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# EFFECT OF PROCESSING OF SULPHUR COMPOUNDS ON TRAY DRIED GUAVA SLICES

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## ABSTRACT
Osmotic dehydration of guava slices was carried out by osmo-tray drying process and to study the moisture loss and solid gain during osmotic dehydration and tray drying. During osmotic dehydration of guava slices, 4 mm thick cut guava slices were used. The sample to solution ratio of 1: 10 was kept constant for all experiments. Three temperature levels of osmotic solution (room temperature 35°C, 45°C, and 55°C) and three concentration levels of Sugar solution (40%, 50% and 60%) along with 0.2% KMS were used. The three time intervals (3, 6 and 9 hours) were selected for studying the moisture loss and solids gain kinetics. The osmosis time was decided on the basis of moisture loss and solid gain. After osmosis at predetermined time interval, the guava slices were drained completely and dried to 4-6 per cent (% d.b.) using tray dryer. The quality parameters namely, rehydration ratio, dehydration ratio, shrinkage, ash content and sensory qualities were studied of each level. Analysis of the results showed that by increasing the osmotic solution concentration, temperature and immersion time, WL and WR will increase. The effect on SG was almost the same as WL except the effect of temperature. Increasing temperature resulted in an initial increase in SG for a period of time, followed by a decrease. Sugar solution concentration, temperature and immersion time showed the significant influence on hardness. Here also mentioned that "WR is dependent on the other variable (SG, WL), and the difference of WL and SG results in WR". 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**.**

## INTRODUCTION
India is endowed with a climate that can produce a wide variety of fruits. Horticultural crops cover just 8.5% of the gross area but contribute to almost 30% of the agricultural GDP and 52% of the export earnings from agriculture (NHB 2011). The post harvest technology of fruit and vegetable processing has been one of the most neglected fronts in agricultural development and policy till recently. India processes little above 2% of fruit and vegetables production, which needs to increase the level of processing in order to avoid market glut, ensure income security to farmers and bring nutritional security. Food processing methods, such as freezing and dehydration, have a significant impact on the stability of various health promoting antioxidant components in processed products. Dehydration is by far the best and widely used preservative method to extend the shelf life of highly perishable produces. In recent years, there has been a considerable improvement in drying technology. Various combination technologies including osmotic dehydration and conventional air drying are being extensively evaluated to reduce drying time and energy consumption and improve the final product quality are most popular fruits among Indians. The Guava fruit is highly nutritive and rich source of β- carotene, ascorbic acid, s, 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 and Suresh Kumar 2010). The objective of this study is 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. At present, this technology is well established, rather inexpensive and straightforward. Recently, investigations have focused towards the development of new and sensory-enriched processed products from tropical fruits in order to generate promising alternatives for producers, which let to reduce the loss of the production by further processing.

## MATERIALS & METHODS
Experiments were conducted in two stages-one, to optimize pre-treatment with sulphur compounds and preservatives and energy in osmotic dehydration of guava slices; and two, to develop an osmotic pre-treated guava slice by drying process. In the first stage, osmosis was carried out using three different concentrations of sugar solution (40%, 50% and 60 %) with 0.2 % potassium meta bisulphite (KMS) in the osmotic solution at three temperature levels (35°C, 45°C and 55°C). The sample to solution ratio was maintained as 1: 10 and four time intervals (6h, 8h, 10h, and 12 hours) were selected. Optimum osmotic dehydration time for further drying was identified on the basis of moisture loss and the solid gain.

In the second stage, guava slices were exposed for osmosis up to the mentioned time established in the first stage and were then dried to 4-6% dry basis in a tray dryer at different drying temperatures (35°C, 45°C and 55°C). Non-treated guava slice samples were also dried to 4-6 % dry basis. Quality of the dried guava slices and rehydration ratio, shrinkage etc. were determined. The best processing conditions for Osmo-tray drying of guava slices was established on the basis of quality attributes etc.

**Quality Analysis**

On each and every step was calculated. Solid gain and moisture loss were calculated for optimum result among osmotic dehydration. Other quality attributes are discussed in 3.2.2.

**Quality Evaluation**

**Sample preparation:**

The sample was observed closely for mould, insect, larvae, extraneous matter etc. about 25 to 50 gm. of sample taken, grinded quickly to pass through a 30 mesh sieve. During sample preparation care had been taken that uptake of moisture does not take place, as it is hygroscopic in nature. (Ref: - Handbook of Analysis and Quality control for Fruit and Vegetable Products S. Ranganna, 1986 Page 976)

**PHYSICO-CHEMICAL QUALITIES**

**Determination of Moisture content**

**Procedure:**

About 5 g weighed accurately of well mixed sample in tarred moisture dish (about 75 mm wide and 25 deep). The dish was placed in an air oven which was maintained at 105 ± 2$^{o}$C and dried at least for 2 hours. Cool in desiccators and weighed. Repeat the process of heating, cooling and weighing until the difference between two successive weighing was less than 1 mg. and recorded the lowest weight.

**Calculation**

$$\text{Moisture percent by weight} = \frac{100\,(M_1 - M_2)}{M_1 - M} \quad \ldots\ldots\ldots\ (3.1)$$

Where,

$M_1$ = weight in gm of dish with material before drying

$M_2$ = weight in gm of dish with the dried material

M = weight in gm of empty dish

(Ref: - I.S.I Handbook of Food Analysis (Part VIII) – 1984 page 12 / Determination of Moisture in Dehydration Vegetables)

**Rehydration ratio**

**Procedure**

Sample was cooked in a beaker one part of dehydrated vegetable in 10 parts water for 20 minutes and then allowed it to cool at room temperature. The time taken for cooking was counted from boiling. Then beaker was filtered with No. 4 What man paper with care and inverting the container for 5 minutes. Cooled material was weighed.

**Calculation**

$$\text{Rehydration ratio} = \frac{\text{Weight of reconstituted sample}}{\text{Weight of dehydrated sample}} \quad \ldots\ldots\ldots\ (3.2)$$

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

**Dehydration Ratio**

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

**Calculation:**

$$\text{Dehydration ratio} = \frac{\text{Weight of sample before drying}}{\text{Weight of sample after drying}} \quad \ldots\ldots(3.3)$$

**Moisture loss**

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

**Calculation:**

$$\text{Moisture loss (\% of initial moisture)} = \frac{M_0 - Mt}{M_0} \times 100 \quad \ldots\ (3.6)$$

Where,

$M_0$ = initial moisture

$M_t$ = moisture at time t

**Solid gain**

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

**Calculation**

$$\text{Solid gain (\% of initial solid)} = \frac{W_o - W_d}{W_d} \times 100 \qquad \ldots (3.7)$$

Where,

$W_d$ = Weight of initial solid

$W_o$ = weight of solid after osmotic dehydration

**Shrinkage**

The drying of a product usually results in a smaller size than the original wet form. So shrinkage is determined in volume ratio. The shrinkage in volume is dependent on the density. Most of the shrinkage occurs in the early drying stages, where 40 to 50 % shrinkage may occur (Okos *et al.,* 1992).

Lazano *et al.* (1983) described the bulk shrinkage by:

$$\text{Shrinkage}_b = \frac{\text{Volume}_t}{\text{Volume}_i} \qquad \ldots (3.8)$$

Where,

$\text{Shrinkage}_b$ = bulk shrinkage

$\text{Volume}_t$ = bulk volume at any time t

$\text{Volume}_i$ = bulk volume at initial moisture

**ORGANOLEPTIC EVALUATION OR SENSORY ANALYSIS**

**Colour**

Colour is one of the predominant attribute in beetroot. In the osmotic dehydration KMS was added to prevent discolouration because beetroot is used as colouring agent in food industries. Colour was determined by two techniques, adobe photoshop7.0 and by human sensory technique.

Difference between colours can be determined by:

$$\Delta E = \sqrt{(Lo* - L*)^2 + (ao* - a*)^2 + (bo* - b*)^2} \qquad \ldots$$

**Texture or Appearance**

Rather to go for any technology human sensory is also an important parameter for consumer’s requirement. It is difficult to classify 100% by machine because it is a subjective factor. So I selected 10 semi–skilled panel members for sensory evaluation of dried guava slices. Main agenda was to evaluate two attributes (colour and appearance) on the basis of 9 point hedonic scale technique.

**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).

The initial of guava was observing in range of 81.42 %( w.b.) –89.12 % (w.b.). This was not a wide range so mean of all experiments conducted for initial was taken 90.18 % (w.b.) or 930.42 % (d.b.). This was used for moisture loss and solid gain calculations. Extraction of were carried out by water bath heating method, weighed peel (450g), distilled water (150 ml) with addition of acids viz. Citric acid, citrate and ascorbic acid and also sulphur compounds. Different pH were adjusted, for maintaining 1.5,2 and 2.5 pH required 45g, 14g and 10g of sodium sulphate (99.5% conc) respectively. Likewise for maintaining concentration (40%, 50% and 60%)) required 0.8ml, 0.10ml and 0.12ml of sodium bisulphate (70%conc. sodium bisulphate), the pH of solution were adjusted in each osmosis process according to different time, temperature and concentration treatment combination. From guava slices analysis of was done by using two different sulphur compounds at different time (3, 6 and 9 hours.), temperatures (35,45 and 55°C) and concentration (40%, 50% and 60%)) total 54 times extraction i.e 2(sulphur compounds) * 27 (treatment combination) . The above process will be same for the analysisof moisture content from guava powder also i.e 54 times, total 81 times conduction of experiments.

The moisture loss and solid gain analysed by using sodium Meta bisulphate from guava slices ranged from 21.4% to 76.0%. The percentwas minimum for guava slices using sodium meta bisulphate at treatment combination of 50% concentration, 3 hours and 55°Ci.e 21.4% ($T_9$). The moisture loss and solid gain was maximum for guava slices using sodium meta bisulphate at treatment combination of 50% concentration, 6 hours and 55(°C) i.e 76.0% moisture loss and solid gain ($T_3$). The % moisture loss and solid gain ranges of moisture loss and solid gain at 50% concentration was higher than 50% concentration and50% concentration for 3 hours extraction.. But as the time increases 50% concentration showed higher yield as shown in Table 1.

The % moisture loss and solid gain of moisture loss and solid gain extracted at 50% concentration for 3hours. at temperature ranges from 45 and 55°C are 41.4 to 47.8%. At 40% concentration for 6hours at temperature ranges from 45 and 55°C are 59.4 to 63.6%. Likewise for 60min. at the same range of temperature the % moisture loss and solid gain are 65.4 to 76.0%.

The %moisture loss and solid gain of moisture loss and solid gain extracted at 50% concentration for 3 hours. at temperature ranges from 45 and 55°C are 44.2 to 48.6%. At 50% concentration for 6hours at temperature ranges from 45 and 55°C are 48.2 to 55.2%. Likewise for 9hours at the same range of temperature the % are 58.2 to 70.4%.The % moisture loss and solid gain of moisture loss and solid gain extracted at 50% concentration for 3hours. at temperature ranges from 45 to 55°C are 21.4 to 26.8%. 50% concentrations for 6hours at temperature ranges from 45 to 55°C are 28.2 to 32.6%. Likewise for 6hours at the same range of temperature the % moisture loss and solid gain are 44.6 to 51.2

The results show that tray dryer temperature had a significant effect ($P<0.05$) on the drying time. As tray dryer temperature increased, drying time decreased. It can be seen that as temperature increased, internal vapour pressure increased which could be explained by more internal heat generated at higher temperatures. The higher pressure led to more rapid moisture removal.

**TABLE 1:** Moisture loss on different temperature and concentration at 3 hours

| Concentration Temperature | 40 % | 50 % | 60 % |
|---|---|---|---|
| 35°C | 34.40902 | 37.37022 | 40.01389 |
| 45°C | 37.91553 | 38.07021 | 40.47359 |
| 55°C | 41.49303 | 43.43755 | 46.11285 |
| 65°C | 42.31859 | 41.44716 | 45.03655 |

**TABLE 2:** Moisture loss on different temperature and concentration at 6 hours

| Concentration Temperature | 40 % | 50 % | 60 % |
|---|---|---|---|
| 35°C | 36.49783 | 40.89592 | 42.02588 |
| 45°C | 38.71422 | 42.91629 | 44.47959 |
| 55°C | 44.10584 | 45.83844 | 49.53808 |
| 65°C | 44.44283 | 46.33538 | 47.24965 |

**TABLE 3:** Moisture loss on different temperature and concentration at 9 hours

| Concentration Temperature | 40 % | 50 % | 60 % |
|---|---|---|---|
| 35°C | 39.29978 | 42.69446 | 42.99144 |
| 45°C | 39.87869 | 44.9912 | 45.22502 |
| 55°C | 45.12899 | 49.20704 | 50.73934 |
| 65°C | 47.24633 | 47.30433 | 48.73514 |

**TABLE 4:** solid gain on different temperature and concentration at 3 hours

| Concentration Temperature | 40 % | 50 % | 60 % |
|---|---|---|---|
| hours | hours | hours | Hours |
| 45°C | 41.94382 | 68.47478 | 91.12504 |
| 55°C | 87.17492 | 127.1304 | 131.2092 |
| hours | hours | hours | Hours |

**TABLE 5:** Solid gain on different temperature and concentration at 3 hours

| hours Temperature | hours | hours | Hours |
|---|---|---|---|
| 35°C | 63.24995 | 72.08332 | 114.45 |
| 45°C | 46.83857 | 76.4268 | 81.79692 |
| 55°C | 108.216 | 128.3449 | 157.9372 |
| 65°C | 95.84685 | 130.0694 | 125.3356 |

**TABLE 6:** solid gain on different temperature and concentration at 3 hours

| Concentration Temperature | 40 % | 50 % | 60 % |
|---|---|---|---|
| 35°C | 64.5584 | 73.85742 | 112.6711 |
| 45°C | 60.19922 | 82.07231 | 97.89937 |
| 55°C | 105.385 | 169.9708 | 150.4958 |
| 65°C | 121.3302 | 141.2485 | 159.3344 |

**TABLE 7:** Osmotic model constants for moisture loss

| | 40 % | 50 % | 60 % |
|---|---|---|---|
| 35°C | 39.21569 | 42.91845 | 43.10345 |
| 45°C | 39.84064 | 45.45455 | 45.6621 |
| 55°C | 45.24887 | 49.01961 | 51.02041 |
| 65°C | 47.16981 | 47.84689 | 48.78049 |
| | 40 % | 50 % | 60 % |

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