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# Determination of the Best Method of Dehydration of Tropical Fruits to be Incorporated in Gelatin-based Dessert with Unaltered Sensory Qualities

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## ABSTRACT

**Background:** Jelly based desserts are very popular among millions of people worldwide. The main gel forming ingredient used in these products is 'Gelatin', which is a complex polysaccharide in their chemical structure. This research study focusses on incorporation of fruit pieces in to the dessert jelly in order to give a novel experience to the consumers.

**Methods:** To determine the best way of incorporating fruit pieces in a commercially available jelly mixture (which is made up of fruit flavour, acid, water, sugar and pectin as the jelling agent), fruit pieces were treated in two ways and compared for the best textural and sensory qualities. First sample constituted unblanched, oven dried fruit pieces in a commercially available jelly mixture and its was compared with a jelly sample with blanched (fruit pieces were pretreated to minimize any possible discolorations and textural changes), osmo air dehydrated and oven dried fruit pieces. Sensory qualities such as texture, mouth feel and flavour of two different samples were gauged through a sensory test.

**Result:** From a sensory test carries out by a panel of 09 sensory panelists it was found that the jelly mixture when incorporated with osmo air dehydrate fruit pieces it did not degrade the texture of the final product as opposed to unblanched dried fruit pieces does. The osmo air dehydrated fruit pieces in the prepared jelly has a texture and an acceptable mouth feel which is closer in texturally to the natural mouth feel and the taste, when they are reconstituted inside the jelly mixture by absorbing the water from the mixture.

**Key words:** Gelatin based desserts, Osmo air dehydration of fruit, Sensory qualities.

## INTRODUCTION

With the view of giving a novel and value-added nutritious experience of consuming jelly desserts with dehydrate fruit pieces, this study was carried out to observe the gelling capacity of normal dessert jelly when incorporated with dehydrated fruit pieces.

The enzymes present in the fruits are found to be having some inhibitory action against the gelation and by breaking down its structure (Sharma *et al*., 2017). Protein digesting enzymes present in fruits attack gelatin, thus reducing its setting power (Chatterjee and Sharma, 2018).

Since the enzymes in the fruits are not completely inactive even during storage at low temperatures, they can be destroyed by exposing to even the mildest conditions of heat to cause the least possible undesirable changes in the material. Practical ways adopted by early investigations are the use of heat (blanching in hot water or in steam) and some form of chemical treatment like use of Sulphur dioxide ($SO_2$) *etc*. (And and Barrett, 2006).

During the blanching process, as the material is warming up with the external thermal conditions for certain enzyme activities are at their optimum, so prolongation of heat supply inactivate the enzyme activity irreversibly (Xu *et al*., 2020). The test for adequate blanching is important and these have been centered round a certain enzyme, '*Catalase*' whose resistance is above that of the enzymes indexed to bring about undesirable changes has become more important as a test for blanching that it probably is as a cause of deterioration though there is some evidence to show that catalase is concerned directly with the darkening of food products (Ali *et al*., 2016). This experiment tried to find out which method of drying of fruit pieces given the better sensory quality such as mouth feel, colour and hardness, maintaining closer to fresh fruit pieces when incorporated with commercially available jelly.

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### Blanching procedure

Enzymatic reactions cause deterioration of fruits in processing and storage. The main purpose of blanching a food product is to inactivate the enzymes that causes quality changes and subsequently responsible for deterioration of flavour, colour, odour texture and also causes breakdown of nutrients. Another objecting of blanching as pretreatment in food technology is to inactivate and destroy microorganisms that causes post contamination of food products (Dorantes-Alvarez *et al*., 2011). Therefore, exposing to a proper blanching process ensures textural stability and retention of nutrient qualities of food products that are to be undergoing different processing methodologies including dehydration (Fernandes *et al*., 2011). However, it is equally important to determine the optimum temperature-heat combination in order to optimize the processing conditions so that the product retain the desirable qualities textually, physiochemical properties such as colour, flavour and nutritious qualities or cause leaching losses. (Kusznierewicz *et al*., 2008; Gupta *et al*., 2012).

### Osmo air dehydration of the fruit

Osmo air dehydration has gain much attention lately as an intermediate phase in dying of fruits. Although it is a simple process, it has several potential advantages in the field of food science and technology, such as extending the shelf life of tropical fruits. It is also resulted in improvement of quality of food products in terms of colour, texture, flavour, product stability, retention of nutrients and prevention of microbial spoilage during post storage. Osmotic drying process has elevated the conventional drying process which has main two advantages, namely; quality enhancement and energy saving (Chavan and Amarowicz, 2012). Different factors such as method of pretreatment, nature and concentration of the osmotic solution used, characteristics of the raw materials, stage of ripeness/ maturity of the food product, size of the piece, duration in which it is undergoing the osmosis, ratio between syrup and fruit piece, temperature at which it is exposed to and amount agitation are researched to be influence the quality of the final product (Tiwari, 2005).

Further the interest on osmo air dehydration has arisen in the field of dehydration fruit products, because of their technical and economic advantages, such as suitability for automatized mixing with other ingredients and weight and volume reduction with consequently lowering of storage and transport cost (Akbarian, 2014). A wide range of water and soluble solids contents in the final product could be achieved in order to prepare a fruit ingredient with functional properties suitable for special food system (Maltini *et al*., 1993). However, air drying of vegetable tissues is characterized by extensive shrinking and micro-structural changes (Anguilera and Stanley, 1999). This phenomenon affects the rate of drying as well as physical and functional properties of the dehydration products. Maximal shrinkage during drying of a fruit material decrease when fruit was impregnated with sugars prior to air drying (Lenart and Cerkowniak, 1996). Partial dehydration and solute intake can be achieved by immersion in concentrated aqueous solution, the so called osmo air dehydration process (Lazarides, 2019). By modifying the extent of the partial dehydration and syrup composition not only the end product can be diversifying but chemical, physical and functional properties can be improved. However, there are several factors that affects he final product subject to osmo air dehydration process such as, quality of raw material, shape, size and thickness of the selected fruit pieces, intensity of pre-treatment, immersion time in the sugar syrup temperature and concentration of solution used in osmo air dehydration (Chavan and Amarowicz, 2012).

### Sensory testing

Instrumental methods and sensory methods are equally been employed to determine the quality of fresh fruits and vegetables. However, in general sensory are frequently used to in developing new products and determining standards of products while instrumental methods are widely used in quality of the of food products routine basis (Predieri *et al*., 2000).

There are two common methods of sensory evaluations in the field of food science and technology, namely; analytical and affective analytical sensory measurements are used to detect differences in different samples or as a descriptive analysis where affective measurements are used to determine preferences (Barrett, 2010).

This study employed a direct laboratory based comparative experiment method, where the physical factors of the fruit pieces exposed to two different heat treatments are determined through an analytical sensory panel test.

## MATERIALS AND METHODS

### Preparation of fruit pieces to be treated prior to incorporation to the jelly mixtures

Stage of maturity and variety of fruit impacts the water loss and solid intake during osmosis process (Chavan and Amarowicz, 2012). Hence selection of fruit at the optimal maturity stage is essential. In this experiment, for the preparation of fruit pieces to be dehydrated to be in cooperated in the jelly mixture, hard textured fully matured/ ripened tropical fruits such as papaya, mango and pineapple are chosen from a local market (over ripened fruits were avoided). The fruits were washed with sanitizing solution (50ppm Chlorine solution) and cleaned thoroughly with potable water, peeled and cut in to small pieces.

### Blanching procedure

The cut-up pieces were blanched in hot water as follows and drained and washed in running water immediately. The best timing for blanching for each fruit was determined from previous similar studies (Agarry *et al*., 2013; Xin *et al*., 2015) (Table 1).

As per Chavan and Amarowicz (2012) dipping fruit pieces prior to dehydration process as a pre-treatment would prevent the discolouration and produce a highly acceptable product. Hence, the blanched fruit pieces were then introduced in to a 3% solution of KMS (Potassium metabisulphate) for about ½ an hour. Then the fruit pieces are packed in polypropylene to avoid absorption of atmospheric moisture.

### Test for adequacy of blanching process

Catalase test is one of the major testing established to measure the adequacy of the blanching treatment as a pre-treatment for the drying (Gökmen, 2010).

### 'Catalase' reaction testing: Methodology

A clean dry test tube of 1" diameter and 6" deep is filled in to a depth of approximately 1" to withstand small cut up pieces of dehydrate fruit (papaya / mango/ pineapple). Content is covered with water and allowed to stand for 10 minutes. An equal volume of 0.3% $H_2O_2$ and the content in the test tube is mixed well by shaking gently. If the test is positive, evolution of Oxygen can be observed (Table 2).

According to the above results it was shown that the blanching for the papaya fruit pieces was not enough while the adequate blanching was shown for mango and pineapple. Hence, the blanching time for the Papaya was increase slight in order to provide adequate enzyme inactivation.

### Experiment I - Method of incorporation of oven dried fruit pieces to jelly based dessert

Half of the commercial gelatin jelly mixture (50 g) was mixed with 225 ml of boiling water and refrigerated till it get set and then 10 g (10% of the jelly crystal weight) of the hot air oven dried fruit pieces were added on top of the set jelly and then the rest of the jelly mixture (50 g dissolve in 225 ml of water) was poured on top of the fruit pieces and it was found the fruit pieces have settled in between the two layers of fruits. But when the sensory characteristics were measured, it was found that the texture of the dehydrated (oven dried) fruit pieces were not satisfactory. Hence, it was decided to dehydrate the fruit pieces using the osmo air dehydration method in order to ensure retention of the texture of the fruit pieces once they are self-rehydrated when they are incorporated with the jelly mixture.

### Experiment II - Method of incorporation of osmo air dehydrated fruits pieces to jelly dessert

Cleaned, weighed fruits were and cut in to small pieces (approximately about 3×2×1mm in size). The cut-up fruit pieces were blanched n hot water for 2-3 minutes and then dipped in sugar syrup for 24 hours.

The composition Sugar syrup is as per the formula:

Total solution weight = Total pulp weight × 0.3

Where

The final sugar syrup contains 59.5% of sucrose 1.03% of Sodium meta-bisulphate (SMS).

### Drying process

The required amount of sugar syrup (calculated according to above formula) was prepared according to the pulp weight obtained. After keeping the cut-up fruit pieces for 24 hours in the sugar syrup in an airtight container, drain the excess of syrup and washed the fruits in clean running water. Then it was introduced to an electric hot air dryer and dried till the final moisture content is about 5%. They are then packed in a polypropylene bag until used (Fig 1).

### Preparation of fruit sample for osmo air dehydration

Total weight - 3485 g,
Total solution needed = Total fruit (3.485 kg) × 0.3 =
3.458 × 0.3 = 1.0374 kg
[Sugar 59.5%. SMS 1.03%]
Sugar = 6.91 kg
SMS = 120.2 kg
Water = 4.64 kg

The solution prepares as per the above method was introduced in to separate bags with the fruit pieces as per the requirement of each fruit and sealed to make it airtight. Keep for 24 hours, with occasional mixing in order to make sure that fruit pieces are properly dipped in the sugar syrup. After 24 hours, drained the sugar syrup and rinsed under clean running slightly cold water to remove excess sugariness on the fruit pieces. Removed the water thoroughly and introduced to the dryer and dried till the end moisture content reduce up to 5% (Table 3).

### Incorporation of osmo air dehydrated fruit pieces to jelly mixture

Method of preparation of the commercially available Jelly mixture: 100 g of Jelly crystal with 450 ml of boiling water while mixing 10 g (10% of the weight) of dehydrated fruits were introduced to the mixture. The prepared mixture was poured in to cups and allowed to cool in the refrigeration temperature.

Sensory properties of the fruit pieces in the mixture was determined through sensory parameters such as mouth-feel, flavour and hardness.

## RESULTS AND DISCUSSION

The results of the sensory test carry out with the participation of 09 sensory panelists were as follows,

When the jelly mixture is incorporated with osmo air dehydrate fruit pieces it did not degrade the texture of the final product as oppose to unblanched dried fruit pieces

**Table 1:** Optimum blanching times carried out for each selected fruit.

| Type of fruit | Time of blanching |
|---|---|
| Papaya | 1 ½ minutes |
| Mango | 2 minutes |
| Pineapple | 2 minutes |

**Table 2:** Results of the catalase reaction tests.

| | | |
|---|---|---|
| Papaya | Slight evolution of $O_2$ | +ve test |
| Mango | No evolution of $O_2$ | - ve test |
| Pineapple | No evolution of $O_2$ | - ve test |

**Table 3:** Preparation of fruit sample for osmo air dehydration.

| Initial weight of the fruits | Weight of the waste (peel and seeds) | Pulp weight of the fruits |
|---|---|---|
| Pineapple- 1100 g | Pineapple- 525 g | Pineapple- 575 g |
| Mango- 835 g | Mango- 130 g | Mango- 705 g |
| Papaya- 2470 g | Papaya- 265 g | Papaya- 2205 g |

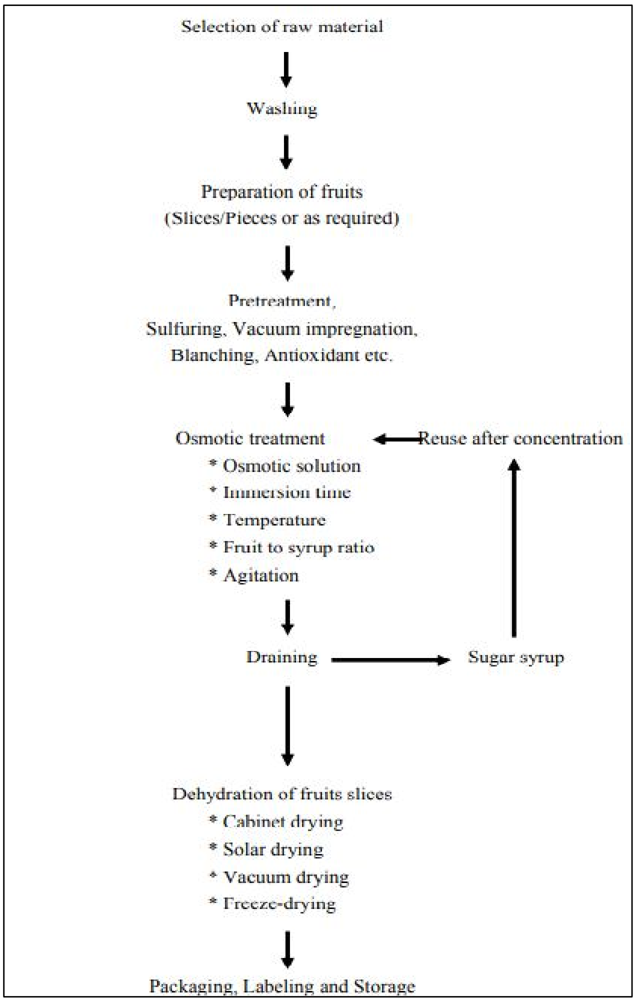


**Fig 1:** Process of osmo air dehydration (Source: Chavan and Amarowicz, 2012).

does. It was also observed that the textural quality of the fruit pieces which are osmo air dehydrated are more favourable than the fruit pieces which are normally oven dried. The osmo air dehydrated fruit pieces in the prepared jelly has a texture and an acceptable mouth feel which is closer in texturally to the natural mouth feel and the taste, when they are reconstituted inside the jelly mixture by absorbing the water from the mixture. In order to avoid the sedimentation of the fruit pieces, the fruits pieces were introducing on to the semi-set jelly mixture and then the rest of the jelly mixture was poured before allowing the whole mixture to set.

According to the results, it was shown that the osmo-air dehydration affects the natural quality of the fruits to a minimum extent. In the first trial it was tried to incorporated commercially available jelly with unblanched oven dried fruit pieces. But the sensory quality of it was not very much acceptable as the mouth feel was poor in that. But when the fruit pieces were osmo air dehydrated, it was found that after preparation of the jelly dessert the hardness and the mouth feel was almost similar to the fresh fruit pieces. Also, the colour of the osmotically dehydrated fruit pieces were found to be more desirable compared to the oven dried fruit pieces.

## CONCLUSION

This is a research study conducted to determine the best drying method for tropical fruit pieces to be incorporated in to the commercially available normal jelly dessert with the intention of introduce a novel value-added jelly-based dessert product to the consumers. While two samples of fruit pieces namely; fruit pieces unblanched and then oven dried and blanched osmo air dehydrated fruit pieces were incorporated with commercially jelly powder separately. The quality of the end product based on the texture, flavour and mouth feel was tested through a sensory panel. It was found that the quality of the jelly dessert incorporated with blanched osmo sir dehydrated fruit pieces was the most desired and closet to the fell of the natural fruit pieces. Hence, it can be concluded that the pre-treatment blanching of the fruit pieces has prevented the fruit pieces from developing undesirable visual qualities such as discolouration while osmo air dehydration process has ensured the retention of textual qualities keeping the flavour and mouth feel of the fruit pieces as natural as much as possible.

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