

CHANGES IN QUALITY CHARACTERISTICS OF BILIMBI (*Averrhoa bilimbi* L.) POWDER DURING STORAGE UNDER AMBIENT CONDITIONS

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INTRODUCTION

Food preservation has an important role in the conservation and better utilization of fruits in order to avoid the glut and utilize the surplus during off-seasons. It is necessary to employ modern processing techniques to extend storage life for better distribution and to preserve them in both small scale and large scale. One of the earliest methods of food preservation is by drying, which reduces water content to delay or prevent microbial growth. Bilimbi (*Averrhoa bilimbi* L.) belongs to the family *Oxalidaceae* and is widely cultivated in the tropics, including Sri Lanka. As Bilimbi is a highly under-utilized fruit, it can be preserved by making it as a processed food to use during off-seasons. Dried powder is the value added product of unripe Bilimbi fruit used in curries, food dishes and as powdered drinks. Realizing the importance of fruit, as a cheap, highly nutritious and of its perishable nature and seasonal availability it was decided to make a preserved product for human consumption throughout the year. Therefore, this study was carried out to utilize the Bilimbi fruit by preserving it as dried powder and to assess the changes in quality characteristics of Bilimbi powder during storage under ambient conditions.

METHODOLOGY

Unripe mature Bilimbi fruits used in this study were obtained from the Regional Agricultural Research Station, Batticaloa from April to June 2010. They were washed and cut into 12 mm thick slices. Potassium metabisulphite solution of 0.05 % (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. The following dehydration methods and temperatures were used to dry the Bilimbi slices: Sun drying, drying in heat pump dehumidifier dryer at 40°C, 50°C, 60°C and 70°C. The temperature and duration for dehydration were identified by preliminary experiments carried out in the laboratory. The dried slices were ground into powder using a grinder for 3 minutes and the resultant powder was sieved into a particle size of 100 µm. The developed powders were stored in airtight plastic containers at ambient temperature of 30±1°C. The samples were tested at 2 weeks intervals to assess the nutritional quality and shelf life. Treatments are;

- T₁ - Powder obtained from unripe Bilimbi dried in sun for 18 hours
- T₂ - Powder obtained from unripe Bilimbi dried at 40°C for 16 hours
- T₃ - Powder obtained from unripe Bilimbi dried at 50°C for 14 hours
- T₄ - Powder obtained from unripe Bilimbi dried at 60°C for 12 hours
- T₅ - Powder obtained from unripe Bilimbi dried at 70°C for 10 hours

Nutritional qualities such as moisture, fibre, tritatable acidity (as % citric acid), ascorbic acid and total sugar content of bilimbi powder were analyzed using standard AOAC methods (2002). The microbial assessment was carried out by estimating total plate count. The organoleptic parameters were judged by 30 untrained members using a nine-point hedonic scale for the drink prepared from bilimbi powder. All analyses were performed in triplicates. Data obtained in nutritional analysis were subjected to ANOVA and mean separation was performed with DMRT. Descriptive statistics was done on sensory attributes and the means were compared using the Tukey's test (p<0.05).

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RESULTS AND DISCUSSION

The results of nutritional analysis of developed Bilimbi powder samples are given below. Bilimbi powder is highly hygroscopic. Moisture increased significantly ($p < 0.05$) throughout the storage period (Figure 1) in which powder obtained from unripe Bilimbi dried at 50°C had the slow rate of increasing trend of 3.4-5.1% than other treatments. This value was found to be within the acceptable level (4-7%) of moisture content in dried products. Similarly, Praveena and Mahendran (2009) reported that moisture was increased from 4.1 to 5.2% in green mango powder during storage at $30 \pm 1^\circ\text{C}$.

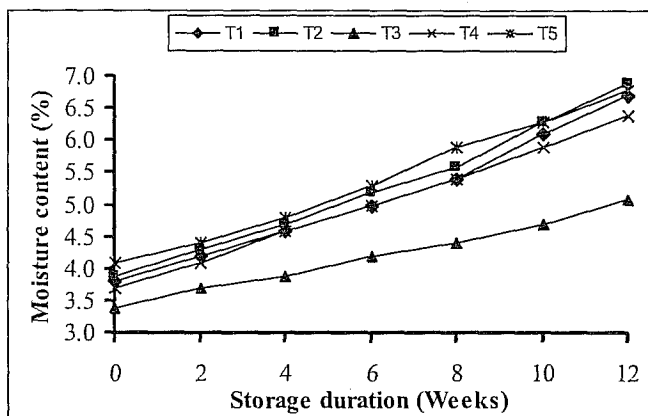


Figure 1: Changes in moisture content of Bilimbi powder during storage

Fibre content in all treatments had the decreasing trend with the storage period due to the hydrolysis of fibres to simple compounds in acidic condition. Increasing acidity in all treatments resulted in the fibres being hydrolyzed at low pH (Brennan, 1994). The maximum value of fibre 0.69% was observed in powder obtained from the unripe Bilimbi dried at 50°C where as the minimum value of 0.32% was observed in powder obtained from unripe Bilimbi dried at 70°C.

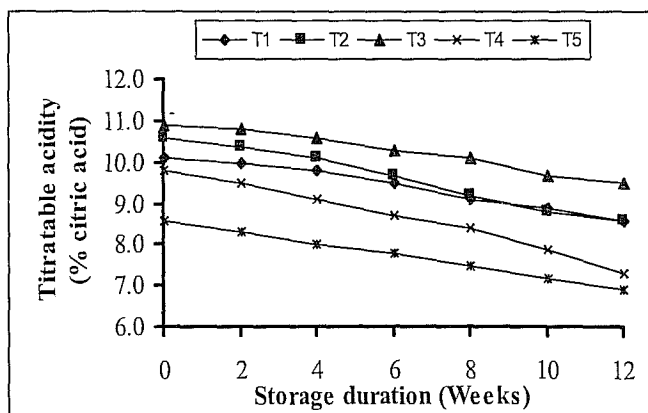


Figure 2: Changes in titratable acidity of Bilimbi powder during storage

The change in titratable acidity of the Bilimbi powder during storage at $30 \pm 1^\circ\text{C}$ is presented in Figure 2. In all treatments titratable acidity was decreased with the storage period. The findings of this study are also supported by Dabhade and Khedkar (1980). The maximum value of acidity 9.5% as citric acid was observed in powder obtained from the unripe Bilimbi dried at 50°C at the

end of storage. According to the ANOVA there were significant differences between the treatments and weeks of storage for the titratable acidity at 5% significance level.

Ascorbic acid content had the decreasing trend with the storage period in all treatments as shown in Figure 3. This reduction is due to the oxidative deterioration of ascorbic acid during storage. According to Srilakshmi (2001) that if fruits are bruised, peeled, cooked or exposed to air vitamin C may be oxidized.

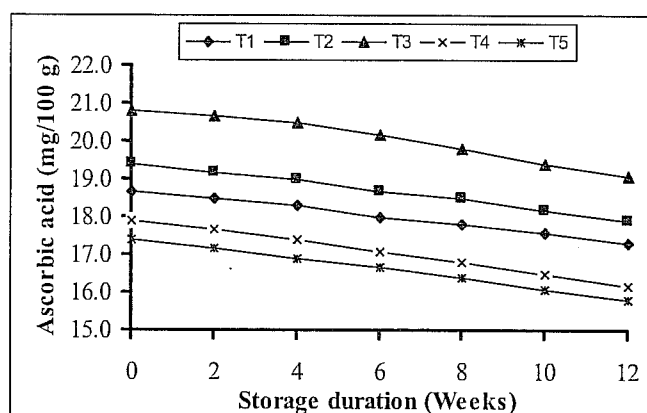


Figure 3: Changes in ascorbic acid content of Bilimbi powder during storage

In all treatments, the total sugar content showed a decreasing trend with the storage period (Figure 4). This may be attributed to the polymerization reactions of sugars during storage at room temperature. During heating sugars undergo dehydration and produce characteristic flavour, aroma and colour. The total sugars losses in foods are due to maillard reaction (Fennema, 1996) during storage.

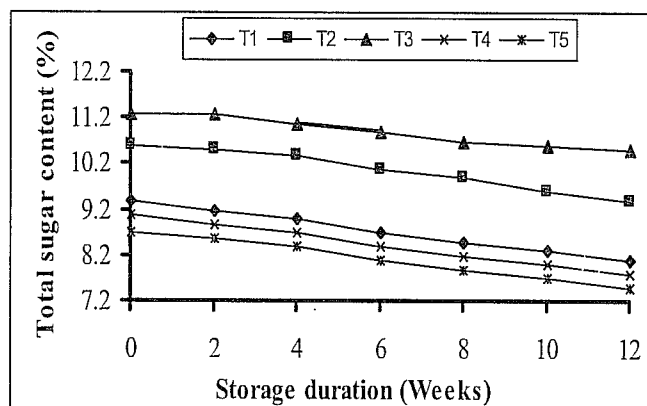


Figure 4: Changes in total sugar content of Bilimbi powder during storage

The microbiological examination, in terms of total plate count revealed that there were no any microbes observed upto 12 weeks of storage in the developed Bilimbi powders because low pH inhibited bacterial growth. Manjunath *et al.* (1991) also reported that there was no microbial contamination in tamarind powder stored at ambient condition. Therefore, these samples are suitable for consumption as it is free from microbes.

No significant differences were observed between the treatments of Bilimbi powder drink obtained from the unripe bilimbi dried at 40°C and sun (T₂ and T₁) for taste, colour, flavour and

absence of off-flavour (Table 1). The powder obtained from the unripe Bilimbi dried at 50°C (T₃) had the highest mean value for taste, colour, flavour and absence of off-flavour. Therefore, the treatment where the Bilimbi powder drink prepared from unripe Bilimbi dried at 50°C for 14 hrs had highest overall acceptability by the panelists.

Treatment code	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

Table 1: Mean values of organoleptic qualities of dried Bilimbi powder drink

CONCLUSIONS

The results of nutritional analysis of Bilimbi powder revealed that there were significant differences between the treatments and period of storage for moisture, fibre, titratable acidity, ascorbic acid and total sugars. Nutritional parameters showed a tendency to decrease with storage period; however at slower rate. Organoleptic qualities of Bilimbi powder were also indicated significant changes during the storage period. The findings of this research revealed that the Bilimbi powder obtained from the unripe Bilimbi dried at 50°C for 14 hrs had the best shelf life with nutritional and organoleptic point of view compared to other treatments. The shelf life evaluation showed that the Bilimbi powder could be stored for 12 weeks without any significant changes in quality with consumable acceptability to the health point of view.

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