

Physicochemical and Microbiological Evaluation of Commercial Tomato Concentrates Consumed In Egypt

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ABSTRACT

This research was undertaken to determine quality characteristics of twenty four samples of commercial concentrated tomato puree was conducted. Fourteen brands of jar (A), five brands of sachet (B) and five brands of can (C) were evaluated for chemical, physical and microbiological properties. Analysis included each of the following determinations: Total soluble solids, pH values, titratable acidity, sodium chloride content, ash content, colour, consistency, Howard mould count, total plate count, mould and yeast. Total soluble solids ranged from 20 to 25%, 22 to 25% and 18% to 30% for A, B and C, respectively. The pH values for all types of concentrated tomato puree were below 4.3. Titratable acidity ranged from 1.18 to 1.9% for samples (A), 1.18 to 1.88% for samples (B) and 1.09 to 2.05% for samples (C). The sodium chloride content varied from 1.73 to 3.40%, 1.94 to 3.70% and 0.84 to 2.81% and ash content ranged from 3.2-5.2%, 3.83-4.98% and 2.48-6.06%, respectively. Colour measured by Hunter Lab Colormeter ranged between 1.43 to 2.31, 1.51 to 2.11 and 1.67 to 2.09 a*/b*, while consistency ranged from 5.9-11.9 cm/30s, 7.45 to 12.67cm/30s and 5.70 to 9.01cm/30s, for samples A, B and C, respectively.

Microbial growth could not be detected in all samples with one sachet concentrated tomato puree being the exception. Howard mould content varied between 12-20, 16-24 and 12-20%, for samples A, B and C, respectively.

Key words: Tomato concentrates, tomato puree, total soluble solids, pH, titratable acidity, NaCl, ash, colour, consistency, Howard count, microbiology.

INTRODUCTION

Tomato (*lycopersicon esculentum*) is one of the most popular and widely grown vegetables in the world, at least one third of the tomatoes are consumed in the form of processed products such as tomato juice, paste, ketchup, and puree, etc (Cantarelli *et al.* 1993, Shao, *et al.* 2013). In fact, tomato is one of the most important vegetables for the food industry, and its product consumption is large and widely included in human diet (Augusto, *et al.* 2011, Nisha, *et al.* 2011).

Tomatoes and tomato-based products are consistently associated with a lower risk of several types of cancer (Grieb *et al.*, 2009, Zhang *et al.*, 2009, Vallverdú-Queralt, *et al.* 2012) and also, to a lesser extent, to a lower incidence of coronary heart disease

(Stahl & Sies, 2005). All tomato-based products contain micronutrients, such as potassium, vitamin C, vitamin E and folate (Agarwal, *et al.* 2001). In addition to their micronutrient content, tomatoes, and their tomato-based products, also contain valuable phytochemicals or bioactive components, mainly phenolic compounds and carotenoids, such as lycopene. Phenolic compounds in tomatoes are mainly represented by flavanones (naringenin glycosilated derivatives) and flavonols (quercetin, rutin and kaempferol glycosilated derivatives) (Stewart *et al.*, 2000, ; Le Gall *et al.*, 2003, Bahorun *et al.*, 2004; Slimestad *et al.* 2008).

Principal products obtained by tomato processing are whole peeled tomatoes, chopped tomatoes, tomato puree, tomato paste, tomato juices, etc., differently classified based on laws in force in every country. Tomato puree is intended for sauce preparation and usually obtained starting from tomato sieving and then partially concentrated; its soluble solid content is less than 12° Brix, net of the added salt, while for tomato paste, the dry matter content is more than 12%. In USA, tomato pastes are divided into four non-mandatory typologies: light (24–28° Brix), medium (28–32° Brix), heavy (32–39.3° Brix), and extra-heavy (more than 39.3° Brix) (Primavesi *et al.* 2011). The consumer demand for minimally processed products of high quality has increased remarkably last years. Preferences shift towards fresh, healthy and rich flavour ready-to-eat foods with enhanced shelf life. Besides microbial safety, important quality aspects of such tomato products are colour, flavour, and consistency (Hayes *et al.* 1998). In tomato products, an important reaction is the degradation of the red pigment lycopene during thermal process, resulting in changes of the colour (Rodrigo *et al.* 2007). Consistency of tomato products refers to their viscosity and the ability of their solid portion to remain in suspension throughout the shelf-life of the product. The consistency of tomato products is strongly affected by the composition of the pectin (Hsu *et al.*, 2008).

Colour is probably the first quality factor judged by tomato product consumers. Thus, an attractive deep red colour is a major quality attribute for tomato products (Thakur *et al.* 1996, Garcia & Barrett, 2006). Among the parameters analyzed for the assessment of tomato quality, pH is very important because acidity influences

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Received November 04, 2013, Accepted December 25, 2013

the thermal processing conditions required for producing safe products (Mckee, *et al* 2003, Anthon &Barrett, 2010).

In general, adequate heat processing is given to tomato paste to achieve commercial sterility (Speck 1984), but subsequent abusive post-process handling/storage may lead to undesirable microbiological changes (Anon, 1980). The objective of the present study therefore was to evaluate the physical, chemical, and microbiological properties of tomato concentrate products that are locally consumed in Egypt.

MATERIALS AND METHODS

Samples

The twenty five brands of concentrated tomato puree distributed for consumption in Egypt were purchased from local markets, Alexandria, Egypt during November '2012. Fourteen brands of concentrated tomato puree are sold in sealed jars, five brands are sold in sachet and five brands are sold in cans. The products were kept sealed and refrigerated at 4°C until the time of analysis. All samples were stirred before placing a sample into the plastic jar with lids for the evaluation.

Physicochemical analysis

Physicochemical analysis including total soluble solids (TSS), pH, acidity, sodium chloride, ash, colour and consistency were determined. All determinations were carried out in triplicates.

The percentage of total soluble solids (TSS) was determined by using an digital refractometer (ATAGO, 0252985, Japan) according to Porretta (1993).

The pH of samples (mixed in distilled water at 1:2 ratio) was determined with a glass electrode pH meter (HANNA 351301, Romania) after standardization. (Efiuvwevere & Atirike, 1998).

Total titratable acidity(%) as citric acid was determined by direct titration of 2 g. of sample with 0.1N sodium hydroxide using phenolphthalein as an indicator according to Ranganna (1986).

Sodium chloride content was determined according to the Moher method as described by Ranganna (1986). Five gm of sample were direct titrated with (0.1N) silver nitrate solution using potassium chromate as indicator and calculated as % sodium chloride.

The ash content was determined according to the methods described in AOAC (2007).

Hunter L*, a*, and b* parameters (colour) of concentrated tomato puree were measured by a Hunter Lab Colorimeter (Colourfelx, CX0558, USA). The red-yellow ratio (a*/b*) was reported to indicate the redness of tomato puree (Hsu, 2008).

Consistency of tomato concentrate samples were diluted to 12 °Brix. Then, their consistencies were measured by Bostwick consistometer (Italy) at 25°C. The results were reported as the distance traveled (cm) in 30 seconds (Barrett, *et al*, 1998).

Microbiological analysis

The Howard mould count was conducted according to the methods described in AOAC (2007).

Total plate count (CFU/g) was determined by using a Plate Count Agar (Difco, Kansas City, USA) after incubation at 25 °C for 48 hr. Yeasts and molds were determined with Malt Extract Agar (Difco, Kansas City, USA) acidified at pH 4.0 after incubation at 25 °C for 72 hr. (Efiuvwevere & Atirike, 1998)

Statistical analysis

The results are presented as their mean values standard deviation (SD). The data were subjected to analysis of variance (ANOVA) using SAS software (2000). Least significant differences test (LSD) was performed to determine difference in means at $P \leq 0.05$.

RESULTS AND DISCUSSION

Physicochemical characteristics

Total soluble solids (TSS)

Table (1) shows that the TSS values of fourteen concentrated tomato puree in jars ranged between 20 to 25%. The TSS values of all brands were within the acceptable limits of Codex Alimentarius Commission (2007) and Egyptian Organization for Standardization and Quality (2005). Tables (2 ,3) indicate that the TSS values of five sachet products ranged between 22(sample 5) to 25% (samples 1&4) and five samples of concentrated tomato puree in cans from 18 % (sample 4) to 30%(sample 3). Processed tomato concentrate is the product prepared by concentrating the juice or pulp obtained from substantially sound, mature red tomatoes (*Lycopersicum esculentum*) strained or otherwise prepared to exclude the majority of skins, seeds and other coarse or hard substances in the finished product(Codex, 2007). According to the Egyptian Organization for Standardization and Quality (2005), tomato puree contains 8 to less than18% of natural total soluble solids while, concentrated tomato puree contains 18 to less than 24% of natural total soluble solids and tomato paste, contains at least 24% of natural total soluble solids. The data revealed that significant differences were noted between the producing companies for each group of products.

The pH value

The pH values of the fourteen concentrated tomato puree in jars are shown in Table (1) all samples had pH values below 4.3. Also, the same results could be

obtained from Table (2) and Table (3) for sachet and cans products. The pH values of all brands were within the acceptable limits of Codex (must be below 4.6) while Egyptian Organization for Standardization and Quality (2005) must be 4.3. Although statistical differences were detected, few practical differences were noted among brands. Mckee, *et al* (2003) found that nine red sauce products had pH values below 4.2. Among the parameters analyzed for the assessment of tomato quality, pH is very important because acidity influences the thermal processing conditions required for producing safe products. Although the pH of mature tomatoes may exceed 4.6, tomato products are generally classified as acid foods ($\text{pH} \leq 4.6$), which require moderate conditions of processing to control microbial spoilage and enzyme inactivation (Hobson and Grierson 1993). Nevertheless, pH 4.4 is suggested (Monti, 1980) as the maximum desirable to avoid potential spoilage caused by thermophilic organisms, and pH 4.25 as the optimum value for processing tomatoes (Monti 1980, Garcia & Barrett, *et al* 2006).

Titratable acidity

Acidity of the fourteen tomato concentrated puree in jars ranged from 1.18% to 1.90% as citric acid from Table(1) it can be seen that Brand 2 had the highest value of acidity. While from Table (2) the acidity ranged from 1.18 % (sample 4) to 1.88% (sample 3) for five sachet tomato concentrated puree, Table (3) shows that acidity ranged between 1.09% and 2.05% for canned concentrated tomato puree. Tomato acidity varies continually during tomato development and maturation. Variation in tomato acidity is attributed to maturity stage rather than genetic differences (Stevens 1972b, Garcia & Barrett, 2006) There is an inverse relationship between pH and titratable acidity, although sometimes the relationship is inaccurate (Stevens 1972a). Mean acidity of processing tomatoes is around 0.35% (Thakur *et al.* 1996). Tomato product flavour depends on the accumulation and balance between sugar and organic acid content (Hobson & Grierson 1993). The ratio of sugars to acids is something that may be used to indicate general flavour quality(Barrett, *et al* 2006).

Sodium chloride content

Sodium chloride content of jar samples under study ranged from 1.73% (sample No. 3) to 3.4% (samples No. 1&6) as shown in Table (1). It ranged between 1.94% (sample No.4) to 3.7% (sample No.2) of samples in sachet while, from 0.84% (sample No. 2) to 2.81% (sample No.3). Because some samples contained more than 3% sodium chloride, thus they do not comply with the Egyptian standard specifications (2005).

Ash content

Table (1) reveals that the ash contents of the fourteen concentrated tomato puree in jars under study ranged between 3.2% (sample No. 5) and 5.2% (sample No. 1) also, ranged from 3.83 - 4.98% for five samples in sachet it can be seen that in Table (2). While Table (3) indicates that the ash contents of five samples in cans ranged from 2.48% (sample No. 4) to 6.06% (sample No. 3) and the sample No. 3 had the highest ash content.

Colour

Colour (a^*/b^* values) of the fourteen tomato concentrated puree in jars ranged between 1.43 to 2.31 as shown in Table (1) and ranged from 1.51-2.11 for products in sachet (Table 2) while, Table (3) indicates that the range was from 1.67 to 2.09 for samples in cans. Colour is probably the first quality factor judged by tomato product consumers. Thus, an attractive deep red colour is a major quality attribute for tomato products (Thakur *et al.* 1996). Red–yellow ratio (a^*/b^*), indicating the redness of tomato products are an a^*/b^* ratio of 1.90 or greater represents a first quality product in terms of colour and an a^*/b^* ratio of less than 1.80 means that the tomato products may be unacceptable for inclusion in products where a bright red colour is desired (Hayes *et al.*, 1998). The result of a low a^*/b^* value represented an orange to brown colour due to the breakdown of lycopene and formation of Maillard reaction products by the intensive heat treatment (Shi & Le Maguer, 2000; Krebbers *et al.*, 2003, Hsu, 2008). On this basis, the worst samples in this respect were sample No. 11 in jars, sample No.3 in sachet and sample No. 1 in cans.

Consistency

Table (1) reveals that the Consistency in jar products ranged between 5.9 cm/30s to 11.9 cm/30s while, from 7.45 cm/30s to 12.67 cm/30s of the samples in sachet and from 5.70 cm/30s to 9.01 cm/30s of the samples in can. Although second only to colour, consistency is probably the most important quality parameter considered in consumer acceptability of tomato products. Consistency is also important for several unit operations (heating, pumping, mixing) involved in tomato processing (Sharma *et al.* 1996). Consistency of tomato paste is typically determined using a Bostwick consistometer. U.S. Department of Agriculture grade C for tomato sauce establishes that tomato product flow should be less than 18 cm/30 s (USDA 1994). Bostwick consistency is a very quick empirical measurement used in tomato industry, to assess quality of tomato products. Smaller Bostwick values indicate a thicker, higher consistency tomato product; therefore, smaller numbers are preferable. Consistency of tomato products is

dependent on the total solids content of tomato products, which include soluble solids (mainly sugars and organic acids) and insoluble solids (protein and polysaccharides such as pectins and hemicelluloses). Many investigators have found that tomato maturity has a considerable effect on consistency; more mature tomatoes tend to produce higher Bostwick values, for example, thinner, low quality paste. Other factors such as cultivar, growing location, processing conditions, solids, electrolytes and pH may affect consistency. Tomato cultivar may be the most important factor (Thakur *et al.* 1996, Boulekou, *et al.* 2011).

Microbiological evaluation

The results in Table(4) indicate that, neither bacteria nor yeast and mold growth were detected in concentrated tomato puree. Brand 5 sachet concentrated tomato puree was the only exception exhibited both bacterial and mold/yeast growth, exhibiting a bacterial growth of 3.1×10^2 CFU/g and a mold/yeast growth 5.1

$\times 10^2$ CFU/g. Among the variables that affect the microbial profile and shelf-stability of canned tomato products are the initial contamination of the raw materials (Anon. 1980; Robinson *et al.* 1994), the temperature-time process regime (Jay 1986), and post-process handling such as transportation and storage conditions (Banwart 1981; Lake *et al.* 1985). Also, from Table 4, it can be noted that the Howard mould count ranged from 12 to 20% for jar concentrated tomato puree, 16-24% for sachet concentrated tomato puree and 12-20% for can concentrated tomato puree. As shown in Table 4, all the samples tested had a lower moulds content than the European Community (EC) limit (70%) (2004). The Howard mould count, represents an index of the quality of the raw material used for the preparation of tomato puree. Maxima for moulds are applied in various countries (Egan *et al.* 1981).

Table 1. Physicochemical characteristics of concentrated tomato puree packed in jar

Samples	Characters*						
	TSS%	pH	Acidity %	Salt%	Ash%	Colour a*/b*	Consistency cm/30s.
1	25.00 ^a	4.27 ^b ±0.01	1.58 ^{cd} ±0.01	3.40 ^a ±0.01	5.2 ^a ±0.04	1.79 ^e ±0.01	7.57 ^g ±0.06
2	23.00 ^d	4.16 ^f ±0.01	1.9 ^a ±0.10	1.91 ⁱ ±0.10	3.53 ^f ±0.06	1.61 ⁱ ±0.01	9.60 ^c ±0.10
3	23.00 ^d	4.15 ^g ±0.01	1.68 ^b ±0.02	1.73 ^h ±0.05	3.52 ^f ±0.08	1.67 ^g ±0.01	8.65 ^c ±0.15
4	24.75 ^b	4.20 ^a ±0.17	1.31 ^{gh} ±0.04	2.10 ^h ±0.02	4.53 ^b ±0.06	1.93 ^d ±0.02	5.90 ⁱ ±0.10
5	24.00 ^c	4.17 ^f ±0.02	1.40 ^{efg} ±0.02	2.19 ^g ±0.02	3.20 ^g ±0.04	2.05 ^c ±0.01	9.90 ^b ±0.10
6	23.20 ^d	4.22 ^{cd} ±0.01	1.65 ^{bc} ±0.01	3.40 ^a ±0.03	4.18 ^{cde} ±0.04	1.71 ^f ±0.01	6.45 ^h ±0.05
7	22.50 ^e	4.21 ^d ±0.01	1.49 ^{de} ±0.01	2.69 ^d ±0.01	3.51 ^f ±0.27	1.45 ^j ±0.01	8.30 ^f ±0.10
8	22.00 ^f	4.01 ⁱ ±0.01	1.58 ^{cd} ±0.03	2.47 ^e ±0.03	4.02 ^e ±0.03	1.67 ^g ±0.01	8.50 ^{ef} ±0.10
9	21.00 ^g	4.12 ^g ±0.02	1.42 ^{ef} ±0.02	2.31 ^f ±0.05	3.26 ^{fg} ±0.08	1.81 ^e ±0.01	8.45 ^{ef} ±0.05
10	23.00 ^d	4.19 ^e ±0.01	1.57 ^{cd} ±0.02	2.85 ^c ±0.05	4.45 ^{bc} ±0.04	1.64 ^h ±0.01	8.50 ^{ef} ±0.10
11	20.00 ^h	4.23 ^c ±0.01	1.26 ^{hi} ±0.01	2.89 ^c ±0.01	4.37 ^{bcd} ±0.11	1.43 ^j ±0.01	11.9 ^a ±0.10
12	22.50 ^e	4.07 ^h ±0.06	1.45 ^{ef} ±0.03	2.94 ^b ±0.04	4.12 ^{de} ±0.09	2.15 ^b ±0.01	9.10 ^d ±0.10
13	22.00 ^f	4.23 ^c ±0.01	1.36 ^{gh} ±0.01	2.05 ^{hi} ±0.01	4.44 ^{bc} ±0.06	2.31 ^a ±0.01	7.58 ^g ±0.14
14	21.00 ^g	4.19 ^e ±0.02	1.18 ⁱ ±0.02	2.22 ^h ±0.29	4.14 ^{de} ±0.07	2.31 ^a ±0.01	8.55 ^{ef} ±0.05
range	20.00-25.00	4.01-4.27	1.18-1.90	1.73-3.40	3.20-5.20	1.43-2.31	5.90-11.9

Means in column not sharing the same letter are significantly different at $P \leq 0.05^*$

TSS: Total soluble solids

Table 2. Physicochemical characteristics of concentrated tomato puree packed in sachet

Samples	Characters*						
	TSS%	pH	Acidity %	Salt%	Ash %	Colour a*/b*	consistency cm/30s
1	25.00 ^a	4.19 ^a ±0.01	1.58 ^b ±0.03	2.85 ^b ±0.05	4.30 ^c ±0.04	1.56 ^c ±0.01	9.10 ^b ±0.10
2	23.00 ^c	4.22 ^a ±0.01	1.53 ^b ±0.03	3.70 ^a ±0.10	4.98 ^a ±0.03	1.80 ^b ±0.01	12.67 ^a ±0.15
3	23.50 ^b	4.19 ^a ±0.01	1.88 ^a ±0.01	1.98 ^c ±0.01	3.83 ^d ±0.06	1.51 ^d ±0.01	9.20 ^b ±0.20
4	25.00 ^a	4.22 ^a ±0.01	1.18 ^c ±0.01	1.94 ^c ±0.02	4.29 ^c ±0.07	1.81 ^b ±0.02	8.25 ^b ±0.35
5	22.00 ^d	4.19 ^a ±0.02	1.23 ^c ±0.01	2.1 ^c ±0.01	4.65 ^b ±0.05	2.11 ^a ±0.01	7.45 ^c ±0.05
Range	22.00 - 25.00	4.19 - 4.22	1.18 - 1.88	1.94 - 3.70	3.83 - 4.98	1.51 - 2.11	7.45 - 12.67

Means in column not sharing the same letter are significantly different at $P \leq 0.05^*$

TSS: Total soluble solids

Table 3: Physicochemical characteristics of concentrated tomato puree packed in cans

Samples	Characters*						
	TSS%	pH	Acidity g/100g	Salt %	Ash%	Color a*/b*	consistency cm/30s
1	28.50 ^b	4.16 ^b ±0.01	2.05 ^a ± 0.05	2.06 ^b ± 0.04	4.71 ^b ± 0.07	1.67 ^e ± 0.02	6.97 ^c ± 0.06
2	24.90 ^c	4.13 ^c ±0.01	1.09 ^d ± 0.01	0.84 ^d ± 0.01	2.57 ^c ± 0.04	2.09 ^a ± 0.01	5.70 ^d ± 0.10
3	30.00 ^a	4.11 ^c ±0.01	1.83 ^b ± 0.03	2.81 ^a ± 0.01	6.06 ^a ± 0.04	1.98 ^b ± 0.01	7.65 ^b ± 0.05
4	18.00 ^e	4.11 ^c ±0.01	1.48 ^c ± 0.02	1.20 ^c ± 0.04	2.48 ^c ± 0.08	1.97 ^c ± 0.02	9.01 ^a ± 0.01
5	21.00 ^d	4.12 ^a ±0.01	1.53 ^c ± 0.01	2.07 ^b ± 0.01	4.77 ^b ± 0.03	1.76 ^d ± 0.01	7.51 ^b ± 0.02
Range	18.00 - 30.00	4.11- 4.16	1.09 - 2.05	0.84 - 2.81	2.48-6.06	1.67 - 2.09	5.70 - 9.01

Means in column not sharing the same letter are significantly different at P≤ 0.05*

TSS: Total soluble solids

Table 4. Microbiological analysis of concentrated tomato puree in different packages

Samples	H.C%	Y&M (CFU/g)	T.P.C (CFU/g)
Jars			
1	12	N.D.	N.D.
2	12	N.D.	N.D.
3	12	N.D.	N.D.
4	12	N.D.	N.D.
5	16	N.D.	N.D.
6	12	N.D.	N.D.
7	20	N.D.	N.D.
8	16	N.D.	N.D.
9	16	N.D.	N.D.
10	12	N.D.	N.D.
11	20	N.D.	N.D.
12	16	N.D.	N.D.
13	12	N.D.	N.D.
14	16	N.D.	N.D.
Sachet			
1	16	N.D.	N.D.
2	20	N.D.	N.D.
3	16	N.D.	N.D.
4	16	N.D.	N.D.
5	24	5.1*10 ²	3.1*10 ²
Cans			
1	12	N.D.	N.D.
2	12	N.D.	N.D.
3	16	N.D.	N.D.
4	20	N.D.	N.D.
5	16	N.D.	N.D.

H.C.:Howard mould count

Y&M: Yeast and mould

T.P.C. Total plate count

N.D: Not detected

In a conclusion, the commercial brands of concentrated tomato puree locally consumed in Egypt are compatible in general with the standard specifications recommended by the Egyptian standard

specifications and Codex. However, analysis of some samples revealed different values from that mentioned on the labels and there were significant differences between the various companies.

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الملخص العربي

التقييم الفيزيوكيماوي والميكروبيولوجي لمركزات الطماطم المستهلكة في مصر

منى حسن حسين بخيت

و(ج) علي الترتيب. اما بالنسبة للون فترواحت قيمة اللون (a^*/b^*) مقدرة بجهاز هانتر ما بين 1.43 و 2.31 للعينات (أ) وبين 1.51 و 2.11 للعينات (ب) وبين 1.67 و 2.09 للعينات (ج) في حين ترواحت اللزوجة من 5.90 إلي 11.90 ومن 7.45 إلي 12.67 ومن 5.70 إلي 9.01 سم³/سم للمجموعات الثلاث من العينات علي الترتيب . ولم يلاحظ أي نمو ميكروبي ما عدا عينة واحدة من الأكياس وكان عد هوارد للفطريات كما يلي من 12 إلي 20 للمجموعة (أ) ومن 16 إلي 24 للمجموعة (ب) ومن 12 إلي 20 % للمجموعة (ج).

مما سبق نلاحظ أنه توجد فروق معنوية واضحة بين الشركات المنتجة كما يوجد في بعض الحالات عدم تطابق بين بيانات البطاقة ونتائج التحليل.

اجريت هذه الدراسة بهدف تقدير الخواص الفيزيوكيميائية والميكروبيولوجية لأربع وعشرين عينة من مركز الطماطم الموجودة في السوق المحلي المصري، اربع عشرة عينة معبأة في عبوات زجاجية (أ) وخمس عينات معبأة في أكياس (ب) وخمس عينات معبأة في علب صفيح (ج) وقد اظهرت النتائج أن نسبة المواد الصلبة الذائبة ترواحت بين 20-25 % للعينات (أ) و 22-25 % للعينات (ب) و 18-30 % للعينات (ج). كما أوضحت النتائج أن قيمة الأس الهيدروجيني لجميع العينات تحت الدراسة كانت أقل من 4.3 بينما ترواحت نسبة الحموضة التنقيطية بين 1.18 إلي 1.9 % للعينات (أ) و 1.18 إلي 1.88 % للعينات (ب) و 1.09 إلي 2.05 % للعينات (ج).

وترواحت نسب كلوريد الصوديوم من 1.73 إلي 3.40 و من 1.94 إلي 3.70 ومن 0.84 إلي 2.81 % للعينات (أ) و (ب)