International Journal of Food Science and Nutrition
ISSN: 2455-4898
Impact Factor: RJIF 5.14
www.foodsciencejournal.com
Volume 3; Issue 5; September 2018; Page No. 33-38

Development of Papad from dehydrated betel leaves (*Piper betel* L.) Powder

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Abstract
The deep green heart shaped betel leaves popularly called as paan in India, belongs to *Piperaceae* family and known for its nutritional and medicinal value. The present study was undertaken develop value added papads from the same in an order to increase the consumption of betel leaves to exploit their nutritional benefits. Papads were prepared by incorporating dehydrated betel leaves both *Kariyele* and *Ambadiyele* powder at 5, 7.5 and 10 per cent levels and evaluated organoleptically in comparison to control sample using 9- point hedonic scale. All the papads were found to be acceptable at 5 percent level of incorporation. *Kariyele* papad found to have higher moisture 10.76 percent, fat 1.52g, vitamin-C 1.73mg and iron 4.94mg whereas *Ambadiyele* papad had higher ash 3.75g, crude fiber 1.27g, β-carotene 413.41µg and calcium 252.15mg. Shelf life study based on sensory evaluation, microbial load and moisture content revealed that both papads were acceptable up to 60days of storage under ambient temperature.

Keywords: dehydration, betel leaves, papads, nutritional, sensory score and shelf life

Introduction
India is blessed with an array of leafy vegetables of which some are cultivated many are gathered. Fruits and vegetables contain different antioxidant compounds such as Vitamin C, vitamin E and carotenoids, whose activities have been established in recent years. Flavonoids, tannins and other phenolic constituents present in food of plant origin are also potential antioxidants. The potentially cancer inducing oxidative damage might be prevented or limited by dietary antioxidants found in fruits and vegetables (Saranya *et al.*, 2017) [1]. Green leafy vegetables constitute a vital part of a balanced diet and are rich in bioactive compounds (polyphenols, carotenoids, flavonoids, flavones, isoflavones and catechins). They are cheap sources of micronutrients which typically provide low calories and dietary fibers.

Deep green heart shaped leaves of *Piper betel* are popularly known as paan in India, belongs to *Piperaceae* family and has over 2000 species. The scientific name of betel vine is *Piper betel* L. *Piper betel* vine is native to Malaysia but it is also cultivated in India, Sri Lanka, Bangladesh, Burma and Nepal (Guha, 2006) [2]. Betel leaves are consumed by about 15-20 million people in the country. It is cultivated following the traditional methods on 55,000 hectare with an annual production worth about Rs. 9000 million in India (Mazumder *et al.*, 2016) [3].

Betel leaves are known for its nutritional and medicinal value. Betel vine is one of the invaluable medicinal plants, leaves are used for many medicinal purposes and has been described from ancient time as an aromatic stimulo-carminative, astringent and aphrodisiac (Sripradha, 2014) [4]. The use of betel leaf can be traced as far back as two thousand years. Betel leaves help to heal the illnesses such as headache, scanty or obstructed urination, weakness of nerves, sore throat, boils, respiratory disorders, constipation, inflammation, wounds and problem of breast milk secretion (Sengupta *et al.*, 2013) [5].

Green leafy vegetables (GLV) are inexpensive sources of micronutrients, however their utilization seems to be limited either due to ignorance or the inability to use them in many products. GLV are seasonal and also highly perishable due to the high water content in their plant tissues. There is a need to preserve the nature's storehouse of nutrients through convenient processing techniques. Therefore dehydration seems to be the simplest technology for preserving greens especially when they are abundantly available. Greens can be utilized in multiple ways by incorporating into existing products and formulation of health foods using techniques of dehydration. There are no processed foods that are available, which incorporate greens (Gupta and Prakash, 2011)[6].Incorporation of these nutrient rich leafy vegetable into papad could be a good source of functional snack. There are very few reports on incorporation of leafy vegetables in papad (Sonawane *et al.*, 2015) [7]. Hence, the present study was undertaken to develop papads from dehydrated both *Kariyele* and *Ambadiyele* betel leaves.

Materials and methods
The two varieties of betel leaves *i.e. Kariyele* and *Ambadiyele* were procured from the local market of Bengaluru. The fresh, green and undamaged leaves were selected, washed in tap water to remove extraneous matter. Leaves were finely chopped, weighed and then they were dried in hot air oven at 60^0 C for 3 hours. The dehydrated leaves were ground into powder and were subjected to nutrient analysis. Moisture, protein, fat, ash, crude fiber, carbohydrate, energy, potassium, sodium, iron and zinc were estimated using standard AOAC (1980) [8] methods. Calcium content was determined by titration method described by (Heau *et al.* 1965) [9]. The vitamin C concentration was determined using redox titration

with potassium iodate in the presence of potassium iodide (Tauber and Kleiner, 1935) [10]. The concentration of β-carotene was measured in spectrophotometer at 450 nm (Ranganna, 2002) [11]. Antioxidant activity by DPPH (2, 2-diphenyl-1-picrylhydrazyl) radical scavenging activity method (Kang and Saltveit, 2002) [12] and Phosphorus by atomic spectrophotometer (Adelowo *et al.*, 2016) [13]. Papad was prepared by incorporating dehydrated betel leaves powder both *Kariyele* and *Ambadiyele* at 5, 7.5 and 10 per cent level. Nutrient composition of the best accepted Papads were computed based on the nutritional composition of the ingredients (Gopalan *et al*., 2014) [14]. Storage study was done for the papads based on sensory evaluation, moisture content and microbial population.

Results and Discussion

Nutritional analysis of dehydrated betel leaves powder

Table 1 shows the findings of nutritional analysis of dehydrated betel leaves powder. It was found that dehydrated *Kariyele* powder had moisture 13.53 percent, protein 13.47g, fat 4.46g, total ash 14.66g, crude fiber 5.2g, carbohydrate 48.63g and energy 288.54 Kcal. β-carotene 5440µg, vitamin C 34.73mg and antioxidant content 43.01mg respectively. Minerals *i.e.* calcium, potassium, sodium, phosphorus, iron and zinc contents were 2018.8mg,4054 mg, 32.83 mg, 213, 23.15mg and 4.65mg respectively. Oxalic acid and tannin content were 0.36g and 447 mg respectively. Whereas dehydrated *Ambadiyele* powder had moisture 12.66 per cent, protein 12.07g, fat4.62 g, total ash 15.33 g, crude fibre 6.5 g, carbohydrate 48.82 g and energy 285.14 Kcal. β-carotene, vitamin C and antioxidant contents were 6693 µg, 32.86 mg and 39.81mg respectively and minerals *i.e.* 2894.2 mg calcium, 3822.3 mg potassium, 24.3mg sodium, 242.3 mg phosphorus, 40.98 mg iron and 6.75 mg zinc. Oxalic acid and tannin content was 0.53g and 503 mg respectively. Moisture, protein, energy, vitamin- C, potassium and sodium were higher in *Kariyele* powder. The results were in accordance with Chauhan and Aishwarya (2016) [15], who reported the nutrient content of dried betel leaves powder moisture 9.45%, protein 3.30%, fat 1.10%, fiber 10.15%, ash 6.87%, carbohydrate 63.92%, vitamin C, iron and calcium as 1.11%, 2.57% and 1.53% respectively on fresh weight basis. These values are lower than present study values except for fiber and carbohydrate, which might be due to difference in variety, climatic conditions and drying condition.

Table 1: Proximate composition of dehydrated betel leaves powder (per 100g dry weight)

Nutrients	*Kariyele*	*Ambadiyele*
Moisture (%)	13.53	12.66
Protein (g)	13.47	12.07
Fat (g)	4.46	4.62
Total ash (g)	14.66	15.33
Crude fiber (g)	5.2	6.5
Carbohydrate (g)	48.63	48.82
Energy (Kcal)	288.54	285.14
Vitamins		
β – carotene (µg)	5440	6693
Vitamin C (mg)	34.73	32.86
Minerals		
Calcium (mg)	2018.8	2894.2
Potassium (mg)	4054	3822
Sodium (mg)	32.83	24.3
Phosphorus (mg)	213	242.3
Iron (mg)	23.15	40.98
Zinc (mg)	4.65	6.75
Oxalic acid(g/100g)	0.36	0.53
Tannins(mg/g TAE)	447	503

Development of Papads

Papads were prepared from both *Kariyele* and *Ambadiyele*. Table 2 shows the formulation of the developed papad using dehydrated betel leaves powder. Sensory evaluation was done to check acceptance of the products using nine point hedonic scale by 21 semi-trained panel members.

Papad is a very popular Indian traditional snack food which is consumed after or with meal. It is made up of cereal or pulse flours blended with salt, spices, edible oil and an additive such as papadkhar, usually circular in shape and completely dried which can be stored for long time.(Sonawane *et al.*,2015) [7]

Table 2: Composition of Betel leaves papad

Ingredients	Quantity (g)	
	Control	I
Green gram dhal flour	60	55
Black gram dhal flour	40	40
Black pepper powder	01	01
Papadkhar	01	01
Vinegar	3-4drops	3-4drops
Salt	02	02
Betel leaves dehydrated powder	-	5

I– Betel leaves powder at 5% level

Three variations of papads were prepared by incorporating *Kariyele* powder and *Ambadiyele* powder at different levels *i.e.* 5, 7.5 and 10 per cent. Both *Kariyele* papad (BKP 1) and *Ambadiyele* papad (BAP 1) was found to be best accepted at 5 percent incorporation with scores for appearance 8.33 and 8.80, colour 8.66 and 8.23, texture 8.42 and 8.57, aroma 8.47 and 8.47, taste 8.19 and 8.04 and overall acceptability 8.71 and 8.19 respectively. And control had scores for appearance, colour, texture, aroma, taste and overall acceptability as 8.71, 8.61, 8.57, 8.33, 8.71 and 8.66 respectively. The mean sensory scores of best accepted papad is given in Fig. 1.

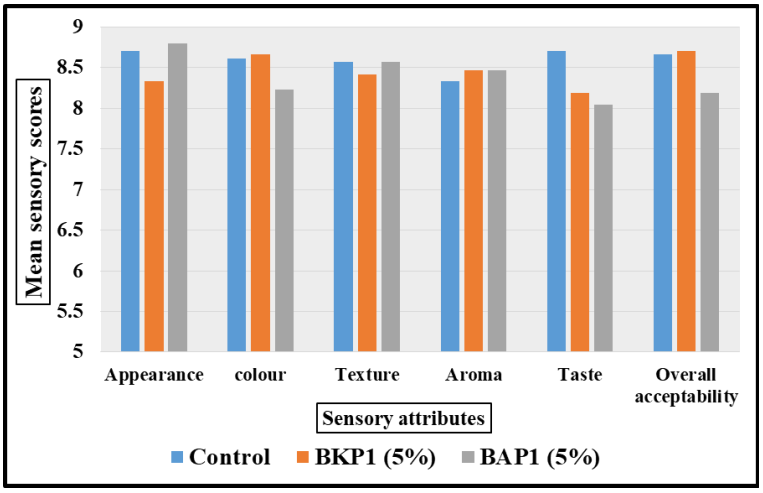

Fig 1: Mean sensory scores for best accepted papad

Nutrient composition of best accepted Papads

Nutrient composition of best accepted products and control were computed and presented in Table 3. It was found that *Kariyele* papad (BKP1) had higher moisture content 10.76 per cent, fat 1.52g, vitamin- C 1.73mg and iron 4.94mg. Whereas *Ambadiyele* papad found to have higher ash content 3.75g, crude fiber 1.27g, β- carotene 413.41µg and calcium 252.15mg. Compared to betel leaves papad, control papad had higher protein 24.41g, carbohydrate 60.27g and energy 350.64 Kcal due to replacement of 5g of greengram dhal flour with 5 per cent betel leaves powder in betel leaves papad.

Table 3: Proximate composition of best accepted products

Nutrients	Papad		
	Control	BKP1	BAP1
Moisture (%)	10.60	10.76	10.72
Protein (g)	24.41	23.85	23.78
Fat (g)	1.34	1.52	1.51
Ash(g)	3.13	3.71	3.75
Crude fiber (g)	0.98	1.20	1.27
Carbohydrate (g)	60.27	59.70	59.71
Energy (K cal)	350.64	347.67	347.49
β – carotene(µg)	84.91	355.81	413.41
Vitamin C(mg)	-	1.73	1.64
Calcium (mg)	111.2	208.35	252.15
Iron (mg)	3.98	4.94	4.85

BKP1 - Betel leaves *Kariyele* papad 1, BAP1- Betel leaves *Ambadiyele* papad 1

Mean sensory score of betel leaves papad during shelf life study

Control, *Kariyele* papad (BKP1) and *Ambadiyele* papad (BAP1) were stored under ambient temperature to observe the changes that take place during storage period of 60 days. The samples were observed daily for visual changes and were subjected to sensory evaluation on initial, 30th and 60th days. The results of the mean sensory score evaluation of papads from initial day to 60 days of storage period are presented in the Table 4. Decrease in the sensory score was observed during storage period. The control sample showed scores of 7.95, 7.71, 7.95, 7.95, 7.90 and 7.85 for appearance, colour, texture, aroma, taste and overall acceptability respectively, whereas the BKP1 5 per cent variation had mean sensory scores of 7.52 (appearance), 7.85 (colour), 7.76 (texture), 7.66 (aroma), 7.57 (taste) and 7.71 (overall acceptability) and BAP1 5 per cent variation had mean sensory scores of appearance, colour, texture, aroma, taste and overall acceptability *i.e.* 8.09, 7.71, 7.95, 8.14, 7.85 and 7.90 respectively after 60 days of storage. It was evident from the sensory scores that, even after 60 days of storage period all the papads *viz*., control, BKP1 and BAP1 were acceptable. Significant difference at 5 per cent level was observed in all the sensory parameters *i.e.* appearance, colour, texture, aroma, taste and overall acceptability.

Best accepted papads *i.e.* BKP1 and BAP 1 were subjected for storage study. Up to 60 days the product was acceptable however, decrease in sensory scores for all sensory attributes was observed during storage and this may be due to increase in free fatty acid content. Sonawane *et al*.,(2015) [7] reported that cereal and legume based papads developed with incorporating green leafy vegetables showed significant difference in the sensory characteristics of papads during storage. Total phenolic content and antioxidant capacity of papad decreased significantly after 30 days of storage period. According to authors, stability of polyphenols and antioxidant capacity in food is influenced by many external factors such as exposure to light, air and different storage temperatures.

Table 4: Mean sensory score of betel leaves papad during shelf life study

Products	Duration	Appearance	Colour	Texture	Aroma	Taste	Overall Acceptability
Control	Initial	8.76	8.66	8.52	8.61	8.71	8.71
	30th day	8.38	8.09	8.28	8.38	8.47	8.33
	60th day	7.95	7.71	7.95	7.95	7.90	7.85
	F value	*	*	*	*	*	*
	SEm±	0.12	0.14	0.12	0.12	0.15	0.16
	CD at 5%	0.35	0.41	0.36	0.34	0.43	0.47
BKP1 (5%)	Initial	8.33	8.66	8.42	8.47	8.19	8.71
	30th day	7.90	8.23	8.09	8.04	7.81	8.28
	60th day	7.52	7.85	7.76	7.66	7.57	7.71
	F value	*	*	*	*	*	*
	SEm±	0.11	0.14	0.10	0.12	0.12	0.15
	CD at 5%	0.31	0.41	0.30	0.36	0.35	0.44
BAP1 (5%)	Initial	8.80	8.23	8.57	8.47	8.04	8.19
	30th day	8.47	7.95	8.28	7.85	7.57	7.66
	60th day	8.09	7.71	7.95	8.14	7.85	7.90
	F value	*	*	*	*	*	*
	SEm±	0.13	0.12	0.13	0.12	0.11	0.11
	CD at 5%	0.37	0.34	0.37	0.36	0.32	0.33

*- Significant at 5% level, NS – Non significant, BKP1 – Betel leaves *Kariyele* papad 1 BAP1- Betel leaves *Ambadiyele* papad 1

Microbial study of betel leaves papad

Table 5 depicts the increase in microbial population of betel leaves papad. As the number of storage days increased, microbial population also increased. The highest microbial population was observed in control for bacteria, moulds and coliforms whereas BKP1 and BAP1 had lower microbial population compared to control. BKP1 variation had significant low population of bacteria and moulds, leading to conclusion that it has more antimicrobial properties. Population of coliforms in BKP1 and BAP1 samples were on par with each other. There was significant differences among variations and duration for both bacteria and moulds population but in coliforms there was non-significant difference among variations.

Result of microbiological analysis of best accepted betel leaves papads (BKP1 and BAP1) which are stored in room temperature showed increased microbial growth with increase in number of days of storage. Results are in line with the study conducted by Chowdhury *et al.,* (2009) [16] who observed slight increase in the microbial growth of papad during 4 months of storage period at room temperature. In present study growth of microorganisms i.e. total bacteria, moulds and coliforms for control was 9.9, 0.7 and 0.4 × 10^2cfu/g, for *Kariyele* papad 8.3, 0.4 and 0.26 × 10^2cfu/g and for *Ambadiyele* papad 8.8, 1.51 and 1.17 × 10^2cfu/g respectively at the end of 60th day. Similar results were reported by Veena *et al.,* (2012) [17] who found that that there was growth of microorganisms in papad which was stored in polyethylene cover for 3 months. At the end of 3 months of storage there were 0.05 × 10^{-2}cfu/g moulds, 1.15 × 10^{-2}cfu/g yeast, 9.15 × 10^{-2}cfu/g bacterial population and 2.20 × 10^{-2}cfu/g spores was observed. The reasons for spoilage according to investigators were higher water vapour and gas transmission rate, poor tensile strength and sun light/rays.

Table 5: Microbial population of betel leaves papad at different intervals

		Duration			
		0	30th day	60th day	Mean
Bacteria (×10^2 CFU/g)	Control	0.00	4.2	9.9	47.33
	BKP1	0.00	3.6	8.3	39.88
	BAP1	0.00	3.9	8.8	42.77
	Mean	0.00	39.33	90.66	
		F- Value	SEm±	CD @ 5%	
	Treatments(T)	*	1.46	4.38	
	Duration(D)	*	1.46	4.38	
	T× D	NS	2.53	-	
Moulds (×10^2 CFU/g)		0	30th day	60th day	Mean
	Control	0.00	0.33	0.7	3.44
	BKP1	0.00	0.16	0.4	1.88
	BAP1	0.00	0.23	0.43	2.22
	Mean	0.00	2.44	5.11	
		F- Value	SEm±	CD @ 5%	
	Treatments(T)	*	0.37	1.12	
	Duration(D)	*	0.37	1.12	
	T× D	NS	0.64	-	

Coliforms ($\times 10^2$ CFU/g)		0	30th day	60th day	Mean
	Control	0.00	0.2	0.4	2.00
	BKP1	0.00	0.13	0.26	1.33
	BAP1	0.00	0.1	0.3	1.33
	Mean	0.00	1.44	3.22	
		F- Value	SEm±	CD @ 5%	
	Treatments(T)	NS	0.24	-	
	Duration(D)	*	0.24	0.71	
	T× D	NS	0.41	-	

*Significant ($p \leq 0.05$), NS – Non significant, BKP1- Betel leaves *Kariyele* papad, BAP1- Betel leaves *Ambadiyele* papad

Shelf life study of the papad by moisture content

Moisture content of best accepted papad was analysed and presented in Table 6 and Fig.2. Moisture content of best accepted *Kariyele* papad (BKP1) was 5.16% initially and it was increased to 5.53% on 60th day. For *Ambadiyele* papad (BAP1) it was 5.30% initially and 5.56%, 5.61% on 30th and 60th day. Even in case of control papad moisture content was increased from 5.38% initially to 5.71% on 60th day of storage period. Statistically significant difference was observed in papads during 60 days of storage period.

Best accepted betel leaves papads (BKP1 and BAP1) were stored at room temperature in aluminium pouches and moisture content was evaluated at 30 days interval up to 60 days. As the number of days of storage increased, moisture content of the product increased. This might be due to moisture absorption of the product from the surrounding environment. Similar results were reported by Chowdhury *et al.*, (2009) [16] who found that moisture content of soya papads packed in polyethylene bags slightly increased after two months of storage. This may be due to variation in atmospheric relative humidity.

Table 6: Mean moisture content of betel leaves papad during shelf life study

Duration	Moisture content		
	Control	BKP1	BAP1
Initial	5.38	5.16	5.3
30th day	5.67	5.26	5.56
60th day	5.71	5.53	5.61
F value	*	*	*
SEm ±	0.02	0.04	0.06
CD at 5%	0.08	0.16	0.21

*- Significant at 5% level, NS – Non significant, BKP1 – Betel leaves *Kariyele* papad 1, BAP1 – Betel leaves *Ambadiyele* papad 1

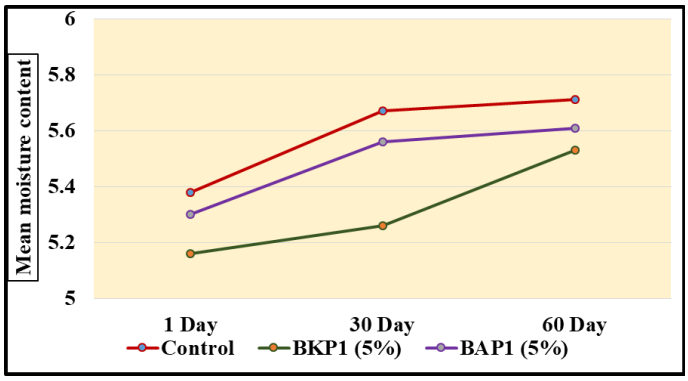

Fig 2: Mean moisture content for best accepted papads

Conclusion

It can be concluded from the results that betel leaves can be dehydrated and shelf stable, nutritious as well as acceptable value added papads can be developed by incorporating dehydrated betel leaves (*Kariyele* and *Ambadiyele*).There was a substantial increase in the nutritional value of the papads enriched by betel leaves powder and it also adds variety to the diet.

Acknowledgement

I am extremely thankful to the faculty of Department of Food Science and Nutrition, University of Agricultural Sciences, GKVK, Bangalore for their constant encouragement and guidance and kind help throughout my course of investigation.

References

1. Saranya R, Devanesan G, Ramesh S, Gopi R. Effect of processing on nutritional quality and antioxidant potentials of leafy vegetables. J Food Pro. Techn. 2017; 8(9):1-6.
2. Guha P. Betel leaf: the neglected green gold of India. J Hum. Ecol. 2006; 19(2):87-93.
3. Mazumder S, Roychowdhury A, Banerjee S. An overview of betel leaf (*Piper betel L.)*: A review. Annals of Food Sci. Tech. 2016; 17(2):367-376.
4. Sripradha S. Betel leaf – the green gold. J Pharm. Sci. and

Res. 2014; 6(1):36- 37.
5. Sengupta R, Banik JK. A review on betel leaf (pan). Int. J Pharm. Sci. Res. 2013; 4(12):4519-4524.
6. Gupta S, Prakash J. Nutritional and sensory quality of micro nutrient rich traditional products incorporated with green leafy vegetables. Int. Food Res. J. 2011; 18:667-675.
7. Sonawane SK, Chandrahas R, Vishwasrao, Ary S. Effect of incorporation of green leafy vegetables on bioactive components of papad – an Indian snack food. The Indian J Nutr. Diet. 2015; 52(3):266-276.
8. A.O.A.C. Official methods of analysis, 13th edition. Association of official agricultural chemists, Washington, D. C. 1980, 191-231.
9. Heau WR, Menzel RG, Roberts H, Freee MH. Methods of soil and plant analysis. Agriculture research service, Department of Agriculture, USA, 1965.
10. Tauber H, Kleiner IS. A method for the quantitative determination of ascorbic acid (vitamin C) content of various plant and animal tissues. J Bio. Chem. 1935; 108:363-570.
11. Ranganna S. Handbook of analysis and quality control for fruit and vegetable products. Tata Mc Graw Hill. Pub. Co. Ltd, New Delhi, 2002.
12. Kang HM, Saltveit ME. Antioxidant capacity of lettuce leaf tissue increases after wounding. J Agr. Food Chem. 2002; 50:7536-7541.
13. Adelowo FE, Oladeji SO, Odelade KA. The Spectrophotometric Evaluation of Phosphate in Soil Samples. MAYFEB J Env. Sci. 2016; 1:20-29.
14. Gopalan C, Rama Sastri BV, Balasubramanian SC. Nutritive value of Indian foods. National Institute of Nutrition, Indian Council of Medical Research. Hyderabad, India. 2014, 40-95.
15. Chauhan ES, Aishwarya J. Proximate and phytochemical scrutiny of *Piper betel* leaves powder. Int. J Ayu. Pharm. Chem. 2016; 5(2):197-204.
16. Chowdhury MG, Mirduddin M, Rahman MM, Islam MS Islam MT. Study on the effect of preservative on the storage quality of spiced papads. J Innov. Dev. Strategy. 2009; 3(1):30-33.
17. Veena B, Reddy BS, Sharan S. Effect of incorporation of soy flour on the quality of papad. J. Biol. Agri. Health care.2012; 2(5):119-127.