Physicochemical and Sensorial Analysis of Papaya Varieties in Ethiopia

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Abstract: A study was carried out on three papaya varieties namely, KK-103, MK-121 and CMF-078 for their physico-chemical, nutritional composition and sensory evaluation grown at Ethiopia. The results showed that maximum fruit weight was observed in MK-121 and lowest in CMF-078. It was also found that the TSS, citric acid, total carotenoid and vitamin C were 10.287-12.620 (brix), 1.455-1.978 (g/l), 13.670-18.912 (µg/g) and 30.854-36.507 (mg/100g) respectively. Proximate analysis of the pulp showed that it contained crude protein (0.200-0.907%), energy (32.744-44.280 kcal/g), crude fat (0.215-0.293%) and fibre (0.732-0.995%). All these results indicate that significantly difference between the papaya varieties. This difference may be come from genetically difference between the varieties. The results showed that papaya fruits had high moisture content (>85.5%), low acidity (>5.3 PH), low crude fat and crude fibre moderate ascorbic acid contents. The sensory evaluation statistical results were showed in case of color, flavor, sourness and sweetness MK-121 Variety was showed significance difference and a higher value than the other two of varieties of papaya whereas except sweetness. The color, flavor and sourness of the two varieties (CMF-078 and kk-103) were showed the same in statistics value. Accordingly, the panelist result in overall acceptability of the sensory CMF-078 variety was showed high acceptability than the others two varieties. Additionally, the statistical result showed significantly different at P<0.05.

Keywords: Papaya, Physiochemical Composition and Proximate Analysis, Sensory Evaluation

1. Introduction

Papaya (Carica papaya L.) is one of the important and versatile fruits of the family Caricaceae and grown worldwide in the tropics and subtropics including India, Bangladesh, Malaysia, Australia, Hawaii, Philippines, Sri Lanka, South Africa and other countries in tropical America [1]. Papaya has been ranked one of the tops for nutritional scores among 38 common fruits [2]. It is available all around the year; therefore, ripe papaya is consumed as fruit and green papaya as vegetable. Carica papaya L. is part of Caricaceae family, and a variety of Caricaceae types have medicinal properties and have been used against diseases for many years [3, 4]. Practically every part of the fruit is used in variety medical purposes [5, 6]. It has been argued by scientists that all parts of papaya, including seeds, roots, rinds, and fruits have positive effects on general health preventing diseases [6, 7].

Fruit quality is one of the most important themes of fruit industry, especially when concerning juice and pulp ones. Since they have a direct impact on the use of synthetic products such as acidifiers, colorants and sugars, for instance, i.e., fruits with adequate physical and chemical properties have the use of synthetic composts reduced on their processed products. The physical and chemical parameters of fruits are important indicators of their maturation and internal and external quality, decisive factors for accomplishment of market demands that have encouraged many researches under different conditions overseas [8, 9].

Papaya fruit quality is affected by the ripening process [10]. Quality is defined as the absence of defects or degree of excellence and it includes appearance, color, shape, injuries, flavor, taste, aroma, nutritional value and being safe for the consumer [10, 11]. Due to a higher market exigency as for high quality products, the juice and pulp industries have been looking for fruits with better internal and external features, including fruit length and width, fruit weight, pulp, seed, peel percentages per fruit, number of
2. Materials and Methods

2.1. Sample Collection and Preparation

This study was conducted in food science and postharvest technology research laboratory of Melkassa agricultural research center. The samples were collected from different tree of papaya; for one variety at least from eight (8)-papaya trees were collected randomly from Melkassa agricultural research center in horticultural research stations. The papaya samples were free from mechanical damage, insect infestation, disease and physiological deterioration. A total of three papaya varieties (kk-103, MK-121, CMF-078) were collected at similar stage of maturity. The collected samples were stored at 12 degrees Celsius for further analysis.

2.2. Sample Preparation

The freshly collected samples of papaya varieties were washed with deionizer water to remove surface dust particles, pathogens from the surface, and the water quickly with a blotting paper and with the aid of a clean sharp knife; the peels, pulp and seed (kernel) of the papaya fruits were removed and homogenized. The fleshes papaya fruits were dried with lyophilizer for further analysis and some of the fresh fleshes fruits were made juice to perform some physicochemical parameters, nutritional composition and sensory analysis. All the experimental analyses were carried out in triplicate analysis.

2.3. Physical and Chemical Properties Analysis

Color of skin and flesh: The color of skin and flesh of papaya varieties were determined through the standard method using color chart [16].

Fruit weight: The fruit weight of papaya varieties was determined through the standard method using sensitive balance [17].

Fruit width, length and diameter: The fruit widths, length, diameter of papaya varieties were determined through the standard method using digital caliper [18].

pH: The pH of the papaya fruit was measured by taking a sufficient quantity of papaya juice sample in 50 mL clean beaker and then the electrode of the pH meter was immersed in to the juice through pH meter [19].

Total Soluble Solid content (TSS): The TSS of papaya varieties was determined using an Atago hand refractometer [20]. A drop of homogenized papaya pulp was placed at the prism of a hand refractometer, which had been calibrated, the lid closed and TSS read directly from the digital scale at 20°C±1 and results expressed in Brix.

TA (Titratable acidity): The TA value was calculated through the standard method of AOAC (2000) [21]. Zero point zero one molar (0.01M) NaOH was titrate against 10ml of the filtrate using phenolphthalein indicator. The end of the titration was indicated through a change in color of the sample to pink. The amount of acid in milligram per hundred grammars (mg /100g) was calculated as stated below.

\[
\text{Titratable acidity} = \frac{0.01 \times 0.0064 \times T \times 10 \times 10}{F_t \times S}
\]

Where 0.01M=morality of NaOH used

0.0064=conversion factor for citric acid, since it is present in papaya.

\(T\)=titer value, \(F_t\)=quantity of filtrate used, \(S\)=quantity of sample weighed

10=dilution factor, and 1000=conversion to mg/100g

Ash (Total Mineral): The ash content was determined followed the standard method described in AOAC (2000) [22]. 2g of dry ground sample was weighted into a clean crucible of predetermined weight. The weight of the sample and crucible was record respectively. The sample was burnt in the muffle furnace at 550°C until the color changed to grey/white hours. The crucible was removed with tong and allowed to cool in desiccators for 30 minutes before reweight the crucible within the samples, the percentage of ash content was calculated using the following formula.

\[
\text{Total ash (\%)} = \frac{\text{Weight of ash}}{\text{Weight of sample}} \times 100
\]

Crude Fat: The crude fat content was determined through soxhlet extraction method described in AOAC (2000) [23]. 5g of dry papaya powder was weighted 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 weighted 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. The amount of crude fat was calculated as the following formula:

\[
\text{Crude fat} = \frac{(WF - W)}{S} \times 100
\]

Where, \(WF\) = weight of the receiver flask and fat deposits \(W\) = weight of empty receiver flask only.
\(S\) = Weight of sample used.

Determination of crude fiber content: The crude fiber content determination was performed according to the standard method AOAC (2000) [24]. 2 grams of dry papaya sample was defatted using soxlet extractor. The fat free sample was transferred into a one-liter (1 liter) beaker. Boiling water was added with 25ml of 2.5M H\(_2\)SO\(_4\) was mixed and the volume was made up to 200ml level. Then, the mixture was boiled for 30 min and filtered by means of suction filtration through the butcher filter. The residue was washed twice with boiling water and transferred into the beaker. Then, 25ml of 2.5M NaOH was added to it and diluted to the 200ml mark. The beaker was heat and boils for 30min and another filtering procedure were done. The resulting residue was quantitatively transferred to a porcelain crucible. Finally, the fiber cake was extracted and dried by moisturizing with small portion of petroleum spirit to half capacity of the volume of the beaker before the fat of the sample was extracted for 4 hours. The crude fat would be cooled in a fume hood; 25 mL of de-ionized water would be added, and shaken to avoid precipitation of sulfate in the solution. A 250mL conical flask containing 25 mL of boric acid, 25 mL of de-ionized water and an indicator solution would be placed under the condenser of the distiller with its tips immersed into the solution. The above digested solution would be transferred into the sample compartment of the distiller. Sodium hydroxide solution (40%) would be added (40 mL) into the digested and diluted solution. The distillation process would be continued for some minute until a total volume reached between 250 mL. The tip of the distiller would be rinsed with a few milliliters of water before the receiver would remove. Finally, the distillate solution would be titrated using 0.1N hydrochloric acid until reddish color appeared. The crude protein would be determined using the formula below:

\[
\text{Protein} = \frac{(V_{\text{HCl sample}} - V_{\text{HCl blank}}) \times N \times 14.0}{W_{\text{L}}} \times 100
\]

Where:
\(N\) = percent of nitrogen
\(V_{\text{HCl sample}}\) = volume consumed by the sample in liter to the end point of titration,
\(V_{\text{HCl blank}}\) = Volume consumed by the blank (without sample)

Total Carotenoid Determination: The total carotenoid content of the sample was performed through harvest plus crops methods of spectrophotometrically using the method described by [27]. About 5 g of papaya flesh sample and 3 g of Hyflosupercel (Celite) were weighted and transferred into a mortar, and then the mixture was grounded with pestle by adding with 50 mL of cold acetone (acetone left in the refrigerator for about 2 ha). It was then filtered with suction filtration through Buchner funnel with filter paper. Then the extract (liquid) sample was put in to a 500-mL separator funnel and 40 mL of petroleum ether was added and mixed with the extract in the separator funnel. 300 mL of distilled water was added slowly and allowed to flow along the walls of the funnel. The upper phase left in the funnels was washed 3–4 times with 200 mL distilled water. The petroleum ether phase was collected in a 50-mL volumetric flask, making the solution pass through a small funnel containing about 15 g of anhydrous sodium sulfate to remove residual water. The sample was made up to volume of 50 ml by adding petroleum ether and the absorbance was read at 450 nm using UV-spectrophotometer. The total carotenoid was calculated with the following formula.

\[
\text{Total carotenoid (µg/g)} = \frac{A \times \text{volume (mL)} \times 10^5}{[A_{1cm} \times \text{sample weight (g)}]}
\]

Where \(A\) = absorbance; \text{volume}=total volume of extract=50 mL; \(A_{1cm}\) = absorption coefficient of β-carotene in petroleum ether (2592).

Vitamin C (Ascorbic Acid): The vitamin c content was determined through the standard methods of Vitamin Assay
2.4. Sensory Analysis

The sensory analysis was conducted by the semi-trained panelist of Melkassa agricultural research staff members accordingly the standard procedures. Statistical analysis of the data was carried out using analysis of variance (ANOVA) technique of completely randomized design (CRD) and all pair wise comparisons test whereas, the Tukey HSD was used for comparison of the treatment means at P<0.05.

3. Results and Discussion

3.1. Physical Properties of Papaya Fruit

The three papaya fruit varieties were subjected to statistical analysis in respect to their physical and chemical characteristics presented in Tables 1 and 2. The fruit weight of the different papaya varieties were varied from the range 355.72 to 1082.6gm (Table 1). The highest fruit weight was recorded in MK-121 and the lowest in CMF-078 variety. Among the varieties, the diameter of the fruit was recorded the maximum in MK-121 and the lowest in CMF-078. As regards to length, it was showed the maximum value in MK-121. Most of the color of fruit was indicated the fruit ripeness even though some fruits skin colors is not (avocado). In case of MK-121 varieties of papaya, the skin and the flash color are the same. However, the rest of two varieties of papaya have been different skin and flash colors. The detailed data of the three papaya varieties were showed different in physical character such as length, weight, and diameter as showed below in the Table 1.

Table 1. The statistical analysis of the physical data of papaya varieties.

| Varieties | Length (mm) | Width (mm) | Weight (gm) | Diameter (mm) | Flesh Color | Skin Color |
|-----------|-------------|------------|-------------|---------------|-------------|------------|
| KK-103    | 186.72a     | 82.782a    | 535.92a     | 38.900ac     | Reddish orange | Yellowish green |
| MK-121    | 250.07b     | 105.385b   | 1082.6b     | 44.182bc     | Bright yellow | Bright yellow |
| CMF-078   | 138.76c     | 77.870c    | 355.72c     | 29.957c      | Reddish orange | Yellow |
| Mean      | 191.85      | 88.678     | 659.08      | 37.680       |             |            |
| CV        | 4.03        | 6.610      | 9.750       | 4.530        |             |            |
| LSD       | 47.96       | 4.912      | 183.20      | 5.282        |             |            |

Note: The table indicated which have the same superscript latter are not significant difference at p>0.05.

3.2. Chemical Parameters of Papaya Fruit

The statistical data on the chemical parameters was presented in Table 2. Based on this statistical data some of the parameters were observed that chemical composition content of selected papaya varieties were not showed much significantly difference (p<0.05) except the vitamin C content. The pH content of the three papaya fruits was not showed significantly different at p<0.05. The TSS (Total soluble solid) value of the three papaya fruit were varied from 10.287 to 12.620 brix. In this case, the TSS value of KK-103 was showed the higher value and CMF-078 Variety was showed the lowest TTS value compared with other selected papaya varieties. The TSS values of papaya in this study highly consistent with the study have been conducted by Zeman and Mekonen teams [29, 30]. Among the variety studied, the acidity (as citric acid) was ranged from 1.454 (MK-121) to 1.978 g/l (CMF-078). The acidity value of the three papaya fruit of this study was consisted with the research work of have been conducted with [6, 30]. Carotenoid is best interesting nutritional part of fruit which have a yellow flesh color like mango, papaya, etc., so in this study the two of papaya fruit varieties the total carotenoid contents were not significant at p<0.05. However, from the three papaya fruit a variety the MK-121 (18.912µg/g) has showed high value of total carotenoid compared with other the two varieties. The Vitamin C (Ascorbic Acid) content of pulp was ranged from 30.854 to 43.407mg/100g. The high value of ascorbic acid/vitamin C content was recorded inMK-121 and the lowest content was recorded in CMF-078 varieties of papaya pulp.

Table 2. The statistical analysis of the chemical parameters data of papaya varieties.

| Varieties | PH | TSS (brix) | Citric acid (g/l) | Total carotenoid (µg/g) | Vitamin C (mg/100g) |
|-----------|----|------------|------------------|------------------------|---------------------|
| kk-103    | 5.667a | 12.620a | 1.6043b | 13.847b | 36.507b |
| MK-121    | 5.520a | 11.493b | 1.4547b | 18.912a | 43.407a |
| CMF-078   | 5.284a | 10.287b | 1.9787b | 13.699b | 30.854b |
| Mean      | 5.49 | 11.47 | 1.68 | 15.49 | 36.922 |
| CV        | 3.78 | 5.89 | 8.03 | 8.80 | 4.21 |
| LSD       | 0.52 | 1.69 | 0.34 | 3.42 | 3.8024 |

Note: The table indicated which have the same superscript latter are not significant difference at p=0.05.

3.3. Sensory Evaluation

Most of the studies on fresh-cut fruits have been concerned with market quality determined objectively and subjectively by color, sensory and texture measurements [31]. In this study sensory evaluation of the three papaya varieties were performed and the analysis was done for the complete ripe papaya fruit. Sensory studies have been carried out to evaluate their quality perception such as color, flavor, sourness and sweetness of the fruit with semi-trained panelists and by using five hedonic scale methods.

Statistically, in case of color, flavor, sourness and
sweetness MK-121 Variety was showed significance difference and a higher value than the other two of varieties of papaya whereas except sweetness; the color, flavor and sourness of the two fruit such as CMF-078 and kk-103 have the same in statistics value. Accordingly the panelist result in over all acceptability of the sensory CMF-078 is better than the others and the result showed statistically different at P<0.05.

### Table 3. Sensorial data analysis of papaya varieties.

| Varieties | Color          | Flavor       | Sourness     | Sweetness     | Overall acceptability |
|-----------|----------------|--------------|--------------|---------------|-----------------------|
| kk-103    | 3.4867<sup>a</sup> | 3.229<sup>b</sup> | 3.0383<sup>a</sup> | 2.8897<sup>b</sup> | 2.9997<sup>b</sup> |
| MK-121    | 4.4133<sup>a</sup>  | 4.594<sup>a</sup>  | 4.1537<sup>b</sup>  | 3.9980<sup>b</sup>  | 3.9623<sup>b</sup>  |
| CMF-078   | 3.2300<sup>b</sup>  | 3.3083<sup>b</sup> | 3.4557<sup>b</sup>  | 4.1280<sup>b</sup>  | 4.7457<sup>b</sup>  |
| Mean      | 3.71            | 3.71         | 3.55         | 3.67          | 3.90                 |
| CV        | 5.92            | 3.25         | 4.99         | 4.02          | 2.83                 |
| LSD       | 0.55            | 0.30         | 0.44         | 0.37          | 0.28                 |

1=Dislike Very Much, 2=Dislike, 3=Neither like nor dislike, 4=Like, 5=Like very much.
Note: The table indicated which have the same superscript latter are not significant difference at p<0.05.

#### 3.4. Proximate Compositions of Papaya Fruit

The proximate composition of papaya fruit statistical data are presented in Table 4. The data showed in Table 4, the moisture content of the three papaya varieties were significantly different at p<0.05 while the range of moisture content was from 87.787 to 90.857%. The KK-103 Variety was showed high value compared with the others varieties. The higher moisture content of the fruit was expected the more exposed to the deterioration/microbial growth. The ash content was ranged from 0.476 (CMF-078) to 0.552 (MK-121). The statistical data showed the ash content was showed a significant difference among varieties. The protein, fat and fiber contents these parameters majorly are not a big deal in fruit and vegetable except some fruits. Because, mostly these parameters are available in high value in cereals, pulse and animal products. However, from this study those varieties of KK-103, CMF-078 were recorded a high value of protein, fat and fiber content respectively. In carbohydrate and energy value, those varieties of MK-121 were recorded in high value. Statistically there were a significant difference in both Carbohydrate and energy value of the varieties of the papaya fruit.

### Table 4. The statistical analysis of the proximate compositions data of papaya varieties.

| Varieties | Moisture    | Ash          | Protein     | Fat          | Fiber         | CHIO %      | Energy (kcal/g) |
|-----------|-------------|--------------|-------------|--------------|---------------|-------------|----------------|
| KK-103    | 90.857<sup>a</sup> | 0.485<sup>b</sup> | 0.907<sup>a</sup> | 0.215<sup>b</sup> | 0.732<sup>a</sup> | 7.543<sup>c</sup> | 32.744<sup>a</sup> |
| MK-121    | 87.784<sup>a</sup> | 0.552<sup>a</sup> | 0.866<sup>a</sup> | 0.238<sup>b</sup> | 0.888<sup>a</sup> | 10.556<sup>a</sup> | 44.280<sup>a</sup> |
| CMF-078   | 89.704<sup>b</sup> | 0.476<sup>b</sup> | 0.200<sup>b</sup> | 0.293<sup>a</sup> | 0.995<sup>b</sup> | 9.32<sup>b</sup> | 36.765<sup>b</sup> |
| Mean      | 89.45       | 0.50         | 0.67        | 0.25         | 0.87          | 9.14        | 37.93          |
| CV        | 0.51        | 1.85         | 3.18        | 4.68         | 2.89          | 4.97        | 4.92           |
| LSD       | 1.14        | 0.023        | 0.05        | 0.03         | 0.06          | 1.14        | 4.68           |

Note: The table indicated which have the same superscript latter are not significant difference at p<0.05.

#### 4. Conclusion and Recommendation

Accordingly, this study it is evident that the physico-chemical parameters of papaya Varieties differed from one other, which is supposed to be due to different general make-up. In addition to this the varieties are because of the difference in their total fruit development. The differences in physico-chemical composition of different papaya varieties are in agreement with the findings of others workers. However, the present study indicates that the fruit of CMF-078 is best since the overall acceptable value for the customer is good. In addition, the variety of MK-121 had a good carbohydrate and energy value than the others and it is good as a source of carbohydrate and energy. Not only had that it had also a better vitamin C and total carotenoid content. So, in this research work the researcher recommended to for fresh consumption of papaya fruit, variety MK-121 is the best in different aspects and it will also use for processing purpose.

#### Conflict of Interest

The authors have no conflict of interest.

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