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PRODUCING AND EVALUATION OF RED PEPPER PASTE AS NEW FOOD PRODUCT

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ABSTRACT

In this study, fresh and dry red pepper and tomato were used to prepare different blends of red pepper paste (100% tomato paste as control, 50% tomato + 50% red pepper, 40% tomato + 60% red pepper, 30% tomato + 70% red pepper, 20% tomato + 80% red pepper, 10% tomato + 90% red pepper, 100% red pepper and 90% tomato + 10% dry red pepper). Two methods were used for preparing red pepper paste (open pan and vacuum technique). The red pepper paste was sensory evaluated. Data obtained for sensory evaluation indicated that red pepper paste produced with the vacuum technique more acceptable than traditional technique (open pan). The paste prepared with open pan technique had low score in color, taste, odor and overall all acceptability. The red pepper paste prepared by vacuum technique was stored for 9 months gradually chemically analyzed, examined for microbiological quality and represented for sensory evaluation. Data indicated that paste prepared from 50% tomato and 50% red peppers was better than other paste products in sensory properties. Total soluble solids were slightly decreased during storage period. Chemical analysis indicated that pH values and total sugars were decreased with increasing storage time for paste products. The β-carotene, lycopene and ascorbic acid were increased with increasing the percentage of adding red pepper in the blendes. These components were decreased with increasing storage time of paste product. Up to six and nine months the microbiological quality of tomato paste was changed. The changing in the microbiological quality was under food low allowance. Sensory evaluation indicated that there are significant differences in all properties of paste samples during storage period.

Key words: Red pepper. Red pepper paste. Tomato puree Chemical composition. Physicochemical properties. Microbiological quality. Sensory characteristics.

INTRODUCTION

Pepper is a Solanaceous agricultural crop belonging to the *Capsicum annum L.* species. Health-promoting, nutritional and sensory attributes make pepper as one of the most worldwide consumed vegetable. Pepper is the second most important solanaceous vegetable after tomato, Vengaiah and Pandey (2007). Pepper is an important agricultural crop, not only because of its economic importance, but also for the nutritional value of its fruits, mainly due to the fact that they are an excellent source of natural colors and antioxidant compounds, (Howard *et al.*, 2000). The genus Capsicum comprises more than 200 varieties (Pruthi, 1980). The fruits vary widely in size, shape, flavor and sensory test. The genus Capsicum comprises five main species: *Capsicum annuum* (comprising the NuMex, Jalapeno and Bell varieties), *Capsicum frutescens* (Tabasco variety), *Capsicum chinense* (Habanero and Scotch Bonnet varieties), *Capsicum baccatum* (Aji varieties) and *Capsicum pubescens* (Rocoto and Manzano varieties), (Pruthi, 1980 and Perez-Galvez, *et al.*, 2006).

The C. *annuum* sort comprises seven varieties. In all of them, the color is the most

important quality of the fruits as they are used for coloring foodstuffs. During ripening of fruits, their color changes from green, due to chlorophylls, to orange and red because of the presence of carotenoids, pigments responsible for fruit color. The carotenoid profile of the ripened fruit includes seven major carotenoid pigments, some of them are only biosynthesized in this fruit (capsanthin and capsorubin) and others with provitamin A activity (β-carotene and β-cryptoxanthin). This profile is kept in all varieties although they present different carotenoid concentrations that directly affect the economical evaluation of fruits and their processed products, Perez-Galvez, *et al.* (2006).

Bell-type peppers are large fruits with a blocky shape and a thick wall, and they are commercially distributed for direct consumption or cooked Perez-Galvez, *et al.* (2006).

Paprika, the dehydrated and milled fruit of certain varieties of red pepper (*Capsicum annuum* L.), is one of the most widely used food colorants for culinary and industrial purposes. Because of its high coloring capacity, and in some cases its peculiar pungency, paprika is used to modify the color and flavor of soups, stews, sausage, cheese, snacks, salad dressing, sauces, pizza, and confectionary products, among others (Nieto-Sandoval, *et al*., 1999).

Peppers are economically important because of the vast consumption of the diverse varieties. The food industry is the largest user of capsicums, where they are used as coloring and flavoring agents in sauces, soups, processed meats, snacks, candies, soft drinks and alcoholic beverages (Pino *et al.,* 2007). Peppers are an important source of β-carotene, which have antimutagenic and/or anticarcinogenic properties (Monsereenusorn *et al*., 1982).

Pepper fruits contain a large spectrum of antioxidant compounds. In particular, polyphenols, vitamin C, flavonoids and carotenoids, with free radical scavenging properties, are essential antioxidants that may protect against the propagation of the oxidative chain (Namiki, 1990; Mateos *et al.,* 2003; Deepa *et al,*. 2007). Consumption of these compounds may prevent several human diseases, including several forms of cancer, arteriosclerosis and cardiovascular diseases (Harris, 1996 and Bramley, 2000). Their quantities vary with genotype and maturity and are influenced by growing conditions and losses after processing (Zewdie and Bosland, 2001).

The amounts and characteristics of flavoring, coloring and especially pungent principles of capsicum fruits are important quality parameters. Their strong pungency has been attributed to capsaicinoids, of which capsaicin and dihydro capsaicin constitute more than 80% (Kirschbaum-Titze *et al*., 2002 and Topuz and Ozdemir, 2004).

The characteristic pungency and aroma, together with the occurrence in a large variety of colors (green, yellow, orange, red and purple), shapes and sizes, which were favor to use peppers in several food processing, (Lucier and Lin, 2001). Indeed, peppers are used for the manufacture of dehydrated products, pickled peppers, pastes and sliced peppers to be eaten raw as salads or to be used in pizzas.

The primary processing step of bell peppers is drying to conserve the perishable fruits, to reduce storage volume, and to decrease transport costs. Traditional sun drying and hot air drying are the major drying methods for peppers (Govindarajan, 1985). Peppers are usually processed in the dried form that lacks fresh capsicum color and flavor (Luning, *et al*., 1995). Although methods of preservation such as drying had been widely practiced, there are demands for alternate processes, which produce favorable nutritive, physico-chemical qualities and shelf-life extensions of chili-based products.

Red peppers are used to produce dehydrated products (such as paprika), pickled peppers, and sliced or diced frozen peppers to be used in pizzas or to be eaten raw as salads. All used of peppers has been increasing considerably in the last years, as part of healthier food habits. But there is not enough

information about quality and stability (acidity, pH, brown pigment formation, aerobic plate count, mould and yeast counts and sensory quality) of red pepper paste in the literature.

There are two main techniques applied for manufacturing of the hot pepper paste. These are concentration in an open pan and under vacuum Bozkurt and Erkmen (2004 and 2005).

The presence of yeasts and moulds in the pasteurized food products had several negative consequences: (1) a decline in pH during storage at 29°C, probably resulting from acid production by these organisms, which could impart off-flavors; and (2) the possibility that acid-metabolizing moulds or bacteria (e.g. *Bacillus licheniformis*) might survive and out grow the acid formers, thereby increasing the pH. Under such conditions, bacterial spores (*Bacillus spp*., *Cl. botulinum*) might germinate, grow and produce toxin or cause spoilage (Vilari *et al.,* 1994). A thermal process capable of inactivating yeasts and moulds is recommended during processing (Zanoni *et al.,* 2003).

The production of pepper in Egypt was too more. The production of it was more than 350000 ton in 1999 as mentioned by MALR (2000). Nearly, most of pepper product in Egypt was red pepper, a lot of them used as fresh vegetable and prepared some kind of pickle.

The aim of this work was to produce and evaluate the red pepper paste as special new food product. Moreover to study the chemical, microbiological and sensory properties of red pepper paste during storage. To publish the benefit of the important of using red pepper in Egypt for producing some products which are imported from foreign countries.

MATERIALS AND METHODS

Materials:

Red pepper:

Red peppers (*Capsicum annuum* L.), family, Solanaceae) were harvested in the morning in a local farm in Kaha city, Qalyoubia Governotate, Egypt, and then transported to the laboratory in Food Science Department, Fac. of Agric., Moshtohor, Benha Univ.. After that, fruits were stored at 4±1 °C until use in analysis or process.

Tomato:

The ripe tomatos (*Lycopersicum esculentum*) were obtained from special farm in Kaha city, Qalyoubia Governotate, Egypt.

Salt: was purchased from a local supermarket.

All chemicals used in this study were of analytical grade which were purchased from Al-Gomhuria Co. for chemical, Cairo, Egypt.

Methods:

Preparation Methods:

Preparation of red pepper puree:

The red pepper was taken to select uniform size, shape, and without any defect on visual inspection and thoroughly clean before manually sorting. The sorted red pepper was washed in cold water to remove soil and dust particles. The thoroughly cleaned samples were manually graded on the basis of their size. Washed red pepper was sliced with knives as approximate sizes of 15 mm x 15 mm of uniform slices with thickness of 2–4 mm. After slicing, the slices were blanched with hot water at 95 °C for 3-5 min. The method of blanching is similar to Ahmed and Shivhare (2001) and Vengaiah and Pandey (2007). The red pepper puree was extracted by laboratory blender Moulinex (Blender Mixer, type: 741). It took five minutes blending to get the red pepper puree. The puree was strained by a stainless steel strainer, then strained again by a clean muslin cloth to get rid of seeds and peels for obtaining pure red pepper puree.

Preparation of tomato puree: tomato fruits were washed, dried in air, cut into small parts. The tomato juice was extracted by laboratory blender Moulinex (Blender Mixer, type: 741). It took five minutes blending to get the tomato juice (using cold break method). The juice was strained by a stainless steel strainer, then strained again by a clean muslin

cloth to get rid of seeds and peels for obtaining pure tomato juice.

Drying of red pepper:

Washed red pepper was sliced with knives as approximate sizes of 15 mm x15 mm. After slicing, these red pepper slices was blanched with hot water at 95°C for 5 min. Drying of red pepper was done by using the solar drying, where the red pepper slices were put on the shelves of the drying bin and the hot air was passing through these dryer upward from the solar collectors. Drying time and final moisture content for product were controlled. Also, the red pepper slices were shifted alternatively inside the solar bin in order to give the same chance for the red pepper slices to have the same drying conditions. The red pepper was ground and kept until uses.

Preparation of red pepper paste:

Red pepper puree, tomato puree and red pepper powder were used to prepare the red pepper paste blends according to the formulas blends in Table (A).

Table (A) formulas of different blends of red pepper paste.

Ingredients	Blend No							
	1	**2**	**3**	**4**	**5**	**6**	**7****	**8**
Red pepper puree	-	50	60	70	80	90	-	100
Tomato puree	100	50	40	30	20	10	90	-
Red pepper powder	-	-	-	-	-	-	10	-

** Formula of this blend has been chosen according to previous various trials which showed this is the best ratio (90% tomato puree: 10% red pepper powder).

Concentration for preparing red pepper paste was done by using two methods as follows:

First method: Open pan technique:

Each puree blends was put in pan concentration and heated at a moderate temperature, and stirred constantly until the mixture reached a temperature between 75 and 80°C, and the mixture attained a TSS content of 25%±1. At this point, 3% salt was added. Each blend was then immediately poured into the glass jar, while still hot, sealed with screw caps, and pasteurization process at 85-90 °C for 15 min. was carried out.

Second method: Vacuum technique:

The rotary evaporator at 45-50°C under vacuum (vacuum pump was used at 500 mm Hg absolute pressure). The total soluble solids (TSS) were 25°Brix and then 3% salt was added and stirred then hot filling, sealed with screw caps and pasteurization process at 85-90 °C for 15 min. was carried out.

All red pepper paste blends were stored at ambient temperature (25-28°C) for 9 months.

Analytical methods:

Physicochemical analysis

Dry matter and ash content:

The homogenized sample was dried until constant weight, first at 70 °C (about 3 h) and, subsequently, at 105 °C (about 16 h) to quantify the dry matter (adapted from AOAC, 2000). Afterwards, the dried sample residue was burnt in a muffle at 525 °C for 16 h and the residue was weighted to determine the ash content (AOAC, 2000). Fat and protein were determined according to AOAC (2000).

pH, titratable acidity, and soluble solids:

10 g homogenized sample followed by centrifugation (10,000g, for 10 min), at 4°C. The supernatant was recovered for pH, titratable acidity, and soluble solids measurements. The pH was measured at 20 °C with a pH meter model Consort pH meter P107. Titratable acidity was determined by titration with 0.1 N NaOH until pH 8.1 was reached and reported as g citric acid/100 g fresh weight. Soluble solids content was determined at 20 °C with a refractometer and reported as °Brix. Total and reducing sugars were determined by Shaffer and Hartman method as described in the AOAC (2000). Crude fiber was determined by Weende method in which

VELP Scientifica extraction unit was used. The method is based on the solubilization of non-cellulosic compounds by sulfuric acid and hydroxide solutions as described in AOAC (2000). Color index was determined by the method of Meydov *et al.* (1977).

Carotenoids determination:

Fresh samples of red pepper fruit or tomato were homogenized using a pestle and mortar in the presence of water bath contains squash ice. Sixteen milliliters of acetone–hexane (4:6) solvent were added to 1.0 g of homogenated sample and mixed in a test-tube. Automatically, two phases were separated, and an aliquot was taken from the upper solution to measure its optical density (OD) at 663, 645, 505, and 453 nm in a spectrophotometer. Lycopene and β-carotene contents were calculated according to the (Nagata and Yamashita, 1992) equations:

Lycopene (mg /100 ml of extract) = (-0.0458 x OD 663 + 0.204 x OD 645 + 0.372 x OD 505- 0.0806 x OD 453).

β-Carotene (mg /100 ml of extract) = (0.216 x OD 663 - 1.22 x OD 645 - 0.304 x OD 505 + 0.452 x OD 453).

Lycopene and β-Carotene were finally expressed as mg / 100 ml, using the fruit water content.

Vitamin C (Ascorbic acid):

Was determined by the 2,6 dichlorophenol–indophenol (Merck KGaA, Darmstadt, Germany) tritimetric method according to (AOAC, 2000).

Measurement of Degree of Discoloration (Dd):

The degree of discoloration was estimated as described by (Askar and Treptow, 1993). All assays for the physicochemical analysis were performed in triplicate.

Microbiological examination:

Paste samples were analysed for total viable bacterial count, yeast and moulds, lactic acid bacteria and coliform group according to the methodology of the American Puplic Health Association (1992) and Oxoid (1990). All tests were carried out in duplicate, and mean values were reported.

Sensory evaluation:

Sensory evaluation was carried out on red pepper paste samples immediately after preparing (zero time), 3, 6 and 9 months of storage. Samples were subjected to a 12 staff member trained sensory panel to find out the red pepper paste products that will be have more palatability by evaluating color, odor, taste, texture and overall acceptability of these products according to Jimenez, *et al.* (1989).

Statistical analysis:

ANOVA was carried out on data of the sensory evaluation applying the function of single factors and the function of two factors with replicates "Excel" Software of Microsoft Office 2003. L.S.D. analysis was adapted according to Gomez and Gomez (1984). Data are expressed as mean ± SE.

RESULTS AND DISCUSSION

Chemical composition of raw materials:

Data in Table (1) show chemical composition of red pepper puree and tomato puree. It can be seen that in general terms that total solids, total soluble solids, ash, fat, protein, total sugars and fiber in red pepper puree were higher than in tomato puree. The pH value of tomato puree was 4.07, while in red pepper puree was 5.14 belonging to non acid food. Data in the same table indicated that red pepper had the high amount of B-carotene, lycopene and ascorbic acid which are more than in the tomato puree. These results for red pepper puree are in agreement with those reported by Vega-Galvez, *et al.* (2009). Pepper fruits contain a large spectrum of antioxidant compounds. In particular, polyphenols, vitamin C, flavonoids and carotenoids, with free radical scavenging properties, which are essential antioxidants that may protect against the propagation of the oxidative chain (Namiki, 1990; Mateos *et al.*, 2003 and Deepa *et al.*, 2007). Consumption of these compounds in the daily diet, may prevent several human diseases, including several forms of cancer, arteriosclerosis and cardiovascular diseases (Harris, 1996 and Bramley, 2000).

Table (1): Chemical composition of raw materials

Components	Red pepper puree	Tomato Puree
Moisture %	88.18 ±1.01	93.07 ±1.46
Total solids %	11.82	6.93
Total soluble solids (° Brix)	10.16 ±0.41	6.46 ±0.35
Ash %	0.89 ±0.04	0.42 ±0.06
Fat %	0.94 ±0.02	0.43 ±0.01
Protein %	1.12 ±0.07	0.38 ±0.01
pH values	5.14±0.12	4.07 ±0.34
Titratable acidity %	0.59 ±0.01	0.63 ±0.01
Total sugars %	4.85 ±0.11	3.22 ±0.17
Reducing sugars %	3.72 ±0.17	2.54 ±0.22
Non reducing sugars %	1.13	0.68
Fiber %	1.61±0.08	0.39 ±0.02
Color index (O.D. at 420 nm)	1.74 ±0.06	1.18 ±0.05
β -Carotene (mg /100 ml)	54.93±1.84	21.84 ±0.10
Lycopene (mg /100 ml)	20.78±0.47	18.17 ±0.08
Ascorbic acid (mg/100g)	176.39±3.24	19.48 ±1.07

Impact of preparation technique on sensory properties of red pepper paste blends:

In red pepper paste, color plays an important role in appearance and acceptability of the product. Browning is another major of hot pepper paste. Data in Table (2) for sensory evaluation indicated that red pepper paste produced with the vacuum technique was more acceptable than traditional technique (open pan). The low score of sensory properties for red pepper paste produced by traditional technique may be related to the used high heat for preparation paste which affect in the pigment of paste, so the color became dark. Moreover the components of flavor and taste were evaporated. Traditional technique was taken long time during preparation which has more effect beside the heat effect. The previous results were nearly agreement with those obtained by Bozkurt and Erkmen (2004 and 2005) who produced hot pepper paste with different techniques. All of the results obtained for sensory evaluation indicated that red pepper paste should be produced with the vacuum technique with respect to their microbiological and chemical. So, the study was completed on the red pepper paste produced by vacuum technique.

Effect of storage at room temperature on some physical and chemical properties of red paste blends:

Data in Table (3) showed that total soluble solids were nearly the same related for end point of making all paste samples. The total soluble solids for all paste ranged from 28.01 to 28.23 % for blends No. 4 and 6, respectively. During storage for 9 months the total soluble solids were slightly decreased gradually with increasing storage period related to some activity of natural enzymes, chemical reaction and activity of microorganisms. The pH values were increasing with increasing the percentage of red pepper in paste. The opposite was found for pH values with increasing storage time for paste. In contrast for results of pH, the titratable acidity was decreased with increasing the percentage of red pepper in paste and increased with increasing storage time. Total sugars had taken the same trend of titratable acidity at 0 month of storage, while they had the trend of pH values during storage time. The major color of red pepper paste is a mix of yellow and red due to the presence of carotenoids. Data in the same table indicated that with increasing the percentage of adding red pepper in the blends, β-carotene, lycopene and ascorbic acid were

increased in tomato paste at 0 month of storage. β-carotene, lycopene and ascorbic acid were decreased in all paste samples with increasing storage time related for oxidation and degradation. On contrast of decreasing β-carotene, lycopene and the degree of discolorration were increased in all paste samples with increasing storage time. This may be due to maillard reaction and ascorbic acid and pigment oxidation. The direction of founding of β-carotene, lycopene and ascorbic acid in red pepper paste during the storage was the same founding in other blends.

Table (2): Sensory evaluation of red pepper paste blends.

Methods of production	Blends	Sensory attributes				
		Color	Taste	Odor	Texture	Over all acceptability
Open pan technique	1	$17.16^{d}\pm0.41$	$17.93^{d}\pm1.62$	$19.62^{de}\pm0.19$	$22.50^{bc}\pm0.31$	$71.2e^{a}\pm1.09$
	2	$17.16^{d}\pm0.41$	$16.87^{de}\pm0.19$	$19.12^{e}\pm0.20$	$21.50^{cd}\pm0.37$	$68.20^{f}\pm1.03$
	3	$16.54^{de}\pm0.60$	$17.04^{de}\pm0.18$	$17.87^{f}\pm0.15$	$21.92^{c}\pm0.43$	$65.91^{g}\pm0.75$
	4	$15.33^{ef}\pm0.27$	$16.29^{ef}\pm0.25$	$16.75^{g}\pm0.23$	$21.00^{d}\pm0.26$	$64.04^{h}\pm0.65$
	5	$15.50^{ef}\pm0.24$	$15.62^{ef}\pm0.26$	$15.66^{h}\pm0.20$	$22.17^{c}\pm0.18$	$64.08^{h}\pm0.33$
	6	$15.25^{f}\pm0.24$	$15.16^{f}\pm0.24$	$15.50^{h}\pm0.19$	$21.63^{cd}\pm0.45$	$62.83^{hi}\pm0.57$
	7	$12.75^{g}\pm0.54$	$11.00^{g}\pm0.52$	$10.58^{j}\pm0.43$	$17.29^{e}\pm0.35$	$55.50^{j}\pm0.43$
	8	$16.20^{e}\pm0.44$	$14.04^{f}\pm0.22$	$14.79^{i}\pm0.21$	$23.21^{b}\pm0.24$	$62.29^{i}\pm0.59$
Vacuum technique	1	$24.45^{a}\pm0.15$	$24.58^{a}\pm0.13$	$24.75^{a}\pm0.97$	$24.67^{a}\pm0.11$	$98.83^{a}\pm0.26$
	2	$24.08^{a}\pm0.17$	$21.54^{b}\pm0.31$	$21.83^{b}\pm0.24$	$24.04^{a}\pm0.21$	$91.20^{b}\pm0.56$
	3	$23.08^{b}\pm0.25$	$20.91^{bc}\pm0.23$	$21.54^{b}\pm0.31$	$22.54^{bc}\pm0.29$	$88.41^{c}\pm0.41$
	4	$22.37^{b}\pm0.32$	$19.87^{c}\pm0.23$	$20.87^{c}\pm0.18$	$22.92^{bc}\pm0.26$	$87.04^{c}\pm0.38$
	5	$22.50^{b}\pm0.28$	$19.54^{c}\pm0.29$	$20.45^{cd}\pm0.22$	$23.00^{b}\pm0.29$	$83.45^{d}\pm0.40$
	6	$22.75^{b}\pm0.27$	$17.83^{de}\pm0.19$	$19.95^{d}\pm0.17$	$23.04^{b}\pm0.19$	$82.75^{d}\pm0.71$
	7	$18.54^{c}\pm0.27$	$15.62^{ef}\pm0.29$	$14.54^{j}\pm0.24$	$20.33^{d}\pm0.46$	$71.83^{e}\pm0.40$
	8	$24.66^{a}\pm0.15$	$16.54^{e}\pm0.27$	$18.87^{e}\pm0.13$	$24.57^{a}\pm0.11$	$82.08^{d}\pm0.31$
LSD		0.9484	1.3413	0.6361	0.80874	1.6824

^{a,b,c,}… There is no significant difference between any two means, within the same column, have the same superscript letter ($p > 0.05$).

Microbiological quality of paste blends made from red pepper and tomato purees:

It is known that vegetable are frequently contaminated by large number of microorganisms especially spoilage type, and in some cases, pathogen microorganisms because of their contact with soil during cultivation and harvesting (De-Cagno *et al*., 2009). The microbiological quality of any food products is dependent on a number of factors such as raw materials and sanitation during process. Initially, the total viable bacterial count of the paste samples were ranged from 128 x10 to 237 x 10 cfu/g for paste prepared from 90% tomato and 10% dried red peppers and paste prepared from red pepper only, respectively as shown in Table (4). The lowest count was found in paste contained 10% of dried red peppers, this may be related to that a_w for dried red peppers not suitable for growing many of organisms opposite fresh tomato and red peppers. Any where the counts of total viable bacterial were nearly similar (all counts in one log cycle). The total viable bacterial counts were increased for all prepared pastes with increasing the storage period. The increasing of total bacterial count after 3 months storage less than one log cycle. On the other hand the increasing in total viable bacterial counts were increasing by one cycle each three months. The counts of total bacterial for paste samples were less than the count of total bacterial in red chilli paste which was found by Ahmed *et al*., (2002), this may be related to some compound in red chilli which affected on microorganisms. Contrary, Ahmed *et al*. (2002) found the total bacterial count was increased in red chill with increasing storage time. Most of survivor bacterial found after pasteurized paste may be spore

forming bacteria included under genus Bacillus as found in tomato concentrate by Vilari *et al.* (1994). Yeast and moulds were not detected in all paste samples after 0, 3 and 6 months storage except paste samples which made from 90% tomato puree plus 10% dry red pepper. Count of yeast and moulds found in previous pastes were less than 15 cfu/g as American public health method counting, these could be referred to some yeasts and moulds included in dry red pepper and the count method. Anywhere, the occurrence of yeast and moulds at 3 and 6 months take the same result as 0 month storage. After 9 months storage all paste samples had yeasts and moulds. The founding of yeast and moulds could be related to a few spores of yeast and moulds which are resistance for heating process (pasteurization). Also count method can't detect the low number of yeasts and moulds. The results for yeasts and moulds were agreement with those obtained by Ahmed *et al.* (2002) who found yeasts and moulds in tomato puree after storage for 6 months. Also, Bozkurt and Erkmen (2004 and 2005) found high number of yeasts and moulds in paste after production and storage but the numbers of yeasts and moulds was descending with storage period. The defect of presence yeasts and moulds was mentioned in the introduction as reported by Vilari *et al.* (1994). Concerning for lactic acid bacteria, their counts were less than 30 cfu/g in all paste samples after 0 and 3 months storage and increased gradually after 6 and 9 months during storage. The presence of lactic acid bacteria may be related to the pH, salt, a_w and other of paste product which are suitable for growing them. These results were accordance with results recorded by Ahmed *et al.* (2002) who found lactobacillus bacteria in red chilli puree after stored 6 months. Coliform group was not detected after 0 and three months storage respected for methodology method for counting, but was found as low numbers (<30) after 6 and 9 month for storage. The numbers of coliform group in paste samples were under all food laws allowance. These results were agreements with Ameyapoh, *et al.* (2008) who found minimum detection limit of total coliform and some of them was thermotolerant.

Sensory evaluation of stored red pepper paste blends at room temperature:

As in all food, the sensory properties are generally the final guide of the quality from the consumer's point of view. Thus, it was beneficial to make a comparison between red pepper pastes. Color average scores (Table 5) during storage period of 9 months for different blends indicated that both blend 1(100% tomato puree) and blend 8 (100 % red pepper puree) had the high scores 22.83 ±0.23 and 23.15 ±0.22; respectively; without significant difference ($p > 0.05$). Blend 7 (90% tomato puree + 10% dry red pepper) had the lowest score (16.21 ±0.35 which is significantly differed than all other blends. The best mixing ratio was 50% red pepper puree plus 50% tomato puree (blend 2) which obtained color scores of 22.08±0.25 and it is significantly differed than other mixing ratios. Texture average scores have the same trend as color.

Data of Table 5 indicated that increasing storage period from 0 to 3, 6 and 9 months was accompanied by significant decreasing ($p<0.05$) in scores of all sensory attributes. The decrease in color values during storage is also likely due to oxidation of carotenoid pigment. Similar observation was also reported by Ahmed *et al.* (2002). In the same time, at the end of 9 months storage period sensory attributes have scores of 19.18±0.2, 17.25±0.3, 18.57±0.3, 18.99±0.1 and 80.46± 0.7 for color (25 scores), taste (25 scores), odor (25 scores), texture (25 scores), and overall acceptability (100 scores), respectively.

Any how blend 2 (50% red pepper puree plus 50% tomato puree) could be recommended to be processed as special new food product.

On the other hand data of Table 5 indicated that, taste, odor, and overall acceptability have the same trend as color and texture except that blends 1 and 8 are significantly differed in the former sensory attributes.

Table (3): Effect of storage (at room temperature) on some physical and chemical properties of red pepper paste blendes.

Components	Storage period (months)	Red pepper paste blendes							
		Tomato paste	50%Tomato: 50% Pepper	40%Tomato: 60% Pepper	30%Tomato: 70% Pepper	20%Tomato: 80% Pepper	10%Tomato: 90% Pepper	90%Tomato: 10% Red Pepper Powder	Red Pepper paste
Total soluble solids (° Brix)	0	28.14± 0.23	28.04± 0.54	28.06± 0.08	28.01± 0.32	28.04± 0.18	28.23± 0.32	28.07± 0.31	28.12± 0.20
	3	28.00± 0.15	27.90± 0.27	27.79± 0.47	27.87± 0.09	27.86± 0.61	28.17± 0.51	27.64± 0.27	27.93± 0.48
	6	27.93± 0.38	27.82± 0.23	27.53± 0.21	27.62± 0.34	27.53± 0.28	27.96± 0.32	27.03± 0.35	27.71± 0.67
	9	27.84± 0.30	27.64± 0.11	27.33± 0.42	27.40± 0.56	27.46± 0.14	27.74± 0.14	26.76± 0.61	27.49± 0.34
pH values	0	4.08± 0.01	4.56 ± 0.00	4.63± 0.04	4.92± 0.01	5.05± 0.04	5.21± 0.03	5.04± 0.02	5.29± 0.02
	3	3.93± 0.02	4.49 ± 0.02	4.55± 0.00	4.80± 0.04	4.83± 0.02	5.13± 0.05	4.86± 0.07	5.16± 0.08
	6	3.90± 0.00	4.40± 0.00	4.47± 0.01	4.67± 0.02	4.71±0. 00	5.02± 0.01	4.72± 0.03	5.07± 0.05
	9	3.85± 0.01	4.26± 0.02	4.31± 0.03	4.57± 0.01	4.64± 0.03	4.89± 0.01	4.54± 0.04	4.96± 0.03
Titratable acidity % (as citric acid)	0	2.03± 0.03	1.48± 0.00	1.43± 0.07	1.38± 0.01	1.31± 0.01	1.28± 0.08	1.33± 0.02	1.09± 0.05
	3	2.11± 0.05	1.55± 0.01	1.47± 0.02	1.44± 0.01	1.43± 0.01	1.31± 0.03	1.37± 0.02	1.12± 0.01
	6	2.34± 0.01	1.69± 0.02	1.69± 0.04	1.61± 0.05	1.59± 0.05	1.39± 0.01	1.41± 0.04	1.27± 0.02
	9	2.59± 0.07	1.76± 0.00	1.77± 0.03	1.69± 0.03	1.65± 0.08	1.47± 0.05	1.53± 0.02	1.39± 0.03
Total sugars %	0	13.06± 0.45	12.34± 0.13	12.15± 0.24	12.06± 0.63	11.99± 0.48	11.92± 0.42	12.96± 0.57	11.78± 0.45
	3	12.86± 0.27	12.14± 0.08	12.01± 0.07	11.86± 0.28	11.73± 0.27	11.71± 0.28	12.49± 0.54	11.65± 0.82
	6	12.55± 0.56	11.95± 0.14	11.88± 0.13	11.48± 0.43	11.49± 0.34	11.41± 0.34	12.08± 0.91	11.51± 0.77
	9	12.14± 0.47	11.69± 0.32	11.60± 0.25	11.19± 0.36	11.16± 0.39	11.12± 0.32	11.78± 0.13	11.37± 0.35
Reducing sugars %	0	10.15± 0.34	9.88± 0.52	9.65± 0.34	9.41± 0.51	9.23± 0.36	9.14± 0.65	10.28± 0.26	9.12± 0.12
	3	10.04± 0.11	9.61± 0.27	9.53± 0.28	9.52± 0.34	9.14± 0.15	9.03± 0.48	10.02± 0.14	8.93± 0.40
	6	9.94± 0.27	9.43± 0.28	9.42± 0.11	9.43± 0.12	9.02± 0.37	8.79± 0.24	9.73± 0.09	8.74± 0.67
	9	9.79± 0.19	9.17± 0.09	9.09± 0.16	9.08± 0.34	8.79± 0.41	8.59± 0.37	9.40± 0.46	8.53± 0.35
Non reducing sugars %	0	2.91	2.46	2.50	2.65	2.76	2.78	2.68	2.66
	3	2.82	2.53	2.48	2.34	2.59	2.68	2.47	2.72
	6	2.61	2.52	2.46	2.05	2.47	2.62	2.35	2.77
	9	2.35	2.52	2.51	2.11	2.37	2.53	2.38	2.84

Table (3): Continue.

Components	Storage period (months)	Red pepper paste blendes							
		Tomato paste	50%Tomato: 50% Pepper	40%Tomato: 60% Pepper	30%Tomato: 70% Pepper	20%Tomato: 80% Pepper	10%Tomato: 90% Pepper	90%Tomato: 10% Red Pepper Powder	Red Pepper paste
β-Carotene (mg/100 ml)	0	48.11± 1.04	84.87± 1.23	91.73± 2.45	97.84± 1.11	103.41± 2.07	109.13± 1.56	73.12± 0.96	118.97± 1.58
	3	46.50± 1.45	80.38± 1.28	89.71± 1.96	95.13± 2.08	98.05± 0.96	102.37± 2.30	71.81± 0.68	114.86± 1.75
	6	44.03± 1.23	77.14± 1.71	86.04± 1.67	92.71± 1.54	93.91± 0.89	98.17± 1.85	68.02± 0.88	109.89± 1.25
	9	43.22± 1.81	76.39± 2.23	82.30± 2.34	88.00± 3.10	88.69± 0.97	91.99± 1.34	66.92± 0.34	106.78± 0.96
Lycopene (mg /100 ml)	0	39.05± 1.00	43.13± 0.94	44.32± 0.12	45.14± 0.27	45.97± 0.31	46.90± 0.41	36.89± 0.12	47.11± 0.17
	3	38.47± 1.14	42.67± 0.73	44.05± 0.34	44.87± 0.38	45.33± 0.20	46.54± 0.27	36.02± 0.45	46.96± 0.12
	6	38.04± 0.91	42.14± 0.68	43.82± 0.15	44.36± 0.64	45.08± 0.54	46.06± 0.36	35.15± 0.37	46.40± 0.46
	9	37.74± 0.84	41.91± 2.11	43.49± 0.53	44.11± 0.17	44.91± 0.14	45.71± 0.40	34.47± 0.41	45.83± 0.14
Ascorbic acid (mg/100g)	0	39.17± 0.54	184± 1.32	213± 2.43	251± 3.11	297± 4.13	319± 3.40	53.11± 3.36	348± 2.38
	3	32.40± 0.37	163± 2.34	194± 1.96	229± 2.56	284± 3.87	302± 2.76	46.37± 3.47	311± 3.14
	6	24.38± 0.67	145± 2.11	174± 3.05	208± 3.41	257± 3.06	269± 2.84	37.00± 2.69	284± 2.89
	9	22.09±0. 43	127± 1.65	161± 3.34	189± 2.15	231± 2.68	236± 1.67	33.27± 2.46	245± 2.54
Degree of Discolouration	0	0.14± 0.00	0.16± 0.00	0.18± 0.00	0.21± 0.01	0.22± 0.00	0.22± 0.00	0.28± 0.01	0.22± 0.00
	3	0.19± 0.00	0.20± 0.00	0.24± 0.00	0.27± 0.00	0.27± 0.00	0.28± 0.01	0.35± 0.01	0.29± 0.00
	6	0.21± 0.00	0.31± 0.01	0.32± 0.00	0.34± 0.00	0.35± 0.00	0.36± 0.00	0.44± 0.01	0.35± 0.00
	9	0.32± 0.01	0.37± 0.01	0.37± 0.01	0.39± 0.01	0.41± 0.00	0.41± 0.01	0.59± 0.01	0.42± 0.00

Table (4): Microbiological quality (cfu/g) of paste samples made from red pepper and tomato purees prepared by vacuum technique.

Microbiological groups	Storage period (month)	Pasta blends							
		Tomato paste	50% TP +50% RPP	40% TP +60% RPP	30% TP +70% RPP	20% TP +80% RPP	10% TP +90% RPP	90% TP +10% RPPO	Red pepper paste
Total viable bacterial count	0	131x10	190x10	199x10	205x10	193x10	210x10	128x10	237x10
	3	195x10	219x10	236x10	244x10	233x10	261x10	188x10	275x10
	6	$121x10^2$	$135x10^2$	$132x10^2$	$171x10^2$	$187x10^2$	$191x10^2$	$162x10^2$	$215x10^2$
	9	$113x10^3$	$141x10^3$	$151x10^3$	$176x10^3$	$201x10^3$	$232x10^3$	$198x10^3$	$251x10^3$
Yeast and moulds	0	ND	ND	ND	ND	ND	ND	>15	ND
	3	ND	ND	ND	ND	ND	ND	>15	ND
	6	ND	ND	ND	ND	ND	ND	23X10	ND
	9	<15	<15	<15	<15	<15	<15	33X10	<15
Lactic acid bacteria	0	<30	<30	<30	<30	<30	<30	<30	<30
	3	<30	<30	<30	<30	<30	<30	<30	<30
	6	70 x 10	64 x 10	55 x 10	61 x 10	44 x 10	49 x 10	45 x 10	42 x 10
	9	$61x10^2$	$66x10^2$	$59x10^2$	$63x10^2$	$51x10^2$	$55x10^2$	$39x10^2$	$34x10^2$
Coliform group	0	ND	ND	ND	ND	ND	ND	ND	ND
	3	ND	ND	ND	ND	ND	ND	ND	ND
	6	<30	<30	<30	<30	<30	<30	<30	<30
	9	<30	<30	<30	<30	<30	<30	<30	<30

•Where: TP: Tomato Puree RPP: Red pepper puree RPPO: Red pepper powder ND: not detect

Table (5): Sensory properties of red pepper paste blends during storage at room temperature.

Sensory attributes	Blendes	Storage period (months)				
		0	3	6	9	Average
Color (25 scores)	Tomato paste	24.45±0.15	23.91±0.17	21.95±0.34	21.00±0.28	22.83^{a}±0.23
	50%TP:50% RPP	24.08±0.17	22.79±0.21	21.91±0.16	20.50±0.38	22.32^{b}±0.22
	40%TP:60% RPP	23.08±0.25	21.62±0.30	20.58±0.33	19.62±0.30	21.22^{c}±0.23
	30%TP:70% RPP	22.37±0.32	21.91±0.35	20.29±0.36	19.37±0.34	20.98^{c}±0.24
	20%TP:80% RPP	22.50±0.28	21.66±0.41	20.66±0.33	19.29±0.42	21.03^{c}±0.25
	10%TP:90% RPP	22.75±0.27	21.95±0.24	21.25±0.36	19.25±0.32	21.30^{c}±0.24
	90%TP:10% RPPO	18.54±0.27	17.45±0.50	15.83±0.35	13.04±0.41	16.21^{d}±0.35
	Red pepper paste	24.66±0.15	24.16±0.19	22.37±0.34	21.41±0.25	23.15^{a}±0.22
	Average	22.80^{a}±0.20	21.93^{b}±0.22	20.60^{c}±0.22	19.18^{d}±0.27	
	LSD(P<0.05) (Storage time) 0.3078					
	LSD(P<0.05) (Blendes) 0.4353					
	LSD(P<0.05) (Storage time * Blendes) 0.8707					
Taste (25 scores)	Tomato paste	24.58±0.13	23.91±0.19	23.58±0.10	23.08±0.14	23.79^{a}±0.10
	50%TP:50% RPP	21.54±0.31	21.16±0.14	20.50±0.19	19.37±0.19	20.64^{b}±0.16
	40%TP:60% RPP	20.91±0.23	20.54±0.14	19.95±0.38	18.95±0.20	20.09^{c}±0.16
	30%TP:70% RPP	19.87±0.23	18.95±0.16	18.33±0.17	17.37±0.13	18.63^{d}±0.15
	20%TP:80% RPP	19.54±0.29	18.33±0.15	17.70±0.24	17.20±0.16	18.19^{e}±0.16
	10%TP:90% RPP	17.83±0.19	17.37±0.21	16.33±0.15	16.45±0.12	17.00^{f}±0.12
	90%TP:10%RPPO	15.62±0.29	14.87±0.13	13.87±0.18	11.54±0.49	13.97^{h}±0.26
	Red pepper paste	16.54±0.27	16.50±0.28	15.25±0.20	14.04±0.15	15.58^{g}±0.18
	Average	19.55^{a}±0.29	18.95^{b}±0.28	18.19^{c}±0.30	17.25^{d}±0.34	
	LSD(P<0.05) (Storage time) 0.2194					
	LSD(P<0.05) (Blendes) 0.3103					
	LSD(P<0.05) (Storage time * Blendes) 0.6207					

Table (5): Continue

Sensory attributes	Blendes	Storage period (months)				
		0	3	6	9	Average
Odor (25 scores)	Tomato paste	24.75±0.09	24.33±0.12	23.75±0.15	22.62±0.19	23.86^{a}±0.13
	50%TP:50% RPP	21.18±0.24	21.75±0.37	21.58±0.50	21.00±0.47	21.54^{b}±0.20
	40%TP:60% RPP	21.54±0.31	21.37±0.17	20.83±0.07	20.08±0.28	20.95^{c}±0.14
	30%TP:70% RPP	20.87±0.18	20.62±0.17	20.00±0.18	18.83±0.15	20.08^{d}±0.14
	20%TP:80% RPP	20.45±0.22	19.83±0.28	19.45±0.20	18.41±0.24	19.54^{e}±0.15
	10%TP:90% RPP	19.95±0.17	19.66±0.32	19.04±0.23	17.87±0.42	19.13^{f}±0.18
	90%TP:10% RPPO	14.54±0.24	14.33±0.22	14.08±0.13	12.75±0.32	13.92^{g}±0.15
	Red pepper paste	18.87±0.13	18.75±0.14	18.08±0.13	17.04±0.15	18.18^{h}±0.12
	Average	20.35^{a}±0.28	20.08^{b}±0.28	19.60^{c}±0.28	18.57^{d}±0.30	
	LSD(P<0.05) (Storage time) 0.2473					
	LSD(P<0.05) (Blendes) 0.3497					
	LSD(P<0.05) (Storage time * Blendes) 0.6994					
Texture (25 scores)	Tomato paste	24.66±0.11	24.04±0.23	21.83±0.26	20.79±0.15	22.83^{a} ±0.25
	50%TP:50% RPP	24.04±0.21	23.12±0.20	21.16±0.16	20.00±0.22	22.08^{b}±0.25
	40%TP:60% RPP	22.54±0.29	21.08±0.21	19.79±0.44	19.25±0.23	20.66^{cd}±0.23
	30%TP:70% RPP	22.91±0.26	21.12±0.20	20.33±0.23	19.37±0.42	20.93^{c}±0.23
	20%TP:80% RPP	23.00±0.29	20.54±0.45	20.00±0.16	18.50±0.19	20.51^{d}±0.26
	10%TP:90% RPP	23.04±0.19	20.14±0.14	20.37±0.22	18.50±0.13	20.58^{cd}±0.25
	90%TP:10% RPPO	20.33±0.46	20.04±0.28	18.12±0.38	14.91±0.25	18.35^{e}±0.35
	Red pepper paste	24.75±0.11	23.08±0.61	21.91±0.47	20.62±0.19	22.59^{a}±0.29
	Average	23.16^{a}±0.16	21.68^{b}±0.18	20.44^{c}±0.15	18.99^{d}±0.19	
	LSD(P<0.05) (Storage time) 0.2813					
	LSD(P<0.05) (Blendes) 0.3978					
	LSD(P<0.05) (Storage time * Blendes) 0.7956					
Over all acceptability (100 scores)	Tomato paste	98.830.26	95.83±0.40	93.25±0.39	90.66±0.41	94.64^{a}±0.47
	50%TP:50% RPP	91.20±0.56	89.00±0.27	86.62±0.30	84.75±0.25	87.89^{b}±0.39
	40%TP:60% RPP	88.41±.041	88.41±0.30	85.58±0.14	83.37±0.34	86.44^{c}±0.34
	30%TP:70% RPP	87.04±0.38	84.25±0.24	83.62±0.15	81.95±0.17	84.21^{d}±0.29
	20%TP:80% RPP	83.45±0.40	82.91±0.26	82.50±0.25	81.16±0.18	82.51^{e}±0.18
	10%TP:90% RPP	82.75±0.71	82.54±0.34	81.79±0.21	80.41±0.33	81.87^{f}±0.25
	90%TP:10% RPPO	71.83±0.40	67.58±0.82	63.75±0.73	62.37±0.16	66.83^{g}±0.60
	Red pepper paste	82.08±0.31	82.83±0.44	81.37±0.50	79.04±0.44	81.33^{f}±0.29
	Average	85.70^{a}±0.76	84.17^{b}±0.79	82.31^{c}±0.81	80.46^{d}±0.78	
	LSD(P<0.05) (Storage time) 0.3894					
	LSD(P<0.05) (Blendes) 0.5507					
	LSD(P<0.05) (Storage time * Blendes) 1.1015					

•Where: TP: Tomato Puree RPP: Red pepper puree RPPO: Red pepper powder
Values represent of 12 panellists (Mean ± S.E.)

a, b There is no significant difference (p≥0.05) between any two means have the same superscripts, within the same acceptability attribute.

CONCLUSION

It could recommend to produce red pepper paste contain tomato puree and red pepper puree with a ratio of 50%: 50% as new food product which will be rich in antioxidant substances.

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