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Shelf Stability of Apple and Pineapple Crisps in Different Packages

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ABSTRACT

The shelf-life of osmotically dehydrated apple and pineapplefruit crisps packed in three different packaging materials viz., LDPE, HDPE and MLP for 15and 30 days and consumer acceptability was studied. Ten-member trained and fifty-member untrained panels were involved in the sensory and consumer acceptance evaluation, respectively. Panelists evaluated the color, flavor, crispiness, sweetness and overall acceptability of the somatically dehydrated fruit crisps using 5-point hedonic.Sensory evaluation showed no significant differences in color, flavor, crispiness, sweetness and overall acceptability of apple crisps stored in MLP, but those stored in HDPE were significantly better. Apple crisps stored in LDPE packs received consistently poor scoring. Pineapple crisps stored in MLP were better than crisps stored in HDPE. Consumers' acceptance was very good and showed no significant differences in the scores for any of the sensory attributes of apple and pine apple crisps.

Key words: *Apple, Pineapple, physico-chemical, Sensory, Storage, Packaging, Consumer acceptability.*

INTRODUCTION

The world fruit production is estimated to be 434.7 million metric tons and vegetables 90.0 million metric tons. India is the second largest producer of fruits and vegetable and its annual fruit production is 74.88 million tons from an area of 6.38 million ha and vegetable production is 146.55 million tons from an area of 8.5 million ha during 2012-2013[1]. Fruits are important sources of minerals, carbohydrates and certain vitamins, particularly vitamin A and C. The moisture in most of the fruits is above 75% and fruits are prone to spoilage by molds and yeasts[2]. Due to the short shelf life of these crops, as much as 30-35% of fruits and vegetables perish during harvest, storage, grading, transport, packaging and distribution. Only 2% of these crops are processed into value-added products. Hence, there is a need for maximum commercial utilization of fruits and vegetables and to adopt production and marketing activities to the requirements of the world market and to cater to domestic demand which, over the past few years, has been increasing because of various socio-economic factors. If the nutritive value of the processed food products could be maintained, this sector will emerge as a major value-added food industry.

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Many processing techniques can be employed to preserve fruits and vegetables. Drying or dehydration is one of the most important operation that is widely practiced because of considerable saving in packaging and storage[3].

Osmotic dehydration is a method of preservation in which the food is dipped in concentrated salt or sugar solutions. Osmotic dehydration is the phenomenon of removal of water from lower concentration of solute to higher concentration through semi permeable membrane resulting in an equilibrium condition on both sides of membrane[4].The main advantages of osmotic dehydration include better color, texture and flavor retention along with minimum heat damage[5].

Packaging plays an important role in determining the stability of foods by influencing those factors which cause or contribute to food deterioration during storage. Packaging is therefore supposed to provide the correct environmental conditions for shelf-life extension of food. Consumer's product choices are often influenced not only by the attributes of the product, but also by the method based on which the product was produced, including factors such as origin, working conditions and production technology. Consumer acceptance of dehydrated products depend on characteristics such as structural, textural, sensorial, and microbiological and rehydration properties[6]. The objective of the study was to investigate the organoleptic, packaging and storage studies of apple and pineapple crisps.

METERIAL AND METHODS

Apple and pineapple fruits were procured from local market of Hyderabad. The experimental studies were carried out at the department of Foods and Nutrition, Post Graduate and Research Center, PJTS Agricultural University, Rajendranagar, Hyderabad. Apple and pineapples were sliced into sections, blanched and osmotically concentrated to 55% TSS, and dehydrated for 8-10hrs at 65^{o}C.

Physico-Chemical Analysis

Moisture content was determined by drying the sample to a constant weight in a hot air oven at 100 to 105^{0}C for 4 hrs and the pH measured using pH meter. The total soluble solids content was determined by Digital Refractometer. Titrable Acidity it was determining by Titrating with 0.1 N NaOH. Total sugar and Reducing sugars were determined by Nelson- Somyogi method, Ascorbic acid content by titration method is using standard 2-6 di-chlorophenol indophenols dye solution.

Sensory and Consumer Evaluation:

osmotic dehydrated apple and pineapple crisps was carried out at laboratory level by trained panel of ten judges using score card of five point hedonic scale. Descriptive terms were given to various quality attributes like, color, flavor, crispiness, sweetness and overall acceptability and numerical scores were assigned. The osmotic dehydrated fruit crisps were packed in three different packaging materials, i.e. low density polyethylene (LDPE) pouch, high density polyethylene (HDPE) pouch and metal laminated aluminium (MLA) pouch stored at ambient temperature for a period of 30 days and evaluated for sensory quality attributes on 15th and 30th day.

Consumer acceptability test was carried out on customers visiting super markets like Balaji Grand and More Super Market at Hyderabad. Samples of the osmotic dehydrated fruit crisps were given for evaluation to 50 consumers using a 5-point hedonic scale as 5-excellent, 4- very good, 3-good,2- fair and 1- poor. The data was pooled and analyzed statistically[7].

RESULTS AND DISCUSSION

Data in Table 1 show that the moisture content of apple crisps stored in LDPE increased from 4.7 to 6.2 % during storage and it was no significantly different (p> 0.05).This could be attributed to permeability to air and water in LDPE and HDPE, while minimum increase in moisture content in the samples stored in MLP pouches could be due to the better moisture barrier properties of the package. Similar results were also reported by Abdelhaq and Labuza[8] in dried apricot. The total pH concentration increased in all packaging

materials during storage and there is no significantly different ($p>0.05$) when compared with total pH content before storage (4.2). Similarly, the TSS value increased from 72.6 to 77.0 % across all the packaging materials but with significantly different ($p<0.05$) when compared with each other. TSS has increased due to reconversion of starch into monosaccharide due to cyclic changes under the storage conditions.

The Titratable acidity value decreased from 0.5% to 0.4% in all three packaging material after storage and were significantly different ($p<0.05$) from initial value before storage (Table 1). The reduction in Titrable acidity of samples in all packaging materials for 15 and 30 days might be due to the utilization of acids during various biochemical reactions occurring in the products during storage.

The ascorbic acid obtained from the apple crisps stored in different packaging materials were not significantly different ($p>0.05$) from each other. Highest retention of ascorbic acid in MLP packed apple crisps might be attributed to maintenance of lower moisture content in laminated pouches thereby less degradation of ascorbic acid. LDPE recorded the decreasing reducing sugar of 12.5% followed by HDPE (15.4%), while MLP recorded the slight increased 15.9%, but was not significantly different($p>0.05$) from apple crisps before storage in (15.5%).The decreasing trend of reducing sugar during storage irrespective of packaging was probably due to the hydrolysis of non reducing sugars during storage. The low total sugar content of crisps packed in LDPE pouches could be due to higher moisture content which might have favored faster non enzymatic reaction during storage.

Table 2 shows that the moisture content of pine apple crisps varied from 3.31 to 5.9% with significant moisture absorption in polyethylene pouch was observed during storage. It was noticed that average mean value of 5.3 % during first 15 days and 5.9 % after 30 days from an initial value of 3.31%. Polyethylene pouches retained more Titratable acid on storage for 30 days as compared to MLP. The average decrease in acidity was found were not significant with the mean value decreased to 1.03to 0.76% after 15 and 30 days of storage from their initial value of 1.13% when the packages compared. The reducing sugar decreased from 16.36 to 15.66 % irrespective package after 30 days storage. The effect of storage and package revealed that there was decrease in reducing sugar whereas in laminated pouches the decrease was not significant ($p> 0.05$). Total sugar among different storage period from 60.9 to 58%. Total sugar decreased in HDPE and increased in laminated pouches during 30 days of storage. Ascorbic acid decreased during storage in both packages, it increased from initial and it will also revealed that decreased in storage period increased in all three packaging material were not significant($p>0.05$).

Sensory evaluation:

The apple and pineapple crisps were evaluated for sensory parameters on day-1, day-15 and 30 days and were scored based on the 5 point hedonic scale, in the decreasing order of highest quality with 5 points to 1 point for poor quality.

Table 3 shows that color of apple crisps scored 4.7 on the 1st day, which decreased as the storage period increased from initial to 15days and further to 30 days in all packaging materials i.e., LDPE, HDPE and MLA. Initially score for flavour was 4.7. As the storage period increased from first day 15th and then to 30 days, the flavor score decreased in all packages. Samples packed in LDPE had the lowest mean score. During storage the crispiness of samples decreased slightly by 15 days, but by 30th day crispiness decreased further to a lower score. Decreased crispiness score indicate moisture absorption causing softening and sogginess in packaging material and this tendency was found to be high in LDPE stored apple crisps compared to other samples. The sweetness score was highest (4.7) in MLP stored apple crisps and LDPE samples scored the least (2.9) on 30th day. Overall acceptability of apple crisps scored 4.6

on the first day and by 15th and 30th day the acceptability score has come down in all samples stored in all three packaging materials.

Osmotic dehydrated pine apple crisps had a slight decrease in the score for color (4.3), (4.5) in HDPE and MLP samples, but the score was very less in samples of LDPE (3.9) as the storage period increased from initial to 15days.The mean flavour scores of pineapple crisps packed in different packaging materials varied from 4.1 to 3.5 with the highest score in high density polyethylene pouches and lowest in the products packed in low density polyethylene pouches. Mean score for crispiness was 4.5 on the first day, which has decreased on the 15th day moderately in samples stored in HDPE and only decrease slight in MLP and stored in LDPE did not show any difference during storage and score were less on 30th day compared to 15th day in HDPE and MLP samples. The mean score for sweetness was 4.3 on the first day but the scores decreased by 15th and 30th day to 3.4 in HDPE and 3.1 in LDPE. Whereas samples stored in MLP had slight decrease in sweetness scores on the 15th day with a score of 4.1 and further decreased to a score of 3.7 on the 30th day. Mean score for overall acceptability has decreased during the storage period increased from initial to 30 days in all three packaging score are presented in table4.

The total sensory score of apple crisp was 22.9±1.69 and pine apple crisp 22.0±1.56 which was the highest score compared to the scores of the samples stored for 15 and 30 days in HDPE, LDPE and MLP packages. Comparison between the sensory score of apple crisps and pine apple crisps was very slightly decreased in all three packaging material for a period of 30th day storage score are presented in table 5.

Within each of the packaging material the total sensory score decreased slightly 15 days to 30 days. Among the three packages, apple crisps in LDPE scored less compared to HDPE and MLP. The lower mean sensory scores observed in pineapple crisps packed in LDPE might be due to higher moisture absorption and gas permeability characteristics of the polyethylene, thereby affecting texture and color of the packed products. The sensory scores were significantly higher in in MLP which might be due to impermeable nature of laminated pouches. The sensory quality deteriorated significantly in all packages during 30 days storage. The maximum deterioration of sensory quality was noticed in LDPE pack, while, samples stored in MLP pouches showed least changes. Sharma *et al* 1998, has also reported reduction in sensory score of dried apple slices during storage. Reduction in sensory quality during storage may be attributed to reduction of SO_2 and increase in moisture in samples resulting in the non-enzymatic browning, oxidation and changes in other chemical constituents of product. Keeping in view the changes during storage for 30 days, it was concluded that the packaging of fruit crisps in hermetically sealed laminated pouches preserved the chemical composition with a little are no change in sensory attributes of the product. The product can successfully be stored in these pouches beyond 6 months also as the quality was as good as to that of a fresh dried fruit[10].

Consumer Acceptability of Fruit Crisps

Apple crisps were rated to have ‘excellent’ color, flavor, crispiness, sweetness and overall acceptability by 50%, 44%, 44%, 40% and 54% consumers respectively. The rating as ‘very good’ for color (34%), flavor (24%), crispiness (14%), sweetness (28%), and overall acceptability (6%) was given by 34%, 24%, 14%, 28% and 6% consumers respectively. Majority of the consumers rated apple crisps as either excellent or very good indicating that they were all appreciating the product.

Pine apple crisps were rated to have ‘Excellent’ sensory attributes like color, flavor, crispiness, sweetness and overall acceptability as perceived by 40%, 30%, 34%, 36% and 40% consumers respectively. The rating as ‘Very Good’ was given by 32% consumers for color, 38% consumers for flavor, crispiness (36% consumers), sweetness (36% consumers), and overall acceptability

(34% consumers). Sixteen to 20% consumers rated the pineapple crisps to be 'Good', while 2-10% consumers rated the pine apple crisps as 'Fair' for different sensory attributes. The results are shown in table 6.

Consumers have given an overall rating to the fruit crisps in the order of preference as first apple then pine apple.

Table 1: Physico- chemical composition of apple crisps in different packaging material at different storage periods

Parameters	Before storage/ 1st day	HDPE		LDPE		MLP		Probability value	
		15days	30days	15days	30days	15days	30days	Storage Period	Packaging
Moisture(%)	4.7	5.70	5.76	5.93	6.2	5.47	5.7	NS	NS
Ph	4.2	4.6	4.4	4.73	4.2	4.6	4.5	NS	NS
Titratableacidity(%)	0.5	0.4	0.48	0.41	0.4	0.47	0.4	0.0007**	NS
Ascorbic acid (mg/ gm)	12.0	11.0	10.56	11.43	10.8	11.3	11.0	3.03E10**	NS
TSS(°bxix)	72.6	76.0	77	76.6	77.0	74.3	72.6	0.0001**	0.003*
Reducing sugar(g)	15.5	15.4	15.9	13.1	12.5	15.9	15.6	NS	0.001**
Total sugar(g)	61.3	64.6	64.0	63.43	63.6	63.2	64.4	NS	NS

Table 2: Physico - chemical composition of pine apple crisps in different packaging materials at different storage periods

Parametes	Before storage/ initial	HDPE		LDPE		Metalized		Probability value	
		15days	30days	15days	30days	15days	30days	Storage Period	Packaging
Moisture (g)	3.31	4.96	5.23	5.3	5.9	4.7	4.6	0.0001**	NS
Ph	4.8	4.36	3.2	4.8	4.7	4.2	3.86	NS	NS
Titrableacidity (%)	1.13	1	0.93	1.16	0.96	1.03	0.76	NS	NS
Ascorbic acid (mg/100g)	14.72	15.4	15.0	15	14.7	15.63	14.53	NS	NS
TSS(°brix)	52.6	59.3	59.6	62	65	54.33	58.3	2.46E-05**	0.008*
Reducing sugars (g)	16.36	16.06	15.7	16.03	15.9	16.36	15.66	NS	NS
Total sugars (g)	60.9	58	61.7	62	62.6	63.66	63.66	NS	NS

Table 3: Sensory scores of apple crisps in different packaging materials at different storage periods

Parameters	Before storage/ initial	HDPE		LDPE		MLP	
		15days	30days	15days	30days	15days	30days
Color	4.7±0.48	4.4±0.69	3.6±0.69	4.2±0.63	3.5±0.52	4.4±0.51	3.8±0.63
Flavor	4.7±0.48	4.2±0.03	3.5±1.26	3.9±0.73	3.7±0.67	4.5±0.71	3.7±0.67
Crispiness	4.2±0.63	4.1±0.56	3.5±0.52	3.7±0.67	2.9±0.56	4.1±0.73	3.4±0.69
Sweetness	4.7±0.48	4.1±0.71	3.8±0.78	3.6±0.84	2.8±0.7	4.7±0.48	3.9±0.73
Overall acceptability	4.6±0.51	4.4±0.51	4.0±0.63	3.6±0.56	3.2±0.63	4.6±0.51	3.9±0.56

Table 4: Sensory scores of pine apple crisps in different packaging materials at different storage periods

Parameters	Before storage/initial	HDPE		LDPE		MLP	
		15days	30days	15days	30days	15days	30days
Color	4.6±0.51	4.3±0.67	3.8±0.78	3.9±0.87	3.9±0.87	4.5±0.52	3.6±1.07
Flavor	4.1±0.56	4.2±1.02	3.6±0.96	3.5±0.84	3.5±0.84	3.9±0.73	3.5±0.84
Crispiness	4.5±0.70	3.9±0.73	3.4±0.69	3.6±0.96	3.6±0.96	4.3±0.67	3.7±0.48
Sweetness	4.3±0.48	3.7±0.94	3.4±0.69	3.3±0.82	3.1±0.87	4.1±0.56	3.7±0.67
Overall acceptability	4.5±0.52	3.9±0.73	3.6±0.51	3.6±0.51	3.6±0.51	4.4±0.51	3.9±0.56

Table 5: Total sensory score of taste panel judges for fruit crisps in different packages at 15 and 30 days storage period

Fruit crisps	Initial	HDPE		LDPE		MLP		Probability value	
		15 day	30 day	15 day	30 day	15 day	30 day	Storage Period	Packaging
Apple	22.9± 1.69	21.2±2.25	18.4± 1.57	19± 2.50	16.1± 1.66	22.3± 1.25	18.7± 1.33	3.14E-20*	1.43E-05*
Pine apple	22.0± 1.56	20± 2.28	17.8± 1.93	17.9± 2.5	17.5± 2.5	21.2± 1.81	18.4± 1.42	3.43-10*	NS

Table 6: Distribution of consumers in evaluation of the sensory parameters of fruit crisps

Product	Colour					Flavor					Crispiness					Sweetness					Overall Acceptability				
	E	VG	G	F	P	E	VG	G	F	P	E	VG	G	F	P	E	VG	G	F	P	E	VG	G	F	P
Apple Crisps	50	34	14	2	0	44	30	24	10	0	44	36	14	2	2	40	32	28	4	0	54	38	6	4	0
Pine Apple Crisps	40	32	16	10	0	30	38	20	8	1	34	36	18	6	0	36	36	20	2	0	40	34	16	10	0

SUMMERY AND CONCLUSION

Fruit crisps were scored less on the 30th day compared to 15thday of storage and the decrease in scores during storage was also statistically highly significant. The fruit crisps stored in LDPE pouches scored less organoleptically for all varieties on 15th day and further less on 30th day of storage compared to the samples stored in HDPE and MLP, but the difference was not significant. The maximum deterioration of sensory quality was noticed in LDPE pack while, sample stored in MLP pouches showed least changes. Keeping in view the changes during storage for 30 days, it was concluded that the packaging of fruit crisps in hermetically sealed laminated pouches preserved the composition with a little are no change in sensory attributes of the product.

Fifty consumers evaluated the fruit crisps and gave their acceptability rating as excellent, very good, good, fair and poor. Nearly 40 to 50% of the consumers score 'excellent' for apple, and pineapple crisps for color, flavor, crispiness, sweetness and overall acceptability and another 30 to 40% scored the same fruits as 'very good'.

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