International Journal of Pharmacology

ISSN 1811-7775

science alert

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Asian Network for Scientific Information

OPEN ACCESS International Journal of Pharmacology

ISSN 1811-7775
DOI: 10.3923/ijp.2019.953.961

Research Article
Antioxidant, Anti-α-amylase and Antimicrobial Activities of Doum (*Hyphaene thebaica*) and Argun (*Medemia argun*) Fruit Parts

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Abstract

Background and Objectives: Doum (*Hyphaene thebaica*) is a common palm tree in Egypt and produce an edible fresh fruits or dried in refreshment drinks. Another relative desert uncommon palm, Argun (*Medemia argun*) deserves extra focus as its fruits were found reserved in Pharaohs tombs. This study is designated to examine the phytochemicals, nutrient content, antioxidant and antimicrobial inhibitions activities of fruit parts of *H. thebaica* (HT) and *M. argun* (MAR). **Materials and Methods:** The total phenolic and flavonoid contents of fruit parts (mesocarp (M), coat (C) and seed endocarp (E)) were investigated spectrophotometrically. Antioxidant properties were measured as total antioxidant capacity, DPPH and H_2O_2 scavenging. The nutritional values determined as carbohydrates, proteins contents and anti-α-amylase activities. A bioassay based on inhibition zone on agar plate was applied to evaluate the antibiotic activity of the HT and MAR metabolites against 4 pathogenic bacterial strains. **Results:** The results displayed that antioxidant, antibacterial activities and nutritional values differ significantly in the endocarp, mesocarp and coat samples of both fruits. Flavonoids and phenolics content are high in endocarp of each fruit and low in mesocarp. Total phenolics from fruits parts ranged between 40.65-327.48 mg GAE g^{-1} of dry sample. The IC_{50} values for radical scavenging of DPPH of MARE, MARM, MARC, HTE, HTM and HTC were 55.01, >500, 293.36, 53.76, >500 and 137.89 μg mL^{-1}, respectively. The hydrogen peroxide scavenging efficacy of the various extracts obtained from HT and MAR was in the order of HTE>MARE>MARC>HTC>HTM>MARM. IC_{50} inhibitory activity of α-amylase showed the maximum in HT mesocarp, followed by HT coat and HT endocarp. At the concentrations of 100, 200, 300, 400 and 500 μg mL^{-1}, HT mesocarp (HTM) showed inhibitory activity of 61.57, 85.67, 86.93, 83.97 and 85.20%, respectively and while MAR mesocarp (MARM) was 60.67, 64.13, 83.83, 82.23 and 82.27%, respectively. HTE and MARE extracts possess potential antioxidant and antibacterial properties followed by HT coat (HTC) and MAR coat (MARC). **Conclusion:** Argun fruit has strong biological activities similar to doum fruits and potentially can be used as food dietary supplement to cure cancer and diabetic diseases.

Key words: Antioxidants, *Hyphaene thebaica*, *Medemia argun*, nutrient compositions, antibacterial activity

Citation: Eman Atito, Mahmoud F. Moustafa, S. Siddiqui and Magdi El-Sayed, 2019. Antioxidant, anti-α-amylase and antimicrobial activities of doum (*Hyphaene thebaica*) and argun (*Medemia argun*) fruit parts. Int. J. Pharmacol., 15: 953-961.

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Competing Interest: The authors have declared that no competing interest exists.

Data Availability: All relevant data are within the paper and its supporting information files.

INTRODUCTION

There are substantial evidence act as key generators for the species of reactive oxygen (ROS) and many others as the main cause of numerous disorders. Nowadays researchers work hard to estimate the antioxidant ability as a main factor in preventing, suppressing and in treating various diseases. Antioxidants were defined as the chemicals that delay or restrain the oxidation of different molecules by bringing down the inception action or oxidizing chain continuous reactions. Antioxidants are divided into 2 fundamentals classes including synthetic and natural occurrence. The industrial antioxidants are chemical agents with various levels of alkyl substitution of phenolic compounds, whereas natural origin of antioxidants can be (flavonoids, tocopherols, phenolic acids), nitrogen bearing compounds (chlorophyll derivatives, alkaloids, amines and amino acids), ascorbic acid or carotenoids[1,2]. Properties of antioxidants of the plant are due to the existence numerous dynamic phytochemicals including flavonoids, vitamins, carotenoids, terpenoids, coumarins, lignin, saponin, curcumins, plant sterol and so on. The harmful role of free radical reactions in illness pathology is well established and is known to be leading to several intense and ceaseless disorders in human, for example, diabetes, atherosclerosis, aging, neurodegeneration and immunosuppression[3]. It is well demonstrated that free radicals cause cell harm through components of covalent attachment and peroxidation of lipid with resulting tissue damage. Antioxidant agents of natural origin have appealed exceptional concern because of their free scavenging of radicals capabilities.

The only species that taxonomically near to *Hyphaene thebaica* plants is *Medemia argun*, to which it is, belongs to the same family, Arecaceae, especially in leaf morphology and the inflorescence. However, it is easily recognized from Hyphaene plants by its bright yellow petiole, supple leaves without a hastula, plum-like fruit and lighter petiole armament, endocarp sperm and unlike *H. thebaica*, an unbranched stem. An Arabic common name for *M. argun* is "Argun" with an ancient hieroglyphic name, Mama-n-Xanin or Mama-n-Khanen, which is different from Mama (*H. thebaica*)[4]. *Hyphaene thebaica* is recorded as a desert palm native to many regions in north Africa, Egypt, West India and sub-Saharan Africa and in Saudi Arabia especially Jizan area[5]. It is commonly in Egypt known as the Doum or gingerbread palm reaching up to 6 or 9 m high with dichotomous stems and leaves shaped like a fan, 65-75 cm. It is regarded as one of the significant plants worldwide, where its trunk is used for construction, as well as for manufacture of various domestic utensils and the leaves for making bind parcels, mats and writing paper. The oblong shape, yellow-brown orange sized fruit with red to brownish outer skin are very thick, with sweaty fibrous fruit pulp (mesocarp), gingerbread taste with a large kernel. The eaten part by many people is the fleshy mesocarp of the fruits also the plant juice is very common in summer season in Egypt and believed to be good for releasing hypertension[6]. The fruit pulp is usually used in cooking and the immature kernel is palatable but the ripe kernel part is very hard and only used as vegetable Ivory[7]. Kernel rind part is applied to manufactures molasses and the ground from kernels usually used to heal the wounds in people in some countries[8,9]. Doum fruits are life-sustaining and were listed as main famine food to the peoples who live in the desert land where doum palms are growing. There was data by USAID[10] claiming that communities living in the Turkana area of Kenya were depending on wild Doum during the dry seasons from 1992-1994. Doum plant recommended to use the fruit due to its high nutritional value, dried pulp of the fruit is often consumed as a tonic for health and for its many other medicinal properties[11]. Previous studies on the fruit pulp reveled that it had valuable nutritional trace elements, proteins and fatty acids especially the essential linoleic acid[12]. Coumarins, hydroxycinnamates, saponins, flavonoids and oils are the main fruit chemical compounds shown by thin-layer chromatography. The doum aqueous fruits extract showed an antioxidant properties due to the significant amount of their dissolved content of phenolics[13]. The water extract of the doum fruits found to have antifungal activity against many fungal strains. Also, a potent antibacterial inhibition activities of doum fruits was found against both gram positive and gram negative bacteria isolates. The nutritional values, physicochemical properties, functional characters of the epicarp and the doum fruit pitted sample (*Hyphaene thebaica*) were studied[14].

M. argun (Syns: *Medemia abiadensis*, *Hyphaene argun*- Hyphaeninae family) is uncommon fan-palm plant genus found in Oasis of the Nubian Desert, Southern Egypt and in Sudan in the Northern. Scientists and the public had various opinions about the palatable parts of the fruit. Some authors claimed that the fruits are bitter in taste and inedible, while others suggest that the fleshy part of the fruit is sweety and may be acceptable, especially to those who are living in the desert. It is also said that Nubian individuals handled *M. argun* fruits by putting them in the lands for a while to increase palatability[15]. Since there's no longer any detailed study about the pharmaceutical and chemicals analysis have been written for *M. argun* plants. Therefore, the aim is to

evaluate the antioxidants and antibacterial activities of doum and argun pericarp parts (Endocarp-Mesocarp) and seed coat and also focusing on the nutritional value by determination dry matter of carbohydrates and proteins. Then comparison of the results of the different assays employed.

MATERIALS AND METHODS

Plants materials: Ripe fruits of *H. thebaica* (HT) and *M. argun* (MAR) were collected from extremely arid desert region of Southern Egypt, Aswan University campus, Aswan. The fruits were separated into coat (C), mesocarp (fleshy part) (M) and endocarp (E) by scraping and peeling the outer part from the woody coat and were air-dried in a room conditions, then it was grinded into a powder with grinder (mortar and pestle).

Extractions preparation: About 1 g of yield crushed powdered fruits parts were extracted with 200 mL of 80% (v/v) aqueous methanol and extraction was performed in triplicate for each one with using ultrasonic homogenizer. The extracts were filtered and residue was re-extracted again under the same experimental conditions to ensure full extraction. The clear filtrates were air-dried. Finally 10 mg from the resulting crude extracts was prepared in 1 mL of 80% methanol and stored at 4°C for antioxidants and antimicrobial analysis. Various concentrations from 100-500 µg were used during determination of some experiments (TAC, DPPH, α-amylase and H_2O_2 scavenging).

Total flavonoid content (TFC): A colorimetric measuring method according to Zhishen *et al.*[16] is used to assay the total flavonoids. Briefly, 20 µL of each examined extract was mixed with 980 µL of 80% MeOH (1 mL). About 0.3 mL of 5% $NaNO_2$ was added and the solution was shaken and was placed for 6 min. After that, 0.3 mL of 10% aluminium nitrate $AlCl_3$ was added and left for 6 min before adding 0.4 mL of 1 M sodium hydroxide (NaOH). The absorbance was determined immediately by using spectrophotometer apparatus at 510 nm. Standards of Rutin in the concentration between 1-0.015 mg mL^{-1} were applied with the tested samples, from which curve for standardization was drawn. The results have been interpreted as mg rutin equivalent in 0.001 g of dried sample (mg RE g^{-1}).

Total phenolics content (TPC): Total phenolic were assayed spectrophotometrically according to Ough and Amerine[17] using gallic acid (GA) as standard. About 1.0 mL from the reagent was added to 1 mL of plant extract and vortexed thoroughly for 5 min then, 1 mL of 10% sodium carbonate ($NaCO_3$) was added to the mixture. After 1 h, the mixture was left at 24°C, after which colorimetric measurements were carried out at 700 nm. Each experiment was done in 3 replicates.

Total antioxidant capacity (TAC): The TAC assay was done following the method reported by Prieto *et al.*[18]. The tubes containing reagent solution and plant extract (28 mM sodium phosphate, ammonium molybdate (4 mM) and sulfuric acid of 0.6 M) were incubated for 90 min at 90°C. The antioxidant activity was determined as an ascorbic acid equivalent (AAE) and gallic acid equivalent (GAE).

DPPH radical scavenging activity: About 3 mL of the mixture (1 mL of 0.2 mM DPPH in ethanol, 0.5 mL of a 0.5 M buffer solution for acetic acid adjusted to pH 5.5 and 1.5 mL of a 50% (v/v) ethanol) was shaken thoroughly with various concentrations of the extracts[19]. After incubation at 24°C for 60 min, the remaining amount of DPPH was measured at 517 nm[20]. The extract inhibition (IC_{50}) concentration was measured from the inhibition percentage plotted in versus to the extract concentrations on the graph. The mean values were calculated based on triple experiments.

Hydrogen peroxide scavenging activity: The hydrogen peroxide scavenging plant extracts ability was evaluated according to Ruch *et al.*[21]. Examined concentrations of extract in 0.1 M buffer for phosphate (pH 7.4) were mixed vigorously with H_2O_2 solution (0.6 mL, 40 mM). The absorbance value was read at 230 nm. A separate sample of blank was used to each tested concentration as background subtraction then H_2O_2 percentage of extracts scavenging capability and standard compounds was calculated.

α-amylase assays: α-amylase activity was conducted as reported by Xiao *et al.*[22] using the starch-iodine method. The reaction mixture consists of phosphate buffer (0.02 M, pH 7.0) with 0.006 M NaCl (0.4 mL), 10 µL of α-amylase solution (10 mg mL^{-1}) and 1% starch solution (0.1 mL). After incubation at 37°C for 10 min, the starch solution previously prepared was added and the mixture was left for incubation again for 60 min. Then, added 0.1 mL of 1% iodine solution, 5 mL (DW), then the absorbance at 565 nm was taken. Sample, substrate and α-amylase individual blank determinations were measured under the same experimental conditions. The above experiment was accomplished using different starch solutions.

Amount of dissolved and non-dissolved carbohydrates: About 50 mg of powdered dry fruits parts were water extracted for 120 min in boiling water bath then cooled and centrifuged to afford carbohydrates fraction. To extract the insoluble carbohydrates, the residue was hydrolyzed in 100°C water bath by using 4 N HCL. Each samples was cooled and centrifuged the supernatant of each fraction was colorimetrically assay[23-25].

Determination of dissolved and non-dissolved proteins: As reported by Lowry *et al.*[26], the water dissolved proteins were extracted from the plant parts and in a certain volume of 1 N sodium hydroxide, the residue was homogenized very well for half an hour, then centrifuged and the supernatant of both dissolved and non-dissolved proteins was used for calculating the protein amount.

Antibacterial activity (qualitative): A bioassay based on inhibition zone on agar plate was used to identify the antibiotic behavioral activity of the metabolite produced by HT and MAR against 4 strains of pathogenic bacterial strains namely *E. coli*, *S. aureus*, *B. subtilis* and *S. pneumonia*. The suspension of bacterial strains were added to nutrient agar medium, then, discs (2 mm in diameter) of filter paper were impregnated with the 80% MeOH extract of the tested samples and then transferred onto nutrient agar plates under aseptic environmental conditions. Another filter paper discs (2 mm) were impregnated with 80% MeOH solvent and transferred onto nutrient agar plates and considered as negative control. All plates have been incubated at 25±2°C for overnight and then, the effect of all extracts on bacterial growth determined by inhibition clear zone as a negative or positive[27,28].

Statistical analysis: Results were shown as mean±standard deviation (SD) using SPSS statistical program, version 20.0. All obtained data were analyzed by one-way ANOVA (*post hoc* test). Significance level was set at p-value of 0.05.

RESULTS

Total phenolics and flavonoid content: By using standard gallic acid, the TPC was calculated and the results have been interpreted as mg gallic acid equivalent and ranged from 327.48-40.65 mg GAE g^{-1} of extract (Table 1). While the content of TFC expressed as rutin equivalent/g extract and ranged from 141.64-21.63 mg RE g^{-1} of extract (Table 1). The results of TPC and TFC content were displayed as HTC<MARC <MARE<MARM<THE<HTM. Although HT endocarp exhibited the highest TPC and TFC but results of all MAR parts were higher than HT other parts (coat and mesocarp).

Table 1: Total phenolics and flavonoid content of *Hyphaene thebaica* (HT) and *Medemia argun* (MAR) fruit parts

Samples	TFC (mg g^{-1})	TPC (mg GAE g^{-1})
MAR endocarp	90.59±1.84^{ab}	284.49±11.28^{de}
MAR mesocarp	43.51±1.98^{a}	200.67±25.04^{c}
MAR coat	58.77±3.30^{a}	235.19±20.51^{cd}
HT endocarp	141.64±3.07^{b}	327.48±9.80^{e}
HT mesocarp	21.63±0.62^{a}	40.65±2.61^{a}
HT coat	38.50±2.39^{a}	101.20±10.68^{b}

Values represent the Mean±Standard deviation (n = 3), values with different superscript letters in the same column are significantly different (p = 0.05)

Table 2: Total antioxidant capacity (TAC) of *Hyphaene thebaica* (HT) and *Medemia argun* (MAR) fruits parts at different concentrations

	Concentration (µg)				
Samples	100	200	300	400	500
MAR endocarp	0.24^{b}	0.51^{b}	0.52^{b}	0.56^{b}	1.06^{b}
MAR mesocarp	0.03^{a}	0.05^{a}	0.01^{a}	0.01^{a}	0.03^{a}
MAR coat	0.01^{a}	0.06^{a}	0.02^{a}	0.03^{a}	0.10^{a}
HT endocarp	0.24^{b}	0.58^{b}	0.41^{b}	0.57^{b}	1.12^{b}
HT mesocarp	0.00^{a}	0.05^{a}	0.01^{a}	0.01^{a}	0.05^{a}
HT coat	0.04^{a}	0.04^{a}	0.04^{a}	0.14^{a}	0.19^{a}

Mean difference is significant at the 0.05 level (p = 0.05)

Total antioxidant capacity (TAC): An increasing in the total antioxidant potentiality of test extracts was found with increasing concentration (Fig. 1a). These results showed that extracts of HT parts and extract of MAR parts were equally potent in TAC. The endocarp part displayed the highest absorbance followed by coat (Table 2).

DPPH radical scavenging activity: The DPPH assay is rapid and convenient method applied to evaluate the capability of extracts to scavenge free radicals through the conversion of DPPH into the stable form DPPH-H after acquiring electron or hydrogen radical. The maximum absorption was given at 517 nm of the odd no. of electron in DPPH free radicals. Due to the hydrogen donating ability, the antioxidants in sample plant extracts convert the purple color into pale yellow. The hydrogen-donating activity displayed that there was a noticeable correlation between the concentration of extract and inhibition percentage (Fig. 1b). The IC_{50} values for radical scavenging of DPPH of MAR endocarp, MAR meso, MAR coat, HT endocarp, HT meso and HT coat were 55.01, >500, 293.36, 53.76, >500 and 137.89 µg mL^{-1}, respectively (Table 3). The result showed that endocarp part of HT and MAR as well as HT coat displayed the highest scavenging activity. While the mesocarp part among all samples displayed the lowest scavenging activity at all its concentrations in which the scavenging activity was lower than 50%.

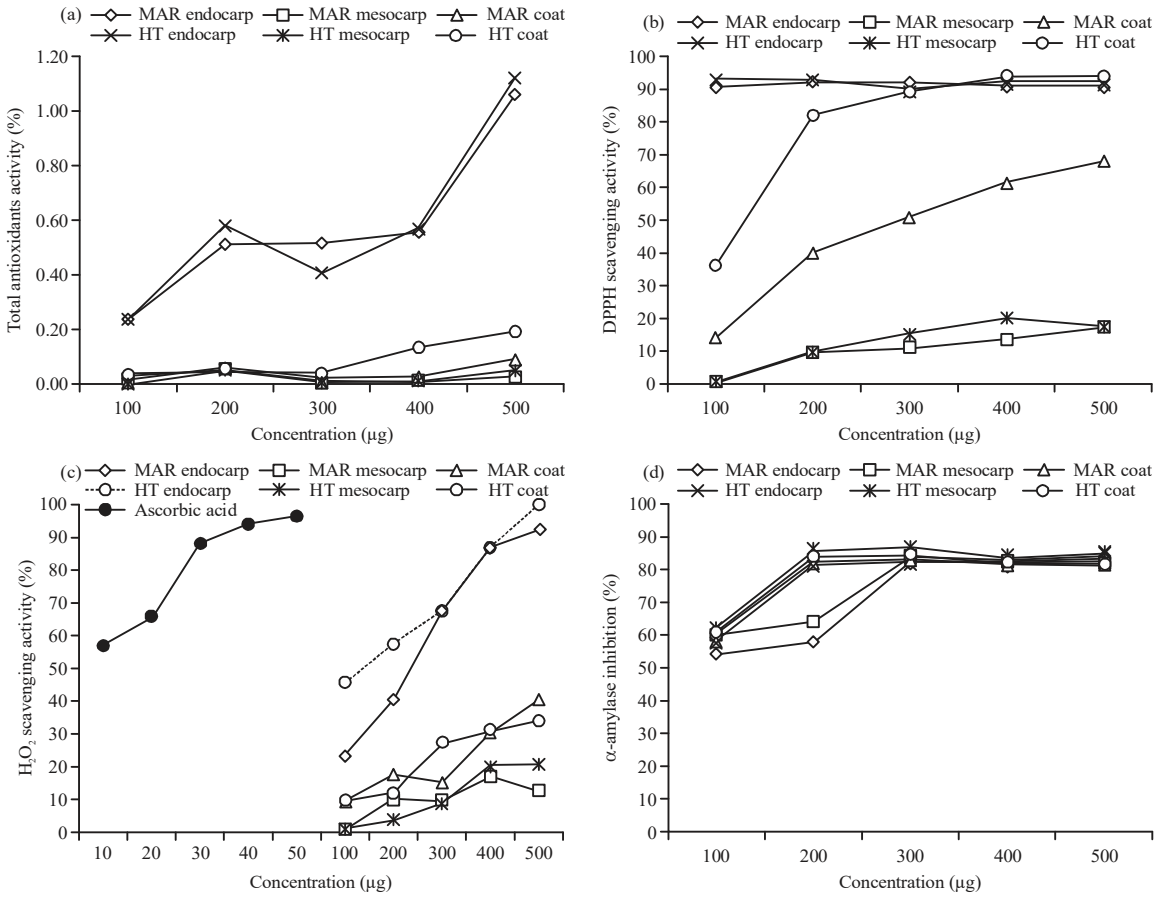

Fig. 1(a-d): Antioxidant activities of different fruits parts of *Hyphaene thebaica* (HT) and *Medemia argun* (MAR) extracts at various concentrations, (a) Total antioxidants activity, (b) DPPH radical scavenging activity, (c) Hydrogen peroxide radical scavenging activity and (d) α-amylase inhibition

Each value represents a Mean±SD (n = 3)

Table 3: Radical scavenging activities and α-amylase inhibition percentage of MAR and HT fruits parts at different concentrations of radical scavenging

	IC_{50} values (µg mL^{-1})		
Extracts	DPPH	H_2O_2 scavenging	α-amylase inhibition (%)
MAR endocarp	55.012	247.684	91.57
MAR mesocarp	>500	>500	82.41
MAR coat	293.36	>500	85.03
HT endocarp	53.76	109.610	87.06
HT mesocarp	>500	>500	81.20
HT coat	137.89	>500	81.83

Each value in the table is represented as Mean±SD (n = 3)

Hydrogen peroxide potency: The scavenging effect of various extracts of HT and MAR on hydrogen peroxide was concentration dependent (100-500 µg mL^{-1}) as shown in (Fig. 1c). HT endocarp displayed strong H_2O_2 scavenging activity (IC_{50} 109.61±21.62 µg mL^{-1}) followed by MAR endocarp (IC_{50} 247.684±21.62 µg mL^{-1}) whereas that of the guideline, ascorbic acid showed 8.84 µg mL^{-1}. IC_{50} values of the extracts in scavenging hydrogen peroxide found to be noticeably different ($p>0.05$) from the IC_{50} measurements gained for ascorbic acid (Table 2). The scavenging efficacy for hydrogen peroxide of various extracts from HT and MAR was in the order of HT endocarp MAR endocarp>MAR coat>HT coat>HT meso>MAR meso, respectively.

α-amylase activity *in vitro*: The present study displayed that all extracts were found to have significant inhibitory effects ($p<0.05$) on cleaving the starch as shown in (Fig. 1d). At 1 mg mL^{-1} concentration in phosphate buffer (Table2), the IC_{50} showed the maximum suppress activity of α-amylase in HT mesocarp, followed by HT coat and HT endocarp. Hence, all HT fruit parts were higher than MAR other parts. A quantity-dependent elevate in α-amylase suppress activity of MAR mesocarp has been found compared to the rest parts of MAR. At the concentrations of 100, 200, 300, 400 and 500 µg mL^{-1}, HT mesocarp showed inhibitory activity of 61.57,

Table 4: Nutritional value of different fruit parts of *Hyphaene thebaica* (HT) and *Medemia argun* (MAR) extracts representing soluble and insoluble carbohydrates and proteins

	Concentration (mg g^{-1})			
Extracts	Soluble carbohydrates	Non-soluble carbohydrates	Soluble proteins	Non-soluble proteins
MAR endocarp	37.99±2.08^{a}	38.52±1.77^{a}	28.42±0.06^{c}	30.32±0.34^{bc}
MAR mesocarp	42.31±0.22^{b}	42.17±0.02^{b}	25.00±0.79^{a}	25.99±2.08^{ab}
MAR coat	41.66±0.14^{b}	41.27±0.27^{b}	25.89±0.84^{ab}	28.22±1.23^{bc}
HT endocarp	37.67±1.25^{a}	38.58±0.43^{a}	28.53±0.09^{c}	33.59±3.03^{c}
HT mesocarp	42.37±0.22^{b}	42.32±0.20^{b}	27.61±1.06^{bc}	20.78±2.48^{a}
HT coat	41.72±0.45^{b}	41.30±0.13^{b}	28.83±0.44^{c}	27.82±1.45^{bc}

Values represent the Mean±Standard deviation (n = 3), values with different superscript letters in the same column are significantly different (p>0.05)

Table 5: Effect of antimicrobial extract activity of HT and MAR on 4 strains of bacteria by bioassay technique

Samples	*B. subtilis*	*E. coli*	*S. pneumonia*	S. *aureus*
MAR endocarp	+	-	+	-
MAR mesocarp	-	-	-	-
MAR coat	-	-	-	-
HT endocarp	++	-	++	-
HT mesocarp	-	-	-	-
HT coat	-	-	-	-

+: Positive effect, ++: Strong positive effect, -: Negative effect

85.67, 86.93, 83.97 and 85.20%, respectively and that in MAR mesocarp found to be 60.67, 64.13, 83.83, 82.23 and 82.27%, respectively.

Soluble and insoluble carbohydrates: Analysis of variance displayed non-significant difference in the total carbohydrates contents of the two fruits species but significant differences within the dissected fruit parts. The phyto-components of the mesocarp part extract possessed the highest value 42.37-42.31 and 42.32-42.17 mg g^{-1} dry matter for dissolved and dissolved carbohydrates in the HT and MAR followed by coat and endocarp and the dry weight of soluble carbohydrates was more than non-soluble carbohydrates (Table 4).

Soluble and insoluble proteins: In this study, the nutritional composition of proteins showed reverse results compared to the carbohydrates. One-way analysis *post hoc* tests has shown a significant difference ($p<0.05$) between the soluble and non-soluble protein level contents. The 6 samples extracts contain high quantity of non-soluble protein rather than soluble and endocarp part possessed the highest value (Table 4). The methanolic extract of this part had high potential food because of their soluble and non-soluble protein content of HT endocarp 28.53 and 33.59 mg g^{-1} dry matter and MAR endocarp 28.42 and 30.32 mg g^{-1} dry matter.

Antibacterial activity: The antibacterial activity results of the extracts of the fruit parts of HT and MAR against the pathogenic bacterial strains were shown in (Table 5). That activity of HT and MAR endocarp extracts had only effect on 2 strains of bacteria (*S. pneumonia* and *B. subtilis*) but HT endocarp was more potent than MAR endocarp and expressed as presence of increasing in diameter of inhibition zone. Other samples extracts did not display any inhibition against pathogenic tested bacterial.

DISCUSSION

Free radicals are involved in many human disorders such as cancer, neurodegenerative diseases and AIDS. Antioxidants owing to their scavenging behavioral activity are crucial for the control and managing these diseases. The fruits can be available sources for carbohydrates, essential amino acids and important proteins and vitamins and also sources for secondary metabolites like flavonoids, phenolics, saponins and alkaloids as phytoprotectant. The studied fruits are potential origin of natural antioxidants and may have a wide spectrum of biological functions. In this study, 6 extracts from fruit parts of HT and MAR were prepared and evaluated for the antioxidant activity and antimicrobial activity. Phenolic and flavonoid chemicals are considered to have roles in stabilizing lipid oxidation in association with antioxidant activity. In this study, it appeared that the higher total phenolic contents of the plant extracts correlated with the higher antioxidant activity. A significant variation of antioxidant activity could be due to the redox attitudes of phenol amount that act as free radical scavenger, a reducing agents, hydrogen donors, metal chelators and a single oxygen quenchers. The obtained data showed also potent positive link between TPC and TFC with free radical scavenging potency. The concurrence also ensure that the mode of action of the extracts for the antioxidant potency may be identical, being associated with the phenolic content and total flavonoid and the free-radical scavenging activity. All plant extracts tested inhibited the DPPH radicals but in different manners. The hydrogen-donating activity proofed that there was a remarkable linking between the extract concentration and percentage of inhibition. The variation observed between the scavenging activities of the same extract depends on the part of the fruit of the plants used here. In both plant fruits, the extract of endocarp part in both plants had the highest IC_{50} followed by the coat part extract and the meso part extract. This difference because of an unequal distribution of the antioxidant molecules such as polyphenol, flavonoids screened in the different fruits parts but there is a slight difference found between the 2 fruits.

There was positive link between phenolic and antioxidant content using the assay of DPPH radical scavenging assay and this ensured by Pearson correlation. The expelling of hydrogen peroxide is crucial as safeguard agents for antioxidant defense to the human cell and for food systems.

H_2O_2 was considered poorly responsive because of its low oxidizing and lessening abilities in which it could be toxic to cell contents as it may yield hydroxyl radical in the cell[29]. It can enter the cell layers quickly; once to be inside the cell, it reacts with Fe^{2+} and possibly Cu^{2+} particles shaping hydroxyl radicals and this might be the commencements of valuable number of its toxic side effects[30]. The diminishing the compound's capacity can serve as a powerful symptoms of its potential antioxidant. However, the potency of antioxidants have been credited to various mechanisms, for example, restrain the chain initiation, deterioration of peroxides, diminishing potentiality and radical scavenging[31]. Hydrogen peroxide can corrupt certain heame proteins, for example, heamoglobin, to discharge Fe^{2+} and hence the hydroxyl radical rummaging action of phytoextracts was estimated. In this study, the meso part in both types of fruits in an increasing concentration was less effective in H_2O_2 scavenging activity whereas endocarp was found more effective. Hyperglycemia has been considered as a routine threat in the diabetes development and the complications linked with it. Inhibition activity of α-amylase and α-glucosidase would restraint carbohydrate degradation, which in turn would cause a carbohydrate reduction in glucose absorption, subsequently decrease the blood glucose post -prandial level[32]. Enzyme inhibitors might be proteinaceous or non-proteinaceous in nature. Subsequently, the action of inhibitors of the concentrates was related with their protein and polyphenolic content, the HT and MAR organic products demonstrated a significant result for the α-amylase inhibitory action. Therefore, these fruits might act as a potential critical controller of high levels blood glucose in the beginning treatment of diabetes mellitus and the reduction of macro and/or microvascular problems. Comparison of 6 samples extracts as potential natural antioxidants sources have been shown in this study. It is crucial to highlight the differences of nutritional contents for carbohydrates and proteins and compared with the previous studies. The present results of carbohydrates is similar with the results on the carbohydrates content of the flesh sample that achieved the highest percentage (72.5%) compared with epicarp and pitted fruit of Doum fruit (*H. thebaica*) reported by Aboshora *et al.*[14]. While the obtained result of protein is different with the result of Aboshora *et al.*[33] who reported that no remarkable differences ($p<0.05$) were noticed in protein compositions of the 3 examined samples (2.4%, exocarp parts; 2.17%; flesh parts and 2.32%, for pitted fruit). Also, the present result is similar in flesh part that is the same for mesocarp part in this study. The similarity appeared in this part of fruit showed the lowest value. Carbohydrates and proteins in this study are also in concurrence with the results obtained by Salih and Yahia[34], who reported the differences of carbohydrate contents between the fruit and seed of *H. thebaica* as percentage in fruits are more than them in the seeds and total proteins percent in the fruits were less than them in the seeds.

The antibacterial inhibition spectra against both bacterial strains either Gram (+ or -) could reveal the presence of active molecules. Methanolic extracts of HTC exhibited potent inhibition killing effects than those of MARC against microbial pathogens including *B. subtilis* and *S. pneumonia*. However, the extract of meso and coat of 2 plants has not shown any antibacterial activities. The results displayed that the production of clear inhibition zone which is presumably because of the yielding of either poisonous metabolites, antibiotics or compounds similar to the antibiotics as mechanisms for biological control possibility of the use of these plant as a bio-control agent against *B. subtilis* and *S. pneumonia*. A phytochemical study is needed for further isolation, purification and identification of active molecules in *H. thebaica* and *M. argun* fruits.

CONCLUSION

The findings of this research show that antioxidant, antibacterial inhibition activities and nutrition values differ greatly in the endocarp, mesocarp and coat samples of doum (HT) and argun (MAR) fruits. However, the methanolic extract of the same part for HT and MAR are semi equal in the activity. HT endocarp and MAR endocarp extracts possess potential activities of antioxidants and antibacterial followed by HT and MAR seed coat. This study is considered as the first report on *M. argun* (MAR) in comparison to *H. thebaica* fruit analysis. Finally, we concluded that argun fruit has strong scavenging activity with similar nutritional value as *H. thebaica* and may be applied as anticancer, anti-diabetic, dietary supplement and also, for the controlling of other diseases.

SIGNIFICANCE STATEMENT

This study revealed that fruit of *M. argun* has similar properties as the traditional edible doum fruits. With highly antioxidant activity, the fruit extracts can help in cancer remedy and this study will help researchers to separate and elucidate new drugs for tumors and diabetes.

ACKNOWLEDGMENT

The authors extend their appreciation to the Deanship of Scientific Research at King Khalid University for funding this work through research project (R.G.P. 305 /39).

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