

## Review on Functional Values of Doum Palm Fruit

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### Abstract

Consumers are currently demanding less use of artificial additives in food products, so more attention had been paid to search for naturally occurring substances that are anticipated to be safe and health-promoting. This is true for plant materials that act as alternative sources of many bioactive compound. Doum palm (*Hyphaene thebaica*) is one of the underutilized fruits that contains many valuable compounds. Doum fruit should be regarded as potential source of natural antioxidant, antimicrobial, dietary fiber, and more, capable of offering significantly low cost and nutritional compound that are safer for human consumption and their use in food products will increase quality and added value. Foods that possess additional physiological effects beyond their nutritional functions of providing nutrients are called functional foods. Functional food can provide nutraceuticals with the therapeutic value that is capable of protecting against various diseases. From this point of view, the present study was designed to review literatures on the natural source of valuable compounds in doum palm fruit.

**Keywords:** Antimicrobial, Antioxidant, Chemical composition, Doum palm, Minerals

### INTRODUCTION

Doum palm (*Hyphaene thebaica*) is one of the world's most beneficial plants and is an Egyptian, Sudan and sub-Saharan African palm (Gharb and Fadhel, 2017; EL-kholy, 2018; Islam *et al.*, 2022; Sabre *et al.*, 2022). The perennial plant is also distributed in desert and subtropical regions of the world (FAO 2006; Aboshora *et al.*, 2014; Khalil *et al.*, 2020; Mansur, 2021). *Hyphaene thebaica* as a common palm tree with edible fruit belongs to the family called Arecaceae (Aremu and Fadele, 2011; Gharb and Fadhel, 2017; Ghada *et al.*, 2020; Khalil *et al.*, 2020; Hussiena *et al.*, 2021; Sabre *et al.*, 2022). It also grows very well in the northern part of Nigeria Arecaceae (Aremu and Fadele, 2011). It names differently such as doum palm, doom palm, gingerbread palm, zembaba, mkoma, arkobkobai and kambash (Orwa *et al.*, 2009; Auwal *et al.*, 2012). The oval, apple-sized bright orange fruit has a reddish shell, a dense, spongy, delicious, fibers rich fruit flesh with a gingerbread-like flavor, and a big kernel and

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the fruit's coating is eatable and may be crushed into powder or sliced into pieces (Islam *et al.*, 2022). The fruit has a sweet taste (Abdel-Rahman *et al.*, 2014).

Doum fruit is an excellent source of carbohydrate, micronutrients such as vitamins especially niacin, folic acid, pyridoxine, riboflavin, and thiamin and important minerals like potassium, sodium, calcium, magnesium, as well as phosphorus (Admassu *et al.*, 2013; Aboshora *et al.*, 2014; Islam *et al.*, 2022). The Doum is known to contain proteins, coumarin, essential oils, saponins, reducing sugars, alkaloids, flavonoids, hydroxycinnamates, glycosides, phenolic compounds, and fatty acids (Hsu *et al.*, 2006; Shady *et al.*, 2021). Doum is considered to contain higher moisture content, crude fiber, ash content, protein, fat, and vitamins (Islam *et al.*, 2022). It contained high amount of amino acids such as valine, leucine, and some non-essential amino acids such as alanine, aspartic acid, glutamic acid, glycine, serine and proline (Abdel-Rahman, 2011). Doum fruits are rich in fibers, antioxidants, B-complex vitamins, essential minerals in the epicarp and mesocarp, and have a considerable content of monosaccharides such as glucose and fructose (Aboshora *et al.*, 2014).

Antioxidants play an important role in food protection from oxidation processes and used as dietary supplements to remove potentially damaging oxidizing agents in a living organism (Shahidi & Chandrasekara, 2015). Various studies have revealed the fact that doum fruit extracts contain high levels of phenols and flavonoids, which possess significant antioxidant and antibacterial activities (Hsu *et al.*, 2006; Aboshora *et al.*, 2015; El-Beltagi *et al.*, 2018; Atito *et al.*, 2019). However, antioxidant compounds and their antioxidant activities varied according to the seasonal variations and the type of phenolics content present in the fruit (Laya & Koubala, 2020). Researchers reported that doum fruits are very rich in volatile compounds and polyphenols, and have a good anticancer and antimicrobial properties (Aboshora *et al.*, 2014, 2017; Reda & Amer, 2015).

Doum has nutritional and pharmacologic properties (Aboshora *et al.*, 2014). It was used in different countries for the treatment of diabetes, obesity, hypertension, dyslipidemias and to reduce cardiovascular diseases (Hsu *et al.*, 2006; Salib *et al.*, 2013). According to Bayad (2016) the fruits of *H. thebaica* have antimicrobial, antioxidant, antidiabetic, antihypertensive and hypolipidemic effects. Doum fruit has been used as an anti-hyperlipidemia drug (Sa'adah *et al.*, 2017).

Doum is a traditional Egyptian beverage that is consumed (Shamandy & Saad, 2022). Doum fruits are consumed in dry, fresh form or cut off to slices before drying and powdering for food products formulation (Shady *et al.*, 2021; Kolla *et al.*, 2021). The fruits are transformed in traditional beverages, juice, jelly or puree and usually used to prepare nutritive diets, and other food products (Kolla *et al.*, 2021; Sabre *et al.*, 2022). The fruit has been a popular component of tea preparation consumed for refreshment, regulation of body weight and blood glucose (Shady *et al.*, 2021).

### CHEMICAL COMPOSITION

The Doum fruits are a rich source of sugar, protein and fats. It contains some minerals such as calcium, phosphorus and high in iron content (Islam *et al.*, 2022). The fruits are rich in thiamin, riboflavin and niacin (FAO, 2006). The edible part of the fruit of Doum contains 74.0% soluble sugars, 22.0% of its starchy substances and 37.0% sucrose, also Doum contain a high percentage of potassium (Abdel-Muti, 2002). Moreover, it contains quantities of proteins, fats, calcium, phosphorus and niacin, with traces of riboflavin and thiamin (Admassu *et al.*, 2013; Aboshora *et al.*, 2014; Islam *et al.*, 2022). FAO (2006) recorded the chemical compositions (per 100 g) of African Doum of 4.00, 3.80, 0.80, 84.10 and 7.30% for moisture, protein, fats,

carbohydrates and ash, respectively. In addition, energy value (390 Kcal), thiamin (0.05 mg) and riboflavin (0.10 mg). The above organization also reported the chemical composition of Indian doum as 9.26, 7.21, 75.81, 50.07 and 3.68%, for protein, fats, carbohydrates, fibre and ash, respectively, and energy value (4.6 KCal) while, Abdel-Rahman *et al.* (2014) recorded composition of Sudanese Doum fruit of 5.47, 3.80, 0.95, 18.36, 7.17, 69.72, 0.38, 50.00 and 4.67% for moisture, protein, fats, fibre, ash, carbohydrates, pectin, total and reducing sugars, respectively. The phytochemical analysis of *H. thebaica* revealed the presence of tannins, steroids, saponins, flavonoids, terpenes and terpinoids (Auwal *et al.*, 2013). Moreover, some primary metabolites such as fatty acids (palmitic, oleic and linoleic acids), some elements such as nickel, iron, cobalt and copper were also identified (Ugochukwu *et al.*, 2003). Several amino acids such as phenylalanine, leucine, glutamic and aspartic acid were identified from the aqueous extract of doum fruit using HPLC (Aamer, 2016).

### **Mineral content**

The mesocarp of *H. thebaica* fruits has some minerals such as magnesium, cobalt, copper, zinc, calcium and iron (Nwosu *et al.*, 2008). Abdel-Rahman *et al.*, (2014) stated that Doum fruit has adequate amount of calcium (Ca), iron (Fe), phosphorus (P), sodium (Na), magnesium (Mg), manganese (Mn) and potassium (K). FAO (2006) mentioned levels of African Doum of Ca (34 mg) and P (110 mg), in addition levels of Ca (268 mg), P (224 mg) and Fe (38.24 mg) for Indian Doum. Abdel Muti (2002) reported 1300 mg/kg (Ca), 17.00 mg/kg (Fe), 1400 mg/kg (P), 900 mg/kg (Na), 1800 mg/kg (Mg), 11.00 mg/kg (Mn) and 30,200 mg/kg (K) for Doum. These differences could be attributed to environmental conditions, or type of the soil used for cultivation.

### **Antioxidants**

Oxidation decreases consumers' acceptability of foods by producing low-molecular-weight off-flavor compounds, as well as by destroying essential nutrients, and it produces toxic compounds and dimers or polymers of lipids and proteins (Choe & Min, 2009). While Antioxidant can interfere with oxidation process by reacting with free radicals, chelating catalytic metals and also by acting as oxygen scavengers and have the ability to prevent free radicals to damage tissues (Shahidi *et al.*, 1992; Aruna & Suneetha, 2016). The decrease of the antioxidant activity defense mechanism inherent to the body affects the generation of hydroxyl radicals, results in lipid peroxidation as the pancreatic beta cells are more susceptible to oxidative damage (Kurutas, 2016). Antioxidants function as the body's defense mechanism against free radicals (Damayanti *et al.*, 2022). These antioxidants are especially an important class of food preservatives (Aruna & Suneetha, 2016). Choe & Min (2009) stated that the antioxidants for foods should be reasonable in cost, nontoxic and stable. However, the artificial compounds with antioxidant properties, like butylated hydroxyanisole (BHA) and butylated hydroxytoluene (BHT), have a limited allowance for food due to their potential cancer-organicity (Duda-Chodak & Tarko, 2007).

The natural antioxidants are a stable part of nutrition as they occur in almost all edible plant products including fruits (Duda-Chodak & Tarko, 2007). Natural antioxidants are primarily polyphenolic compounds that may occur in all parts of the plant. Example of common plant phenolic antioxidants include flavonoid compounds, tocopherols, cinnamic acid derivatives, coumarins and poly functional organic acids (Shahidi *et al.*, 1992). Fruits and vegetables have a significant polyphenol content, which contributes to their bioactivity (Asami *et al.*, 2003). Tocopherols, ascorbic acid, carotenoids, flavonoids, amino acids, phospholipids, and sterols are natural antioxidants in foods (Choe & Min, 2009). Oroian & Escriche (2015) stated that the major classes of compounds with antioxidant activity are: vitamins (vitamin C and vitamin E), carotenoids (carotenes and xanthophylls) and polyphenols (flavonoids, phenolic acids,

lignans and stilbenes). Plants' phenolics are well known for their ability to scavenge reactive radicals. The polyphenols' antioxidant characteristics are linked to the existence of functional groups within ring and circular structure of atoms, as well as connected double bonds (Działo *et al.*, 2016).

### Phytochemicals in Doum palm

Doum is a poly-phenolic compound-rich traditional beverage popular in Egypt (Islam *et al.*, 2022). Various researchers have found that doum fruit flour extracts contain significant concentrations of flavonoid and phenolic compounds, which function as antioxidants and antibacterials, reducing the negative oxidative stress and preventing illnesses caused by infectious microbes (Eldahshan *et al.*, 2009). It has been studied that the extracts of doum flour possess antioxidant properties; this is owing to a significant quantity of water-soluble phenolic content in the fruits (Aamer, 2015). Moreover, several polyphenolics such as 3-OH tyrosol, catechin, E-vanillic, oleuropein, chlorogenic, p-OH benzoic, ellagic, salicylic, protocatechic, caffeic and vanillic acids were also identified (Aboshora *et al.*, 2017). High concentrations of glycoside, saponin and flavonoids were quantified from the methanol extracts of doum fruits (Nwosu *et al.*, 2008).

Doum fruit contain phenolic substances such as: catechin, chlorogenic, metoxi-cinnamaci, hydroxycinnamic, and caffeic acids Vanillic acid, sinapic acid, chlorogenic acid, catechin, methoxy-cinnamic acid, p-hydroxybenzoic acid, 3,4 di hydroxycinnamic acid, caffeic acid, 2-hydroxycinnamic acid, Epicatechin, and cinnamic acid were the most prevalent phenolic chemicals found in doum (Sultana *et al.*, 2012; Salih &Yahia, 2015). Doum fruits have many flavonoid compounds, which included quercetin, naringin, glycosides and isoquercetrin (Aamer, 2016; Farag & Pare, 2013). The flavonoid concentration of various doum fruit flour extracts ranged from 24.04-milligram/gram to 47.17-milligram/gram. The total flavonoids (milligram/gram) within quercetin equivalent of *H. thebaica* flour was 46.28 milligram/gram DW, according to report by Mohamed *et al.* (2010). The fruit contains flavonoids (quercetin, hesperetin and naringin), steroids, terpenes and tannins, carbohydrates, cardiac glycosides, terpenes and terpenoids (Hossam *et al.*, 2018). Eleven flavonoids were identified and quantified in the aqueous extract of doum palm fruit using HPLC (naringin, rutin, hesperidin, rosmarinic acid, quercitrin, quercetin, naringenin, hesperetin, kaempferol, 7-hydroxy-flavone and apigenin (Aamer, 2016).

### Antimicrobial s activities in Doum plam

Pisoschi *et al.* (2018) stated that many foodborne diseases are caused by ingestion of food and food products contaminated with microbial pathogens. Natural antimicrobial compounds are a re-emerging alternative to food preservation and the antimicrobial power of plant extracts have been recognized for centuries (Ayala-Zavala *et al.*, 2011). Doum palm fruit have significant antimicrobial activities which were attributed to the presence of flavonoids (Dahiru & Nadro, 2022). Antibacterial Activities of *Hyphaene thebaica* (Doum Palm) Fruit Extracts were also determined by Ewansiha *et al.* (2021) due to the presence of some phytochemicals. The antibacterial potential of the extract against six clinical bacterial isolates resistant to antibiotics was investigated and it was found that, the methanol extract of doum fruit was characterized by antibacterial action toward one Gram-positive  $\beta$ -lactamase bacteria (*Staphylococcus aureus*), and one Gram-negative Multidrug-resistant bacteria (*Proteus mirabilis*) (Abdallah *et al.*, 2021).

### Reviews on Doum palm (*H. thebaica*)

Kolla *et al.*, (2021) uses three types of doum (*H. thebaica*) fresh, dried from tree, and dried fruits purchased from local fruit market and investigated bioactive compounds, and antioxidant

properties of these fruit. The results showed significantly ( $p < 0.01$ ) higher dry matter (98.73 g/ 100g), pH (7.09), tannins (27.64 mg/ g), flavonoids (19.90 mg/ g) and total polyphenols (7.13 mg/ g) contents in pericarp than other parts of fruit. The pulp without pericarp exhibited higher ash, amino acids, proteins and vitamin C contents, however, pulp of whole fresh fruit had higher Ca (1.67 mg/ g), Na (640.26 mg/ g) and Zn (11.63  $\mu$ g/ g). Pulp of fruit purchased from local market showed significantly stronger antioxidant activities (DPPH and ABTS). A hot water extract from the fruit of *Hyphaene thebaica* was also examined by Hsu *et al.* (2006), the Doum extract exhibited potent antioxidant activity in terms of GAE and showed ascorbic acid, ethylenediamine tetraacetic acid, and gallic acid. Their results showed that the fruit of *Hyphaene thebaica* fruit is a source of potent antioxidants. Dahiru & Nadro (2022) determined the phytochemical composition and antioxidant potential of *Hyphaene thebaica* fruit and the result revealed the presence of alkaloids, saponins, terpenoids, and flavonoids in all the extracts. Flavonoids (5.80 $\pm$ 0.20%) were higher than all the other phytochemicals in the ethyl acetate extract, followed by saponins which were present up to 2.50 $\pm$ 0.11%, then terpenoids. Glycosides were present in higher amounts compared to steroids. However, alkaloids (0.08 $\pm$ 0.05%) were in smaller amounts compared to the other phytochemicals quantified. The antioxidant activities showed a concentration-dependent increase in absorbance of the extract as displayed by the standard (ascorbic acid). The extract had an IC<sub>50</sub> of 52.21  $\mu$ g/ mL, significantly ( $p < 0.5$ ) higher than the standard (14.10  $\mu$ g/ mL).

A study was also conducted on doum palm fruit by Datti *et al.* (2021) and the fruit were found to contain some minerals including K (3366.21 mg/100 g), Ca (292.04 mg/100 g), Na (212.27 mg/100 g), Mg (177.14 mg/100 g), Fe (4.86 mg/100 g), Mn (0.83 mg/100 g), Zn (0.68 mg/100 g), Cu (0.40 mg/100 g), Ni (0.32 mg/100 g) and Co (0.12 mg/100 g). The proximate composition of the doum palm fruit pulp reveals protein (2.86%), lipid (0.92%), ash content (6.24%), crude fiber (12.87%), moisture content (8.64%) and carbohydrate 68.47%. The DPPH radical scavenging efficacy of the ethanol extract of the fruit of the doum palm at concentration 0.0625 mg/ mL, 0.125 mg/ mL, 0.250 mg/ mL and 0.500 mg/ mL the extract showed inhibitory activity of 31%, 61%, 72% and 81% respectively. Doum fruit extract (*Hyphaene thebaica*) was concluded to be an alternative to antidiabetic drinks BY Damayanti *et al.* (2022) because their analysis showed that the IC<sub>50</sub> value in boiled water was 74,098 ppm, and Doum immersion water was 78,654 including strong antioxidant activities.

Gharb & Fadhel (2017) investigated antioxidant activity of doum (*Hyphaene thebaica*) fruit using soxhlet apparatus for 9 hours to each of ethanol and ethyl acetate solvents. The antioxidant activity was done by using (DPPH) 2, 2 - diphenyl, 1- picrylhydrazyl and (FRAP) ferric reducing antioxidant power assays. (BHT) butylated-hydroxy-toluene was used as control. The results showed that the scavenging effects of both extracts from the plant on DPPH radicals increased by increasing the concentration. Ethyl acetate extract of the *H. thebaica* showed strong DPPH scavenging activity at concentrations (400, 600, 800  $\mu$ g/ mL) more than ethanolic extract and BHT which were 70.20, 88.70 and 95.80% respectively. The results also revealed that doum fruits can be used as a natural antioxidant as well as the possibility of using it as food additives.

Doum fruits (*Hyphaene thebaica*. L) were extracted with boiling water and ethanol: water (80: 20 v/v) respectively, phenolic, flavonoids compound and antioxidant activities were determined as well as analyzed by HPLC. Total phenolic, total flavonoids and antioxidant activity content of ethanolic doum extracts were higher than aqueous doum extracts. Ethanolic doum extracts were rich in phenolic compounds; The highest quantities were Oleuropein (45.41 mg/ g), Coumarin (25.17 mg/ g), Catechin (19.55 mg/ g), Ferulic (14.21 mg/ g) and Salicylic (10.05 mg/ g). In addition to presence five flavonoid compounds were

Rosmarinic acid (40.12 mg/g), Hesperidin (28.35 mg/g), Quercitrin (19.02 mg/g), Myrecetin (12.44 mg/g) and Apigenin (8.12 mg/g) (Shamandy and Saad, 2022). Phenolic profiling of edible parts *Hyphaene thebaica* (Doum palm) are identified using LC-ESI-MS by Hussiena *et al.* (2021), twenty three isolated compounds were identified as ; Caffeic acid, protocatechuic acid, rhamnetin, catechin, quercitrin, vanillic acid, kaempferol 3-O-acetylglycoside , cinnamic acid, apigenin-7-O-glucose , intricatin-3-O-htyrosol, luteolin, quercetin, naringenin , kaempferol ,vanillic acid-4-β-D-glycoside coumaric acid, ferulic acid, luteolin-6-arbinose-8-glucose, p-coumaroyl malic acid eriocitrin, apigenin and hesperetin.

Khider *et al.* (2022) study shows that Doum fruit has more antioxidant and more antimicrobial effect. Also, Doum exhibit high content of minerals which increases the nutritional value. Moreover, fermented milk drinks can be improved to produce high-quality synbiotic products with good nutrient sources, antimicrobial, antioxidant properties, moderate viscosity and good taste with doum palm fruit. The qualitative determination of the phytochemicals in Doum (*Hyphaene thebaica*) fruit aqueous extract indicated the presence of steroids, saponin, tannins, phlobatannins, terpenoids, alkaloid, glycoside, and flavonoids, the fruit extract showed antioxidant activities by scavenging the DPPH radicals with IC<sub>50</sub> of 128 μm/mL (Abdullahi *et al.*, 2022).

### Utilization of Doum palm

Doum has many benefits, traditionally, people consumed it for food supply and for local and marketable purposes (Idohou *et al.*, 2016). Mainly children are using doum fruits as a snack (Aboshora *et al.*, 2015). Food s fortification have gained more attention with the purpose to enhance the health-benefiting effects, especially for children, and women (pregnant women and lactating mother) to protect them against malnutrition (Olson *et al.*, 2021). The fortified food products were superior in terms of nutritive values (proteins, carbohydrates, minerals, and vitamin contents) (Olson *et al.*, 2021; Sabre *et al.*, 2022) and also provide additions to the healthy content of antioxidant and antimicrobial compounds (Aboshora *et al.*, 2016; Shahin & Helal 2021).

Doum fruit powder is generally dried and used as a flavoring ingredient in foods (Orwa *et al.*, 2009; Abdel-Rahman *et al.*, 2015; Islam *et al.*, 2022). Doum fruits' powder was involved in bread baking such as toast bread and gluten-free pan (Olson *et al.*, 2021). Mix of milled wheat with Doum fruit powder increases the rheological properties of the dough and consequently improving the bread quality (Aboshora *et al.*, 2015; Aminu *et al.*, 2022). Other doum food products also include biscuits, crackers, syrups, jelly, and ice creams (Shahin & Helal 2021). The powder of *H. thebaica* fruit is applied in some industrial stuff as a source of fiber and stabilizer (Abdel-Rahman *et al.*, 2015). In Turkana, Kenya, the powder is also used to make a mild alcoholic drink by adding water and leaving it to stand (Vogt, 1995). Also, aqueous doum palm extracts increased the viability and activity of some certain dairy starter cultures which used in the manufacture of some dairy products especially probiotics (Hassan & Aumara, 2005).

Medicinal plants are those that have the inherent capacity or potential to treat or prevent a variety of illnesses. Plants have been used for therapeutic purposes since antiquity. In underdeveloped nations, where infectious illnesses are widespread and contemporary healthcare facilities are woefully inadequate, medicinal plant usage is more visible and tactile (Usman *et al.*, 2022). Due to its phytochemical compositions and antioxidant activities, *H. thebaica* can be used as a medicinal plant (Dahiru & Nadro, 2022). Doum wild fruit has adequate amount of many pharmacological compounds such as saponins, coumarins, hydroxyl cinnamates, essential oils and flavonoids (Aamer, 2016). *Hyphaene thebaica* is a

potential source of antioxidant and antimicrobial secondary metabolites agents such as polyphenolics including proto-anthocyanides, flavonoids and phenolics in addition to other classes of secondary metabolites such as alkaloids and saponins (Abdel-farid *et al.*, 2019). Studies have reported that doum water extract can be able to decrease hyperlipidemic and blood glucose lowering ability due to their phenolics and flavonoids that work as antioxidant (Aboshora *et al.*, 2014; Nisreen & Heba, 2020; Shady *et al.*, 2021). Doum fruit aqueous extract also showed anti-inflammatory, antimicrobial, anticancer and pharmacological prospectives due to its major constituents (Eldahshan, 2009; Mohamed, 2009; Shalaby & Shatta 2013; Bello *et al.*, 2017; El-Beltagi, 2018). Doum fruit also used to prepare a standardized extract antihypertensive drug (Khalil *et al.*, 2018). The extract of fruit is used for the treatment of gastric pains (El-Gazali *et al.*, 1998). The flavonoid extracts significantly increased adiponectin levels in diabetic rats, which arouse the hypoglycemic activity of insulin without changing the concentration of insulin in the blood (Salah *et al.*, 2011; Habib *et al.*, 2014). The fruit pulp of *Hyphaene thebaica* has good antibacterial activities against some Gram-positive and Gram-negative bacteria, the consumption of this fruit would exert several beneficial effects by virtue of its antibacterial activities (Dosurnu, *et al.*, 2006; Abdallah *et al.*, 2021).

### CONCLUSION

Doum palm fruit is an alternative fruit that have different kinds of active compounds such as polyphenolic flavonoids which are not exploited in our society at the moment, but could find practical application in various food industries and homes. A successful and novel formulation of doum fruit powders should be encouraged among food industries, new products like sweets, snacks and drinks as well as producing natural powdered and liquid flavours in existence to make economic use of this local raw materials. It could be concluded that the local doum palm fruit can be used as a potential source for functional food ingredients as they are promising source of antioxidants and antimicrobial compounds and offering new commercial opportunities to small scale and large food industries.

Based on the findings in this review, the following recommendations are made. Food industries should consider the application of doum fruit to enhance the nutritional quality of their product. New and more product development with doum palm fruit should be encouraged among the food entrepreneurs. Efforts should be directed towards propagation and domestication of doum palm (*Hyphaene*) trees to avoid its scarcity and rescue them from becoming extinct. Government should provide modern technology to the producers of Doum palm fruits so as to improve the quality of their products to be able compete favourably with synthetic ones

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