

## Evaluation of some processed cheese spreads and sauces available in the Egyptian market.

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### Abstract

Eighteen samples of available processed cheese spreads were collected randomly from the local Egyptian market. These samples were classified as 15 samples full-fat, and 3 samples only were low-fat cheese spread and represented (nowadays) in brands. The samples were analysed chemically, rheologically, microbiologically and organoleptically evaluated. There were a great variations in composition among the collected samples but all were within the Egyptian Standards for processed cheeses. Wide variations were also observed among samples in all rheological tests (*i.e.* hardness, chewiness, cohesiveness, adhesiveness and gumminess) as well as sensory evaluation scores. Consequently, seven of the available processed cheese sauces were collected from different retailer's shops in Egyptian market. All the collected samples were imported. The sauce samples were analysed chemically, rheologically (*i.e.* viscosity), microbiologically as well as they were sensory evaluated. Great variations were observed among samples in all tests and properties. All of them were good from sensory side of view (there was no Egyptian standard for sauces). The great variation in processed cheese samples either for spreads or sauces were due to the different raw materials used to formulate the blends according to the manufactures.

**Keywords:** processed cheese, sauces, composition, rheological properties, sensory properties.

### Introduction

Cheese is widely used as an ingredient in most of prepared foods to add taste, texture and nutritional quality. The high costs associated with natural cheese production and storage, however, has improved industry to research for alternatives (Kiely *et al.*, 1991).

Processed cheese is an-oil-in water emulsion in which dairy proteins play the important role of emulsifiers. The majority of the proteins are caseins (from cheese, rennet casein or other milk casein sources), the emulsification potential of which is improved by the use of chelating salts. The versatility of the system of processed cheese can be made either from a simple basic net of ingredients consisting of cheese, water and melting salts, or from a complex mix of ingredients including different types of proteins, fat, gums, stabilizers, flavourings, humectants and other added minerals. Modern technology have allowed other non-milk protein and fat percent sources to be used in processed cheese making for, replacing a portion of the natural cheeses. Casein, caseinate, whey protein concentrate, milk powder and milk protein concentrate may be used as protein source and cream, butter, milk fat fractions and vegetable oils can be used in various proportions to adjust the fat in cheese mix. Poly saccharides, gums, stabilizers and preservatives may also be added to reduce costs, improve flavour or texture, or improve the shelf-life of the final product (Tamime *et al.*, 1999).

During processed cheese manufacture, some water is added to produce a smooth and stable emulsion (Berger *et al.*, 1993). Water helps in

dissolving the calcium chelating salts, hydrating the

proteins and dispersing the components. Water is also required to achieve certain product attributes such as softness in a cheese spread and its shelf life. Commercial full-fat processed cheese spreads have a moisture content between 40 and 65% with a fat content of at least 20% (Caric & Kâlab, 1993; Kosikowski & Mistry, 1997 & El-Shibiny *et al.*, 2007). However commercial low-fat 10-24%fat) processed cheese spreads have been found to contain as much as 73% moisture (Lee & Klostermeyer, 2001).

Nowadays, increasing demanding convenience-type food by consumers, which take a minimum of preparation time but which are comparable to homemade foods in terms of their taste and quality. There was many attempts to produce high quality dairy based and/or cheese based sauces (Rispoli *et al.*, 1987; Hine, 1994; Lei *et al.*, 2004; Mounsey and O'Riardan, 2008 and Aly *et al.*, 2011).

Generally, processed cheese sauces like other processed cheese products comprise an oil-in-water emulsion which is stabilized by cheese protein, and more specifically by casein which is predominant protein in comprised therein. The sauces are sometimes thickened with starch, and modified starch which generally preferred for preparation of low acid heat sterilized sauces which require a serve thermal process.

The cheese sauce and meal kit including at least one pouch containing the cheese sauce. The cheese sauce exhibits desirable texture and mouth-feel, as well as desirable flavour and visual appearance. Further, the cheese sauce has a shelf life of up to

twelve months or more. The cheese sauce contains cheese solids present in an amount of about 10% or less, at least one non-cheese dairy, water natural preservative such as nisin, at least one phosphate emulsifier salt, oil, and savory flavor profile. The cheese sauce made by processing at higher temperature ~ 90°C under vacuum and packaged using a hot fill process. The cheese sauce packaged into pouches and popular for use with meal kits and side dishes.

Therefore, this study has been done to survey of some processed cheese spreads and processed cheese sauce brands available in the Egyptian market, the chemical composition, formula and properties of these different brands were studied.

## Materials and Methods

### Materials:

Eighteen processed cheese spread samples were collected randomly from different retailer's outlets in Egypt. These samples represent 6 brands made locally. The samples were classified as 15 samples full-fat and 3 were low-fat cheese spreads. Surveyed processed cheese spreads were with a brand coded from 1 to 18:

Consequently, seven processed cheese sauce samples were collected from different retailer's shops in Egypt. All samples were imported and they were belong to 7 brands from 5 manufactories and coded as Brand1, Brand 2, Brand 3, Brand 4, Brand 5, Brand 6 and brand 7.

All the collected samples were stored at ~ 5±1°C until analysed chemically, rheologically, microbiologically and organoleptically. The results are the means of three packages from each.

Three replicates were done either from cheese spreads or sauces.

### Chemical Analysis:

Moisture, fat and salt contents of the processed cheese spread and sauce samples were determined according to AOAC (2005). TN, SN and NPN were determined by the method described by IDF (2001). The ash was determined using the method of BSI (1988). The total carbohydrate (CHO) was calculated by differences. Titratable acidity was determined according to the method of BSI (2010). While the pH was measured using pH meter JENCO model 1671, USA. The TVFA was determined according to the method of Kosikkowski (1982).

### Rheological properties

#### Oil separation:

Oil separation was determined according to Thomas (1973).

Texture profile analysis was determined according to Kycia, (2008) using a Brookfield CT3 texture analyzer.

#### Viscosity:

Viscosity of processed cheese sauce samples

was measured according to Viturawong et al., (2008) using a Coaxial Rotational viscometer, Brookfield Engineering labs DV-III ultra rheometer, at shear rates ranging from 12.411 to 74.467sec<sup>-1</sup>. The measuring device spindle (HA-07) was used with a sample volume of 110g per run. The apparent viscosity was recorded as shear rates.

### Microbiological analysis:

Total bacterial count (T.C), Yeasts & Moulds (Y&M), Coliforms, Aerobic and Anaerobic spore formers were determined according to the method described by Oxide, (2006).

### Sensory Evaluation of processed cheese spreads and sauces:

The processed cheese spreads and cheese sauce samples were organoleptically evaluated using IDF (1997). Cheese scoring was carried out by 10 of the staff members of Dairy Sci, Dept., Fac. of Agri., Moshtohor, Benha Unvi., Egypt.

## Results and Discussion

### Chemical composition of surveyed processed cheese spreads.

The gross chemical composition of processed cheese spreads collected from the Egyptian market is shown in table (1).

The moisture content of full-fat processed cheese spreads ranged from 53.16 to 55.93 with an average of 54.54%, while it ranged from 53.54% to 54.86 with an average of 54.20% in low-fat cheeses. There was a noticeable variation in moisture content of all samples either full-fat or low-fat spreads. All the cheeses are within the Egyptian Standard (2005) and they agree with khader et al., (1997) and Abou El-Nour (2001). These variations in moisture content are due to the variations in the formulas used in the production of these spreads and the differences in raw materials used to formulate the cheese blends.

Fat /Dry matter (F/DM) of processed cheese spreads ranged from 47.26 to 59.24 with an average of 53.34% in full-fat cheese which are within the Egyptian Standard (2005) and this agree with many previous researches (Abou El-Nour 2001). The Fat/DM in low-fat cheese was 19.9% in average and this complied with the Egyptian standard (2005) of processed cheese.

Protein content of the full-fat processed cheese spread ranged from 13.86 to 17.53% with an average of 15.54% in full-fat cheese, while the average was 17.45% in low-fat which is higher than that of full-fat spreads to provide the appropriate body and texture characteristics of the cheese and reduce the caloric value of the product.

Variations in the protein, ash, carbohydrates and salts in both full-fat and low-fat are due to different components used in formulation of the blends and differences in fat and total solids content.

**Table 1.** Gross chemical composition of some processed cheese spreads available in the Egyptian market.

Samples code		%Moisture	F/DM	%Protein	%CHO	%Ash	Salt/Moisture
<b>Full- fat processed cheese spreads</b>							
1		55.96	48.91	14.47	2.5	2.84	2.69
2		55.73	50.44	14.26	2.4	2.63	3.04
3		54.58	49.85	14.75	2.1	2.64	3.03
4		53.85	47.60	14.14	2.3	2.77	2.76
5		53.41	48.46	14.80	2.2	2.94	2.64
6		54.86	50.46	13.86	2.7	3.48	2.74
7		54.47	56.42	17.53	1.6	3.43	3.13
8		53.16	47.26	14.63	1.2	3.25	3.06
9		53.42	48.08	14.30	1.7	3.36	3.04
10		55.51	52.55	14.83	2.0	3.51	3.04
11		55.13	53.95	14.67	2.5	3.26	3.78
12		53.21	50.15	14.71	2.9	3.61	3.80
13		53.73	53.47	14.50	2.7	3.61	3.04
14		53.69	53.40	14.85	2.8	3.11	3.97
15		54.77	59.42	17.22	2.7	3.27	3.69
<b>Range</b>	<b>Max</b>	55.93	59.42	17.53	2.9	3.61	3.97
	<b>Mini</b>	53.16	47.26	13.86	1.2	2.63	2.64
<b>Average</b>		54.54	53.34	15.54	2.05	3.12	3.30
<b>Low- fat processed cheese spreads</b>							
16		55.83	21.28	17.90	2.1	2.92	2.51
17		54.86	18.83	17.01	2.6	3.10	2.81
18		53.54	19.59	17.29	2.4	3.30	3.04
<b>range</b>	<b>Max</b>	54.86	21.28	17.90	2.6	3.30	3.04
	<b>Mini</b>	53.54	18.83	17.01	2.1	2.92	2.51
<b>Average</b>		54.20	20.05	17.45	2.35	3.11	2.55

**Nitrogen fractions:** Soluble N and N.P.N (table 2) were averaged in full-fat 0.222 and 0.148% while in low fat cheese were 0.261 and 0.136%, respectively. These differences are due to the amount and degree of cheese ripening in the blends. Also, these variations may be due to the composition of other added ingredients in the cheese blends. (Tamime *et al.*, 1999).

The pH values of full-fat spreads were ranged from 5.53 to 6.16 with an average of 5.85. Regarding to low-fat spreads the pH was ranged from 5.78 to 5.81. All the Egyptian cheese spreads were within the range of Lee & Klostermeyer (2001) who recommended that pH for processed cheese spread ranged from 5.6 to 6.2.

TVFA in full-fat and low-fat cheese spreads (table 3) averaged 25 and 23 ml 0.1N NaOH /100g cheese, respectively. The TVFA was higher in full-fat cheese than low-fat cheese due to the higher fat content in the formulas, also, the variation in TVFA may be due to the differences in the amount and ripening degree of the cheese used in making the cheese spreads and at the same time to the added flavours.

#### Oil Separation:

The oil separation index of full-fat spreads ranged from 0.0 to 19.0% as there was three samples free from oil separation, also one sample from low fat spreads was free from oil separation (Table 3). The

wide variation of oil separation is due to several factors i.e. (the percentage and type of the

emulsifying salts and the use of vegetable oil with different melting index to replace part of the milk fat). Generally, low-fat spreads were lower than full-fat spreads in their oil separation index. The results are in the vicinity of those of khader *et al.*, (1997) and Abd Rabo *et al.*, (2005).

#### Rheological properties:

##### Texture profile

The texture profile parameters i.e. (hardness, adhesiveness, cohesiveness, springiness, gumminess and chewiness) of some processed cheese spreads available in Egyptian market were determined by texture profile analysis using Brookfield AT3 Texture Analyzer and the results are illustrated in Table (4). Adhesiveness is described to imitate as the stickiness of sample in the mouth throughout mastication (from slippery to sticky). The Adhesiveness values clear high variation as it ranged from 0.0 to 13.53kg with an average of 6.768kg in full-fat spread cheeses. In low-fat spreads, one sample did not measured. The great variation of the adhesiveness can be attributes to the different ingredients involved in preparation of the cheese spread blends. Cohesiveness imitate by the panels as the degree to which the cheese sample deforms before rupturing. Data in Table (4) indicate the instrumental cohesiveness values of some processed cheese spreads in the local Egyptian market. There was a great variation in the values of cohesiveness ranging from 0.101 to 0.85cm with an average of 0.482cm.

**Table 2.** Nitrogen fractions of some processed cheese spreads available in the Egyptian market.

Samples code		%T.N	%S.N	S.N /T.N	%N.P.N	N.P.N /T.N
<b>Full- fat processed cheese spreads</b>						
1		2.268	0.243	10.71	0.123	5.42
2		2.235	0.241	10.78	0.114	5.10
3		2.312	0.216	9.34	0.114	4.93
4		2.216	0.216	9.75	0.118	5.32
5		2.319	0.203	8.75	0.115	4.96
6		2.173	0.245	11.27	0.124	5.71
7		2.747	0.255	9.28	0.115	4.19
8		2.293	0.253	11.03	0.183	7.98
9		2.242	0.191	8.52	0.179	7.98
10		2.324	0.243	10.46	0.172	6.35
11		2.300	0.241	10.48	0.182	7.91
12		2.306	0.246	10.67	0.177	7.68
13		2.272	0.252	11.09	0.179	7.88
14		2.328	0.246	10.57	0.182	7.82
15		2.699	0.246	9.11	0.177	6.56
Range	Max	2.747	0.255	11.27	0.183	7.98
	Mini	2.173	0.191	9.11	0.114	4.19
Average		2.83	0.222	10.19	0.148	6.09
<b>Low- fat processed cheese spreads</b>						
16		2.805	0.258	9.20	0.113	4.03
17		2.666	0.265	9.94	0.125	4.69
18		2.710	0.260	9.59	0.172	6.35
Range	Max	2.805	0.265	9.94	0.172	6.35
	Mini	2.666	0.258	9.20	0.113	4.03
Average		2.747	0.261	9.57	0.136	5.19

**Table 3.** % Acidity, pH value, TVFA and oil separation index of some processed cheese spreads available in the Egyptian market.

Samples		Acidity %	pH value	T.V.F.A*	Oil separation Index
<b>Full- fat processed cheese spreads</b>					
1		0.56	5.81	21	19
2		0.56	5.80	27	12
3		0.54	5.75	27	9
4		0.77	5.97	27	13
5		0.99	5.95	30	0
6		0.98	5.81	27	0
7		0.99	5.61	28	14
8		0.95	5.53	20	17
9		0.60	6.00	26	17
10		0.88	5.74	26	12
11		0.52	5.88	28	17
12		0.79	5.96	22	13
13		0.54	6.02	26	19
14		0.89	5.71	28	11
15		0.61	6.16	27	11
Range	Max	0.99	6.16	30	19
	Mini	0.52	5.53	20	0
Average		0.76	5.85	25	9.5
<b>Low- fat processed cheese spreads</b>					
16		0.65	5.81	27	9
17		0.82	5.78	20	0
18		0.70	5.81	19	10
Range	Max	0.82	5.81	27	10
	Mini	0.65	5.78	19	0
Average		0.74	5.80	23	5

ml 0.1 N NaOH /100g cheese\*

**Hardness** considered as an important parameter for cheese quality (from soft to firm) (Lee *et al.*, 1978). The values of spreads hardness varied from 33.5 to 430.0 with an average of 231.75 in full-fat cheese spreads. In low-fat spreads one sample did not measured any results on the apparatus while the other two samples recorded 44.5 and 41.5g, respectively.

The obtained results for hardness gave high variations which attributed to the different ingredients used in the blends especially fat content and its type, emulsifiers and other substances used and the pH of the spreads (Ennis and mulvihill, 1997).

**Springiness** was described to the panelists as bouncing property of sample through several consecutive liters (from plastic to elastic). Springiness values of the Egyptian cheese spreads varied between 11.02 to 29.02 with an average of 20.02cm in full-fat cheese, but in low-fat cheese it was 15.34 and 18.4cm and one sample did not measured. The variations attributed to the different ingredients used in the blends in addition to the variation of the salt or emulsifier agent, also it was found a higher correlation between springiness and

the pH and the lactose of the cheese spreads (Younis *et al.*, 1991 and Abou El-Nour 2001).

**Gumminess** is expressed as a result of hardness multiplied with cohesiveness. Table (4) recorded the values of gumminess of the processed cheese spreads available in the Egyptian market. It is obvious that there was a range of variation between 27.2 to 159.2 with an average of 93.20g in full-fat spreads, while it was 27.1 and 35.4 in two samples of low-fat spreads.

**Chewiness** described to the panelist as the number of chews required to swallow a certain amount of sample. It is described from tender to tough. It is related to primary character of hardness, cohesiveness and springiness. The results of chewiness property of some processed cheese spreads available in Egyptian market varied from 2.9 to 56.7 with an average of 29.80kg/cm for full-fat samples, while it was 4.07 and 6.29 in two samples of low-fat spreads. The great variation in this respect is due to different blends used in the cheese manufacture. These results are in the same trend found by Younis *et al.*, (1991b) who found that there are high relationship between the total nitrogen and chewiness properties of processed cheese.

**Table 4.** Texture analysis of some processed cheese spreads available in Egyptian market.

Samples	Adhesiveness (kg)	Cohesiveness cm	Hardness (g)	Springiness mm	Gumminess (g)	Chewiness (kg/cm)	
<b>Full- fat processed cheese spreads</b>							
1	1.50	0.70	49.0	12.56	30.0	2.90	
2	2.60	0.78	38.0	16.51	29.6	4.79	
3	0.00	0.85	33.5	17.51	28.5	4.90	
4	1.82	0.74	36.5	16.65	27.2	4.43	
5	3.12	0.78	39.0	16.00	30.4	4.76	
6	1.96	0.51	50.0	14.04	25.5	3.51	
7	4.88	0.89	68.0	22.25	60.7	13.25	
8	3.44	0.57	130.0	13.71	63.8	9.92	
9	1.89	0.45	121.5	11.02	54.2	5.86	
10	3.30	0.61	89.5	14.18	55.9	7.77	
11	9.97	0.66	42.0	15.01	27.7	4.08	
12	9.93	0.73	430.0	18.33	157.4	56.70	
13	9.04	0.56	280.5	16.88	156.5	25.91	
14	13.53	0.55	263.5	18.16	159.2	28.36	
15	4.54	0.101	79.5	29.02	79.0	19.12	
Range	Max	13.53	0.85	430.0	29.02	159.2	56.70
	Mini	0.00	0.101	33.5	11.02	27.2	2.90
	Average	6.768	0.482	231.75	20.02	93.20	29.80
<b>Low- fat processed cheese spreads</b>							
16	2.44	0.65	41.5	15.34	27.1	4.07	
17	2.80	0.80	44.5	18.14	35.4	6.29	
18	NM*	NM	NM	NM	NM	NM	
Average	2.62	0.725	43	16.74	31.25	5.18	

\*Not Measured

### Microbiological quality

The result of total bacterial count of the processed cheese spreads in all the surveyed samples were  $<8$  cfu  $g^{-1}$  and there was no growth recognized at  $10^{-1}$  dilutions for Y&M or coliforms.

Processed cheese spreads consider to be shelf stable products in hermetically sealed containers. They have a good safety record with regarded to hazard of botulism (Tanka *et al.*, 1986; Somers and Taylor, 1987).

Regarding the spore former count in all spreads, they were free from aerobic except two samples code 10, 11 brands and there was less than 10 from anaerobic spore formers in both two samples. The microbiological quality of all processed cheese spread samples collected from Egyptian local market consider to be very good. This is due to good sanitation of processing and due to the preservatives added during manufacturing and high technology used in processing.

### Sensory evaluation

All the collected samples of processed cheese

spreads were evaluated organoleptically for the different sensory attributes and the results are recorded in table (5). The outer appearance of the surveyed processed cheese spreads which mainly affected by cheese colour where the cheese coded 7 (38) gave the highest score and the lowest score was given for the flavour of the hot paper as it was unpreferred for the panelists. Sample coded 13 was very hot at the same time the colour was unpleasant. Due to the inner appearance which expressed by "body and texture" of the cheese, the highest score was given to the cheese sample coded 4 as it is very smooth, lacks sandiness followed by the samples coded 8 and code 9, respectively while the lowest score was for code 15. Looking for the appearance scores, the highest score was for cheese samples coded 5, 6, and 7 as they are very chiny and very acceptable than the other samples. The lowest score was given for cheese sample coded 15. The overall scores and overall acceptability was for cheese sample coded 7, which have the highest scores (94) while the lowest score (84) was for that cheese sample coded 13, 14, 15.

**Table 5.** Organoleptic properties of some processed cheese spreads available in Egyptian market.

Samples	Characteristics				
	Flavour (40)	Body and Texture (50)	Appearance (10)	Total scores (100)	
<b>Full- fat processed cheese spreads</b>					
1	35	45	9	89	
2	37	45	9	91	
3	35	46	9	90	
4	36	47	10	93	
5	35	44	10	89	
6	36	45	10	91	
7	38	46	10	94	
8	35	47	8	90	
9	34	47	8	89	
10	35	45	8	88	
11	33	46	8	87	
12	35	45	7	87	
13	32	45	7	84	
14	35	43	6	84	
15	35	43	6	84	
Range	Max	38	47	10	94
	Mini	32	43	6	84
Average	35	45	8	89	
<b>Low- fat processed cheese spreads</b>					
16	39	45	9	93	
17	39	48	10	97	
18	34	47	8	89	
Range	Max	39	48	10	97
	Mini	34	45	8	89
Average	36.5	46.5	9	93	

### Chemical composition of processed cheese sauces.

Table (6) shows the gross chemical composition of processed cheese sauce samples available in the Egyptian market.

Moisture content ranged from 36.18 to 66.43 with an average of 51.31%. Great wide variations observed in these collected sauce samples are, due to the different formulas used in the sauce blends and the differences from moisture side of view in the raw

materials used. Brand (1) recorded the highest moisture content while minimum moisture content was for cheese sauce brand (6). The average of the obtained moisture content is lower than those given by **Saad, (2011)**.

**F/DM** content was averaged 57.29% which was lower than **Saad, (2011)**. The highest value was for brand (3) and the lowest was for the sauce brand (1). The differences were attributed to the raw materials used to formulate the blends.

**Protein** content of the processed cheese sauces which illustrated in table (6) ranged from 3.56 to 9.34 with an average of 6.45%. It was noticed that the sample which had minimum protein content was characterized by high fat level (table 6). The same observation was recorded by **Saad, (2011)**.

**The carbohydrate (CHO)** according to the data calculated by differences for processed cheese sauce (table 7) ranged from 7.30 and 10.13 with an average of 8.72%. The differences in the CHO are due to the raw materials used in formulating the processed cheese sauce blends which are especially from the skim milk or whey as they are rich in lactose. The highest carbohydrate content was for processed cheese sauce brand (4) and the lowest for sample code brand (3).

**The ash** content of processed cheese sauce samples collected from Egyptian market (Table 7) ranged from 2.79 and 3.84 with an average of 3.33%. All brands examined lies within the **Egyptian Legal Standard 1970** (*i.e.* not more than 8%). The results are in accordance with **Saad, (2011)**.

**Table 6.** Gross chemical composition of some processed cheese sauce samples collected from Egyptian market.

Sample code	%Moisture	F/DM	Protein%	% CHO	Ash%	Salt /Moisture	
Brand 1	66.43	37.21	9.34	8.73	3.53	3.027	
Brand 2	61.63	60.07	4.20	8.36	2.90	2.767	
Brand 3	37.02	77.36	3.56	7.30	3.40	2.220	
Brand 4	47.12	27.87	7.06	10.13	2.79	2.090	
Brand 5	44.46	73.08	3.79	8.53	3.13	2.627	
Brand 6	36.18	74.76	3.67	8.15	3.84	3.537	
Brand 7	40.77	73.95	4.26	7.65	3.76	3.430	
Range	Max	66.43	77.36	9.34	10.13	3.84	3.537
	Mini	36.18	37.21	3.56	7.30	2.79	2.090
Average	51.31	57.29	6.45	8.72	3.33	2.814	

**Salt/moisture** ratio in the Egyptian market sauces averaged 2.814% ranging from 2.090 to 3.537%. The variation in the salt/moisture ratio may be deduced to different ratios of salt in the ingredients from which they were made. Also, the salt/moisture ratio affected by the moisture content of surveyed processed cheese sauces however, all varieties lies within **Egyptian Legal Standards (1970)** for processed cheese (*i.e.* not more than 4%). The results also agree with **Saad, (2011)**.

**Nitrogen fractions are presented in (table 7)**. The SN ranged from 0.231 to 0.758 with an average

of 0.495% while SN/TN ranged from 40.47 to 68.41 with an average of 54.44%. SN/TN ratio with wide variations among the tested brands suggested differences in the amount and degree of ripening in the cheeses which was used in its manufacture. The SN lies within the range given by **Saad, (2011)**. NPN/TN also showed a wide variation among the different samples ranging from 8.53 to 20.49 with an average of 14.51%. The NPN constitutes a part from soluble nitrogen of cheese. This may be originated from the ingredients used or from the peptizing effect of emulsifying salts (**Meyer, 1973**).

**Table 7.** Nitrogen fractions of some processed cheese sauce samples collected from Egyptian market.

Sample code	TN%	SN%	SN/TN	NPN%	NPN/TN	
Brand 1	1.466	0.594	40.52	0.125	8.53	
Brand 2	0.656	0.350	53.35	0.114	17.38	
Brand 3	0.576	0.231	40.47	0.113	19.02	
Brand 4	1.108	0.758	68.41	0.114	10.29	
Brand 5	0.594	0.241	40.57	0.113	19.02	
Brand 6	0.576	0.316	54.86	0.118	20.49	
Brand 7	0.667	0.275	41.23	0.123	18.44	
Range	Max	1.466	0.758	68.41	0.125	20.49
	Mini	0.576	0.231	40.47	0.113	8.53
Average	1.020	0.495	54.44	0.117	14.51	

**Acidity** of the collected processed cheese sauces from the Egyptian market ranged from 0.55 to 0.90

with an average of 0.73% (table 8). While the pH values ranged from 3.88 to 4.84 with the average of

4.36. **The pH** value of the sauces is important to balance bacterial and pathogenic growth with desirable texture and flavour. All sauce samples presented almost the acidic level of the pH. The acidic taste of sauce could be favorable by some consumers. The values of pH are in agreement with those reported by **Saad (2011)**.

**The TVFA** of processed cheese sauces are shown in table (8). It ranged from 37.33 to 82.23 with an average of 59.78 ml 0.1N NaOH /100g cheese sauce. The results indicate a wide variation which is due to the differences in the ripening degree of the used cheeses in the same mix. Also, it may be due to the type of fat used in the formula of these sauces. **Saad (2011)** mentioned that adding vegetable oils into the base blend of cheese sauces resulted in higher values

of volatile fatty acids more than that of animal fat. It was noticeable that the TVFA values of cheese sauce brand (1) had the lowest fat content and a high TVFA values. These values may be due to the use of some artificial flavours. **Saad (2011)** found the same observation.

#### Physical properties

The data of **oil separation index** of cheese sauce samples are listed in table 8. It was ranged from 16.54 for the brand (6) to 106.89 for brand (1) with an average of 61.72%. These wide variations may be due to the different raw materials used to formulate the blends especially the type of fat and protein used. The values of oil separation index are in accordance within the range given by **Saad (2011)**.

**Table 8.** % Acidity, pH value, TVFA and oil separation index of cheese sauce samples collected from Egyptian market.

Sample code	Acidity%	pH value	TVFA	Oil separation index	
Brand 1	0.58	3.99	75.27	106.89	
Brand 2	0.82	4.08	82.23	80.86	
Brand 3	0.90	3.88	55.27	70.86	
Brand 4	0.59	4.84	51.00	32.60	
Brand 5	0.60	4.76	47.97	100.6	
Brand 6	0.55	4.12	37.33	16.54	
Brand 7	0.86	4.08	39.97	46.57	
Range	Max	0.90	4.84	82.23	106.89
	Mini	0.55	3.88	37.33	16.54
Average	0.73	4.36	59.78	61.72	

ml 0.1N NaOH /100g

**The viscosity** data of the processed cheese sauce samples collected from the Egyptian market are shown in table (9). It is obvious that the viscosity values were decreased with increasing shear rate values in all samples. The lowest value of viscosity was for brand (1) at the first shear rate and also, at the higher shear rate ( $74.467\text{s}^{-1}$ ), while the sample of brand (6) gave the highest value at the start ( $12.411\text{ s}^{-1}$

$^1$ ) and all over till the end ( $74.467\text{s}^{-1}$ ). The average value of all samples was 6740 at start ( $12.411\text{ s}^{-1}$ ) and 1644 at the end of the test ( $74.467\text{ s}^{-1}$ ). The wide variation of the viscosity values may be attributed to the composition of the ingredients used in the blend especially the type, age and ratio of added cheese, the thickening agents in the base formula and processing condition (time and temperature).

**Table 9.** Viscosity values of processed cheese sauce samples collected from Egyptian market.

Samples code	Share rate ( $\text{s}^{-1}$ )						
	12.411	24.822	37.233	49.644	62.056	74.467	
Brand 1	2280	2000	1600	1320	966	700	
Brand 2	4800	3000	2267	1900	1600	1400	
Brand 3	4262	3700	3500	2990	1870	1550	
Brand 4	3000	2390	1870	1600	1350	1202	
Brand 5	4680	3700	3120	2733	2233	2000	
Brand 6	11200	8500	6150	5330	3040	2588	
Brand 7	4240	3900	3200	2400	1900	1600	
Range	Max	11200	8500	6150	5330	3040	2588
	Mini	2280	2000	1600	1320	966	700
Average	6740	5250	3875	3325	2003	1644	

#### Microbiological quality

Looking for the total count (T.C), it recorded 30, 21, 7, 19, 29, 17 and  $9 \times 10^7$  cfu/g<sup>-1</sup> for sauce brands from 1 to 7, respectively. Brand (1) contained

the highest T.C while the brand (4) had the lowest T.C. This may be due to the highest moisture content in the former but the later sample contained lower content of moisture.



Concerning yeasts & moulds, coliforms and spore forming bacterial counts, all samples of cheese sauces were free from all the tested organisms. This may attributed to the processing conditions and that all brands contained preservatives

#### Sensory evaluation of sauces

The sensory evaluation of processed cheese sauce samples collected from the Egyptian market is presented in table (10).

Generally, the additives added to the base sauces formula (*i.e.* flavours, thickening agent, colours..., *etc*) affect on the properties of the final products.

The colours of cheese sauces have wide differences according to the panelists evaluation, the brand (1) and brand (4) were the best samples of

cheese sauces scored (19), while brand (6) and brand (5) got the lowest points (15). Referred to flavour, the scores (39) were given almost to all samples according to panelists opinion except the sample brand (1) as it got the lowest points (35) due to the differences of the aroma and flavour. Regarding to the inner appearance which expressed by the body and texture, the cheese sauces showed a variation among the all samples. Brand (7) cheese sauce was the lowest in body and texture score (33) as it showed an oily separated body with low emulsion viscosity. Surveyed samples of processed cheese sauce cleared that brand (2 and 3) were the most accepted samples and they got the highest total scores (95) for its good appearance and chiny, good aroma and smooth and have a good body and texture.

**Table 10.** Organoleptic properties of processed cheese sauce samples collected from Egyptian market.

Sample code	Characteristic			
	Outer appearance (20)	Body and Texture (40)	Flavour (40)	Total scores (100)
Brand 1	19	39	35	93
Brand 2	17	39	39	95
Brand 3	17	39	39	95
Brand 4	19	35	39	93
Brand 5	15	35	37	87
Brand 6	15	36	39	90
Brand 7	16	33	39	88
Range	Max	19	39	95
	Mini	15	35	87
Average	17	37	37	91

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## تقييم بعض أنواع الجبن المطبوخ القابل للفرد والمشهيات الموجوده في السوق المصري

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الجبن المطبوخ عبارة عن مستحلب من الدهن في الماء. حيث تلعب بروتينات اللبن دورا هاما للمستحلب. والجبن المطبوخ متعدد الانواع حيث يوجد منها اكثر من نوع ومن هذه الانواع يوجد في الاسواق الجبن المطبوخ القابل للفرد ومشهيات الجبن المطبوخ. تم تجميع ثمانية عشر عينة عشوائية من الجبن المطبوخ القابل للفرد الموجوده في السوق المصري وقد احتوت العينات علي خمسة عشر عينة كاملة الدسم وثلاثة عينات منخفضة الدسم. تم تحليل العينات جميعها كميائيا وميكروبيولوجيا وريولوجيا وحسبا وقد وجد أنها بالنسبة للتحليل الكميائي جميعها في حدود المواصفات القياسية المصرية بالرغم من الإختلافات الكثيرة الموجودة بين العينات. وبالنسبة للميكروبيولوجي فقد وجدت العينات جميعها خالية من بكتريا القولون والخمائر والفطريات وكذلك البكتريا المتجرثمة سواء الهوائية أوالغير هوائية ولكن وجدت أجزاء قليلة جدا بالنسبة للعدد الكلي. أما عن الإختبارات الريولوجية فقد وجد كثيرا من الاختلاف بين العينات وكذلك عند التحكيم بين العينات ولكنها جميعا مقبولة. أما بالنسبة لمشهيات الجبن المطبوخ فقد تم تجميع 7 عينات من السوق المحلي وكانت جميعها مستوردة حيث انها لا تصنع في مصر. تم تحليل العينات كيميائيا وريولوجيا وميكروبيولوجيا وحسبا. وقد أظهرت جميع النتائج كثيرا من الاختلافات بين العينات ولكنها جميعا في حدود المواصفات القياسية بالنسبة للجبن المطبوخ ولكن لا يوجد مواصفات قياسية في مصر للمشهيات. الاختلافات الكثيرة الموجودة بين عينات الجبن المطبوخ سواء المفرد أو المشهيات يرجع الي الاختلاف في المواد الخام المكونة للمخلوط.