

Nutritional Values, Phytochemicals and Antioxidant Activity in Peel of Mangosteen (*Garcinia mangostana* L.) Fruits

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Abstract

The mangosteen fruit (*Garcinia mangostana* L.) is one of the most famous edible fruits in Myanmar. The present research aimed to study the nutritional values, phytochemicals and antioxidant activity of peel of mangosteen fruits. The sample was collected from Hpa-an Township, Kayin State. The nutritional values were moisture (83.5 %), ash (0.50 %), protein (0.40 %), fiber (1.5 %), fat (1.0 %) and carbohydrate (13.1 %). The energy value was 63 kcal/100 g. Elemental analyses were carried out by AAS method and the results indicated that the presence of Ca (15.41 ppm), Mg (0.694 ppm), Fe (0.497 ppm) and Zn (0.143 ppm). Phytochemical tests revealed the presence of alkaloids, glycosides, carbohydrates, α -amino acids, phenolic compounds, flavonoids, steroids, terpenoids, saponins, tannins, starch and reducing sugars. The antioxidant activity of ethanol and watery extracts of mangosteen peel was screened using DPPH free radical scavenging assay. Both extracts showed significant antioxidant activity and ethanol extract was found to possess more potent activity than watery extract. The IC₅₀ values of ethanol and watery extracts of mangosteen peel were 6.04 μ g/mL and 35.75 μ g/mL, respectively. According to the experimental results, mangosteen peel possesses valuable nutrients, bioactive secondary metabolites and significant amounts of antioxidants.

Keywords: mangosteen peel, nutritional values, phytochemicals, antioxidant activity, DPPH

Introduction

According to much of the research done, fruits are a valuable source of anticancer and anti-mutagenic substances which help protect against cardiac disorders. Fruits and vegetables contain many different antioxidant components. Vitamins A, C and E, as well as polyphenols contained in fruit have antioxidant features and can play an important role in the prevention of many diseases (Jablonska-Rys *et al.*, 2009). Therefore, it was of interest to measure the total antioxidant capacity of a fruit or vegetable.

The purpose of this study is to measure the nutritional values, phytochemicals and antioxidant activity in ethanol and watery extracts of mangosteen peel (*Garcinia mangostana* L.).

Scientific Classification of Mangosteen

Family	:	Clusiaceae
Genus	:	<i>Garcinia</i>
Species	:	<i>G. mangostana</i>
Botanical name	:	<i>Garcinia mangostana</i> L.
Habit	:	Small tree
Myanmar name	:	Mingut
Common name	:	Mangosteen
(Kress <i>et al.</i> , 2003; Wikipedia, 2019)		

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The photographs of mangosteen (*Garcinia mangostana* L.) tree and fruits are shown in Figure 1. The mangosteen is a small, evergreen tree, very slow-growing, erect with a pyramidal crown; attains 6-25 m in height, has dark-brown or nearly black, flaking bark, the inner bark containing yellow, gummy, bitter latex. The fruit itself can range from 50 – 75 mm round. It has a purple colour rind when ripe with a white aromatic sweet flesh, which has 4-8 segments. It is very sweet with flavours of strawberry, peach and vanilla ice-cream. Generally fruiting season extends from November, through the wet season into January (Morton, 1987).



Figure 1. Photographs of mangosteen tree and fruits

Mangosteen Fruit

Mangosteen was first domesticated in Thailand and Myanmar. Mangosteen peel is enrich with many health benefits. Because of its delicious taste, mangosteen is a widely popular fruit in market. The mangosteen fruit is dark purple or reddish, with white, soft and juicy edible pulp with a slightly acid and sweet flavor and a pleasant aroma.

Chemical Constituents of Mangosteen Fruits

Mangosteen is well known to be a rich source of oxygenated and prenylated xanthenes. Xanthenes or xanthen-9H-ones are secondary metabolites found in some higher plant that involves mangosteen. Xanthenes have been isolated from pericarp, whole fruit, bark, and leaves of mangosteen. α -, β - and γ -mangostins, garcinone E, 8-deoxygartanin and gartanin are the most studied xanthenes. Mangosteen is a source of mangostin, tannin, chrysanthemin, garcinone, gartanine, vitamin B₁, B₂ and vitamin C (Suksamrarn *et al.*, 2006).

Medicinal Uses and Pharmacological Activity of Mangosteen

Mangosteen has been a part of the traditional medicines of various Asian countries for a very long time. A leaf infusion can be applied to wounds. The rind is effective in curing chronic intestinal catarrh. Dried fruit rind is used pharmaceutically as an astringent. The pericarp of mangosteen has been used for the treatment of skin infections, wounds, and diarrhea for many years (Moongkarndi *et al.*, 2004).

Xanthone derivatives compounds isolated from mangosteen possess antimicrobial, antiacne, antifungal, cytotoxic, antioxidant, reduce tumor growth and inflammation, antimalarial, cytoprotective activity, anticancer and histamine and serotonin receptor blockers (Suksamrarn *et al.*, 2006).

Materials and Methods

Collection of Mangosteen Fruit Sample

The matured ripened dark purple fresh mangosteen fruits were collected in Hpa-an Township, Kayin State, Myanmar. The period of sample collection was in July, 2017. The mangosteen fruit were washed with running water, and then distilled water. After washing the peels of the fruits, they were separated from edible part and chopped before drying at room temperature. And then the peels were dried at 50 °C in oven for 5 hours. The chopped dried peel sample was ground with a mechanical grinder to make fine powder. The powdered dried sample was stored in an airtight container to avoid contamination.

Determination of Nutritional Values in Peel of Mangosteen Fruits

The nutritional values such as moisture, ash, crude protein, crude fiber, crude fat, carbohydrate contents and energy value of the fresh mangosteen peel were determined by standard method of AOAC (2000). The determination was carried out at Food Industries Development Supporting Laboratory (FIDSL), Myanmar Food Processors and Exporters Association (MFPEA), Yangon, Myanmar.

Determination of Mineral Elements in Peel of Mangosteen Fruits

The quantitative analysis of some mineral elements present in peel of mangosteen was carried out using Atomic Absorption Spectroscopic technique at Chemistry Department, Hpa-an University.

Preliminary Phytochemical Investigation of Peel of Mangosteen Fruits

Mangosteen peel was screened for the presence of various bioactive principles. Dried powdered sample was conducted to study whether the presence of phytochemicals such as alkaloids, glycosides, carbohydrates, phenolic compounds, saponins, tannins, α -amino acids, reducing sugars, steroids, terpenoids, flavonoids, starch, cyanogenic glycosides and organic acids (Harborne, 1998).

Determination of Antioxidant Activity of Peel of Mangosteen Fruits

The scavenging of DPPH (2, 2-diphenyl-1-picrylhydrazyl) free radicals was used for measuring the antioxidant activity in the ethanol and watery extracts of mangosteen peel according to the method of Weecharangsan *et al.*, (2006). The standard (ascorbic acid) was assessed on the basis of the radical scavenging effect of (DPPH) free radical.

Results and Discussion

Nutritional Values of Peel of Mangosteen Fruits

The present study aimed at studying nutritional facts of peel of mangosteen fruits and its impact on betterment of health. In the present study, proximate analyses were carried out of the peel of mangosteen fruit to know the nutritional significance. Proximate compositions *viz.* moisture, ash, crude protein, crude fiber, crude fat, carbohydrate and energy value were carried out using standard methods for food analysis (AOAC, 2000). The nutritional values of 100 g of fresh mangosteen peel are presented in Table 1. The nutritional values such as moisture, ash, crude protein, crude fiber, crude fat and carbohydrate values in the peel of mangosteen fruit were found to be 83.5 %, 0.5 %, 0.40 %, 1.5 %, 1.0 % and 13.1 % respectively. It was also

observed that energy value was 63 kcal/100 g. Nutritional Results obtained from literature are also indicated in Table 3.1.

According to the results from the analyses, it can be said that peel of mangosteen fruit is a rich source of nutrient values such as protein, fiber, fat and carbohydrate which are required to keep our body functioning in a healthy and proper manner. These are very important primary metabolites for human life. Mangosteen peel is a great healthy fruit to eat and to drink its juice with lots of beneficial nutrients which are readily metabolized from the natural mangosteen fruit.

Table 1. Nutritional Values of Fresh Mangosteen Peel

Parameter	Composition* (Observed)	Composition* (Wikipedia, 2019)
Moisture (%)	83.5	80.0
Ash (%)	0.50	0.4
Crude Protein (%)	0.40	0.41
Crude Fiber (%)	1.5	1.8
Crude Fat (%)	1.0	0.58
Carbohydrate (%)	13.1	17.91
Energy value (kcal/100g)	63	73

Mineral Elements in Peel of Mangosteen Fruit

The mineral element characterization of fruits is acquiring interest to evaluate the link between their nutritional status and fruit quality. For this reason, the aim of the present study was to determine the some mineral element content in peel of mangosteen fruit.

The presence of mineral elements such as calcium, magnesium, iron and zinc of mangosteen peel were quantified by Atomic Absorption Spectrometry (AAS). Concentration of some mineral element content in peel of mangosteen fruit is indicated in Table 2.

Table 2. Concentration of Mineral Elements in Peel of Mangosteen Fruits

Element	Concentration (ppm)
Calcium (Ca)	15.41
Magnesium (Mg)	0.694
Iron (Fe)	0.497
Zinc (Zn)	0.143

Preliminary Phytochemical Investigation

Phytochemicals are derived from plants and described the large number of secondary metabolic compounds found in plants. Phytochemicals are main application to the quality control of herbal medicine of various chemical constituents. The investigation of phytochemical constituents in the peel of mangosteen fruits was carried out. According to the results, it was found that the presence of alkaloids, glycosides, carbohydrates, α -amino acids, phenolic compounds, flavonoids, steroids, terpenoids, saponins, tannins, starch and reducing sugars in mangosteen peel.

Antioxidant Activity of Peel of Mangosteen Fruits

The aim of this study was to assess the antioxidant activity of ethanol and watery extracts of mangosteen peel. The antioxidant activity of mangosteen peel sample was assessed by DPPH free radical assay. The measurement of the DPPH radical scavenging activity was performed according to methodology described by Brand-Williams *et al.*, in 1995.

The DPPH antioxidant assay is the best on the ability of 2, 2-diphenyl-1-picrylhydrazyl which is a stable free radical to decolorize in the presence of antioxidants. The DPPH free radical contains an odd electron, which is responsible for the absorbance at 517 nm and also for a visible deep purple colour. When DPPH free radical accepts an electron donated by an antioxidant compound, the DPPH is decolourized. Changes in colour can be quantitatively measured from the changes in absorbance. The absorbance was determined by UV-1800 spectrophotometer. The absorbance values may indicate the amount of % radical scavenging activity (% RSA) at a concentration of a sample.

As the ethanol and watery extracts of peel of mangosteen fruit showed the dose dependent antioxidant activity comparable to ascorbic acid, antioxidant agent. Radical scavenging activity of mangosteen peel extracts are indicated in Table 3. and illustrated in Figure 1.

Parameter interpretation of the results of the test method with DPPH antioxidant activity is the IC₅₀ or 50 % inhibition. The IC₅₀ values were calculated using linear regression equation and expressed in Table 4. The IC₅₀ values of ascorbic acid, ethanol extract and watery extract were 0.12 μ g/mL, 6.04 μ g/mL and 35.75 μ g/mL, respectively.

According to the experimental results, ethanol extract of mangosteen peel showed the more potent antioxidant activity than watery extract because the smaller the IC₅₀ value the greater the antioxidant activity. Watery extract also showed the significant antioxidant activity. The results of the *in vitro* antioxidant activity assay indicated that the peel of mangosteen fruit contains significant amount of antioxidant agents such as xanthone and its derivatives responsible for antioxidant activity.

Table 3. Radical Scavenging Activity of Mangosteen Peel Extracts

Concentration ($\mu\text{g/mL}$)	% RSA	
	Ethanol Extract	Watery Extract
3.12	37.23	13.35
6.25	50.90	20.26
12.50	68.02	37.77
25.00	74.77	45.22
50.00	81.98	56.34
100.00	84.91	67.05
200.00	85.58	70.63

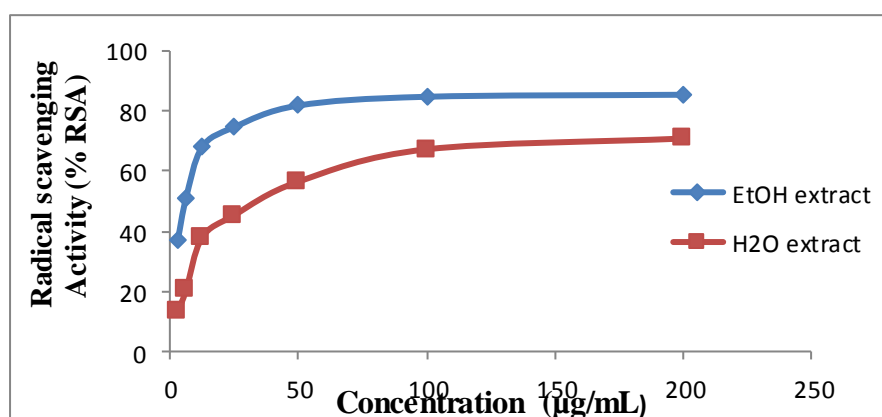


Figure 1. Radical scavenging activity of mangosteen peel extracts

Table 4. IC₅₀ Values of Ascorbic Acid and Mangosteen Peel Extracts

Sample	IC ₅₀ Value ($\mu\text{g/mL}$)
Ascorbic Acid	0.12
Ethanol Extract	6.04
Watery Extract	35.75

Conclusion

In conclusion, the results of the present study show that peel of mangosteen fruit contains significant nutritional values and bioactive phytochemicals and it might be a potential source of natural antioxidants.

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