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EFFECT OF PACKAGING MATERIALS ON SENSORY EVALUATION OF OSMOTICALLY TREATED PAPAYA (*Carica papaya* L.)

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Abstract: Papaya fruits (Carica *papaya* L.) cubes after washing, peeling and cutting were subjected to osmotic treatment in sugar syrup with concentration of 65^0 Brix for 6 hours at ambient pressure in an incubator followed by draining and air-drying at 60^0C in conventional tray dryer. The air-dried products (fresh and osmosed) were then packaged in two packaging materials *viz.* High density polyethylene (HDPE) and Laminated aluminum film (LAF). After packaging products were stored at room temperature and refrigerated temperature for 4 months. Sensory evaluation of the stored products was carried out during storage period. From the study it was concluded that the samples packed in HDPE and stored at refrigerated temperature had better retention of sensory attributes such as color, flavor, texture, appearance and overall acceptability. LAF was found best for untreated samples stored at refrigerated temperature. It was also concluded that, the osmotic processing could process papaya into intermediate moisture products. The process is economical, simple and non-destructive with least wastage of fruit during processing.
Keywords: Papaya, osmotic treatment, air-drying, HDPE, LAF, room temperature.

INTRODUCTION

In last few decades India has doubled its fruit production and has reached to 50 MT annually. Now, India is largest producer of many fruits including papaya. The area and production of papaya has increased from 16050 hectare and 0.25 million tonne in 1965 to more than 67.7 thousand hectare and 1.58 million tonnes in 1998-99, respectively. The productivity of papaya is 23.4 tonnes per hectare (Negi *et al,* 2000). The absence of adequate modern facilities for handling, transportation and storage of papaya and lack of technical training and infrastructure for its processing and preservation causes a loss of about 30 per cent and in some cases it exceeds to 50 per cent (Jayaraman, 1988; Alzamora *et al,* 1995).

Papaya is a tropical fruit more prominently in recent years, production next to fruits such as mango, banana, citrus and pineapple at the global level. The papaya fruit has a rapid growth and short life span. The fruit is harvested in almost all tropical regions. In Spain, especially in

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the Canary Island, papaya production has existed for two centuries usually near banana plantations or with other tropical crops (Rodriguez and Galan, 1992). Brazil has aa large production area of papaya (Carica *papaya* L.) participating with 37% of the world production (Magalhaes *et al*, 1996).

Papaya has usually high amounts of bound water (37-43% as compared to <10% for other fruits) (Salunke and Desai, 1984). This bound water has high affinity to some structural components such as polysaccharides and proteins, and remains unfrozen even at -20 ^{0}C. Quality changes associated with processed papaya products include development of off flavour and color modification after prolonged storage (Chan *et al,* 1975). Freezing and frozen storage (-18 ^{0}C) produced an increase of peroxidise activity while polyphenol activity was only slightly affected (Cano *et al,* 1995).

The fruit is low in acid with an average pH above 4.5, and often served sliced in food establishment in fresh pieces, in maxis for salad bars, at dilicounters and as a pulp juice. Papaya pulp has 13.5 ^{0}Brix, acidity 1.83% with 4.5 pH, and total and reducing sugars of 10.6 and 10.4% respectively. Its fragility, however, is a characteristic that limits large-scale exportation to countries of the fruit and the total post harvest loss is estimated upto 40% of total production making the preservation of papayas a necessitated field of study. Further, the fruit pulp is prone for easy spoilage and demands consideration for processing into value addition to aid sstorage and marketing, over non-producing geographic regions of the world (Penteado and Leitao, 2004).

In the course of last few years a number of activities have been undertaken in order to apply drying for preservation of food (especially of solid food) as widely as possible. Conventional drying is a simultaneous heat and mass transfer process, accompanied by phase change (Barbanti *et al,* 1994). The factors that govern the transfer mechanism determine the drying rate. These factors are: vapor pressure of the material and drying air, air velocity and temperature, water diffusion velocity in the material, thickness and surface exposed for drying.

Dried food, especially fruits and vegetables, can be stored and transported at a relatively low cost. However, water removal leads to a serious decrease in the nutritive and sensorial values (Lenart, 1996). One of the research objectives is to achieve the best possible quality of the final product.

Osmotic dehydration is a useful technique that involves product immersion in a hypertonic aqueous solution leading to a loss of water through the cell membranes of the product and subsequent flow along the inter-cellular space before diffusion into the solution (Sereno *et al,* 2001). For fruit dehydration, sucrose solutions with concentration from 55 to 75^0 Brix have been used (Lerici *et al*, 1985). The osmotic process has received considerable attention as a pre-drying treatment so as to reduce energy consumption and improve food quality (Jayaraman and Das Gupta, 1992; Karathanos *et al,* 1995; Sereno *et al,* 2001; Torreggiani, 1993). As part of the process of fruit and vegetable concentration, after osmotic dehydration, a complementary method, such as conventional drying, freezing or pasteurization, must be used (Sankat *et al,* 1996).

Osmotic dehydration is one of the potential preservation techniques for producing high quality products. This provides minimum thermal degradation of the nutrients due to low temperature water removal process. Water removal in case of osmotic dehydration is influenced by many factors such as type and concentration of osmotic agents, temperature, agitation/circulation of solution, solution to sample ratio, thickness of the food material, pre-treatment, *etc.*

Osmotic dehydration is one of the less energy intensive techniques than air or vacuum drying process because it can be conducted at low or ambient temperature. It is the process of water removal by immersing water containing cellular solid in concentrated aqueous solution. The driving force for water removal is the concentration gradient between the solution and the intracellular fluid. The solute penetration in food material is less at first, but increases with respect to time. The solute (sugar) penetration in the fruit directly affects the quality, *i.e.* both flavour and taste of the end product. This treatment is also responsible for increasing drying rate in subsequent convective drying (Kumar *et al,* 2009).

According to Pokharkar *et al* (1997), the main advantage of the osmotic dehydration process as a pre-treatment are: (1) minimized heat damage, (2) least discolouration of fruits by enzymatic browning, (3) increased retention of volatile matter, flavour and aroma, (4) improved textural quality and (5) lower energy consumption than the air drying. (6) retention of natural color without addition of sulphites. However, osmotic process will not give a product of sufficiently low moisture content to be considered as shelf stable and therefore, osmosed product needs to be further dried through air, vacuum or freeze drying.

The effect of various factors and operating conditions used in these studies revealed that osmotic dehydration of papaya could be successful. It may help in reducing the post harvest losses of papaya fruits by developing the process technology, which can be an effective alternative for the utilization of surplus produce.

Drying is the removal of water up to predetermined level. Some of the advantages of drying process are (1) it make water unavailable for microbial growth, (2) process does not destroy nutrients, (3) it produces concentrated form of food and (4) inhibits microbial growth and autolytic enzymes.

Therefore the aim of this work was to study the effect of packaging materials on physicochemical properties of osmotically treated and air-dried papaya.

MATERIAL AND METHOD

Osmotic dehydration and convective drying:

Papaya (Carica *papaya* L.) after washing and peeling were divided into two lots. One was kept as control and second lot was cut into pieces resembled like cubes and were then osmotically treated with 65 ^{0}Brix sugar syrup concentration for 6 hours with syrup to fruit ratio of 4:1. For the osmotic treatment purpose incubator was used with operating conditions of 60 ^{0}C temperature and 110±1 rpm. After 6 hour osmotic treatment syrup was drained out and fruits were then lightly rinsed with water and extra surface moisture were removed by using tissue paper and these samples were then placed on a pre-weighed drying tray in order to proceed to the drying process for 6-7 hours. Fresh papaya samples without osmotic treatment were also air-drier using the same dryer.

Packaging and storage

The fresh air-dried papaya cubes as well as osmotically pre-dehydrated and air-dried papaya cubes were brought to the Post Harvest Technology Laboratory. Fruit cubes were weighed and packed into two packaging materials selected for the study.

The papaya samples with osmotic treatment and air-dried packed in two packaging materials were stored at refrigerated temperature and ambient temperature. The sample packets were put into a single layer inside the refrigerator and same for outside for the storage period of four months.

Fresh air-dried papaya cubes packed into two packaging materials were also stored at two temperature conditions for the comparative study as a control.

Sensory evaluation:

The samples from fresh dried and osmotically treated air dried, packed in two packaging materials and stored at ambient & refrigerant conditions were evaluated at the end of every month for four months on the basis of nine point hedonic scale by the nine untrained panellists, who evaluated the product for appearance, color, texture, flavour and overall acceptability (Krokida *et al,* 1999). This panel was selected randomly on the basis of gender and age and was briefly acquainted with the sensory characteristics that were to be judged and also with the available scales according to which the samples were to be rated.

Statistical analysis:

The data recorded from various experiments were analyzed to determine effect of osmotic treatment followed by air-drying on the sensory attributes of the papaya (Carica *papaya* L.). The statistical analysis of the data was done by using software SPSS 16.0 in general linear model using CRD factorial. Analysis was done considering the main effects and two factor interactions at 5% level of significance.

RESULTS AND DISCUSSION

Sensory evaluation of the food products plays an important rolein judging the sensory acceptability or rejection of food items in the market. Data in table shows the significant ($P \leq 0.05$) effect for the production of osmotically treated papaya and storage intervals (30, 60, 90 and 120 days) on the sensory scores (color flavour, texture, appearance and overall acceptability) of osmotically treated papaya. Table given in results and discussion is on the basis of overall acceptability which was decided on the scores of color, flavour, texture and appearance of the product during four month of storage.

Fig. 1(a) shows the effect of packaging materials on sensory evaluation of osmotically treated papaya samples stored at refrigerated temperature. It was observed that, the values of sensory scores for the samples packed in HDPE decreased from 8 point (liked very much) to 6 (liked slightly) during the four months of storage. Similarly the values of sensory scores for the sample packed in LAF decreased from 7 point (liked moderately) to 6 point (liked slightly) during storage period of four months. But the overall acceptability of the sample packed in HDPE packaging material was higher than the sample packed in LAF packaging material. Fig. 1(b) shows the effect of packaging materials on sensory evaluation of osmotically treated papaya samples stored at room temperature. It was observed that for both the samples packed in HDPE and LAF, the sensory scores decreased from 7 point (liked moderately) to 3 point (disliked moderately) during storage period. But the overall acceptability of the sample packed in HDPE is higher than the sample packed in LAF.

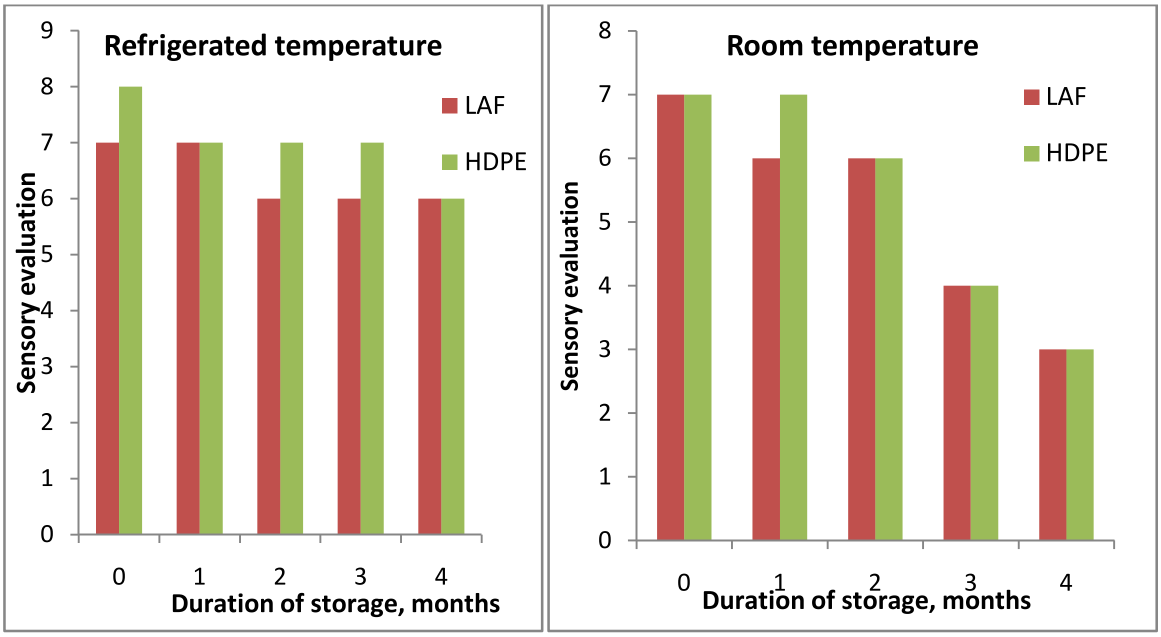
Fig. 2(a) shows the effect of packaging materials on sensory evaluation of the sample dried without osmotic treatment stored at refrigerated temperature. It was observed that, the values of sensory scores for the samples packed in HDPE decreased from 8 point (liked very much) to 5 (neither liked nor disliked) during the four months of storage. Similarly the values of sensory scores for the sample packed in LAF decreased from 7 point (liked moderately) to 6 point (liked slightly) during storage period of four months and the overall acceptability was also higher than the sample packed in HDPE packaging material. Fig. 2(b) shows the effect of packaging materials on sensory evaluation of the sample dried without osmotic treatment stored at room temperature. It was observed that the values of sensory scores decreased from 8 point (liked very much) to 4 point (disliked slightly) for the sample packed in HDPE and had shelf-life of two months only. The same kind of decreasing trend was observed for the values of sensory score of the sample packed in LAF packaging material; but had shelf-life of four months. Also the overall acceptability of this sample was higher than the sample which was packed in HDPE packaging material. Data were statistically analyzed and was found significant at 0.05 levels

CONCLUSION

The sensory evaluation of the osmotically treated sample and sample dried without osmotic treatment were carried out on nine-point hedonic scale. It can be calculated from the study that the both types of sample showed best results when packed in HDPE packaging material.

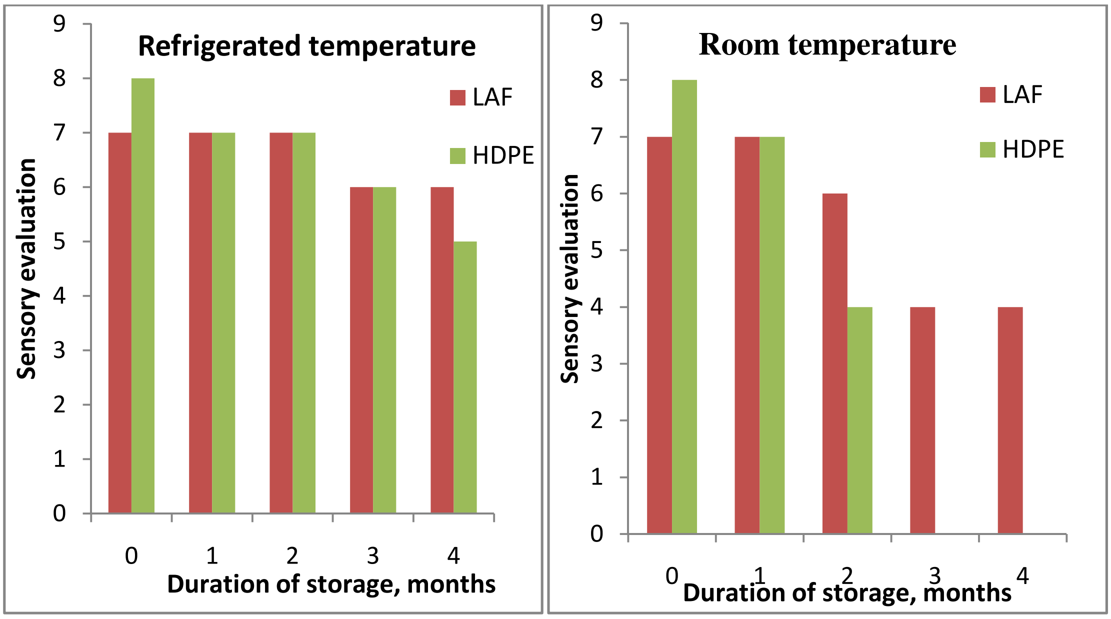
- Untreated control samples were rated inferior.
- Flavor was better preserved in osmo treated samples.
- In osmotically treated, air-dried sample, better results were even observed during storage at refrigerated temperature as compared to sample air-dried without osmotic treatment or control sample.

The process can be carried out under ambient atmosphere and is least expensive with better color, flavour and texture retention in the osmosed or processed products.



(a) (b)

Fig. 1: Effect of packaging materials on sensory evaluation of osmotically treated papaya samples stored at refrigerated and room temperature



(a) (b)

Fig. 2: Effect of packaging materials on sensory evaluation of the samples dried without osmotic treatment stored at refrigerated temperature and room temperature

Table 4: Effect of packaging materials on sensory evaluation of osmotically treated and untreated papaya samples stored at room temperature and refrigerated temperature

Duration of storage, months	Sample specification	Packaging material			
		LAF		HDPE	
		Room temperature	Refrigerated temperature	Room temperature	Refrigerated temperature
0	Treated	7.0	7.0	7.0	8.0
1		6.0	7.0	7.0	7.0
2		6.0	6.0	6.0	7.0
3		4.0	6.0	4.0	7.0
4		3.0	6.0	4.0	6.0
0	Untreated	7.0	7.0	8.0	8.0
1		7.0	7.0	7.0	7.0
2		6.0	6.0	4.0	7.0
3		4.0	5.0	Sample spoiled	6.0
4		3.0	5.0	Sample spoiled	5.0

CD ($P \leq 0.05$)

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