THE EFFECT OF SALT AND SUCROSE ON THE QUALITY CHARACTERISTICS OF OSMOTICALLY DEHYDRATED BANANA SLICES

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ABSTRACT

Bananas (Musa spp.) are one of the most consumed fruits in the world, being produced in almost all tropical countries. It has a high nutrition value and is a good source of energy due to its high level of starch and sugar, as well as been a source of vitamins A and C, potassium, calcium, sodium and magnesium. The study conducted for banana slices during osmotic dehydration followed by tray drying and the influence of process variables on the quality characteristics. The samples were osmodehydrated in salt (5-15%), sugar (25-60°Brix) and combination of sugar (25-60°Brix) and salt (5%) solution at temperature of 30°C in 4:1 ratio. The treated sample slices were spread on stainless steel trays of the tray dryer and they were dried in tray dryer at temperature 50°C. The samples were weighed at an interval of 30 minutes. The sample took around 2 to 3 hours depending on the drying temperature to reach equilibrium moisture content. It was observed that the weight reduction, solid gain and weight loss increased with increase of the parameters like time, concentration of the sugar solution and ratio of the solution to sample.

Keywords: Osmotic Dehydration, Banana, Vitamins, Tray Dryer, Weight Reduction, Solid Gain and Weight Loss.

INTRODUCTION

Osmotic dehydration is particularly recommended for food conservation because of the satisfactory nutritional and organoleptic characteristics it imparts on the foods [9]. However, foods treated solely by osmotic dehydration are usually unstable and as such complementary treatments (drying, freezing, pasteurisation, or addition of chemical preservatives) are necessary to ensure proper food conservation. This study, a follow-up to a previous study on the chemical and organoleptic quality of selected sweet banana varieties [3] validates osmotic dehydration and drying as a simple and cost effective method of preserving sweet bananas (using sugar and NaCl solutions) in forms of value-added figs of improved nutrient status, storage and availability. The osmotic dehydration process has even been tested for several tropical fruits soaked in sucrose solution, notably papaw, mango and sweet bananas [6,7]. These methods, however, entail the use of relatively expensive equipment and expertise often beyond the financial means and technical capacities of most peasant farmers. Chemical food preservatives such as sugar and NaCl, common in most culinary habits, bind water satisfactorily, rendering it unavailable for microbial growth on food products. By soaking fruits in concentrated solutions of the preservatives, osmotic dehydration occurs.

Bananas (Musa spp.) are one of the most consumed fruits in the world, being produced in almost all tropical countries. It has a high nutrition value and is a good source of energy due to its high level of starch and sugar, as well as been a source of vitamins A and C, potassium, calcium, sodium and magnesium. Banana can be pretreated with different antibrowning agents [2] and dried in order to save the part of production that will not be readily consumed. Drying is considered to be a classical method of food preservation, which provides an extension of shelf life, lighter weight for transportation and less space for storage [1]. It should be noted that enzymatic browning reaction are occurred during their dehydration. This causes changes in colour, sugar loss and HMF formation, thereby affecting the quality of the final products [4]. If the fruits are properly pre-treated, enzymatic and non enzymatic browning can be controlled thereby good quality of the final product is enhanced [5].

MATERIALS AND METHODS

• Osmotic dehydration
• Drying- Tray drying.

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Quality analysis.

Sample preparation
Fresh banana were purchased locally. They were cut into pieces of 1.5 cm size. Sugar and salt are the osmotic agent was purchased from the local supermarket.

Osmotic Dehydration
The osmotic dehydration was conducted in a 500 ml beaker which was placed in a water bath. Sample were cut into small pieces and weighed and then placed into dehydration vessel containing salt (5-15%), Sugar (25-60°Brix) and combination of sugar solution of varying concentration (25-60°Brix) and salt(3%). The vessel was placed into the water bath at temperature 30°C. The solution and sample ratio is 4:1. After each 30 minutes the pieces were taken and weighed. The treated sample slices were spread on stainless steel trays of the tray dryer and they were dried in tray dryer at temperature 50°C. The samples were weighed at an interval of 30 minutes. The samples took around 2 to 3 hours depending on the drying temperature to reach equilibrium moisture content. The average moisture and dry matter content of the sample were determined by drying in hot air oven. In order to follow adequately the osmotic dehydration kinetics, individual analysis for each sample were carried out and from these; weight reduction (WR), solid gain (GN) and weight loss (WL) data were obtained, according to the following expression [8,10].

\[
\text{Weight reduction, } \frac{W_0 - W}{W_0} \times 100 \tag{1}
\]

\[
\text{Solid gain, } SG = \frac{M - M_0}{W_0} \times 100 \tag{2}
\]

\[
\text{Weight loss, } WL = \text{WR} + \text{SG} \tag{3}
\]

Where,

- \(W_0\) – Initial sample weight (g),
- \(W\) – Sample weight after osmotic dehydration (g),
- \(M_0\) – Initial solid content in the fresh sample (g),
- \(M\) – Solid content in the sample after osmotic dehydration (g).

RESULTS AND DISCUSSION
This chapter deals with the experiments conducted on osmotic dehydration of Banana. The results obtained are tabulated and discussed in detail.

Concentration of the osmotic agent: salt (%)-(4:1)

<table>
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<th>Time (mins)</th>
<th>5</th>
<th>6</th>
<th>7</th>
<th>8</th>
<th>9</th>
<th>10</th>
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<th>15</th>
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<td>46.73</td>
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Concentration of the osmotic agent: sugar (°brix) -(4:1)

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<th>40</th>
<th>45</th>
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</table>
Concentration of the osmotic agent: sugar (°brix) and salt (5%)-(4:1)

<table>
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<th>Time (mins)</th>
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<th>35</th>
<th>40</th>
<th>45</th>
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<th>60</th>
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<td>49.96</td>
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<td>51.3</td>
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<td>48.62</td>
<td>48.19</td>
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<td>42.88</td>
<td>44.33</td>
<td>44.92</td>
<td>44.12</td>
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</tbody>
</table>

WEIGHT REDUCTION

Concentration of the osmotic agent: salt (%)-(4:1)

The weight reduction of Banana increased from (2.42-15.27%), (1.96-15.76%), (1.63-15.06%), (0.80-17.76%), (3.49-17.49%), (1.86-15.54%), (2.44-17.18%), (2.84-17.68%) for all the treatments in temperature from 30°C with increase in salt concentration from 5-15% and solution to sample ratio 4:1.

Concentration of the osmotic agent: sugar (°brix) - (4:1)

The weight reduction of Banana increased from (2.40-5.94%), (1.64-12.17%), (1.24-17.25%), (2.81-9.94%), (2.67-12.13%), (9.49-29.88%), (8.24-27.83%), (3.41-17.52%) for all the treatments in temperature from 30°C with increase in sugar concentration from 25-60°brix and solution to sample ratio 4:1.
The weight reduction of Banana increased from (0.84-4.62%), (3.7-21.9%), (9.78-28.18%), (2.97-15.91%), (3.2-16.22%), (4.35-17.10%), (5.19-17.46%), (6.44-15.91%) for all the treatments in temperature 50°C with increase in sugar and salt (5%) concentration from 25-60°brix and solution to sample ratio 4:1.

**SOLID GAIN**

**Concentration of the osmotic agent: salt (%)-(4:1)**

![Graph of solid gain of salt (%)](image1)

**Concentration of the osmotic agent: sugar (°brix) - (4:1)**

![Graph of solid gain of sugar(°brix)](image2)

**Concentration of the osmotic agent: sugar (°brix) and salt (5%)-(4:1)**

![Graph of solid gain of salt (5%) and sugar(°brix)](image3)

The solid gain of Banana increased from (18.48-24.54%), (18.58-25.12%), (18.54-24.48%), (18.38-25.56%), (18.98-24.74%), (18.68-25.30%), (18.88-25.32%), (18.78-25.18%) for all the treatments in temperature 30°C with increase in salt concentration from 5-15% and solution to sample ratio 4:1.

The solid gain of Banana increased from (18.78-22.54%), (18.50-24.88%), (18.54-25.04%), (18.78-24.70%), (18.74-25.16%), (18.96-25.10%), (18.64-24.84%), (18.38-25.28%) for all the treatments in temperature 30°C with increase in sugar concentration from 25-60°brix and solution to sample ratio 4:1.

The solid gain of Banana increased from (18.58-24.74%), (18.48-24.56%), (18.78-25.24%), (18.48-25.18%), (19.04-24.44%), (18.88-25.16%), (18.44-25.16%), (19.04-25.40%) for all the treatments in temperature 30°C with increase in sugar and salt (5%) concentration from 25-60°brix and solution to sample ratio 4:1.
WEIGHT LOSS

Concentration of the osmotic agent: salt (%)-(4:1)

The weight loss of Banana increased from (20.9-29.81%), (20.41-30.65%), (20.5-29.54%), (20.01-29.62%), (19.78-32.5%), (22.17-32.79%), (20.74-30.86%), (21.22-32.36%) for all the treatments in temperature from 30°C with increase in salt(%) concentration from 5-15% and solution to sample ratio 4:1.

Concentration of the osmotic agent: sugar (°brix)-(4:1)

The weight loss of Banana increased from (21.18-28.48%), (20.14-37.05%), (19.78-42.29%), (21.59-34.64%), (21.41-37.29%), (28.45-54.98%), (26.88-52.67%), (21.79-42.80%), for all the treatments in temperature from 30°C with increase in sugar concentration from 25-60°brix and solution to sample ratio 4:1.

Concentration of the osmotic agent: sugar (°brix) and salt (5%)-(4:1)

The weight loss of Banana increased from (19.42-29.36%), (22.18-46.46%), (28.56-53.42%), (21.45-41.09%), (22.24-40.66%), (17.23-42.26%), (23.63-42.62%), (25.48-41.31%) for all the treatments in temperature from 30°C with increase in sugar and salt(5%) concentration from 25-60°brix and solution to sample ratio 4:1.

Chemical analysis – Ash content for the osmotic dehydration of Banana.

<table>
<thead>
<tr>
<th>S.No</th>
<th>Concentration of the sample</th>
<th>Ash content(g)</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Control (raw Banana sample)</td>
<td>0.5</td>
</tr>
<tr>
<td>2</td>
<td>Concentration of salt(15%), 30°C, 4:1</td>
<td>0.16</td>
</tr>
<tr>
<td>3</td>
<td>Concentration of sugar(45°brix), 30°C, 4:1</td>
<td>0.25</td>
</tr>
<tr>
<td>4</td>
<td>Concentration of sugar(50°brix), salt(10%), 30°C, 4:1</td>
<td>0.19</td>
</tr>
</tbody>
</table>
From the above table, the ash content was analyzed. The ash content for the concentration of salt(15%) is 0.16g, Concentration of sugar(45°brix) is 0.25g, Concentration of sugar(50°brix) and salt(10%) is 0.19g was analyzed for the raw Banana sample to the osmotic dehydrated of Banana at 30°C, 4:1 ratio.

Chemical analysis – Analysis of Reducing Sugars for the osmotic dehydration of Banana.

<table>
<thead>
<tr>
<th>S.No</th>
<th>Concentration of the sample</th>
<th>Reducing Sugar</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
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<tr>
<td>2</td>
<td>Concentration of sugar(50°brix), 30°C, 4:1</td>
<td>22.4</td>
</tr>
<tr>
<td>3</td>
<td>Concentration of sugar(60°brix), 30°C, 4:1</td>
<td>21.5</td>
</tr>
<tr>
<td>4</td>
<td>Concentration of sugar(60°brix), salt (5%), 30°C, 4:1</td>
<td>24.4</td>
</tr>
</tbody>
</table>

From the above table, the Reducing sugar for the Concentration of sugar(40°brix), 30°C, 4:1 is 23.6, Concentration of sugar(50°brix), 40°C, 4:1 is 22.4, Concentration of sugar(60°brix), 30°C, 4:1 is 21.5, Concentration of sugar(60°brix), salt (5%), 30°C, 4:1 is 24.4 was analyzed for the osmotically dehydrated Banana.

CONCLUSION

Most efficient water removal occurred between 0.5 to 2 hours indicating that it may not be necessary to carry out the osmotic treatment step for longer hours. However, weight reduction, solids gain and weight loss increased with longer time of treatment. The results also suggest that for bananas, temperature is an important variable. Due to the soft texture of bananas, osmotic treatment of bananas needs not to be done at extreme conditions of temperature and concentration. Results obtained suggest that a product for further drying could be obtained by treating the slices at temperatures not more than 30°C and using osmotic solutions at 25 or 60 Brix. Sugar and NaCl solutions were tested for their efficiency as preservatives for banana. Soaking of banana strips in NaCl and sugar solutions prior to oven-drying significantly modified the chemical composition, as well as the organoleptic and storage qualities of banana. The results show the advantage of using high sucrose concentrations for the osmotic solution, and the use of the osmotic treatment to reduce the total processing time of fruit drying.

REFERENCES