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# Physicochemical Properties of Baobab Seeds (*Adansonia digitata*) Crude Oil and Its Use in Food Frying

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## Abstract

This study was conducted to recognize the physical and chemical properties of baobab seeds crude oil and its use in food frying process. The seeds were milled for proximate analysis: oil content, protein content, moisture content, total ash, crude fiber, and carbohydrate, then the results were recorded 27.5%, 14.0%, 5.7%, 3.4%, 15.0%, 34.4% respectively. The oil was extracted by mechanical pressing, then the physical properties density, viscosity, refractive index, and moisture content were tested, the results were recorded 0.9139, 22.6 cp, 1.4690, 0.1% respectively. Also the chemical properties peroxide value, free fatty acids, saponification value, and iodine value, were determined, the results were recorded 9.0 meq$o_2$/kg, 1.8%, 240.4, 54.0 respectively. The fatty acids composition were determined as oleic acid, linoleic acid, palmitoliec acid, palmitilaidic acid, palmitic acid, stearic acid, arachidic acid, lauric acid, capric acid, and others, the results were recorded25.7, 30.1, 0.2, 1.3, 17.8, 1.0, 1.4, 0.03, 0.04%, and 22% respectively. The statistical analysis showed that there was significant difference ($P \leq 0.05$) in physical properties moisture content 0.2, viscosity 26.6, of baobab seeds crude oil after first frying compared with a refined commercial edible oil 0.1, 23.7,respectively, while there was no significant difference ($P > 0.05$) in density 0.9 123,refractive index 1.4700, of baobab seeds crude oil after first frying compared with a refined commercial edible oil 0.9164, 1 .4730 respectively, also the statistical analysis showed that there was significant difference ($P \leq 0.05$) in viscosity 38.3cp of baobab seeds crude oil after second frying compared with a refined commercial edible oil 25.9, while there was no significant difference in moisture content 0.2, density 0.9170, and refractive index 1.4700, of baobab seeds crude oil after second frying compared with a refined commercial edible oil 0.1, 0.9158, 1.4740 respectively. Also there was no significant difference in chemical properties peroxide value 9.0, of baobab seeds crude oil before frying compared with a refined commercial edible oil 9.0, also there was no significant difference in peroxide value 12.9 of baobab seeds crude oil after second frying compared with refined commercial edible oil 15.9, while there was significant difference in peroxide value 9.9, of baobab seeds crude oil after first frying compared with a refined commercial edible oil 13.9.

The statistical analysis showed that there was significant difference in free fatty acids 1.8, 1.9, 1.7 of baobab seeds crude oil before and after first and second frying compared with refined commercial edible oil 0.6, 0.6, 0.6 respectively. The statistical analysis showed that there was no significant difference in organoleptic test color, texture, flavor, taste, and acceptability of potato fried by baobab seeds crude oil after first and second frying compared with the refined commercial edible oil.

**Keyword Gongolase, Tabaldi, Introduction**

*Adansonia digitata*, the baobab, is a well known tree "The habitual of this tree is the hot, dryer regions of tropical Africa and it extends from Northern Transvaal and Namibia to Ethiopia, Sudan and Southern Fringes of Sahara" (Abdelmuti, 1991).

In Sudan, the local name is " Tabaldi tree" and a number of other names are given such as "Mother of tree", "Gonglase" and "Elhamaraia".

The baobab is one of the biggest and oldest living creatures attributed with supernatural powers and spirits, for this, we found a lot of names in Africa like, "Vegetative elephant", "Prehistoric Plant monument" and "Abode of the god". Many people in Africa express deep religious veneration, for this outstanding tree is believed to recur its strength from heaven (Sidibe and Williams, 2002)..

The multiple use model of this tree has further insured its special place in African culture. Only few other trees approach its significant it often serves as a preferred place for market, meeting and preserving water for the time of drought (Kheiri, 1996).

"Several varieties of the genus Adansonia exist in Madascar and In Australia" (Van May Doll, 1990). In Sudan till now we have not enough information about the varieties of Adansonia. "A study on the vital statistics of the baobab tree population in Zambia, Sudan, Mali, Kenya, and Tanzania showed that the population appear to be much younger that has generally been believed and only very few trees live to age in excess of 400 years.

The baobab fruit pulp because of its antioxidant effect is a good raw material for cosmeticians to inhibit aging of the skin. An infusion of roots is used in' Zimbabwe to bathe babies to promote smooth skin (Wickens, 1982). Since seed oil is used to treat skin complaints, to a degree it is used cosmetically. Nutritional uses of baobab as a food have been reported, for example roots reported to be cooked and eaten in West Africa in time of famine (Wickens, 1982). Young leaves as vegetables in soups as reported by FAO (1988). In Sudan the green leaves, when mixed with Aradeb pulp (*Tamarindus indica*) were served as a full meal; also the dried leaves are used as dry okra because of their mucilaginous properties (Abdelmuti, 1991). According to Wickens (1982), the seeds sockets (containing 9% oil) are edible and when are dried and ground were used to flavor soup or roasted to provide substitute for coffee.

. Palmer and Pitman (1972) stated the levels of vitamin C in baobab pulp were higher compared to orange. also Agbessi and tome (1996) concluded that vitamin C content of baobab fruit (1690 mg/kg) is higher compared to fresh hot pepper (1060 mg/kg). in Malawi the fruit pulp recorded 179mg ascorbic acid in l00g (Saka *et al*, 1994). Sudanese varieties showed 300mg/100g) (Nour *et al*, 1980). Manfredini (2002)

mentioned that ascorbic acid content range between 280 to 300mg/l00g (to compare: 51 in orange).

The seeds are used as antidote and for dental disorder; the leaves are used for treatment of coughs, insect bites, as prophylactic against fever divertic kidney and bladder diseases . Gastro-enteritis , cure inflammations, colic and cliaphoretie , the roots is used for treatment of malaria and smooth skin for babies (Van May Doll ,1990).

Ramadan *et al* (1994) reported that the baobab pulp is traditionally used in the treatment of fever, diarrhea, dysentery, hemoptysis, .small box and measles. Mixed with honey it is used as a cough mixture. Due to its high vitamin C content, the fruits were used by Arabic sailors to prevent scurvy.

In Sudan especially western people depended on the pulp of *A. digitata* for treatment of dysentery, diarrhea, gastro-enteritis and colics. Seeds are used for treatment of kidney inflammation by boiling the seed till the color becomes brown and drinking it for many days (Ramadan *et al*,1994).

**The objectives**

- To determine the oil content and their physical and chemical properties.

- To determine the fatty acids composition of the oil.

- To study the suitability of the baobab seeds crude oil for frying process.

- To evaluate the product fried by oil.

**Materials and Methods**

The required quantity of baobab fruits were bought from local market (Soug Khalifa ) in Omdurman, then immersed in water for about 12 hrs in order to obtain the seeds then they were cleaned, coarsely milled and mechanically pressed to obtain oil which was used for frying process. The refined commercial edible oil (control) was obtained from market produced by a well known company labeled antioxidant anti foaming 3 kg of potato tubers used in experiment were purchased from the local market of Khartoum North.

Potato tubers were cleaned, peeled, and sliced by using mechanical slicer and immersed in water to reduce browning before frying. The sliced potatoes were equally divided into two groups , group one fried in baobab seeds crude oils, and the other group fried by refined commercial edible oils , the frying process took 7 to 11 minute at frying temperature of 180 °C in 0.75 pound of oil for each group by using frying pot. Then the two types of oil withdrawn and kept in cleaned plastic container for analysis ,and the same was done for the second frying process.

Moisture content, refractive index (RI),oil density , peroxide value (PV) ,free fatty acids (FFA) , iodine value , saponification value, oil content, protein content, crude fiber, and ash content were determined according to the AOAC method (2000).
The viscosity of oil samples was determined by using Oswald — u- Tube, viscometer No 7647 (A.O.C.S, 1982). Fatty acid composition of oil was determined by gas chromatography apparatus (Py E-UNICAM model GCD). (ACMLT, 1990).

**Results and Discussion Proximate analysis of baobab seeds**

Table (1) shows that the proximate analysis of baobab seed as follows.The oil content was found to be 27.5%, this result was higher than that obtained by FAO (1982), and magboul and Mustafa (1979), 17.5 , 19.0 % respectively ,but was lower than that found by Nkafamiya *et al* (2007), 45%. differences might be due to plant varieties .The protein content of baobab seeds was 14.0 % which was lower than that obtained by both Osman (2004) and Nkafamiya *et al* (2007), 18.4 , and 21.75 % respectively. The moisture content of baobab seeds was found to be 5.7%, while Sidibe and Williams (2002), Osman (2004) and Nkafamiya *et al* (2007) reported that the moisture content of baobab seeds were 2.08 , 4.3 ,and 4.3% respectively. The ash content of baobab seeds was 3.4 %, this result was lower than that obtained by both Osman (2004), and FAO (1982), 3.8, and 5.5 % respectively.

The crude fiber was found to be 15.0 %, this result was higher than that obtained by FAO (1982), 14.5 % but was lower than that reported by Osman (2004), 16.2 %.

The carbohydrate was found to be 34.4 %, this result was lower than that reported by both Osman (2004) and FAO (1982), 45.0, and 60.4 %, respectively.

**4-2 Physical properties of baobab seeds crude oil**

Table (2) shows that the physical properties of baobab seeds crude oil the density was 0.9139, this result was lower than that reported by both Sidibe and Williams (2002), 0.9370.

The refractive index was 1.4690, this result was higher than that reported by both Nkafamiya *et al* (2007), and Sidibe and Williams (2002) 1.4590, and 1.4680 respectively.

The viscosity of baobab seeds crude oil was 22.6 cp

**Table (1): Proximate analysis of baobab seeds**

| Parameters | Mean |
|---|---|
| Oil content % | 27.5 |
| Protein content % | 14.0 |
| Moisture content% | 5.7 |
| Total ash% | 3.4 |
| Crude fiber% | 15.0 |
| Carbohydrate % | 34.4 |

**Table (2): physical properties of baobab seeds crude oil**

| **Parameters** | **Unit** |
|---|---|

| | |
|---|---|
| Moisture content | 0.1% |
| Density | 0.9139 |
| Viscosity | 22.6 cp |
| Refractive index | 1.4690 |

**4-3 Chemical properties of baobab seeds crude oil**

Table (3) shows that the chemical properties of baobab seeds crude oil which included The peroxide value was 9.0 meq $O_2$/kg, this result was higher than those obtained by both Sidibe and Williams (2007) and Nkafamiya *et al* (2007), 0.5, and 4,5 respectively, this may be due to many different factors such as bad storage of seeds ,season, variety, mishandling during seeds collection etc. The free fatty acids was 1.8 %, this result was higher than that reported by Nkafamiya *et al* (2007), 0.5,%.

The saponification value was 240.4, this result was higher than that obtained by both Nkafamiya *et al* (2007), and Sidibe and Williams (2002), 196, and 157.1 respectively .The iodine value was 54.0, this result was lower than that reported by both Nkafamyia *et al* (2007), and Sidibe and Williams (2002), 87.9, and 85.2 respectively.

**4-4 The fatty acids composition of baobab seed crude oil**

Table (4) shows that the fatty acids composition of baobab seeds crude oil , the Oleic acid was 25.7%, Linoleic acid was 30.1%, Palmitic acid was 17.8%, Stearic acid was 1.0%, Arachidic acid was 1.4%, all the above fatty acids composition were lower than those reported by Osman (2004), 35.8%, 30.7%,24.2%,4.6% respectively except the Arachidic acid which was higher 1.4%. The Laurie acid was 0.03%, the Capric acid was 0.04%, the Palmitoleic acid was 0.2%, the Palmitelaidic acid was 1.3%.

**Table (3): chemical properties of baobab seeds crude oil**

| **Type of test** | **Units** |
|---|---|

| | |
|---|---|
| Peroxide value | 9.0meq$O_2$/kg |
| Free fatty acid | 1.8 |
| Saponification value | 240.4 |
| Idoine value | 54.0 |

**Table (4): The fatty acids compositions of baobab seeds crude oil.**

| **Saturated fatty acids** | | **Unsaturated fatty acids** | |
|---|---|---|---|
| Plamitic acid | 17.8% | Oleic acid | 25.7% |
| Stearic acid | 1.0% | Linoleic acid | 30.1% |
| Arachidic acid | 1.4% | Palmitoleic acid | 0.2% |
| Lauric acid | 0.03% | Palmitelaidic acid | 1.3% |
| Carpic acid | 0.04% | Otehrs | 22% |

**4-5 The physical properties of baobab seeds crude oil compared with refined commercial edible oil before and after frying process**

Table (5) shows that there was no significant differences in physical properties between baobab seeds crude oil ,before frying process where the

moisture content 0.1%, density 0.9139, viscosity 22.6, refractive index 1.4690, and refined commercial edible oil moisture content 0.1%, density 0.9171, viscosity 20.4, and refractive index 1.4730 respectively.

Table (5) also shows that there was significant difference in moisture content 0.2%, viscosity 26.6 cp, of baobab seeds crude oil and refined commercial edible oil. 0.1% 23.7, respectively after first frying process. While there was no significant difference in density 0.9123, refractive index 1.4700, of A baobab seeds crude oil and commercial edible oil, 0.9164, and 1.4730, respectively after first frying process.

Table (5) also shows that there was significant difference in viscosity (3 8.3), of baobab seeds crude oil and refined commercial edible oil, 25.9 after second frying process. While there was no significant difference in moisture content 0.2%, density 0.9070, refractive index 1.4700, of baobab seeds crude oil and refined commercial edible oil 0.1, 0.9158, 1.4740, respectively after second frying process.

**Table (5) The physical properties of baobab seeds crude oil compared with refined commercial edible oil before and after frying process**

| Type of oil | Before frying | | | | After first frying | | | | After second frying | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | Moisture | Density | Viscosity | RI | Moisture | Density | Viscosity | RI | Mois | Den | Vis | RI |
| | Mean±Sd | Mean±Sd | Mean±Sd | Mean±Sd | Mean±Sd | Mean±Sd | Mean±Sd | Mean±Sd | Mean±Sd | Mean±Sd | Mean±Sd | Mean±Sd |
| Baobab oil | $0.1^{a}$±0.0 | $0.9139^{a}$±0.0 | $22.6^{a}$±0.0 | $1.4690^{a}$±0.0 | $0.2^{a}$±0.0 | $0.9123^{a}$±0.0 | $26.6^{a}$±0.5 | $1.4700^{a}$±0.0 | $0.2^{a}$±0.0 | $0.9170^{a}$±0.0 | $38.3^{a}$±0.5 | $1.4700^{a}$±0.0 |
| Commercial oil | $0.1^{a}$±0.0 | $0.9171^{a}$±0.0 | $20.4^{a}$±0.0 | $1.4730^{a}$±0.0 | $0.1^{b}$±0.0 | $0.9164^{a}$±0.0 | $23.7^{b}$±0.5 | $1.4730^{a}$±0.0 | $0.1^{a}$±0.0 | $0.9158^{a}$±0.0 | $25.9^{b}$±0.5 | $1.4740^{a}$±0.0 |

Mean values having different superscript letter (s) in each column and rows differ significantly ($P \leq 0.05$) Mois =moisture, Den =Density, Vi s =Viscosity, R.I = refractive index

**4-6 The chemical properties of baobab seeds crude oil compared with refined commercial edible oil before and after frying process**

Table (6) shows that there was no significant difference. in peroxide value of baobab seeds crude oil (9.0) and commercial edible oil (9.0) before frying , while there was significant difference in peroxide value of baobab seeds crude oil (9.9) and commercial edible oil (13.9) after first frying process ,also table (6) shows that there was no significant difference in peroxide value of baobab seeds crude oil (12.9) and refined commercial edible oil (15.9) after second frying process .Also there was significant difference in free fatty acids of baobab seeds crude oil 1.8, 1.9 , 1.7 and refined commercial edible oil 0.6, 0.6 , 0.6 before and after first and second frying process respectively.

**4-7 Sensory evaluation of potato chips fried with baobab seeds crude oil and refined commercial edible oil after first and second frying processes**

Table (7) shows the sensory evaluation of potato chips fried with baobab seeds crude oil and refined commercial edible oil after first and second frying processes. We noticed that there was no significant differences in color of potato chips after both first and second frying process with baobab seeds crude oil compared to that fried with refined commercial edible oil, also there was no significant changes in texture, taste, flavor and acceptability of potato chips after both first and second frying processes with baobab seeds crude oil compared to that fried in refined commercial edible oil for first and second frying process.

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**Table (6): The chemical properties of baobab seeds crude oil compared with commercial edible oil before and after frying process**

| Type of oil | Before frying | | After first frying | | After second frying | |
|---|---|---|---|---|---|---|
| | P.V | F.F.A | P.V | F.F.A | P.V | F.F.A |
| | **Mean±Sd** | **Mean±Sd** | **Mean±Sd** | **Mean±Sd** | **Mean±Sd** | **Mean±Sd** |
| **1. Baobab oil** | **$9.0^{a}$±0.1** | **$1.8^{a}$±0.1** | **$9.9^{a}$±0.1** | **$1.9^{a}$±0.02** | **$12.9^{a}$±1.5** | **$1.7^{a}$±0.0** |
| **2. Commercial oil** | **$9.0^{a}$±0.1** | **$0.6^{b}$±0.00** | **$13.9^{b}$±0.1** | **$0.6^{a}$±0.00** | **$15.9^{a}$±0.1** | **$0.6^{b}$±0.00** |

Mean values having different superscript letter (s) in each column and rows differ significantly ($P \leq 0.05$) P.V = Peroxide value, F.F.A = Free fatty acids

**Table (7): Sensory evaluation of potato chips fried with baobab seeds crude oil and refined commercial edible oil.**

| **Sample** | **Color** | | **Texture** | | **Taste** | | **Flavor** | | **Acceptability** | |
|---|---|---|---|---|---|---|---|---|---|---|
| | After first frying | After second frying | After first frying | After second frying | After first frying | After second frying | After first frying | After second frying | After first frying | After second frying |
| Baobab seeds crude oil | $19^{b}$ | $16^{b}$ | $19^{b}$ | $20^{b}$ | $18^{b}$ | $17^{b}$ | $20^{b}$ | $17^{b}$ | $18^{b}$ | $18^{b}$ |
| Refined commercial edible oil | $17^{b}$ | $20^{b}$ | $17^{b}$ | $16^{b}$ | $18^{b}$ | $19^{b}$ | $16^{b}$ | $19^{b}$ | $18^{b}$ | $18^{b}$ |

Mean values having different superscript letter (s) in each column and rows differ significantly ($P \leq 0.05$)

## Conclusion

The study concluded that the baobab seeds crude oil is acceptable oil according to its physical and chemical properties, also stated that the oil is good in food frying according to it's sensory evaluation after first and second frying. The peroxide of oil was stable after first frying.

## Recommendations

1. We recommend more studies should be paid in baobab seeds crude oil to recognize the shelf life.
2. We recommend for the local communities in Sudan to use baobab seeds crude oil for cooking purposes.
3. We recommend more attention and care should be taken for growth and maintenance of baobab tree.

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