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Effect of anti-oxidant and packaging material on the quality of banana [*Musa paradisiaca* L.] peel based 'Sev'

Gohil Mehul M, Dev Raj, JM Mayani and AK Pandey

Abstract
Present investigation entitled effect of anti-oxidant and packaging material on the quality of banana [*Musa paradisiacal* L.] peel based sev' was aimed to evaluate nutritive quality of banana peel based 'sev' during storage. For preparation of banana peel based 'sev', an experiment was laid out with ten treatment combinations comprised of five different levels of TBHQ as anti-oxidant (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- Aluminium laminated bag). The prepared 'sev' was stored for a period of 5 month to analyse the quality attributes at monthly intervals. The results of the investigation revealed that banana peel based 'sev' fried in oil using 150 ppm TBHQ and packed in aluminium laminated bags observed to have minimum increase of peroxide value, moisture and NEB. Overall findings of investigation also revealed that banana peel based 'sev' possess better nutritional attributes can be prepared by frying 'sev' in sunflower oil containing 150 ppm TBHQ followed by packing in aluminium laminated bag. The banana peel based 'sev' can be successfully stored for a period of 5 months with minimum changes in physico-chemical quality.

Keywords: Banana peel, TBHQ, packaging, peroxide

Introduction
Banana (*Musa paradisiaca* L.) is a herbaceous perennial monocotyledonous plant, belonging to family Musaceae of order Scitamineae. The plant is also known as *Kalpatharu*, meaning herb with all imaginable uses. Banana and plantains, one of the most favorite fruits, widely grown in many countries, being the fourth most important food crop in the world as well as in India is a staple food and export commodity (Ganapathi *et al.*, 1999) [12]. It contributes to the food security of millions of people in the developing world.

Banana peel being an key source of many functionally important bioactive compounds are still underutilized and very little scientific effort has been put to identify its functionality in terms of application to 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*. The quantity of all essential amino acids is reported higher than FAO standard except for lysine (Emaga *et al.*, 2007) [9].

Gallocatechin content found in fruit peel has been reported to be in higher amount than in fruit. The higher gallocatechin content of the banana peel may account for the better antioxidant effects. Total polyphenols and flavonoids contents of the peel are higher as compared to the fruit pulp at all stages of fruit ripening. Similarly, the ability of banana peel extracts to scavenge DPPH radicals reported higher which is associated with the stronger antioxidant activity (Fatemeh *et al.*, 2012) [10].

The consumption of banana peel may help in the regulation of body fluids and maintained normal blood pressure. It also helps in control kidney, heart and respiratory problem (Anhwange, 2008) [4]. Feming (1998) [11] has state that the percentage of iron content in banana peel is an ideal source for carrying oxygen to the cells and production of energy, synthesis of collagen and for proper functioning of the immune system, cell growth and heart.

Nowadays owing to increased demand and consumption of processed snack food, there is a need to increase production of more nutritious and cost effective snacks. Although, 'sev' is an established snack food in various parts of the country but high cost of the product is a limiting factor in its production. The high cost of the raw material, *i.e*. Chick pea flour contributes towards final cost of the finished product. The bananas are comparatively cheaper and the peel generated during the processing of banana can cause pollution problem if not handled properly. However, as discussed earlier, banana peel being rich source of various nutrients, possess great potential for its utilization in the preparation of snack foods. Thus addition of peel in chick pea flour can overcome the limiting cost of the 'sev'.

Materials and method

An experiment was conducted for banana peel based 'sev' with ten treatment combinations comprised of five different 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- Aluminium laminated bag). The fresh, ripe banana were washed with water and then peel was separated manually and dipped in a solution of 2% salt (NaCl) and 100 ppm ascorbic acid followed by blanching of peel in hot water for 3 minutes at 90 ^oC and cooled in water for 2 minutes. The blanched peel was mashed in a mixer blender to obtain the peel paste. 'Sev' formulation for the experiment were prepared by addition of banana peel paste, salt, chilli powder and other ingredients into 70% chick pea flour as shown in recipe. All the ingredients were taken in stainless steel and kneaded manually by addition of water. The quantity of water added was adjusted to such a level that finally kneaded dough remained pliable. The dough was then extruded manually directly over hot sunflower oil containing different concentration of TBHQ (control, 50 ppm, 100 ppm, 150 ppm and 200 ppm) for frying at a temperature of 175±5 ^oC. Frying was considered complete when bubbling from the 'sev' ceases. After frying sample of 'sev' were taken out of frying pan and kept in separate pan to allow draining of excess oil. The deep fat fried 'sev' were brought to room temperature and then packed in two different packaging materials (polypropylene and aluminum laminated bags) and stored at room temperature. Principal steps used for powder preparation are illustrated 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.

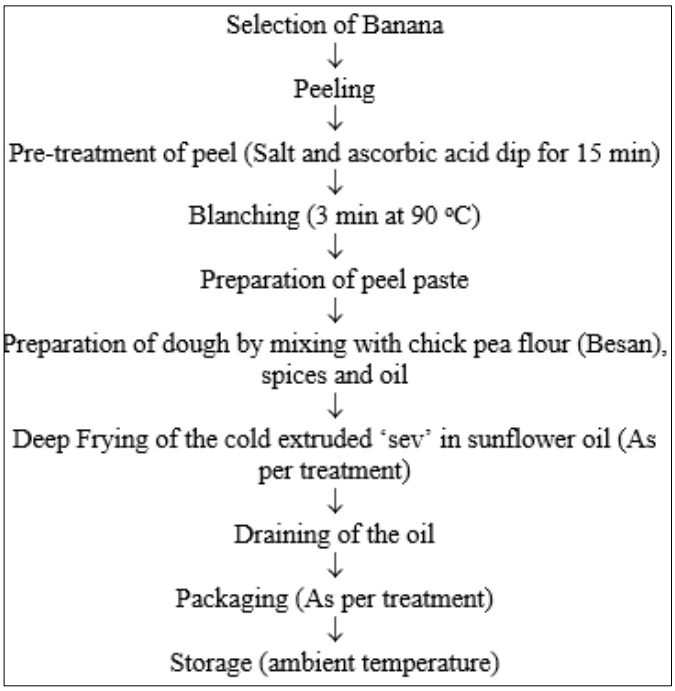

Fig 1: Principal steps used for preparation of banana peel based 'sev'

Results and Discussion

Yield: The perusal of data pertaining to yield of banana peel based 'sev' has been presented in Table 1. Data showed that yield of 'sev' fried in oil containing different concentration of TBHQ varied from 87.13 per cent to 87.16 per cent, with maximum yield for 'sev' prepared using 50, 100 and 200 ppm TBHQ and minimum in frying oil containing no and 150 ppm TBHQ. However, non-significant differences were observed for yield. Similar non-significant differences were observed by Raj and Lal (2008) for potato chip when prepared using different concentration of TBHQ in frying oil. The anti-oxidant used in frying oil do not possess any effect on the oil absorption and thus have non-significant effect on yield.

Oil absorption: The perusal of data pertaining to oil absorption in banana peel based 'sev' has been presented in Table 1. Data showed that oil absorption in 'sev' fried in oil containing different concentration of TBHQ varied from 20.30 per cent to 20.33 per cent, with maximum oil absorption in 'sev' prepared using oil containing no TBHQ as well as in 50, 100 and 150 ppm TBHQ and minimum in 'sev' prepared using 200 ppm TBHQ. However, non-significant differences were observed for oil absorption in 'sev'. Similar non-significant differences were observed by Raj and Lal (2008) for potato chip when prepared using different concentration of TBHQ in frying oil.

Table 1: Effect of anti-oxidant concentrations on yield (%) and oil absorption (%) of banana peel based 'sev'

Anti-oxidants concentrations (C)	Characteristics	
	Yield (%)	Oil absorption (%)
C1	87.13	20.30
C2	87.16	20.30
C3	87.16	20.30
C4	87.13	20.30
C5	87.16	20.33
Mean (C)	87.15	20.31
S.Em±	0.392	0.102
$CD_{0.05}$	NS	NS
CV	1.10	1.24

Moisture: Perusal of data pertaining to effect of anti-oxidant concentration (TBHQ) treatments on moisture content of 'sev' during five months storage has been presented in Table 2. Data showed that among different anti-oxidant concentration treatments, the mean moisture content of 'sev' varied from 3.42 per cent to 3.43 per cent, with minimum moisture in 'sev' prepared by using oil containing no TBHQ as well as those prepared by 50, 100 and 150 ppm TBHQ in frying oil and maximum in 200 ppm TBHQ. However, TBHQ treatments were found to have non-significant effect. Data revealed that among different packaging treatments, mean moisture of 'sev' (P) varied significantly between 3.39 per cent and 3.46 per cent, with minimum moisture content on 'sev' packed in aluminium laminated bag (P_2) and maximum in polypropylene bag

Table 2: Effect of different treatments on moisture (%) of banana peel based 'sev' during storage

Storage (S)	Packaging materials (P)	Moisture (%)						
		Anti-oxidant concentrations (C)					Mean	Mean (P)
		C_1	C_2	C_3	C_4	C_5		
Initial (S_1)	P_1	2.39	2.38	2.39	2.38	2.39	2.38	3.46
	P_2	2.39	2.39	2.39	2.39	2.39	2.39	3.39
	Mean	2.39	2.39	2.39	2.39	2.39	2.39	
1 Month (S_2)	P_1	2.60	2.59	2.60	2.60	2.59	2.60	
	P_2	2.55	2.55	2.57	2.56	2.56	2.56	
	Mean	2.57	2.57	2.59	2.58	2.57	2.58	
2 Month (S_3)	P_1	2.90	2.90	2.89	2.90	2.89	2.90	
	P_2	2.82	2.83	2.82	2.82	2.83	2.83	
	Mean	2.86	2.87	2.85	2.86	2.86	2.86	
3 Month (S_4)	P_1	3.42	3.41	3.42	3.40	3.42	3.41	
	P_2	3.32	3.31	3.31	3.32	3.33	3.32	
	Mean	3.37	3.36	3.36	3.36	3.38	3.37	
4 Month (S_5)	P_1	4.20	4.20	4.19	4.19	4.18	4.20	
	P_2	4.08	4.09	4.09	4.08	4.10	4.09	
	Mean	4.14	4.15	4.14	4.14	4.14	4.14	
5 Month (S_6)	P_1	5.27	5.26	5.26	5.26	5.27	5.27	
	P_2	5.15	5.16	5.15	5.14	5.14	5.15	
	Mean	5.21	5.21	5.20	5.20	5.21	5.21	
Mean (C)		3.42	3.42	3.42	3.42	3.43		
S.Em.±	C	P	C×P	S	C×S	P×S	C×P×S	
	0.014	0.009	0.020	0.014	0.032	0.02	0.045	
CD at 5%	NS	0.027	NS	0.040	NS	0.057	NS	
CV %	2.44			2.30				

(P_1). Similar observations were reported by Allam *et al.* (2015) [2-3] for rice based snack and Butt *et al.* (2003) [7] for breakfast cereals. Data depicted that storage of 'sev' resulted significant increase in mean moisture content (S) from initial value of 2.39 per cent to 5.21 per cent during five month storage. The increase in moisture content during storage might be due to migration of water vapor from the storage environment into the packaging material (Kumar and Mishra. 2004) [17]. Increase in moisture during storage was earlier reported by Swain *et al.* (2013) [27] for dried capsicum slices. Almost similar observations were also documented by Navale *et al.* (2016) for jack fruit chips.

Table 3: Effect of different treatments on water activity (a_w) of banana peel based 'sev' during storage

Storage (S)	Packaging materials (P)	Water activity (a_w)						
		Anti-oxidant concentrations (C)					Mean	Mean (P)
		C_1	C_2	C_3	C_4	C_5		
Initial (S_1)	P_1	0.406	0.405	0.406	0.405	0.406	0.406	0.467
	P_2	0.406	0.405	0.406	0.405	0.406	0.406	0.454
	Mean	0.406	0.405	0.406	0.405	0.406	0.406	
1 Month (S_2)	P_1	0.440	0.442	0.440	0.442	0.440	0.441	
	P_2	0.418	0.417	0.415	0.415	0.417	0.416	
	Mean	0.429	0.429	0.427	0.429	0.429	0.429	
2 Month (S_3)	P_1	0.464	0.462	0.462	0.464	0.462	0.463	

	P_2	0.451	0.451	0.453	0.448	0.453	0.451	
	Mean	0.458	0.457	0.457	0.456	0.458	0.457	
3 Month (S_4)	P_1	0.480	0.477	0.479	0.477	0.479	0.478	
	P_2	0.465	0.463	0.463	0.462	0.465	0.464	
	Mean	0.472	0.470	0.471	0.470	0.472	0.471	
4 Month (S_5)	P_1	0.504	0.503	0.503	0.502	0.500	0.502	
	P_2	0.490	0.490	0.491	0.486	0.486	0.489	
	Mean	0.497	0.497	0.497	0.494	0.493	0.495	
5 Month (S_6)	P_1	0.511	0.511	0.510	0.507	0.508	0.509	
	P_2	0.499	0.498	0.498	0.495	0.496	0.497	
	Mean	0.505	0.505	0.504	0.501	0.502	0.503	
Mean (C)		0.461	0.460	0.461	0.459	0.460		
S.Em.±	C	P	C×P	S	C×S	P×S	C×P×S	
	0.001	0.001	0.002	0.002	0.004	0.002	0.006	
CD at 5%	NS	0.002	NS	0.005	NS	0.007	NS	
CV %	2.01			2.18				

Water activity

Perusal of data pertaining to effect of anti-oxidant concentration (TBHQ) treatments on water activity of 'sev' during five months storage has been presented in Table 3. Data showed that among different anti-oxidant concentration treatments, the mean water activity of 'sev' varied from 0.459 to 0.461, with minimum water activity in 'sev' prepared by using 150 ppm TBHQ (C_4) in frying oil and maximum in oil without TBHQ and 100 ppm TBHQ ($C_1$and C_3). However, TBHQ treatments were found to have non-significant effect. Pernille (1989) [19] reported similar findings with non-significant effect in water activity content of potato flakes. Data revealed that among different packaging treatments, mean water activity of 'sev' (P) varied significantly between 0.454 and 0.467, with minimum water activity in 'sev' packed in aluminium laminated bag (P_2) and maximum in polypropylene bag (P_1). Similar observations were reported by Irwandi *et al*. (1998) [13] for durian fruit leather and Swain *et al*. (2013) [27] for dried capsicum slices. Data depicted that storage of 'sev' resulted significant increase in mean water activity (S) from initial value of 0.406 to 0.503 during five month storage. The increase in water activity content during storage observed similar to that of moisture content due to migration of water vapor from the storage environment into the packaging material (Swain *et al.* 2013) [27]. Increase in water activity during storage was earlier reported by Swain *et al*. (2013) [27] for dried capsicum slices. Almost similar observations were also documented by Navale *et al.* (2016) for jackfruit chips.

Peroxide value

Perusal of data pertaining to effect of anti-oxidant concentration (TBHQ) treatments on peroxide value of 'sev' during five months storage has been presented in Table 4. Data showed that among different anti-oxidant concentration treatments, the mean peroxide value of 'sev' varied from 6.80 m.eq/kg to 7.94 m.eq/kg, with minimum peroxide value in 'sev' prepared by using 150 ppm TBHQ (C_4) in frying oil and maximum in oil without TBHQ (C_1). However, TBHQ treatments were found to have significant effect. Similar observations were reported by Watinee *et al*. (2008) for rice crackers, Bhattarai (2010) [6] for noodle and Rababah *et al*. (2011) [21] for rice corn chips. Data revealed that among different packaging treatments, mean peroxide value of 'sev' (P) varied significantly between 6.35 m.eq/kg and 6.41 m.eq/kg, with minimum peroxide value content on 'sev' packed in aluminium laminated bag (P_2) and maximum in polypropylene bag (P_1). Similar observations were reported by Tiwari and Jha for snacks (2017), Khanvilkar *et al*. (2016) [14] for banana chips and Butt *et al*. (2003) [7] for breakfast cereals. Data depicted that storage of 'sev' resulted significant increase in mean peroxide value (S) from initial value of 2.51 m.eq/kg to 12.77 m.eq/kg during five month storage. The increase in peroxide value content during storage might be due to migration of water vapor from the storage environment into the packaging material (kumar and Mishra. 2004) [17]. Increase in peroxide value during storage was earlier reported by Swain *et al*. (2013) [27] for dried capsicum slices. Almost similar observations were also documented by Navale *et al.* (2016) for jack fruit chips.

Total soluble solids

Perusal of data pertaining to effect of anti-oxidant concentration (TBHQ) treatments on TSS of 'sev' during five months storage has been presented in Table 5. Data showed that among different anti-oxidant concentration treatments, the mean TSS of 'sev' varied from 15.34

Table 4: Effect of different treatments on peroxide value (m.eq/kg) of banana peel based 'sev' during storage

Storage (S)	Packaging materials (P)	Peroxide Value (m.eq/kg)						
		Anti-oxidant concentrations (C)					Mean	Mean (P)
		C_1	C_2	C_3	C_4	C_5		
Initial (S_1)	P_1	2.51	2.51	2.51	2.51	2.51	2.51	6.41
	P_2	2.51	2.51	2.51	2.51	2.51	2.51	6.35
	Mean	2.51	2.51	2.51	2.51	2.51	2.51	
1 Month (S_2)	P_1	3.84	3.82	3.46	2.77	2.76	3.33	
	P_2	3.77	3.76	3.75	2.69	2.66	3.33	
	Mean	3.81	3.79	3.61	2.73	2.71	3.33	
2 Month (S_3)	P_1	5.60	5.61	4.27	3.33	3.33	4.43	
	P_2	5.58	5.25	4.26	3.32	3.31	4.35	

	Mean	5.59	5.43	4.27	3.33	3.32	4.39	
3 Month (S_4)	P_1	7.91	7.89	6.46	4.56	4.54	6.27	
	P_2	7.89	7.86	6.42	4.42	4.45	6.21	
	Mean	7.90	7.88	6.44	4.49	4.50	6.24	
4 Month (S_5)	P_1	11.75	11.62	9.04	6.54	6.55	9.10	
	P_2	11.60	11.61	8.80	6.41	6.48	8.98	
	Mean	11.68	11.61	8.92	6.47	6.51	9.04	
5 Month (S_6)	P_1	16.21	16.18	13.09	9.26	9.27	12.80	
	P_2	16.10	16.16	12.95	9.22	9.24	12.73	
	Mean	16.15	16.17	13.02	9.24	9.26	12.77	
Mean (C)		7.94	7.90	6.46	4.80	4.80		
S.Em.±	C	P	C×P	S	C×S	P×S	C×P×S	
	0.017	0.011	0.025	0.018	0.041	0.026	0.058	
CD at 5%	0.051	0.032	NS	0.051	0.114	NS	0.162	
CV %	1.64			1.57				

°Brix to 15.36 °Brix, with minimum TSS in 'sev' prepared by using 150 ppm TBHQ (C_4) in frying oil and maximum in without TBHQ, 50 and 100 ppm TBHQ (C_1, C_2 and C_3). However, TBHQ treatments were found to have non-significant effect. Pernille (1989) [19] reported similar findings with non-significant effect in TSS content of potato flakes. Data revealed that among different packaging treatments, mean TSS of 'sev' (P) varied non-significantly between15.33 °Brix and 15.38 °Brix, with minimum TSS content on 'sev' packed in aluminium laminated bag (P_2) and maximum in polypropylene bag (P_1). Similar observations were reported by Sharma *et al*. (2000) [25] for osmo-air dried apricot. Data depicted that storage of 'sev' resulted non-significant increase in mean TSS content (S) from initial value of 15.23 °Brix to 15.50 °Brix during five month storage. Similar observations were reported by Anon. (2014) [1] for 'sev'.

Table 5: Effect of different treatments on TSS (°Brix) of banana peel based 'sev' during storage

Storage (S)	**Packaging materials (P)**	**Total soluble solids (°Brix)**						
		Anti-oxidant concentrations (C)					**Mean**	**Mean (P)**
		C_1	**C_2**	**C_3**	**C_4**	**C_5**		
Initial (S_1)	P_1	15.20	15.23	15.25	15.23	15.24	15.23	15.38
	P_2	15.21	15.24	15.22	15.22	15.23	15.22	15.33
	Mean	15.20	15.24	15.24	15.22	15.24	15.23	
1 Month (S_2)	P_1	15.28	15.27	15.29	15.27	15.28	15.28	
	P_2	15.25	15.26	15.27	15.25	15.25	15.26	
	Mean	15.27	15.27	15.28	15.26	15.27	15.27	
2 Month (S_3)	P_1	15.35	15.34	15.33	15.32	15.33	15.33	
	P_2	15.30	15.31	15.29	15.29	15.28	15.29	
	Mean	15.33	15.32	15.31	15.31	15.30	15.31	
3 Month (S_4)	P_1	15.42	15.43	15.40	15.38	15.38	15.40	
	P_2	15.36	15.35	15.34	15.34	15.35	15.35	
	Mean	15.39	15.39	15.37	15.36	15.37	15.38	
4 Month (S_5)	P_1	15.50	15.48	15.48	15.45	15.44	15.47	
	P_2	15.43	15.42	15.40	15.39	15.40	15.41	
	Mean	15.47	15.45	15.44	15.42	15.42	15.44	
5 Month (S_6)	P_1	15.57	15.55	15.56	15.54	15.55	15.55	
	P_2	15.48	15.46	15.46	15.42	15.45	15.46	
	Mean	15.53	15.51	15.51	15.48	15.50	15.50	
Mean (C)		15.36	15.36	15.36	15.34	15.35		
S.Em.±	C	P	C×P	S	C×S	P×S	C×P×S	
	0.081	0.051	0.115	0.097	0.216	0.137	0.306	
CD at 5%	NS	NS	NS	NS	NS	NS	NS	NS
CV %	3.18			3.45				

Non-enzymatic browning

Perusal of data pertaining to effect of anti-oxidant concentration (TBHQ) treatments on NEB of 'sev' during five months storage has been presented in Table 6. Data showed that among different anti-oxidant concentration treatments, the mean NEB of 'sev' varied from 0.424 (OD_{440nm}) to 0.430 (OD_{440nm}), with minimum NEB in 'sev' prepared by using 150 and 200 ppm TBHQ (C) in frying oil and maximum in without TBHQ (C_1). However, TBHQ treatments were found to have non- significant effect. Data revealed that among different packaging treatments, mean moisture of 'sev' (P) varied non-significantly between 0.421 (OD_{440nm}) and 0.431 (OD_{440nm}), with minimum NEB content on 'sev' packed in aluminium laminated bag (P_2) and maximum in polypropylene bag (P_1). Similar observations were reported by Irwandi *et al*. (1998) [13]. for durian fruit leather. Data depicted that storage of 'sev' resulted non-significant increase in mean NEB content (S) from initial value of 0.402 (OD_{440nm}) to 0.460 (OD_{440nm}) during five month storage. The increase in NEB content during storage might be due to increase of reducing sugar during storage. Increase in NEB during storage was earlier reported by Raj and Lal (2008) for potato chips. However, effect of storage level was found to have significant effect.

Table 6: Effect of different treatments on NEB (OD_{490nm}) of banana peel based 'sev' during storage

Storage (S)	Packaging materials (P)	Non-enzymatic browning (OD_{490nm})						
		Anti-oxidant concentrations (C)					Mean	Mean (P)
		C_1	C_2	C_3	C_4	C_5		
Initial (S_1)	P_1	0.402	0.402	0.401	0.402	0.403	0.402	0.431
	P_2	0.401	0.402	0.401	0.402	0.403	0.402	0.421
	Mean	0.402	0.402	0.401	0.402	0.403	0.402	
1 Month (S_2)	P_1	0.406	0.404	0.404	0.404	0.404	0.404	
	P_2	0.403	0.404	0.404	0.403	0.403	0.404	
	Mean	0.405	0.404	0.404	0.404	0.404	0.404	
2 Month (S_3)	P_1	0.426	0.424	0.420	0.420	0.418	0.421	
	P_2	0.415	0.412	0.410	0.409	0.408	0.411	
	Mean	0.420	0.418	0.415	0.415	0.413	0.416	
3 Month (S_4)	P_1	0.438	0.438	0.436	0.435	0.430	0.435	
	P_2	0.426	0.422	0.421	0.422	0.420	0.422	
	Mean	0.432	0.430	0.429	0.428	0.425	0.429	
4 Month (S_5)	P_1	0.460	0.455	0.453	0.452	0.452	0.454	
	P_2	0.440	0.438	0.435	0.433	0.433	0.436	
	Mean	0.450	0.446	0.444	0.442	0.443	0.445	
5 Month (S_6)	P_1	0.482	0.471	0.470	0.465	0.466	0.471	
	P_2	0.456	0.452	0.450	0.443	0.448	0.450	
	Mean	0.469	0.462	0.460	0.454	0.457	0.460	
Mean (C)		0.430	0.427	0.425	0.424	0.424		
S.Em.±	C	P	C×P	S	C×S	P×S	C×P×S	
	0.001	0.001	0.002	0.002	0.004	0.002	0.005	
CD at 5%	NS	0.003	NS	0.005	NS	0.006	NS	
CV %	2.34			2.12				

Protein: Perusal of data pertaining to effect of anti-oxidant concentration (TBHQ) treatments on protein of 'sev' during five months storage has been presented in Table 7. Data showed that among different anti-oxidant concentration treatments, the mean protein of 'sev' varied from 8.66 per cent to 8.67 per cent, with minimum protein in 'sev' prepared by using 100, 150 and 200 ppm TBHQ (C) in frying oil and maximum in oil without TBHQ and 50 ppm TBHQ (C_1 and C_2). However, TBHQ treatments were found to have non-significant effect. Chastain *et al.* (1982) reported similar findings with non-significant effect in protein content of pork steaks. Data revealed that among different packaging treatments, mean protein of 'sev' (P) varied non-significantly between 8.65 per cent and 8.68 per cent, with minimum protein content on 'sev' packed in polypropylene bag (P_1) and maximum inaluminium laminated bag (P_2). Similar finding

Table 7: Effect of different treatments on proteins (%) of banana peel based 'sev' during storage

Storage (S)	Packaging materials (P)	Proteins (%)						
		Anti-oxidant concentrations (C)					Mean	Mean (P)
		C_1	C_2	C_3	C_4	C_5		
Initial (S_1)	P_1	8.74	8.75	8.76	8.75	8.76	8.75	8.65
	P_2	8.74	8.76	8.75	8.75	8.75	8.75	8.68
	Mean	8.74	8.75	8.76	8.75	8.75	8.75	
1 Month (S_2)	P_1	8.66	8.66	8.65	8.64	8.65	8.65	
	P_2	8.70	8.69	8.69	8.67	8.67	8.68	
	Mean	8.68	8.68	8.67	8.66	8.66	8.67	
2 Month (S_3)	P_1	8.65	8.64	8.63	8.62	8.63	8.63	
	P_2	8.69	8.67	8.67	8.66	8.65	8.67	
	Mean	8.67	8.66	8.65	8.64	8.64	8.65	
3 Month (S_4)	P_1	8.64	8.63	8.62	8.62	8.62	8.63	
	P_2	8.68	8.67	8.66	8.65	8.64	8.66	
	Mean	8.66	8.65	8.64	8.63	8.63	8.64	
4 Month (S_5)	P_1	8.63	8.63	8.62	8.62	8.63	8.63	
	P_2	8.67	8.67	8.66	8.65	8.65	8.66	
	Mean	8.65	8.65	8.64	8.64	8.64	8.64	
5 Month (S_6)	P_1	8.62	8.62	8.61	8.61	8.62	8.62	
	P_2	8.66	8.66	8.65	8.64	8.64	8.65	
	Mean	8.64	8.64	8.63	8.62	8.63	8.63	
Mean (C)		8.67	8.67	8.66	8.66	8.66		
S.Em.±	C	P	C×P	S	C×S	P×S	C×P×S	
	0.030	0.019	0.042	0.031	0.069	0.044	0.096	
CD at 5%	NS	NS	NS	NS	NS	NS	NS	
CV %	2.03			1.95				

was observed by Allam *et al*. (2015) [2-3] for snacks. Data depicted that storage of 'sev' resulted non- significant decrease in mean protein content (S) from initial value of 8.75 per cent to 8.63 per cent during five month storage. Similar observations were reported by Singh *et al*. (2011) for chicken snacks and Rababah *et al.* (2011) [21] for corn chips.

Table 8: Effect of different treatments on fibre (%) of banana peel based 'Sev' during storage

Storage (S)	Packaging materials (P)	Fibre (%)						
		Anti-oxidant concentrations (C)					Mean	Mean (P)
		C_1	C_2	C_3	C_4	C_5		
Initial (S_1)	P_1	8.82	8.84	8.83	8.82	8.83	8.83	8.80
	P_2	8.83	8.84	8.83	8.83	8.83	8.83	8.80
	Mean	8.82	8.84	8.83	8.83	8.83	8.83	
1 Month (S_2)	P_1	8.81	8.81	8.81	8.80	8.81	8.81	
	P_2	8.82	8.81	8.81	8.80	8.81	8.81	
	Mean	8.82	8.81	8.81	8.80	8.81	8.81	
2 Month (S_3)	P_1	8.80	8.80	8.80	8.80	8.81	8.80	
	P_2	8.81	8.81	8.80	8.80	8.81	8.81	
	Mean	8.81	8.81	8.80	8.80	8.81	8.81	
3 Month (S_4)	P_1	8.79	8.79	8.79	8.79	8.80	8.79	
	P_2	8.80	8.80	8.79	8.79	8.80	8.80	
	Mean	8.79	8.80	8.79	8.79	8.80	8.79	
4 Month (S_5)	P_1	8.78	8.78	8.78	8.78	8.79	8.78	
	P_2	8.78	8.79	8.78	8.79	8.79	8.79	
	Mean	8.78	8.79	8.78	8.79	8.79	8.79	
5 Month (S_6)	P_1	8.77	8.77	8.77	8.77	8.78	8.77	
	P_2	8.76	8.77	8.78	8.78	8.78	8.78	
	Mean	8.77	8.77	8.77	8.78	8.78	8.77	
Mean (C)		8.80	8.80	8.80	8.80	8.80		
S.Em.±	C	P	C×P	S	C×S	P×S	C×P×S	
	0.035	0.022	0.049	0.034	0.076	0.048	0.107	
CD at 5%	NS	NS	NS	NS	NS	NS	NS	
CV %	2.35			2.11				

Fibre

Perusal of data pertaining to effect of anti-oxidant concentration (TBHQ) treatments on fibre of 'sev' during five months storage has been presented in Table 8. Data showed that among different anti-oxidant concentration treatments, the mean fibre content (8.80 per cent) of 'sev' fried in sunflower oil containing different concentrations of anti-oxidant (C). However, TBHQ treatments were found to have non-significant effect. Rababah *et al.* (2011) [21] reported similar findings with non-significant effect in protein content of corn chips. Data revealed that mean fibre content (8.80 per cent) of 'sev' packed in different packaging materials (P). However, packaging treatments were found to have non-significant effect. Similar observation was reported by Ajayi *et al*. (2015) [1] for dried mushroom. Data depicted that storage of 'sev' resulted non-significant decrease in mean fibre content (S) varied from initial value of 8.83 per cent to 8.77 per cent during five month storage. Similar observations were reported by Rababah *et al.* (2011) [21] for corn chips and Ajayi *et al*. (2015) [1] for dried mushroom.

Conclusion

The findings summarized above indicate 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 lower peroxide value, moisture and water activity attributes during storage.

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