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Evaluation of nutritional and anti-nutritional contents in some varieties of *Mangifera indica* Fruits from Kulfo garden area of Arbaminch

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Abstract
This study was conducted to assess the physical parameters as well as the nutritional and anti-nutritional contents of two *Mangifera Indica* (mango) varieties locally named them as Fringe and Abash mangos. And for each mango variety physical parameters like length, dimension, firmness and weight were determined. The result revealed that the length, dimension, firmness and weight of Fringe mango were 6.5 cm, 4.63cm, 16.6 and 264.17g respectively. Similarlly the same parameters for the Abash mango were 5.67 cm, 4.07 cm, 10.33, 244.0 g respectively. Analysis of the nutritional and anti-nutritional contents of the Fringe mango also showed that pH, Titrable acidity, Oxalate, Protein, Fat, Dry matter, Total ash, Vitamin C, Mg and Ca were 3.96, 3.84%, 1.75 mg/100g, 0.46%, 0.43%, 15.0%, 10.2%, 0.43 mg/100g, 16.13 mg/100g, 9.19 mg/100g respectively. Whereas the levels of pH, Titrableacidity, Oxalate, Protein, Fat, Dry matter, Total ash, Vitamin C, Mg and Ca for A bash mango were 4.14, 6.02%, 1.41mg/100g, 0.62%, 0.47%, 17.4mg/100g and 6.2 mg/100g respectively. The result indicated that all the measured physical parameters of Fringe mango were larger as compared to a bash mango. The result also revealed that the Abash mango was rich in terms of the nutritional contents as compared to the Fringe mango; but high amounts of total ash and oxalate which is categorized as antinutritional was recorded in Fringe mango. Finally the findings revealed that the Abash mango contained appreciable amount of nutrients like protein, vitamin C, Mg and Ca that the body required for its normal metabolic functions as compared to the Fringe mango.

Keywords: *Mangifera indica L*., Abash, Fringe, Nutrition, Antinutrition

1. Introduction

Mango is a fruit belongs to the genus *Mangifera indica*, consisting of numerous species of tropical fruiting trees in the flowering plant family Anacardiaceace. The mango is indigenous to India, cultivated in many tropical and subtropical regions and distributed widely in the world [1]. Mango is used as food in all stages of its development and the genus *Mangifera* contains several species that bear edible fruits. Green or unripe mango contains a large portion of starch which gradually changes into glucose, sucrose and maltose as the fruit begins to ripe. It disappears completely when the fruit is fully ripe. There are other edible *Mangifera* species that generally have lower quality fruits that are commonly referred to as wild mangos [1, 2]. The quality parameters such as size, shape, color, total soluble solids (TSS), acidity, pH, physiological weight, juice, pulp and moisture content are important for the table purpose and value addition of mango fruit [3]. Moreover, some of the key components that contribute for the production and acceptance of high quality fresh mango by the consumer are flavor, volatiles, texture and chemical constituents [4, 5].

Mango contains both nutrients and antinutrients. The mango kernel contains phenols, this phenolic compound has powerful antioxidant and the antioxidant helps lower a person's risk of developing Alzheimer disease. In addition to this other important nutrients like vitamin C which is also found in mango and used to protect immune system deficiencies, cardiovascular diseases and prenatal health problems [1]. Mango is also rich in minerals like Ca and Mg. Ca is responsible for strong bones and teethes. Similarlly Mg has many roles including; supporting the functional of the immune system, assists in preventing dental decay by retaining the calcium in teeth enamel; it has an important role in the synthesis of proteins, fat, nucleic acids and glucose metabolism as well as membrane transport system of cell. Magnesium also plays role in muscle contraction and cell integrity.

Mango fruits sometimes may contain some antinutrients which are believed to be toxic for human consumption. The anti-nutrients that may be present include lead, cadmium, phytate, oxalate which cause cancer [6]. Oxalates are anti-nutrients which under normal condition are confined to separate components. However, whine it is processed and digested, it comes in to contact with nutrients in the gastrointestinal tract. When it is released oxalic acid, it is bind with nutrients rendering form inaccessible to the body [7]. Contents of the nutrients appear to vary across different mango species [8]. Therefore; the objective of this study was to evaluate some nutritional and antinutritional parameters of two *Mangifera indica* (mango) varieties locally named them as Fringe mango and Abash mango caltivated in Kulfo garden area.

2. Materials and Methods

2.1 Sample Collection: Matured and riped fresh fruit samples of the mango cultivars were collected from Arba Minch, Kulfo garden area. The mango fruits were cleaned, labeled and packed into plastic containers and transported to laboratory for further analysis.

2.2 Determination of Physicochemical Parameters of Mango
Determinaton of fruits weight and kernels dimension: Fruit (seeds and kernels) weight was measured using digital electronic balance. While, the length and breadth of each kernel was determined using tape rule.

Determination of pH of the fresh mango kernels: Five grams of each fresh mango kernel was mashed into a 100 ml beaker, 45 ml of distilled water (pH 7.0) was added and allowed to stand for 30 minitues while stirring occasionally with a glass rod. The pH was measured with pH meter after allowing the suspension to stand still.

Determination of titrable acidity of fresh mango kernels: In the determination of titrable acidity the official method of AOAC [9] and [10] were used. Accordingly 0.01M NaOH was titrated against 10 ml of the filtrate using phenolphthalein indicator. The end point was indicated by a change in color of the sample to pink. The amount of acid in milligram per hundred grams (mg /100g).

Determination of dry matter content of mango kernels: In the determination of dry matter content AOAC [9] standard method was used. Based on this two- grams of fresh mango kernel were weighed into a clean boat of predetermined weight. The sample was dried to a constant weight in an oven at 100 ºC for 24 hours. The porcelain boat was placed in the desiccator and allowed to cool for 1 hour before it was reweighed. Dry matter was calculated and expressed as percentage.

$$Dry\ matter\ (\%) = \frac{Weight\ left\ after\ drying}{Initial\ Weight\ of\ sample} * 100$$

Determination of total ash in mango kernels: The standard method described in AOAC [9] was used and 2g of dry ground sample was weighed into a clean crucible of predetermined weight. The weight of the sample and crucible were recorded. The sample was burnt in the muffle furnace at 600 ºC for 3 hours. The crucible was removed with tong and allowed to cool in a desiccator for 2 hours before it was reweighed, the percentage ash was calculated as:

$$\text{Total ash}\ (\%) = \frac{\text{Weight of ash}}{Weight\ of\ sample} * 100$$

Determination of crude protein: Crude protein was determined by the method described by AOAC [9]. Accordingly 2g of each dry mango kernel was weighed into a Kjeldahl flask, 10g of sodium sulphate (to raise the boiling point) and 0.5g copper sulphate was added as catalyst; then, 25ml of conc. sulphuric acid was added. This was digested by burning on a heating mantle until a clear solution was obtained (when oxidation was completed) the digestion converted all the organic nitrogen to ammonia which is trapped as ammonium sulphate. The emerging clear solution was allowed to cool and distilled water was added to it and rinsed into 250 ml volumetric flask and was make-up to mark. 5ml of diluted solution was introduced into a semi-automatic Buchi distillation unit (Model K-350). The ammonia was released by the auto-addition of 5ml of 40% sodium hydroxide (or excess). The mixture was steam distillated for 3 munites when about 65ml of the distillate was collected into 5ml boric acid – methyl red – methylene blue indicator and then titrated with 0.01M hydrochloric acid. The amount of 0.01M HCl used to regenerate the original blue colour of the indicator from the green was recorded as the titer value. The nitrogen content of protein is generally assumed to be 16% by weight. The percentage nitrogen content of each sample was calculated multiplied by a conversion factor of 6.25 to obtain the percentage crude protein.

Determination of crude fat: The fat content was determined using Soxhlet extraction method as described in the AOAC [9]. Based on this 2g of dry mango kernel cake was weighed into a previously prepared extraction thimble. The mouth of the thimble was plugged with fat free absorbent cotton wool. The receiver flask of the soxhlet was clean, dried and weighed accurately before the thimble with sample was introduced into the soxhlet extractor. The apparatus was assembled and filled with petroleum spirit to half capacity of the volume of the flask before the fat of the sample was extracted for 4 hours. Finally the curde fat was determined.

Determination of vitamin C: Hundred gram fresh samples was cut into small pieces and was grinded in a mortal and pestle. Ten ml of distilled water was added several times while grinding the samples and decanting off the liquid extract into a 100 ml volumetric flask. Finally, the ground samples pulp was strain through cheese cloth. The pulp was rinsed with a few 10 ml portions of distilled water and all filtrate and washing were collected in the volumetric flask. The extracted solution was made to 100 ml with distilled water. Five ml of the aliquot sample solution was pipetted into 250 ml conical flask and 20 ml of distilled water, 2 ml of starch indicator solution added to each of the samples. The samples were titrated rapidly with an accurately standardized 0.01N iodine solution containing 16 g potassium iodide per acid. The end point of the titration was identified as the colour changes. Each millititre of iodine is equivalent to 0.88 mg of ascorbic acid, lactone form. The milligram of vitamin C per millitre can be calculated from the relationship, titre value x 0.88 mg [11].

Determination of Oxalate: To determine the oxalte 2 grams of ground mango kernel were suspended in 190 ml of distilled water contained in a 250 ml volumetric flask and boiled for 1 hour. 10 ml of 6M HCl was added before digestion at 100 ºC. The suspension was cooled and made-up to 250 ml mark of the flask and then filtered. Duplicate portion (125 ml) of the filtered mango kernel digest was placed in two different 250ml beaker, followed by the addition of conc. NH_4OH solution (drop-wise) until the test solution changes from its salmon pink color to a faint yellow color. Each portion was heated to 90ºC, cooled and filtered with Whatman No.1 filter paper to remove brownish precipitate containing ferrous ions. The golden yellow filtrate was heated to 90ºC and 10 ml of 5% calcium chloride solution was added while being stirred constantly. The solution was cooled and left overnight at 5ºC thereafter the solution was centrifuged at 2500 rpm for 5min. The supernatant was decanted and the precipitate completely dissolved in 20 cm^3 of 20% v/v H_2SO_4 solution. Finlly the total filtrate resulting from the digestion and oxalate precipitation, which dissolved, in 20 ml of 20% v/v H_2SO_4 solution was titrated against 0.05M KMnO4 solution to a faint pink color which persisted for 30 secs. Finally oxalate was determined using the modified method employed by [12].

Determination of mineral elements: One gram of each sample was weighed into the digestion flask of 250 ml capacity, a 25 ml of nitric acid, perchloric and sulphuric acid was added to each sample. The flask was fixed to a clamp and kept overnight. When the initial reaction subsided, the temperature of the micro-digestion bench was increased slowly from 180 °C to 200 °C. The digestion was continued at that temperature until no visible

particles observe, the temperature was raised up to 240 °C and the digestion acid was evaporated until dense white fume formed within the digestion flask. After the digestion was completed, the content of the flask was filtered and the digested material was kept in a dust proof glass chamber. The samples were digested with the disappearance of brown fumes, diluted to 100 ml for AAS analysis using suitable hallow cathode lamp [11].

Statistical analysis: All statistical data analysis was carried out using stastical package for social studies (SPSS) software version 16.0 and t-test was used to compare the mean differences at the 5% level of significance for each parameters in the mango varietties.

3. Results and Discussion

3.1. Physical characteristics of the components of studied *Mangifera Indica* (mango) fruits

The results of the physical parameters of mango fruit varieties of a bash and Fringe were presented in Table 1.

Table 1: Physical characterstics of diffent *Mangifera indica* L. fruits

Mango variety	Physical parametrs				
	Color	Length (cm)	Dimension (cm)	Firmness	Weight (g)
Firnge	Yellowish	6.5±0.01	4.5±.02	18.3±.01	265.0±0.00
	Yellowish	7.0±0.06	5.2±0.01	15.0±0.05	270.0±0.00
	Yellowish	6.0±0.05	4.2±0.01	15.2±0.01	257.5±0.00
Average	**Yellowish**	**6.5**	**4.63**	**16.61**	**264.17**
Abash	Yellowish	6.0±0.07	4.0±0.01	7.1±0.01	225.0±0.00
	Yellowish	5.5±0.02	4.2±.01	8.9±0.01	249.5±0.00
Average	Yellowish	5.5±0.01	4.0±0.03	15.0±0.01	257.5±0.00
	Yellowish	**5.67**	**4.07**	**10.33**	**244.0**

The weight of Fringe mango measured in this study was ranged from 257.5 g to 270.0 g (Table 1). Similarly the weights of the measured Abash mangos were ranged from 225 g to 257.5 g. comparing the average results of the two mangos showed that Fringe mango was larger in weight than the Abash mango. This diffence in their weight were also statistically significant. The measured kernels dimension for Fringe fruit was also varied from 4.2 to 5.2 cm (Table 1). Whereas the kernels dimension for A bash fruit was ranged from 4.0 to 4.2 cm. Looking on the average kernel dimensions of the two mangos; maximum dimensions was observed in Firnge while minimum kernel dimension was recorded in A bash fruit (Figure 1). Data on kernels dimension were also found statistically significant for both mango varieties.

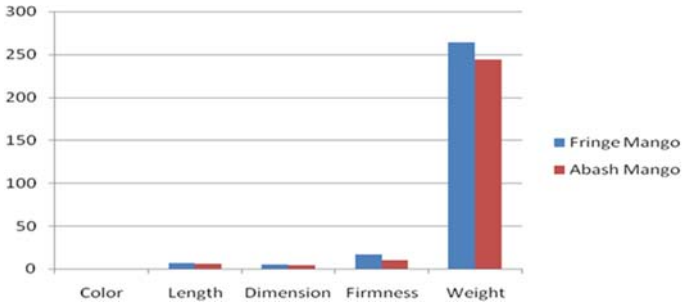

Fig 1: Comparison between the measured physical paramers of mango varieties

Data regarding fruit length of Mango varieties showed that the length of Fringe mango fruit was in between 6.5 to 7.0 cm and the length of Abash fruit was also ranged from 5.5 to 6.0 cm (Table 1). Thus indicated that the length of Fringe mango fruit was larger than the Abash mango fruit. In addition to this the fruit firmness also varied notably according to mango varieties (Figure 1). The higher fruit firmness values were detected in Fringe fruit which is ranged from 15.0 to 18.3. While the lower data recorded on Abash fruit ranged from 7.1 to 14.9.

3.2. Nutritional and antinutritional contents of the studied mango fruits

Similar to the physical parameters of mango, the results of nutritional and antinutritional contets of the measured mango varietries were presented in the following table 2.

Table 2: Results (mean ± SD, n = 3) of nutrients, anti-nutrients and mineral elements in *Mangifera indica* Linn. fruit

Parametrs	Types of mango	
	Fringe mango (mean±SD)	Abash mango (mean±SD)
PH	3.96±0.03	4.14±0.04
Titrableacidity (%)	3.84±0.02	6.02±0.06
Oxalate (mg/100g	1.75±0.03	1.41±0.04
Protein (%)	0.46±0.03	0.62±0.03
Fat (%)	0.43±.02	0.47±0.04
Dry matter (%)	15.0± 0.45	17.4±0.05
Total ash (%)	10.20±0.04	6.20±0.06
Vitamin C (mg/100g)	0.43±0.02	0.75±0.04
Mg (mg/100g)	16.13±0.04	16.98±0.04
Ca (mg/100g)	9.19±0.04	9.49±0.22

The pH in the mango varieties ranged from 3.96 to 4.14 (Table 2). The Fringe mango was contained 3.96 pH value which was lower as compared to the values obtained from the Abash mango which is 4.41 (Figure 2). In addition to this the two mango varieties also contained titratable acidity in between 3.84 - 6.02% showed that the kernels are highly acidic irrespective of the cultivar's. Data regarding ash content (Table 2) also showed that significant variations in between the two mango fruits was observed. Higher ash contents was noticed in Fringe mango variety which is 10.2% as compared to Abash mango variety which is 6.2% (Figure 2).

The amount of Ascorbic acid in both mango varieties show a marked variation (Table 2). The highest content of vitamin C was obtained from Abash mango variety which is 0.75 mg/100g whhile a lowest vitamin C was recorded in Fringe mango variety which is 0.43 mg/100g. In addition there was a statistically significant difference in the vitamin C contents of the samples (p<0.05). Nwofia *et al* [13] stated that vitamin C plays an active role in human health and welfare mostly as an antioxidant. It is also generally used for protein metabolism and collagen synthesis [14]. In general the vitamin C values in the mango fruit variety imply that Abash mango is good source of vitamin C as compared to the Fringe mango.

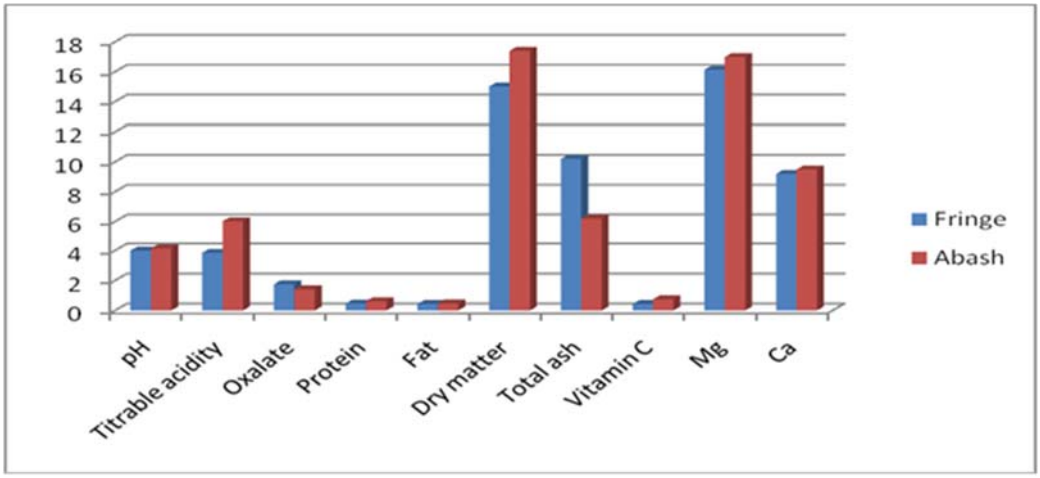

Fig 1: Comparison between the measured nutritional and antinutritional values of mango varieties

Similarly the protein content in the mango fruit samples ranged between 0.62% to 0.46%. The highest protein content 0.62% was observed in the Abash mango and lowest amount in Fringe mango 0.46% (Table 2). There was a significant difference between the mean values of protein in the two mango variety samples. The dry matter content of the studied mango fruit was also ranged between 15.0–17.4%, values obtained for the Abash mango was 15% and Fringe mango was 17.4%. The high dry matter content was recoreded in Fringe mango as compared to Abash mango (Figure 2). In terms of the antinutrient measured in this study the result revealed that the the big seeded variety Fringe mango had the highest values for oxalate 1.75 mg/100 g. Whereas the small seeded variety Abash mango had the lowest value which is 1.41 mg/100 g.

Crude fat content varied from 0.43% to 0.47%. The highest amount of crude fat was recorded in the Abash mango variety which was 0.47% as compared to the values obtained from Fringe mango which is 0.43%. A similar trends was observed in the mineral contents of calcium and magnesium of the two mango variety samples. The amounts of Mg and Ca in the Abash mango were 16.98 mg/100g and 9.49mg/100g respectively. And the amounts of Mg and Ca in the Fringe were 16.13 mg/100g and 9.19 mg/100g respectively (Table 2). In general the contents of Mg and Ca in Abash mango fruit were higher as compared to the values obtained from Fringe mango fruit.

4. Conclusions

The study has shown that in the two varieties of mango; the measured physical parameters like length, dimension, firmness and weight of Fringe mango was higher as compared to the Abash mango. But in the case of measured nutrients like vitamin C, protein, fat and minerals of Ca and Mg the Abash mango was higher as compared to the Fringe mano. The measured antinutrient of oxalate was larger in Fringe mango as comprared to the values obtained from Abash mango. In general based on the measured parameters the Abash mango variety was adjudged to have higher nutritional quality being found to contain the highest amount of nutritional parameters investigated and being the most acceptable as compared to the Fringe mango. But it is also impartant to evalualte the rest nutritional and antinutritional parameters of the *Mangifera indica* to evaluate the overall contents of the mango varieties.

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