

## Effect of Osmotic Dehydration on drying method and physicochemical Properties of Pineapple (*Ananas comosus*.var.*Queen*)

**Abstract:** Osmotic dehydration in hot air drying of pineapple cubes by using sucrose solution is able to improve the quality like colour, aroma, texture, appearance as well as overall acceptability. The physico-chemical properties and organoleptic quality of the product were evaluated during the experiment. There were significant differences among different treatments. The range of recovery % (13.210%-14.780%), TSS°Brix (54.52°Brix-75.40°Brix), reducing sugars % (30.14%-39.80%), non-reducing sugars % (14.67%-43.70%), total sugars (50.20%-73.85%), acidity% (1.45%-1.67%), pH (3.32-3.95), ascorbic acid % (25.1%-35.1%) moisture% (9.95-15.90%), weight loss % (10.25%-32.04%), solid gain % (11.87%-18.65%), dehydrated yield % (13.02%-14.95%), dehydration ratio (6.75-7.77), rehydration ratio (1.23-1.71) were observed.

**Keywords:** Pineapple, drying method, Osmosis, dehydration

### Introduction:

Pineapple (*Ananas comosus*.var.*Queen*) is one of the commercially important fruit crops of tropical world belong to the family Bromeliaceae. According to Baker and Collins (1939), it probably originated in central and southern Brazil, northern Argentina and Paraguay. It lends itself very well to processing. Due to this, it has become the most important commercial fruit of the world. In India pineapple is cultivated in 1, 16,000 ha with a production of 1980 million tonnes. Pineapple fruit is non-climacteric in nature and has characteristic pleasant flavour, distinct aroma, exquisite taste and absence of seeds qualifies it as one of the choicest fruits throughout the world Pineapple is a good source of vitamin A, vitamin C and is fairly rich in vitamin B. It also contains phosphorus and minerals like calcium, magnesium, potassium and iron (Lodh *et al.* 1973). The cultivar Queen is rich yellow in colour, weighing about 1-1.5 kg. The flesh is deep golden-yellow, less juicy than Kew, crisp textured with a pleasant aroma and flavour. Eyes are small and deep requiring a thicker cut when removing the skin. It is generally grown in India, Australia and South Africa. Hence, osmotic treatments have been studied in combination with drying method and addition of preservatives. Dehydration is the process of water removal from the food under controlled conditions like temperature, relative humidity, air flow, etc. The main objective of dehydration is to reduce the bulk weight and to reduce water activity. This process is best suited for developing countries with poor thermal processing facilities.

### Materials and Methods:

This study was conducted in the Post harvest Laboratory, department of Fruit science at college of Horticulture, Rajendranagar, Hyderabad, SKLTSHU during the year 2017-2018. This experiment was conducted in factorial Complete Randomised Design (CRD) with six treatments and four replications. Matured, fully ripe of uniform size, free from pest and disease damage and bruises pineapple fruits cv. Queen were procured from Navsari Fruit Market. The selected fruits were peeled using stainless steel knife. The edible fruit portion was cut into cubes after removing the core. Three different concentrations of sugar syrup *i.e.* 50, 60 and

70°Brix were prepared. One kg of sucrose and one kg of water were used to prepare 50°Brix sucrose syrup concentration, 1.2 kg of sucrose and 0.8 kg of water were mixed to prepare 60°Brix sucrose syrup concentration and also 1.4 kg of sucrose and 0.6 kg of water were used to prepare 70°Brix sucrose syrup concentration as fruit pieces to sucrose syrup ratio was 1:2 (Noroës *et al.* 2010). During heating of the sucrose syrup solution, 0.3% per cent of citric acid was added. After adjusting the concentration of sucrose syrup, 0.1% of potassium metabisulphite (KMS) and 0.1% Sodium benzoate was added as preservative in sucrose syrup in dissolved form when the syrup got cooled (Chavan *et al.* 2010). During osmosis process, water flows from the fruit pieces to the syrup and solute was moved into the fruit pieces.. The prepared fruit pieces were put in sucrose syrup solution and left for 24 h for osmosis. After 24h, the fruit pieces were drained out of the osmotic solution (Rashmi *et al.* 2005). Osmosed pineapple cubes were drained and loaded uniformly over stainless steel trays .Before loading, the cubes are shade dried to avoid browning. Inner and bottom of the tray was wiped with glycerin to avoid metal contact. Loaded stainless steel trays were kept in a cabinet tray drier and hot air oven for dehydration with intermittent turning of cubes for quick drying (Chavan *et al.* 2010). Fruit pieces were dried at 60°C temperature until constant weight is obtained. The details of factors and different treatments were given below.

**Factor- I:** (Sucrose °Brix): Three

S<sub>1</sub>:50°Brix

S<sub>2</sub>:60°Brix

S<sub>3</sub>:70°Brix

**Factor- II:** (Drying method): Two

D<sub>1</sub>: Cabinet tray drier

D<sub>2</sub>: Hot air oven drying

**Treatment combinations:**

1. S<sub>1</sub>D<sub>1</sub>-Sucrose concentration 50°Brix. + Cabinet tray drying
2. S<sub>1</sub>D<sub>2</sub>-Sucrose concentration 50°Brix. + Hot air oven drying
3. S<sub>2</sub>D<sub>1</sub>-Sucrose concentration 60°Brix. + Cabinet tray drying
4. S<sub>2</sub>D<sub>2</sub>-Sucrose concentration 60°Brix. + Hot air oven drying
5. S<sub>3</sub>D<sub>1</sub>-Sucrose concentration 70°Brix. + Cabinet tray drying
6. S<sub>3</sub>D<sub>2</sub>-Sucrose concentration 70°Brix. + Hot air oven drying

## Results and Discussions:

The observations on physico-chemical composition of fresh pineapple fruits are presented in Table 1. average fruit weight (1.23 kg), average crown weight (0.128 kg), average peel with discarded weight (0.430 kg), average core weight (0.170 kg), yield of the fruit cubes (0.528 kg), average moisture content (88.2%), average TSS (14.8 °Brix), average ascorbic acid (35.56 mg/100g), average acidity (1.02%), average total sugars (13.20%), average reducing sugars (6.08%), average non-reducing sugars (7.12%), and average pH (3.94) .Similar results found by Surabhi *et al.* (2007) and Nazaneen *et al.* (2015) in pineapple. After the preparation of osmo-dehydrated pineapple cubes, physico-chemical parameters was evaluated at initial stage in respect of moisture content, water loss, solid gain, dehydrated yield, dehydration ratio, rehydration ratio, TSS (°Brix), reducing sugars (%), non-reducing sugars (%), total sugars (%), acidity (%), pH and ascorbic acid (mg/100g) which are described as below.

## Moisture (%)

The data pertaining to the effect of sucrose syrup concentration and drying method on moisture content of pineapple cubes was presented in Table 4 . Significant differences was recorded in moisture content of osmosed pineapple as influenced by sucrose syrup, drying method and their interaction. The maximum moisture content (14.82%) was recorded in  $S_1(50^\circ\text{Brix})$  and minimum moisture content(9.97 %) was recorded in  $S_3(70^\circ\text{Brix})$  with respect to factor sucrose syrup concentration. In factor drying method, the maximum moisture content (12.28%) was observed in  $D_2$  (hot air oven drying) and minimum moisture content (11.55%) was observed in  $D_1$ (cabinet tray drying). The interaction among  $S \times D$  showed significant results. The treatment combination  $S_1D_2$  (50°Brix syrup concentration with hot air oven drying) recorded significantly highest moisture content (15.90%). While, significantly lowest moisture content was found in  $S_3D_2$  (70°Brix syrup concentration with hot air oven drying) *i.e.*, (9.95%). The result indicated that moisture content of osmo-dehydrated pineapple cubes was decreasing with increase in sucrose syrup concentration. This might be due to the increased diffusional changes and osmotic pressure exerted on the fruit cell structure which consequently resulted in greater moisture reduction in higher concentration solutions. However, the minimum moisture content was found in  $S_3D_2$  (70°Brix syrup concentration with hot air oven drying) followed by  $S_3D_1$  (70°Brix syrup concentration with cabinet tray drying) and the maximum moisture content found in  $S_1D_2$  (50°Brix syrup concentration with hot air oven drying). Similar results was observed by Khanom *et al.* (2014) in pineapple.

## Weight loss (%)

The data pertaining to the effect of sucrose syrup concentration and drying method on weight loss (%) of pineapple cubes was presented in Table 3. Significant differences was recorded in per cent weight loss of osmosed pineapple as influenced by sucrose syrup, drying method and their interaction. The maximum weight loss (31.083%) was recorded in  $S_3$  (70°Brix) and minimum weight loss (15.17%) was recorded in  $S_1$  (50°Brix) with respect to factor sucrose syrup concentration. In factor drying method, the maximum weight loss (26.08%) was observed in  $D_1$  (cabinet tray drying) and minimum weight loss (21.50%) was observed in  $D_2$  (hot air oven drying). The interaction among  $S \times D$  showed significant results. The treatment combination  $S_3D_1$  (70°Brix syrup concentration with cabinet tray drying) *i.e.*, (32.04%) recorded significantly highest weight loss. While, significantly lowest weight loss was found in  $S_1D_2$  (50°Brix syrup concentration with hotair oven drying) *i.e.*, (10.25%). The result indicated that weight loss of osmo-dehydrated pineapple cubes was increasing with increase in sucrose syrup concentration. The reason was that the viscosity of hypertonic solution was lowered and the diffusion coefficient of water increased at high temperature. The maximum weight loss was found in  $S_3D_1$  (70°Brix syrup concentration

with cabinet tray drying) followed by S<sub>3</sub>D<sub>2</sub> (70°Brix syrup concentration with hot air oven drying) and the minimum weight loss found in S<sub>1</sub>D<sub>2</sub> (50°Brix syrup concentration with hot air oven drying).

### **Solid gain (%)**

The data pertaining to the effect of sucrose syrup concentration and drying method on solid gain (%) of pineapple cubes was presented in Table 4. Significant differences were recorded in per cent solid gain of osmosed pineapple as influenced by sucrose syrup concentration, drying method and their interaction. The maximum solid gain (18.33%) was recorded in S<sub>3</sub> (70°Brix) and minimum solid gain (13.46%) was recorded in S<sub>1</sub> (50°Brix) with respect to factor sucrose syrup concentration. In factor drying method, the maximum solid gain (15.88%) was observed in D<sub>1</sub> (cabinet tray drying) and minimum solid gain (15.36%) was observed in D<sub>2</sub> (hot air oven drying). The interaction among S×D showed significant results. The treatment combination S<sub>3</sub>D<sub>1</sub> (70°Brix syrup concentration with cabinet tray drying) *i.e.*, (18.65%) recorded significantly highest solid gain. While, significantly lowest solid gain was found in S<sub>1</sub>D<sub>1</sub> (50°Brix syrup concentration with cabinet tray drying) *i.e.*, (11.87%). The result indicated that solid gain of osmo-dehydrated pineapple cubes was increasing as increase in sucrose syrup concentration. However, the maximum solid gain was found in S<sub>3</sub>D<sub>1</sub>(70°Brix syrup concentration with cabinet tray drying) followed by S<sub>3</sub>D<sub>2</sub> (70°Brix syrup concentration with hot air oven drying) and the minimum solid gain was found in T<sub>1</sub>C<sub>1</sub> (50°Brix syrup concentration with Cabinet tray drying) during osmotic dehydration.

### **Dehydrated yield (%)**

The data pertaining to the effect of sucrose syrup concentration and drying method on dehydrated yield (%) of pineapple cubes was presented in Table 4. Significant differences were recorded in percent dehydrated yield of osmosed pineapple as influenced by sucrose syrup concentration, drying method and their interaction. The maximum dehydrated yield (14.62%) was recorded in S<sub>2</sub>(60°Brix) and minimum dehydrated yield (13.47%) was recorded in S<sub>1</sub> (50°Brix) with respect to factor sucrose syrup concentrations. In factor drying method, the maximum dehydrated yield (14.16%) was observed in D<sub>1</sub> (cabinet tray drying) and minimum dehydrated yield (13.98%) was observed in D<sub>2</sub>(hot air oven drying). The interaction among S×D showed significant results. The treatment combination S<sub>2</sub>D<sub>1</sub>(60°Brix syrup concentration with Cabinet tray drying) recorded significantly highest dehydrated yield(14.95%). While, significantly lowest dehydrated yield was found in S<sub>1</sub>D<sub>2</sub> (50°Brix syrup concentration with hot air oven drying) *i.e.*, (13.02%).The increase in recovery of dehydrated yield may be attributed to the transfer of sugars from syrup to fruit slices through osmosis during period of osmodehydration.

### **Dehydrated ratio**

The data pertaining to the effect of sucrose syrup concentration and drying method on dehydrated ratio of pineapple cubes was presented in Table 5. Significant differences was recorded in per cent dehydrated ratio of osmosed pineapple as influenced by sucrose syrup concentration, drying method and their interaction. The maximum dehydrated ratio (7.50) was recorded in  $S_1(50^\circ\text{Brix})$  and minimum dehydrated ratio (6.84) was recorded in  $S_2(60^\circ\text{Brix})$  with respect to factor sucrose syrup concentration. In factor drying method, the maximum dehydrated ratio (7.28) was observed in  $D_2(\text{hot air oven drying})$  and minimum dehydrated ratio (7.11) was observed in  $D_1(\text{cabinet tray drying})$ . The interaction among  $S \times D$  showed significant results. The treatment combination  $S_1D_2$  ( $50^\circ\text{Brix}$  syrup concentration with hot air oven drying) recorded significantly highest dehydrated ratio (7.77). While, significantly lowest dehydrated ratio was found in  $S_2D_1$  ( $60^\circ\text{Brix}$  syrup concentration with cabinet tray drying) *i.e.*, (6.75)

### **Rehydrated ratio**

The data pertaining to the effect of sucrose syrup concentration and drying method on rehydrated ratio of pineapple cubes was presented in Table 5. Significant differences was recorded in rehydrated ratio of osmosed pineapple as influenced by sugar concentration, drying method and their interaction. The maximum rehydrated ratio (1.68) was recorded in  $S_2(60^\circ\text{Brix})$  and minimum rehydrated ratio (1.35) was recorded in  $S_3(70^\circ\text{Brix})$  with respect to factor sugar concentrations. In factor drying method, the maximum rehydrated ratio (1.50) was observed in  $D_1(\text{Cabinet tray drying})$  and minimum rehydrated ratio (1.44) was observed in  $D_2(\text{hot air oven drying})$ . The interaction among  $S \times D$  showed significant results. The treatment combination  $S_2D_2$  ( $60^\circ\text{Brix}$  syrup concentration with hot air oven drying) recorded significantly highest rehydrated ratio (1.71). While, lowest rehydrated ratio was found in  $S_1D_2$  ( $50^\circ\text{Brix}$  syrup concentration with hot air oven drying) *i.e.*, (1.23). Presence of more tissues might have helped in more absorption of water resulting higher rehydration ratio. In contrast, presence of very higher sugars adversely affected water uptake by osmotically dehydrated samples

### **TSS**

The data pertaining to the effect of sucrose syrup concentration and drying method on TSS (%) of pineapple cubes was presented in Table 6. Significant differences was recorded in TSS of osmosed pineapple as influenced by sucrose syrup concentration, drying method and their interaction. The maximum TSS ( $75.25^\circ\text{Brix}$ ) was recorded in  $S_3(70^\circ\text{Brix})$  and minimum TSS ( $55.06^\circ\text{Brix}$ ) was recorded in  $S_1(50^\circ\text{Brix})$  with respect to factor sucrose syrup concentrations. In factor drying method, the maximum TSS ( $66.63^\circ\text{Brix}$ ) was observed in  $D_2(\text{hot air oven drying})$  and minimum TSS ( $66.26^\circ\text{Brix}$ ) was observed in  $D_1(\text{cabinet tray drying})$ . The interaction among  $S \times D$  showed significant results. The treatment combination  $S_3D_1$  ( $70^\circ\text{Brix}$  syrup concentration with cabinet tray drying) recorded significantly highest TSS ( $75.40^\circ\text{Brix}$ ). While, lowest TSS was found in  $S_1D_1$  ( $50^\circ\text{Brix}$  syrup concentration with cabinet tray

drying) *i.e.*, 54.52°Brix. The result indicated that TSS of osmo-dehydrated pineapple cubes was increasing as increase in sucrose syrup concentration. However, the maximum TSS was found in S<sub>3</sub>D<sub>1</sub> (70°Brix syrup concentration with cabinet tray drying) followed by S<sub>3</sub>D<sub>2</sub> (70°Brix syrup concentration with hotair oven drying) and the minimum TSS was found in S<sub>1</sub>D<sub>1</sub> (50°Brix syrup concentration with cabinet tray drying) during osmotic dehydration.

### **Reducing sugars (%)**

The data pertaining to the effect of sucrose syrup concentration and drying method on reducing sugars (%) of pineapple cubes was presented in Table 6. Significant differences was recorded in percentreducing sugars of osmosed pineapple as influenced by sucrose syrup concentration, drying method and their interaction. The maximum reducing sugars (37.66 %) was recorded in S<sub>1</sub>(50°Brix) and minimum reducing sugars (30.70%) was recorded in S<sub>3</sub>(70°Brix) with respect to factor sucrose syrupconcentrations. In factor drying method, the maximum reducing sugars (35.92%) was observed in D<sub>1</sub> (Cabinet tray drying) and minimum reducing sugars (33.08%) was observed in D<sub>2</sub>(hotair oven drying). The interaction among S×D showed significant results. The treatment combination S<sub>1</sub>D<sub>1</sub> (50°Brix syrup concentration with cabinet tray drying) *i.e.*, recorded significantly highest reducing sugars(39.80%). While, significantly lowest reducing sugars was found in S<sub>3</sub>D<sub>1</sub> (70°Brix syrup concentration with Cabinet tray drying) *i.e.*, 30.15%. The result indicated that reducing sugars of osmo-dehydrated pineapple cubes was decreasing with increase in sucrose syrup concentration. The maximum reducing sugars was found in S<sub>1</sub>D<sub>1</sub> (50°Brix syrup concentration with cabinet tray drying) followed by S<sub>2</sub>D<sub>1</sub> (60°Brix syrup concentration with Cabinettray drying) and the minimum reducing sugars was found in S<sub>3</sub>D<sub>1</sub> (70°Brix syrup concentration with cabinet tray drying) during osmotic dehydration.reducing sugars were higher in dehydrated pineapple cubes than fresh one owing to removal of water leading to concentration of sugars.

### **Non reducing sugars (%)**

The data pertaining to the effect of sucrose syrup concentration and drying method on non-reducing sugars (%) of pineapple cubes was presented in Table 7.Significant differences was recorded in non reducing sugars of osmosed pineapple as influenced by sucrose syrup concentration, drying method and their interaction. The maximum non reducing sugars (42.80%) was recorded in S<sub>3</sub> (70°Brix) and minimum non-reducing sugars (15.73 %) was recorded in S<sub>1</sub> (50°Brix) with respect to factor sucrose syrupconcentrations. In factor drying method, the maximum non-reducing sugars (30.35%) was observed in D<sub>1</sub> (cabinet tray drying) and minimum non-reducing sugars (29.425) was observed in D<sub>2</sub> (hotair oven drying). The interaction among S×D showed significant results. The treatment combination S<sub>3</sub>D<sub>2</sub> (70°Brix syrup concentration with hotair oven drying)(41.90%) recorded significantly highest non reducing sugars(41.90%). While, significantly lowest non-reducing sugars was found in S<sub>1</sub>D<sub>2</sub>

(50°Brix syrup concentration with hotair oven drying) *i.e.*, (14.67%). The result indicated that non-reducing sugar of osmo-dehydrated pineapple cubes was increasing as increase in sucrose syrup concentration. However, the maximum non reducing sugars was found in S<sub>3</sub>D<sub>1</sub> (70°Brix syrup concentration with cabinet tray drying) followed by S<sub>3</sub>D<sub>2</sub> (70°Brix syrup concentration with hotair oven drying) and the minimum non-reducing sugars was found in S<sub>1</sub>D<sub>2</sub> (50°Brix syrup concentration with hotair oven drying) during osmotic dehydration.

### **Total sugars (%)**

The data pertaining to the effect of sucrose syrup sugar concentration and drying method on total sugars (%) of pineapple cubes was presented in Table 7. Significant differences was recorded in percent total sugar of osmosed pineapple as influenced by sucrose syrup concentration, drying method and their interaction. The maximum total sugars (73.50 %) was recorded in S<sub>3</sub> (70°Brix) and minimum total sugars (53.40 %) was recorded in S<sub>1</sub> (50°Brix) with respect to factor sucrose syrup concentrations. In factor drying method, the maximum total sugars (66.29%) was observed in D<sub>1</sub> (cabinet tray drying) and minimum total sugars (62.51%) was observed in D<sub>2</sub> (hotair oven drying). The interaction among S×D showed significant results. The treatment combination S<sub>3</sub>D<sub>1</sub> (70°Brix syrup concentration with cabinet tray drying) recorded significantly highest total sugars (73.85%). While, significantly lowest total sugars was found in S<sub>1</sub>D<sub>1</sub> (50°Brix syrup concentration with cabinet tray drying) *i.e.*, (56.60%). The result indicated that total sugar of osmo-dehydrated pineapple cubes was increasing as increase in sucrose syrup concentration. The maximum total sugars was found in S<sub>3</sub>D<sub>1</sub> (70°Brix syrup concentration with cabinet tray drying) followed by S<sub>3</sub>D<sub>2</sub> (70°Brix syrup concentration with hotair oven drying) and the minimum total sugars was found in S<sub>1</sub>D<sub>2</sub> (50°Brix syrup concentration with hotair oven drying) during osmotic dehydration. The increment of total sugar content was due to the solute gain action during osmosis.

### **Acidity (%)**

The data pertaining to the effect of sucrose syrup concentration and drying method on acidity (%) of pineapple cubes was presented in Table 8. The maximum acidity (1.66%) was recorded in S<sub>2</sub> (60°Brix) and minimum acidity (1.46%) was recorded in S<sub>3</sub> (70°Brix) with respect to factor sucrose syrup concentrations. In factor drying method, the maximum acidity (1.60%) was observed in D<sub>1</sub> (cabinet tray drying) and minimum acidity (1.53%) was observed in D<sub>2</sub> (hotair oven drying). The interaction among S×D showed significant results. The treatment combination S<sub>1</sub>D<sub>1</sub> (50°Brix syrup concentration with cabinet tray drying) recorded significantly highest acidity (1.67%). While, significantly lowest acidity was found in S<sub>3</sub>D<sub>2</sub> (70°Brix syrup concentration with hotair oven drying) *i.e.*, (1.45%). The result indicated that acidity of osmo-dehydrated pineapple cubes was decreasing as increase in sucrose syrup concentration. The maximum acidity was found in S<sub>1</sub>D<sub>1</sub> (50°Brix syrup concentration with cabinet tray drying) followed by S<sub>2</sub>D<sub>1</sub> (60°Brix syrup concentration with cabinet tray drying) and the

minimum acidity was found in S<sub>3</sub>D<sub>2</sub> (70°Brix syrup concentration with hotair oven drying) during osmotic dehydration. The decrease in acidity might be attributed to leaching of acid from fruit slices to hypertonic solution through a semi-permeable membrane.

## **P<sup>H</sup>**

The data pertaining to the effect of sucrose syrup concentration and drying method on P<sup>H</sup> of pineapple cubes was presented in Table 8 and. Significant differences was recorded in P<sup>H</sup> of osmosed pineapple as influenced by sucrose syrup concentration, drying method and their interaction. The maximum P<sup>H</sup> (3.68) was recorded in S<sub>3</sub> (70°Brix) and minimum P<sup>H</sup> (3.32) was recorded in S<sub>1</sub> (50°Brix) with respect to factor sucrose syrup concentration. In factor drying method, the maximum P<sup>H</sup> (3.57) was observed in D<sub>1</sub> (cabinet tray drying) and minimum P<sup>H</sup> (3.39) was observed in D<sub>2</sub> (hotair oven drying). The interaction among S×D showed significant results. The treatment combination S<sub>3</sub>D<sub>1</sub> (70°Brix syrup concentration with cabinet tray drying) recorded significantly highest P<sup>H</sup> (3.95). While, significantly lowest P<sup>H</sup> was found in S<sub>1</sub>D<sub>1</sub> (50°Brix syrup concentration with cabinet tray drying) *i.e.*, (3.32). The result indicated that P<sup>H</sup> of osmo-dehydrated pineapple cubes was increasing as increase in sucrose syrup concentration. However, the maximum P<sup>H</sup> was found in S<sub>3</sub>D<sub>1</sub> (70°Brix syrup concentration with cabinet tray drying) followed by S<sub>2</sub>D<sub>1</sub> (60°Brix syrup concentration with cabinet tray drying) and the minimum P<sup>H</sup> was found in S<sub>1</sub>D<sub>1</sub> (50°Brix syrup concentration with cabinet tray drying) during osmotic dehydration.

## **Ascorbic acid (%)**

The data pertaining to the effect of sucrose syrup concentration and drying method on ascorbic acid (%) of pineapple cubes was presented in Table 9. Significant differences was recorded in per cent ascorbic acid of osmosed pineapple as influenced by sucrose syrup concentration, drying method and their interaction. The maximum ascorbic acid (32.65%) was recorded in S<sub>2</sub> (60°Brix) and minimum ascorbic acid (26.40 %) was recorded in S<sub>3</sub> (70°Brix) with respect to factor sucrose syrup concentrations. In factor drying method, the maximum ascorbic acid (30.43%) was observed in D<sub>1</sub> (Cabinet tray drying) and minimum ascorbic acid (27.60 %) was observed in D<sub>2</sub> (hotair oven drying). The interaction among S×D showed significant results. The treatment combination S<sub>2</sub>D<sub>1</sub> (60°Brix syrup concentration with cabinet tray drying) recorded significantly highest ascorbic acid (31.10%). While, significantly lowest ascorbic acid was found in S<sub>3</sub>D<sub>2</sub> (70°Brix syrup concentration with hotair oven drying) *i.e.*, (30.21%). The result indicated that ascorbic acid of osmo-dehydrated pineapple cubes was increasing with increase in sucrose syrup concentration. However, the maximum ascorbic acid was found in S<sub>2</sub>D<sub>1</sub> (60°Brix syrup concentration with cabinet tray drying) followed by S<sub>2</sub>D<sub>2</sub> (60°Brix syrup concentration with hotair oven drying) and the minimum ascorbic acid was found in S<sub>3</sub>D<sub>2</sub> (70°Brix syrup concentration with hotair oven drying) during osmotic dehydration.

## References

Baker, K. and Collins, J. L. (1939). Notes on the distribution and ecology of *Ananas* and *Pseudananas* in South America. *Amer. J. Bot.*, (26): 397-702.

Lodh, S. B. Diwaker, N. G. Chadha, K. L. Melanta, K. R. and Selvaraj, Y. (1973). Biochemical changes associated with growth and development of pineapple fruits var. *Kew-III*. *Indian J. Hort.*, (30): 381-383.

Noroos, E. R. V. Brasil, I. M. Lima, J. R. Bianchi, M. and Tau, T. G. (2010). Kinetics of the osmotic dehydration of guava. *Acta Hort.*, (864):367-370.

Chavan, U. D. (2012). Osmotic Dehydration Process for Preservation of Fruits and Vegetables. *J. Food Res.*, 1(2): 202-209.

Khanom, S. A. A. Rahaman, M. M. and Uddin, M. B. (2014). Influence of concentration of sugar on mass transfer of pineapple slices during osmotic dehydration. *Journal of Bangladesh Agriculture University*, 12 (1): 221-226.

**Table 1. Physico-chemical parameters of fresh pineapple fruit.**

S.No	Physical parameters	Results
1.	Avg. weight of fruit (g)	1.23 kg
2.	Crown	0.128 kg
3.	Peel with discarded	0.430 kg
4.	Core	0.170 kg
5.	Yield of the fruit cubes	0.528 kg
	Chemical parameters	Results
1.	Moisture content (%)	88.2%
2.	TSS ( <sup>o</sup> Brix)	14.8 <sup>o</sup>
3.	Ascorbic acid (mg/100g <sup>-1</sup> )	35.56 mg 100g <sup>-1</sup>
4.	Acidity (%)	1.02%
5.	Total sugars (%)	13.20%
6.	Reducing sugars (%)	6.08%
7.	Non-reducing sugars (%)	7.12%
8.	p <sup>H</sup>	3.94

**Table-2: Recovery (%) of fruit cubes after osmotic dehydration**

Treatments	Drying method		
	Recovery (%)		
Sugar syrup concentration	D <sub>1</sub>	D <sub>2</sub>	Mean
S <sub>1</sub>	13.850	13.210	13.530
S <sub>2</sub>	<b>14.780</b>	14.660	<b>14.720</b>
S <sub>3</sub>	14.183	13.700	13.941
Mean	<b>14.271</b>	13.857	

	S	D	S x D
SE(m)	0.140	0.114	0.197
C.D.	0.418	0.341	0.581
	2.808		

**Table 3: - Effect of sucrose syrup concentration and drying method on Moisture loss (%) and Weight loss (%) of osmo - dehydrated pineapple cubes**

Treatments	Drying method					
Sugar syrup concentration	Moisture (%)			Weight loss (%)		
	D <sub>1</sub>	D <sub>2</sub>	Mean	D <sub>1</sub>	D <sub>2</sub>	Mean
S <sub>1</sub>	15.210	18.320	16.765	20.090	10.250	15.170
S <sub>2</sub>	13.110	14.418	13.764	26.130	24.153	25.141
S <sub>3</sub>	<b>10.558</b>	11.240	<b>10.899</b>	<b>32.040</b>	30.125	<b>31.083</b>
Mean	<b>12.959</b>	14.659		<b>26.087</b>	21.509	

	S	D	S x D	S	D	S x D
SE(m)	0.145	0.179	0.309	0.260	0.213	0.368
C.D.5 %	0.435	0.119	0.926	0.780	0.637	1.103
C.V.	2.977			3.095		

**Table 4: - Effect of sucrose syrup concentration and drying method on Solid gain(%) and dehydration yield(%) of osmo - dehydrated pineapple cubes**

Treatments	Drying method					
Sugar syrup concentration	Solid gain (%)			Dehydrated yield (%)		
	D <sub>1</sub>	D <sub>2</sub>	Mean	D <sub>1</sub>	D <sub>2</sub>	Mean
S <sub>1</sub>	11.875	15.050	13.463	13.920	13.020	13.470
S <sub>2</sub>	17.125	13.025	15.075	14.953	14.300	<b>14.626</b>
S <sub>3</sub>	<b>18.65</b>	18.025	<b>18.338</b>	13.623	14.153	13.888
Mean	<b>15.883</b>	15.367		<b>14.165</b>	13.981	

	S	D	S x D	S	D	S x D
SE(m)	0.154	0.126	0.218	0.131	0.107	0.185
C.D. 5%	0.218	0.377	0.653	0.391	0.320	0.554
C.V.	2.794			2.642		

**Table 5: - Effect of sucrose syrup concentration and drying method on Dehydration ratio and Rehydration ratio of osmo - dehydrated pineapple cubes**

Treatments	Drying method					
Sugar syrup concentration	Dehydration ratio			Rehydration ratio		
	D <sub>1</sub>	D <sub>2</sub>	Mean	D <sub>1</sub>	D <sub>2</sub>	Mean
S <sub>1</sub>	7.233	<b>7.770</b>	<b>7.501</b>	1.688	1.230	1.459
S <sub>2</sub>	6.753	6.930	6.841	1.660	<b>1.713</b>	<b>1.686</b>
S <sub>3</sub>	7.348	7.140	7.244	1.303	1.405	1.354
Mean	<b>7.11</b>	7.280		<b>1.50</b>	1.449	

	S	D	S x D	S	D	S x D
SE(m)	0.069	0.056	0.097	0.020	0.016	0.029
C.D. 5%	0.205	0.168	0.291	0.060	0.049	0.085
	2.697			3.802		

**Table 6: - Effect of sucrose syrup concentration and drying method on TSS(TSS °Brix) and reducing sugars (%) of osmo - dehydrated pineapple cubes**

Treatments	Drying method					
Sugar syrup concentration	TSS(TSS °Brix)			Reducing sugars (%)		
	D <sub>1</sub>	D <sub>2</sub>	Mean	D <sub>1</sub>	D <sub>2</sub>	Mean
S <sub>1</sub>	54.520	55.618	55.069	39.800	35.513	<b>37.656</b>
S <sub>2</sub>	68.855	69.198	69.026	37.800	32.503	35.151
S <sub>3</sub>	<b>75.408</b>	75.100	<b>75.254</b>	30.148	31.253	30.700
Mean	66.261	<b>66.638</b>		<b>35.916</b>	33.089	

	S	D	S x D	S	D	S x D
SE(m)	0.655	0.535	0.926	0.324	0.265	0.459
C.D.5%	1.961	1.654	1.968	0.971	0.793	1.373
	2.788			2.658		

**Table 7: - Effect of sucrose concentration and drying method on Non reducing sugars (%) and total sugars (%) of osmo - dehydrated pineapple cubes**

Treatments	Drying method	
Sugar syrup	Non Reducing sugars (%)	Total sugars (%)

concentration						
	D <sub>1</sub>	D <sub>2</sub>	Mean	D <sub>1</sub>	D <sub>2</sub>	Mean
S <sub>1</sub>	16.800	14.675	15.738	56.600	50.200	53.400
S <sub>2</sub>	31.573	30.700	31.138	68.425	64.200	66.313
S <sub>3</sub>	<b>43.700</b>	41.900	<b>42.800</b>	<b>73.850</b>	73.150	<b>73.500</b>
Mean	<b>30.358</b>	29.425		<b>66.292</b>	62.517	

	S	D	S x D	S	D	S x D
SE(m)	0.302	0.247	0.427	0.608	0.497	0.860
C.D.5%	0.905	0.739	1.280	1.821	1.487	2.575
	2.860			2.671		

**Table 8: - Effect of sucrose syrup concentration and drying method on acidity (%) and P<sup>H</sup> of osmo - dehydrated pineapple cubes**

Treatments Sugar syrup concentration	Drying method					
	Acidity(%)			P <sup>H</sup>		
	D <sub>1</sub>	D <sub>2</sub>	Mean	D <sub>1</sub>	D <sub>2</sub>	Mean
S <sub>1</sub>	<b>1.700</b>	1.550	<b>1.625</b>	3.325	3.325	3.325
S <sub>2</sub>	1.550	1.550	1.550	3.450	3.425	3.438
S <sub>3</sub>	1.475	1.450	1.463	3.950	3.425	<b>3.688</b>
Mean	<b>1.575</b>	1.517		<b>3.575</b>	3.392	

	S	D	S x D	S	D	S x D
SE(m)	0.018	0.015	0.026	0.034	0.028	0.049
C.D.5%	0.054	0.044	0.077	0.103	0.084	0.145
	3.323			2.790		

**Table 9: - Effect of sucrose syrup concentration and drying method on Ascorbic Acid (%) of osmo - dehydrated pineapple cubes**

Treatments	Drying method
Sugar syrup concentration	Ascorbic Acid (%)

	<b>D<sub>1</sub></b>	<b>D<sub>2</sub></b>	<b>Mean</b>
<b>S<sub>1</sub></b>	28.500	27.525	28.013
<b>S<sub>2</sub></b>	35.100	30.200	<b>32.650</b>
<b>S<sub>3</sub></b>	27.700	25.100	26.400
<b>Mean</b>	<b>30.433</b>	27.608	

	<b>S</b>	<b>D</b>	<b>S x D</b>
<b>SE(m)</b>	0.241	0.197	0.341
<b>C.D 5 %.</b>	0.723	0.590	1.022
	2.352		

UNDER PEER REVIEW