constituents.0.56% loss of fat was observed when the nut was cooked for additional 25 min, from 80 to 105 min. The fat content of *T. conophorum* nut cooked for 60 and 80 min were 16.55% and 17.13%. An increase in the period of hydrothermal treatment for African walnuts led to an increase in the fat content of the nut at a certain point but then decreased.

Carbohydrates

There was significant difference in the carbohydrate content of the nut as heat was continuously applied. The carbohydrate content of the raw nut was found to be 16.00% which was close to the one gotten by Ndie et al. (2010) whose value was 16.90%. At 105 min of hydrothermal treatment the carbohydrate content was 12.23% which was also close to the one gotten by Enujiugha (2003) whose value was 12.58% as the nut was cooked for 2 h. A loss of about 3.73% resulted when the nut was cooked for 105 min. As shown in Figure 1, increased period of hydrothermal treatment led to decrease in carbohydrate content of the walnut. According to Nkwonta (2010), it is known that during heat treatment, plant food materials suffer considerable loss of low molecular weight of carbohydrates, due to leaching into processing water. The decrease in carbohydrate content in this work agrees with the report of Obizoba and Atti (1994) on pearl millet seeds. It can be said that application of heat for long period of time decreases the carbohydrate content of the nut. Oladele and Aina (2009) also reported that the decrease in the carbohydrate content of the toasted nuts could be due to reaction which occurred between carbonyl group of reducing sugars at high temperature.

Ash

The results obtained for ash were 2.02, 2.52, 2.45 and 3.00% for raw nut and those cooked for 60, 80 and 105 min, respectively. As shown in Figure 1, it can be observed that there was an increase in ash content of the nut as it was prepared within the time limit. An increase in the period of hydrothermal treatment led to an increase in the ash content of the nut. Agnieszka et al. (2011) reported that the increase in ash content of nuts could be attributed to leaching of some soluble constituents of the kernel into the cooking water. The percentage of ash gotten for raw *T. conophorum* nut is closed to the one gotten by Edem et al. (2009) whose value was 2.03% while the nut cooked for a period of 105 min had comparable results with what was gotten by Enujiugha, (2003) whose value was 3.09% for a period of hydrothermal treatment of 2 h. The presence of ash in *T. conophorum* nut indicates that minerals are available in it. From Figure 1, it can be said that moisture had the highest percentage composition and ash had the lowest percentage composition. Moisture content, fat, crude fibre and ash increased with corresponding increase in period of application of heat treatment but carbohydrate and protein decreased with duration of application of heat treatment. These shows that as the duration of application of heat treatment increased the percentage composition of crude protein and carbohydrate continued to decrease. Fat increased in composition between time periods of 0 to 80 min but decreased between periods of 80 to 105 min.

CONCLUSIONS

From the study carried out, it can be concluded that increase in duration of time of application of heat increased the percentage composition of moisture, fat, crude fibre and ash content but decreased the composition of crude protein and carbohydrate content. Also, *T. conophorum* cooked for 80 min at a constant temperature of 100°C gave better results in terms of nutrient retention; it is therefore advised that the nuts should be cooked for 80 min at a constant temperature of 100°C so as to utilize the benefits of this highly nutritive nut. Further study can be carried out to investigate the effect of thermal treatment on other properties

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