Indian Journal of Natural Products and Resources
Vol. 7 (2), June 2016, pp. 176-180

SHORT COMMUNICATION

Evaluation of technology for low cost drying of banana slices

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Received 11 January 2014; Revised 5 April 2016

Banana for table purpose is among the largest grown fruit in India. Ripe banana contains about 80 % moisture, hence susceptible to post harvest losses. Due to its bulky nature and rapid weight loss, it is very difficult to transport the fruits and long-term storage as such is not possible, thus drying it is one of the options for reducing post harvest losses. Thus, the present study was undertaken to standardize the best pretreatment for drying of bananas with better retention of quality characteristics. The pretreatments used were 0.2 % citric acid dip and blanching. These were then compared with control in which no treatment was given to the banana slices. Sensory analysis was conducted by the panelists for different parameters like colour, taste, texture and overall acceptability. However, colour retention was found better in both the treatments as compared to the control. Effect of drying on different parameters like moisture content, rehydration ratio and starch content were also analyzed. Drying of bananas slices in poly tunnels with these pretreatments has been found cost effective and an easy method to reduce the bulk of the crop and increase its shelf life.

Keywords: Banana, Drying, Pretreatments, Solar drying, Low cost, Value addition.

IPC code; Int. cl. (2015.01)–A23B 7/00, A23N 12/00, A61K 36/00, F26 B

Introduction

Banana is an important fruit crop produced largely world over. It is a good source of carbohydrate[1] and is consumed both as energy-yielding food and as dessert, providing more than 200 calories a day[2]. It is enriched with calcium, vitamins A, B_1, B_2, B_3, B_6, C and minerals such as potassium and phosphorous. But due to the high water content, it is susceptible to mould growth. The shelf-life of fruit is very less and it cannot be stored for more than two weeks. Drying brings substantial reduction in weight and volume, which minimizes packaging, storage and transportation costs[3,4]. Moreover, products with low moisture content can be stored at ambient temperatures for longer periods of time due to a considerable decrease in the water activity of the material with reduced microbiological activity, minimized physical and chemical changes[5,6]. Blanching or acid dip is an important pre-treatment step to facilitate drying of fruits and vegetables[7-9]. Solar drying of bananas is the cheapest method of drying and preserving the fruits for long term[10] and therefore, drying under solar drier is a good option to minimize the postharvest losses. However, the drying process may lead to changes in physico-chemical and functional components. Therefore, the main objective of this study was to determine the effect of different pre-treatments and solar tunnel drying on the physico-chemical and functional properties of banana.

Material and Methods

Preparation of chips

Banana fruits for the study were obtained from the local market and all the physico-chemical analysis for fresh and dried bananas were carried out in the Department of Food Science and Technology, Dr YS Parmar University of Horticulture and Forestry, Nauni, HP, India. For preparation of banana chips different treatments (0.2 % citric acid and blanching for one minute) were used, whereas in control only water dip was given. After removal of banana peel, chips of equal size were prepared and dried under solar drier for 24 h. Dried chips were vacuum packed in high density polybags for further use (Fig. 1).

Physico-chemical analysis

Rehydration of fruit samples

Rehydration experiments were carried out in distilled water at 45 °C[11]. Fruit samples (10 g) were added to 100 mL of water and mixed thoroughly. The samples were allowed to rehydrate for 5 h. After rehydration period, the excess water was drained out.

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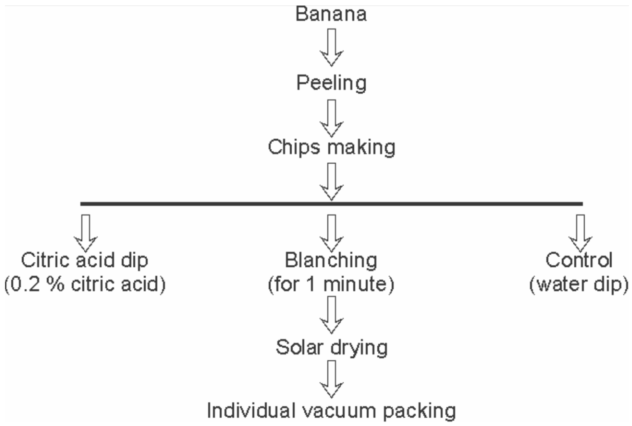

Fig. 1-Unit operation for preparation of dried banana chips

Rehydration ratio

Rehydration ratio was expressed as a ratio of water absorbed by the dried sample to the weight of the dried sample[12].

Total ash

For determination of ash content, 10 g of each sample was weighed in a silica crucible[12]. The crucible was heated in a muffle furnace for about 3-5 h at 600 °C. It was cooled in a desiccator and weighed after completion of ashing. To ensure complete ashing, it was heated again in the furnace for another half an hour, cooled and weighed. This was repeated consequently till the weight became constant (ash became white or grayish white).

Total soluble solids (TSS)

TSS of fresh and dried samples (after rehydration) was measured using Erma hand Refractometer. The readings were corrected for temperature variation to 20 °C as per International Temperature Correction Table 3 and results were expressed as °Brix.

Titratable acidity

Titratable acidity was estimated by titrating a known volume of the sample against standard 0.1 N NaOH solution by using phenolphthalein as an indicator up to the end point (pink colour). The titratable acidity was expressed as per cent malic acid[12].

Reducing and total sugars

A known weight of sample (25 g) was taken in a 250 mL volumetric flask and 100 mL water was added to it. Solution was neutralized with 1 N NaOH and 2 mL of 45 % lead acetate was added to it and kept for 10 minutes. Excess of lead acetate was removed from the sample by using 2 mL of 22 % potassium oxalate in 250 mL volumetric flask. After diluting it up to the mark, the solution was filtered and clear filtrate was taken to estimate reducing sugars by titrating against a known quantity of Fehling's A and Fehling's B solution using methylene blue as an indicator[14].

Total sugars were estimated by adding 5 g of citric acid to 50 mL calibrated sample solution and heating it for 10 minutes. For complete inversion of sugars, neutralizing with NaOH and making volume 250 mL in volumetric flask was done.

Quantitative analysis of antioxidant compounds

Ascorbic acid

Ascorbic acid content was determined as per standard AOAC method using 2, 6- dichlorophenol indophenol dye[11]. The sample extracted in 3 % m-phosphoric acid was titrated with the dye to an end point of pink colour. Results were expressed as mg per 100 g of sample.

Total phenolics

The amounts of total phenolics in the fruits were determined with the Folin-Ciocalteu reagent according to the method of Bray and Thorpe[15] using catechol as a standard. One gram of sample was taken and grinded with 10 mL of 80 % ethanol in pestle and mortar, and centrifuged for twenty minutes at 1000 rpm and filtered. Filtrate was evaporated in oven up to dryness and dried extract was dissolved in 5 mL distilled water. Aliquot (0.2-2.0 mL) was taken in separate test tubes and volume was made up to 3 mL, to which 0.5 mL Folin-Ciocalteu reagent was added. After three minutes, 2 mL of Na_2CO_3 (20 %) was added and mixed. Test tubes were placed in boiling water bath for one minute and then cooled. Optical density of the sample was recorded at 650 nm with the help of Spectronic-20, USA. The concentration was determined as per the standard procedure from the standard curve prepared using different concentrations (8-32 µg/mL) of catechol and the results were expressed as mg per 100 g on fresh weight basis.

Sensory analysis

Sensory analysis was performed over 9 point hedonic scale[16]. Coded samples were given to the judges and asked for evaluation as per prescribed performa.

Statistical analysis

The data of physico-chemical studies were analysed by completely randomized design[17]. Data of sensory analysis generated by different experiments in general were analysed by randomized block design as per the recommended methods[18].

Results and Discussion

Physico-chemical properties

Physico-chemical analysis of fresh banana (Table 1) shows that it contains higher amount of TSS (23.20±0.16 °B), moisture content (75.57±0.009 %) and sufficient amount of acidity (0.125±0.002 % MA), which makes it more susceptible to microbial and physiological damage. A good amount of antioxidant compounds, ascorbic acid (20.6±0.16 mg/100 g) and total phenols (46.96±0.03 mg/100 g) makes the fruit rich in antioxidant.

Figure 2 shows the effect of different treatments on amount of moisture loss in banana with drying time. As the initial moisture content was very high, hence the loss of moisture from 0-3 h was high. As the moisture content decreases, loss in weight was also reduced as compared to initial weight. After 5 h equilibrium point was reached and there was no further loss in weight from 5-6 h[19,20]. From the figure, it can be observed that loss in weight was higher in banana chips treated with citric acid as compared to control.

Table 2 shows the effect of different treatments on weight of banana chips before and after drying. Blanching has been reported with more loss in weight and better drying of banana chips[23]. Blanching is known to increase the permeability of cell walls, thus favouring faster water migration to the surface for removal[21]. Moreover, pectic substances are reduced by blanching and may account for the greater change in thickness[22].

Effect of different treatments on physico-chemical properties of dried banana is shown in Table 3. Highest TSS was observed in citric acid (0.2 %) treated banana slices followed by the blanching treatment and lowest in control. The rehydration ratio was lowest in case of blanching (1:3.14) and highest in case of citric acid dip (3.85:1). This might be because blanching causes broken membranes with formation of vesicles, plasmalemma breakage as well as some cell wall degradation[23].

Antioxidant compounds

Table 4 represent the antioxidant compounds (ascorbic acid and total phenols) present in dried banana chips of different pre-treatments. Ascorbic acid decreased after drying compared to fresh fruit though the highest amount was observed in citric acid dip treatment (6.14 mg/100 g) followed by blanching (5.32 mg/100 g). Ascorbic acid, a water-soluble vitamin, is difficult to retain during the dehydration of foods because it is susceptible to heat[24,25]. Moreover,

Table 1-Functional characteristics of fresh banana

Physico-chemical characteristics	Fresh banana
TSS (°B)	23.20±0.16
Moisture content (%)	75.57±0.009
Acidity (% MA)	0.125±0.002
Reducing sugars (%)	17.23±0.16
Total sugars (%)	19.22±0.03
Antioxidant compounds	
Ascorbic acid (mg/100 g)	20.6±0.16
Total phenols (mg/100 g)	46.96±0.03

Table 2-Weight of fresh and dried banana chips of different treatments

Characteristics	Citric acid dip (0.2 %)	Blanching (1 minute)	Control
Fruit weight	1490 g	1470 g	1430 g
Waste	740 g	650 g	600 g
Weight of chips (after drying)	161.77 g	167.11 g	198.45 g

Table 3-Physico-chemical properties of dried banana

Characteristics	Citric acid dip (0.2 %)	Blanching (1 minute)	Control
TSS (°B)	74.20±0.16	65.20±0.09	64.60±0.16
Rehydration ratio	3.85:1	3.73:1	3.14:1
Total ash (%)	2.40±0.06	2.10±0.10	1.86±0.12
Acidity (% MA)	1.186±0.53	1.007±0.003	0.991±0.01
Reducing sugars (%)	23.95±0.03	20.44±0.04	18.33±0.02
Total sugars (%)	52.85±0.02	47.44±0.03	45.96±0.02

Table 4-Antioxidant compounds after sun drying in banana chips

Antioxidant compounds	Citric acid dip (0.2 %)	Blanching (1 minute)	Control
Ascorbic acid (mg/100 g)	6.14±0.06	5.32±0.11	5.03±0.12
Total phenols (mg/100 g)	62.21±0.03	54.22±0.04	49.83±0.05

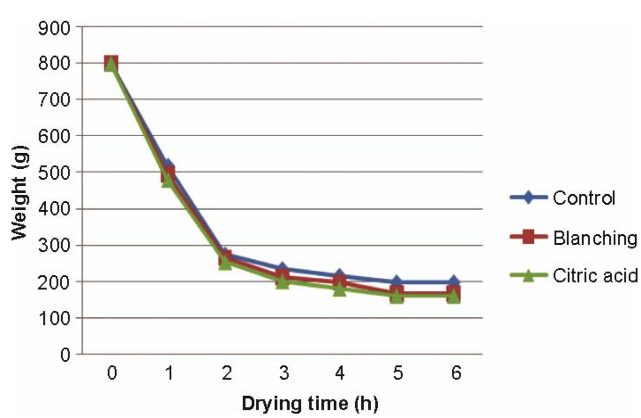

Fig. 2-Effect of different treatments on drying of banana chips

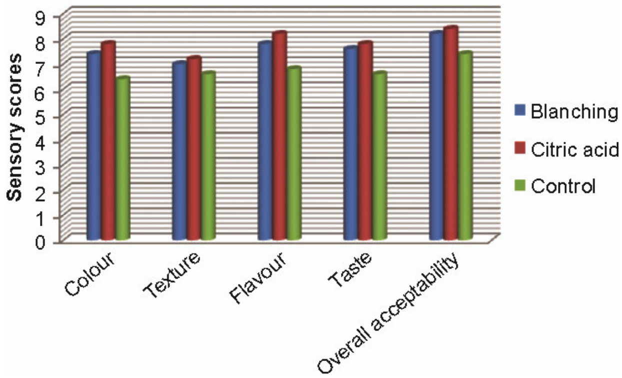

Fig. 3-Sensory analysis of dried banana chips of different treatments

ascorbic acid and its oxidation product (dehydro ascorbic acid), has many biological activities in the human body due to its antioxidant properties[26,27].

Total phenols increased after solar drying as compared to fresh fruit. It might be due to the formation of Maillard reaction products leading to formation of new phenolic compounds from their precursor at high temperature[28,29]. Moreover, it can be presumed that bound phenolics with larger molecular weight in samples, might have been liberated into simple free forms by heat treatment leading to enhancement of total phenolic contents[30].

Sensory analysis

Sensory analysis was conducted by the panel of judges for the banana chips of different treatments (Fig. 3). Colour, texture, flavour, taste and overall acceptability of banana chips of citric acid treatment was adjudged best, which might be due to better preservation of the colour during drying and moreover addition of acids may have improved the flavour and taste of the dried chips.

Conclusion

Banana being a perishable commodity has a short shelf-life. To increase its shelf-life, it can be converted into value added products and a low cost method i.e. drying is an ideal option. Among the different treatments, citric acid dip pre-treatment before solar tunnel drying can improve the quality of dried banana slices. Moreover, citric acid treatment is able to preserve the nutrients loss and also improve the flavor of banana chips. Preservation of the functional properties of banana chips during solar tunnel drying is cost effective method of drying and dried fruits can be utilized in the preparation of different value added products or can be consumed as such.

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