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"Studies on Effect of Sulphur Compounds on Osmotically Dehydrated Guava Slices"

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Abstract

Tray drying of guava was conducted in two stages. In the first stage, osmosis was carried out using three different concentrations of sugar solution (40, 50 and 60 %) with 0.2 % potassium metabisulphite (KMS) and sodium meta bisulphate in the osmotic solution at three temperature levels (35°C, 45°C, and 55°C) were maintained for three time interval (3, 6 and 9hours), whereas, constant parameters were sample to solution ratio of 1: 10 and sample thickness of 4 mm during osmotic solution. The combinations of three parameters for moisture loss as well as solid gain were developed. It was found that best 55°C describes the moisture loss and solid gain patterns when other conditions of osmosis remain constant. The combined effect of solution temperature, sugar concentration and time of moisture loss and solid gain was investigated by developing treatment combinations. It was found that relationship exists between moisture loss and solution temperature, sugar concentration and time. Similar relationship was observed with solid gain. The final conditions of osmotic dehydration were determined on the basis of permissible solid gain in guava slices and these were found as 60%sugar solution concentration, 55°C solution temperature and 9 hours time.

The best process temperature was selected on the basis of statistical analysis of quality parameters, namely, rehydration ratio, dehydration ratio, shrinkage, and sugar, ash and ascorbic acid content and sensory quality parameters (colour, appearance and overall acceptability) and it was 55°C tray drying temperature requiring 6 hours drying time.

Keywords: *Guava, osmotic dehydration, tray drying, drying characteristics, sulphur compounds.*

1. Introduction

India is one of the largest producers of the guava fruit (*Psidium guajava* L.) in the world. Guava is an important fruit crop of India and called the "Apple of the Tropics". Improved packaging technology and storage reduces post harvest losses and increases the shelf life of fresh guava fruit and processed products of the fruit. It also reduces the glut in the market and farmers fetch remunerative price during harvesting season in the domestic market. Freshly harvested and fully matured guava fruit **(Lucknow-49)** were procured from a farm of Allahabad District.

The guava fruit is highly nutritive and rich source of β- carotene, ascorbic acid, sugar, tannins and minerals like Ca, Fe and P. But unfortunately this is bound by seasonality and it is highly perishable. Thus, osmotic dehydration is the best technique to extend their availability even in the off-season (**Sagar & Suresh Kumar 2010**). The objective of this study was to investigate the tray drying kinetics of guava fruit and identifying the best drying condition for maximum retention of physico-chemical characteristics of final dried produces.

In Osmotic dehydration the prepared fresh material is soaked in a heavy (thick liquid sugar solution) and or a strong sugar solution and then the material is tray dried **(Alakali et al., 2006; Torres et al., 2006).**

Osmotic dehydration results in increased shelf-life, little bit loss of aroma in dried and semidried food stuffs, lessening the load of freezing and to freeze the food without causing unnecessary changes in texture **(Petrotos and Lazarides, 2001).** It has been reported that osmotic dehydration reduced up to 50% weight of fresh vegetables and fruits **(Rastogi and Raghavararo, 1997).**The following study was undertaken with the objectives of studying the effect of sulphur compounds, to study the effect of concentrations and osmotic treatment time on quality characteristics and storage stability of osmotically dehydrated guava slices.

2. Materials and Method

Raw material i.e. guava (*cv. Allahabad Safeda*) was obtained from the local market of Allahabad District. Water sinker fruits of guava were selected and washed thoroughly with water and peeled manually with stainless steel knife. About six slices from one fruit lengthwise were prepared.

2.1 Methodology

The blanched fruits were dipped in cold water for 2 min for easy separation of segments and removal of seeds. Osmotic treatment was used as a pre-treatment to facilitate the water removal and to minimize the direct drying effects on products. Fruit slices and segments were suspended in sugar solution containing 0.05% potassium meta-bisulphate (KMS) and 0.1% citric acid in the stainless vessel. The temperature (55°C) and sugar concentration (60^0B) of the solution was maintained at pre-set value. The ratio of the fruits and osmotic solution was maintained as 1:4 in order to ensure proper soaking of samples. Samples were withdrawn from osmotic solution after 6 hours of immersion time and drained quickly and wiped gently with tissue paper to remove the sugar solution from outer surface of the segments. For the dehydration of the pretreated samples were spread on perforated aluminum trays with tray load of 0.40 g/cm2 and were kept in the tray drier (40–50 °C and 60–80% RH).The samples were turned over at every 3 hour interval for uniform drying to a final moisture content of 9–11%.

Analysis of various physic chemical aspects of guava slices were done using three different sulphur compounds (viz., Sodium sulphate, sodium bisulphate and sodium meta bisulphate) ,three different times(3, 6 and 9 hours) and temperatures of 35°C,45°C and 55°C .three concentrations of sugar were also used. i.e. (40^0, 50^0 and 60^0 Brix) to select the best processing conditions for osmotically dehydrated guava slices.

2.2. Physico-Chemical Qualities

2.2.1. Moisture content

Moisture content at any time was determined by this equation as it was the primary objective of osmotic dehydration.

Calculation:

$$\text{Moisture content (\% of initial moisture)} = \frac{M_0 - M_t}{M_0} \times 100$$

Where,
M_0 = initial moisture
M_t = moisture at time t
(Ref: - I.S.I Handbook of Food Analysis (Part VIII) – 1984 page 12 / Determination of Moisture in Dehydration Vegetables)

2.2. 2. Solid gain

After osmotic dehydration Solid gain was calculated on percentage of initial dry matter.

Calculation:

$$\text{Solid gain (\% of initial solid)} = \frac{W_o - W_d}{W_d} \times 100$$

Where,
W_d = Weight of initial solid
W_o = weight of solid after osmotic dehydration
Volume $_t$ = bulk volume at any time t
Volume $_i$ = bulk volume at initial moisture × 100

2.2.3. Rehydration ratio

Procedure:
Sample was cooked in a beaker one part of dehydrated fruit in 10 parts water for 20 minutes and then allowed it to cool at room temperature.

Calculation:

$$\text{Rehydration ratio} = \frac{\text{Weight of reconstituted sample}}{\text{Weight of dehydrated sample}}$$

(Ref: - Handbook of Analysis and Quality control for Fruit and Vegetable Products S. Ranganna, 1986 Page 978).

2.2.4 Dehydration Ratio

Dehydration ratio was calculated by taking the weights of sample before drying and the weight of sample after drying.

Calculation:

$$\text{Dehydration ratio} = \frac{\text{Weight of sample before drying}}{\text{Weight of sample after drying}}$$

2.2.5. Ascorbic acid / vitamin C

Principle:

This method is based upon the reduction of the dye 2-6 di-chlorophenol indophenols by an acid solution of ascorbic acid. In the absence of interfering substances (Cu^{++}, Fe^{++}, Sn^{++}etc) the reduction capacity of the extract of the sample is directly proportional to the ascorbic acid content.

2.2.6. Total sugar

Total sugar was calculated as in making use of titre value of invert. This was obtained in the determination of sugars. The percent total invert sugar and percent reducing sugar originally present (in the form of percent reducing sugar + % Sucrose).

2.2.7. Statistical analysis

The experiment was conducted by adopting completely randomized design of the data recoded. During the course of investigation, product of different formulations were analysed statistically by the 'Analysis of Variance' (ANOVA).

3. Results and Discussion

3.1 Initial moisture content

The initial moisture content of guava slices were observed to be in the range of 81.42%(d.b.) –89.12% (w.b.), the mean of which was taken as 90.18% (d.b.) or 930.42% (d.b.). The least final moisture content was found for sample (T_1) which was 41.4% (d.b.). The reasons for highest moisture loss can be attributed to using high process temperature level. These findings are accordance with the findings of **(Lazarides et al., 1997; Li and Ramaswamy, 2006)**. This moisture content were used for moisture loss and solid gain calculations. The maximum moisture loss was reported for sample 41.4% and minimum for sample 34.6% .Likewise maximum solid gain was reported for sample 95.84% and minimum for sample 63.4%.This could be explained by as by increasing sucrose concentration and temperature. .similar findings were reported by **(Lazarides et al., 1995; Khin et al., 2007)**. Analysis of the results showed that increase in osmotic solution concentration, temperature and immersion time will increase the moisture loss and solid gain.

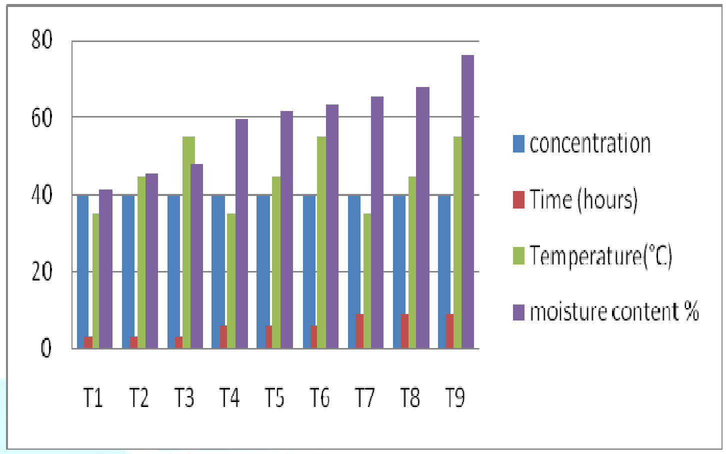

Fig. 3.1. Graph for moisture content at 40^0,50^0 and 60^0 brix with 3 hours immersion time for sodium sulphate.

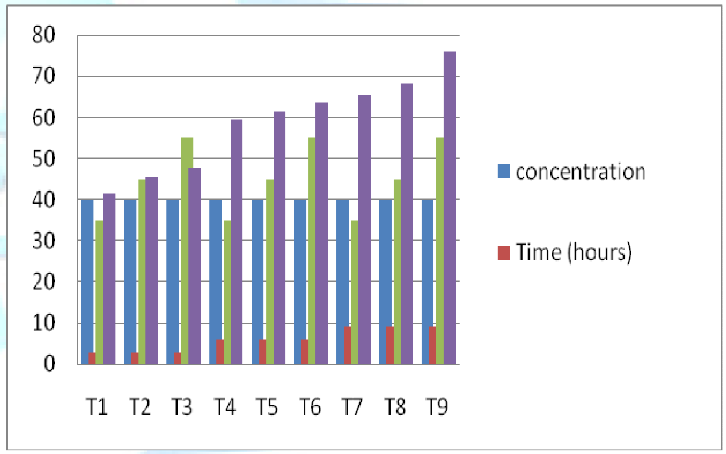

Fig. 3.2. Graph for moisture content at 40^0,50^0 and 60^0 brix with 6hours immersion time for sodium bisulphate.

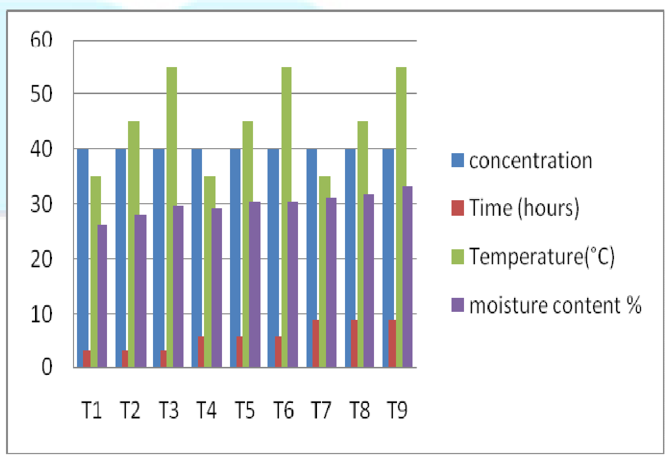

Fig. 3.3. Graph for moisture content at 40^0,50^0 and 60^0 brix with 9hours immersion time for sodium metabisulphate.

3.2 Rehydration ratio and Dehydration ratio

The highest rehydration ratios were observed for sample T_3 which was 2.93. The highest rehydration ratio was recorded for sample T_3 which was 5.2 (significance of rehydration ratio and dehydration ratio). The findings of **(Sagar V.R., Suresh Kumar P. (2010)** are support of these results.

3.3. Ascorbic acid

All the samples were analyzed for their ascorbic acid content which is an indication of sample T_1 showed the highest ascorbic acid content OF 5.2% and sample T_3showed the lowest ascorbic acid content OF 2.4%. According to the findings a sugar solution of 60^0 brix**, 9** hours of immersion time with sodium meta bisulphate as a preservative showed highest ascorbic acid retention which could be attributed to its difference of ascorbic acid content on each variety which content high total sugars. Similar findings were reported by (**Lazarides & Petrotes 2007).**

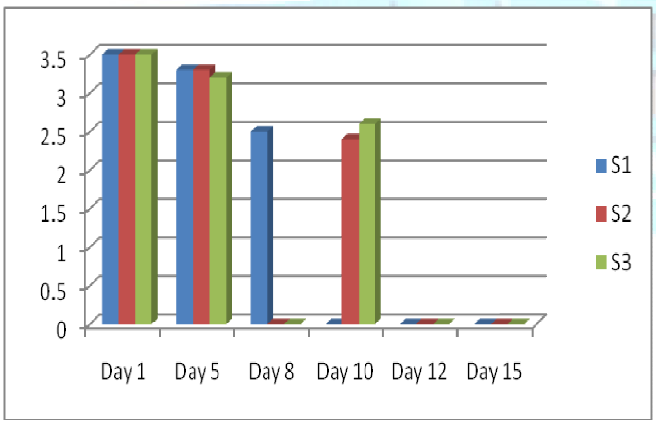

Fig. 3.4.Amount of ascorbic acid content in guava powder

3.4 Total sugars

Total sugar is an indication of % reducing sugar and % Sucrose. In the present study of sample T_1 showed the highest total sugar content where as sample T_2 showed the lowest total sugar content. A treatment combination of 60^0 Brix**,** 9 hours of immersion time with sodium meta bisulphate as a preservative showed highest total sugar content of osmotically dehydrated guava slices. This could be explained as The **(Joshi et *al*., 2005)** another reason may due to microbiological activity the transformation sucrose into invert sugar, raffinose and other organic compounds may also account for the reduction in sugar level during storage **(Wyse and Dexter, 1971**).

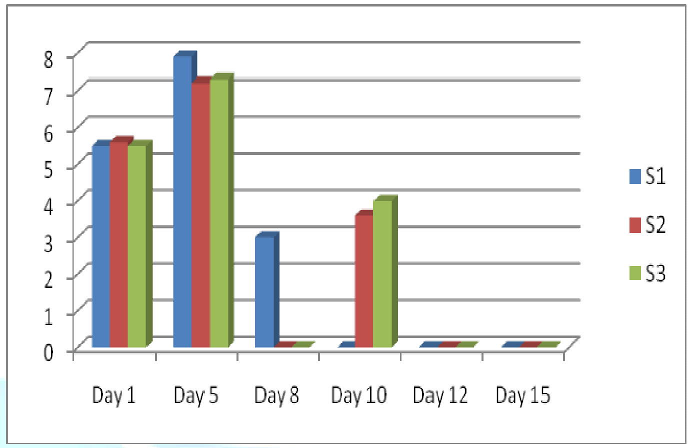

Fig. 3.5 Amount of total sugar content in guava powder

4. Conclusion

Osmo-tray drying study was carried out in order to study the effect of concentration, temperature and time interval the moisture loss and solid gain. The optimum conditions of osmosis were established on the basis of permissible solid gain during osmosis in beetroot. Optimized result (at 55ºC with 60 % sugar solution for 9hours) further dried under different tray drying temperatures.

The osmosis process can be used for removing almost 16 % of initial moisture at 55ºC temperature using with 60 % sugar solution for 9hours without deteriorating the quality of guavas. Both the moisture loss and solid gain increased non-linearly with duration of osmosis at a given sugar solution concentration and solution temperature. This can be describe the moisture loss pattern of tray drying of osmosed samples closely at all drying tray dryer temperatures (45ºC ,55ºC and 65ºC). Osmo-tray drying of guava is a potential alternate method of guava dehydration capable of yielding a good quality finished product within 9 hour plus 6 hour osmotically concentrated fruits. The osmo guava slices were dried in a tray dryer at55ºC for 9hrs to obtain 11 per cent moisture content.

Table 1. ANOVA for effect of rehydration at tray dryer temperature

Source of variation	SS	3df	MS	F	F cal
Treatment	0.2602	3	0.0520	14.3816	3.3258
Replication	0.0147	2	0.0074	2.0372	4.1028
Error	0.0363	10	0.0036		
Total	**0.3112**	**17**			

Table 2. ANOVA for effect of dehydration at tray dryer temperature

Source of variation	SS	3df	MS	F	F cal
Treatment	0.1456	3	0.0292	0.6722	3.3258
Replication	0.0133	2	0.0067	0.1535	4.1028
Error	0.4332	10	0.0433		
Total	**0.5921**	**17**			

Table 3. ANOVA for Ascorbic acid

Source of variation	SS	3df	MS	F	F cal
Treatment	0.0199	3	0.0040	5.0224	3.3258
Replication	0.0038	2	0.0019	2.4053	4.1028
Error	0.0079	10	0.0008		
Total	**0.0316**	**17**			

Table 4. ANOVA for total sugars

Source of variation	SS	df	MS	F	F cal
Treatment	0.00352	3	0.00070	2.14601	3.32583
Replication	0.00038	2	0.00019	0.57269	4.10282
Error	0.00328	10	0.00033		
Total	**0.00718**	**17**			

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