DEVELOPMENT AND QUALITY CHARACTERISTICS OF GREEN MANGO POWDER (*AMCHUR*) AT DIFFERENT DEHYDRATION TEMPERATURES

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ABSTRACT

A research was conducted to prepare green mango powder (*Amchur*) at different dehydration temperatures and to assess the qualities characteristics during storage. Unripe mature mangoes were washed, peeled and cut into 12 mm thick slices. Potassium metabisulphite solution of 0.1 % (w/v) was prepared and the slices were dipped into the solution for 5 minutes. These slices were placed in a single layer on trays. Mango slices were dried in the sun and at 40°C, 50°C, 60°C and 70°C in a vacuum drier. Nutritional analysis was carried out for fresh unripe mango and green mango powder (*Amchur*) for moisture, titrable acidity, ascorbic acid and total sugars. The results of nutritional analysis of greenmango powder revealed that therewere significant differences between the treatments for moisture, titrable acidity, ascorbic acid and total sugars Nine-point hedonic scale ranking method was used to evaluate the organoleptic characteristics. The results indicated that there were significant differences among the mango powder of different preparations in flavour, taste, colour, absence of off-flavour and overall acceptability. The findings of the research revealed that the green mango powder prepared from the unripe mango dried at 50°C had the best shelf life in terms of nutritional and organoleptical qualities.

Key words: *Amchur, dehydration, green mango powder, quality, shelf life*

1.INTRODUCTION

Fresh fruits are inherently perishable after harvest. During the process of distribution and marketing, substantial losses are incurred which range from a slight loss of quality to total spoilage. Postharvest losses of fresh produce range from 40 to 60% which can be occur at any point in the marketing process from the initial harvest through assembly and distribution to the final consumer. The causes of losses are many: physical damage during handling and transport, physiological decay, or sometimes simply because there is a surplus in the market place and no buyer can be found. Losses are high in many Asian countries because of the inherent difficulty of collecting and transporting small quantities of produce from numerous small farms and trying to collect these into a large enough quantity for efficient domestic marketing or for export (Loesecke, 2004).

Due to above reasons and their nature of production seasonality, the world take an attempt in the production of fruits in large amount by introducing modern technologies. But they are forced to face some problems when produce abundant quantity. Compared with temperate fruit crops, tropical and subtropical fruits often have greater problems in harvesting, storage and transportation because of their greater postharvest losses and perishability. Therefore, fruits must be subjected to preservation techniques soon after harvesting. One of the oldest methods of food preservation is drying, which reduces water activity sufficient to delay or prevent bacterial growth. Historically, food was dried in the sun. Nowadays, we can sun dry or dry in an oven or a dehydrator that is especially designed for home drying Srilakshmi (2001). Most of the raw sour mangoes are wasted due to their sour taste. Dehydration of raw mangoes can overcome this problem. It is an economically feasible method, because not only reduce the wastage but also prevent the problem faced during harvesting, packaging, storage and transportation. Therefore, this study was conducted to find out the suitable temperature for drying of green mango and to evaluate the quality and shelf life of green mango powder.

2.METHODOLOGY

2.1. Material Collection and Sample Preparation

Unripemature mango fruits (cv. *walamba*) wereobtained from a commercialfarm in the Batticaloa District. Unripe mature mangoes were washed and peeled. They were cut into suitable size (12mm thick slice). Potassium metabisulphite solution of 0.1 % (w/v) was prepared and the slices were dipped into the solution for 5

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minutes. These slices were placed in a single layer on trays. The following dehydration methods and temperatures were used to dehydrate the mango slices: Sun drying, 40°C, 50°C, 60°C and 70°C.

The treatments are listed as follows:

T_1 Green mango powder obtained from unripe mango dried in sun for 16 hours

T_2 Green mango powder obtained from unripe mango dried at 40°C for 15 hours

T_3 Green mango powder obtained from unripe mango dried at 50°C for 12 hours

T_4 Green mango powder obtained from unripe mango dried at 60°C for 10 hours

T_5 Green mango powder obtained from unripe mango dried at 70°C for 9 hours

2.2 Nutritional Analysis of Green Mango Powder during Storage

The powder was obtained by grinding the dried material in a grinder for 3 min and stored in plastic lids airtight containers. The chemical characteristics of the dried mango powder were assessed using standard AOAC (2000) methods. The moisture content was measured by drying the powder in oven at 105ºC. The ascorbic acid content was determined using sodium salt of 2, 6-dichlorophenol indophenol dye. Measurement of total acidity was conducted using a standard 1% phenolphthalein solution, titrated against 0.1 N NaOH and the result was expressed as percentage of citric acid in the sample. The total sugar content was estimated by Layon and Eynon method using Fehling's solutions. Three replicates were carried out for each treatment. Storage studies were also carried out for the dried mango powder at 2 weeks interval throughout the experimental period.

2.3. Shelf life Evaluation

The shelf life of green mango powder (*Amchur*) was assessed based on the nutritional and sensory qualities. The samples were nutritionally tested at 2 weeks interval and visual observations also carried out daily to evaluate the spoilage of powder.

2.4. Sensory Evaluation

The sensory evaluation was carried out by a panel consisting of 30 trained people. Organoleptic evaluation was carried out for mango flavour, taste, colour, absence of off-flavour and overall acceptability for the best dried green mango powder. Panelists were asked to rate the samples using a nine-point hedonic scale in 1 is denoted as "dislike extremely" and 9 denoted as " like extremely".

2.5. Statistical Analysis

Nutritional and storage studies were analyzed by Analysis of Variance (ANOVA) and the difference between means was compared using Duncan's Multiple Range Test (DMRT), through Statistical Analysis System (SAS) software statistical package while the Sensory parameters were analyzed by Friedman's Test using Minitab software.

3. RESULTS AND DISCUSSION

The moisture content of fresh unripe mango was 80.4%. This was supported by Wenkam (1990). The unripe mature mango slices were dried at different dehydration temperatures until the slices became dry but not sticky and leathery. The size, shape, colour and texture of unripe mango slices were changed during drying. Srilakshmi (2001) reported that the optimal temperature and time for drying of fruits is 50°C and 20-24 hours. Changes in the nutritional quality of foods may occur as a result of drying. In general, drying should result in high retention of nutrients with the exception of vitamins C and D. Vitamin B losses in drying relatively low (Brennan, 2000). The moisture content of fresh unripe mango and the green mango powder soon after the product prepared is shown in Table 1.

Table 1: Moisture Content of Fresh Unripe Mango and Green Mango Powder

Treatment	Moisture Content (%)
Fresh	80.4
T_1	6.1
T_2	6.9
T_3	7.6
T_4	7.4
T_5	7.0

Moisture increased significantly ($p<0.05$) throughout the storage period. Treatment 3 (T_3) (*Amchur* obtained from unripe mango dried at 50°C) had the slowest rate of increasing trend than all other treatments. Green mango powder (*Amchur*) is highly hygroscopic. Dabhade and Khedkar (1980) found that the optimum relative humidity for proper storage of *Amchur* was 40 – 43% and observed that equilibrium relative humidity of *Amchur* with initial moisture of 7.3% was found to

be 40%. Above 70%, deterioration in colour, texture and mould infestation take place and therefore *Amchur* should be stored in dark, relatively dry place (below 70% relative humidity). Teaotia *et al*., (1987) observed that *Amchur* packed in glass jars could be stored up to six months at room temperature of 12-35°C.

The Titratable acidity of fresh unripe mango and the green mango powder soon after drying is shown in Figure 1.

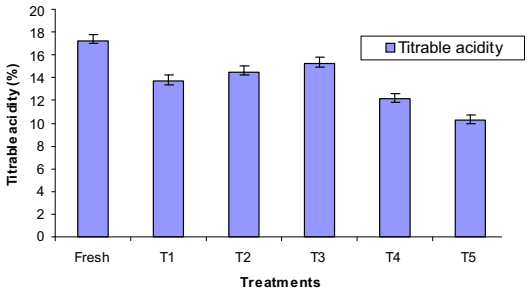

Figure 1: Titrable Acidity of Fresh Unripe Mango and Green Mango Powder

The acid content of *Amchur* was lower than the fresh mango. This is due to the evaporative losses of acids during drying. The *Amchur* obtained from the unripe mango dried at 70°C showed low acid content than the other treatments. This is supported by Josyin (1980). Mahedran (2008) stated that drying of mango pulp at high temperatures cause high losses of acids in the dehydrated powder. In all treatments titratable acidity was decreased with the storage period. This is may be due, reaction of acids with other food components. Our findings are also supported by Dabhade and Khedkar (1980).

The ascorbic acid content of fresh unripe mango and the green mango powder soon after the product prepared is shown in Figure 2. This is to compare the effects of dehydration temperatures on the ascorbic acid content of green mango powder. Fresh unripe mango shows higher ascorbic acid content than the green mango powder. The green mango powder obtained from the unripe mango dried at 70°C showed the lowest amount of ascorbic acid content than the A*mchur* obtained from the unripe mango dried in sun, 40°C, 50°C and 60°C. This is due to the loss of ascorbic acid by oxidation at high temperature treatment. This was supported by Watada *et al*. (1991).

Ascorbic acid content has the decreasing trend with the storage period in all treatments. This reduction is due to the oxidative deterioration of ascorbic acid

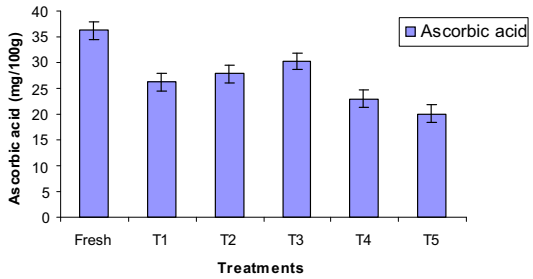

Figure 2: Ascorbic acid Content of Fresh Unripe Mango and Green Mango Powder

during storage. According to Srilakshmi (2001) that if fruits are bruised, peeled, cooked or exposed to air vitamin C may be oxidized. When comparing the temperature effect, the loss of ascorbic acid content was higher in *amchur* obtained from unripe mango dried in higher temperature than at the lower temperature.

The total sugar of fresh unripe mango and the green mango powder soon after the product prepared is shown in table 2. Among the treatments the green mango powder obtained from the unripe mango dried at 70°C contained lowest total sugar content. This is due to the high losses of sugars taken place at high temperature by caramalization and non – enzymatic browning than that of low temperature. Similar results were reported for mangoes (Peacock and Blake, 1990) and Banana (Mahendran and Prasannath, 2008). High caramalization of sugars taken place during drying of fruits at high t-emperature than that of low temperatures (Mahendran, 2008).

Table 2: Total Sugar content of fresh unripe mango and green mango powder

Treatment	Total Sugar Content (%)
Fresh	14.1
T_1	10.4
T_2	11.6
T_3	12.3
T_4	10.0
T_5	9.1

In all treatments, the total sugar content has the decreasing trend with the storage period due to the losses of sugars during storage at room temperature. During heating, the sugars undergo dehydration and produce characteristic flavour, aroma and colour. The powder loses its nutritional value due to maillard reaction (Fennema, 2000). The green mango powder obtained from the unripe mango dried at 70°C had lower total sugar content than the green mango powder obtain from the unripe mango dried at 40°C, 50°C, 60°C and sun. This is due to the high losses of sugars taken

place at high temperature than that of low temperatures. This is supported by Peacock and Blake (1990).

The Ready-to-serve drink was prepared from green mango powder and evaluated for the sensory qualities by trained panelists. The results are shown in Table 3. There were no significant differences between the treatments of green mango powder drink obtained from the unripe mango dried at 40°C and sun (T_1 and T_2) for taste, colour, flavour and absence of off flavour. The treatment of green mango powder obtained from the unripe mango dried at 50°C (T_3) had the highest mean value for taste, colour, flavour and absence of off flavour.

Table 3: Sensory Attributes of Green Mango Powder Drink

Treatments	Taste	Colour	Flavour	Absence of Off - flavour	Overall acceptability
T_1	6.35 ± 0.16^b	6.65 ± 0.13^b	6.60 ± 0.13^b	5.90 ± 0.16^b	6.55 ± 0.16^b
T_2	6.20 ± 0.17^b	6.80 ± 0.13^b	6.20 ± 0.18^b	7.90 ± 0.17^b	6.15 ± 0.16^b
T_3	8.20 ± 0.17^a	8.40 ± 0.15^a	7.10 ± 0.16^a	7.35 ± 0.20^a	8.20 ± 0.17^a
T_4	6.75 ± 0.16^c	5.60 ± 0.13^c	6.35 ± 0.16^c	5.80 ± 0.15^c	5.75 ± 0.16^c
T_5	4.80 ± 0.17^d	5.05 ± 0.16^d	4.55 ± 0.19^d	5.70 ± 0.14^c	4.85 ± 0.18^d

The values are means of 30 replicates ± standard error
The means with the same letters are not significantly different from each other at 5% level based on DMRT.
The sensory qualities were analyzed in 9.0 hedonic scale.

Table 3 shows that the green mango powder obtained from the unripe mango dried at 60°C and 70°C (T_4 and T_5) had the least mean value and they were significantly differed from each other. Therefore, the treatment where the green mango powder drink obtained from unripe mango dried at 50°C had highest overall acceptability based on the organoleptic qualities.

CONCLUSION

The results of nutritional analysis of green mango powder revealed that there were significant differences between the treatments and days of storage for moisture, acidity, ascorbic acid and total sugars. Nutritional parameters were decreased with storage period. The changes in organoleptic qualities attribute such as colour, flavour, taste, absence of off-flavour and overall acceptability was low in green mango powder (*Amchur*) during the storage period. The findings of the research revealed that the green mango powder obtained from the unripe mango dried at 50°C had the best shelf life based on the nutritional and organoleptic point of view compared to other treatments. The shelf life evaluation revealed that the green mango powder could be stored for 12 weeks without any significant changes in quality attributes.

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