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Nutritional Evaluation of Different Mango Varieties available in Sri Lanka

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Abstract— *The study was carried out to evaluate the nutritional properties of five varieties (Willard, Karthakolomban, Malwana, Bettiamba and Gira Amba) of mango. Nutritional properties were significantly ($p < 0.05$) varied among the different mango varieties. The highest edible portion (79.49%), total soluble solids (0.75%), ash, total carbohydrate, sugar (30.56 mg/100 gm) and crude fiber were found in Karthakolomban. The highest amount of fat and moisture content were found in Malwana. The maximum amount of caloric value was found in Bettiamba. Gira Amba variety indicated the highest amount of protein content among the other mango varieties. Gira Amba has the highest titratable acidity meanwhile Karthakolomban has the lowest value considerably. Mango verities in this study possess pH values without any significant deviations and Bettiamba was recorded as the variety with highest pH value meanwhile Malwana claimed to be the lowest. Therefore, this study contributed to the identification of the characteristic biochemical properties of several prominent Sri Lankan mango varieties.*

Keywords— ***Sri Lankan mango, Nutrient analysis, Chemical property analysis.***

I. INTRODUCTION

Mango is a tropical and subtropical fruit scientifically known as*MangiferaindicaL.* India, Pakistan, Mexico, Brazil, Haiti, Philippines and Bangladesh are known to be the leading cultivators of mango. The genus of Mangifera consists of 69 species and mostly restricted to tropical Asia [1]. As a South Asian country, A narrow range of mango cultivars presently grows widely throughout Sri Lanka in dry, intermediate and wet zones. Best and adaptable varieties are only chosen for the cultivation to get a higher yield from a mango tree. Fruits are provided annually from most of the Sri Lankan mango cultivations. Sri Lanka produces several superior varieties of mango namely Karuthakolomban, Willard Vellaicolomban, Ambalavi, Chembatan, Malwana, Betti Amba, These mango varieties have their own demand and have commercial importance in food industries. Mango is not only delicious but also rich in prebiotic dietary fiber, vitamins, minerals and polyphenolic flavonoid antioxidant compounds. It also contains sugar, small amount of protein, fats and other nutrients. Mango is frequently eaten fresh. It's also been partaken as desserts such as juices, jellies,jams, nectars as well as crisp mango chips [2]. Mangoes are consumed in both raw and cooked form in South Asian countries and also, they are consumed at all stages of fruit development from the tiny fruit stage, that shed abundantly on to develop beyond the initial stage to the fully mature ones.Nutritional properties of mango fruitvary from variety to variety and developmental stages[3]. Many scientific research approaches on analyzing the physicochemical characteristics of different mango varieties were recorded in past few decades[4], [5],[6],[7]. Physicochemical and nutritional characteristics of most of the varieties of mango grown in Sri Lankawere not properly analyzed. Considering the above fact, the present study was designed to evaluate the nutritional status of five different mango varieties (Willard, Karthakolomban, Malwana, Bettiamba and Gira Amba) grown in Sri Lanka to recommend their use in daily life and commercial purposes.

II. MATERIALS AND METHODS

Sample collection

The experiment was conducted insidea food processing and analyzing laboratory in the Department of Food Science and Technology, University of Sri Jayewardenepura, Sri Lanka. Five popular varieties of mangoes were analyzed in this study. These include Willard, Karthakolomban, Malwana, Bettiamba and Gira Amba. Selected mangoes were collected from five local markets in Colombo city.

Sample preparation

Fresh mango samples free from insect's bites were collected and washed with deionized water in order to eliminate visible dirt.Excessive dripping water on the surface was removed quickly with a blotting paper. Those were then cut into small pieces, homogenized. Accurate quantity was weighed as required for different analysis. Every experiment was replicated nine times to have a result for each parameter.

Determination of nutritional properties

The edible portion of the fruit was calculated by subtracting the weight of indigestible parts of fruits from

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the weight of whole fruits. The pH of fruit extract was determined with the use of a digital pH meter (HQ11d).Moisture content was determined by digital moisture analyzer (A&D MX-50). Titratable acidity was estimated with the visual acid base by digital method [8]. The total soluble solid (TSS) was determined with a hand refractometer (Ade Advanced Optics, Model-REF234). Reducing sugar and total sugar contents were determined by Lane and Eynon method [9]. The estimation of total protein was made by Kjeldahl method[10]. Determination of the crude fibreand fat were carried out according to AOAC procedure [11]. Ash content of the mango was determined by incinerating and heating sample in a muffle furnace at 600^{0}C for six hours until a constant weight was reached [12]. The total carbohydrate amount was determined by the following equation [13]

Total Carbohydrate (%) =100 - {Moisture (%) + Protein (%) + Fat (%) + Ash (%)}

The gross food energy was estimated by using a bomb calorie meter [14]

Statistical analysis

The data were statistically analyzed using SPSS (Statistical Package for Social Sciences version 22.00) to assess and compare of physico-chemical, nutritional properties of the mango varieties.

III. RESULTS AND DISCUSSION

The outcome of nutritional properties including their physical characters of five different mango varieties were analyzed and compared. Each value represents the average from nine replications and the results expressed as mean values ± standard deviations (SD). After performing ANOVA (Analysis of variance) test it is evident that two physical characteristics (edible portion and moisture content) are significantly different ($p < 0.05$). It is also found that chemical properties such as pH, Titratable acidity, TSS and the macro nutrients such as Total Sugar, Reducing Sugar, Total protein, Total fat, Crude fiber, Ash, Total carbohydrate, Total energy of different varieties of mango had a significant variation. ($p < 0.05$).

Table.1: Maturity stage, organoleptic properties, edible portion, and moisture content of mango varieties

Mango Variety	Maturity stage	Taste	Colour	Edible portion	Moisture content
Willard	Ripen	Sweet	Red and yellow	75.34 ± 2.58	75.34 ± 3.34
Karthakolomban	Over Ripen	Very sweet	Green and Yellow	78.28 ± 2.35	71.63 ± 4.46
Malwana	Ripen	Sweet	Green and yellow	65.49 ± 2.54	84.28 ± 2.39
Bettiamba	Ripen	Sweet	Green and yellow	74.88 ± 4.28	72.56 ± 2.12
Gira Amba	Ripen	Very sweet	Green and Yellow	69.67 ± 3.43	77.23 ± 3.89

Nutritional properties

Maturity stage, taste and colour of different mango varieties were depicted in table 1. Willard, Malwana, Bettiamba and Gira Amba were found in ripe stage but Karthakolomban was found in over ripe stage. The tastes of mango varieties varied sweet to very sweet. While Karthakolomban and were identified as very sweet while Willard, Malawana, Bettiamba and Gira Amba were found as sweet. Colour of different mango varieties was visually observed and most of the mangoes were bicolour almost all the varieties consisted with red, yellow and green colours at the stage of observation.

Edible portion and moisture content of different mango varieties were differed significantly ($p < 0.05$) as shown in Table 1. The highest amount of edible portion was found in Karthakolomban (78.28%) and the lowest amount of edible portion was found in Malwana (65.49%). Karthakolomban, Bettiamba and Gira Amba resulted in higher (above 70%) edible portion. Previously conducted similar study indicates that the Karthakolomban possess 78% edible portion and Willard contains 76% edible portion which are comparatively accurate with the current study. Moisture content was observed more than 70% in all varieties. The highest and lowest moisture content was found in Malwana (84.28 %) and Karthakolomban (71.63 %), respectively. It was reported that most fruits are composed of 70% to 90% of water [15] [16]. Therefore, the observations obtained clarify the previously reported results.

Significant chemical properties such as pH, total soluble solids, titratable acidity, total sugars and reducing sugars of different varieties of mangoes are included in the Table 2. All values were found to be varied significantly ($p < 0.05$) among all the mango varieties. It is observed that pH value of mango varieties ranged from 4.31 to 4.67. Bettiamba was found with highest pH (4.67) and Malwana with the lowest pH (4.31) value. The pH values for Willard (4.34) and Karthakolomban (4.41) are bit contradictory to another previously mentioned study. However, this study contains lower values comparatively to the previous study due to variables such as ripening stage.Titratable acidity was found to be maximum in Gira Amba (0.68%) followed by Willard (0.67%) and Bettiamba (0.54%). A previous study reported, higher pH (4.2 to 5.7) and lower acidity (0.05 to 0.22%) in mango grown in Mediterranean subtropical climate [17]. According to another study titratable acidity of mango varies from 0.25 to 0.60% [18]. Because of the maturity stage of mango, theacidity in varieties we observed, ranges from 0.26% to 0.75%. The variations in pH value and titratable acidity of mangoes cause due to ripening and their storage period [19].

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Total soluble solids content was also differed significantly ($p < 0.05$) and found maximum in Karthakolomban (21.96 %) followed by Bettiamba (18.43 %) and it was minimum in Gira Amba (16.56 %). Total soluble solids (TSS) are directly correlated with the acidity of fruit. Generally, acidity of fruit decreases and total soluble solids increases during maturity and ripening stage of fruit [20] [21]. It was also reported Total soluble solids in Willard is 23.5% even though the current study indicates it as 20.17%. But the TSS value for the Karthakolomban was not quite deviated from the previous study.

The amount of total sugar and reducing sugar of different mango varieties varied significantly ($p < 0.05$). Total sugar ranged from 4.27% to 5.48% and reducing sugar ranged from 4.61% to 3.04%. The maximum amount of both the total sugar and reducing sugar were found in Karthakolomban, 5.96% and 5.14%, respectively and minimum amount of total sugar and reducing sugar was found in Malwana (4.32 % and 4.13 %), respectively.

Table 2. pH, Titratable acidity, total soluble solid, total sugar, reducing sugar of mango varieties

Mango Variety	pH	Titratable acidity	Total soluble solids	Total sugar	Reducing sugar
Willard	4.34 ± 0.14	0.67 ± 0.04	20.17 ± 0.32	5.14 ± 0.24	4.32 ± 0.16
Karthakolomban	4.41 ± 0.23	0.35 ± 0.04	23.96 ± 1.24	5.96 ± 0.83	5.14 ± 0.24
Malwana	4.31 ± 0.15	0.43 ± 0.02	17.46 ± 0.54	4.32 ± 0.54	4.13 ± 0.18
Bettiamba	4.67 ± 0.16	0.54 ± 0.08	18.43 ± 0.67	4.58 ± 0.28	4.28 ± 0.34
Gira Amba	4.34 ± 0.32	0.68 ± 0.06	16.56 ± 0.48	4.43 ± 0.43	4.17 ± 0.12

Significant variation ($p < 0.05$) of total protein, total fat, crude fiber, ash, total carbohydrate and total energy content was observed among the different varieties of mango (Table 3). It is seen that the total protein content ranged between 0.17 gm/100 gm and 0.28 gm/100 gm. The highest amount of total protein was found in Giraamba (1.18 gm/100 gm) and lowest amount of total protein (0.07 gm/100 gm) was found in both the Karthakolomban. According to previous studies conducted, maximum protein content in all the fruits varies from 1.57 to 5.42% and maximum protein content in the different varieties of tropical fruits vary from 0.4 to 0.8% [22].

Table 3: Total protein, total fat, crude fiber, ash, total carbohydrate and total energy of mango varieties

Mango Variety	Total protein	Total fat	Crude fiber	Ash	Total carbohydrate	Total energy
Willard	0.21 ± 0.03	0.67 ± 0.03	1.17 ± 0.05	0.39 ± 0.04	23.39 ± 0.04	95.75 ± 2.56
Karthakolomban	0.17 ± 0.02	0.41 ± 0.02	3.16 ± 0.06	0.58 ± 0.03	27.21 ± 0.02	100.57 ± 1.89
Malwana	0.18 ± 0.01	0.86 ± 0.02	1.46 ± 0.03	0.32 ± 0.04	14.36 ± 0.03	60.06 ± 2.04
Bettiamba	0.24 ± 0.02	0.59 ± 0.02	1.98 ± 0.04	0.22 ± 0.02	26.39 ± 0.04	103.91 ± 1.56
Gira Amba	0.28 ± 0.02	0.72 ± 0.04	2.06 ± 0.04	0.24 ± 0.03	21.53 ± 0.03	85.48 ± 2.76

The total fat ranged from 0.41 gm/100 gm to 0.86 gm/100 gm. Malwana variety was found rich in total fat content (1.20 gm/100 gm) and Karthakolomban (0.41 gm/100 gm) was found with the lowest amount of fat content. It was reported that usually fat content of different fruits is not greater than 1% [23].

Both crude fiber and ash contents possess a significant variation ($p < 0.05$) in different mango varieties. The maximum amount of crude fiber was found in Karthakolomban (3.16 gm/100 gm) followed by Gira Amba (2.06 gm/100 gm) and Bettiamba (1.98 gm/100 gm). The lowest amount of crude fiber was found in Willard (1.17 gm/100 gm). The highest amount of ash was found in Karthakolomban (0.58 gm/100 gm) and lowest in Bettiamba (0.22 gm/100 gm). Regarding ash content, [24] reported that the total content of mineral salt as ash in fruits varied from 0.2% to 1.5%, which range is almost similar to our observed findings.

Total carbohydrate and total energy of different mango varieties were also significantly ($p < 0.05$) varied (Table 3). Generally, carbohydrate of fruit is less concentrated than cereals because of their high-water content. Fruits rich in carbohydrate provides a high amount of energy. In this study, Bettiamba indicated the highest amount of energy (103.91 Kcal/100 gm) due to its high carbohydrate content (26.39 gm/100 gm) followed by Karthakolomban (100.57 Kcal/100 gm) and the lowest amount of energy showed in Malwana (46.05 Kcal/100 gm) due to its low carbohydrate content (14.36 gm/100 gm).

IV. CONCLUSION

The study has indicated that the mango is an adequate source of energy and macronutrients such as carbohydrate and crude fibre. Bettiamaba and Karthacolomban have high amount of carbohydrate and both are rich sources of contains high carbohydrate hence provides more energy. Malwana contains highest moisture content and Karthakolombanpossesses the highestedible portion when compared. It also consists with the highest total soluble solids, total sugar and reducing sugar.Considering the nutritional facts, Karthakolomban is highly nutritive and fibrous. Gira Amba contains higher percentage of protein, and a higher fat content with respect to the other varieties compared. Malwanacontains low reducing sugar, low total

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sugar and low total soluble solids. Therefore, such varieties and their processed products may be suitable for diabetic patients. As for the conclusion, nutritional properties of these main mango varieties of Sri Lanka were systematically addressed under their nutritional parameters.This may assist the consumers, dietitian and food processors. Further analysis like vitamin and mineral profile will be required for complete nutritional information of these mango varieties.

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