Indian Journal of Natural Products and Resources
Vol. 5 (3), September 2014, pp. 262-267

Development and evaluation of bell pepper (*Capsicum annuum* L.) based instant chutney powder

Rakesh Sharma* and V K Joshi
Department of Food Science and Technology
Y S Parmar University of Horticulture and Forestry, Nauni, Solan-173 230, India

Received 16 August 2013; Accepted 21 February 2014

Present study was conducted to standardize a recipe for the preparation of bell pepper (*Capsicum annuum* L.) based instant chutney powder by blending different levels of bell pepper powder with other spice ingredients. Blanched and pre-treated shreds of bell pepper were dried in a mechanical dehydrator (55±2° C) till a constant weight was achieved and converted into powder. All the recipes (R_1 to R_6) were assessed for their chemical composition and sensory quality during storage for three months. The total soluble solids among different recipes ranged between 51.0 to 56.0° B, whereas titratable acidity varied from 1.60 to 6.52 per cent. During storage for a period of three months, all the products of various recipes recorded decrease in titratable acidity, total sugars and ascorbic acid content, whereas increase in moisture content, reducing sugars and total phenols. Sensory analysis of reconstituted chutney powder (R_5) scored highest overall acceptability score of 7.90 (liked extremely) even after three months of storage of powder at room temperature (18.0-24.5°C). On the basis of physico-chemical and sensory attributes, the recipe R_5 was adjudged the best followed by recipe R_6. The critical moisture content of optimized instant bell pepper chutney powder (R_5) was 13.75 % which equilibrated at 46 % RH without any mold growth, indicating good shelf-stability of instant chutney powder at room temperature.

Keywords: Bell pepper, *Capsicum annuum*, Instant chutney powder, Dehydration, Sorption isotherm.

IPC code; Int. cl. (2014.01)–A61K 36/00

Introduction

The bell pepper (*Capsicum annuum* L.) belonging to family Solanaceae, is used world wide either as a vegetable or a condiment[1]. Peppers are gaining popularity because they are cholesterol free, low in sodium and calories and good source of vitamin A and C[2]. They are known to possess antimicrobial activity, reduce the risk of life-style related diseases such as arthritis, cancer and cardiovascular diseases[3-5], in addition to delaying the ageing process[6]. Red bell pepper is an important ingredient in food industry where it is used as colouring and flavouring agent in making sauces, soups, pickles and pizzas[7].

In India, bell pepper has become one of the major commercial cash crops of mid hill regions of the country especially Himachal Pradesh, Uttar Pradesh, parts of Uttrakhand and J&K[8]. Like other vegetables, bell pepper is perishable in nature and deteriorates within a few days after harvest especially in rainy season and these losses are further enhanced when there is glut in the market due to storage problems, marketing and lack of appropriate processing technologies[9]. Thus, to minimize the losses and to provide remunerative returns to the growers, processing and preservation of bell pepper is the only alternative. The primary preservation method for any fruit and vegetable is drying which is accomplished either by traditional sun drying or industrially through the use of solar dryers or hot air drying. Hot air drying has been reported for drying of red bell peppers for their use as spice and flavor ingredient[10]. Further, various pre-treatments prior to drying of vegetables like blanching, chemical treatment, etc. have been suggested by various researchers for obtaining better quality characteristics of the product[1, 11].

Presently, due to changing life style of the people and desire for more leisure time, there is considerable change in food habits with a strong demand for processed Ready-to-Eat (RTE) and Ready-to-Cook (RTC) food products[12]. This trend has also resulted in huge demand for peppers in Indian markets for use in convenience foods, dry salad mixes, dehydrated soups, pizzas, etc[13]. Interestingly, the literature on utilization of bell pepper for preparation of instant

*Correspondent author:
E-mail: drrakes@gmail.com
Phone: +91-1792252410

chutney powder is not available, however several instant chutney powders based on raw mango, tamarind, tomato, stone fruits, apple, wild pomegranate, mint, curry leaves, etc. have been reported by various researchers[12, 14-18]. Thus, there exists a need to develop suitable technology for the development of bell pepper based instant chutney powder that will not only check the losses but also generate additional revenue for the growers.

Materials and Methods

Fresh bell peppers cultivar. 'California Wonder' (red coloured) were procured from the Department of Seed Production, Dr Y. S. Parmar University of Horticulture and Forestry, Solan (HP). Other ingredients such as sugar, salt, chilli powder, *anardana*, citric acid and spices were purchased from the local market.

Preparation of bell pepper powder

The diseased and bruised peppers were sorted out and then thoroughly washed in running tap water to remove dust and other extraneous materials from the surface of fruits. The fruits were shredded with a manual shredder followed by removal of seeds and washing. The shreds were then subjected to different pre-treatments, viz. blanching and chemical treatment as shown in Fig. 1. For blanching, the shreds were dipped in boiling water for 3 min followed by dipping in normal water (1:1) containing KMS (0.2%) and CA (0.50%) for 5 min. Thereafter, the shreds were dried in a mechanical dehydrator at 55.0 ± 2.0°C for 8-10 h. Later, the dried material was ground in a laboratory mixture and sieved to obtain fine powder.

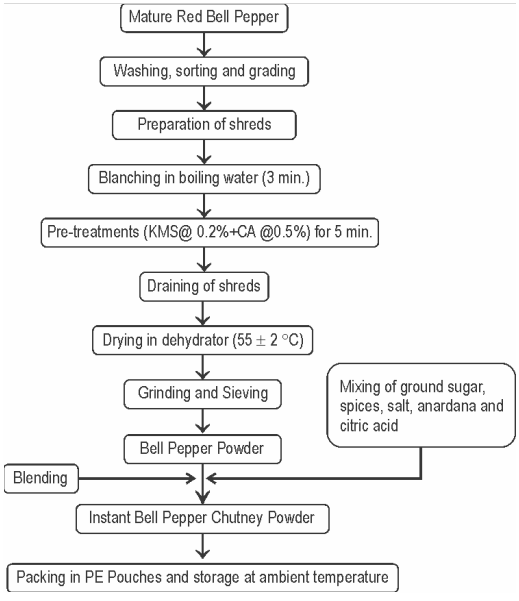

Fig.1—Unit operations for the preparation of bell pepper based instant chutney powder

Standardization of recipe for the preparation of bell pepper based instant chutney powder

The recipe was standardized by preparing different products using bell pepper powder and spice ingredients in varying quantities as per the details given in Table 1 to obtain a palatable product. All the powdered components were mixed, blended in a food processor and packed in polyethylene (PE) pouches and stored at room temperature (18.0-24.5°C) for a period of three months for further studies. The unit operations involved in the preparation of bell pepper based instant chutney powder is presented in Fig. 1.

Biochemical analysis

The fresh bell pepper, powder and instant chutney powders were analyzed for various physico-chemical and sensory parameters on preparation day and after 3 months of storage. Total soluble solid (TSS) contents were measured by hand refractometer (Erma Make), whereas, the moisture content, total solids, sugars, titratable acidity (citric acid), ascorbic acid, crude fibres and ash content were estimated as per standard procedures[19]. Total phenolic content was determined according to the method described by Thimmaiah[20] using Folin–Ciocalteau reagent. Equilibrium moisture content-relative humidity (EMC-RH) studies were conducted for the developed recipe as per standard method[21] by exposing the sample to different relative humidity conditions ranging from 10-100% using

Table 1—Composition of recipes of bell pepper based instant chutney powder (100g)

Ingredients (g)	Recipes					
	R_1	R_2	R_3	R_4	R_5	R_6
Bell pepper powder	24	22	24	22	24	22
Sugar	46	48	48	50	48	49
Salt	10	12	10	12	10	10
Onion powder	4	3	4	3	4	3
Garlic powder	1	1	1	1	1	1
Ginger powder	1	1	1	1	1	1
Black pepper	2	2	2	2	2	2
Cardamom	1	1	1	1	1	1
Cumin	1	1	1	1	1	1
Clove	1	1	1	1	1	1
Chilli powder	1	1	1	1	1	1
Anardana powder	8	7	-	-	-	-
Citric acid (CA)	-	-	6	4	-	-
Anardana powder + CA (1:1)	-	-	-	-	6	8
Total (g)	100	100	100	100	100	100

standard normal solutions of sulphuric acid at room temperature. The samples were observed critically for adverse changes like lump formation, discoloration and mold growth during the study. Accordingly, moisture sorption isotherm of the product was drawn.

Sensory analysis

For sensory evaluation, chutneys were prepared from different bell pepper based instant chutney powder recipes by reconstituting with warm water in 1:2 ratios to make them ready to use. The reconstituted chutneys were analyzed for sensory quality by a group of 10 semi-trained panelists for various parameters, viz. appearance, color, flavor, taste and overall acceptability. The sensory data were collected on 9-point hedonic scale with a maximum score of 9 for "like extremely" and minimum of 1 for "dislike extremely" as per the procedure described by Joshi[22].

Statistical analysis

All the analytical parameters were recorded in triplicate and mean values with standard deviation (SD) are presented. Statistical analysis of data pertaining to physico-chemical characteristics was also carried out by completely randomised design (CRD), whereas that of sensory analysis by randomised block design (RBD)[22-23].

Results and Discussion

Proximate composition of fresh and dried bell pepper

The fresh as well as dried samples of red peppers were evaluated for their proximate composition. The moisture content of the fresh and dried pepper samples was 82.50±1.7 and 11.75±0.85%, respectively. The fresh bell pepper contained 0.25% titratable acidity, 4.84% total sugars, 0.55% ash content, 1.8% crude fibers, 94. 5 mg/100 g ascorbic acid and 850.15 mg/100 g total phenols. It was observed that the application of hot-air-drying has significantly increased the dry matter from 17.50 to 88.25 %. Accordingly, as expected the sugars, ash content, crude fibers and phenolic contents were increased upon drying due to increase in dry matter content. Similar observations were also reported by various researchers while drying chilli and peppers[6, 24]. The fresh bell peppers had a considerable quantity of ascorbic acid (94.5 mg/ 100g), which was reduced to 72.60 mg/100 g in dried powders. A similar reduction in vitamin C content has also been reported during preparation of green chilli powder[24-25].

Physico-chemical characteristics of bell pepper based instant chutney powder during storage

The effect of storage on selected chemical parameters of bell pepper based instant chutney powders for assessing the storage stability is presented in Table 2. It is evident that the moisture content of all samples of chutney powders has increased during storage period at ambient temperature indicating the hygroscopic nature of powders. The recipe R_3 recorded the highest moisture content of 5.75 and 8.05 % during preparation day and after 3 months of storage, respectively. This may be due to the presence of comparatively more amount

Table 2—Changes in the biochemical composition of bell pepper based instant chutney powder during storage at room temperature

Characteristics	Storage intervals (Months)											
	R_1		R_2		R_3		R_4		R_5		R_6	
	0	3	0	3	0	3	0	3	0	3	0	3
Moisture (%)	5.25 ± 0.13	6.10 ± 0.18	5.00 ± 0.25	5.85 ± 0.20	5.75 ± 0.20	8.05 ± 0.15	5.60 ± 0.23	7.70 ± 0.18	5.38 ± 0.12	6.20 ± 0.20	5.45 ± 0.16	6.50 ± 0.18
TSS (^{o} B)	52.0 ± 1.02	50.6 ± 0.98	54.5 ± 1.08	53.1 ± 1.12	55.0 ± 0.80	52.30 ± 1.05	56.0 ± 1.10	54.5 ± 1.15	55.0 ± 0.98	52.0 ± 1.05	55.5 ± 1.15	53.0 ± 1.05
TA (%)	1.60 ± 0.29	1.56 ± 0.35	1.60 ± 0.23	1.56 ± 0.20	6.52 ± 0.30	5.70 ± 0.20	4.85 ± 0.23	3.80 ± 0.18	3.90 ± 0.19	3.42 ± 0.26	5.06 ± 0.30	4.60 ± 0.25
RS (%)	31.86 ± 0.56	32. 95 ± 0.50	32.50 ± 0.60	33.85 ± 0.50	32.80 ± 0.72	35.05 ± 0.58	32.75 ± 0.78	34.40 ± 0.68	32.00 ± 0.65	32.85 ± 0.78	33.20 ± 0.80	34.05 ± 0.76
TS (%)	45.68 ± 0.85	44.58 ± 0.90	45.76 ± 0.98	45.20 ± 0.83	46.02 ± 0.78	45.50 ± 0.87	46.15 ± 0.93	45.85 ± 0.81	46.25 ± 0.85	46.00 ± 0.77	46.25 ± 0.86	45.85 ± 0.80
AA (mg/100g)	31.28 ± 0.30	26.87 ± 0.38	30.18 ± 0.40	26.00 ± 0.28	28.65 ± 0.40	26.85 ± 0.40	28.05 ± 0.32	25.23 ± 0.28	30.02 ± 0.34	26.45 ± 0.30	30.22 ± 0.36	26.50 ± 0.40
Total phenols (mg/100g)	157.25 ± 1.50	208.13 ± 2.08	150.35 ± 1.87	192.63 ± 1.65	130.15 ± 2.04	173.60 ± 1.90	128.75 ± 2.5	172.46 ± 1.92	150.08 ± 2.05	190.60 ± 2.00	152.50 ± 1.94	192.86 ± 2.03

Values expressed are means of 3 replicates ± SD TSS= Total Soluble Solids; TA= Titratable acidity; RS = Reducing sugars; TS= Total sugars; AA= Ascorbic acid

of citric acid which has increased its hygroscopicity. Increase in moisture content in instant tomato pickle mix during storage has also been reported in the literature[17]. However, a non-significant variation ($p< 0.05$) in the total soluble solids among different instant chutney powders was observed irrespective of storage period, which ranged between 51.0° B to 56.0° B. The initial titratable acidity of different powders ranged between 1.60 to 6.52 % with a maximum value for recipe R_3 and minimum value in recipe R_1 and R_2 (Table 2). The significant variation in initial acid content among different recipes is attributed to varying amount of citric acid added as an acidulate in different recipes. However, the titratable acidity of all the powders decreased upon storage for a period of three months. Similar results were also reported in dehydrated fruit powders[12]. The maximum initial reducing sugars content of 32.80 % was noticed in recipe R_3 followed by 32.75 % for recipe R_4 while minimum (31.86 %) for recipe R_1 has been observed which showed slight increase upon storage. The increase in reducing sugars might be due to the hydrolysis of polysaccharides and their subsequent inversion into reducing sugars. The initial total sugar content among different recipes varied non-significantly ($p< 0.05$) between 45.68-46.25 %. However, slight loss in total sugars during storage has been observed which could be attributed to the utilization of sugars in non-enzymatic reactions[12, 18]. Bell pepper based chutney powders were found to be good source of ascorbic acid which is considered as an indicator of nutritional quality of any processed product. It was observed that comparatively higher content of ascorbic acid (30.02-31.28 mg/100 g) was obtained in recipes R_1, R_2, R_5 and R_6 and were found to be statistically at par ($p< 0.05$) with each other, but differ significantly with rest of the recipes. A significant loss in ascorbic acid content was observed during storage among different recipes. The loss of ascorbic acid during storage of processed food products is due to their oxidation especially at ambient storage temperature[26]. Whereas, significant increase in total phenolic contents among different instant chutney powders was observed during storage. The possible reason for this could be reaction of polymeric phenols with moisture content which might have released bound phenols during storage at ambient temperature[16]. A similar trend was also noticed during the storage of dehydrated green chilli powder[27] and instant raw mango *pulihora* mix powder[28].

Sensory characteristics of bell pepper based instant chutney powder during storage

Sensory evaluation of different instant bell pepper chutney powders which were reconstituted with warm water (1:2) was carried on the preparation day and after 3 months of storage of chutney powders (Table 3). Among different recipes, recipe R_5 (consisting of bell pepper powder- 24 g, sugar-48 g, salt- 10 g, onion-4 g, garlic-1 g, ginger-1 g, black pepper- 2 g, cardamom, cumin, clove and chilli powder-1 g each and *anardana* + citric acid (1:1) = 6 g was adjudged best on the basis of better sensory score for appearance, taste, flavour and overall acceptability followed by recipe R_6. The overall acceptability of the recipe was initially 8.0 and it was 7.9 when prepared after a period of 3 months (Table 3). It is apparent from the data that there was no significant difference in the sensory attributes during the storage. However, slight decrease in overall acceptability of the product might be due to loss of colour and flavor during storage period. Similar observations were also observed in instant tomato pickle mix[17] and instant wild pomegranate chutney[18].

Table 3—Changes in sensory characteristics[#] of bell pepper based instant chutney powder during storage at room temperature

Characteristics	Storage intervals (Months)											
	R_1		R_2		R_3		R_4		R_5		R_6	
	0	3	0	3	0	3	0	3	0	3	0	3
Appearance	7.00 ± 0.13	6.75 ± 0.26	7.00 ± 0.10	6.80 ± 0.19	7.00 ± 0.20	6.50 ± 0.28	7.00 ± 0.13	7.00 ± 0.20	7.50 ± 0.14	7.50 ± 0.25	7.50 ± 0.18	7.50 ± 0.28
Texture/ Consistency	7.00 ± 0.26	6.90 ± 0.34	7.00 ± 0.33	6.75 ± 0.40	7.00 ± 0.28	6.70 ± 0.30	7.00 ± 0.40	7.00 ± 0.33	7.50 ± 0.30	7.50 ± 0.36	7.00 ± 0.30	6.90 ± 0.28
Taste	6.50 ± 0.21	6.50 ± 0.29	6.50 ± 0.27	6.50 ± 0.21	6.50 ± 0.20	6.00 ± 0.28	6.90 ± 0.30	6.50 ± 0.17	8.50 ± 0.26	8.20 ± 0.16	8.00 ± 0.20	8.00 ± 0.18
Flavour	6.50 ± 0.28	6.50 ± 0.27	6.50 ± 0.40	6.30 ± 0.38	6.50 ± 0.25	6.35 ± 0.35	7.00 ± 0.36	6.75 ± 0.32	8.00 ± 0.38	8.00 ± 0.42	8.00 ± 0.27	7.85 ± 0.35
OAA	6.90 ± 0.23	6.80 ± 0.29	6.75 ± 0.21	6.50 ± 0.35	6.65 ± 0.31	6.50 ± 0.26	6.95 ± 0.20	6.85 ± 0.35	8.00 ± 0.38	7.90 ± 0.31	7.75 ± 0.30	7.50 ± 0.28

[#] = Sensory evaluation on 9- point hedonic scale; OAA= Overall acceptability

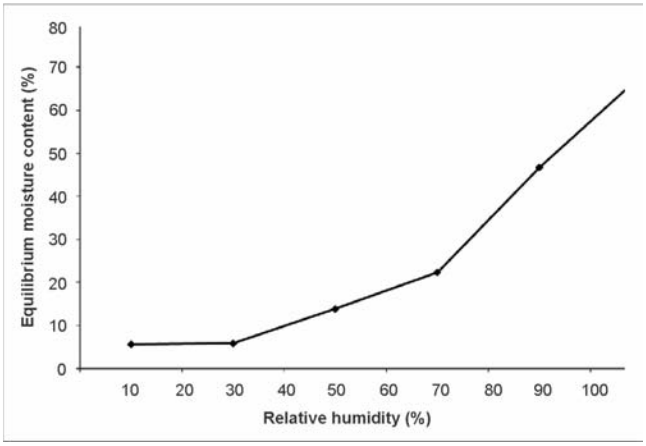

Fig. 2—Moisture sorption isotherm for bell pepper based instant chutney powder (R_5)

Moisture sorption isotherm

Moisture sorption isotherm of bell pepper based instant chutney powder of best recipe (R_5) was recorded at room temperature (18.0-24.5° C). The powder had an initial moisture content (IMC) of 5.6 %, which equilibrated at 32 % RH at room temperature (Fig. 2). Visual lump formation was noticed when the sample attained moisture content of 13.75 % (critical moisture content), which equilibrated at 46 % RH. Though, the powder gained moisture and discoloured at above 50 % RH at room temperature but no mold growth was observed which might be due to presence of spices like garlic, ginger, cumin, black pepper, etc. in the powder which might have exerted their preservative action against mold growth. This indicates the shelf-stability of instant chutney mix powder in polyethylene pouches during storage at room temperature.

Conclusion

For the present study, it was concluded that bell pepper can be dried and utilized successfully for the preparation of Ready-to-Eat instant chutney powder. The chutney powder had good amount of ascorbic acid and phenolics, besides having characteristic flavour. The developed product was self stable up to three months of storage at room temperature.

References

1 Doymaz I and Pala M, Hot air drying characteristics of red pepper, *J Food Eng*, 2002, **55**, 331-335.

2 Luning PA, Yuksel D, Vuurst-de-Vries RV and Roozen JP, Aroma changes in fresh bell peppers (*Capsicum annuum*) after hot-air drying, *J Food Sci*, 1995, **60**(6), 1296-1276.

3 Lee Y, Howard LR and Villalon B, Flavonoid and ascorbic acid content and antioxidant activity of fresh pepper (*Capsicum annuum*) cultivars, *J Food Sci*, 1995, **60**(3), 473-476.

4 Zhang DZ and Hamauzu Y, Phenolic compounds, ascorbic acid, carotenoids and antioxidant, properties of green, red and yellow bell pepper, *J Food Agric Environ,* 2003, **2**, 22-27.

5 Nishino H, Murakosh M, Tokuda H and Satomi Y, Cancer prevention by carotenoids, *Arch Biochem Biophys*, 2009, **483**, 165-168.

6 Ozgur M, Ozcan T, Akpinar-Bayizit A and Yilmaz-Ersan L, Functional compounds and antioxidant properties of dried green and red peppers, *Afric J Agric Res*, 2011, **6**(25), 5638-5644.

7 Chuah AM, Lee YC, Yamaghuchi T, Takamura H, Ying L J and Matobu T, Effect of cooking on the antioxidant properties of colored pepper, *Food Chem*, 2008, **3**, 20-28.

8 Kumar M and Verma V, Bell pepper (*Capsicum annum* L) production in low cost naturally ventilated polyhouses during winters in the mid hills of India, *Acta Hortic*, 2009, **807**(1), 389-393.

9 Kaushal M, Joshi VK and Sharma Rakesh, Preparation and evaluation of value added products from bell pepper, *Indian Food Packer*, 2011, **65**(6), 159-165.

10 Bareh GF, Nadir AS, Wafaa, Abozeid M and Elzamazmy F M, Effect of solar drying on nutritional characteristics of different pepper varieties and its mixtures with tomato, *J Appl Sci*, 2012, **8**(3), 1415-1424.

11 Tunde-Akintunde TY, Effects of pre-treatment on drying time and quality of chilli pepper, *J Food Proc Preser,* 2010, **34**(4) 595-608.

12 Sharma KD, Sharma R and Attri S, Instant value added products from dehydrated peach, plum and apricot fruits, *Indian J Nat Prod Res*, 2011, **2**(4), 409-420.

13 Take AM, Jadhav SL and Bhotmange MG, Effect of pretreatments on quality attributes of dried green chilli powder, *J Engg Sci*, 2012, **1**(1) 71-74.

14 Balaswamy K, Jyothirmayi T and Rao DG, Studies on preparation of curry leaf (*Murraya koenigii* L.) chutney powder, *Foodservice Res Inter*, 2004, **14**, 175-187.

15 Jyothirmayi T, Narsing Rao G and Rao DG, Studies on instant raw tamarind chutney powder, *J Foodservice*, 2006, **17**, 119-123.

16 Narsing Rao G, Prabhakara Rao PG, Jyothirmayi T and Rao DG, Chemical composition, standardization and storage studies on raw mango chutney powder, *J Food Sci Technol*, 2008, **45** (5), 436-438.

17 Narsing Rao G, Prabhakara Rao PG, Balaswamy K and Rao DG, Preparation of instant tomato pickle mix and evaluation of its storage stability, *Inter Food Res J,* 2011*,* **18**, 589-593.

18 Thakur NS, Bhat MM and Sharma Rakesh, Standardization of recipe for the preparation of instant dried wild pomegranate chutney, *Himachal J Agric Res,* 2010, **36**(2), 254 -258.

19 Ranganna S, Handbook of analysis and quality control for fruit and vegetable products*,* 2nd edn, Tata McGraw Hill Publishing Company, New Delhi, 1997, pp. 1152.

20 Thimmaiah S R, Standard methods of biochemical analysis, Kayani Publishers, New Delhi, 1999, 287-288.

21 Landrock AA and Procter BE, A new graphical interpolation method for obtaining humidity equilibrium data with special reference to its role in food packaging studies, *Food Technol,* 1951, **5**, 332-337.

22 Joshi VK, Sensory Science: Principles and Applications in Evaluation of Food, Agro-Tech Publishers, Udaipur, 2006, p. 527.

23 Cochran WG and Cox CM, Experimental Design, John Wiley and Sons, New York, 1967, 171-217.

24 Wiriya P, Paiboon T and Somchart S, Effect of drying air temperature and chemical pre-treatments on quality of dried chilli, *Inter Food Res J*, 2009, **16**, 441-454.

25 Sarker MSH, Hasan SMK, Aziz MG, Islam MT, Azam SM R, Roy S and Ibrahim MN, The effect of processing treatments on the shelf life and nutritional quality of green chilli (*Capsicum annum* L.) powder, *Pertanika J Trop Agric Sci*, 2012, **35**(4), 843-852.

26 Mishra PM, Verma V, Mishra S and Rai GK, Studies on development of ready to eat amla (*Emblica officinalis*) chutney and its preservation by using class one preservatives, *Am J Food Technol*, 2011, **6**, 244-252.

27 Jyothirmayi T, Narsing Rao G and Rao DG, Physico-chemical changes during processing and storage of green chilli (*Capsicum annum*) powders, *J Food Proces Preserv,* 2008, **32**(5), 868-880.

28 Prabhakara Rao PG, Narsing Rao G, Nagender A, Jyothirmayi T and Satyanaryana A, Standardization, chemical characterization and storage studies on an instant *pulihora* mix based on raw mango, *Indian J Trad Knowledge*, 2012, **11** (1), 90-95.