



Utilization of Ripe Pumpkin (*Cucurbita moschata*) for the Development of Fruit Bar

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Authors' contributions

This work was carried out in collaboration among all authors. Author AKD designed the study and wrote the protocol. Authors PT, PR managed the analyses of the study. Authors SA, DK wrote the first draft of the manuscript and performed the statistical analysis. All authors read and approved the final manuscript.

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ABSTRACT

The study aim at utilization of bulk availability of low cost ripe pumpkin into processed products possessing health benefits. A fruit bar was developed using pumpkin (*Cucurbita moschata*) at 40°Brix, 1.5% citric acid and 2% pectin by varying cooking method (with and without cooking of ingredients; with and without cooking of ingredients using concentrated pumpkin pulp (PP)). Pumpkin bar prepared using concentrated pulp and with cooking of ingredients had obtained maximum sensory score, as well as maximum content of β -carotene (9.89 mg/100 g) and ascorbic acid (8.75 mg/100 g). Pumpkin bar was evaluated for quality and stability during storage. The values for chemical and sensory parameters decreased significantly during storage but the bar was of good quality up to six months under ambient conditions. Aluminium Laminated Pouches (ALP) was observed to be better packaging material as compared to Low Density Polyethylene (LDPE) and Polypropylene (PP) boxes. Hence, it was concluded that ripe pumpkin can be utilized for the production of good quality and nutritionally enriched bar at remunerative cost.

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1. INTRODUCTION

Fruit bar/leather is an intermediate food product prepared by dehydration of pulp/puree of fruits into leathery sheets which further can be cut into desired shape and size [1]. It is a semi-moist foods usually represented as flexible strips or sheets with shiny appearance and texture [2]. It is considered to be an age old traditional product accepted by almost all sections of the society. Fruit leathers come under the category of healthy snacks because of high nutritional value based on natural ingredients along with the chewy structure. Due to the attractive structure of fruit bars/leathers and shelf stable to microbial growth at ambient conditions, they constitute a practical way to increase fruit solids consumption. Their consumption adds variety to diet and allows intake of dietary fiber, vitamins and minerals, while providing a substantial energy input. Although, the fruit bars can be prepared from any type of fruit, irrespective of their compositional variation but acceptable bars cannot be prepared from juicy fruits until suitable additives such as maltodextrin, pectin, soluble starch, carboxyl methyl cellulose, etc are added [3]. Fruits such as papaya, mango, sapota, jackfruit, durian, guava and kiwifruit [4] are the most commonly used for the preparation of fruit bar among which mango bar is commercially available in Indian markets [5].

Pumpkin (*Cucurbita moschata* Duch ex Poir) is also known as *kashiphal* or *lal kaddhu* is one of the important Cucurbitaceous vegetables grown extensively in tropical and sub-tropical countries like Mexico, South America, South Asia, Central Africa, etc. It is oval or round in shape with varying size and colour [6]. Depending upon the cultivar, it is a rich source of protein, starch, pectin, and dietary fiber along with minerals like calcium, selenium, iron, phosphorus, etc [7]. Besides being nutritionally rich, pumpkin possesses many medicinal properties due to presence of phytonutrients such as carotenoids, zeaxanthin, vitamin E, ascorbic acids, phytosterols, selenium, and linoleic acid, which act as natural antioxidant in human nutrition [8]. Being rich in β -carotene, it slows down the process of aging and also prevents cataract formation. Although in foreign countries, pumpkins are utilized for the preparation of various value added products viz. pies, freeze, canned, and dried products. But in India, pumpkin is mostly consumed as fresh vegetable

with exception of their use in vegetable sauces where pumpkin is added as a thickening agent.

The food industry in India is always in search of finding a new raw material of high nutritional quality for the production and development of various food products. Pumpkin is a crop which has bulk availability, rich in various valuable nutritional components and known to possess many health protecting properties. Therefore, the aim of the study was to develop fruit bar/leather from ripe pumpkin.

2. MATERIALS AND METHODS

The ripe pumpkin was used for the preparation of fruit bar. It was purchased from local market of Solan. The chemicals required for preparation of pumpkin bar (pectin, citric acid) and conducting chemical analysis were acquired from Loba International Scientifics and Surgicals, Solan (HP). Other material like sugar, Aluminium laminated pouches (ALP), Polyethylene pouches (LDPE), and Plastic boxes were also purchased from the Solan market. The whole experiment was conducted in the Department of Food Science and Technology, UHF, Nauri, Solan, HP, India.

2.1 Preparation of Pumpkin Bar

The ripe PP was prepared according to the method standardized by [9]. The concentrated PP was obtained using rotary vacuum evaporator by concentrating the pulp at different temperature and time ($N_1= 60^\circ\text{C}$ for 20 min, $N_2= 70^\circ\text{C}$ for 15 min, and $N_3= 80^\circ\text{C}$ for 10 min). The ripe PP was used for the production of pumpkin bar. The PP was mixed with powdered sugar in order to get the desired TSS of 40°Brix . Mild heat treatment was given to mix the sugar thoroughly with pulp on low flame. Different cooking method was followed for preparation of bar. The detail for different combinations are $C_1=$ Preparation of bar without cooking of ingredients, $C_2=$ Preparation of bar with cooking of ingredients, $C_3=$ Preparation of bar by using concentrated pulp and without cooking of ingredients, and $C_4=$ Preparation of bar by using concentrated pulp and with cooking of ingredients. The amount of citric acid and pectin was 1.5 and 2 per cent, respectively. The mixed mass was allowed to cool down at room temperature. The aluminium trays were prepared by greasing with vegetable oil to prevent the sticking of bar after drying. The

mixture was poured in aluminium trays and dried in a mechanical dehydrator (60°C). After drying the sheet was cut into pieces of uniform shape and size to convert into bars. The bars were packed in LDPE pouches, PP boxes, and ALP and sealed by using sealing machine for storage studies. The product was evaluated for chemical and sensory characteristics.

2.2 Analytical Method

2.2.1 Chemical characteristics

Pumpkin bar was analyzed for different chemical characteristics. Moisture content was determined using hot air oven by measuring the weight loss due to evaporation of water [10]. Water activity was estimated by computer digital water activity meter (HW₃ model, Rotronic International, Switzerland), where direct measurements were taken at room temperature. Total Soluble solids (TSS) were measured at ambient temperature using hand refractometer of 0-32, 28-62, and 58-92°Brix [10]. Titrable acidity was analyzed by titrating known volume of sample against standard 0.1 N NaOH in the presence of phenolphthalein as an indicator [11]. Digital pH meter (CRISON Instrument, Ltd Spain) was used to determine pH. Ascorbic acid content was determined using 2,6-dichlorophenol indophenols dye [10]. Sugars and β-carotene was estimated as per the method described by Ranganna [11]. For non-enzymatic browning, pumpkin bar of known weight was kept for 12 h in 20 ml of 60% ethyl alcohol and then UV-VIS spectrophotometer was used to determine the absorbance of extract at 440 nm [11].

2.2.2 Antioxidant activity

The antioxidant activity in bar was measured as per the method of Brand-Williams et al. [12] using DPPH (2, 2-diphenyl-1-picrylhydrazyl) as a source of free radical. A quantity of 3.9 ml of 610-5 mol/L DPPH in methanol and 0.1 ml of sample extract was put in cuvette and decrease in absorbance was measured at 515 nm for 30 minutes. Methanol was used as blank and 610-5 mol/L DPPH in methanol is used as control. The antioxidant activity was calculated using following equation:

Antioxidant activity (%)

$$= \frac{\text{Absorbance of control} - \text{Absorbance of sample}}{\text{Absorbance of control}} \times 100$$

2.2.3 Antimicrobial activity

Antimicrobial activity of samples against common microorganisms i.e. *Staphylococcus aureus* and *Escherichia coli* under aerobic conditions was detected by Well Diffusion method discussed by Schillinger and Lucke [13]. The test microorganisms were uniformly swab with the help of sterilized cotton buds on nutrient agar plate. Wells of 6 mm diameter were cut in, loaded with 100µL of sample and placed on the solid medium. Plates were incubated at 37°C for 24 hours and the results obtained were in the form of zone of inhibition. The diameter of inhibition zone (mm) formed by samples against the respective test microorganism was measured.

2.2.4 Sensory score evaluation

A panel of 10 semi trained judges evaluated pumpkin bar for its colour, texture, flavour and overall acceptability on 9-point Hedonic scale ranging from 1 (dislike extremely) to 9 (like extremely).

2.2.5 Statistical analysis

All the experiments were performed in three replications and the results of those replicate were determined with standard deviations. The data for quantitative analysis of various chemical attributes were analysed by Completely Randomized Design (CRD) while the data pertaining to sensory evaluation were analysed by Randomized block design (RBD) using OPSTAT software [14].

3. RESULTS AND DISCUSSION

3.1 Standardization of Technique for Concentration of Pumpkin Pulp

The concentrated pulp was evaluated for chemical and sensory characteristics given in Table 1. The analysis for chemical characteristics revealed that maximum retention of β-carotene (11.51 mg/100 g) and ascorbic acid (10.46 mg/100 g) was observed in N₂ (70°C for 15 min) which was statistically at par with N₃ (80°C for 10 min). The lowest β-carotene and ascorbic acid content was found in N₁ (60°C for 20 min). The maximum OD for non-enzymatic browning was observed in N₃ (0.210) while minimum in N₁ (0.153). The treatment N₁ was statistically at par with N₂ for non-enzymatic browning. In case of sensory score, the maximum score for colour, flavor, and overall acceptability was obtained by

N₂ (70°C for 15 min) followed by N₁ (60°C for 20 min) and N₃ (80°C for 20 min). It is evident that treatment N₂ retained highest nutritional composition which was statistically at par with N₃. The sensory evaluation also showed the highest scores for treatment N₂. Therefore, N₂ (70°C for 15 min) was selected for further use in cooking methods.

3.2 Chemical Characteristics and Sensory Score of Pumpkin Bar Prepared by Different Cooking Method

Data pertaining to chemical characteristics of pumpkin bar prepared by different cooking methods are presented in Table 2. It was observed that cooking methods had a significant effect on the chemical characteristics of pumpkin bar. It was observed that moisture content and water activity were found to decrease with cooking of ingredients. The lower moisture and water activity in C₃ and C₄ may be due to the concentration of pulp. Similar finding was observed by Manimegalai et al. [2] who have reported 16.48% moisture in jackfruit bar prepared by cooking and Mukisa et al. [15] observed 18.85% moisture content in jackfruit bar prepared by using concentrated pulp. A value of 0.63 for water activity in mango leather and 0.69 in apple and quince leather has been observed by Effah-Manu et al. [16] and Torres et al. [17], respectively when prepared without cooking of ingredients. The comparative analysis of values for total soluble solids (TSS), total sugars, and reducing sugars of pumpkin bar of different treatments indicates that these were found to increase with enhancement of cooking time. The change in total sugars of pumpkin bar may be attributed to various cooking methods used. The moisture loss during concentration of pulp followed by cooking of ingredients might have led to the concentration of sugar, resulted in higher total and reducing sugars in C₄ (concentration of pulp and with cooking of ingredients) in comparison to other treatments. Attri et al. [18] developed papaya leather by cooking method and observed 36.0 and 16.6% total and reducing sugars while a quite higher values of 72.5 and 43% for total and reducing sugars were noticed by Sharma et al. [19] in wild apricot fruit bar. The highest value of titrable acidity was 1.72% in bar of C₂ and lowest value of 1% in C₁ while opposite value was observed in case of pH. The increased acidity of bar prepared by cooking method might be due to

loss of moisture during cooking leading to concentration of acid. It is clearly evident that treatments with higher acidity had the lowest pH.

It is well known fact that ascorbic acid is the least stable of all the vitamins and is highly sensitive to heat and oxidation during processing and cooking therefore, lower ascorbic acid content was observed in bar prepared by employing cooking method (C₂). The fruit bars prepared without cooking of ingredients retained maximum ascorbic content in comparison to with cooking of ingredients. A decrease from 83.33 to 74.70 and 260 to 237 mg/100 g in ascorbic acid content of pawpaw and guava fruits was revealed by Ashaye et al. [20] when prepared bars by cooking method. The data also showed a decrease in β -carotene with increase in extent of cooking which may be attributed to prolonged cooking that leads to degradation of carotenoids and the same is the reason for lower β -carotene in bars prepared with cooking methods in comparison to without cooking. Attri et al. [18] have reported a reduction from 3144 to 1946.20 μ g/100 g in carotenoids of papaya fruit when converted in to fruit bar. The processing conditions, time and temperature have great effect on the non-enzymatic browning of the fruit products. The maximum (0.791) non-enzymatic browning was observed in C₂ while minimum (0.109) in C₁. The non-enzymatic browning in product might be due to the formation of coloured compound by the reaction between organic acids and sugars during cooking. The results for non-enzymatic browning are almost near to the values given by Kaushal et al. [3] and Deepika et al. [21], respectively for seabuckthorn leather (0.66) prepared with cooking of pulp and aonla fruit bar (0.158) developed without cooking.

The pumpkin bar prepared by using four different cooking methods showed a significant effect on the sensory scores (Table 2). For colour the highest score (8.33) was awarded to C₄ (concentration of pulp and with cooking of ingredients) and lowest (7.46) to C₁ (without cooking of ingredients). The intermediate scores of 7.78 and 8.12 were obtained by C₂ and C₃, respectively. The flavour scores ranged from 7.35 to 8.57 with maximum for bar of treatment C₄ and minimum for C₁. A similar trend was observed for texture scores of bar of different treatments with maximum of 8.44 for C₄ and minimum of 6.83 in C₁. As far as overall acceptability is concerned the data showed that the highest scores of 8.39 was awarded to C₄

followed by C₂ (7.73), C₃ (7.26) and C₁ (6.93). It can be seen from data that bar of treatment C₄ was most liked by the panelist while the bar of C₁ was least liked that might be due to the undesirable texture of the bar as per the feedback from the panelists.

3.3 Storage Stability of Pumpkin Bar

The pumpkin bar represented a significant difference at 5% level of significance in its storage quality when packed in different packaging material for 6 months (Table 3). There was a slight decrease in moisture content, water activity, pH, and total sugars while slight increase in TSS, titrable acidity, and reducing sugars during six months storage of pumpkin bar. The mean moisture content was found to decrease from 17.44 to 13.64, 15.40 and 16.44 per cent in pumpkin bar packed in LDPE, PP boxes and ALP, respectively with mean maximum value 17.04 per cent in bar packed in ALP. The decrease in moisture content of bar during storage may be attributed to the loss of moisture which might be due to increased ambient temperature. The bar packed in ALP recorded

the maximum mean value of 0.622 followed by PP boxes and LDPE with a value of 0.594 and 0.586, respectively for water activity. The TSS was found to be increased during storage which might be due to acid hydrolysis of polysaccharides especially pectin into soluble sugars [22]. ALP showed lowest increase in TSS content as compared to LDPE being highest. A significant increase in titrable acidity of pumpkin bar packed in LDPE, PP boxes and ALP. The mean titrable acidity was found to increase from 1.60 per cent to 2.05, 1.95 and 1.75 per cent in pumpkin bar packed in LDPE, PP boxes and ALP, respectively during a period of six months. However, the pH of bars declined significantly during storage reflecting the mean maximum pH in bar packed in ALP (3.35) and minimum in LDPE (3.19) Increase in acidity might be due to formation of acids by degradation of polysaccharides and oxidation of reducing sugars or by breakdown of pectic substances [22]. Similar increasing trend in titrable acidity during storage has been reported by Parekh et al. [23] in mango bar. The total sugars decreases while reducing sugars increases during storage due to acid hydrolysis of total sugars

Table 1. Effect of heat treatment on chemical characteristics and sensory scores of concentrated pumpkin pulp

Treatments	β -carotene (mg/100 g)	Ascorbic acid (mg/100 g)	Non enzymatic browning	Colour	Flavour	Overall acceptability
N ₁ (60°C for 20min)	10.46	9.44	0.153	7.71	7.53	7.34
N ₂ (70°C for 15min)	11.51	10.46	0.160	8.02	7.85	7.95
N ₃ (80°C for 10min)	10.82	9.67	0.210	7.34	7.33	7.25
CD _{0.05}	0.96	0.90	0.007	0.10	0.04	0.05

CD: Critical Difference

Table 2. Effect of cooking methods on physico-chemical characteristics and sensory score of pumpkin bar

Cooking method (C) Characteristics	C ₁	C ₂	C ₃	C ₄	CD _{0.05}
Moisture (%)	23.38	20.57	21.21	17.45	0.06
Water activity	0.699	0.648	0.654	0.633	0.006
Dehydration ratio	1.78	1.67	1.73	1.64	0.04
TSS (^o Brix)	68.24	72.21	71.59	72.75	0.14
Titrable acidity (% citric acid)	1.61	1.72	1.64	1.69	0.03
pH	3.74	3.30	3.57	3.40	0.06
Total sugars (%)	61.84	63.01	62.13	63.52	0.02
Reducing sugars (%)	29.76	32.29	30.91	33.65	0.54
β -carotene (mg/100 g)	12.05	5.71	10.32	9.89	0.04
Ascorbic acid (mg/100 g)	11.56	4.93	10.34	8.75	0.05
Non-enzymatic browning (OD at 440 nm)	0.109	0.791	0.155	0.274	0.005
Drying time (hours)	18	15	16	14	0.55
Colour	7.46	7.78	8.12	8.33	0.01
Flavour	7.35	8.15	7.54	8.57	0.01
Texture	6.83	7.95	7.21	8.44	0.04
Overall acceptability	6.93	7.73	7.26	8.39	0.04

CD: Critical Difference

Table 3. Effect of different packaging material and storage physico-chemical characteristics of pumpkin bar

Parameters	Packaging material	Storage interval (month)			Mean	CD _{0.05}
		0	3	6		
Moisture (%)	LDPE	17.45	15.44	13.64	15.51	P=0.11
	PP Boxes	17.45	16.51	15.40	16.45	S=0.11
	ALP	17.45	17.24	16.44	17.04	S×P=0.19
	Mean	17.45	16.39	15.16		
Water activity	LDPE	0.656	0.586	0.515	0.586	P=0.006
	PP Boxes	0.656	0.595	0.532	0.594	S=0.006
	ALP	0.656	0.615	0.594	0.622	S×P=0.01
	Mean	0.656	0.599	0.547		
Total soluble solids (°Brix)	LDPE	72.33	75.40	77.50	75.07	P=0.13
	PP Boxes	72.33	74.60	76.46	74.46	S=0.13
	ALP	72.33	73.40	74.53	73.42	S×P=0.23
	Mean	72.33	74.46	76.16		
Titrable acidity (%)	LDPE	1.60	1.86	2.06	1.84	P=0.01
	PP Boxes	1.60	1.77	1.95	1.77	S=0.01
	ALP	1.60	1.68	1.77	1.68	S×P=0.02
	Mean	1.60	1.77	1.93		
pH	LDPE	3.57	3.16	2.86	3.20	P=0.03
	PP Boxes	3.57	3.27	2.95	3.26	S=0.03
	ALP	3.57	3.38	3.14	3.36	S×P=0.06
	Mean	3.57	3.27	2.98		
Total sugars (%)	LDPE	63.54	60.55	56.56	60.22	P=0.12
	PP Boxes	63.54	62.52	58.29	61.45	S=0.12
	ALP	63.54	61.59	60.63	61.92	S×P=0.21
	Mean	63.54	61.56	58.50		
Reducing sugars (%)	LDPE	33.67	38.67	39.62	37.32	P=0.10
	PP Boxes	33.67	36.61	38.64	36.30	S=0.10
	ALP	33.67	35.52	36.59	35.26	S×P=0.18
	Mean	33.67	36.93	38.28		

Parameters	Packaging material	Storage interval (month)			Mean	CD _{0.05}
		0	3	6		
β -carotene (mg/100g)	LDPE	9.89	6.86	5.57	7.44	P=0.11
	PP Boxes	9.89	7.64	6.60	8.04	S=0.11
	ALP	9.89	8.63	7.64	8.72	S×P=0.20
	Mean	9.89	7.71	6.60		
Ascorbic acid (mg/100g)	LDPE	8.75	4.56	3.10	5.47	P=0.10
	PP Boxes	8.75	5.40	4.66	6.27	S=0.10
	ALP	8.75	6.77	5.62	7.05	S×P=0.18
	Mean	8.75	5.58	4.46		
Antioxidant activity (free radical scavenging activity %)	LDPE	64.87	59.41	55.53	59.94	P=0.08
	PP Boxes	64.87	60.40	56.53	60.60	S=0.08
	ALP	64.87	61.63	58.82	61.77	S×P=0.13
	Mean	64.87	60.48	56.96		
Antimicrobial activity (mm) against <i>Staphylococcus aureus</i>	LDPE	13	8	6	9.0	P=0.26
	PP Boxes	13	10	8	10.3	S=0.26
	ALP	13	11	9	11.0	S×P=0.46
	Mean	13.0	9.7	7.7		
Antimicrobial activity (mm) against <i>Escherichia coli</i>	LDPE	10.00	7.00	5.00	7.33	P=0.01
	PP Boxes	10.00	8.00	6.00	8.00	S=0.01
	ALP	10.00	9.00	8.00	9.00	S×P=0.03
	Mean	10.00	8.00	6.33		

Where, P= Packaging material, S= Storage interval, CD= Critical difference

Table 4. Effect of different packaging material and storage on sensory score (on 9 point hedonic scale) of pumpkin bar

Parameters	Packaging material	Storage interval (month)			Mean	CD _{0.05}
		0	3	6		
Colour score	LDPE	8.87	8.21	7.33	8.13	P=0.06
	PP Boxes	8.87	8.34	7.45	8.22	S=0.06
	ALP	8.87	8.54	7.92	8.44	S×P=0.11
	Mean	8.87	8.36	7.56		
Texture score	LDPE	8.42	7.32	6.34	7.36	P=0.09
	PP Boxes	8.42	7.43	6.89	7.58	S=0.09

Parameters	Packaging material	Storage interval (month)			Mean	CD _{0.05}
		0	3	6		
	ALP	8.42	8.16	7.55	8.04	S×P=0.16
	Mean	8.42	7.64	6.92		
Flavour score	LDPE	8.57	7.56	7.00	7.71	P=0.21
	PP Boxes	8.57	7.88	7.39	7.94	S=0.21
	ALP	8.57	8.20	7.98	8.25	S×P=0.37
	Mean	8.57	7.88	7.45		
Overall acceptability	LDPE	8.66	7.56	7.33	7.85	P=0.06
	PP Boxes	8.66	7.76	7.34	7.92	S=0.06
	ALP	8.66	8.27	8.03	8.32	S×P=0.11
	Mean	8.66	7.86	7.57		

Where, P= Packaging material, S= Storage interval, CD= Critical difference

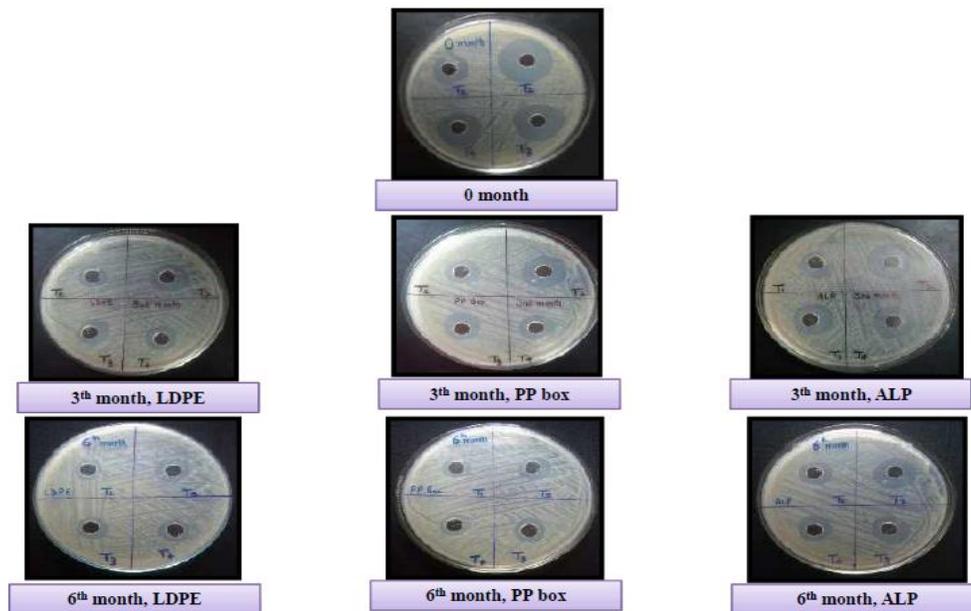


Fig. 1. Antimicrobial activity (mm) of pumpkin bar against *Staphylococcus aureus*

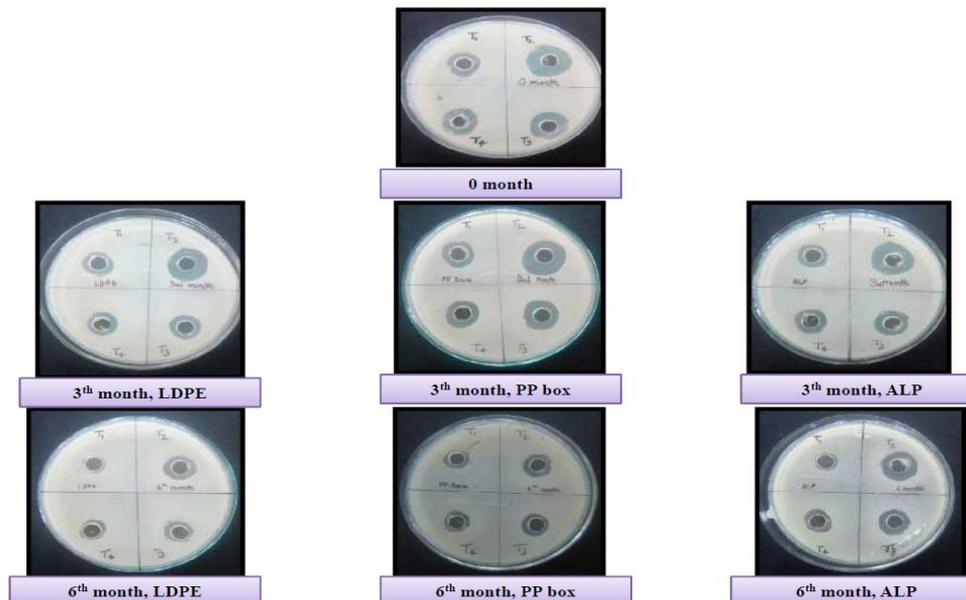


Fig. 2. Antimicrobial activity (mm) of pumpkin bar against *Escherichia coli*

and thereby inversion into reducing sugars. Total sugars were retained maximum in ALP while for reducing sugar LDPE was found to be best.

Pumpkin bar contain mean value of 6.6 mg/100 g for β -carotene and 4.46 mg/100 g for ascorbic acid during 6 months of storage. The decline in β -carotene might be due to the photosensitive nature, isomerization and epoxide forming nature of carotene and oxidative degradation of

carotenoids during storage. ALP was able to retain maximum content of both for β -carotene and ascorbic acid. The results for decreasing trend in β -carotene during storage has been supported by the findings of Manimegalai et al. [2] in jackfruit bar, Kaushal et al. [3] in seabuckthorn leather. A decrease in the mean antioxidant activity from 64.10 to 55.05 per cent in bar packed in Low Density Polyethylene (LDPE) pouches while decrease up to 56.05 and

58.09 per cent in Polypropylene boxes (PP) and Aluminium laminated pouches (ALP), respectively can be visualized for the results. Among different packaging material the mean maximum antioxidant activity was recorded in ALP (61.06%) and minimum was noticed in LDPE (59.37%). The decrease in antioxidant activity might be due to degradation of total phenolic compounds, vitamin C and carotenoids due to oxidation and other reactions during storage.

The mean antimicrobial activity against *Staphylococcus aureus* (Fig. 1) was found to decrease from 16.5 to 9.5, 11.0 and 12.8 mm in LDPE, PP box and ALP, respectively during storage. The mean decrease in antimicrobial activity against *Escherichia coli* (Fig. 2) was from 13.25 to 8.25, 9.25 and 11.25 mm in Low Density Polyethylene pouches (LDPE), Polypropylene boxes (PP) and Aluminium laminated pouches (ALP), respectively. The overall effect of storage period (S) on the antimicrobial activity of pumpkin bar indicated a decrease from 16.5 to 11.1 mm and 13.25 to 9.58 mm against *Staphylococcus aureus* and *Escherichia coli*, respectively. The decrease in antimicrobial activity of bar might be due to loss of volatile components present in bar during storage.

The data in Table 4 of sensory quality measured on 9-point-hedonic scale for pumpkin bar was liked very much by the panelist indicate that colour, texture, flavor and overall acceptability were 8.87, 8.42, 8.57 and 8.66, respectively at 0 month analysis. It is clear from the data that during three months storage, packaging material ALP was found to be best with maximum mean value 8.44, 8.04, 8.25 and 8.32, respectively. These findings are in accordance with the reports of Parekh et al. [21]; Shakoor et al. [24]; Kumar et al. [25]; Bhatt and Jha [26], respectively in mango bar, guava leather, papaya leather and wood apple fruit bar. Different workers have reported that the colour and leather taste of product were improved by the addition of sugar to the mango pulp while preparing mango leather. Heikal et al. [27] reported that flavor and texture of finished product can be improved by the addition of citric acid and pectin.

4. CONCLUSION

The study reveals that ripe pumpkin may be utilized for the development of good quality and nutritionally enriched fruit bar of remunerative cost. Furthermore, it was also observed that the

pumpkin bar can be stored safely under ambient condition with better retention of functional components. This work may also provide major contribution in the development of nutritious pumpkin bar at industrial scale level.

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COMPETING INTERESTS

Authors have declared that no competing interests exist.

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