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Proximate Analysis of Melon Seeds Available in Bangladesh

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Abstract

The seeds of winter (wax gourd), long (bottle gourd) and large (pumpkin) melon were analyzed for nutritional parameters mainly protein, fat/oil, carbohydrate, dietary fiber, protein, minerals and moisture and fatty acids composition. The double beam ultraviolet-visible spectrophotometer was used for analysis of total sugar. The protein content was determined using the Kjeldahl method. An atomic absorption spectrophotometer was used to quantify minerals (Fe, Cu, and Zn). Fatty acid was analyzed by gas chromatography (GC) equipped with a flame ionization detector (FID). From the proximate analysis, it was found that the winter melon (wax gourd) seeds contain protein, oil, carbohydrate, soluble dietary fiber, moisture and ash content of 19.71, 16.46, 56.48, 3.10, 68.88 and 4.26 %, respectively. Similarly, long melon (bottle gourd) was found to contain 16.12, 13.61, 46.88, 2.2, 76.45 and 5.2% of protein, oil, carbohydrate, soluble dietary fiber, moisture and ash, respectively. The contents of protein, oil, carbohydrate, soluble dietary fiber, moisture and ash in large melon (pumpkin) seeds were found to be 29.64, 18.17, 55.32, 1.3, 79.53 and 5.12%, respectively. In mineral analysis, iron, copper, and zinc contents were found to be 6.75, 0.62, and 6.10 mg/100g in winter melon; 7.8, 1.63, and 4.25 mg/100g in long melon; and 13.95, 1.15, and 5.11 mg/100g in large melon, respectively.

Keywords: Dietary fiber, mineral, nutritional parameter, proximate analysis, seed

I. Introduction

Melon is very special for its diversity as a vegetable and fruit. The members of the Cucurbitaceae are commonly known as melons/gourds. Different types of melon are growing in Bangladesh such as water, bitter, winter, long, musk, oriental, egusi, rock, yellow and large melons in different seasons. Edible melon seeds are the important source of plant proteins and the seeds are being tested and investigated for the low-cost fabricated foods or other new products.[1] They contain carbohydrates (glucose, fructose, and sucrose, starch, pectin), vitamins, folic acid, minerals, various aromatic compounds and carotene.[2]

Melon is one of the most popular as well as healthiest fruits in the world. Whatever it is vegetable or fruit, but the common practice of Bangladeshi people is to avoid the seeds. But seeds are the storehouse of nutrients. Melon seeds are being used as important food ingredients to prepare food condiment, as flavouring agent in soup, in stews (as thickener), in steam dumpling, in patties as meat substitute, in sauces.[3,4] Due to the wide variety of chemical constituents and biological activities in seeds and a great focus of research is premeditated for promoting human health and nutrition, and found versatile medicinal significances against diseases. The composition of oil varies with the source.[5] The composition is also varies with climatic conditions, soil type, maturity of plant and variety.[6,7] This work is, therefore, aimed to evaluate the nutritional values of different melon seeds collected from different areas of Bangladesh. Hence, the present investigations were highlighted with a view to find out some important nutrients (ash, moisture, protein, carbohydrate, fat, dietary fiber) and fatty acid composition of seed oil and also mineral contents (iron, copper and zinc) of seeds obtained from three varieties of melon family. Determination of the nutritional composition would significantly contribute to the valorization of melon seeds potential in the food, cosmetic and pharmaceutical industries. This may lead to the innovative utilization of melon seeds as an alternative for industrial uses.

II. Materials and Methods

Sample collection

Fresh and mature fruits of winter melon (Wax gourd), large melon (Bottle gourd) and long melon (Pumpkin) were collected from three different districts (Brahmanbaria, Noakhali and Dhaka) of Bangladesh during September and October 2019. Then the seeds were separated from the fruits manually. The seeds were cleaned and sun dried for about 7days. The seeds were ground into fine powder using blender machine. The powder samples were then kept in refrigerator at -20 °C prior to analysis.

Chemicals and reagents

The chemicals and reagents used were of analytical reagent grade. Sulfuric acid (98%, w/w, BDH, U.K.), phenol (Merck, Mumbai, India), ethanol (99.99%), anhydrous sodium sulphate (Na_2SO_4) (Scharlab S.L, 08181 Sentmenat, Spain), n-hexane (RCI Labscan Limited, USA), acetone (Sigma-Aldrich, France), boron trifluoride-methanol complex (Sigma-Aldrich, E. Merck, Germany), AR Grade HNO_3 (RCI Labscan Ltd, Bangkok, Thailand) were used in the laboratory during the research work.

Instruments

An electric balance (FR-200, NDO-450ND, Japan), a blending machine (Miyako Chopper, Japan), a rotary vacuum evaporator (Heidolph, Germany),a centrifuge machine (Hanil

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Science Industrial Co. Ltd., Model-Combi 514 R) with a rotation up to 4000 rpm, a carbolite furnace (Japan, capacity 750-1250°C), atomic absorption spectrophotometer-AAS (Shimadzu AA-7000) and a gas chromatograph (Shimadzu, GC-2025) having flame ionization detector equipped with an auto-injector (AOC-20i), quartz capillary column (HP-5) with column length 30 m, diameter 0.25 mm and film thickness 0.25µm were used during the research work.

Total Carbohydrate Determination

The total carbohydrate in seed samples was determined by performing the modified phenol sulfuric acid test.[8] It is a well-known method for the determination of the total carbohydrate in the food product. In this method, 80% aqueous phenol and concentrated sulfuric acid (98%) were used. The 10 mg powder of melon seeds were taken in 10 mL volumetric flask and were diluted 20 times with sulfuric acid. Each was taken in a screw cap test tube and reaction was done with 5 µL of 80% aqueous phenol and 3 mL of conc. sulfuric acid, respectively. The absorbance of the solutions was given at 475 nm in the UV-visible spectrophotometer.

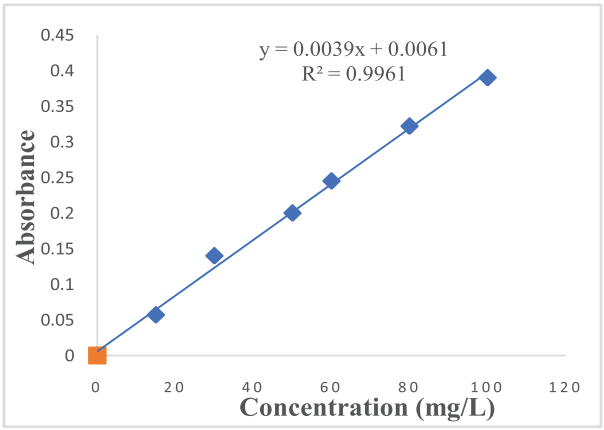
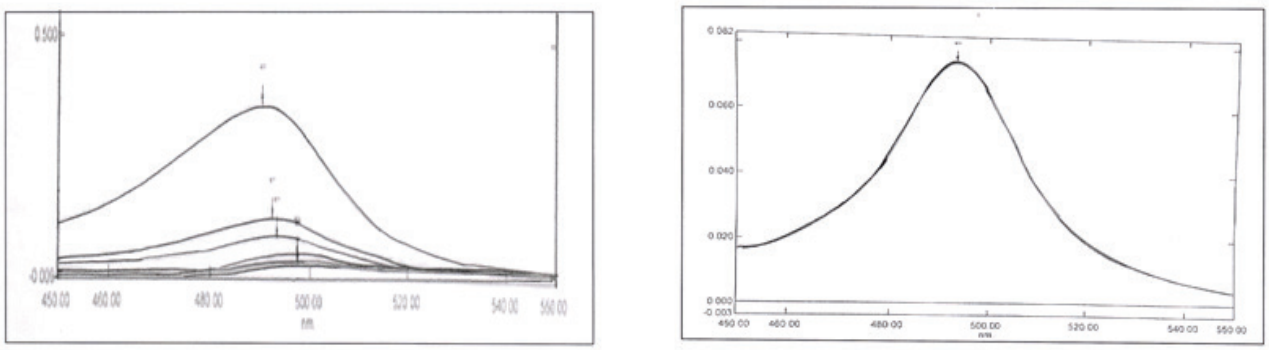
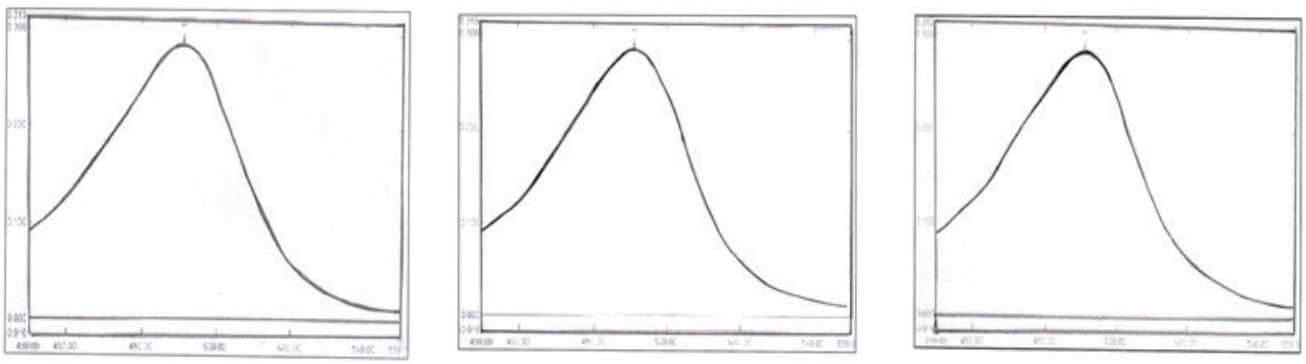


Fig. 1. Calibration curve for standard D-(+)-glucose.



(a) (b)

Fig. 2. Overlain UV-visible spectrum of standard glucose at different concentrations (a) and spectrum of standard glucose at 30 ppm (b).



(a) (b) (c)

Fig. 3. UV-Visible Spectrum of winter melon (a), large melon (b), long melon (c) for total carbohydrate.

Mineral determination

The dry ashing of the samples for determination of iron (Fe), copper (Cu) and zinc (Zn) content was done by following the AOAC official method 999. 11.[9] The 10g of homogenized sample was taken into a crucible and heated at 700°C for 6 hours to ashes. 5 mL of AR grade HNO_3 was added and then kept overnight. The sample digested with HNO_3 is filtered and taken into a volumetric flask of 25.0 mL and the solution is made up to the mark. The minerals detection was performed in the Bangladesh Council of Scientific and Industrial Research (BCSIR).

Oil content and composition of fatty acid determination

Oil extraction

The 5g of powdered seed sample was transferred into a round bottle flask. Then 15mL of n-hexane was added into it and refluxed for one hour in a water bath. n-Hexane extract was collected by decantation and extraction was repeated twice with another 15 mL of n-hexane. The n-hexane extract was combined with earlier extract. The combined n-hexane extract was filtered through a cotton filter and the extract was concentrated by rotary evaporator. The clear n-hexane extract was collected and the weight of the oil was recorded.

Preparation of NaOH (0.5 M) solution in MeOH

Alcoholic NaOH solution was prepared for hydrolysis of the oil. For the preparation of 0.5 M NaOH in MeOH, 1.0867 g of NaOH was taken in a 100 mL volumetric flask and the volume was up to marked with methanol.

Saponification of Fats for Fatty Acid Analysis

The saponification of the extracted melon seed oil was done in a pear-shaped flask where 50 mg of oil was taken in addition to 2.0 mL of methanolic NaOH (0.5M). The mixture was ultrasonicated for 1 minute and was refluxed at 40˚C for 40 minutes. The solvent was evaporated by a rotary evaporator. Then distilled water was added to dissolve the content. The pH of the solution was adjusted to 4.5 (just acidic) with 2M HCl. The mixture was then taken in a separatory funnel and extracted with n-hexane. The hexane layer was collected in another pear-shaped flask and the solvent was evaporated by a rotary evaporator.

Preparation of methyl ester of fatty acids

The methylation of the saponificated fat in the pear-shaped flask was done by adding 1.0 mL of boron trifluoride-methanol complex and then it was ultra-sonicated for 1 min. The solution was heated in a water bath for 15 min and cooled to room temperature. Then the solution was concentrated by the rotary evaporator. Approximately 3.0 mL of n-hexane was added to the concentrated solution and filtered through a pasture pipette containing cotton with anhydrous Na_2SO_4. The esterified content was then taken in a GC vial for analysis by GC-FID.

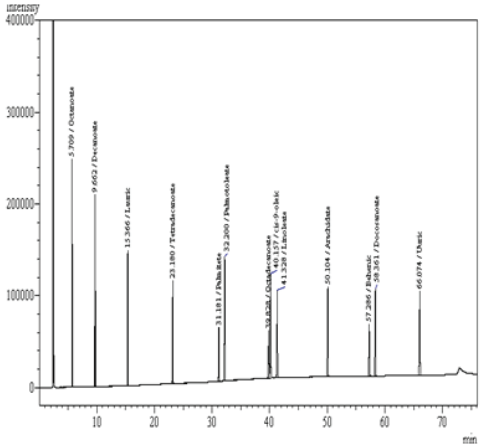


Fig. 4. GC-FID Chromtogram of 13 standard fatty acids.

Ash and moisture content

The moisture and ash content were determined by heating the samples in an oven and at carbolite furnace, respectively. Approximately 1 g of each sample was taken into different crucibles. The crucibles with samples were dried in an oven for 4 hours at 105ºC for moisture content and 6 hours at 700 ºC for ash content.

Determination of Protein content

The Kjeldahl method was used for determination of protein content. The method was performed according to the AOAC International method (981.10).[10]

Soluble Dietary Fiber (SDF) determination

The melon seeds powder (5 g) was extracted in 100 mL of distilled water. The pH was adjusted to 2.0 with sulfuric acid. The mixture was stirred at 80ºC in a water bath for 4 hours and then filtered. The filtrate was concentrated and ethanol was subsequently added to up to a final concentration of 70%. After slight precipitation, the solution was centrifuged and the soluble dietary fiber (SDF) was collected and dried at room temperature. The percentage yield of the obtained soluble dietary fiber (SDF) was calculated as the amount of melon seeds powder used.[11]

III. Results and Discussion

Total Carbohydrate

The total carbohydrate means the sum of sugar, starches, and dietary fiber. Using the calibration curve of the standard glucose solution, the total carbohydrate was determined by UV-visible spectrophotometer (Table 1). Winter (wax gourd), long (bottle gourd) and large melon (pumpkin) contained 56.48, 46.88 and 55.32% of total carbohydrate. These values are comparable to *amaranthus hybridus* seeds (58.31%), little millets (47.85%), and *millettia griffonianus* (59.49 ± 0.80 %).[12-14]

Table 1. The amount of total carbohydrates and protein in melon seeds.

Melon Seed Sample	Sample Code	Carbohydrate			Protein
		Amount (mg/L)	Percentage (%)	Average (%)	Content (gm/100gm)
Winter (Wax gourd)	WG-1	69.67	58.06	56.48	16.46
	WG-2	65.33	54.44		
	WG-3	68.34	56.94		
Long (Bottle gourd)	BG-1	55.34	46.17	46.88	16.12
	BG-2	57.21	47.67		
	BG-3	56.16	46.80		
Large (Pumpkin)	P-1	67.60	56.33	55.32	29.64
	P-2	66.42	55.35		
	P-3	65.14	54.28		

Minerals analysis

The dried samples of melon seeds were analyzed for determination of the minerals (Fe, Cu, Zn) and was recorded in mg/kg according to APHA (1998).[15] The iron, copper and zinc content were found to be 6.75, 0.62 and 6.10 mg/100g in winter melon, 7.8, 1.63 and 4.25 mg/100g in long melon and 13.95, 1.15 and 5.11 mg/100g in large melon, respectively (Figure 5). The heavy metals are essential for both aquatic organisms and human body.

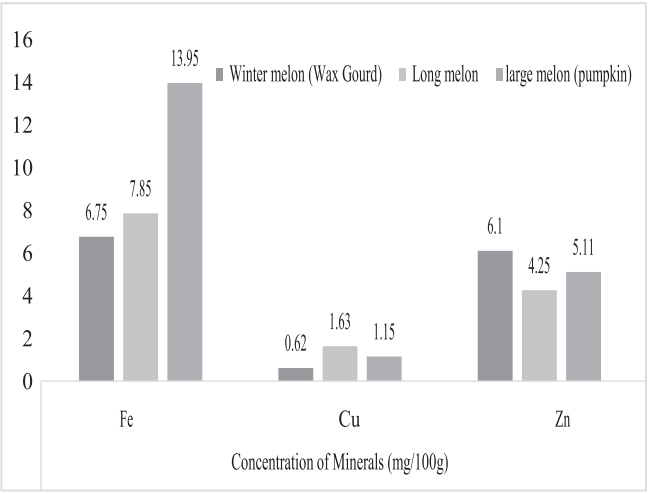


Fig. 5. Amount of iron, copper and zinc in the melon seeds samples.

Protein content in melon seeds

Proteins are essential nutrients for the human body. The protein content in winter melon, long melon and large melon were determined by the Kjeldahl method.[16] The protein content (Table 1) in the melon seeds was found to be in a range16.12% (Long melon) to 29.64% (Large melon) which was comparable to be reported by Jacob *et al*. (30.63%).[4] The seeds of long melon (16.12%) generally have the lowest protein values while those of large melon (29.64%) generally have the highest protein values. These values were higher than the data announced by other authors (Gowtham *et al.* and Anwar *et al.*)[17, 18] which were within the limits from 11.67 to 35.0 %.

Moisture and Ash content

Moisture content is an important indicator of shelf life for foods. Moisture content was found to be 68.88% in winter and 79.53% in large melon, which were significantly higher than those reported for winter melon (63.66%) and large melon (66.38%) by Gowthami and Poornima.[17]Ash refers to any inorganic material that remains after heating, removes water and organic material. The ash content was found to be in the range of 4.26 to 5.52% which is slightly higher than the reported value of melon seed varieties; 3.35-4.89%, but close to another reported study by Jacob *et al* for melon seeds; 6.84-6.99%.[4] The high ash content indicates the presence of inorganic minerals in melon seeds. High mineral elements in foods can catalyze the metabolic processes in human body and enhance the growth and development.

Oil content

The fat content was found (Figure 6) to be in the range of 13.61-19.71% which is lower than that reported by Jacob *et al.* for four varieties of melon seeds 40.26-45.21%.[4] Winter melon seeds contained 19.71 % oil, which was similar to those reported by Anwar *et al.*[18] According to USDA, fat content in pumpkin seeds was 19.4 % which was similar to the present study 18.17 %.

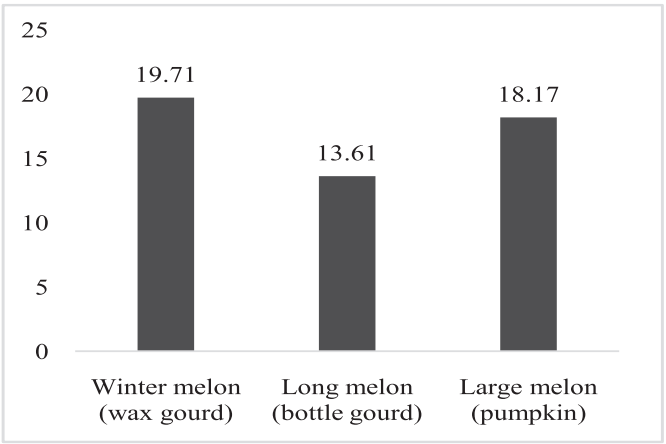


Fig. 6. Percent of oil in melon seeds.

Analysis of Fatty Acid Compositions in seed Samples

The GC chromatogram (Figure 4) showed the identification of palmitoleic acid, stearic acid, oleic acid and linoleic acids in melon seeds oil. The percentage of palmitoleic acid, stearic acid, oleic acid and linoleic acids in melon seeds oil were in the range of 12.46-34.73, 35.05-56.54, 8.7-44.10, and 1.95-15.49, respectively (Table 2). It was found that the winter, long and large melon seed oil generally contained relatively high contents of unsaturated fatty acids than saturated fatty acids.

Amount of Soluble Dietary Fiber (SDF)

The winter, long, and large melon seed samples were found to be contained 3.1, 2.2 and 1.3% soluble dietary fiber. Soluble dietary fiber is a low-calorie compound that is widely used in the food industry to improve nutrition, taste or to modify the product texture. In addition, SDF plays a valuable role in the prevention of atherosclerosis, diabetes, hemorrhoids, and gastrointestinal cancer.[19,20]

Table 2. Relative Fatty acid composition (%) in melon seed samples.

Seed Sample	Sample Code	Saturated Acid	Unsaturated Acid		
		Stearic (%)	Palmitoleic (%)	Oleic (%)	Linoleic (%)
Winter melon	WG-1	40.51	13.17	44.10	2.22
(Wax Gourd)	WG-2	56.54	28.27	8.7	6.49
	WG-3	44.26	12.46	41.33	1.95
Long Melon	BG-1	37.15	16.68	42.05	4.12
(Bottle Gourd)	BG-2	42.31	31.07	11.16	15.49
	BG-3	42.67	24.50	22.73	10.1
Large melon	P-1	38.13	32.66	22.24	6.97
(Pumpkin)	P-2	36.78	23.14	30.80	9.28
	P-3	35.05	34.73	21.41	8.81

IV. Conclusion

The seeds of the three melon varieties (winter, long, and large melon) exhibited comparable chemical composition. The results obtained showed the proximate composition of 19.71% protein, 16.46 % oil, 56.48 % total carbohydrate, 3.10 % soluble dietary fiber, 68.88 % moisture and 4.26 % ash, in winter melon seeds. Similarly, Long melon (bottle gourd) seed have protein, oil, carbohydrate, soluble fiber, moisture and ash content of 16.12, 13.61, 46.88, 2.2, 76.45 and 5.2 %, respectively, and large melon (pumpkin) have 29.64, 18.17, 55.32, 1.3, 79.53 and 5.12 %, respectively. The mineral determination showed that the winter, long, and large, melon seeds contain 67.5, 78, and 139.5 ppm of iron; 6.2, 16.3, and 11.5 ppm of copper; and 61, 42.5, and 51.1 ppm of zinc, respectively. This study offers a complete observation of the chemical and fatty acid composition of melon seeds. Due to the healthy composition, melon seeds can be used successfully in the food industry as functional food, as snacks, as a thickener and flavor component of soups, etc. The oil can be used as food additives in medicine and as an ingredient in cosmetics in facial and body creams, sunscreens, soaps, etc. From the above reports it can be realized that it is very urgent to focus more on the seeds of different types of melons available in Bangladesh. Mostly the fruit seeds are thrown as waste. The present research is very much important to explore the utilization of melon seeds in Bangladesh. The information and data from the present work on the nutritional qualities may provide valuable research updates and may expand the scope of knowledge for the public and other stakeholders for possible local or industrial utilization of melon seeds.

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