

Effect of sugar concentration and duration of osmosis on water loss solid gain and yield in osmotically dehydrated banana var. 'ROBUSTA' and 'NEYPOOVAN'

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Banana is one of the most important fruit crops of India with an annual production of 264.7 lakh tonnes having great socio-economic significance. It is a highly perishable fruit suffers from high post harvest losses to an extent of about 20 to 40 per cent. Therefore, it is necessary to develop shelf stable value added products and the osmotically dehydrated slices have good potential. The inclusion of osmotic process in conventional dehydration has two major advantages of quality improvement and energy savings. An increase in duration of osmosis and syrup concentration increased weight loss, moisture loss and solid gain in the banana slices. In general there was an increase in yield by increasing the concentration of sugar syrup from 50 to 70°Brix as well as duration of osmosis from 4 to 24 hours.

Key Words : Banana, Osmotic dehydration, Air-drying, Weight loss, Solid gain, Yield

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Banana (*Musa* spp.) a member of Musaceae family and fruit of tropics is one of the most important fruit crops of India with great socio-economic significance. India leads world in production of banana with an annual production of 264.7 lakh tonnes out of total world production of 950 lakh tonnes (NHB, 2010). It is largely grown in the states of Tamil Nadu, Maharashtra, Karnataka, Andhra Pradesh, Gujarat,

Assam, Bihar, Kerala, Orissa, West Bengal and Madhya Pradesh. Most of the banana produced in our country is consumed as fresh fruit. Being highly perishable, this fruit suffers from high post harvest losses to the extent of about 20 to 40 per cent. Development of shelf stable value added products is essential to prevent the losses and also to properly utilize the expected increase in production.

Application of osmotic dehydration process in the production of safe, stable, nutritious, tasty and economical product is gaining more attention. This process involves placing solid food, whole or in pieces in sugar or salt aqueous solution of high osmotic pressure which removes 30-50 per cent of the water from fresh ripe fruits such as mango, pineapple, sapota, papaya, guava and jackfruit (Lewicki and Lenart, 1995). The quality of dried fruits is enhanced to a great extent due to increase in sugar content, reduction of sour taste and prevention of loss of natural flavour along with better retention of nutrients (Ponting *et al.*, 1966). The major advantage of inclusion of osmotic process in conventional dehydration are quality improvement (Ponting *et al.*, 1966; Raoult-wack, 1994) and

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energy savings (Raoult-wack, 1994; Lewicki and Lenart, 1995). Influence of osmotic agents on drying behaviour and product quality have been reviewed by Pointing *et al.* (1966), Torreggiani (1993), Raoult-Wack (1994), Lewicki and Lenart (1995) and more recently by Rastogi *et al.* (2002). Work on osmotic dehydration in fruits such as banana (Bongirwar and Sreenivasan, 1977).

Present investigation was conducted to study the effect of syrup concentration and duration of osmosis on water loss, solid gain, weight reduction and yield of osmotically treated slices of banana cultivars Robusta and Ney Poovan.

EXPERIMENTAL METHODS

Fully matured banana fruits of Robusta and Ney Poovan were procured from market and allowed to ripe at room temperature. Fruits were peeled, cut into 10 mm slices before subjecting to the osmotic pretreatments.

Treatment:

Prepared banana slices (1 kg each) were dipped in 50, 60 and 70°Brix sugar syrup containing 0.2 per cent of citric acid and 0.1 per cent each of potassium metabisulphite (KMS) and sodium metabisulphite (NaMS) in 1:2 fruit to syrup ratio and allowed to undergo osmosis for 4, 6 and 24 h at room temperature (20-30°C). Slices were drained and rinsed with water to remove adhering syrup. One lot of slices without osmotic dip (untreated) was sulphited in 0.1 per cent KMS for 10 min to serve as control. Treatment details are as follows:

- Syrup Concentration: 50, 60 and 70°Brix
- Duration of osmosis: 4, 6, 24h
- Treatments were replicated for 3 times

Dehydration:

Osmosed slices from different treatments were spread on stainless steel trays and were dehydrated in a cabinet drier at 55 ± 2°C on to a constant moisture level. The dried banana samples were packed in polythene covers (300 gauges).

Observations:

The following observations were during experimentation.

$$\text{Weight loss (\%)} = \frac{\text{Initial weight} - \text{weight at time}}{\text{Initial weight}} \times 100$$

$$\text{Moisture loss (\%)} = \frac{\text{Initial moisture} - \text{moisture at time}}{\text{Initial moisture}} \times 100$$

$$\text{Solid gain (\%)} = \text{Moisture loss (\%)} - \text{weight loss (\%)}$$

$$\text{Slice recovery (\%)} = \frac{\text{Weight of prepared carrot slices}}{\text{Weight of fresh carrot slices}} \times 100$$

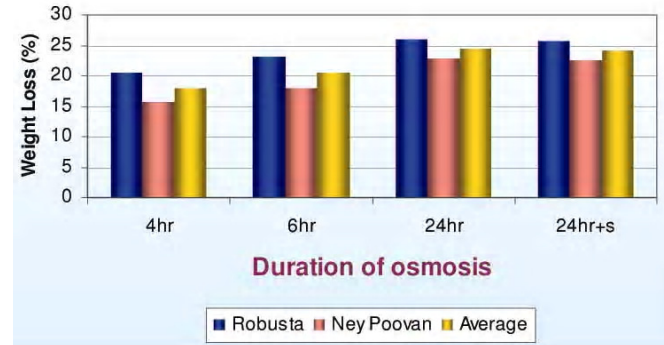
$$\text{Dehydrated yield (\%)} = \frac{\text{Weight of dehydrated carrot slices}}{\text{Weight of fresh carrot slices}} \times 100$$

EXPERIMENTAL FINDINGS AND ANALYSIS

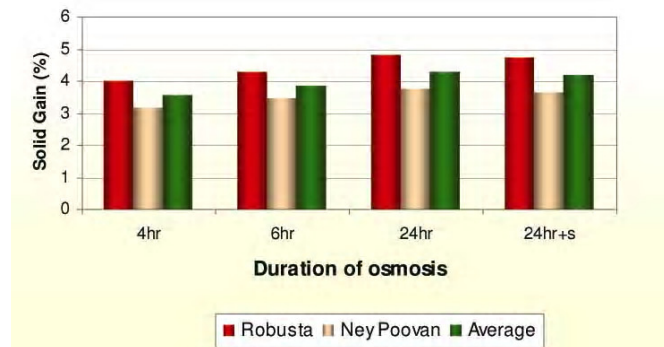
The results of the present study as well as relevant discussions have been presented under following sub heads:

Effect of pre-treatments on per cent weight loss by banana slices after osmosis:

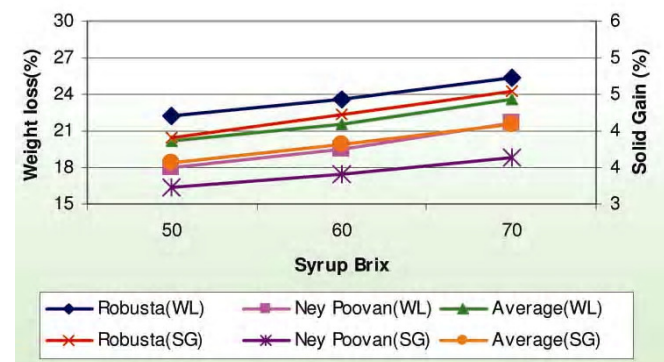
Further data shown in Fig.1a and 1b indicate that an increase in the duration of osmosis or syrup concentration



(a) Effect of duration of osmosis on weight loss



(b) Effect of duration of osmosis on solid gain



(c) Effect of syrup brix on weight loss and solid gain

Fig. 1 : Effect of duration of osmosis (a and b) and syrup concentration (c) on weight loss and solid gain in osmosed slices of banana varieties Robusta and Ney Poovan

resulted in the increase in weight loss. By increasing the duration of osmosis from 4 to 24 hour resulted in increase in weight loss which varied from 20.48 to 25.88 per cent in Robusta slices and 15.56 to 22.72 per cent in Ney Poovan. On the other hand, an increase in the syrup concentration from 50 to 70°Brix resulted in increase in weight loss which ranged from 22.24 to 25.41 per cent in Robusta slices and 18.03 to 21.65 per cent in Ney Poovan. It was observed that osmotic pre-treatments also resulted in shrinkage in the size of banana slices.

Effect of pre-treatments on per cent solid gain of osmoted banana slices:

The effect of increase in syrup concentration resulted in increase in overall solid up take which was 3.67 per cent in 50°Brix, 3.97 per cent in 60°Brix and 4.30 per cent in 70°Brix. In case of Robusta slices, the solid gain ranged from 4.09 to 4.85 per cent while it was 3.28 to 3.76 per cent in Ney Poovan. Further, an increase in the duration of osmosis resulted in increase in solid up take and values were 3.56 per cent in 4 hours, 3.86 per cent in 6 hours, 4.30 per cent in 24 hours and 4.21 per cent in 24 hours in addition of salt (Fig- 1b and 1c).

Effect of osmotic pre-treatments on per cent moisture loss by banana slices after osmosis:

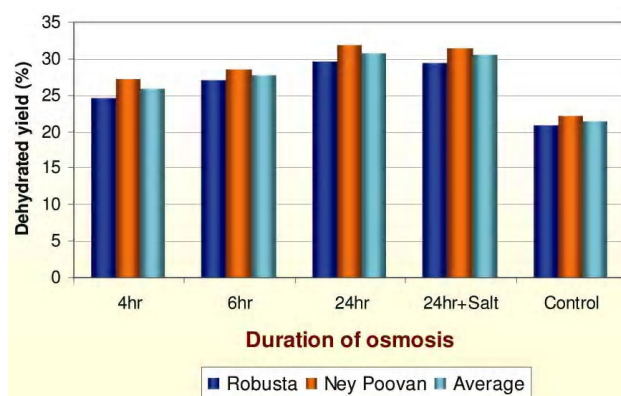
It was also observed that an increase in the duration of osmosis or syrup concentration resulted in the increase in moisture loss (Fig -1c).

Effect of syrup concentration and duration of osmosis on yield:

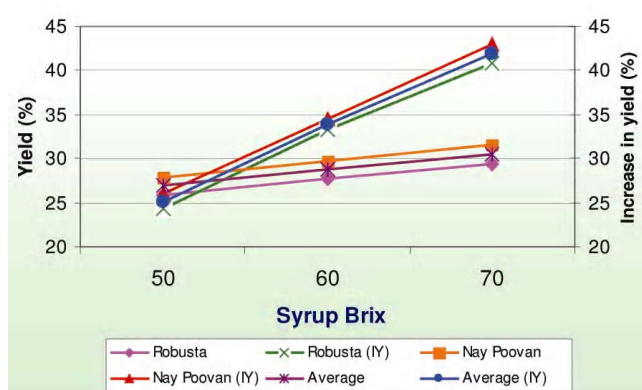
A close perusal of the data given in Fig. 2a and 2b indicate that there was an increase in yield by increase in the concentration of sugar syrup from 50 to 70°Brix. The yield increase over control varied from 24.27 to 40.80 per cent in variety Robusta, while it was 25.97 to 42.92 per cent in Ney Poovan slices.

In general, the response of increase in the concentration of sugar syrup was similar in both the varieties for 6 and 24 hours of osmosis, while 4 hours osmotic treatment resulted in higher yield recovery in Ney Poovan as compared to Robusta slices (Fig. 2a and b).

Raoult-Wack *et al.* (1991) and Raoult Wack (1994) stated that osmotic dehydration is also termed as a dewatering and impregnation soaking process (DISP). The principle used in the osmotic dehydration is that the water diffuses from dilute solution to concentrated solution (hypertonic solution) through a semi-permeable membrane until concentration equilibrium is reached. The driving force is the water activity gradient caused due to the osmotic pressure. Hence, the banana slices subjected to osmotic dehydration responded in the line of above facts. Further, variation in response of different concentrations observed may be due to varying osmotic pressure of the osmotic medium. It has been reported that increasing the sugar syrup



(a) Effect of duration of osmosis on dried yield



(b) Effect of syrup brix on the dried yield

Fig. 2 : Effect of duration of osmosis (a) and syrup concentration (b) on yield of osmotically dehydrated slices of banana varieties Robusta and Ney Poovan

concentration favours water loss more than solid gain (Pointing *et al.*, 1966; Hawkes and Flink, 1978; Torreggiani, 1993).

It has been reported that due to increase in the solid gain and the volume reduction of the osmo-dehydrated products there is threefold increase in drier load and process yield (Torreggiani, 1993).

Conclusion:

An increase in duration of osmosis and syrup concentration increased weight loss, moisture loss and solid gain in the banana slices. In general there was an increase in yield by increasing the concentration of sugar syrup from 50 to 70°Brix as well as duration of osmosis from 4 to 24 hours.

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