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Preparation of instant tomato pickle mix and evaluation of its storage stability

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Abstract: Studies were conducted for preparation of instant tomato pickle mix (ITPM) by blending optimized levels of tomato powder (TP) and other spice ingredients. The TP and ITPM were assessed for their storage stability. Titrable acidity and protein content in ITPM was found to be 4.8 and 12%; calcium and iron contents were found to extent of 318 and 11.7 mg /100g respectively in the pickle mix. Total polyphenol content increased (1026 to 1608 mg/100g) and lycopene content decreased (14.01 to 5.2 mg/100g) in samples packed in PE pouches during storage for six months. The critical moisture content of ITPM was 12.20%, equilibrating at 50% RH indicated its shelf-stability at room temperature. Sensory analysis of reconstituted instant tomato pickle mix packed in MPE pouches with cooked rice scored very good (8.1) after six months of storage.

Keywords: Tomato powder, instant tomato pickle mix, lycopene, polyphenols, sorption isotherms

Introduction

Tomato (*Lycopersicon esculantum* L.*)* belongs to the family of *Solanaceae,* and is an economically important fruit crop widely grown in India. A wide variety of tomato products viz., juice, powder, puree, sauce, soup and traditionally *chutneys, curries* and *pickles* are prepared in India. India ranked fourth in tomato production with 10.26 MMT out of the total world production of 129 MMT in 2008-09 (Anonymous*,* 2008), Tomatoes are generally sold at lower prices during glut season and they are prone to microbial spoilage, unless preserved or processed. Lack of infrastructural facilities for preservation / processing at farm level is also one of the major factors for the losses.

Literature on composition of tomato and its processing into value added products was reported extensively. Tomatoes are a rich source of lycopene (60-90 mg/kg), vitamin C (160-240 mg/kg), polyphenols (10-50 mg/kg) and small quantities of vitamin E (5-20 mg/kg) (Charanjeet *et al*., 2004). Lycopene content in tomato (Garcia and Barrett, 2006) and antioxidant activity of fresh and processed tomato samples (Giovanelli *et al*., 2004) were reported. It was reported that acidification was found to be effective on reducing pectin esterase activity for maintaining the optimum turbidity and color characteristics in tomato juice (Sarr and Tsai, 2008). The preparation of tomato powder by different drying methods (Gupta *et al*., 2006) and the nutritive value of dry tomato were reported (Inyang *et al*., 2004) earlier. Effect of pre-treatments such as blanching, calcium chloride, sodium chloride, potassium metabisulphite, and type of dryers (solar drying and tunnel dryer) used for dehydration was assessed on physico-chemical parameters, lycopene and color characteristics of tomato powder during storage for six months (Davoodi *et al*., 2007). Lycopene content was reduced to an extent of 21% during spray drying of tomato pulp (Goula and Adamopoulos, 2005).

Chutneys and pickles are relished along with rice and breakfast items like chapathi, idly, dosa, and vada in India. Several instant chutney powders and chutneys based on mint, hibiscus, curry leaves and tamarind leaves, onion-chilly, raw tamarind pods and raw mangoes were reported earlier form our Laboratory (Satyanarayana *et al*., 2001; Balaswamy *et al*., 2004[a]; Balaswamy *et al.*, 2004[b]; Prabhakara Rao *et al*., 2004; Jyothirmayi *et al*., 2006; Narsing Rao *et al*., 2008).

Interestingly, there was not much literature available on utilization of tomato powder for further processing into value added products except instant soup preparations and dustings on deep fat fried products. The main objective of the present study was to process locally available tomatoes of high acid content and low solids into an instant pickle mix and to evaluate the sensory quality and shelf life of the product in selected packaging materials.

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Materials and Methods

Materials

Mature ripe tomatoes (var. Annapurna) were procured from local vegetable market. White sesame seed (*Sesamum indica*), red chilly (*Capsicum annum*), dry ginger (*Zingiber officianale*), cumin seeds (*Cuminum cyminum*), refined peanut oil and salt were purchased from local market. Chemicals used in this study were of laboratory grade procured from Sd Fine Chemicals Ltd., Mumbai, India.

Preparation of instant tomato pickle mix (ITPM)

Whole ripe tomatoes were cleaned thoroughly with running water to remove adhering dust, foreign matter and wiped with muslin cloth to remove surface moisture. Tomatoes were cut into pieces followed by drying in a cabinet tray dryer (Chemida India, Mumbai) at 55±2ºC for 7-8 h. Later the dried material was ground in a laboratory mixer (Sumeet Food Processor, Nashik, India) to pass through BS 30 (500 µ) mesh sieve. White sesame seed (750 g) was partially roasted on pan at 120°C for 1 min to remove raw odor. The seeds were ground coarsely in a laboratory mixer and fat was removed with hexane at room temperature (26±2ºC). The solvent was decanted and the residue was dried under vacuum (55 mm Hg) at 50±2ºC to obtain solvent free defatted sesame meal. The sesame meal was ground in the laboratory food processor and sieved through BS 30 mesh. Red chillies, cumin seeds and dry ginger in the proportion of 15:2:2 were ground in a laboratory mixer to pass through BS 30 (500 µ) sieve to obtain a spice mix. Composition of spice ingredients were optimized by addition of spice mix, defatted white sesame meal and salt at 38:22:40 ratio. Various trials were conducted to standardize the recipe for the preparation of ITPM using tomato powder and spice ingredients in the range of 25:75, 30:70, 45:55, 50:50 and 60:40 to yield a palatable product.

Chemical composition

Both TP and ITPM were analyzed for chemical parameters viz., moisture, total ash, crude fat, crude protein, crude fiber and acidity using standard methods described by Ranganna (1986). The carbohydrate content was calculated by difference method. Salt and calcium contents were estimated according to AOAC method (1995). Iron was estimated by a spectrophotometric method (AOAC, 1995) by using UV-Visible spectrophotometer (Shimadzu, UV-160A model, Japan). The lycopene content was estimated by following a standard procedure (AOAC, 1995). Total polyphenol content was determined by extracting with 80% ethanol, color development with Folin–Ciocalteau reagent and reading optical density at 675 nm (Sadasivam and Manickam, 1997). The samples were also measured for color units of red, yellow and blue using Lovibond Tintometer (Lovibond Tintometer Ltd, Model F, UK).

Equilibrium moisture content - relative humidity (EMC-RH) studies

Both TP and ITPM were exposed to different relative humidity conditions ranging from 10 - 100% using standard normal solutions of sulphuric acid (Landrock and Procter, 1951) at 26±4ºC. The moisture absorbed by sample was determined at regular intervals until the samples equilibrated to constant weight. The samples were observed critically for adverse changes like lump formation, discoloration and mold growth during the study. Accordingly, moisture sorption isotherms of samples were drawn for further analysis.

Storage studies and sensory analysis

Both samples (TP and ITPM) were packed in 25 µ polyethylene (PE) and metalized polyester (2.5 µ)/ polyethylene (7.5 µ) (MPE) laminated pouches of 14 X 12 cm size and stored at room temperature (26±4ºC) over a period of six months. Samples were drawn at bi-monthly intervals for chemical and sensory analysis. Changes in moisture, total lycopene and total polyphenol contents were determined during storage period in both packaging material.

The ITPM was rehydrated with water in 1:3 ratio and seasoned with spices in peanut oil at 15% (based on ITPM) to make the ready to use pickle. The reconstituted pickle was analyzed for sensory quality by serving with cooked rice to a group of 9 semi-trained panelists who acquaint themselves with various traditional chutney powders for 5 parameters viz., appearance, color, flavor, taste and overall quality. The sensory data were collected on Hedonic scale with a maximum score of 9 for "like extremely" and minimum of 1 for "dislike extremely" (Amerine *et al*., 1965)

Statistical analysis

All the analytical parameters were analyzed in triplicate and mean values with standard deviation (SD) are presented. The data was analysed statistically by ANOVA using SPSS 15.0 to evaluate the difference at $p < 0.05$.

Results and Discussion

Standardization of ITPM and its composition

Simple unit operations employed in the preparation of instant tomato pickle mix were cutting, dehydration, grinding, blending and packing. Drying of 24 kg of fresh mature ripe tomatoes yielded 1.38 kg of dry tomato powder. The recipe for the preparation of ITPM was standardized by blending tomato powder and spice ingredients noted to be 50:50 ratio to obtain appropriate acidity, flavour, taste and palatability. The tomato powder (1.38 kg) was mixed with defatted sesame powder (0.303 kg), spice mix (0.861 kg) and salt powder (0.215 kg) and blended in a laboratory mixer to obtain ITPM (2.76 kg).

Data obtained from chemical analysis of TP and ITPM were reported in Table 1. The total protein content in both of them was identical (~12.65%). Decrease in acidity of ITPM was observed due to the addition of other ingredients to TP. Calcium (212, 318 mg/100 g) and iron (7.5, 11.7 mg/100 g) contents were observed in TP and ITPM respectively. There is a significant increase in amounts of calcium and iron by addition of spice ingredients and would be added advantage of ITPM.

Moisture sorption isotherms

The equilibrium moisture content and relative humidity (EMC-RH) data for food materials, particularly for powders were essential to evaluate the storage characteristics under different environmental conditions. Moisture sorption isotherms (Figure 1) were drawn to evaluate the hygroscopicity or hygroemissivity of the tomato powder and ITPM. The tomato powder had an initial moisture content (IMC) of 12.39%, which equilibrated at 20% RH. Similarly the instant tomato pickle mix had an IMC of 7.89%, and equilibrated at 26% relative humidity.

Table 1. Chemical composition of tomato powder and instant tomato pickle mix

Parameter	Tomato powder	Instant tomato pickle mix
Moisture (%)	12.39 ± 0.64	7.89 ± 0.33
Total ash (%)	7.35 ± 0.27	24.70 ± 0.44
Crude protein (% N X6.25)	12.56 ± 0.32	12.74 ± 0.66
Crude fat (%)	3.33 ± 0.35	7.29 ± 0.26
Crude fibre (%)	9.78 ± 0.40	10.94 ± 0.57
Carbohydrates (% by difference)	54.59 ± 082	36.44 ± 1.31
Energy (kcal/100g)	299 ± 2.97	262 ± 1.68
Sodium chloride (%)	ND	19.93 ± 0.24
Acidity as citric acid (%)	8.87 ± 0.39	4.85 ± 0.38
Calcium (mg/100g)	212 ± 2.0*	318 ± 2.0*
Iron (mg/100g)	7.5 ± 0.46*	11.7 ± 0.30*

ND: Not determined, * indicates significant difference P<0.05 in a row

Results indicated that the both TP and ITPM were hygroscopic in nature and hence required immediate packing. Visual lump formation was noticed at when the samples attained moisture contents of 17.72% and 12.20% (critical moisture content), which equilibrated at 49% and 50% RH for tomato powders and ITPM respectively. The moisture content in TP and ITPM packed in MPE pouches were increased to 17.13 and 10.97% respectively during six months storage period, which were in safety limits.

Storage studies

Changes in various parameters namely moisture, lycopene and polyphenol contents in both TP and ITPM were determined during storage of six months and presented in Table 2. Moisture content increased more in tomato powder than in ITPM irrespective of the packaging material during the storage period of six months. There was no significant change in moisture after a period of six months in both samples.

Lycopene content decreased significantly during storage at room temperature in both the packaging materials. The lycopene content decreased from 17.57 to 2.39 and 3.17 mg/100 g in PE and MPE pouches respectively. In case of ITPM the lycopene content decreased from 14 to 5.26 mg/100 g in PE and 5.5 mg/100 g in MPE pouches. These results indicate that oxygen is the only factor and light has little influence on lycopene degradation. Loss of lycopene was lower in instant mix during storage than that in the tomato powder. This may be due to binding of pigment with the other spice components particularly red chilly. Lovric *et al.* (1971) also observed significant losses of lycopene content in foam-mat dried tomato powder, which decreased from 88 mg to 25 mg during storage period of 9 months. Davoodi *et al*. (2007) also reported that lycopene content of the powder reduced by 50% from an initial value of 84 mg/100 g during storage of 6 months.

Significant changes in total polyphenol content in both TP and ITPM were observed. Total polyphenol content increased in tomato powder from 1158 to 1816 and 1789 mg/100 g in PE and MPE pouches respectively. Total polyphenol content in ITPM increased from 1026 to 1608 and 1300 mg/100 g in PE and MPE pouches during storage period. The increase in polyphenol content during storage may be due to the reaction of polymeric phenols with the water moiety to form monomers. Similar changed in polyphenol content in tomato were also observed by Cieslik *et al.* (2006). However, the polyphenol content was reported to increase in case of tomato

Sensory quality during storage

Sensory data of re-hydrated and seasoned ITPM

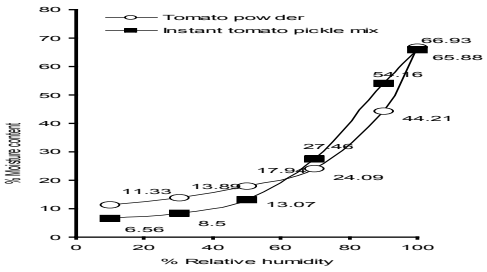

Figure 1. Moisture sorption isotherms of tomato powder and instant tomato pickle mix

pulp, puree and no changes in tomato paste (Charanjeet *et al*., 2004).

Tintometer color readings were measured for TP and ITPM using the Lovibond tintometer which had a significant effect on the quality attributes of the product. Tintometer color units for red, yellow and blue indicated that there was a marginal color change for both the powders. However, the color degradation was more in PE than that in MPE for both the powders (Table 3). Lovric *et al*. (1970) also observed color fading in foam-mat dried tomato powder and concluded that it was due to oxidation or isomerization of lycopene.

Table 2. Moisture, lycopene and polyphenol contents in tomato powder and instant tomato pickle mix in different packaging material during storage

Parameter	Storage period (months)							
	PE				MPE			
	0	2	4	6	0	2	4	6
	Tomato Powder							
Moisture (%)	12.29±0.13	13.12±0.23	17.76±1.0	18.03±0.18	12.29±0.13	12.87±0.83	16.89±0.37	17.13±0.35
Lycopene (mg/100g)	17.57±0.52	9.31±0.34	3.54±0.39	2.39±0.33	17.57±0.52	11.74±0.35	4.25±0.10	3.17±0.10
Polyphenol (mg/100g)	1158±2.64	1259±3.20	1403±4.58	1816±3.60	1158±2.64	1274±4.50	1659±5.00	1789±4.35
	Instant Tomato Pickle Mix							
Moisture (%)	7.89±0.27	8.91±0.29	11.57±0.30	11.77±0.27	7.89±0.27	8.50±0.31	10.06±0.18	10.97±0.23
Lycopene (mg/100g)	14.01±0.13	8.72±0.40	5.42±0.26	5.26±0.22	14.01±0.13	7.37±0.16	5.80±0.20	5.55±0.21
Polyphenol (mg/100g)	1026±1.73	1291±5.56	1423±2.64	1608±1.15	1026±1.73	1191±2.64	1212±2.64	1300±2.00

Values are significantly different $P<0.05$ from 0 days in a row

Table 3. Tintometer color values in tomato powder and instant tomato pickle mix in PE and MPE during storage

Storage period (months)	Tomato powder						Instant tomato pickle mix					
	PE			MPE			PE			MPE		
	R	Y	B	R	Y	B	R	Y	B	R	Y	B
0	8.2 ± 0.26	20.0 ± 0.43	2.0 ± 0.15	8.2 ± 0.26	20.0 ± 0.43	2.0 ± 0.15	6.0 ± 0.20	12.4 ± 0.60	1.0 ± 0.26	6.0 ± 0.20	12.4 ± 0.60	6.0 ± 0.26
2	6.7 ± 0.43	20.0 ±. 0.20	3.0 ± 0.26	6.8 ± 0.30	20.6 ± 0.35	2.2 ± 0.19	5.6 ± 0.34	20.0 ± 0.91	2.0 ± 0.34	5.9 ± 0.26	20.0 ± 1.21	2.0 ± 0.36
4	6.6 ± 0.26	21.0 ± 0.70	3.0 ± 0.17	6.2 ± 0.23	21.0 ± 0.48	3.0 ± 0.20	5.3 ± 0.2	19.1 ± 0.75	2.0 ± 0.43	5.7 ± 0.17	19.3 ± 0.60	2.0 ± 0.17
6	6.0 ± 0.2	26.0 ± 0.78	3.0 ± 0.55	6.2 ± 0.20	30.0 ± 1.32	3.0 ± 0.50	5.1 ± 0.36	19.1 ± 0.18	2.0 ± 0.20	5.5 ± 0.30	19.6 ± 0.45	2.0 ± 0.34

Values are significantly different $P<0.05$ from 0 days in a column

Table 4. Sensory score of instant tomato pickle mix in different packaging material during storage*

Parameter	Storage period (months)							
	PE				MPE			
	0	2	4	6	0	2	4	6
Appearance	8.7 ± 0.24	8.3 ± 0.40	8.1 ± 0.33	7.8 ± 0.43	8.7 ± 0.24	8.5 ± 0.44	8.3 ± 0.40	8.2 ± 0.37
Color	8.7 ± 0.42	8.5 ± 0.36	8.3 ± 0.42	7.9 ± 0.44	8.7 ± 0.42	8.5 ± 0.33	8.4 ± 0.36	8.1 ± 0.51
Flavor	8.4 ± 0.31	8.0 ± 0.57	7.6 ± 0.30	7.6 ± 0.26	8.4 ± 0.31	8.5 ± 0.37	8.5 ± 0.34	8.2 ± 0.39
Taste	8.8 ± 0.15	8.3 ± 0.60	8.2 ± 0.44	7.9 ± 0.44	8.8 ± 0.15	8.7 ± 0.36	8.3 ± 0.53	8.1 ± 0.49
Overall quality	8.7 ± 0.25	8.3 ± 0.54	8.2 ± 0.51	7.8 ± 0.41	8.7 ± 0.25	8.5 ± 0.51	8.3 ± 0.50	8.1 ± 0.46

Values mean of nine replicates and are significantly different at $P<0.05$ from 0 days in a row

was presented in Table 4. The results showed good response to the product even after a storage period of six months. A decrease in overall sensory score of ITPM packed in PE is mainly due to loss of colour and flavour. Even though a significant decrease in sensory score of ITPM, the sample stored in MPE scored very good (8.1) than that of PE pouch (7.8).

Conclusion

In general, preparation of traditional chutney is a simple process. Instant tomato pickle mix using dehydrated tomato powder and other spice ingredients had a greater advantage to utilize the raw material during glut seasons. The product was found to be shelf-stable for six months either in PE or MPE pouches at room temperature without the addition of chemical preservatives. Iron and calcium contents were also seen in good amounts in the ITPM. Increase in polyphenol content during storage of instant tomato pickle mix may be useful in human health point of view.

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