



Some Quality Indices of *Gnetum africanum* (Afang) Leaves as Affected by Drying Methods

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ABSTRACT: *Gnetum africanum* is a tropical plant with origin in the rain forest of Nigeria and contains valuable nutrients but susceptible to speedy spoilage due to its high moisture content. This necessitates its preservation, through drying, as it is not readily available for consumers in parts of Nigeria where it is not grown. This research, therefore, was carried out to evaluate the effect of three drying methods (solar drying, sun drying and oven drying) on some quality indices of *Gnetum africanum* leaves with a view to determine the most appropriate drying method for maximum nutrient retention. Fresh *Gnetum africanum* leaves were obtained from the local market, defoliated, washed, drained and sliced. The sliced vegetable was divided to four portions of 200g each. With the initial properties of the fresh vegetable (sample A) determined, samples B, C and, D were subjected to solar, sun and oven drying respectively. The properties evaluated were analyzed and the results showed that sun dried vegetable (sample C) had the least overall quality retention. Moreover, solar dried vegetable (sample B) had the highest quality retention in terms of protein (3.92%), fat content (6.67%) and carotene (6.10IU) while oven dried one (sample D) had the highest quality retention of crude fiber (0.63%), ash content (7.87%), carbohydrate (72.49%) and sensory properties (taste, colour, aroma and texture). These results indicated that drying, especially solar and oven drying can be used to preserve *Gnetum africanum* leaves with considerable retention in its nutritional and sensory properties.

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Lifestyle changes and advent of certain degenerative diseases has raised the consumption of vegetables varieties in recent times. This is because vegetables are rich and cheap sources of several vitamins and minerals which have potent power against inflammatory and carcinogenic effects. In this context, attention of consumers are drawn to indigenous vegetables of high nutritional and culinary properties. *Gnetum africanum*, generally referred to as Okazi, Ukazi, or Afang, falls within the category of these indigenous green leafy vegetables commonly found in Nigeria and other African countries such as Cameroon, Gabon, Congo, and Angola (Biye *et al.*, 2017). *Gnetum africanum* is not usually cultivated but grows as a wild, ever-green climbing plant in the tropical rain forest of Nigeria. Its leaves possess embedded nutrients such as proteins, several minerals and essential amino acids. In fact, certain studies have

also shown that *Gnetum africanum* leaves contain flavonoids, anthocyanins and other phenolic substances with powerful antioxidant, anti-inflammatory and anticarcinogenic effects which make it not only suitable for nutritional purposes but also medicinal uses (Hamzah *et al.*, 2013; Nwanna *et al.*, 2016). The presence of several nutrients in *Gnetum africanum* leave predisposes it to a variety of uses ranging from its use as food, food supplements and medicine. For instance, *Gnetum africanum* leaves are used in the preparation of soup and stew when finely chopped or eaten raw in local vegetable salads (Fakayode and Ojoawo, 2019). Reports also showed that they can be used as antidotes to certain conditions such as nausea, sore throats, diabetes, piles, hypertension, enlarged spleen, pain reduction during child-birth and also to combat malnutrition, especially in developing countries (Ayuk *et al.*, 2017;

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Biye *et al.*, 2017; Obeten *et al.*, 2019). Moreover, nutritionists are of the opinion that *Gnetum africanum* leaves could provide a good amount of beneficial fats (when prepared into soup) which can provide energy for long exercise sessions and promote absorption of vital nutrients. It also contains high level of laxatives and essential dietary fibers which enhance weight loss and prevent certain digestive disorders such as colon cancer and constipation (Etta *et al.*, 2011). Despite the huge importance of *Gnetum africanum* leaves, deterioration sets in fast due to the very high moisture content of the vegetable. This limits its shelf life and predisposes it to spoilage bacteria attack. Hence, there is need to apply certain preservation technique, such as drying, to elongate the shelf life and enhance the availability of the vegetable during off seasons. Several methods of preservation exist but drying has been reported to be one of the most widely used preservation methods that is applicable to vegetables. Drying is a complex process that involves simultaneous transfer of heat and mass along with several rate processes, such as physical or chemical transformations to lower the moisture content of food material to a desired level where infestation of spoilage microbes is drastically limited (Adepoju and Osunde, 2017; Deng *et al.*, 2017). Drying has been extensively used in preserving vegetables and other bioproducts because of its many advantages. These include product quality control, new products development, reduced weight and volume of vegetables resulting in lower packaging, storage, and transport costs (Kamiloglu *et al.*, 2016). In addition, drying vegetables such as *Gnetum africanum* provides new products patterns such as vegetable crisps with unique texture and physical properties. Various techniques of drying have been used for several agro-products including vegetables. These ranges from simple and common ones such as sun, solar and oven drying to more sophisticated ones like freeze, microwave, flash and even spray drying of bio-products into powders (Adepoju and Osunde, 2017; Dereje and Abera, 2020; Nguyen *et al.*, 2019; Zhang *et al.*, 2017). The common methods of drying were used for *Gnetum africanum* leaves in this study because they are accessible to farmers and householder for easy preservation of these vegetables, especially in the less developed part of the world. The aim of this work is to determine the effects of drying methods on the nutritional and sensory properties of *Gnetum africanum* leaves with the view to determine the most suitable method to ensure quality retention and all year around availability.

MATERIALS AND METHODS

Fresh *Gnetum africanum* leaves were obtained from a market in Minna, Niger State. The leaves were

defoliated, washed, drained and sliced (Figure 1 and 2). The sample was divided into four portions (4) (Samples A, B, C and D) of 200 grams each. The nutritional and sensory evaluations were carried out on the fresh leave (Sample A) to serve as control. Sample B was dried using a solar dryer with its temperature ranging between 40 to 60°C, the temperature during the sun drying of sample C ranged between 30 to 45°C while the oven dried sample was dried at 70°C. Drying of all samples was terminated when the sample weight remains constant at three consecutive reading.

Proximate and β -carotene contents of the dried samples were determined using standard laboratory procedures as described by the Association of Official Analytical Chemists (AOAC, 2005). Sensory evaluation was carried out based on 9-hedonic scale with 9 being like extremely and 1 is dislike extremely. This was carried out using the basic setup of 20 people minimum for hedonic test described by Singh-Ackbarali and Maharaj (2014) and these comprised mainly of undergraduate students. Data collected were analyzed statistically to determine the effect of drying methods on the nutritional and sensory properties of *Gnetum africanum* leaves.



Fig 1: *Gnetum africanum* leaves



Fig 2: Sliced *Gnetum africanum* leaves

RESULTS AND DISCUSSION

Proximate Composition of Fresh Gnetum africanum Leaves: Before the leaves of *Gnetum africanum* were subjected to the drying operations, the proximate evaluation of the fresh leaves were done and the results

of the analysis are presented in Table 1. The moisture, ash and fibre contents of the fresh *Gnetum africanum* leaves used in this study were lower while the protein, fat and carbohydrate contents were higher than that used by Abdulrasheed-adeleke *et al.*, (2021) while comparing the effect of processing methods on the nutritional value of *Gnetum africanum* leaves and other vegetables. These variance in values may be as a result of the difference in the location and probably the soil conditons where the leaves were grown (Okezie *et al.*, 2017). Some of the proximate values obtained in this study were also similar to those reported by Okezie *et al.*, (2017) in the evaluation of proximate contents of five selected vegetables (including *Gnetum africanum*) consumed by Afaha Eket indigenes of Akwa Ibom State in southern Nigeria.

Table 1. Proximate properties of fresh *Gnetum africanum* leaves

Parameters	Values
Moisture content (%)	34.77±0.00 ^d
Protein (%)	4.06±0.01 ^d
Fat (%)	7.57±0.00 ^d
Crude fibre (%)	1.20±0.00 ^d
Ash (%)	5.58±0.00 ^a
Carbohydrate (%)	46.83±0.01 ^a

Note: superscripts represent significant differences ($P \leq 0.05$)

Effects of Drying Methods on Proximate Composition of Dried Gnetum Africanum leaves: The effects of

drying methods on the proximate composition of dried *Gnetum africanum* leaves were studied and the results were presented in Figure 3. The result shows that the moisture content of the leaves reduced from 34.77% in the fresh leaves to 12.15% in the oven dried sample which had the least moisture content when compared to the solar and sun dried leaves with values of 18.66% and 15.00% respectively. This is obviously a resultant effect of the higher temperature used in the oven drying method. Similar trends in the reduction of moisture content were observed when Emelike and Akusu (2020) dried four different vegetables using oven drying at 50°C. Decrease in moisture content in relation to different drying methods was also recorded by Olalusi *et al.* (2019) for locust bean and also during the drying of six selected green leafy vegetables (Khatoniari *et al.*, 2019). Further from the results, a decrease in the protein, fat and fibre contents of the *Gnetum africanum* leaves was recorded in the following order: control>solar dried>sundried>oven dried while higher values were observed in the same order in the ash and carbohydrate contents of the vegetable. These results are almost similar to the patterns recorded by Hussein *et al.*, (2018), Okezie *et al.*, (2017) and Olalusi *et al.*, (2019) in their studies on the effects of different drying methods on varieties of vegetables and locust bean.

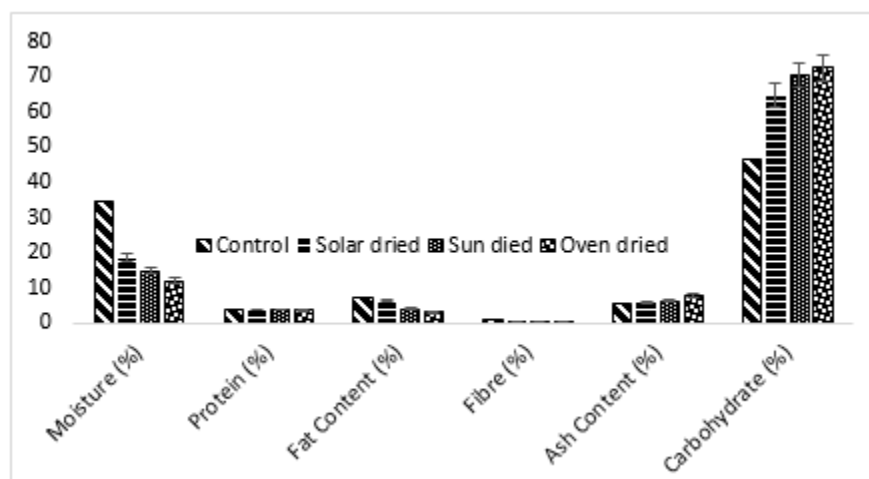


Fig 3. Proximate properties of dried *Gnetum africanum* leaves

Effects of Drying Methods on β -carotene content of Dried Gnetum Africanum leaves: The effects of drying methods on β -carotene content of dried *Gnetum africanum* leaves are presented in Table 2. β -carotene has been identified as the the main carotenoid present in the human diet and the most potent precursor of vitamin A in most vegetables. It is very effective in combacting Vitamin A deficiency diseases that frequently cause deaths of children, especially in developing countries (Elvira-Torales *et al.*, 2019;

Manhivi *et al.*, 2020). The results of this study revealed that the fresh leaves of *Gnetum africanum* had the highest value of β -carotene in comparison with the dried ones. A reduction in values were recorded in the dried sample in the order solar dried > sun dried > oven dried. The values obtained for β -carotene in this study were lower than those observed in the findings of Davidson and Monulu (2018) for boiled and steamed *Solanum macrocarpon* and *Gnetum africanum* leaves. However, these values are higher

than those recorded for shade dried *Gnetum africanum* and *Basella alba* leaves in a comparative study on the effect of processing methods on the nutritional value of some vegetables (Abdulrasheed-adeleke *et al.*, 2021).

Table 2. β -carotene contents of fresh and dried *Gnetum africanum* leaves

Samples	β -carotene (IU)
A Control	8.50 \pm 0.00 ^d
B Solar dried	6.10 \pm 0.00 ^c
C Sun dried	1.76 \pm 0.00 ^b
D Oven dried	0.83 \pm 0.00 ^a

Means followed by the same letter(s) in column are not significantly different by Duncan Multiple Range Test at 5% level of probability. Sample A=Fresh leaf (control); B=Solar dried leaves; C=Sun dried; D=Oven dried

The variation and reduction in the β -carotene contents of different vegetables and particularly, *Gnetum africanum* may be as a result of various factors ranging from processing/drying conditions (time and temperature), interaction between processing methods of the vegetables to climatic factors and even soil type of the area where the vegetables are grown (Chang *et al.*, 2013; Karabacak and Karabacak, 2019; Pan *et al.*, 2019).

Effects of Drying Methods on the Sensory Evaluation of Gnetum africanum Leaf: Sensory evaluation were carried out on the dried *Gnetum africanum* leaves and the findings, represented Figure 4 indicated that the different drying methods had effects on the various sensory attributes of the leaves.

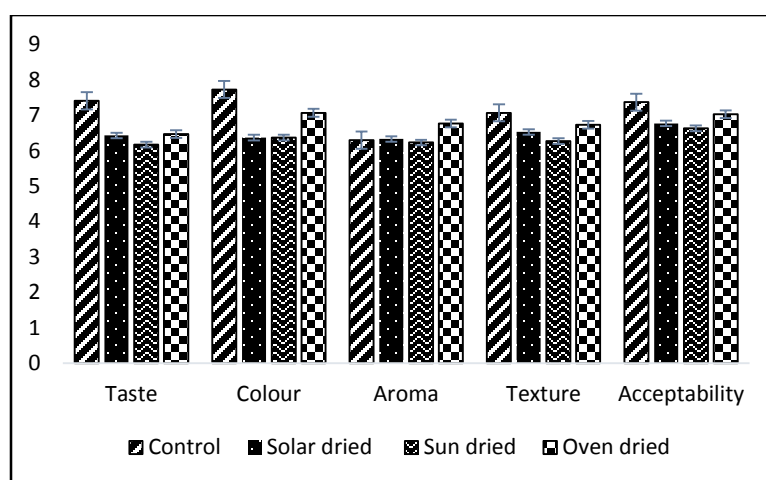


Fig 4. Sensory Evaluation of Dried *Gnetum africanum* Leaves

Of the three drying methods used in this study, oven drying had the highest score for taste, colour, aroma, texture and overall acceptability, apart from the fresh leaves. This observation agrees with the findings of Oluwalana *et al.*, (2011) which stated that oven dried water leaf samples were significantly rated better in terms of aroma, mouth feel, taste and their level of acceptability. However, contrary findings were recorded in a study on the effect of traditional and improved solar drying methods on the sensory quality and nutritional composition of fruits with solar-dried fruits being considered to have the overall acceptability (Mohammed *et al.*, 2020). In another study where pawpaw was dehydrated using a convective dryer, an intermediate acceptability was observed with the dried pawpaw classified as 'neither like nor dislike' and 'liked slightly' (Reis *et al.*, 2018). Looking at the result, sun dried *Gnetum africanum* leaves has the least score for taste, aroma, texture and overall acceptability as compared to other samples. This may be as a result of fluctuating intensity of the sun during the drying period which in turns lead to

longer exposure time of the vegetable to air and the resulting enzymatic browning. This observation correlates with those recorded in a study on the effect of drying methods on the physicochemical properties of *Talinum triangulare* (Oluwalana *et al.*, 2011)

Conclusion: From this study, it can be concluded that drying irrespective of the methods used has significant effects on the proximate and sensory qualities of fresh *Gnetum africanum* leaves. Oven dried samples had the highest quality retention of the evaluated qualities and acceptability in terms of the taste, aroma and texture. The sun dried samples had the least retention in terms of all the evaluated qualities. This study establishes that oven drying method is desirable for the preservation of *Gnetum africanum* leaves and therefore recommended for its drying.

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