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RESEARCH ARTICLE

Assessment of Carbohydrates, Vitamins and Free Amino Acids in Seeds, Peels and Pulps of Guddaim (*Grewia tenax*. Forssk) Fiori Fruits

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Abstract

Free amino acids, vitamins and sugar contents of Guddaim fruits (seeds peels and pulps) were studied. Pulps exhibited lower values in carbohydrate contents than peels and seeds, fat and protein contents were high in the seeds more than peels and pulps. The total energy values of seeds, peels and pulps were 303.4, 306.7 and 364.5 Kcal/100 g, respectively. Vitamin C was highest in the pulps (2.4 mg/g) than seed and peels (0.007 and 0.002 mg/g) respectively. The total sugar content of peels (59.7 mg/g) were more than the pulps and seeds (27.9 and 15.4 mg/g) respectively, sucrose was detected in seeds sample whilst not detected in peels and pulps. Total essential free amino acid (EFAA) concentrations of three samples were 36.5 g/100 g for peels, 33.7 g/100g for pulps and 25.2 g/100g for seeds sample. The total non-essential free amino acids in peels (31.6 g/100g) was higher than pulps and seeds (27.4 and 25.2 g/100 g) respectively.

Keywords: Guddaim fruits, nutritive contents, seeds, peels, pulps, essential free amino acid.

Introduction

Fruits and vegetable consumptions have attracted increasing interest because many epidemiological and biochemical studies have consistently demonstrated a clear and significant positive correlation between intake of these natural food products, consumed regularly as part of the Mediterranean diet and reduced rates of heart disease, common cancers and other degenerative diseases, as well as aging. The protection that fruits and vegetables provide against these maladies has been attributed to the presence of several antioxidants, especially to antioxidative vitamins, including ascorbic acid (vitamin C), α-tocopherol (vitamin E) and β-carotene (pro-vitamin A). Nevertheless, recent studies seem to indicate that (poly) phenolic substances are the main phytochemicals with antioxidant properties found in the plants (Rodríguez-Medina *et al.,* 2009; Garcia-Salas *et al.,* 2010). Grewia genus (Tiliaceae) comprises approximately 150 species of small trees and shrubs, distributed in subtropical and tropical regions of World and is the only genus in the family that yields edible fruits (Zia-Ul-Haq *et al.*, 2013). Numerous such plants have been identified, but the lack of data on their chemical composition has limited the prospects for their utilization (Vijayakumari *et al.*, 1994, Viano *et al.,* 1995). Limited research has been carried out on exploitation and utilization of Grewia species fruits as a possible food source. Moreover, their good taste is acceptable to the human taste, a light porridge is prepared by the addition of flour or custard to Grewia drink during the fasting month of Ramadan and is also fed to lactating mother to improve their health (Elhassan and Yagi, 2010).

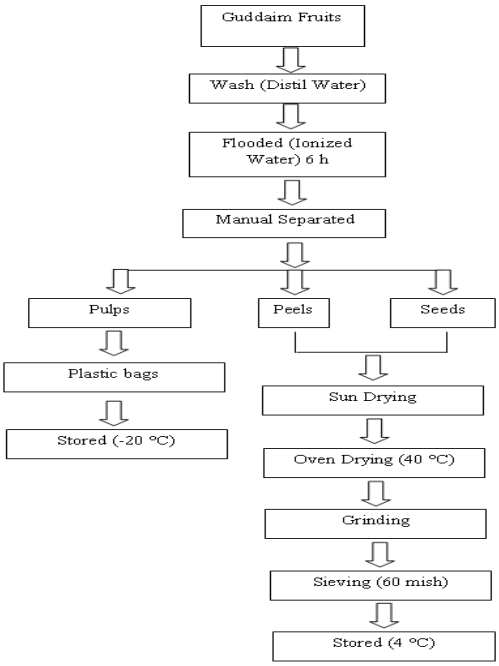
Grewia tenax. Forssk Fiori fruit is known in Sudan as the Guddaim, tree prevalence in Africa and Southeast Asiatic continents. It is largely spread in arid area such as sand and near mountains, especially in the Savanna plantation area of the Northern and Middle of Sudan (FAO, 1988). Guddaim fruits, when ripe, are either eaten fresh or left to dry for consumption later. In Sudan, a drink is prepared by soaking the fruits overnight and then they are manually pressed, sieved and sweetened. Considering the beneficial attributes of Guddaim fruits, the aim of the present study was to determine the concentrations of free amino acids, carbohydrates and the total energy in seeds peels and pulps of Guddaim fruits.

Materials and methods

Raw materials: The fruits of Guddaim (*Grewia tenax*) were purchased in July 2013 from a local market (Wad Medani City, Gezira State, Sudan) and brought to the laboratory of school of food science and technology in Jiangnan University, Jiangsu-China. The fruits were sorted to remove low quality ones and stored in plastic bags at room temperature until use.

Sample preparation and separation: Sample preparation and separation steps are shown in Fig. 1. The sample of Guddaim fruits were put in a large bowl, first washed with tap water followed with distilled water to get rid of any impurities or dust on their surface. The fruits were flooded with ionized water for 6 h, after that the fruits were divided into three sample groups, as follows: seeds, peels and pulps.

Fig.1. Sample preparation and separation steps of seeds, peels and pulps of Guddaim fruits.



The seeds were separated from the peels and pulps manually and allowed to dry using direct sun light for about 4 d. The drying was made also using an oven (Oven DGG-9070A: Shanghai, China) at 40°C for 24 h to achieve complete drying. Dried samples were ground into powder using a blender (25000 rpm, type WK–1000A. Qing Zhou Jing Cheng Machinery Co., Ltd., Shandong–China), then shifted through a 60 mesh sieve gauge to produce a fine powder. The seeds and peel powders were sealed in plastic bags and stored in a refrigerator at 4°C, while the pulps was collected and sealed in plastic bags and stored at -20°C in a refrigerator until use (Aboagarib *et al*., 2014).

Determination of chemical composition: The total protein content was evaluated using a FOSS nitrogen analyzer (DK-3400 Hilleroed, Denmark) with a 6.25 conversion factor. Fat contents were determined using standard AOAC (1990) methods 932.06, 925.09, 985.29, and 923.03, respectively. Total carbohydrate content was calculated by sum of moisture, fat, protein and ash contents were subtracted from 100 to obtain the total carbohydrate according to James (1996).

Caloric values (energy): Caloric values were calculated and determined according to the standard methods (Osborne and Voogt, 1978, Sukker, 1985), using the Atwater factor. About 1 g of protein provides (4 K calories), 1 g of carbohydrates provides (4 K Calories), and 1 g of fat provides (9 K calories).

HPLC analysis of vitamins: It was done according to the methods of Papadoyannis *et al.* (1997), Moreno and Salvado (2000) with some modifications. The quantitative vitamin contents of Guddaim fruits samples were determined by reversed-phase high-performance liquid chromatography (RP-HPLC) system (Agileat 1100, USA). The ground sample (0.5 g) was macerated in a glass blender containing 5 mL 30% sodium metaphosphate. The macerate was diluted to 25 mL in a graduated flask with distilled water. The diluted solution was then filtered through a 0.45 µm filter before HPLC analysis. The filtrate was then injected directly into the HPLC with the injection volume 10 µL, column (Dimonsil C18 Sun fire 4.6 × 250 mm), temperature 30°C, flow rate (1.0 mL/min), detector (Ultraviolet detector 254 and 280 nm) and a mobile phase methanol (A) and 0.05 M of sodium 1-heptanesulfonate(B) at different time intervals. The elution gradient was carried out as follows: 0 min, 90% B; 20 min, 30% B; 25 min, 30% B; 30 min 90% B.

Analysis of sugar concentrations: For sugars, samples were prepared and determined as described by Choi *et al.* (2000) with slight modifications. Guddaim fruit sample was extracted with hydro alcoholic solution of 10 mL (30/70, v/v) in the sonication device for 30 min at 60°C and it was centrifuged for 20 min at 5000 rpm. Then supernatant was filtrated through 0.45 µm filter before injecting into HPLC.
Analytical column used was sugarback-1 (6.5 × 300 mm) and the mobile phase was water at 0.4 mL/min flow rate, the column temperature was keep at 85°C and injection volume was 10 µL.

Analysis of free amino acid concentration: The Guddaim fruit samples were prepared for analysis of free amino acid by following the method described by Kim *et al.* (1995). About 1.0 g of sample was diluted with 25 mL of 5% trichloroacetic acid (TCA) solution. The sample was sonicated for 30 min at room temperature. The mixture was then filtrated (Whatman No.4) and centrifuged at 10,000 rpm for 10 min. The collected supernatant liquid was separated and quantified by injecting 50 µL in to Hitachi 835-50 amino acid analyzer equipped with 2.6 mm × 150 mm ion exchange column packed with resin 2619 and the column temperature was 53°C. The amino acid composition was expressed as g of amino acid per 100 g samples.

Results and discussion

Chemical compositions: The chemical compositions of Guddaim fruit seeds, peels and pulps were shown in Table 1. The results using pulps exhibited lower values in carbohydrate contents of 8.7% than peels (70%) and seeds (59.6%). On the other hand, the study shown that both fat and protein contents were high in the seeds 10.7, 7.2% more than peels 1.7, 2.1% and pulps 0.2, 3.6% respectively. Moisture content of seed was lower than that reported by Abdualrahman *et al.* (2011) who reported 7.30% for Guddaim fruits seed, moisture is an important parameter in the storage of flours, levels greater than 12% allow for microbial growth (Kaur *et al.,* 2013).

Table 1. Chemical concentration of seeds, peels and pulps Guddaim fruits (%).

Contents	Samples		
	Seeds	peels	pulps
Crude protein	7.2	2.1	3.6
Crude fats	10.7	1.7	0.2
Carbohydrate	59.6	70.7	8.7

Table 2. Total energy of seeds, peels and pulps Guddaim fruits.

Contents	Samples			Total energy (kcal/100 g)
	Carbohydrate	Fats	Protein	
Seeds	238.2	303.4	28.8	303.4
Peels	282.9	306.7	8.5	306.7
pulps(on dry weight basis)	348.4	364.5	14.3	364.5

Table 3. Vitamin composition of seeds, peels and pulps Guddaim fruits (mg/g).

Parameters	Samples		
	Seeds	peels	pulps
(Vit C) L-Ascorbic acid	0.007	0.002	2.4
(Vit. B_1) Thiamin	9.3	0.05	0.01
(Vit. B_2) Riboflavin	0.5	0.003	0.8
(Vit. B_6) Pyridoxine	2.3	0.1	0.03
(Vit. B_{12})	0.002	Not detected	Not detected

Table 4. Concentration of sugars (mg/g) of seeds, peels and pulps Guddaim fruits (mg/g).

Sugars	Samples		
	Seeds	peels	pulps
Sucrose	2.0	Not detected	Not detected
Glucose	5.7	12.8	7.2
Fructose	7.6	56.8	20.7
Total	15.4	69.7	27.9

Caloric values (Energy): The energy content was given in Table 2 in which the calorific value was calculated for each of the protein, fat and carbohydrates. The total energy values of seeds, peels and pulps were 303.4, 306.7 and 364.5 Kcal/100g, respectively. From this data, Guddaim fruits can be considered as a good source of calories. That is, foods supply the body with energy, which is released when foods are broken down during digestion. Energy enables cells to do all their functions, including building proteins and others substances needed by the body. The energy can be used immediately or stored for later use (Duyff, 2011).

Vitamins and total sugars content: Vitamins can be classified into two main groups: the fat-soluble vitamins and water-soluble vitamins. Among the B group of water-soluble vitamins, thiamine (B1), riboflavin (B2) and pyridoxine (B6) are the most important vitamins. They play important, different, specific and vital functions in metabolism and their lack or excess produce specific diseases (Moreno and Salvado, 2000). Vitamin C is an essential component of the diet for humans and an adequate intake is important not only for the prevention of scurvy but also to limit the risk of developing chronic diseases such as heart disease and cancer (Carr *et al.,* 2013). The results for vitamin content of Guddaim fruit samples are presented in Table 3.

L-Ascorbic acid (C), Thiamine (B1), Riboflavin (B2) and Pyridoxine (B6) were shown in all samples, while Vitamin (B12) was emerged only in seeds sample. The results shown that Vitamin (C) was highest in the pulps (2.4 mg/g) than seeds and peels (0.007 and 0.002 mg/g) respectively. That means, the pulps of Guddaim fruits was rich in vitamin C. Results shown that thiamin (Vit B_1) was mainly available in seeds with trace amount in peels and pulps, the quantity of riboflavin (Vit B_2) in pulps was approximately double that found in seeds and it was available in trace amount in peels. On the other hand, pyridoxine was found in seeds more than that found in peels and pulps, Vitamin B_{12} was only available in trace amount in seeds. The results on sugar profiles and total sugar of seeds, peels and pulps are shown in Table 4. Results shown glucose and fructose were present in higher concentrations in peels than pulps and seeds. Sucrose was detected in seeds sample whilst not detected in peels and pulps sample. However, the results shown the total sugar content of peels (69.7 mg/g) was more than that of pulps and seeds (27.9 and 15.4 mg/g) respectively.

Free amino acid concentrations: The amino acids are classified nutritionally into two classes, essential and non-essential, that is distinguished between those that the body can manufacture and those that have come from the diet (Kim *et al.,* 2009).

Table 5. Free amino acid composition in seeds, peels and pulps sample of Guddaim fruits (g/100g).

Essential Free Amino Acids (EFAA)	Indispensable amino acid of Guddaim samples fruit (g/100 g)		
	Seeds	Peels	pulps
Histidine	5.3	3.1	2.1
Thereonine	1.1	5.0	3.3
Arginine	1.2	9.5	9.5
Valine	1.4	3.6	2.1
Methionine	3.3	1.5	3.0
Phenylalanine	2.46	1.2	3.8
Isoleucine	1.3	4.9	4.4
Leucine	1.6	6.3	4.2
Lysine	1.2	1.3	1.4
Total	17.6	36.5	33.7
Non-essential amino acid			
Tyrosine	1.0	4.7	1.2
Cysteine	5.8	1.5	2.2
Aspartic acid	4.3	2.8	2.6
Glutamic acid	3.9	1.0	1.3
Serine	1.5	1.2	2.8
Glycine	1.2	5.7	4.9
Arginine	1.2	9.46	9.5
Proline	2.4	3.3	1.5
Alanine	3.8	1.9	1.3
Total	25.2	31.6	27.4

Total essential free amino acids (EFAA) concentrations of three samples were 36.5 g/100 g for peels, 33.7 g/100 g for pulps and 17.6 g/100 g for seeds (Table 5). The total non-essential free amino acids (N-EFAA) of peels (31.6 g/100 g) was higher than that of pulps and seeds (27.4 and 25.2 g/100 g) respectively. Almost all these amino acids were detected in Guddaim fruits peels, seeds and pulps under this study.

Conclusion

This work is a first study investigated the characterization of *Grewia Tenax* (guddaim) fruits. Results were shown that Guddaim fruits parts namely seeds, peels and pulps were good source of nutritional components, in addition these parts contain high energy values. From nutrition point of view, Guddaim fruits were rich by water soluble vitamins, essential free amino acids and non-essential amino acids. Results of this study confirmed the previous image that built in public minds; Guddaim fruit as a healthy component. Analytical data presented in this study suggests the possible use of Gudaim fruit as a supplementary source to most foods.

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