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Evaluation of KMS and sugar syrup on dehydrated banana

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ABSTRACT

A study was conducted to compare the dehydrated banana as influenced by sugar syrup and potassium metabisulphite (KMS) with various shapes for quality parameters and sensory attributes. Significant differences for the treatments were observed for most of the physico-chemical and sensory parameters studied. Quality parameters like drying time, total sugars, moisture content, protein and sensory attributes like flavour, texture and taste of dehydrated banana were improved by the KMS treatment, while dry recovery based on pulp and whole fruit, titratable acidity and ascorbic acid contents were improved by sugar syrup. However, higher total sugars, acidity, ascorbic acid and protein were recorded in the dehydrated banana, when compared to fresh banana fruits. Among the various shapes, dehydrated whole fruit proved to be better for most of the quality parameters studied.

Key words: Banana, KMS, sugar syrup, dehydration, shapes, quality, sensory attributes.

INTRODUCTION

Banana is the most important fruit crop grown in India. Banana and plantain form the staple food for millions of people across globe, providing balanced diet than any other fruit or vegetable. It is endowed with rich source of carbohydrate, vitamins and minerals, which provides nutritional security to huge population, world over. Banana is grown almost in all the states of the country with 8.30 lakh ha area under cultivation producing 29.78 million tonnes. Though, India is the largest producer of fruits and vegetables in the world, still only about 2.0% of the total production is processed. Since fresh bananas and plantains are available throughout the year, the scope for processing and value-addition has not gained real momentum yet. About 22-30% of banana goes as waste every year due to improper post-harvest handling, transportation, storage and ripening practices (Narayana and Mustaffa, 7). This has necessitated the importance to go for processing and product development through value-addition of banana. There is great scope and demand for development of value-added products in banana and plantain and commercialize them in domestic and international markets. In this endeavour, many value-added products in banana have been developed (Mustaffa and Shiva, 6) and commercialized (Shiva *et al*., 10).

Potassium metabisulphite (KMS) is commonly used chemical preservative for fruits based products. Osmotic dehydration is widely used for the partial removal of water from the plant tissues by immersion in a hypertonic solution. The diffusion of water is accompanied by the simultaneous counter diffusion of solutes from the osmotic solution into the tissues. Since the membrane responsible for osmotic transport is not preferably selective, other solutes present in the cells can also be leached into the osmotic solution (Giangiacomo *et al*., 2). The rate of diffusion of water from any material made up of such tissues depends on factors such as temperature, concentration of osmotic solution, size, shape and geometry of material, etc. (Pokharkar and Prasad, 8). Osmosis would be better complementary step in drying, if not an alternative. Hence, considering these points in view, the present investigation was undertaken in order to compare the two methods namely KMS and osmosis, followed by dehydration and its effect on physico-chemical and sensory parameters of banana.

MATERIALS AND METHODS

Uniform and healthy bunch of banana cv. Karpuravalli was harvested at 90% maturity from the Experimental Farm, National Research Centre for Banana, Tiruchirappalli. They were de-handed, washed with clean water and ripened with ethylene at room temperature. The uniformly ripened fruits at were peeled off by hand and the pulps were cut into different shapes, *viz*., thin slices, longitudinal segments, cubes and cones with uniform thickness and compared against whole fruit. One set of fruit slices along with whole fruit was immersed in 0.1% KMS solution for 5 min. and another set in 30°Brix sugar syrup (equivalent to TSS of the fruit) for 2 h in hot air oven at 50°C. Both the sets were withdrawn from the KMS and sugar syrup solutions and dried/dehydrated in the hot air oven at 50°C to the desired level.

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Observations were recorded in the fresh as well as in the dehydrated samples. Physical characters of fruits namely drying time and recovery based on pulp and whole fruit were recorded on dry weight basis. The total soluble solids (TSS) were determined by using ERMA hand held refractometer. Moisture, acidity, ascorbic acid, total sugars and protein were determined as per the standard procedures given by Ranganna (9). Organoleptic parameters for colour, flavour, texture, taste and overall acceptability were evaluated by experienced panel of ten judges on 1-9 point Hedonic scale (Amerine *et al.*, 1). The experiment was laid out in factorial completely randomized design with three replications. The data thus collected were subjected to standard statistical analysis as per Gomez and Gomez (3).

RESULTS AND DISCUSSION

In general, the fruit pieces treated with KMS took lesser time for drying, when compared to osmosed fruit pieces (Fig. 1). In both the treatments, whole fruit pieces took more time for drying than that of others, i.e., other fruit pieces took about half or less than half of the time taken for drying of whole fruits, which could be due to the fact that the surface area exposed for removal of moisture during drying is much more, *i.e.*, the distance travelled by water to reach surface area was smaller for other fruit (thinner) pieces, which would have facilitated speedier removal of moisture than that of whole fruits (Kadam *et al.*, 4).

Higher dry recovery was recorded in all the fruit pieces (shapes) treated with sugar syrup than that of KMS treated ones based on pulp as well as whole fruit weight (Figs. 2 & 3), which could be attributed to the solid gain due to the penetration of sugar molecules into the fruits through a natural semi-permeable membrane of the fruits (Suresh Kumar and Sagar, 13) and also the maximum surface area available in various fruit pieces for penetration of sugar solution. Moisture content is an important parameter in deciding the quality of final product, particularly the processed/ dehydrated (value-added) products. Dehydrated whole fruit recorded the maximum moisture content, followed by dehydrated cubes and the lowest with the dehydrated thin slices, when compared to the initial moisture level of fresh ripened fruit. There was no significant difference due to treatments. However, significant differences were observed with shapes as well as between treatments and shapes. Both KMS and osmotic dehydrated whole fruit recorded the maximum moisture content and the least with the dehydrated thin slices treated with KMS (Table 1). The maximum moisture content registered with the osmotic dehydrated whole fruit is attributed to the

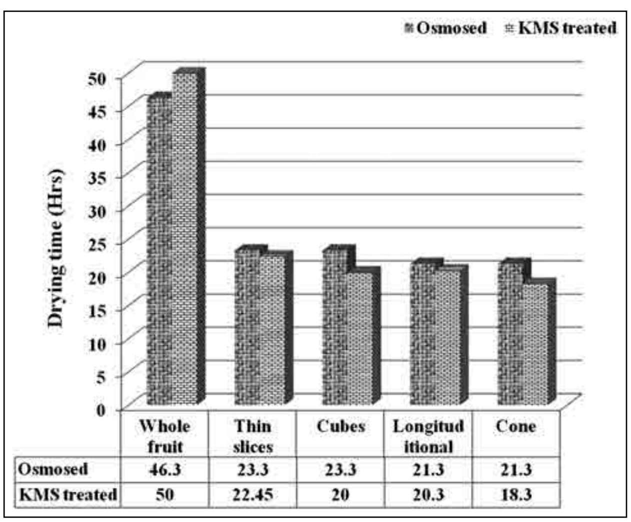

Fig. 1. Drying regime of osmosed and KMS treated banana.

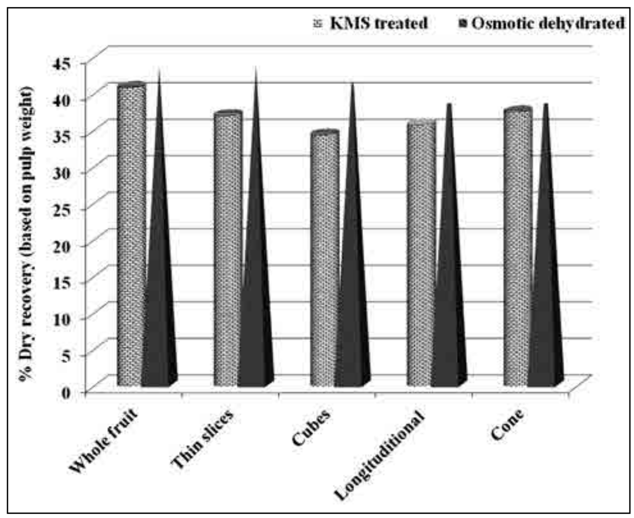

Fig. 2. Effect of KMS and osmotic dehydration on recovery (on pulp weight) of banana.

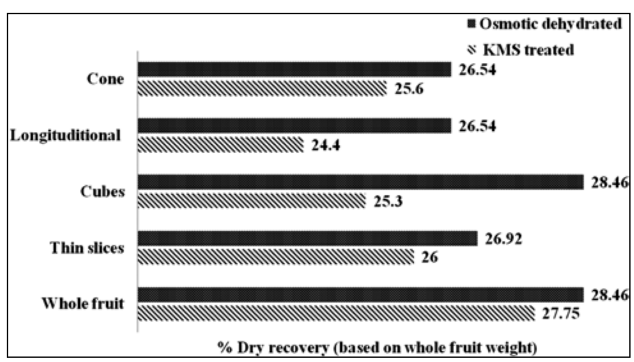

Fig. 3. Effect of KMS and osmotic dehydration on recovery (on whole fruit) of banana.

Table 1. Effect of potassium metabisulphite (KMS) and osmotic dehydration on moisture and total sugar contents of banana.

	Moisture (%)			Total sugars (%)		
Shape\Treatment	KMS	Osmotic dehydration	Mean	KMS	Osmotic dehydration	Mean
Whole fruit	12.92	15.07	13.99	58.66	61.33	60.00
Thin slice	9.34	8.58	8.960	57.33	51.33	54.33
Cube	11.96	9.48	10.72	56.00	51.33	53.66
Longitudinal	9.32	9.55	9.430	62.00	58.00	60.00
Cone	10.04	9.72	9.881	63.33	60.66	62.00
Mean	10.714	10.481		59.466	56.533	
CD (p = 0.05)	Treatment (T)	Shape (S)	T × S	Treatment (T)	Shape (S)	T × S
	N.S.	0.420	0.595	1.289	2.039	N.S.

Initial moisture = 62.73%, Initial total sugars = 21%

solid gain of sugar molecules into the fruits through a natural semi-permeable membrane of the fruits (Suresh Kumar and Sagar, 13), which would have favoured retention of more moisture in the fruits.

Total sugars varied significantly between the treatments. High amount of sugar was estimated with the fruits dehydrated with KMS treatment, irrespective of the shapes of the fruits. Cone shape registered maximum amount of total sugars (62%), followed by whole fruit (60%) and longitudinal sections (60%), however, they are at par with each other (Table 1). About three-fold increase in total sugars content was noticed in both the dehydrated samples treated with KMS and sugar syrup over initial value of the fresh fruits (21%). However, the interaction effect between the treatment and shape was found to be non-significant. The increase in the total sugars content in the dehydrated samples could be attributed to the combined effect of sugar used as osmotic agent and temperature as drying media on moisture removal and solute diffusivity, as confirmed by Kayamak-Ertekin and Sultanglu (5) in apple ring slices.

A reduction in the titratable acidity of osmotic dehydrated fruit samples was noticed. However, higher acidity was observed both in the KMS and sugar syrup treated fruits than fresh fruits (0.26%) (Fig. 4). The increase in acidity upon dehydration was a concentration effect due to the removal of a large amount of water from the tissues as reported by Suresh Kumar and Sagar (13) in dried mango and guava slices. The reduction in the acidity of osmotic dehydrated fruit pieces is governed by concentration of sugars and it is attributed to the leaching of acids from the fruits to the hypertonic solution.

The ascorbic acid content of the dehydrated fruit samples was significantly affected by the treatments as well as the shapes of fruits and its

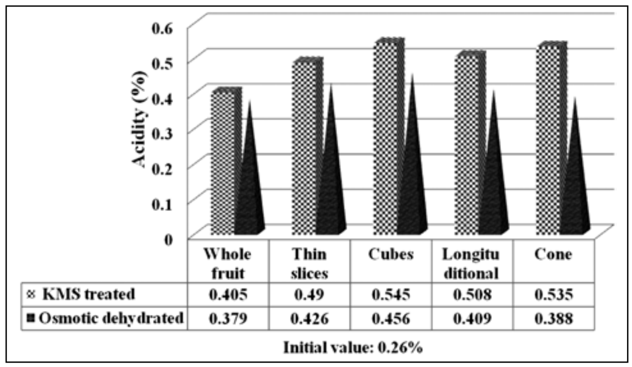

Fig. 4. Effect of KMS and osmotic dehydration on acidity of banana.

interaction effects (Table 2). Osmotic dehydration favoured retention of high ascorbic acid than that of KMS treated ones, when compared to fresh fruits, irrespective of the shapes. Among the shapes, cubes were recorded with the highest ascorbic acid content, followed by longitudinal sections and cones. These samples retained higher values as compared to initial value (5.20 mg/100 g). With respect to interaction, osmotic dehydrated cubes registered maximum ascorbic acid content (6.74 mg/100 g), followed by osmotic dehydrated cones (6.52 mg/100 g), which were at par with each other, which were higher than the fresh fruit and the least with whole fruit (3.49 mg/100 g). High ascorbic acid content recorded with osmotic dehydrated fruit pieces could be due to better protection of ascorbic acid by the sugar solution (Suresh Kumar and Sagar, 12), in addition to the compactness of the shapes. The reduction in the ascorbic acid during dehydration can be attributed to heat destruction and leaching of acid in hypertonic solution. Similar results are also reported by Suresh Kumar and Sagar (13) in osmotic dehydrated mango

Table 2. Effect of potassium metabisulphite (KMS) and osmotic dehydration on ascorbic acid and protein contents of banana.

Shape\Treatment	Ascorbic acid (mg/100 g)			Protein (%)		
	KMS	Osmotic dehydration	Mean	KMS	Osmotic dehydration	Mean
Whole fruit	3.49	3.98	3.735	3.05	2.35	2.700
Thin slice	5.64	4.20	4.923	2.90	2.15	2.525
Cube	5.58	6.74	6.160	2.75	2.45	2.600
Longitudinal	5.09	5.50	5.300	2.62	2.02	2.316
Cone	3.97	6.52	5.245	3.50	2.15	2.825
Mean	4.754	5.388		2.963	2.223	
CD (p = 0.05)	Treatment (T) 0.103	Shape (S) 0.163	T × S 0.231	Treatment (T) 0.058	Shape (S) 0.092	T × S 0.130

Initial ascorbic acid = 5.20 mg/ 100 g; Initial protein = 1.20%

and guava slices and *aonla* segments; Suresh Rai *et al.* (12) in dehydrated pineapple slices.

Protein content was significantly affected by treatment as well as by the shapes (Table 2). Among the treatments, the maximum protein content was recorded with the fruits treated with KMS and dehydrated. The protein content varied from 2.32 to 2.82%, irrespective of the treatments. The highest value was registered with cone shape and the least with longitudinal section of the fruit pulp. With respect to the interaction effect, cone shape treated with KMS and dehydrated expressed maximum protein (3.50%), followed by whole fruit treated with KMS and dehydrated (3.05%) and the minimum value with the osmotic dehydrated longitudinal section (2.02%). In general, the protein content of the dehydrated fruit samples was reported to be the higher as compared to fresh fruit (1.20%). This increase in the protein content could be due to the withdrawal of moisture from the dehydrated fruit pieces in addition to chemical preservative (KMS) and osmosis.

Sensory score is an important parameter to decide the acceptance of the product by the consumer. Flavour, texture and taste are the major determinants of fruit quality. Overall acceptability was higher with the dehydrated whole fruits treated with KMS (Fig. 5) than those treated with sugar syrup (Fig. 6). This may be due to higher total sugars and less ascorbic acid content (Sudha *et al.*, 11), which is also evident from the better colour, flavour, texture and taste.

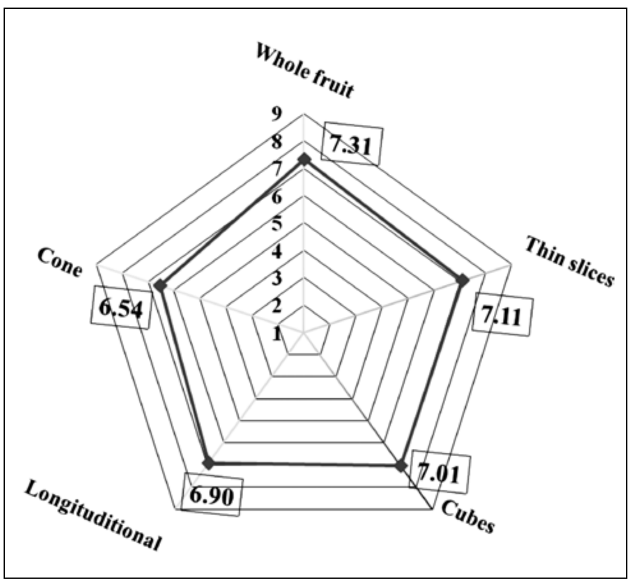

Fig. 5. Overall sensory score of MS dehydrated banana.

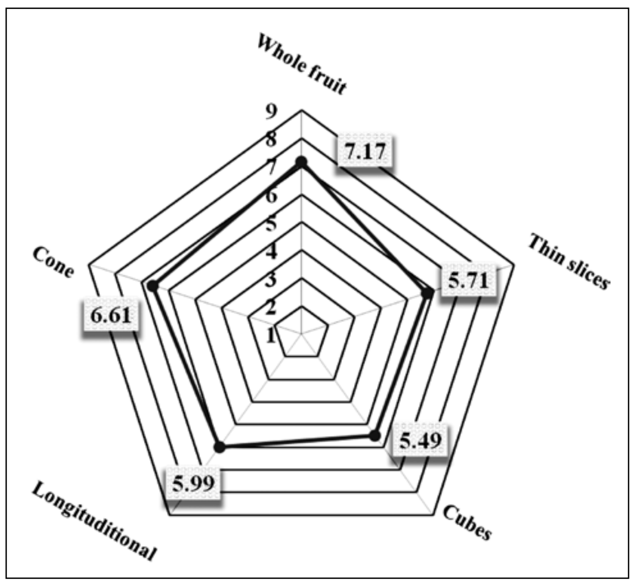

Fig. 6. Overall sensory score of osmotic dehydrated banana.

Based on these results, it may be concluded that both KMS and sugar syrup are having beneficial effect on quality and sensory attributes of the dehydrated banana.

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