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Pre-Treatments Maintain the Quality of Banana Flakes

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Authors' contributions

This work was carried out in collaboration between all authors. All authors read and approved the final manuscript.

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ABSTRACT

Objective: Pre treatments such as T2 (citric acid 1% + 0.5% haldi +1% salt) and T3 (citric acid 1% + KMS 0.5%) were the most effective to reduce browning and resulted high quality banana flakes. The flakes were evaluated for moisture content, non enzymatic browning and sensory (color, texture and flavour) quality attributes after treatment and during storage.
Study Design: Completely Randomized Block Design (CRD)
Place and Duration of Study: Department of food Science and Postharvest Technology, BAU, Sabour (Bihar) India during March 2013 to August 2015.
Methodology: In this curriculum, banana flakes prepared from different cooking and Table banana cultivars (G-9, Kothiya, Alpan and Batisha,) were subjected to different pre-treatments with citric acid, potassium meta bisulphite, salt and turmeric powder. The flakes were evaluated for moisture content, non enzymatic browning and sensory (color, texture and flavour) quality attributes during storage.
Results and Conclusions: Pre treatments prior to drying decreased the incidence of browning of finished products as compared to control. Pre treatments such as T_3 (citric acid 1% + KMS 0.5%)

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and T_2 (citric acid 1% + 0.5% haldi +1% salt) were the most effective to reduce browning and resulted high quality banana flakes. OD at 445 was recorded minimum in all cultivars (Kothiya-0.61, Digha-0.68, Batisha-0.69 and G-9-0.72 against T_3. Hence treatment T_3 maintained whiter colour than other treaments. From the results, it is suggested that quality banana flakes could be prepared from all the cultivars using theses pre-treatments.

Keywords: Pre treatments; banana flakes; enzymatic and non enzymatic browning; storage.

1. INTRODUCTION

Banana is one of the major fruit crops grown in India with a production of 300.08 million MT [1]. High production and perishable nature of this fruit creates glut during peak harvesting season. Postharvest losses in banana are very high as it loses its quality during marketing in a very short span of time [2]. Drying and dehydration is the easiest way to preserve the quality and reduce postharvest losses. Drying banana into chips requires suitable cultivars and sophisticated equipments with technical knowhow. However, drying banana into flakes is easy and also requires less equipment. Non enzymatic browning is a major problem in preparation of dehydrated products including banana flakes. Pre-treatments before drying have been reported by many workers to reduce browning during drying and storage. Pre-treatments with ascorbic acid and citric acid have been well studied as anti browning agents by Zhu, Pan, & McHugh in 2007 [3]. A reduction in non enzymatic browning during drying process and storage has been observed in tomato by Toor and Savage in 2006 [4]. Pre treatments of banana chips before drying have also been studied by Ayim, et al. in 2012 [5]. However, there is no or very little work has been studied on pre-treatments of banana flakes before drying. The objective of this study is to investigate the effects of pre treatments as anti browning agent for preparation of quality banana flakes.

2. MATERIALS AND METHODOLOGY

Only standard methods for measurement of quality attributes were followed for entire experiment. Analytical grade chemicals and glass wares (borosil make) were utilized for conducting these experiments. Few analytical methods were modified as per literature review to provide better and more precise quality estimation. Aqueous solutions were prepared and pretreatments were given as per standard procedure. Different concentrations were taken as independent variables for the study and their ranges were finalized based on the observations and results obtained in preliminary experiments.

2.1 Raw Materials

Fully matured but unripe banana cultivar G-9 was obtained from the University Orchards, Bihar Agricultural University, Sabour and other cultivars, like Kothiya, Alpan and Batisha (Fig. 1) were procured from local retail markets and brought to the Research Laboratory of department of Food Science and Postharvest Technology. The fingers were separated carefully from hands with a stainless steel knife, washed and kept on clean table for draining extra water.

2.2 Experimental Plan

The washed fingers were peeled and sliced into flakes (longitudinal slices of size 4-5 mm thickness and 8-12 mm long). Flakes were thoroughly mixed and divided into four groups for pre-treatments as illustrated in the treatment conditions (Table 1). Approximately 2 kg of banana flakes was taken for each treatment and treated in aqueous solution for 5-minutes with three replications using distilled water. Treated samples were kept on a stainless steel (ss) wire mess for 8-10 minutes to drain out excess water before putting inside the dehydrator for drying at 64 ± 2^0C. The experiments were arranged in a complete randomized design (CRD) with 3 replicates using 20 fruits for each treatment. Analysis of variance (ANOVA) and the test of mean comparison were calculated according to Tukey's test with the level of significance of 0.05. The statistical software, SAS System for windows, version 9.0 (SAS institute, Cary, NC), was used for the analysis. Descriptive statistics was done on sensory attributes and the means were compared using the Tukey's test ($P<0.05$).

2.3 Preparation of Aqueous Solution for Treatments

Treatment, T_1 (CA 1%) was prepared by dissolving 10 gram CA in 800 ml distilled water and final volume made 1000 ml. Treatment, T_2 (CA 1% + 0.5% Turmeric powder (haldi) +1% salt) was prepared by dissolving 10 gram CA, 5

gram turmeric powder and 10 gram salt in 800 ml distilled water and final volume made 1000 ml. Similarly Treatment T_3 (CA 1% + KMS 0.5%) was prepared by dissolving 10 gram CA and 10 gram Potassium Meta Bisulphide (KMS of 50% active ingredients was used) in 800 ml distilled water and final volume made 1000 ml). Only plain distilled water was used for control treatment (T_4).

2.4 Experimental Setup

Laboratory scale cabinet dryer was used for drying banana flakes. The dryer was preheated before the samples were placed into it. The temperature was set to 64 ± 2˚C. Now drained banana flakes along with wire mess were placed on perforated stainless steel trays and dried at a temperature of at 64 ± 2˚C for 4-5 hours till constant weight (Fig. 2.) and packed in polyethylene for storage study.

2.5 Analytical Techniques for Quality Parameter

Rehydration Ratio was determined by Lee and Farid in 2006 [6]. The rehydration ratio was calculated by dividing the weight of rehydrated sample by the weight of dried sample. The sensory attributes of dried banana flakes was evaluated by a 10 members sensory evaluation team consisting of teachers, staff and postgraduate students. The evaluation was done on 9-point hedonic scale for each attribute in which 1 is denoted as “dislike extremely” and 9 denoted as “like extremely” [7].

2.6 Sample Preparation and Measurement

The moisture content of dried banana flakes was determined according to AOAC Official Methods of Analysis [8]. Three samples from each treatment were used for the moisture determination and the average moisture content is reported. A modified method was used to determine Non enzymatic browning of the dried banana as described by Cernîşev in 2010 [9]. The extent of browning was evaluated as browning index (BI) measured as absorbance at 445 nm. Brown pigments were extracted from 2 g dried banana flake. Samples were ground into fine powder with a kitchen blender for 2 min after which 50 ml of ethanol (60%, v/v) was added and allowed to stand for 12 h. After 12 h, the mixture was agitated and then filtered through 0.45 µm nylon filter membrane. Browning index of filtrates was evaluated with spectrophotometer (UNICO 7200, Shanghai, China) against 60% ethanol. All samples were extracted in duplicate.

Table 1. Treatment conditions

Treatments	Treatment details	Cultivars
T1	CA (1%)	Kothiya, Alpan, Batisha & G-9
T2	CA 1% + Turmeric powder (Haldi) 0.5% + Salt 1%	Kothiya, Alpan, Batisha & G-9
T3	CA 1% + KMS 0.5%	Kothiya, Alpan, Batisha & G-9
T4	Control (dipped in distilled water)	Kothiya, Alpan, Batisha & G-9

Abbreviation used
CA= Citric Acid
KMS= Potassium metabisulphite

Fig. 1. Different cultivars of banana used for preparation of banana flakes

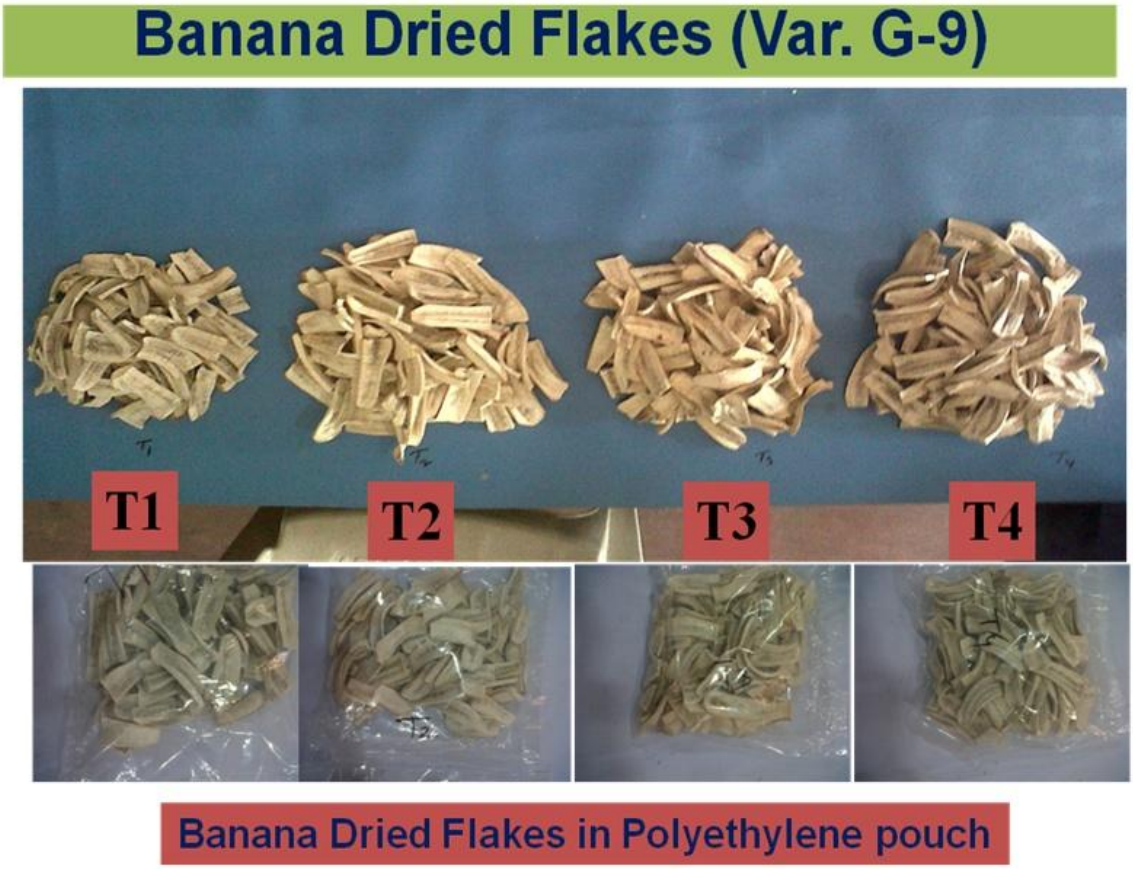

Fig. 2. Dried banana flakes with and without packed in polyethylene pouches

3. RESULTS AND DISCUSSION

Moisture content was recorded immediately after drying, after 2 months and after 4 months as shown in Table 1. It is evident from the table that no significant difference was observed among the treatments and cultivars during storage period.

3.1 Effect of Pretreatments on Non enzymatic Browning

Non enzymatic browning of banana flakes is shown in Table 2. It is evident from the data that pre-treatment with Citric acid 1% + 0.50 KMS (T3) before drying to cooking cultivars (Kothiya, Digha) and Table variety (G-9 and Batisha) were found excellent in retaining white color after drying (Kothiya-0.61, Digha-0.68, Batisha-0.69 and G-9-0.72) against T_3 followed by treating fruit pieces with citric acid alone (T1). Similar results were also obtained in table cultivars where minimum OD was observed in treatment T3 followed by T1. This might be due to anti browning activity and anti oxidant activity of KMS and Citric acid. Salt of Potassium and Sodium Sulphites is widely used as a food preservative to inhibit oxidation either by oxygen (in air) or enzymes [10].

3.2 Effect of Pretreatments on Sensorial Quality of Banana Flakes

The results of sensory analysis of banana flakes from all of the dried samples are presented in Table 3. The organoleptic test was evaluated just after drying and after an interval of every two months up to four months storage period. It was observed that organoleptic scores for color, texture and flavour decreased during the course of storage period in all treatments and in all cultivars. However, the maximum decrease was observed in control treatment and minimum in treatment T_2. The preference rating for colour of all samples was significantly higher as compared to control. However, treatment T_2 (CA 1% + 0.5%

turmeric powder +1% salt) was significantly higher than T_1 (CA 1%) but at par with T_3 (CA 1% + KMS 0.5%). This product (T_2) had an attractive yellow colour, good texture and flavour. The highest texture score and flavour was observed again in the same treatment i.e. T_2 followed by T_3 and T_1. The lowest score was recorded in control fruits. The overall acceptance score for the bananas from the treatment T_2 was significantly higher than that of other treatments and control fruits. Turhan and Sahbaz in 1988 [11] also reported an improved overall acceptability of dried banana products if blanching is performed prior to drying and freezing. This might be due to the fact that blanching inactivate or destroy the enzymes responsible for browning reactions [12].

Table 1. Moisture content during storage of local cultivars (Kothiya, Alpan, Batisha & G-9)

Variety	Treatments	Storage period			
		After drying	After 2 months	After 4 months	CD
Kothiya	T1-	7.82	7.87	7.90	NS
	T2	7.90	7.91	7.91	
	T3	7.91	7.94	7.97	
	T4	7.82	7.90	8.00	
Alpan	T1	8.27	8.10	7.60	NS
	T2	8.37	8.03	7.43	
	T3	8.15	7.83	7.43	
	T4	8.48	8.02	7.42	
Batisha	T1	7.80	7.93	7.97	NS
	T2	7.93	7.97	8.04	
	T3	8.07	8.17	8.23	
	T4	7.77	7.87	7.93	
G-9	T1	7.67	7.90	8.03	NS
	T2	7.73	8.03	8.10	
	T3	8.10	8.10	8.20	
	T4	7.60	7.73	7.87	

Table 2. Non enzymatic browning of banana flakes prepared from local cultivars (Kothiya, Digha, Batisha and G-9)

Non enzymatic brown (OD at 445)			
Variety	Treatments	Mean	CD
Kothiya	T1	0.74	0.097
	T2	0.69	
	T3	0.61	
	T4	0.88	
Digha	T1	0.78	0.14
	T2	0.79	
	T3	0.68	
	T4	0.89	
Batisha	T1	0.79	NS
	T2	0.81	
	T3	0.69	
	T4	0.84	
G-9	T1	0.80	0.11
	T2	0.83	
	T3	0.72	
	T4	0.86	

Table 3. Sensory evaluation (Organoleptic) of dried flakes

Cultivars	Treatments	Storage periods				
		After drying	After 2 months	After 4 months	Mean	CD
Kothiya	T1	7.17	6.83	5.67	6.56	1.73
	T2	7.83	7.67	6.83	7.44	
	T3	7.6	7.27	6.5	7.12	
	T4	5	4	3.33	4.11	
Alpan	T1	7.25	7	6	6.75	1.6
	T2	8.5	7.5	6.5	7.50	
	T3	7.9	7.1	6.5	7.17	
	T4	5.6	4	3.33	4.31	
Batisha	T1	7.9	7.4	5.67	6.99	0.96
	T2	8.5	7.3	6.5	7.43	
	T3	8	7.2	6.3	7.17	
	T4	5	4	3.33	4.11	
G-9	T1	7.17	6.83	5.67	6.56	0.92
	T2	7.83	7.67	6.83	7.44	
	T3	7.6	7.27	6.5	7.12	
	T4	5.0	4.0	3.33	4.11	

Table 4. Effect of pre treatments on Total soluble solids of dried flakes of banana prepared from banana cultivars (Kothiya, Alpan, Batisha and G-9)

Cultivars	Treatments	Storage Periods				
		After drying	After 2 months	After 4 months	Mean	CD
Kothiya	T1	7.12	6.89	5.67	6.55	NS
	T2	6.67	6.47	6.83	6.13	
	T3	6.63	6.50	6.5	6.70	
	T4	7.13	6.50	3.33	6.17	
Digha	T1	8.27	7.0	8.10	7.60	NS
	T2	8.37	7.5	8.03	7.43	
	T3	8.15	7.1	7.83	7.43	
	T4	8.48	4.0	8.02	7.42	
Batisha	T1	7.68	7.49	5.67	7.16	NS
	T2	7.97	7.76	6.5	7.26	
	T3	7.87	7.68	6.3	7.21	
	T4	8.20	7.83	3.33	7.40	
G-9	T1	7.62	7.57	5.67	7.14	NS
	T2	7.87	7.65	6.83	7.15	
	T3	7.91	7.61	6.5	6.83	
	T4	8.08	7.73	3.33	6.33	

3.3 Effect of Pretreatments on Total Soluble Solids (TSS) and Rehydration Ratio of Banana Flakes

The data presented in Tables 4 and 5 suggested that treatments effect on total soluble solids and on rehydration ratio was non-significant at 5% level of significance. This might be due to the fact that conversion of starch into sugar in dried products reduced drastically after drying. The heat treatment as well as pre treatments might have destroyed or inactivate the enzymes responsible for conversion of starch to sugars. Rehydration ratio of dehydrated tomato slices was also reported non significant by Asare et al. in 2014 [13]. However, in variety Batisha, the

Table 5. Effect of pre treatments on rehydration ratio of banana flakes prepared from banana cultivars (Kothiya, Digha, Batisha and G-9)

Cultivars	Treatments	Dehydration ratio	CD
Kothiya	T1	4.85	NS
	T2	4.85	
	T3	5.05	
	T4	4.57	
Digha	T1	4.70	NS
	T2	4.81	
	T3	4.97	
	T4	4.50	
Batisha	T1	4.49	0.25
	T2	4.63	
	T3	4.70	
	T4	4.37	
G-9	T1	4.93	NS
	T2	4.71	
	T3	4.81	
	T4	4.45	

treatment effects on rehydration ratio was found significant. This might be due to the fact that geletization of starch molecules took place and it might have prevented uptake of water necessary for rehydration.

4. CONCLUSIONS

Postharvest losses in banana fruits could be reduced, if these fruits are dehydrated and processed into banana flakes. The results of this study revealed that pre-treatments with Citric Acid (1.0%)+ Turmeric powder (0.5%) + Salt (1.0%) before drying to cooking cultivars (Kothiya, Batisha) and Table cultivars (G-9 and Alpan) were found excellent in retaining white color with minimum browning after drying into flakes which could be converted into powder. Another treatment containing 1% C.A. (1.0%) + KMS (0.5%) yielded best quality banana flakes. Based on the results, all cooking cultivars are suitable for drying and dehydration. Whereas, only mature green stage of Table cultivars are suitable for preparation of dehydrated products.

COMPETING INTERESTS

Authors have declared that no competing interests exist.

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