Effect of TBHQ concentration on sensory qualityof banana peel based ‘sev’ in package materials.

Abstract

Present investigation was aimed to evaluate sensory quality of banana peel based ‘sev’ during storage. An experiment was set up with ten treatment combinations consisting of five different TBHQ concentrations and two different packing materials for the preparing of banana peel-based ‘sev.’ The prepared ‘sev’ was kept for five months in order to analyze the sensory characteristics every month. The investigation's findings showed that banana peel-based 'sev' that was frying in oil containing 150 ppm TBHQ and packaged in laminated aluminum bags showed little loss in color, taste, texture, flavor and overall acceptability. Overall research findings showed that banana peel-based ‘sev’ with improved sensory qualities could be made by frying ‘sev’ in sunflower oil containing 150 ppm TBHQ, then packing in laminated aluminum bags. The banana peel based ‘sev’ can be successfully stored for a period of 5 months with minimum changes in sensory quality

Keywords: Banana peel, TBHQ, Packaging, Peroxide

Introduction

Banana(*Musa paradisiaca* L.) is a monocotyledonous herbaceous perennial plant of the Scitamineae family. The plant is sometimes referred to as Kalpatharu, which means herb of endless uses. The fourth-most important food crop in the world and one of the most popular fruits, bananas and plantains are a staple food and export good in India as well (Ganapathi *et al*., 1999). Millions of people in underdeveloped nations benefit from it in terms of their ability to access food.

Despite being a major source of numerous functionally significant bioactive chemicals, banana peel is still underutilized and very little research has been done to determine its potential applications in food and nutraceuticals. Banana peel is rich source of dietary fiber (50% on a dry matter basis), protein (8-11%), crude fat (3.8-11%), lipid (2.2-10.9%), pectin, essentials amino acids (leucine, valine, phenylalanine and threonine), polyunsaturated fatty acids mainly (linoleic acid and α-linolenic acid) and micronutrients like potassium, phosphorous, calcium, magnesium *etc*. With the

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exception of lysine, the quantity of all essential amino acids is stated to be higher than FAO standards (Emaga *et al*., 2007).

Fruit peels have reportedly been shown to contain more gallocatechin than the actual fruit. The greater antioxidant benefits of the banana peel could be attributed to its higher gallocatechin concentration. At all stages of fruit ripening, the peel has higher total polyphenol and flavonoid levels than the fruit pulp. Similar to this, banana peel extracts have been shown to have a higher capacity to scavenge DPPH radicals, which is related to their increased antioxidant activity (Fatemeh *et al*., 2012).

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Consuming banana peel may aid in maintaining normal blood pressure and fluid balance in the body. Additionally, it aids in managing respiratory, cardiac and kidney issues (Anhwange, 2008). According to Feming (1998), banana peels contain an appropriate amount of iron for delivering oxygen to the cells, generating energy, synthesizing collagen, and maintaining healthy immunological, cellular growth, and cardiovascular systems.

There is a current need to produce more wholesome and affordable snacks due to the rise in demand and consumption of processed snack foods. Although 'sev' is a well-known snack food in many regions of the country, the product's high cost restricts the amount that can be produced. Chickpea flour's high cost as a raw material affects how much the completed product will ultimately cost. The peel produced during the processing of bananas might result in pollution issues if it is not managed properly, yet bananas are relatively less expensive. However, as was previously said, banana peels have a great deal of potential for use in the creation of snack meals because they are a rich source of numerous nutrients. Thus addition of peel in chick pea flour can overcome the limiting cost of the 'sev'.

Materials and method

Ten treatment combinations of five distinct levels of TBHQ (C_1- control, C_2- 50 ppm, C_3- 100 ppm, C_4- 150 ppm, and C_5- 200 ppm) and two levels of packaging material (P_1- polypropylene bag and P_2- aluminum laminated bag) were used in an experiment for banana peel-based 'sev'. The peel of the fresh, ripe banana was manually detached, immersed in a solution of 2% salt (NaCl) and 100 ppm ascorbic acid, then blanched in hot water for three minutes at 90 ^{o}C, followed by cooling in water for two minutes. To make the peel paste, the blanched peel was mashed in a blender. In accordance with the recipe, 70% chick pea flour was combined with additional ingredients to create the 'Sev' formulation used in the experiment. Every

item was placed in a stainless steel bowl and hand mixed with water. The amount of water supplied was regulated so that the finished kneaded dough maintained its malleability. Afterward, the dough was manually extruded over heated sunflower oil that contained several concentrations of TBHQ (control, 50 ppm, 100 ppm, 150 ppm, and 200 ppm) for frying at a temperature of 175±5 ^{o}C. When bubbling from the'sev' stops, the frying is thought to be finished. After frying, 'sev' samples were removed from the frying pan and kept in a different pan to let the excess oil to drain. The deep-fat fried 'sev' was cooled to room temperature before being packing in two types of packaging (polypropylene and laminated aluminum bags) and kept there. The main procedures for sev preparation are shown in Fig. 1.

Recipe for making 'sev': The recipe for the preparation of ripe banana peel based 'sev' comprised of 30 g ripe banana peel paste, 70 g chick pea flour (Besan), 2.5 g common salt, 1.5 g chilli powder, 0.75 g white pepper powder, 1.0 g turmeric powder, 2.5 g coriander powder and 5 ml edible oil.

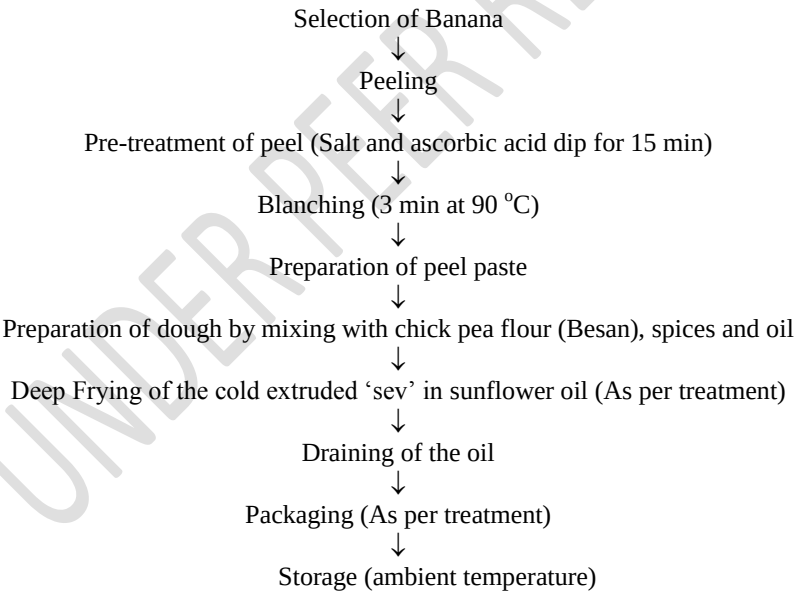

Fig 1: Principal steps used for preparation of banana peel based 'sev'

Results and Discussion

Colour

Interaction of TBHQ concentration and storage (Table 1) depicted variations in mean color score from 8.50 to 7.50, with decrease in color score from 8.50 to 7.50 in 'sev' fried in oil containing no TBHQ, 50, 100, 150 and 200 ppm TBHQ ($C_1S_1$to C_1S_6,C_2S_1 to C_2S_6,C_3S_1 to C_3S_6,C_4S_1 to C_4S_6 and C_5S_1 to C_5S_6).Interaction of packaging treatments and storagedepicted variations in meancolor during five months storage from initial value of 8.50 to 7.42, with minimum decrease from 8.50 (P_2S_1) to 7.58 (P_2S_6) in 'sev' packed in aluminium laminated bag and maximum decrease from 8.50 (P_1S_1) to 7.42 (P_1S_6) in 'sev' packed in polypropylene bag.

Further, interaction of TBHQ, packaging material and storage depicted variations of meancolor score in 'sev' during five month storage from initial value of 8.50 to 8.42, with minimum decrease (8.50 to 7.58) in 'sev' fried in oil using no TBHQ, 50, 100, 150 and 200 ppm TBHQ and packed in aluminium laminated bags ($C_1P_2S_1$to $C_1P_2S_6$,$C_2P_2S_1$to $C_2P_2S_6$,$C_3P_2S_1$to $C_3P_2S_6$,$C_4P_2S_1$to $C_4P_2S_6$and $C_5P_2S_1$to $C_5P_2S_6$) andmaximum decrease in color score (8.50 to 7.42) was found in 'sev' prepared by oil without TBHQ, 50, 100, 150 and 200 ppm TBHQwith polypropylene bags ($C_1P_1S_1$to $C_1P_1S_6$,$C_2P_1S_1$to $C_2P_1S_6$,$C_3P_1S_1$to $C_3P_1S_6$,$C_4P_1S_1$to $C_4P_1S_6$and $C_5P_1S_1$to $C_5P_1S_6$). Significant differences were observed for P×S interaction and non-significant differences were observed in color among interactions of C×P,C×S andC×P×S.The decrease in color score during storage might be attributed due to non-enzymetic reaction leads to browning of 'sev'. Decrease in colourduring storagewas earlier reportedby Wanna *et al*. (2002) for banana chips.

Table 1: Effect of different treatments on sensory score for colour of banana peel based 'sev' during storage

Storage (S)	Packaging materials (P)	Colour (9 point Hedonic scale)						
		Anti-oxidant concentrations (C)					Mean	Mean (P)
		C_1	C_2	C_3	C_4	C_5		
Initial (S_1)	P_1	8.50	8.50	8.50	8.50	8.50	8.50	**8.10**
	P_2	8.50	8.50	8.50	8.50	8.50	8.50	**8.17**
	Mean	**8.50**	**8.50**	**8.50**	**8.50**	**8.50**	**8.50**	
1Month (S_2)	P_1	8.42	8.42	8.42	8.42	8.42	8.42	
	P_2	8.42	8.42	8.42	8.42	8.42	8.42	
	Mean	**8.42**	**8.42**	**8.42**	**8.42**	**8.42**	**8.42**	
2Month (S_3)	P_1	8.33	8.33	8.33	8.33	8.33	8.33	
	P_2	8.42	8.42	8.42	8.42	8.42	8.42	
	Mean	**8.38**	**8.38**	**8.38**	**8.38**	**8.37**	**8.38**	
3Month (S_4)	P_1	8.08	8.08	8.08	8.08	8.08	8.08	
	P_2	8.17	8.17	8.17	8.17	8.17	8.17	

	Mean	**8.12**	**8.12**	**8.13**	**8.13**	**8.12**	**8.12**	
4Month (S_5)	P_1	7.83	7.83	7.83	7.83	7.83	7.83	
	P_2	7.92	7.92	7.92	7.92	7.92	7.92	
	Mean	**7.88**	**7.88**	**7.87**	**7.87**	**7.87**	**7.87**	
5Month (S_6)	P_1	7.42	7.42	7.42	7.42	7.42	7.42	
	P_2	7.58	7.58	7.58	7.58	7.58	7.58	
	Mean	**7.50**	**7.50**	**7.50**	**7.50**	**7.50**	**7.50**	
Mean (C)		**8.13**	**8.13**	**8.13**	**8.13**	**8.13**		
S.Em.±	C	P	C×P	S	C×S	P×S	C×P×S	
	0.018	0.011	0.025	0.017	0.038	0.024	0.054	
CD at 5%	NS	0.034	NS	0.048	NS	0.068	NS	
CV %	1.35			1.15				

Texture

Interaction of TBHQ concentration and storage (Table 2) depictedvariations in mean texture score from 8.78 to 7.80, with minimum decrease in texture score from 8.78 to 7.90 in 'sev' fried in oil containing150 ppm TBHQ (C_4S_1 to C_4S_6), whereas maximum decrease in texture (8.78to 7.80) in 'sev' fried in oil containing no TBHQ (C_1S_1 to C_1S_6).Interaction ofpackaging treatments and storage depicted variations in mean texture during five months storage from initial value of 8.78 to 7.78, with minimum decrease from 8.78 (P_2S_1) to 7.94 (P_2S_6) in 'sev' packed in aluminium laminated bag and maximum decrease from 8.78 (P_1S_1) to 7.78 (P_1S_6) in 'sev' packed in polypropylene bag.

Table 2: Effect of different treatments on sensory score for texture of banana peel based 'sev' during storage

Storage (S)	**Packaging materials (P)**	**Texture (9 point Hedonic scale)**						
		Anti-oxidant concentrations (C)					**Mean**	**Mean (P)**
		C_1	**C_2**	**C_3**	**C_4**	**C_5**		
Initial (S_1)	P_1	8.78	8.78	8.78	8.78	8.78	8.78	**8.28**
	P_2	8.78	8.78	8.78	8.78	8.78	8.78	**8.38**
	Mean	**8.78**	**8.78**	**8.78**	**8.78**	**8.78**	**8.78**	
1Month (S_2)	P_1	8.60	8.60	8.60	8.60	8.60	8.60	
	P_2	8.66	8.66	8.66	8.66	8.66	8.66	
	Mean	**8.63**	**8.63**	**8.63**	**8.63**	**8.63**	**8.63**	
2Month (S_3)	P_1	8.35	8.35	8.37	8.40	8.40	8.37	
	P_2	8.50	8.50	8.50	8.50	8.50	8.50	
	Mean	**8.42**	**8.43**	**8.44**	**8.45**	**8.45**	**8.44**	
3Month (S_4)	P_1	8.10	8.12	8.15	8.15	8.15	8.13	
	P_2	8.28	8.20	8.30	8.28	8.30	8.27	
	Mean	**8.19**	**8.16**	**8.22**	**8.22**	**8.22**	**8.20**	
4Month (S_5)	P_1	8.00	8.03	8.05	8.08	8.05	8.04	
	P_2	8.13	8.13	8.13	8.16	8.13	8.14	
	Mean	**8.07**	**8.08**	**8.09**	**8.12**	**8.09**	**8.09**	

5Month (S_6)	P_1	7.70	7.75	7.80	7.82	7.82	7.78	
	P_2	7.90	7.92	7.95	7.97	7.97	7.94	
	Mean	**7.80**	**7.84**	**7.87**	**7.90**	**7.89**	**7.86**	
Mean (C)		**8.32**	**8.32**	**8.34**	**8.35**	**8.34**		
S.Em.±	C	P	C×P	S	C×S	P×S	C×P×S	
	0.020	0.012	0.028	0.017	0.038	0.024	0.054	
CD at 5%	NS	0.037	NS	0.047	NS	0.067	NS	
CV %	1.42			1.11				

Further, interaction of TBHQ, packaging material and storage depicted variations of meantexture score in 'sev' during five month storage from initial value of 8.78 to 7.70, with minimum decrease (8.78 to 7.97) in 'sev' fried in oil using 150 and 200 ppm TBHQ and packed in aluminium laminated bags ($C_4P_2S_1$to $C_4P_2S_6$and $C_5P_2S_1$to $C_5P_2S_6$) and maximum decrease in texture score (8.78 to 7.70) was found in 'sev' prepared by oil using without TBHQ with polypropylene bags ($C_1P_1S_1$to $C_1P_1S_6$). Significant differences were observed for P×S interaction and non-significant differences were observed in texture among interactions of C×P,C×S andC×P×S. The decrease in texture score during storage might beattributed due to an increase in the moisture content in the 'sev' (Tiwari andJha.,2017). Decrease in texture during storage was earlier reported by Singh *et al*. (2011) for chicken snacks.

Taste

Interaction of TBHQ concentration and storage (Table 3) depicted variations in mean taste score from 9.00 to 4.12, with minimum decrease in taste score from 8.50 to 6.85 in 'sev' fried in oil containing200 ppm TBHQ (C_5S_1 to C_5S_6), whereas maximum decrease in taste (9.00to 4.12) in 'sev' fried in oil containing no TBHQ (C_1S_1 to C_1S_6).Interaction of packaging treatments and storage depicted variations in meantaste during five months storage from initial value of 8.80 to 5.32, with minimum decrease from 8.80 (P_2S_1) to 5.45 (P_2S_6) in 'sev' packed in aluminium laminated bag and maximum decrease from 8.80 (P_1S_1) to 5.32 (P_1S_6) in 'sev' packed inpolypropylene bag.

Table 3: Effect of different treatments on sensory score for taste of banana peel based 'sev' during storage

Storage (S)	**Packaging materials (P)**	**Taste (9 point Hedonic scale)**						
		Anti-oxidant concentrations (C)					**Mean**	**Mean (P)**
		C_1	**C_2**	**C_3**	**C_4**	**C_5**		
Initial (S_1)	P_1	9.00	8.91	8.83	8.75	8.50	8.80	**7.38**
	P_2	9.00	8.91	8.83	8.75	8.50	8.80	**7.46**
	Mean	**9.00**	**8.91**	**8.83**	**8.75**	**8.50**	**8.80**	

1Month (S_2)	P_1	8.75	8.83	8.78	8.75	8.48	8.72	
	P_2	8.75	8.83	8.78	8.75	8.48	8.72	
	Mean	**8.75**	**8.83**	**8.78**	**8.75**	**8.48**	**8.72**	
2Month (S_3)	P_1	7.67	7.72	7.80	8.70	8.43	8.06	
	P_2	7.67	7.75	8.86	8.72	8.45	8.29	
	Mean	**7.67**	**7.73**	**8.33**	**8.71**	**8.44**	**8.18**	
3Month (S_4)	P_1	6.44	6.50	6.68	8.61	8.35	7.32	
	P_2	6.47	6.56	6.73	8.67	8.40	7.37	
	Mean	**6.46**	**6.53**	**6.70**	**8.64**	**8.38**	**7.34**	
4Month (S_5)	P_1	4.36	4.45	5.86	7.80	7.72	6.04	
	P_2	4.45	4.55	5.91	7.89	7.80	6.12	
	Mean	**4.41**	**4.50**	**5.79**	**7.85**	**7.76**	**6.08**	
5Month (S_6)	P_1	4.08	4.22	4.72	6.84	6.76	5.32	
	P_2	4.16	4.30	4.83	7.03	6.94	5.45	
	Mean	**4.12**	**4.26**	**4.78**	**6.93**	**6.85**	**5.39**	
Mean (C)		**6.73**	**6.79**	**7.22**	**8.27**	**8.07**		
S.Em.±	C	P	C×P	S	C×S	P×S	C×P×S	
	0.020	0.013	0.029	0.019	0.043	0.027	0.061	
CD at 5%	0.060	0.038	0.085	0.053	0.119	0.076	0.170	
CV %	1.65			1.42				

Further, interaction of TBHQ, packaging material and storage depicted variations of meantaste score in 'sev' during five month storage from initial value of 9.00 to 4.08, with minimum decrease (8.50 to 6.94) in 'sev' fried in oil using 200 ppm TBHQ and packed in aluminium laminated bags ($C_5P_2S_1$to $C_5P_2S_6$) and maximum decrease in taste score (9.00 to 4.08) was found in 'sev' prepared by oil without TBHQ with polypropylene bags ($C_1P_1S_1$to $C_1P_1S_6$). Significant differences were observed for P×S, C×S, C×PandC×P×S interactions.The decrease in taste score during storage might be attributed due to increase of peroxide value during storage (Jaswir *et al.*, 2000). Decrease in taste during storage was earlier reported by Butt *et al*. (2003) for breakfast cereals.

Table 4: Effect of different treatments on sensory score for flavour of banana peel based 'sev' during storage

Storage (S)	**Packaging materials (P)**	**Flavour (9 point Hedonic scale)**						
		Anti-oxidant concentrations (C)					**Mean**	**Mean (P)**
		C_1	**C_2**	**C_3**	**C_4**	**C_5**		
Initial (S_1)	P_1	8.75	8.75	8.75	8.75	8.75	8.75	**7.42**
	P_2	8.75	8.75	8.75	8.75	8.75	8.75	**7.48**
	Mean	**8.75**	**8.75**	**8.75**	**8.75**	**8.75**	**8.75**	
1Month (S_2)	P_1	8.56	8.62	8.73	8.74	8.75	8.68	
	P_2	8.69	8.70	8.67	8.70	8.69	8.69	
	Mean	**8.63**	**8.66**	**8.70**	**8.72**	**8.72**	**8.69**	
2Month (S_3)	P_1	7.47	7.58	8.65	8.71	8.72	8.23	
	P_2	7.61	7.67	8.67	8.73	8.73	8.28	
	Mean	**7.54**	**7.63**	**8.66**	**8.72**	**8.73**	**8.26**	

3Month (S_4)	P_1	7.04	7.08	7.79	8.02	8.02	7.59	
	P_2	7.02	7.07	7.97	8.23	8.22	7.70	
	Mean	**7.03**	**7.08**	**7.88**	**8.12**	**8.12**	**7.65**	
4Month (S_5)	P_1	5.06	5.07	6.29	7.32	7.32	6.21	
	P_2	5.00	5.04	6.53	7.55	7.55	6.33	
	Mean	**5.03**	**5.06**	**6.41**	**7.43**	**7.44**	**6.27**	
5Month (S_6)	P_1	3.83	3.82	5.19	6.22	6.22	5.06	
	P_2	3.88	3.89	5.24	6.28	6.28	5.11	
	Mean	**3.86**	**3.86**	**5.22**	**6.25**	**6.25**	**5.09**	
Mean (C)		**6.80**	**6.84**	**7.60**	**8.00**	**8.00**		
S.Em.±	C	P	C×P	S	C×S	P×S	C×P×S	
	0.013	0.008	0.018	0.016	0.035	0.022	0.050	
CD at 5%	0.038	0.023	NS	0.044	0.099	0.062	0.140	
CV %	1.04			1.16				

Flavour

Interaction of TBHQ concentration and storage (Table 4) depictedvariations in mean flavour score from 8.75 to 3.86, with minimum decrease in flavour score from 8.75 to 6.25 in 'sev' fried in oil containing150 and 200 ppm TBHQ (C_4S_1 to C_4S_6 and C_5S_1 to C_5S_6), whereas maximum decrease in flavour (8.75to 3.86) in 'sev' fried in oil containing no TBHQ and 50 ppm TBHQ (C_1S_1 to C_1S_6 and C_2S_1 to C_2S_6).Interaction of packaging treatments and storage depicted variations in mean flavour during five months storage from initial value of 8.75 to 5.06, with minimum decrease from 8.75 (P_2S_1) to 5.11 (P_2S_6) in 'sev' packed in aluminium laminated bag and maximum decrease from 8.75 (P_1S_1) to 5.06 (P_1S_6) in 'sev' packed in polypropylene bag.

Table 5: Effect of different treatments on sensory score for overall acceptability of banana peel based 'sev' during storage

Storage (S)	**Packaging materials (P)**	**Overall acceptability (9 point Hedonic scale)**						
		Anti-oxidant concentrations (C)					**Mean**	**Mean (P)**
		C_1	**C_2**	**C_3**	**C_4**	**C_5**		
Initial (S_1)	P_1	8.76	8.73	8.71	8.70	8.63	8.71	**7.79**
	P_2	8.76	8.73	8.72	8.70	8.63	8.71	**7.87**
	Mean	**8.76**	**8.73**	**8.72**	**8.70**	**8.63**	**8.71**	
1Month (S_2)	P_1	8.59	8.63	8.63	8.62	8.55	8.60	
	P_2	8.62	8.65	8.64	8.64	8.57	8.62	
	Mean	**8.61**	**8.64**	**8.63**	**8.63**	**8.56**	**8.61**	
2Month (S_3)	P_1	7.96	8.00	8.28	8.53	8.47	8.25	
	P_2	8.04	8.08	8.62	8.60	8.53	8.37	
	Mean	**8.00**	**8.04**	**8.45**	**8.56**	**8.50**	**8.31**	
3Month (S_4)	P_1	7.40	7.44	7.68	8.22	8.16	7.78	
	P_2	7.49	7.51	7.79	8.33	8.27	7.88	
	Mean	**7.45**	**7.47**	**7.73**	**8.28**	**8.21**	**7.83**	
4Month	P_1	6.30	6.33	7.02	7.77	7.74	7.03	

(S_5)	P_2	6.39	6.42	7.12	7.87	7.84	7.13	
	Mean	**6.35**	**6.38**	**7.07**	**7.82**	**7.79**	**7.08**	
5Month (S_6)	P_1	5.76	5.81	6.28	7.07	7.05	6.39	
	P_2	5.88	5.92	6.40	7.21	7.19	6.52	
	Mean	**5.82**	**5.86**	**6.34**	**7.14**	**7.12**	**6.46**	
Mean (C)		**7.50**	**7.52**	**7.82**	**8.19**	**8.14**		
S.Em.±	C	P	C×P	S	C×S	P×S	C×P×S	
	0.008	0.005	0.012	0.009	0.020	0.012	0.028	
CD at 5%	0.025	0.016	NS	0.025	0.056	0.035	NS	
CV %	0.70			0.61				

Further, interaction of TBHQ, packaging material and storage depicted variations of meanflavour score in 'sev' during five month storage from initial value of 8.75 to 3.82, with minimum decrease (8.75 to 6.28) in 'sev' fried in oil using 150 and 200 ppm TBHQ and packed in aluminium laminated bags ($C_4P_2S_1$to $C_4P_2S_6$and $C_5P_2S_1$to $C_5P_2S_6$) and maximum decrease in flavour score (8.75 to 3.82) was found in 'sev' prepared by oil contains 50ppm TBHQ with polypropylene bags ($C_2P_1S_1$to $C_2P_1S_6$). Significant differences were observed for P×S, C×S andC×P×S interaction and non-significant differences were observed in flavour among interaction of C×P.The decrease in flavor score during storage might be due to development of lipid oxidation during storage (Rababah *et al.*, 2011). Decrease in flavore during storage was earlier reported by Pernille (1989) for potato flakes.

Overall acceptability

Interaction of TBHQ concentration and storage (Table 5)depictedvariations in mean overall acceptability score from 8.76 to 5.82, with minimum decrease in overall acceptability score from 8.63 to 7.12 in 'sev' fried in oil containing200 ppm TBHQ (C_5S_1 to C_5S_6), whereas maximum decrease in overall acceptability (8.76to 5.82) in 'sev' fried in oil containing no TBHQ (C_1S_1 to C_1S_6).Interaction of packaging treatments and storage depicted variations in mean overall acceptability during five months storage from initial value of 8.71 to 6.39, with minimum decrease from 8.71 (P_2S_1) to 6.52(P_2S_6) in 'sev' packed in aluminium laminated bag and maximum decrease from 8.71 (P_1S_1) to 6.39 (P_1S_6) in 'sev' packed in polypropylene bag.

Further, interaction of TBHQ, packaging material and storage depicted variations of meanoverall acceptability scorein 'sev' during five month storage from initial value of 8.76 to 5.76, with minimum decrease (8.63 to 7.19) in 'sev' fried in oil using 200 ppm TBHQ and packed in aluminium laminated bags ($C_5P_2S_1$to $C_5P_2S_6$)

and maximum decrease in overall acceptability score (8.76 to 5.76) was found in 'sev' prepared by oil without TBHQ with polypropylene bags ($C_1P_1S_1$to $C_1P_1S_6$). Significant differences were observed for P×S and C×S interaction and non-significant differences were observed in overall acceptability among interactions of C×P andC×P×S.Similar observations were reported by Allam *et al*. (2015) for rice based snacks, Butt *et al*. (2003) for breakfast cereals, Pawase*et al*. (2019) for mix fruit bar and Raj and Lal (2008) for potato chips.

'L' value

Interaction of TBHQ concentration and storage (Table 6) depicted variations in mean 'L' value from 59.38 to 56.16, with minimum decrease in 'L' value from 59.38 to 56.18 in 'sev' fried in oil containing150 ppm TBHQ (C_4S_1 to C_4S_6), whereas maximum decrease in 'L' value (56.38 to 56.16) in 'sev' fried in oil containing 50 ppm TBHQ (C_2S_1 to C_2S_6).Interaction of packaging treatments and storage depicted variations in mean'L' value during five months storage from initial value of 59.37 to 55.54, with minimum decrease from 59.37 (P_2S_1) to 56.80 (P_2S_6) in 'sev' packed in aluminium laminated bag and maximum decrease from 59.37 (P_1S_1) to 55.54 (P_1S_6) in 'sev' packed in polypropylene bag.

Table 6: Effect of different treatments on 'L' value of banana peel based 'sev' during storage

Storage (S)	Packaging materials (P)	'L' Value						
		Anti-oxidant concentrations (C)					Mean	Mean (P)
		C_1	C_2	C_3	C_4	C_5		
Initial (S_1)	P_1	59.37	59.38	59.37	59.37	59.38	59.37	**57.72**
	P_2	59.37	59.37	59.38	59.37	59.37	59.37	**58.42**
	Mean	**59.37**	**59.38**	**59.38**	**59.37**	**59.38**	**59.37**	
1Month (S_2)	P_1	59.19	59.18	59.20	59.19	59.20	59.19	
	P_2	59.22	59.21	59.24	59.24	59.23	59.23	
	Mean	**59.21**	**59.20**	**59.22**	**59.22**	**59.22**	**59.21**	
2Month (S_3)	P_1	58.32	58.35	58.34	58.36	58.33	58.34	
	P_2	58.91	58.92	58.91	58.93	58.92	58.92	
	Mean	**58.62**	**58.64**	**58.63**	**58.65**	**58.62**	**58.63**	
3Month (S_4)	P_1	57.30	57.29	57.31	57.30	57.32	57.30	
	P_2	58.44	58.45	58.43	58.45	58.44	58.44	
	Mean	**57.87**	**57.87**	**57.87**	**57.88**	**57.88**	**57.87**	
4Month (S_5)	P_1	56.52	56.56	56.55	56.58	56.56	56.56	
	P_2	57.78	57.76	57.78	57.77	57.77	57.77	
	Mean	**57.15**	**57.16**	**57.16**	**57.18**	**57.17**	**57.16**	
5Month (S_6)	P_1	55.50	55.54	55.55	55.57	55.54	55.54	
	P_2	56.82	56.78	56.80	56.79	56.79	56.80	
	Mean	**56.16**	**56.16**	**56.18**	**56.18**	**56.17**	**56.17**	

Mean (C)		58.06	58.07	58.07	58.08	58.07		
S.Em.±	C	P	C×P	S	C×S	P×S	C×P×S	
	0.144	0.091	0.204	0.178	0.398	0.251	0.562	
CD at 5%	NS	0.269	NS	0.498	NS	0.704	NS	
CV %	1.48			1.68				

Further, interaction of TBHQ, packaging material and storage depicted variations of mean'L' value in 'sev' during five month storage from initial value of 59.38 to 55.50, with minimum decrease (59.37 to 56.82) in 'sev' fried in oil using no TBHQ and packed in aluminium laminated bags ($C_1P_2S_1$and$C_1P_2S_6$) and maximum decrease in 'L' value (59.37 to 55.50) was found in 'sev' prepared by oil without TBHQ with polypropylene bags ($C_1P_1S_1$ and $C_1P_1S_6$). Significant differences wereobserved for P×S interaction and non-significant differences were observed in 'L' value among interactions of C×P, C×S and C×P×S.The decrease in 'L' value content during storage might be dueto change in water-vapor transmitivityof packaging materials with the increase in relative humidity of air by which the color pigments were subjected to losses in their brightness (Swain *et al.* 2013). Similar observations were reported by Kruger *et al*. (1998) and Tiboonbun *et al.* (2011) for noodle, Saifullah *et al*. (2009) for banana peel based noodle and Allam *et al*. (2015) for rice based snacks.

'a' value

Interaction of TBHQ concentration and storage (Table 7) depictedvariations in mean 'a' value from 12.16 to 13.46, with minimum increase in 'a' value from 12.18 to 12.36 in 'sev' fried in oil containing 200 ppm TBHQ (C_5S_1 to C_5S_6), whereas maximum increase in 'a' value (1.17 to 13.46) in 'sev' fried in oil containing no TBHQ (C_1S_1 to C_1S_6).Interaction of packaging treatments and storage depicted variations in mean'a' value during five months storage from initial value of 12.17 to 13.70, with minimum increase from 12.17 (P_2S_1) to 13.15 (P_2S_6) in 'sev' packed in aluminium laminated bag and maximum increase from 12.17 (P_1S_1) to 13.70 (P_1S_6) in 'sev' packed in polypropylene bag.

Further, interaction of TBHQ, packaging material and storage depicted variations of mean'a' value in 'sev' during five month storage from initial value of 12.16 to 13.75, with minimum increase (12.17 to 13.14 and12.18 to 13.15) in 'sev' fried in oil using 150 and 200 ppm TBHQ and packed in aluminium laminated bags ($C_4P_2S_1$to$C_4P_2S_6$and $C_5P_2S_1$to$C_5P_2S_6$) and maximum increase in 'a' value (12.17 to

13.75) was found in 'sev' prepared by oil without TBHQ withpolypropylene bags ($C_1P_1S_1$to$C_1P_1S_6$). Significant differences were observed for P×S interaction and non-significant differences were observed in 'a' value among interactions of C×P, C×S and C×P×S. The increase in 'a' value content during storage in the present investigation are in linewith the observation reported by Irwandi *et al*. (1998) for durian fruit leather, Sonia *et al.* (2015) for banana chips and George *et al.*(2011) for potato crisps.The increase in 'a' value content during storage might be due to change in water-vapor transmitivity of packaging materials with the increase in relative humidity of air by whichthe color pigments were subjected to losses in their yellowness(Swain *et al*. 2013). Increase in'a' value during storage was earlier reported by Swain *et al*. (2013) for dried capsicum slices.Almost similar observations were also documented by Irwandi *et al*. (1998) for durian fruit leather.

Table 7: Effect of different treatments on 'a' value of banana peel based 'sev' during storage

Storage (S)	Packaging materials (P)	'a' Value						
		Anti-oxidant concentrations (C)					Mean	Mean (P)
		C_1	C_2	C_3	C_4	C_5		
Initial (S_1)	P_1	12.17	12.16	12.16	12.17	12.18	12.17	**12.94**
	P_2	12.17	12.16	12.16	12.17	12.18	12.17	**12.75**
	Mean	**12.17**	**12.16**	**12.16**	**12.17**	**12.18**	**12.17**	
1Month (S_2)	P_1	12.67	12.65	12.66	12.67	12.66	12.66	
	P_2	12.56	12.56	12.57	12.57	12.56	12.56	
	Mean	**12.62**	**12.60**	**12.62**	**12.62**	**12.61**	**12.61**	
2Month (S_3)	P_1	12.95	12.90	12.89	12.89	12.91	12.91	
	P_2	12.74	12.73	12.72	12.70	12.70	12.72	
	Mean	**12.84**	**12.81**	**12.80**	**12.80**	**12.81**	**12.81**	
3Month (S_4)	P_1	13.09	13.08	12.05	13.04	13.04	12.86	
	P_2	12.90	12.86	12.87	12.85	12.85	12.87	
	Mean	**12.10**	**12.97**	**12.46**	**12.94**	**12.94**	**12.86**	
4Month (S_5)	P_1	13.38	13.35	13.34	13.34	13.33	13.35	
	P_2	13.07	13.06	13.05	13.04	13.06	13.06	
	Mean	**13.23**	**13.21**	**13.20**	**13.19**	**13.20**	**13.20**	
5Month (S_6)	P_1	13.75	13.73	13.69	13.68	13.67	13.70	
	P_2	13.18	13.15	13.14	13.14	13.15	13.15	
	Mean	**13.46**	**13.44**	**13.42**	**13.41**	**13.41**	**13.43**	
Mean (C)		**12.89**	**12.87**	**12.78**	**12.86**	**12.86**		
S.Em.±	C	P	C×P	S	C×S	P×S	C×P×S	
	0.039	0.025	0.055	0.048	0.107	0.068	0.152	
CD at 5%	NS	0.073	NS	0.134	NS	0.189	NS	
CV %	1.83			2.04				

'b' value

Interaction of TBHQ concentration and storage (Table 8) depictedvariations in mean 'b' value from 54.61 to 51.65, with minimum decrease in 'b' value from 54.60 to 51.67 in 'sev' fried in oil containing 150 ppm TBHQ (C_4S_1 to C_4S_6), whereas maximum decrease in 'b' value (54.61 to 51.65 and 54.61 to 51.66) in 'sev' fried in oil containing 50 ppm TBHQ (C_2S_1 to C_2S_6).Interaction of packaging treatments and storage depicted variations in mean'b' value during five months storage from initial value of 54.60 to 51.08, with minimum decrease from 54.60 (P_2S_1) to 52.23 (P_2S_6) in 'sev' packed in aluminium laminated bag and maximum decrease from 54.60 (P_1S_1) to 52.23 (P_1S_6) in 'sev' packed in polypropylene bag.

Further, interaction of TBHQ, packaging material and storage depicted variations of mean'b' value in 'sev' during five month storage from initial value of 54.61 to 50.13, with minimum decrease (54.60 to 53.16) in 'sev' fried in oil using no TBHQ and packed in aluminium laminated bags ($C_1P_2S_1$to$C_1P_2S_6$) and maximum decrease in 'b' value (54.60 to 50.13)was found in 'sev' prepared by oil without TBHQ with polypropylene bags ($C_1P_1S_1$to$C_1P_1S_6$). Significant differences were observed for P×S and P×C×S interaction and non-significant differences were observed in 'b' value among interactions of C×P and C×S. Significant differences were observed in 'b' value among interactions of C×P and C×S.The decrease in 'b' value during storage might be due to change in water-vapor transmitivity of packaging materials with the increase in relative humidity of air by which the color pigments were subjected to losses in their yellowness (Swain *et al*. 2013). Similar observations were reported by Saifullah *et al.* (2009) for banana peel based noodle, Petitot *et al*. (2009) for pasta, Kihong *et al.* (2014) for noodle and Wanna *et al.* (2002)for banana chips.

Table 8: Effect of different treatments on 'b' value of banana peel based 'sev' during storage

Storage (S)	Packaging materials (P)	'b' Value						
		Anti-oxidant concentrations (C)					Mean	Mean (P)
		C_1	C_2	C_3	C_4	C_5		
Initial (S_1)	P_1	54.60	54.61	54.60	54.60	54.61	54.60	**53.08**
	P_2	54.60	54.60	54.61	54.60	54.60	54.60	**53.73**
	Mean	**54.60**	**54.61**	**54.61**	**54.60**	**54.61**	**54.60**	
1Month (S_2)	P_1	54.92	54.59	54.30	53.89	54.47	54.43	
	P_2	53.97	54.29	54.62	55.02	54.44	54.47	

	Mean	**54.45**	**54.44**	**54.46**	**54.46**	**54.46**	**54.45**	
2Month (S_3)	P_1	53.76	53.69	53.82	53.67	53.21	53.65	
	P_2	54.05	54.16	54.01	54.20	54.52	54.19	
	Mean	**53.90**	**53.93**	**53.92**	**53.94**	**53.92**	**53.92**	
3Month (S_4)	P_1	53.09	52.15	52.99	52.36	52.93	52.70	
	P_2	53.35	54.29	53.46	54.09	53.52	53.74	
	Mean	**53.22**	**53.22**	**53.23**	**53.23**	**53.22**	**53.22**	
4Month (S_5)	P_1	51.52	52.29	51.82	52.35	52.07	52.01	
	P_2	53.59	52.86	53.33	52.81	53.07	53.13	
	Mean	**52.56**	**52.57**	**52.58**	**52.58**	**52.57**	**52.57**	
5Month (S_6)	P_1	50.13	51.20	51.21	51.80	51.06	51.08	
	P_2	53.16	52.10	52.12	51.54	52.25	52.23	
	Mean	**51.65**	**51.65**	**51.67**	**51.67**	**51.66**	**51.66**	
Mean (C)		**53.40**	**53.40**	**53.41**	**53.41**	**53.41**		
S.Em.±	C	P	C×P	S	C×S	P×S	C×P×S	
	0.145	0.092	0.205	0.130	0.290	0.183	0.409	
CD at 5%	NS	0.270	NS	0.362	NS	0.513	1.145	
CV %	1.63			1.33				

Conclusion

It can be concluded that ripe banana peel based 'sev' can be prepared by frying in sunflower oil containing 150 ppm TBHQ and packed in 400 gauge aluminium laminated bags to have better storage stability upto 5 month. The 'sev' prepared from the above treatment combination, possess higher sensory quality attributes, 'L' value, 'b' value and lower 'a' value during storage. Thus, the developed technology can commercially be adopted by food processing industry for the production of 'sev' by utilizing banana peel.

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