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Investigation and Chemical Constituents of Muskmelons

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Abstract: Three different varieties of muskmelons (Cucumis melo) bought from local market in the city of Toungoo, Pegu Region, Myanmar, were analyzed in this research. pH of these muskmelon ranged from 6.35 to 6.89 and found to be comparable. Highest protein content of 10.66% was observed in white-fleshed, non-netted, smooth surface melon, Muskmelon samples contained low fiber contents of 2.35% to 5.00% and thus, it was not a good source of fiber. Highest available carbohydrate content of 55.61% was observed in green-fleshed netted melon. By AAS analysis potassium was found to be the highest (5016-5037mg/100g) followed by sodium (1249-1487/100g), calcium (312.0-715.1mg/100g), manganese (11.3-15.7mg/100g), copper (5.9-11.6mg/100g) and zinc (2.6-5.1mg/100). Iodometric titrimetric analysis revealed that total sugar contents were in range of 9.00-9.72%. Lowest reducing sugar (1.50%) was found in white-fleshed, non-netted melon. Lowest reducing sugar as a percentage of total sugar of 15.43% was also observed in white-fleshed variety.

Key words: Cucumis melo, muskmelon, calorific value, elemental values, total sugar, reducing sugar

1. INTRODUCTION

Fruits and vegetables have been recognized as a good source of vitamins and minerals. They have been especially valuable for their ability to prevent vitamin C and vitamins A deficiencies. Some of the good things in fruits and vegetables include vitamins, minerals, flavonoids (plant chemical that act like antioxidants) saponins (plant chemicals that have a better taste) phenols (organic compounds in foods) carontenoid (vitamin A-like compounds) isothiocyanatae s (sulfur-compounds) and several types of dietary fiber. Diets containing substantial and varied amount of fruits and vegetables could prevent 20 percent or more of all cases of cancer. Higher intake of fruits and vegetables could reduce the risk of a stroke by up to 25 percent. Higher intake of fruits and vegetables seemed to increase the ventilation function of the lungs. Muskmelon is native to northwest India where it spread to China and Europe via the Persian Empire [5]. The varied cultivars produced have been divided into multiple cultivar groups. The muskmelon belongs to Cucurbitaceae family [8]. It is a large sweet fruits. This is produced by an annual trailing vine. It is a round or oblong, green or yellow fruit with horizontal stripes on the rind. Its juicy flesh may be yellow, white, orange or green in colour depending upon the species and has a sweet flavor and a slightly musky smell. Mature fruits are eaten as a dessert fruits used in sorbets, processed and their juice extracted as muskmelon juice.

1.1 Botanical Description

Family	-	Cucuribitaceae
Genus	-	Cucumis
Species	-	C.melo
Botanical name	-	Cucumis melo
English name	-	Muskmelon
Myanmar name	-	Thakwa-hmwei

Figure 1 Three varieties of Muskmelon

1.2 Health Benefits of Muskmelon

Muskmelons have been associated with regulating heart beat and, possible preventing strokes. In addition to health benefits, muskmelon takes care of skin too. It contains Vitamin A, which is useful in maintain healthy skin. The fruit contains

Vitamins A, B, C and minerals like magnesium, Sodium and potassium. It has zero cholesterol and is safe for blood cholesterol patient [3] Muskmelon is a good source of vitamin C, which is an anti-oxidant. This to prevent heart diseases and even cancer [4].

1.3 Carbohydrates

Carbohydrate are polyhydroxy aldehydes, polyhydroxy ketone, or compounds that can be hydrolyzed to them [10]. A carbohydrate that cannot be hydrolyzed to simpler compound is called a monosaccharide [3]. A carbohydrate that can be hydrolyzed to two monosaccharide molecules is called a disaccharide. A carbohydrate that can be hydrolyzed to many monosaccharide molecules is called a polysaccharide. A monosaccharide may be further classified. If it contains an aldehyde group, it is known as an aldose; if it contains a keto group, it is known as a ketose. Depending upon the number of carbon it contains, a monosaccharide is known as a triose, tetrose, pentose, and so on. An aldohexose, for example, is a six-carbon monosaccharide containing an aldehyde group; a ketopentose is a five-carbon monosaccharide containing a keto group. Most naturally occurring monosaccharides are pentoses or hexoses. Carbonhydrates that reduce Fehing's (or Benedict's) or Tollin's reagent are known as reducing sugar [11].All monosaccharide, whether aldose or ketose, are reducing sugars. Most disaccharides are reducing sugar; sucrose (common table sugar) is a notable exception, for it is a non-reducing sugar.

2. MATERIALS AND METHODS

Three different varieties of muskmelon (green- fleshed, netted melon, orange-fleshed netted melon and white-fleshed, non-netted, smooth surface melon) were bought from local market in the city of Toungoo, Pegu, Region, Myanmar. The fruits were washed with water and then cut into slices and dried in the shade at room temperature. The air dried samples were used for analysis.

2.1 Determination of pH

Distilled water (200mL) was placed in a 250 mL round-bottomed flask and it was boiled to remove CO_2. Then, the carbon dioxide-free distilled water was cooled prior to use. The flask was capped to avoid contact with atmospheric air. Muskmelon sample (10g) was placed into the beaker. Carbon dioxide-free distilled water (20mL) was added to the sample and it was stirred for 10 min. Then pH of the sample was measured with a pH meter (Oyster-15) which was previously calibrated with standard buffer solution pH 4 and 7.

2.2 Determination of Protein Content in Three Varieties of Muskmelon

Sample (1.g) was introduced to a Kjeldahl flask. The catalyst mixture (9.0g anhydrous potassium sulphate and 1.0g copper sulphate) and concentrated sulphuric acid 15ml were then added. The flask was partially closed by means of a funnel and the contents were digested by heating the flask in an inclined position, starting first with a gentle heat for about 30 min and then heating was continued vigorously for about 3hr until the solution was totally digested and became clear. The flask was

The fruit provides pretty fair amount of folic acid [5] which is especially important for pregnant women. Thought it offers special benefits to women, men can also get great many benefits. Folic acid in the fruit acts as a mild antidepressant [6]. Research has suggested that muskmelon might reduce the risk of developing kidney and age-related bone loss [7].
shaken gently from time to time during the digestion process. The flask was allowed to cool and about 10ml of distilled water were added and the Kjeldahl distillation apparatus was set up. Into the flask 70ml of 40% sodium hydroxide solution was poured through the side arm together with 200ml of distilled water. The contents were distilled by direct heating. The ammonia evolved was allowed to absorb in 25ml of 4% boric acid solution contained in a receiver flask. The ammonia distillate was titrated with 0.5M sulphuric acid, using methyl red as an indicator solution until a red colour just appeared.

2.3 Determination of Fibre contents in Three Varieties of Muskmelon

Sample (5g) was added into a 500ml conical flask having a 200ml marks. Into the above conical flask hot dilute sulphuric acid (1.25%) was added to the mark and boiled the mixture. Boiling was continued for half an hour. The level was maintained by adding water periodically to prevent the loss by evaporation. It was then filtered through a fine piece of muslin cloth and washed three times with boiling water. The substance on the cloth was transferred carefully into the same flask with 200ml of hot sodium hydroxide solution (1.25%). It was then boiled gently for half an hour maintaining the constant level by adding water at intervals to prevent the loss by evaporation. It was filtered through apiece of fine muslin and washed with boiling water till the washing were neutral. Finally, it was washed with 5 ml of ethanol and 10 ml of ether. The fibre was transferred to a clean and dry crucible. After drying at 105C to constant weight the crucible was cooled and weighed. The fibre was incinerated completely and determined the weight of ash. The difference in weight of the fibre before and after incineration was the weight of fibre.

2.4 Determination of Carbohydrate Content

The total carbohydrate content of food can be obtained as the difference between 100 and the sum of percentages of moisture, protein, fat, ash and fibre [1].

2.5 Determination of Calorific Value

The sample calorific value was estimated (in kcal) according to the formula [2],
Energy = (g protein$\times$ 2.44) + (g fat $\times$8.37) + (g available carbohydrate $\times$3.57)

2.6 Quantitative Determination of Trace Elements by Atomic Absorption Spectroscopy (AAS)

The amounts of trace elements were quantitatively determined by Atomic Absorption Spectrophotometric method using a Perkin Elmer AAnalyst 800 atomic absorption spectrophotometer (England).The sample (0.1g) was digested for 15min with 2 ml of concentrated hydrochloric acid solution. Then the resulting solution of the sample was evaporated to dryness and dissolved in 6 ml of 25% hydrochloric acid solution (volume by volume) followed by centrifugation. The supernatant solution was decanted and the clear solution was made up to 100 ml with distilled water. Standard and the clear solution were prepared using analar chemicals and dilution was made using their specific hollow cathode lamps. The prepared solutions were now ready for analysis of trace elements by Atomic Absorption Spectrophotometer.

2.7 Determination of Total Sugar, Reducing sugar and Non-reducing Sugar in Three Varieties of Muskmelon

Total sugar, reducing sugar and non- reducing sugar were determined by iodometric technique (Buzarbarua, 2000).The sample (10g) was ground in a mortar, The ground mass was boiled with distilled water and filtered through a piece of white cloth after cooling, The volume of the filtrate was made up to 205 ml in a volumetric flask with distilled water. The stock solution(12.5 ml) was taken and purified by adding a mixture of 10 ml of 5% $ZnSO_4$ and 10 ml of 5% $Ba(OH)_2$ to the solution. Then, the solution was filtered and filtrate was made up to 100 ml with distilled water in a volumetric flask to obtain purified sugar solution. Purified sugar solution (5 ml) and (5 ml) of Somogyi's reagent were added into three separate test tubes. For the blank, 5 ml of Somogyi's reagent and 5 ml of distilled water were added into another three test tubes. The six tubes covered with glass stoppers were immersed in a boiling water bath for 20 min. After the required time, the mixture of the sample tubes turned brown and the mixture of the blank tubes remained blue. The solution in each tube was placed in a conical flak and 2 ml of freshly prepared KI solution was then added. After a few minutes 2 ml of 2N H_2SO_4 were added to the solution followed by immediate addition of a few ml of thiosulphate from the burette to prevent the liberation of I_2 from KI solution was then added. Next, 1 ml of starch indicator was added and the solution turned blue. The solution was tiratedafainst with thiosulphate solution until the blue colour just disappeared.

Purified sugar solution (30ml) was added in a beaker and hydrolyzed by (0.6 ml) of HCI. The whole mixture was heated for 15 min and cooled. The solution was neutralized with solid Na_2 CO_3 and then the volume made up to 100ml with distilled water in a volumetric flask. The further procedure was carried out in the same manner as in the case of reducing sugar, by mixing 5 ml of Somogyi's reagent and 5 ml of hydrolyzed solution.

3. RESULTS AND DISCUSSION

3.1 pH Content of Three Varieties of Muskmelon

pH values of muskmelon analyzed were 6.57, 6.89 and 6.35 for green fleshed, netted melon, orange-fleshed, non-netted, smooth surface melon, respectively, Table .1 found to be comparable.

3.2 Nutritional Compositions of Three Different Varieties of Muskmelon

The crude fibre contents of these fruits ranged between 2.35% to 5.00% (Table.1).Muskmelon with netted orange flesh had the highest fibre content of 5.00%. The muskmelon studied have low fibre levels; an indication that they cannot be considered as good source of fibre. However, the fibre present in these samples, though of low levels, could contribute to the important role of fibre in the diet, that of helping to stimulate peristalsis, thus aiding the movement of food through the digestive system, thereby preventing constipation [12]. Available carbohydrate contents were 55.61%, 43.64% and 48.69% (Table.1) for green-fleshed, netted melon, orange-flesh, netted melon, and white-fleshed, non-netted, smooth surface melon respectively.

Calorific values were37.78kcal/100g, 202.78kcal/100g and 227.87kcal/100g for green –fleshed netted melon, orange-fleshed netted melon and white-fleshed, non-netted, smooth surface melon respectively (Table 1). High calorific values in these muskmelons mean that it can be considered as an important source of energy and thus, it can be used as food especially for people engaged in heavy activity.

3.3 Elemental Concentrations by Atomic Absorption Spectroscopy (AAS)

Mineral concentrations in three varieties of muskmelon are shown in Table. 2. It was observed that white fleshed non-netted melon contained high amount of potassium i.e., 5016 mg/100g, 5037 mg/100g and 500 mg/100g respectively. Thus, muskmelons are rich in potassium, which can help control blood pressure and can prevent the risk of strokes. Potassium in the fruit can also reduce the problem of developing kidney stones. High potassium may also prevent renal calcium loss, in effect preventing bone break down. In diarrhea, it contributes with electrolyte replacement, as well as increased adsorption of nutrients.

Sodium contents were found as 1352 mg/100g, 1249 mg/100g and 1487mg/100g in white-fleshed, non-netted melon, green-fleshed netted melon and orange-fleshed, netted melon respectively. Sodium is associated with potassium in the body in maintaining proper acid-base balance and never transmissions. By high potassium to sodium contents, muskmelon may prevent high blood pressure and its complications.

Calcium contents ranged from 312.01-7.15.1 mg/100g were also observes in three varieties of muskmelon. Calcium content in green-fleshed, netted melon was found to be the highest (715.1 mg/100g) followed by white-flesh, non-netted melon (583.9mg/100g) and orange-fleshed netted melon (312.0mg/100g). Calcium is famous as a bone protector but it plays roles, too, helping nerve cells communicate, muscles contract and to lower blood pressure and prevent colon cancer and premenstrual syndrome.

Magnesium contents in three varieties of muskmelon were in the range of 356.4-45.8 mg/100g and observed to be not much different. Magnesium maintains healthy bones and helps of

Table 1 pH and Nutritional compositions all three varieties of muskmelon

No	Sample	pH	Crude Fibre (%)	Crude Protein (%)	Available Carbohydrate (%)	Calorific value (kcal/100g)
1	**Green-fleshed netted melon**	**6.57**	**2.35**	**5.89**	**55.61**	**237.78**
2	**Orange-fleshed netted melon**	**6.89**	**5.00**	**9.11**	**43.64**	**202.78**
3	**White-fleshed non-netted smooth surface melon**	**6.35**	**4.76**	**10.66**	**48.69**	**227.87**

Table. 2 Elemental concentration (dry weight basis) in three varieties of muskmelon

Sample	Mineral concentration (mg/100)							
	K	Na	Ca	Mg	Fe	Mu	Cu	Zn
White-fleshed non-netted melon	501	1352	583.9	356.4	141.1	11.3	8.3	2.6
Green-fleshed netted melon	5037	1249	715.1	450.8	144.2	14.5	11.6	4.6
Orange-fleshed netted melon	5022	1487	312.0	375.9	137.6	15.7	5.9	5.1

muscle relax as well as regulating mood, nerve and muscle functions.

Iron contents in the muskmelon samples studied were ranged from 137.6 to 144.2 mg/100g and found to be comparable. Iron main function is in hemoglobin, the part of red blood cells that carries oxygen from the lungs to all the cells of the body. It is also important for immunity.

Trace amount of manganese (11.3-15.7 mg/100g), copper (5.9-11.6 mg/100mg), and zinc (2.6-5.1 mg/100g) were also present in these muskmelons. Manganese assists a wide range of bodily functions, including the development of healthy bones, the way of body process carbohydrates, and protective antioxidant activity in the body. Copper helps transport oxygen through the body, maintains hair colour, and is used to make hormones. Zinc helps to keep the skin healthy, aid wound healing, regulates the sense of taste and is important for immune system strength. It is particularly important during pregnancy and for infant development. A deficiency in adulthood has been linked to increase risk of infection, skin and hair problems and a low sperm count.

3.5. Total Sugar, Reducing Sugar and non-reducing Sugar in Three Varieties of Muskmelon

The reducing sugar and total sugar were determined by Somogyi's reagents using iodometric technique (Buzarbarua, 2000). Somogy's devised in 1945, the most accurate and the sensitive method for the detrmination of glucose (reducing sugar) quantitatively by adopting iodometric technique. By this method the concentration of glucose or other reducing sugar from 0.01 g to 3.0g can be determined of glucose or other reducing sugar from 0.01g to 3.0g can be determined accurately.

The iodometric technique is based on the following reactions:

$$2\ Cu\ So_4 + 4KI \longrightarrow Cu_2I_2+2K_2SO_4+I_2$$

$$I_2+2(Na_2\ S_2\ O_3.5H_2O) \longrightarrow 2Nal+Na_2S_4O_6+10H_2O$$

The above reactions showed that when KI is added to cupric salt, Cu_2I_2 is quantitatively precipitated and simultaneously corresponding to each atom of Cu present one atom of I is liberated. The iodine liberated is titrated against a standard thiosulphate solution in the presence of starch indicator.

If some amount of reducing sugar is added to the Cu SO_4 solution before addition of KI, The liberation of I_2 will be less due to reducing of $CuSO_4$ to Cu_2O by the sugar. As a result, the amount of thiosulphate solution for the titration will be less. The different of these two readings will give the amount of Cu reduced by the sugar present in the unknown simple from which the present of the reducing sugar can be calculated out.

Total sugar content in the muskmelon samples were 9.72%, 9.54 %, and 9.00% respectively, in white- fleshed and orange fleshed varieties (Tables 3 and figure 2). Total sugar contents in these varieties were found to be not much different. These values are in accordance with the literature review of 9.83 % [9] . Lowest amount of reducing sugar was observed in white-fleshed, non-netted melon (1.5%).

Reducing sugar contents of green-fleshed and orange-fleshed melons were nearly the same, i.e., 2.50% and 2.43% respectively. Non-reducing sugar contents were calculated by the difference between total sugar content and reducing sugar content. Non-reducing sugar contents were observed as 8.22%, 7.00%, and 6.57% in the white-fleshed melon, green-fleshed and orange-fleshed melon respectively.

Highest value of reducing sugar as a percentage of total sugar was found in orange-fleshed, netted melon (27.00%) followed by the green-fleshed netted melon (26.21%) and white-fleshed non-netted melon (15.43%).

Table 3 Total sugar, reducing sugar and non-reducing sugar in muskmelon sample

Sample	Total Sugar (%)	Reducing Sugar (%)	Non-reducing (%)	Sugar Reducing sugar as % of total sugar
White-fleshed Non-netted melon	9.72	1.50	8.22	15.43
Green-fleshed Netted melon	9.54	2.50	7.00	26.21
Orange-fleshed Netted melon	9.00	2.43	6.57	27.00

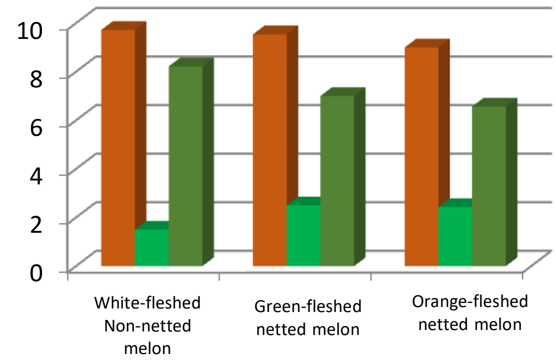

Figure 2 Total sugar, reducing sugar and non-reducing sugar contents in the varieties of muskmelon

4. CONCLUSION

Three varieties of muskmelon (green-fleshed, netted melon, orange-fleshed, netted melon and white-fleshed, non-netted melon were collected from local market in the city of Toungoo, Pegu Region, Myanmar. The experimental results the following interferences can be deduced.

.pH of these muskmelons was in the range of 6.35 to 6.89. Analysis by AAS also revealed that potassium contents in muskmelons ranged from (5016-5037 mg/100g) and found to be the highest among the elements determined. Second highest element was sodium which ranged between 1249-1487mg/100g. Among three varieties of muskmelon highest calcium content of 715.1mg/100g was found in green-fleshed, netted melon and lowest calcium content of 312.0mg/100g was found in orange fleshed netted melon. Magnesium and iron contents in three varieties of muskmelon range between 356.4-450.8mg/100g and 137.6-144.2mg/100g respectively and found to be not much different which each other. Manganese, copper and zinc concentrations in three varieties of muskmelons were 11.3-15.7mg/100g, 5.9-11.6 mg/100g and 2.6-5.1 mg/100g respectively.

Total and reducing sugar contents were determined by conventional titrimetric analysis using iodometric method. White-fleshed, non-netted melon contained high amount of total sugar (9.72%) among these varieties. Reducing sugar contents of green-fleshed and orange- fleshed, netted melons were 2.50% and 2.43% respectively. Total sugar content of green –fleshed variety (9.54%) was slightly higher than that of orange-fleshed variety (9.00%). Non-reducing sugar contents were calculate by difference between total sugar and reducing sugar and found to be 8.22%, 7.00%a and 6.57% in white-fleshed non-netted, green-fleshed, netted and orange-fleshed, netted melons respectively. Lowest reducing sugar as a percentage of sugar was observed in white-fleshed variety. This research contributes the information on the nutrition compositions, elemental concentrations and total and reducing sugar contents of three varieties of muskmelon which are highly priced by Myanmar people.

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