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Sensory evaluation of osmatic dehydrtated pineapple products (*Ananas comosus.* var. Queen) during storage

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Abstract
Shelf life estimation is an important concern to predict the freshness of fruits. This study aimed to investigate the shelf life and the organoleptic parameters of dehydrated pineapple cubes after osmotic dehydration and four months storage. The organoleptic acceptability of the osmo-dehydrated pineapple cubes at storage as influenced by different parameters and their interaction pertaining to colour, flavour, texture, taste and overall acceptability. The data recorded pertaining to organoleptic evaluation of osmotically dehydrated cubes showed significant differences among treatments for all sensory attributes. The treatment i.e. Sucrose concentration 60ºBrix. + Cabinet tray drying+ aluminum laminated polyethylene packaging of 200 gauge was fund best in appearance, smell, taste and color. Overall acceptability was rated good for osmotically dehydrated pineapple cubes treated with sucrose syrup of concentration 60°Brix and dried in cabinet tray drier as compared to other treatments.

Keywords: Pineapple, Dehydration, Osmosis, storage, sensory evaluation

Introduction

Fruits and vegetables play an significant role in human nutrition as they are supplying complex carbohydrates and proteins, essential minerals, vitamins and dietary fiber [Farkas *et al. 1969*] [4]. Pineapple (*Ananas comosus* (L.) *Merr*.) is one of the commercially important temperate fruit crops of tropical world with edible multiple fruit consisting of coalesced berries, and the most economically significant plant in the *Bromeliaceae* family. Pineapples may be cultivated from a crown cutting of the fruit, possibly flowering in 20–24 months and fruiting in the following six months. The main producer countries reported are Brazil, Philippines, Costa Rica, Thailand and China. Pineapple fruit accepted by majority of consumers around the world, mainly due to its sensory characteristics, pleasant flavour, distinct aroma, taste and absence of seeds. Osmotic dehydration is a simpler preservation technique that does not require any sophisticated equipment. It is a process that entails the partial removal of water from fruits which is based on a tendency to reach equilibrium between osmotic pressure inside the biological cells (fruit) and the surrounding osmotic solution, which has an increased osmotic pressure caused by high concentration of soluble osmotic agent. Unlike conventional drying processes, osmotic dehydration does not produce a stable product and as such further steps like drying, freezing, pasteurization, canning and frying, or the addition of preservatives are needed (Nanjundaswamy *et al.* 1978) [5]. Therefore, storage stability of osmotically pre-treated products needs to be evaluated critically in order to ensure microbial safety of such products. Therefore, the present work was carried out to evaluate the stability of osmotically pre-treated and subsequently vacuum dried pineapple cubes using three different types of packaging materials on storage. In the recent years the interest in osmotic treatments arised primarily because of the need to get better quality product, larger storage and economics. Quality improvement is meant for removal of water without any thermal stress and also impregnation of solutes takes place with the correct choice of solutes, controlled and equilibrated ratio of water removal and impregnation process. Therefore, it is possible to enhance natural flavour and colour retention of fruit products. Osmo-dehydrated products are also called as intermediate moisture products. There is limited research work carried out in India on osmotic dehydration of pineapple. In recognition of the above needs, the present investigation was proposed to standardize the syrup concentration, drying method and packaging material of osmo-dehydration of pineapple cubes to evaluate their acceptability and quality.

Materials and Methods

The present study was conducted at Post harvest Laboratory, department of Fruit science at college of Horticulture, Rajendranagar, Hyderabad, SKLTSHU during the year 2017-2018. Pineapple (*Ananas comosus* L.) cv. queen fruits of commercial maturity were collected from gudimalkapoor market, Hyderabad. The fruits, after receiving in the laboratory, were crowned and washed thoroughly in running tap water and air-dried to remove the surface moisture. They were then manually peeled and cored. The prepared fruits were then cut in to cubes measuring and cubes were blotted gently with a tissue paper to remove the surface moisture before the osmotic treatment. Three different concentrations of sugar syrup i.e. 50, 60 and 70°Brix were prepared. 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) [3]. The dehydrated pineapple cubes were packed in Aluminum laminated polyethylene of 200 gauge & High density polyethylene packaging of 200 gauge and were sealed. The packages were stored under ambient temperature respectively for 4 months. Organoleptic quality evaluation of osmotically dehydrated pineapple cubes was done initially after osmosis and drying of the sample and subsequently upto 4 months of storage. The various sensory features of the dehydrated samples was done by a panel of skilled judges by adopting a 9 - point Hedonic rating scale procedure described by Amerine *et al.*(1965) [2].

Table 1: Hedonic 9- point rating scale

S. No.	Sensory Attributes	Code A	Code B	Code C	Code D	Code E	Code F	Code G
1.	Colour							
2.	Appearance							
3.	Texture							
4.	Taste							
5.	Flavour							
6.	Overall Acceptability							

Organoleptic evaluation was conducted immediately after osmotic dehydration and after four months of storage.

Results and Discussions

Effect of osmodehydration on organoleptic evaluation of osmotic dehydrated pineapple cubes

Osmotic dehydrated cubes were evaluated for the sensory qualities. Sensory score obtained from colour, appearance, texture, taste, flavour and overall acceptability is presented in table 1.

The data recorded pertaining to organoleptic evaluation of osmotically dehydrated cubes showed significant differences among treatments for all sensory attributes (taste, flavour, texture, colour, appearance, and overall acceptability).

The data pertaining to taste attribute recorded significant differences among different treatments. the best score was recorded in treatment S_2D_1- (Sucrose concentration 60ºBrix. + cabinet tray drying *i.e.*8.91among all treatments followed by S_2D_2 (Sucrose concentration 60ºBrix. + hot air oven drying) and S_3D_1 (Sucrose concentration 60ºBrix. + cabinet tray drying). The treatment S_1D_2 (Sucrose concentration 50ºBrix. + hot air oven drying showed significantly lowest score (7.94) compared to all other treatments.

From the data recorded pertaining to flavour attribute, it was observed that there was significant differences among treatments; the best score was recorded in treatment S_2D_1- Sucrose concentration 60ºBrix. + cabinet tray drying (8.68) among all treatments and which was followed by S_2 D_2: Sucrose concentration 60ºBrix. + hotair oven drying (8.66), S_3D_1: Sucrose concentration 70ºBrix. + cabinet tray drying (8.55) S_3D_2: Sucrose concentration 70ºBrix. + hot air oven drying (8.51). The treatment S_1D_2: Sucrose concentration 50ºBrix. + hot air oven drying resulted lowest score (8.12) compared to all other treatments.

The data recorded pertaining to texture attribute showed significant differences among treatments; the best score was recorded in treatment S_2D_1- Sucrose concentration 60ºBrix. + cabinet tray drying for (8.67) among all treatments and followed by treatment S_2D_2: Sucrose concentration 60ºBrix. + hotair oven drying (8.44), S_3D_1: Sucrose concentration 70ºBrix. + cabinet tray drying (8.41) and S_3D_2: Sucrose concentration 70ºBrix. + hot air oven drying (8.29). The treatment S_1D_2: Sucrose concentration 50ºBrix. + hot air oven drying gave significantly lowest score (7.33) compared to all other treatments.

The data pertaining to colour attribute showed significant differences among treatments; the best score was recorded in treatment S_2D_2- Sucrose concentration 60ºBrix. + hot air oven (8.72) among all treatments followed by S_2D_1: Sucrose concentration 60ºBrix. + cabinet tray drying (8.71), S_3D_2: Sucrose concentration 70ºBrix. + hot air oven drying (8.60), S_3D_1: Sucrose concentration 70ºBrix. + cabinet tray drying. The treatment S_1D_2: Sucrose concentration 50ºBrix. + hotair oven drying resulted in significantly lowest score (7.98) compared to all other treatments.

The data pertaining to appearance recorded showed significant differences among treatments; the best score was recorded in treatment S_2D_1- Sucrose concentration 60ºBrix. + cabinet tray drying (8.78) among all treatments followed by S_2D_2: Sucrose concentration 60ºBrix. + hot air oven drying (8.68), S_3D_2: Sucrose concentration 70ºBrix. + hot air oven drying (8.56) and S_3D_1: Sucrose concentration 70ºBrix. + cabinet tray drying (8.54). The treatment S_1D_2: Sucrose concentration 50ºBrix. + hot air oven drying significantly lowest score (7.81) compared to all other treatments.

The data pertaining to overall acceptability recorded showed significant differences among treatments; the best score was recorded in treatment S_2 D_1- Sucrose concentration 60ºBrix. + cabinet tray drying (8.86) among all treatments and which was followed by S_2D_2: Sucrose concentration 60ºBrix. + hot air oven drying (8.80), S_3D_1: Sucrose concentration 70ºBrix. + cabinet tray drying (8.74) and S_3D_2: Sucrose concentration 70ºBrix. + hot air oven drying (8.67). The treatment S_1D_2: Sucrose concentration 50ºBrix. + hot air oven drying significantly lowest score (7.91) compared to all other treatments followed.

Organoleptic evaluation of dehydrated pineapple cubes during storage

The composite values of organoleptic acceptability of the osmo-dehydrated pineapple cubes at storage as influenced by different parameters and their interaction pertaining to colour, flavour, texture, taste and overall acceptability result are discussed as below.

Colour

Colour score was found to be significant in osmo-dehydrated pineapple cubes during four months of storage period Table 1. In first, second, third and fourth month maximum colour score was obtained in treatment combination T_1C_1 (8.3, 8.0, 7.5 and 7.2) respectively. This is due to prevention of enzymatic and oxidative browning as the fruit cubes was surrounded by sugar thus making it possible to retain good colour. Similar results was observed by Kumar and Sagar (2009) [7] for osmo-dehydrated mango, guava slices and aonla segments. Colour score of osmo-dehydrated pineapple cubes had declined with the advancement of storage period. In first, second, third and fourth month lowest colour score was found in treatment combination T_3C_2 (7.3, 6.9, 6.5 and 6.02) respectively. It may be due to absorption of atmospheric moisture, caramalization of sugar present in the product resulting brown colour of the product which effects on compositional status and it was reflected in colour acceptability. These kinds of results was also recorded by Chavan *et al*. (2010) [3] for osmotic dehydration of banana slices, Relekar (2010) [8] for osmo-dehydration of sapota and Naik (2013) for intermediate moisture aonla shreds.

Taste

Taste score of osmo-dehydrated pineapple cubes was found to be significant during four months of storage period (Table 2). In first, second, third and fourth month maximum taste score was obtained in treatment combination T_1C_1 (8.7, 8.3, 8.02, 7.5) respectively. Lowest taste score in first, second and third month was found in treatment combination T_2C_2 (7.3, 7.1 and 7.02) while in fourth month lowest taste score is found in T_3C_2 (6.8) Taste score had decreased with advancement of storage period because of moisture increase and there by dilution of sugars and change in acidity in product. These types of results was also recorded by Chavan *et al*. (2010) [3] for osmotic dehydration of banana slices, Relekar (2010) [8] in osmo-dehydration of sapota and Naik (2013) for intermediate moisture aonla shreds.

Flavour

The flavour score of osmo-dehydrated pineapple cubes was found to be significant during four months of storage period.Table:3. The maximum flavour score in all four months was noticed in treatment combination T_1C_1 (8.3, 8.03, 7.5 and 7.02) respectively. This is attributed mainly to optimum level of osmosis at 60°Brix lowest flavour score in all four months was find in treatment combination T_3C_2 (7.3, 6.9, 6.5 and 5.98) respectively. Flavour score showed decreasing trend during storage which might be due to increase in moisture level and decrease in taste and colour score as well as oxidation of ascorbic acid during storage. These types of results were also reported by Rao and Roy (1980) in mango pulp dehydration, Ahmed and Choudhary (1995) for osmotic dehydration of papaya and Chavan *et al*. (2010) [3] for osmotic dehydration of banana slices.

Texture

The maximum texture score in first, second, third and fourth month was noticed in treatment combination T_1C_1 (8.4, 8.2, 8.02 and 7.54) respectively. Table: 4.4. This could be due to better solid gain and optimum water loss at 60°Brix concentration (Kumar and Sagar, 2009) [7]. In first, second, third and fourth month lowest texture score was found in treatment combination T_3C_2 (7.5, 7.3, 6.9 and 6.42) respectively. Texture score had decreased during storage period of four months which might be due to the absorption of moisture and hygroscopic nature of osmo-dehydrated cubes which soften the tissue in pulp. Similar observation was also recorded by Ahmed and Choudhary (1995) for osmotic dehydration of papaya, Chavan *et al*. (2010) [3] for osmotic dehydration of banana slices, Relekar (2010) [8] in osmo-dehydration of sapota and Naik (2013) aonla shreds.

Table 2: Effect of packaging materials on taste of osmotic dehydrated pineapple cubesduring storage.

Treatments	Storage period (months)			
	1	2	3	4
T_1C_1	8.710	8.337	8.027	7.510
T_1C_2	7.810	7.560	7.127	7.013
T_2C_1	8.517	8.027	7.923	7.233
T_2C_2	7.347	7.187	7.020	6.867
T_3C_1	8.020	7.887	7.537	7.020
T_3C_2	7.520	7.627	7.110	6.810
C.D. at 5 %	0.340	0.427	0.423	0.365
S.Em. ±	0.114	0.202	0.141	0.122
CV%	2.845	3.672	3.785	3.444

Table 3: Effect of packaging materials on flavour of osmotic dehydrated pineapple cubesduring storage.

Treatments	Storage period (months)			
	1	2	3	4
T_1C_1	8.310	8.030	7.543	7.020
T_1C_2	7.910	7.220	7.030	6.127
T_2C_1	8.110	7.473	7.317	6.967
T_2C_2	7.627	7.020	6.910	6.023
T_3C_1	8.020	7.340	7.150	6.637
T_3C_2	7.313	6.950	6.547	5.980
C.D. at 5 %	0.334	0.312	0.299	0.272
S.Em. ±	0.111	0.104	0.100	0.091
CV%	2.826	2.841	2.818	2.816

Table 4: Effect of packaging materials on texture of osmotic dehydrated pineapple cubesduring storage.

Treatments	Storage period (months)			
	1	2	3	4
T_1C_1	8.430	8.210	8.023	7.540
T_1C_2	7.930	7.657	7.340	7.020
T_2C_1	8.210	8.030	7.970	7.340
T_2C_2	7.630	7.530	7.040	6.977
T_3C_1	8.030	7.950	7.660	7.020
T_3C_2	7.577	7.330	6.957	6.427
C.D. at 5 %	0.337	0.427	0.426	0.361
S.Em. ±	0.113	0.143	0.142	0.121
CV%	2.829	3.665	3.791	3.438

Table 5: Effect of packaging materials on colour of osmotic dehydrated pineapple cubesduring storage.

Treatments	Storage period (months)			
	1	2	3	4
T_1C_1	8.310	8.030	7.543	7.240
T_1C_2	7.887	7.203	7.030	6.127
T_2C_1	8.110	7.533	7.340	6.980
T_2C_2	7.623	7.103	6.963	6.530
T_3C_1	8.020	7.380	7.137	7.020
T_3C_2	7.310	6.987	6.533	6.023
C.D. at 5 %	0.334	0.407	0.402	0.343
S.Em. ±	0.112	0.136	0.134	0.115
CV%	2.834	3.688	3.787	3.442

Table 6: Effect of packaging materials on appearance of osmotic dehydrated pineapple cubesduring storage

Treatments	Storage period (months)			
	1	2	3	4
$T_1 C_1$	8.703	8.533	8.030	7.960
$T_1 C_2$	7.973	7.647	7.320	7.127
$T_2 C_1$	8.533	8.030	7.960	7.650
$T_2 C_2$	7.647	7.320	7.127	7.020
$T_3 C_1$	8.030	7.973	7.623	7.350
$T_3 C_2$	7.320	7.143	7.023	6.980
C.D. at 5 %	0.340	0.427	0.425	0.376
S.Em. ±	0.113	0.143	0.142	0.126
CV%	2.823	0.202	3.778	3.421

Table 7: Effect of packaging materials on overall acceptability of osmotic dehydrated pineapple cubesduring storage.

Treatments	Storage period (months)			
	1	2	3	4
$T_1 C_1$	8.447	8.243	8.027	7.980
$T_1 C_2$	7.980	7.657	7.383	7.117
$T_2 C_1$	8.123	8.023	7.970	7.613
$T_2 C_2$	7.653	7.347	7.167	7.023
$T_3 C_1$	8.027	7.980	7.603	7.377
$T_3 C_2$	7.610	7.120	7.020	6.980
C.D. at 5 %	0.338	0.425	0.427	0.376
S.Em. ±	0.113	0.142	0.142	0.126
CV%	2.829	3.671	3.785	3.422

Appearance

Appearance

The maximum appearance score in first, second, third and fourth month was noticed in treatment combination T_1C_1 (8.7, 8.53, 8.03 and 7.9) respectively. In first, second, third and fourth month lowest appearance score was found in treatment combination T_3C_2 (7.3, 7.1, 7.02 and 6.9) respectively. Table: 4.5. Appearance score had decreased during storage period of four months which might be due to the absorption of moisture and hygroscopic nature of osmo-dehydrated cubes which soften the tissue in pulp. Similar observation was also recorded by Relekar (2010) [8] in osmo-dehydration of sapota and Naik (2013) in aonla shreds.

Overall acceptability

Overall acceptability of osmo-dehydrated pineapple cubes was determined by considering the colour, taste, flavor, texture and appearance score. The overall acceptability of osmo-dehydrated pineapple cubes varied significantly as given in Table: 4.6. Significantly. The highest overall acceptability score in first, second, third and fourth month was found in T_1C_1 (8.4, 8.2, 8.02 and 7.98) respectively, lowest overall acceptability score in first, second, third and fourth month was found in treatment combination T_3C_2 (7.6, 7.12, 7.02 and 6.98) respectively. The overall acceptability had decreased significantly during storage period of four months. The decrease in overall acceptability score may be due to absorption of atmospheric moisture, dilution of sugars and changes in acidity, oxidation of ascorbic acid, hygroscopic nature of osmo-dehydrated cubes as well as changes in biochemical constituents of cubes. The above findings is in agreement with those reported by Chavan *et al.* (2010) [3] for osmotic dehydration of banana slices, Relekar (2010) [8] in osmo-dehydration of Sapota and Naik (2013) for aonla shreds.

Conclusion

Regarding the sensory tests of osmoted pineapple cubes, it was found that Sucrose concentration 60ºBrix. + Cabinet tray drying+ aluminum laminated polyethylene packaging of 200 gauge are accepted, both in appearance, smell and taste, as for the color. Overall acceptability was rated good for osmotically dehydrated pineapple cubes treated with sucrose syrup of concentration 60°Brix and dried in cabinet tray drier as compared to other treatments.

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