Yadla and Sachdev, 2:3
http://dx.doi.org/10.4172/scientificreports689

Open Access Scientific Reports

Research Article Open Access

Development of Fresh and Processed Tomato Salsa with Herbs

Aruna kumari Yadla[1]* and Poonam A Sachdev[2]

[1]Teaching associate, Department of Food Technology, College of Food Science and Technology, Acharya N G Ranga Agricultural University, Bapatla, Andhra Pradesh, India

[2]Professor, Department of Food Science a006Ed Technology, Punjab Agricultural University, Ludhiana, Punjab, India

Abstract

The present study was carried out to develop fresh and processed tomato salsa with herbs. Formulation of tomato salsa was finalized on the basis of sensory evaluation as tomato (70%), vinegar (10%), sugar (8%), cilantro (1.5%), onion (5.2%), garlic (0.6%), capsicum (1.5%), green chilli (0.6%), oregano (0.3%), cumin (0.15%), pepper (0.15%), guar gum (0.2%) and salt (2%). The shelf life of fresh (unprocessed) salsa was 1 week at room temperature (28-35°C) and 2 months at refrigeration temperature (4-10°C) while that processed salsa remained highly acceptable up till 4 months of storage studies at both the temperatures in all kinds of packaging material used. Non significant effect of storage and packaging was found on moisture, TSS, pH, total sugars, tannins, total phenolics, flavonoids, ash and viscosity but significant effect was found on ascorbic acid, reducing sugars, lycopene and β-carotene of tomato salsa. Microbiological studies found negligible plate count (cfu/g) of bacteria, mould and yeast in processed tomato salsa packed in cans, glass jars and retort pouches during 4 months of storage studies. Sample in glass jars (refrigeration temperature) showed maximum antioxidant activity among all the samples initially and also during storage. Sensory scores of tomato salsa packed in three packaging materials were found acceptable during 4 months of storage studies in the following order: glass jars (refrigeration temperature) > cans > glass jar (room temperature) > retort pouch (refrigeration temperature) > retort pouch (room temperature).

Keywords: Tomato salsa; Oregano; Cilantro; Retort pouches; Antioxidant activity

Introduction

Tomatoes are popular as the "poor man's apple" constitute one of the chief vegetables of India. Its products rank "first" among all processed vegetables [1]. Tomato has an excellent nutritional profile owing largely to its balanced mixture of vitamins such as A, B1, B2, K, biotin, folic acid, nicotinic and pantothenic acids, vitamin-C (160-240 mg/kg), vitamin-E (5-20 mg/kg), and minerals like potassium, calcium, phosphorus, iron and zinc. It is a richest source of antioxidants, lycopene (60-90 mg/kg), phenolic acids (ferulic, chlorogenic, caffeic acids 10-50 mg/kg) with immuno-stimulatory properties [2,3]. β-carotene and lycopene contribute 7 and 87% respectively of total carotenoids in ripe and red tomatoes [4].

Tomatoes are consumed as such, canned or processed into tomato ketchup, paste, puree, sauce and chutney [1]. However the wide individual variation in what human beings live on, led to noticeable changes in eating behavior and in certain cases, it has posed substantial demand for new types of food. The new demands include more types of food, less energy dense foods, less fat, less salt and more dietary fibers which leads to preference for so called 'light' foods, products with reduced fat and energy [5]. So there is a need to develop product with low calorie, low fat, high fiber and antioxidant rich ready to serve/use tomato products. Tomato salsa is one such kind of product with low calorie, high fiber, vitamin and mineral rich product. Tomato salsa is described as having firm chunks of whole tomato suspended in an aqueous medium of fresh juice or pulp fully blended with chopped ingredients such as onions, garlic, salt and acid [6].

Production of salsa will be beneficial to the farmers as well as entrepreneurs because it requires minimum equipment and machinery; and can also be prepared at home scale with low cost. Tomato salsa is a low calorie, shelf stable product from a highly nutritive perishable vegetable (tomato). Addition of herb (cilantro and oregano leaves) will not only increase sensory quality but also enhance nutritional profile of the product with certain vitamins, minerals, antioxidants and antimicrobial agents that these herbs contain naturally [7].

Materials and Methods

Raw materials (onion, garlic, Green chillies, capsicum, cilantro and oregano leaves) were thoroughly cleaned, and yield was calculated. Tomatoes were blanched and peeled and cut into halves to remove core and seeds. Then these materials were chopped into small cubes with a food processor chopping machine. Tomato puree was prepared by concentrating tomato juice up to 8.37% TSS.

Fresh tomato salsa was prepared by mixing all ingredients such as tomato slices, tomato puree, onion, garlic, green chillies, capsicum, cilantro, salt, sugar, vinegar, oregano leaves, pepper and cumin powder in a frying pan and was packed in glass jars and was stored at refrigeration temperature (4-10°C). Processed tomato salsa was prepared by heat processing , followed after addition of 0.2% guar gum and simmered for 30 minutes and filled hot into cans, glass jars and retort pouches then sealed and processed and were stored at room (28-35°C) and refrigeration temperatures (4-10°C).

Physico-chemical analysis of raw materials (tomato, onion, garlic, green chilies, capsicum, cilantro and oregano leaves) and fresh and processed tomato salsa formulations, which were stored at ambient and refrigeration temperature, was carried out for various physico chemical characteristics including color, moisture, total soluble solids, total

***Corresponding author:** Aruna kumari Yadla, Teaching associate, Department of Food Technology, College of Food Science and Technology, Acharya N G Ranga Agricultural University, Bapatla, Andhra Pradesh, India, E-mail: arunamoses007@yahoo.com

Received December 20, 2012; **Published** May 31, 2013

Citation: Aruna Kumari Y, Poonam AS (2013) Development of Fresh and Processed Tomato Salsa with Herbs. 2: 689 doi:10.4172/scientificreports.689

and reducing sugars, pH, acidity, ascorbic acid, carotene, lycopene, viscosity and tannins by the methods followed from Ranganna [8]. Swain and Hillis method was followed for total phenolics, Ting and Rouseff [9] method was followed for Flavonoids where sample was extracted with water and made volume up to 100ml, filtered with filter paper (watman no.1). 0.5 ml of the extract was pipette out into an Erlenmeyer flask further added 0.5 ml of 4N NaOH and 24 ml of 90% diethyl glycol (DEG). Mixed gently by swirling and stood for 10 min. Absorbance of the developed color after 30 minutes was measured at 420 nm using spectronic-20 spectrophotometer. A standard curve was plotted by taking known amount of Naringin as reference standard. 0.5 ml distilled water in the place of sample was used for blank. DPPH method was followed for antioxidant activity. Free radical scavenging activity was determined by DPPH (di phenyl picryl hydrazyl) method. Five hundred micro liters of 0.5 mM DPPH solution and 2 mL of 80% methanol aqueous solution were mixed with 25 µL of methanolic extract of sample, and absorbance was determined under 517 nm (blank as 80% methanol and tris buffer) after maintaining at 20°C for 30 minutes. The free radical scavenging activity was evaluated by comparing the absorbance of the sample solution with control solution to which distilled water was added instead of sample.

$$*FRSA\% = \frac{Control\ O.D - Sample\ O.D}{Control\ O.D} \times 100$$

*FRSA= Free Radical Scavenging Activity

Pericles (1982) method was used to determine anthocyanins present in the samples. Product viscosity was calculated by using Brookfield viscometer [8] and Mineral estimation was carried out for raw material and product by using atomic absorption spectrophotometer described by AOAC [10] method, APHA [11] for microbial count and sensory evaluation by nine point hedonic scale.

Results and Discussion

Raw materials used in the preparation of tomato salsa were analyzed for physico-chemical parameters viz. moisture, TSS, acidity, ascorbic acid, total and reducing sugars, ash, minerals and yield and are represented in Table 1. Moisture content of tomato and other ingredients i.e. capsicum, cilantro, green chilli, onion and garlic were found to be 93.2, 92.5, 91.7, 90.9, 90.6, 63.9% on the fresh weight basis. Oregano leaves (dried) found to contain 7.16% moisture content (Table 1). Berry [2] reported that the moisture content of tomato was 93.1%. Moisture content of onion was said to be ranging from 88.6 - 92.8% [12]. Nwinuka et al. [13] reported that moisture content of garlic and onion was 41 and 4.9% respectively. Total soluble solids (TSS) of the tomato, capsicum, cilantro, green chilli, onion and garlic were found to be 5, 4.2, 3.8, 4.2, 7.7 and 3.2°B respectively. Sethi and Anand [1] reported the TSS of Hybrid Tomato varieties ranging from 3.8 to 4.62 °Brix. Tomato contained 6.742 mg/100g of ascorbic acid and capsicum, cilantro, green chilli, onion, garlic and oregano leaves found to contain 22.6, 6.98, 37.1, 2.35, 5.58 and 0.62 mg/100g of ascorbic acid respectively.

Abushita et al. [14] reported that the concentration of ascorbic acid ranged between 14.6 - 21.7 mg/100g fresh weight of ripe tomato fruit where as Hounsome et al. [15] reported that ascorbic acid of tomato as 20 mg/100g. Shi reported that ascorbic acid content in whole mature-red fresh tomatoes was 13.2%. Lopez-Hernandez et al. [16] reported vitamin C content of *Capsicum annuum* L. var. *Longum* grown in Galicia (N.W. Spain) peppers was 24 mg/100 g). Peter reported the ascorbic acid content of oregano was 45 mg/100g. Acidity (% citric acid) of tomato, capsicum, cilantro, Greenchilli, onion, garlic and oregano was noted as 0.11%, 0.08%, 0.10%, 0.11%, 0.31%, 0.04% and 0.002% respectively. Sethi and Anand [1] reported that the titrable acidity of hybrid varieties of tomato ranging from 0.33 to 0.48%. Tomato was found to have 2.7% reducing sugars and 4.19% total sugars and remaining ingredients like, cilantro, green chilli, capsicum, onion, garlic and oregano were found to contain 0.71, 0.68, 1.81, 2.31, 0.93 and 0.08% and of total sugars were noted as 0.99, 1.02, 2.19, 7.08, 2.47 and 0.11 per cent respectively. Kaur and Bains [3] reported that the reducing sugars of two tomato varieties were 3.9% (Pusa Sawani) and 2.9% (Punjab Padmani). Sethi and Anand [1] reported that total sugars of Hybrid Tomato varieties ranging from 2.16 to 2.91%. Ash content of tomato, cilantro, green chilli, capsicum, onion, garlic and oregano leaves were found to be 2.15, 0.91, 0.39, 1.24, 0.26, 0.60 and 6.43% respectively. Tepic et al. [17] reported that ash content of tomato inbred lines ranged from 7.62% to 9.90%.

The total ash content (8.33 to 9.09%) of red mature tomatoes is a little less than 10% of the dry matter [18]. Oregano is rich in mineral elements such as potassium, calcium, magnesium, phosphorus, zinc, manganese, iron, copper, sulphur, chlorine, iodine and selenium, where its sodium content is low. Elemental analysis carried out to find out mineral content of raw ingredients. Antioxidant activity of raw ingredients was found to be in following order: cilantro > oregano > tomato > capsicum > onion > garlic (Table 2 and Figure 1). Standardization of the preliminary treatments such as blanching and lye treatments was done on the basis of ease of peeling and minimum weight loss after peeling. Lye treatment was found optimum at boiling water for 3 seconds with 0.2% lye solution and blanching in boiling water for 5 seconds was found optimum. Blanched tomato was found to be good for preparation of tomato salsa as compared to lye treated tomato due to its better color and texture.

Blanched tomato was found to be good for preparation of tomato salsa as compared to lye treated tomato due to its better color and texture. Formulation of tomato salsa was finalized on the basis of sensory evaluation and the selected levels of vinegar, sugar and cilantro were found to be 10%, 8% and 1.5% respectively in 70% of tomato which was the major ingredient of tomato salsa. The remaining ingredients i.e. onion (5.2%), garlic (0.6%), capsicum (1.5%), green

Sample	Moisture (%)	TSS (°B)	Acidity (%citric acid)	Ascorbic acid (mg/100g)	Total sugars (%)	Reducing sugars (%)	Ash (%)	Yield (%)
Capsicum	92.5	4.2	0.09	22.6	2.19	1.81	1.24	75
Cilantro	91.7	3.8	0.10	6.98	0.99	0.71	0.91	83
Green chilli	90.9	4.2	0.12	37.1	1.02	0.68	0.39	79
Tomato	93.2	5.0	0.11	6.74	4.19	2.70	2.15	57
Onion	90.6	7.7	0.31	2.35	7.08	2.31	0.26	76
Garlic	63.9	3.2	0.05	5.58	2.47	0.93	0.60	59
Oregano leaves	7.16	-	0.00	0.62	0.11	0.08	6.43	88

Table 1: Physico-chemical characteristics and yield of raw material.

Sample Time (min.)	5 min.	10 min.	15 min.	20 min.	25 min.	30 min.	LSD (P ≤ 0.05)
BHT	0.098	0.092	0.091	0.090	0.087	0.085	NS
Tomato	0.170	0.159	0.156	0.132	0.125	0.111	1.2
Cilantro	0.153	0.151	0.121	0.117	0.103	0.091	1.1
Oregano	0.18	0.151	0.132	0.127	0.119	0.107	1.4
Onion	0.372	0.369	0.341	0.322	0.282	0.222	1.1
Garlic	0.399	0.387	0.375	0.358	0.341	0.323	1.3
Capsicum	0.173	0.171	0.165	0.152	0.147	0.122	1.1
Green chilli	0.165	0.162	0.154	0.151	0.147	0.145	1.3

Table 2: Antioxidant activity (optical density) of raw ingredients used in tomato salsa.

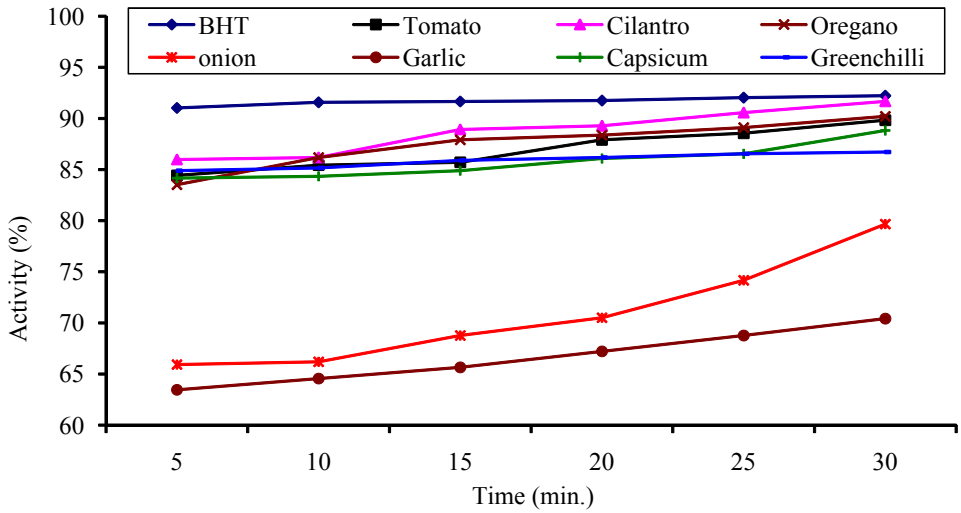

Figure 1: Antioxidant activity (%) of raw ingredients used in tomato salsa.

Parameter	"0" day	After 30days	After 60 days	LSD (P ≤ 0.05)
Appearance	8.5	8.0	7.6	0.53
Flavor	8.5	7.7	7.7	0.63
Consistency	8.5	8.3	7.6	0.52
Overall acceptability	8.5	8.0	7.6	0.53

Table 3: Effect of storage on sensory quality of fresh tomato salsa stored at refrigeration (4-18°C) temperature (n=10).

chilli (0.6%), oregano (0.3%), cumin (0.15%), pepper (0.15%) and salt (2%) were added according to the taste acceptability of the panelists. Four hydrocolloids i.e. Carboxy methyl cellulose (CMC), guar gum, pectin and sodium alginate were added to the tomato salsa at different concentrations (0.2, 0.4, 0.6, 0.8 and 1%) to avoid the separation of serum from the product. Out of four hydrocolloids guar gum at 0.2% was found optimum on the basis of consistency and sensory evaluation.

Shelf life of fresh tomato salsa found to be 2 months under refrigerated conditions (4-18°C) and 8-10 days (Table 3) under room temperature (28-35°C). There was no significant effect on total soluble solids (14°B), pH (4.0-4.2), total sugars (18%), tannins (45.5%), viscosity (1100-1185 cP) and total phenolics (10.5%) but moisture (1.4%), titrable acidity (26%), ascorbic acid (54.2%), reducing sugars (3.8%), lycopene (25.6%), β-carotene (4%) and ash content (16%) were significantly decreased during storage in fresh tomato salsa (unprocessed) under refrigerated conditions (4-10°C). Processed salsa showed significant decrease in ascorbic acid, Lycopene and β-carotene and increase in reducing sugars at both room (28-35°C) and refrigeration temperatures (4-10°C). Maximum loss of ascorbic acid was found in tomato salsa packed in retort pouches at room temperature (45%) followed by glass jars at room temperature (43%), retort pouches at refrigeration temperature (40%), glass jars at refrigeration temperature (30%) and cans (24%) than glass jars (30%) and retort pouches (40%) stored at refrigeration temperature (4-10°C) during storage studies.

There was significant increase in reducing sugars of tomato salsa packed in glass jars stored at room temperature (16%) followed by cans (14%), retort pouches stored at room temperature (8%) retort pouches stored at refrigeration (6%) glass jars stored at room temperature (4%) during storage (Table 4).

Maximum retention of lycopene (Table 5) was found in tomato salsa packed in glass jars stored at refrigeration temperature (91%) followed by glass jars stored at refrigeration temperature (80%), retort pouches stored at refrigeration temperature (75%), retort pouches stored at room temperature (75%) and cans (65%). β-carotene was found to retain maximum in tomato salsa packed in glass jars stored at refrigeration temperature (69%) followed by glass jars stored at room temperature (64%), cans (64%), retort pouches stored at refrigeration temperature (51%) and retort pouches stored at room temperature (48%) during storage studies.

Minimum decrease in antioxidant activity (Table 6 and Figure 2) was noticed in tomato salsa packed in glass jars stored at refrigeration

Storage time (months)	Reducing sugars (%)					Total sugars (%)				
	Can	Glass jar		Retort pouch		Can	Glass jar		Retort pouch	
	Room temp.	Room temp.	Ref. temp.	Room temp.	Ref. temp.	Room temp.	Room temp.	Ref. temp.	Room temp.	Ref. temp.
0	6.64	6.90	6.90	6.70	6.70	10.38	10.40	10.40	10.50	10.50
1	7.11	7.05	6.92	6.83	6.83	9.84	10.08	10.02	9.76	9.44
2	7.49	7. 24	7.38	6.99	6.89	9.72	9.92	9.64	9.65	9.03
3	7.58	7.43	7.60	6.88	7.09	9.69	9.83	9.58	9.49	9.98
4	7.72	7.65	7.17	7.32	7.16	9.51	9.34	9.31	9.32	9.32
LSD (LSD<0.05)										
Room Temp.	0.14					NS				
Ref. Temp.	0.11					NS				

NS: Non significant

Table 4: Effect of packaging and storage on reducing and total sugars of tomato salsa stored under room and refrigeration temperatures (n=3).

Storage time (months)	Lycopene (mg/100g)					β-carotene (mg/100g)				
	Can	Glass jar		Retort pouch		Can	Glass jar		Retort pouch	
	Room temp.	Room temp.	Ref. temp.	Room temp.	Ref. temp.	Room temp.	Room temp.	Ref. temp.	Room temp.	Ref. temp.
0	12.70	12.09	12.09	12.13	12.13	6.79	6.99	6.99	6.93	6.93
1	11.72	11.89	11.80	10.50	11.07	5.94	5.88	5.90	5.83	5.21
2	9.56	9.55	11.32	10.16	10.14	5.77	4.66	4.65	3.81	3.98
3	8.90	9.89	10.49	9.13	9.15	5.69	4.58	4.92	3.53	3.70
4	8.26	9.70	10.96	9.11	9.12	4.32	4.44	4.79	3.35	3.56
LSD (LSD<0.05)										
Room Temp.	0.24					0.12				
Ref. Temp.	0.18					0.11				

Table 5: Effect of packaging and storage on Lycopene and β-carotene of tomato salsa stored under room and refrigeration temperatures (n=3).

Storage time (months)	Antioxidant activity (%)				
	Can	Glass jar		Retort pouch	
	Room temp.	Room temp.	Ref. temp.	Room temp.	Ref. temp.
0	86.6	90.7	90.7	82.1	82.1
1	84.9	89.3	89.8	79.6	81.1
2	82.6	87.2	91.1	75.2	79.8
3	79.9	83.5	90.9	71.6	74.4
4	82.6	79.9	86.3	71.6	77.1
LSD (LSD≤0.05)					
Room Temp.	1.7				
Ref. Temp.	1.3				

Table 6: Effect of packaging and storage on Antioxidant activity (%) of tomato salsa stored under room and refrigeration temperatures (n=3).

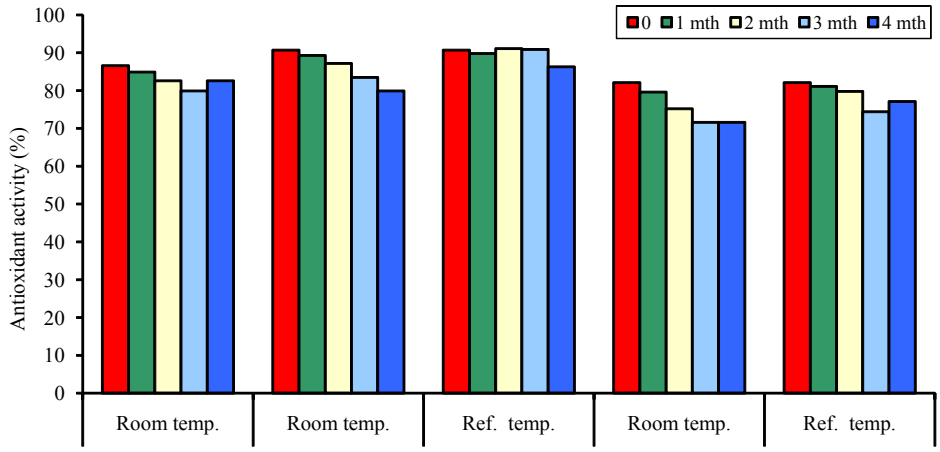

Figure 2: Effect of packaging and storage on Antioxidant activity (%) of tomato salsa stored under room and refrigeration temperatures.

temperature (5%) was minimum followed by cans (5.5%), retort pouches stored at refrigeration temperature (6%), glass jars stored at room temperature (12%) and retort pouches stored at room temperature (13%) during 4 months of storage studies. During storage of processed

Storage time (months)	Bacterial count (cfu/g)					Yeast and mould count(cfu/g)				
	Can	Glass jar		Retort pouch		Can	Glass jar		Retort pouch	
	Room temp.	Room temp.	Ref. temp.	Room temp.	Ref. temp.	Room temp.	Room temp.	Ref. temp.	Room temp.	Ref. temp.
0	-	-	-	-	-	-	-	-	-	-
2	2	22	18	19	13	-	-	-	2	4
4	13	29	15	23	29	-	8	5	18	12
LSD (LSD<0.05)										
Room Temp.	NS					NS				
Ref. Temp.	NS					NS				

NS: Non significant

Table 7: Effect of packaging and storage on bacterial, yeast and mould count acceptability of tomato salsa stored under room and refrigeration temperatures (n=3).

tomato salsa the parameters like moisture, acidity, viscosity, tannins, phenolics, flavonoids and ash content were found to decrease and pH and TSS were found to increase non significantly irrespective of packaging material used. Sensory parameters like appearance and flavor showed non significant decrease whereas consistency and overall acceptability showed non significant increase in tomato salsa stored under room temperature.

Summary

At refrigeration temperature (4-10°C) there was non significant effect of storage on the sensory parameters of tomato salsa packed in all packaging materials. The shelf life of fresh (unprocessed) salsa was 1 week at room temperature (28-35°C) and 2 months at refrigeration temperature (4-10°C) while that processed salsa remained highly acceptable up till 4 months of storage studies at both the temperatures in all kind of packaging material used. Microbiological studies (Table 7) found negligible plate count (cfu/g) of bacteria, mould and yeast in processed tomato salsa packed in cans, glass jars and retort pouches during 4 months of storage studies at room as well as refrigeration temperatures.

References

1. Sethi V, Anand JC (1986) Quality characteristics of hybrid tomatoes for puree preparation. Indian Food Packer 40: 13-19.
2. Berry SK (2007) Healthier living the tomato way. J Processed Food Industry 10: 21-28.
3. Kaur B, Bains GS (1992) Comparative studies on 'Ready to serve' canned okra/ lady's fingers (Hibiscus esculentus L.) in brine and tomato juice. Indian Food Packer 46: 21-26.
4. Singh J, Rai M (2006) Lycopene in tomato for Human Health. J Indian Hort 54: 33-34.
5. Sabapathy SN, Bawa AS (2007) Nutritional assessment of industrially processed foods. Ind J Nutr Dietet 44: 89-95.
6. Allison AA, Chambers IVE, Gibson E, Aramouni FM (1999) Sensory Characteristics of Heat-processed and Fresh Tomato Salsa Containing Honey. J Food Sci 64: 560-564.
7. Saha B, Maity TK, Mishra AK (2007) Herbs and spice-naturally occurring antimicrobials. The Ind J Nutr Dietet 44: 89-95.
8. Ranganna S (1986) Handbook of analysis and quality control for fruit and vegetable products (second edition). Tata Mc-Graw Hill Publishing company Ltd. New Delhi. Pp1112, 514.
9. Ting SV, Rouseff RL (1986) Citrus Fruits and Their Products: Analysis and Technology. Newyork, pp: 108-112.
10. AOAC (2005) Official Methods of Analysis. Association of Official Analytical Chemists, Washington D.C, 14th edition.
11. Anonymous (1984) Method of microbiological examination of food. (APHA) American Public Health Association, Washington.
12. ftp://166.111.30.161/incoming/new_book/Food%20Science/Handbook%20of%20Herbs%20and%20Spices/35628_21.pdf
13. Nwinuka NM, Ibeh GO, Ekeke GI (2005) Proximate Composition and Levels of Some Toxicants in Four Commonly Consumed Spices. J Appl Sci Environ Mgt 9: 150-155.
14. Abushita AA, Daood HG, Biacs PA (2000) Change in carotenoids and antioxidant vitamins in tomato as a function of varietal and technological factors. J Agric Food Chem 48: 2075-2081.
15. Hounsome N, Hounsome B, Tomos D, Edwards-Jones G (2008) Plant metabolites and nutritional quality of vegetables. J Food Sci 73: 48-65.
16. Lopez-Hernandez J, Oruna-Concha MJ, Simal-Lozano J, Vazquez-Blanco ME, Gonzalez-Castro MJ (1996) Chemical composition of Pardon peppers (Capsicum annuum L.) grown in Galicia (N.W. Spain). Food Chem 57: 557-559.
17. Tepic AN, Vujicic BL, Takac AJ, Krstic BD, Calic LJ (2006) Chemical Heterogeneity of Tomato Inbred Lines. UDC 635.64:66.014, 37: 45-50.
18. http://www.oecd.org