

PROXIMATE, ANTIOXIDANT AND SENSORY PROPERTIES OF COFFEE SUBSTITUTE DEVELOPED FROM SEEDS OF ADANSONIA DIGITATA L. AND PHOENIX DACTYLIFERA L.

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ABSTRACT

The use of coffee as a beverage is a widespread practice all over the world. However, the adverse effects of caffeine is a challenge for consumers, hence the need for development of coffee substitutes. This study explored the proximate, free-radical scavenging (DPPH) and sensory properties of coffee substitute developed from seeds of *Adansonia digitata* L. and *Phoenix dactylifera* L. Seeds were processed into coffee through drying, roasting and milling. Analytical procedures were carried out following standard procedures. Sensory properties of the two coffee substitutes were compared to that of a commercial coffee. Baobab coffee had significantly higher ($p < 0.05$) ash, protein, fat, fiber and carbohydrate content than those from date palm seeds. While the normal coffee scored higher in aroma and flavor compared to the coffee substitutes, the overall acceptability of baobab coffee was comparable to that of normal coffee. In conclusion, these coffee substitute have nutritional benefits and are acceptable by consumers. However, further technological developments are required to improve the aroma and flavor to a level comparable to that true coffee.

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INTRODUCTION

The coffee tree is indigenous to Ethiopia; from where it spread to Arabia, India, South America and the rest of Africa. The name coffee is used as a general term for the fruits and seeds of plants of the genus *Coffea* (Lásztity, 2009). The use of coffee as a beverage dates back more than 700 years; its consumption is high in most households worldwide. The popularity of coffee as a beverage is ever increasing despite the negative side effects it has due to the presence of alkaloid caffeine, which can cause addiction and stimulate the central nervous system (Fadel, Mageed and Lotfy, 2006). Everyone cannot consume coffee because of its caffeine content. The food industry offers a number of coffee substitutes which are usually produced by roasting of grains, seeds or roots (Zawirska-

Wojtasiak *et al.*, 2018). Although the beverages prepared from these products have some similar characteristics to coffee, they do not contain caffeine or the corresponding stimulative effect. Coffee substitutes are becoming increasingly popular as a wellness product. They are complementary sources of nutrients (carbohydrates, fibre, and minerals) and important bioactive substances essential to the proper functioning of the body (Olivera *et al.*, 2012). They are also more affordable than plain coffee and can be consumed by children. The most well-known is chicory. The acceptability of coffee substitutes depends on the economy of production and their sensory properties.

The baobab (*Adansonia digitata* L.) tree grows naturally and is found in scattered turfs all over the places, it grows in typically the savannah

grasslands (De Caluwe *et al.*, 2009). It produces fruits which are usually harvested in April and May (Amarteifio and Mosase, 2006). The baobab tree is a multipurpose tree which is used as various food products, for medicinal properties as well as for a variety of other applications such as fibre making (De Caluwe *et al.*, 2009). There are reports that baobab seeds, as well as beans of other plants, are used by members of some communities in Botswana as coffee substitutes. The use has been for personal consumption and no scientific or documented data is available to validate or rebut those claims, except a report by Hankey (2004) alluding to the fact that the seeds of the baobab plant can be roasted and eaten by children as a snack or even used as coffee substitute.

Date (*Phoenix dactylifera* L.), is one of the oldest known fruit crops and has been cultivated in North Africa and the Middle East for at least 5000 years (Zohary and Hopf, 2000). *Phoenix dactylifera* (Date Palm) is a flowering plant species in the palm family Arecaceae, which yields edible sweet fruits. Date palms produce many products that are useful to humans. The primary product is the date fruit, which can be eaten fresh, dried, or in various processed forms. Date seed is a by-product of date fruit industry and it is normally discarded and sometimes used as animal feed ingredient (Chao and Krueger, 2007).

Both baobab and date palm seeds have uses as food and in traditional medicine. The use of baobab and date palm seeds have been reported by local people and a few research publications (Salih and Yahia, 2015; Venkatachalam and Sengottian, 2016). The present research, therefore, aimed at comparing the nutritional, antioxidant and sensory properties of coffee substitute made from seeds of baobab and date palm.

Materials and methods

The preparation of coffee substitute and sensory analysis were carried out in Dukwi village of Botswana while the laboratory analyses were carried out in the Biochemistry laboratory of the National Horticultural Research Institute, Nigeria. Fallen dried baobab fruits were collected randomly in May 2018 at Dukwi village in Botswana while date palm seeds (*Phoenix dactylifera* L) were purchased from the grocery store. Baobab fruits were cut open and the seeds were removed and pound to remove the white pulp coating. The seeds

were then washed to remove the remaining excess pulp and were then immediately sun-dried. The dried seeds were roasted in an oven at a temperature of 200 °C for 30 minutes to brown them and to develop the aroma. The roasted seeds were pound using pestle and mortar, and then sieved (mesh size 0.5 mm) to yield crude coffee substitutes. The crude coffee was further dried in an oven at a temperature of 180 °C for one hour to remove excess moisture. As for date palm seeds, they were washed to free it from any adhering date flesh and then roasted the same way as the baobab seeds. A popular brand coffee was purchased from the grocery store and used as control. Prepared coffee substitutes were packed in airtight poly ethylene bags and taken to Nigeria for proximate and antioxidant analysis. The analytical reagents were purchased from Sigma-Aldrich (Sigma-Aldrich Tokyo, Japan).

Proximate analysis

The coffee powders were analyzed for moisture, ash, crude protein, crude fat and crude fiber according to their respective methods as described in Association of Official Analytical Chemists (AOAC). All analyses were done in triplicates

Antioxidant activity

The antioxidant activities of coffees were measured using DPPH ((2, 2-diphenyl-1-picrylhydrazyl) free radical scavenging method. The DPPH assay was carried out following the method reported by (Burits *et al.*, 2000). Various amounts of the samples dissolved in methanol were added to 5 mL of a 0.004% methanol solution of DPPH. After 30 min of incubation at room temperature, the absorbance was read against a blank at 517 nm (Hatano *et al.*, 1988). Vitamin C was used as positive controls. Percent inhibition of free radical DPPH (I %) was calculated as follows;

$$I\% = (A_{\text{control}} - A_{\text{sample}} / A_{\text{control}}) \times 100.$$

Sensory evaluation of coffee substitute

Ten grams of each coffee was mixed with 4 g of sugar and, 5 ml of water and milk at ratio 1:1. They were then evaluated for their sensory qualities by twenty (20) Dukwi dwellers who indicated as coffee drinkers. A 9-point hedonic scale ranging from 1 to 9 (9 = like extremely; 1 = dislike extremely) was used to describe the taste, aroma, colour and overall acceptability of the coffee.



Results and Discussion

The proximate and free radical (DPPH) scavenging properties of coffee substitutes prepared from baobab and date palm seeds are displayed in Table 1. Baobab coffee had significantly higher ($p < 0.05$) ash, protein, fat, fiber and carbohydrate content than those from date palm seeds. Lasztity (2009) reported a range of proximate values for roasted true coffee bean; ash=4.2-4.7, fat 13-14; fiber 14-16 and protein 11-15%. This gives an indication that roasted baobab seeds might be superior to normal coffee in terms of proximate composition. The coffee substitutes from both seeds have considerably high fiber and carbohydrate content. Fiber are important part of diet that are necessary for proper digestion while carbohydrates are energy sources.

The proximate composition values reported for coffee substitute from date seeds in the present study is similar to that of Sobia and colleagues

(2017) who reported ash value of $1.17 \pm 0.04\%$, protein value of $5.85 \pm 0.23\%$ and fat value of $7.95 \pm 0.39\%$. The crude fiber value of $64.75 \pm 2.59\%$ reported by Sobia and colleagues is much higher than the 17.37 ± 0.01 reported here. It has been shown that the fiber content of date seeds may vary widely depending on the variety and the stage of ripeness (Bouaziz et al 2010).

The antioxidant activity of the coffee substitute as demonstrated by their DPPH inhibitory activity indicates their potential in contributing to maintaining good health. Other coffee substitute materials such as artichoke and chicory have been reported to have DPPH activity ranging from 29-35 mgTE/g. (Zawirska-Wojtasiak et al, 2018). Coffee is a rich source of dietary antioxidants. It itself reduces oxidative stress in many disease conditions (Liang and Kitts, 2014).

Table 1: Proximate Composition and antioxidant capacity of Coffee Substitute

Parameters Coffee	Moisture (%)	Ash (%)	Protein (%)	Fat (%)	Fibre (%)	CHO (%)	Antioxidant activity (% DPPH)
Baobab	3.05 ± 0.01^a	6.8 ± 0.08^a	33.72 ± 0.34^a	24.5 ± 0.16^a	21.76 ± 0.23^a	10.17 ± 0.08^a	61.02 ± 0.60^a
Date Palm	5.90 ± 0.07^b	1.87 ± 0.00^b	6.12 ± 0.04^b	8.19 ± 0.06^b	17.37 ± 0.01^b	60.55 ± 0.98^b	49.96 ± 0.92^b

Values expressed are means of 3 replicates \pm SD

All mean scores bearing different superscripts in columns differ significantly ($P < 0.05$).

The results of the sensory study (Table 2) showed significant variation in the perceived taste and aroma of the coffees. Normal coffee scored higher in aroma and taste compared to the two coffee substitutes. Baobab and Date Palm coffees did not differ significantly in their aroma and color. Overall acceptability of baobab coffee substitute was comparable to the of normal coffee substitute.

Table 2: Mean scores of sensory evaluations of normal Coffee and Coffee substitutes from Baobab and date seeds

Parameters Coffee	Taste	Aroma	Colour	Overall Acceptability
Baobab	8.3 ± 0.06^a	7.9 ± 0.10^a	8.5 ± 0.02	8.3 ± 0.21^b
Date Palm	7.8 ± 0.02^b	7.8 ± 0.07^a	8.0 ± 0.01	7.7 ± 0.13^a
Control	9.00 ± 0.00^c	9.00 ± 0.00^b	8.81 ± 0.01	8.96 ± 0.01^b

Results are means \pm Standard deviation (SD) of evaluation score of 20 panelists composed of normal coffee drinkers. All mean scores bearing different superscripts in columns differ significantly ($P < 0.05$).

Conclusion

Development of coffee substitute from locally available seed such as baobab and date palm show significant dietary benefits. However, coffee drinkers may easily identify the difference in taste and aroma. Further, studies are required to enhance the aroma and taste of these coffee substitute to improve its acceptability.

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