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QUALITY CHARACTERISTICS OF MARKETED FISH ROE AND CAVIAR

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SUMMARY

Seventy random samples of fish roe and caviar (35 samples of each) were collected from different supermarkets in Cairo and Giza Governorates and subjected to microbiological and chemical examinations. Microbiological examination revealed that the mean values of Aerobic bacterial count, Anaerobic bacterial count, coliforms count, Enterobacteriaceae count, Staphylococcus aureus count and Mould& Yeast count were $4.7x10^2$, $2.2x10^2$, 49, $1.5x10^2$, $0.08x10^2$ and $1.6x10^2$ CFU/gm for fish roe and $2.9x10^2$, $1x10^2$, 1.09, $1.2x10^2$, $.006x10^2$ and $0.8x10^2$ CFU/gm for caviar, respectively. These mean values exceeded the permissible limits recommended by Egyptian Organization for Standardization and Quality Control (EOSQC, 1996). The chemical examination revealed that the mean pH values of fish roe and caviar samples were 5.9 and 5.8 respectively, which were within the permissible limit recommended by EOSQC (1996).

The mean values of moisture % of fish roe and caviar samples were 42.55% and 50.1%, respectively. They were exceeded the permissible limit recommended by EOSQC (1996). However, the mean values of sodium chloride of fish roe and caviar were 7.45% and 5.35% respectively which were within the permissible limit recommended by EOSQC (1996). Moreover the mean values of lead, mercury and cadmium residues for fish roe were 0.105, 0.227 and 0.071ppm, respectively. Lead residues were exceeded the permissible limits while mercury and cadmium residues were within the permissible limits recommended by EOSQC (1993).

In caviar samples, the mean values of lead, mercury and cadmium residues were 0.064, 0.162 and 0.052 ppm respectively, which were within the permissible limit recommended by EOSQC

(1993).

It was found that 80% of the examined fish roe 85.7% of the examined Caviar were accepted. Therefore, the caviar samples were of higher quality than fish roe samples.

INTRODUCTION

Good microbiological and sensory qualities are essential characteristics of high value products such as fish roe. Fish eggs are initially sterile (Trust, 1974). However, during reproduction, roe is inevitably slightly contaminated (Himelbloom and Crapo, 1998), Moreover, pathogenic microorganisms can contaminate roe during reproduction owing to the presence of the pathogens in the aquatic environment and also in fish and fish processing factories (Hanna et al. 2003).

Salmon caviar is a salt-cured delicacy exported primarily to Japan as whole ovaries or skeins (sujiko) and single eggs (ikura). Concerns have been raised on how this extra handling affects product quality (Himelbloom and Crapo, 1998). The overall quality of roe is based on safety with respect of pathogens and with respect of microbial, biochemical and sensory qualities. All of which are directly dependent on the initial production quality of the roe.

Sensory quality is influenced not only by microbial activity but also by chemical substances such as salt, preservatives and biochemical changes in lipid composition during storage, causing rancidity (Kaitaranta, 1982). In a study of Katsiadaki et al. (1999), the designated ovary maturity stages were found to be closely related to the quality grade and a significant relationship between roe quality and moisture content was also observed, with high-value cod roe having a lower moisture content. Consuming of a sea food containing spores of anaerobic bacteria will facilitate growth in the intestine and released toxins causing illness in the man accompanied by high mortality rate (Acha&Szyfres, 1991; Adams & Moss, 1995; Gracey et al. 1999 and FDA, 2001).

In sea food either fish or fish products, coliforms have been, and still are, used as indicators of possible fecal contamination and hence, the possibility that pathogenic organisms may also be present (Lillard et al. 1984 and Speck, 1984).

Large amounts of metals were found in a number of water re-sources including ponds, rivers and public reservoir due to the bad habits and incorrect disposal of sewage material within it (Bl et al. 1983).

Heavy metals are one of the major sources aquatic pollution and constitute the highly to and long retained substances. They are conser tive or persistent type of pollutants and can not broken down or destroyed over long time of h treatment and become perminant additives

aquatic environment.

The continual anthropogenic input of heavy metals in aquatic habitats constitutes a potential threat to ecosystem by direct toxic action of these metals to aquatic organisms (Nuzzi, 1972; Levensen and Barnard, 1988).

This work is planed to evaluate the microbiological and chemical quality of fish roe and caviar.

MATERIALS AND METHODS

Seventy random samples which were accepted organoleptically from salted pasteurized Mugil roe and salted pasteurized vaccum packed salmon caviar (35 samples of each) were collected from different supermarkets of Cairo and Giza Governorates. Each roe and caviar samples was weight 125 and 100 grams respectively. The collected samples were subjected to microbiological and chemical examinations.

I) Microbiological examination: (APHA, 1992)

Preparation of sample homogenate:

Twenty five grams from each sample were aseptically placed in a sterile blender with 225 ml of 2% sterile peptone water, dilutions $^1/_{10}{}^2$, $^1/_{10}{}^3$ were done, then, subjected to the following examinations:

1- Aerobic bacterial count:-

From the original sample homogenate ($^1/_{10}$ dilution), one ml was dispensed into sterile plates, then 15 ml of plate count agar were poured. After solidification, the plates were incubated at 30°C for 24 hours. The total aerobes were calculated as follow:

APC (CFU/gm) = No. of colonies X dilution factor.

2- Anaerobic bacterial count:-

Plates of reinforced clostridium media (RCM) was streaked by 0.1 ml of the original homogenate then, incubated anaerobically at 37°C for 48 hours in anaerobic Gas pack jar. The total anaerobic count was calculated.

3- Staphylococcus aureus count:-

From the food homogenate ($^1/_{10}$), 0.1 ml was streaked into Baird Parker agar. The plates were incubated at 37°C for 24-48 hours. The presumptive colonies were calculated as follow:

Staphylococcus aureus count (CFU/gm)= No. of colonies X dilution factor X 10.

3.1. Test for coagulase:- For detection of *Staphylococcus aureus* (coagulase positive) using test kits. The coagulase positive counts were recorded.

4- Coliforms count:- (Most Probable Number MPN):-

The three tube method of MacConkey broth was used. The tubes showing acid and gas

productions were considered positive. The MPN was estimated using table of de Man (ICMSF, 1978).

- **Enterobacteriaceae count:-**
One ml from the original homogenate was dispensed in sterile plates, then the hot melted (45°C) violet red bile glucose agar (VRBGA) was poured into the p. After solidification, the plates were incubated at 32°C for 24-48 hours. All purple colonies were counted and calculated.

- **Total Yeast and Mould counts:-** (T. Y. M. C.):- The degree of mould growth was determined using malt extract agar adjusted at pH 3.5 using 10% lactic acid and incubated at 25°C for 3-5 days. The Yeast as well as mould colonies were enumerated on countable plates and recorded.

I) Chemical examination: (AOAC, 1990):-

- **Measurement of pH value:-** Using digital pH meter.
- **Determination of moisture %:-** The technique was carried out using ten gram of fish roe or caviar , which were placed in a previously weighed porcelain dish, then dried in hot air oven at 100°C for four hours till obtaining of two successive fixed weights. The moisture percentage was calculated.

Determination of sodium chloride %:- It was carried out using silver nitrate (0.1N) precipitation technique.

4- **Determination of heavy metals:-** (lead, mercury and cadmium) (ppm):- It was carried out by using atomic absorption spectrophotometry.

RESULTS AND DISCUSSION

1-Bacteriological examination:-

From the results obtained in table (1), the mean values of aerobic bacterial count in fish roe and caviar were $4.7x10^2 \pm 0.38x10^2$ and $2.9x10^2 \pm 0.22x10^2$ CFU/gm respectively. Nearly similar results were obtained by Rodriguez-Jerez et al. (1994). Sodium chloride concentration was the main factor influencing the decreasing bacterial counts. In contrast, Himelbloom and Crapo (1998) found that aerobic bacterial count for pink salmon caviar increased as the production season progressed, with a final count of $4.5x10^7$ CFU/gm for fish eggs.

The mean values of anaerobic bacterial counts for fish roe and caviar samples were $2.2x10^2 \pm 0.003x10^2$ and $1x10^2 \pm 0.005 \times 10^2$ CFU/mg respectively.

The results of coliforms count indicated that their mean values in fish roe and caviar samples were 3.49 ± 0.005 and 1.09 ± 0.004 MPN/gm respectively. These results were agreed with those obtained by Hanna et al. (2003). The contamination of food by coliforms were lead to clinical symptoms include diarrhoea, abdominal cramps.

nausea, vomiting, chills, fever, dizziness within 2-36 hours following ingestion of suspected food. (Varnam & Evans, 1991).

The mean values of Enterobacteriaceae count of fish roe and caviar were $1.5x10^2 \pm 0.002x10^2$ and $1.2x10^2 \pm 0.004x10^2$ CFU/gm, respectively.

The mean values of Staphylococcus aureus in fish roe and caviar were $0.08x10^2 \pm 0.001x10^2$ and $0.006x10^2 \pm 0.0004x10^2$ CFU/gm, respectively.

The presence of Staphylococcus aureus may be due to contamination of food from human sources, equipments, during the handling and the processing (Forbes et al. 1998). The production of enterotoxins (heat stable toxins) by Staphylococcus aureus in food cause nausea, vomition, retching, abdominal cramping, postration and diarrhoea in human. In more sever cases, headache, muscle cramping and transiet changes in blood pressure may occur. (Acha & Szyfres, 1991 and Gracey et al. 1999).

The mean values of moulds and yeast count of fish roe and caviar were $1.6x10^2 \pm 0.002x10^2$ and $0.8x10^2 \pm 0.004x10^2$ CFU/gm, respectively. The presence of moulds and yeast constitute a public health hazard resulting in respiratory, digestive ad urinary tract infections. (Rippon, 1982). Some of Asperigillus are frequently implicated in cases of food borne illness through Aflatoxin production (Dager, 1976).

The mean values of anaerobic bacterial, Enterobacteriaceae and Staphylococcus aureus counts for fish roe and caviar were exceeded the permissible limit (Free) recommended by EOSQC (1996).

From the results recorded in table (2) according to the EOSQC (1996), it was revealed that the accepted & rejected percentage of fish roe were 85.7 & 14.3 (aerobic bacterial, anaerobic bacterial, Enterobacteriaceae, Staphylococcus aureus, Mould & Yeast counts) and 88.6 &11.4 (coliforms count), respectively. However, in caviar samples, the highly percentage was 94.3 due to high coliforms count while the lower rejected percentage was 5.7% due to coliforms count also. The accepted and rejected percentage due to Aerobic plate and Enterobacteriaceae counts were 91.4 and 8.6, respectively. Moreover, the accepted and rejected percentages of caviar were 88.6 and 11.4 due to Anaerobic bacterial, *Staphylococcus aureus* and Mould & yeast counts. This could be attributed to the microbiological status of additives used by different classes of factories, common salt are the common sources of microbial contamination. (Bauer et al. 1981 and Bernard et al. 1982).

From the results presented in table (3), it is evident that the frequency distribution of examined

fish roe and caviar samples at interval less than three (MPN/gm) for coliforms count were 88.57 and 94.3% respectively. The highest frequency distribution percentage at interval 3 - <102 CFU/ gm was (94.3) was recorded for Enterobacteriaceae count of caviar samples, while the lowest frequency distribution percentage at interval 10^2-10^3 CFU/gm of caviar samples (5.7%) was also recorded for Enterobacteriaceae.

The poorest microbiological quality was most often that for vendace roe, probably because the small size of ovaries necessiates more handling during production, and hence the consequent contamination is more extensive than that for larger fish species. Since roe is normally eaten as a raw delicacy, there is always a risk that pathogens will be present and multiply in the product. (Hanna et al. 2003).

Salmon caviar is a raw product that is a good medium for microbial growth. It is highly perishable and requires freezing or pasteurization to prevent spoilage. (Himelbloom and Crapo, 1998).

2- Chemical examination:-

From the results recorded in table (4), it was revealed that the mean pH values of fish roe and caviar samples were 5.9 ± 0.14 and 5.8 ± 0.6 respectively which were within the permissible limit (5.5-6) as recommended by EOSQC (1996). The obtained results supported those recorded by Gimenez and Dalgaard (2004).

The mean moisture % of fish roe and caviar we 42.55 ± 0.14 and 50.1 ± 0.31 respectively. The mean values were exceeded the permissible lim (not more that 40%) recommended by EOSQ (1996).

These high values may be due to the seasonal in pact on fish composition or due to differences manner of salting or both.

The mean values of sodium chloride % for fi roe and caviar samples were 7.45 ± 0.53 and 5.3 ± 0.15 respectively which were within the permi sible limit (not more than 8% for roe and 6% f caviar) recommended by EOSQC (1996).

The mean values of lead residues for fish roe an caviar were 0.105 ± 0.001 and 0.064 ± 0.002 pp respectively which were exceeded the permissibl limit (0.1 ppm) for fish roe and within the permis sible limit (0.1 ppm) for caviar recommended b EOSQC (1993).

The mean values of mercury residues were 0.22 ± 0.003 and 0.162 ± 0.001 ppm for fish roe an caviar respectively. Meanwhile the mean value of cadmium residues for fish roe and caviar wer 0.071 ± 0.003 and 0.052 ± 0.001 ppm respective ly.

The mean values of mercury and cadmium residues were within the permissible limit (0.5 and 0.1 ppm) respectively for both fish roe and caviar samples recommended by EOSQC (1993).

pH values for fish roe and caviar were 11.4 and 5.7 respectively. The highest percentage of rejected samples of fish roe was 20 due to high moisture % while the lowest percentage was 2.9 due to high cadmium residue.

Concerning the accepted and rejected samples according to EOSQC (1993 and 1996) (table 5), it is found that the percentage of rejected samples in

In caviar samples, the highest percentage of rejected samples was 14.3 due to high moisture percent while no rejected percent in caviar samples

Table (1): Microbiological counts of examined fish roe and caviar samples (n=35 for each).

		Fish roe	Caviar
Aerobic bacterial count	Min. Max. Mean ±SE	$<10^2$ 5.8×10^2 4.7×10^2 0.38×10^2	$<10^2$ 4.3×10^2 2.9×10^2 0.22×10^2
Anaerobic bacterial count	Min. Max. Mean ±SE	$<10^2$ 3×10^2 2.2×10 0.003×10^2	$<10^2$ 2×10^2 10^2 0.005×10^2
Coliforms count	Min. Max. Mean ±SE	<3 47 3.49 0.005	<3 21 1.09 0.004
Enterobacteriaceae count	Min. Max. Mean ±SE	$<10^2$ 3.7×10^2 1.5×10^2 0.002×10^2	$<10^2$ 3×10^2 1.2×10^2 0.004×10^2
Staphylococcus aureus count	Min. Max. Mean ±SE	$<10^2$ 2×10^2 0.08×10^2 0.001×10^2	$<10^2$ 10^2 0.006×10^2 0.0004×10^2
Mould and Yeasr count	Min. Max. Mean ±SE	$<10^2$ 4.1×10^2 1.6×10^2 0.002×10^2	$<10^2$ 3×10^2 0.8×10^2 0.004×10^2

Table (2): Percentage of accepted and rejected examined fish roe and caviar samples due to the examined parameter according to EOSQC, 1996 for roe and caviar.

		Fish roe		Caviar	
		No.	%.	No.	%.
Aerobic bacterial count	A	30	85.7	32	91.4
	R	5	14.3	3	8.6
Anaerobic bacterial count	A	30	85.7	31	88.6
	R	5	14.3	4	11.4
Coliforms count	A	31	88.6	33	94.3
	R	4	11.4	2	5.7
Enterobacteriaceae count	A	30	85.7	32	91.4
	R	5	14.3	3	8.6
Staphylococcus aureus count	A	30	85.7	31	88.6
	R	5	14.3	4	11.4
Mould and Yeasr count	A	30	85.7	31	88.6
	R	5	14.3	4	11.4

A = Accepted
R = Rejected

Table (3) Frequency distribution of examined fish Roe and Caviar samples based on their microbiological counts (n = 35 for each).

Intervals	Aerobic plate count				Anaerobic plate count				Coliforms count				Enterobacteriaceae count				Staphylococcus aureus count				Mould and Yeast count			
	Fish Roe		Caviar		Fish Roe		Caviar		Fish Roe		Caviar		Fish Roe		Caviar		Fish Roe		Caviar		Fish Roe		Caviar	
	No.	%	No.	%	No.	%	No.	%	No.	%	No.	%	No.	%	No.	%	No.	%	No.	%	No.	%	No.	%
<3*	0	0	0	0	0	0	0	0	31	88.57	33	94.3	0	0	0	0	0	0	0	0	0	0	0	0
3-<10^2**	30	85.7	32	91.4	30	85.7	31	88.6	4	11.43	2	5.7	30	85.7	33	94.3	30	85.7	31	88.6	30	85.7	31	88.6
10^2-10^3**	5	14.3	3	8.6	5	14.3	4	11.4	0	0	0	0	5	14.3	2	5.7	5	14.3	4	11.4	5	14.3	4	11.4
Total	35	100	35	100	35	100	35	100	35	100	35	100	35	100	35	100	35	100	35	100	35	100	35	100

* MPN/gm

** CFU/gm

Table (4): Chemical analysis of examined fish roe and caviar samples. (n = 35 for each)

			Fish roe	Caviar
PH		Min. Max. Mean ±SE	5.59 6.8 5.9 0.14	5.52 6.9 5.8 0.6
Moisture%		Min. Max. Mean ±SE	34.7 65.8 42.55 0.14	35.6 77 50.1 0.31
Nacl %		Min. Max. Mean ±SE	6.04 9.1 7.45 0.53	4.39 7.1 5.35 0.15
Heavy metals	Lead	Min. Max. Mean ±SE	0.001 0.611 0.105 0.001	0.001 0.425 0.064 0.002
	Mercury	Min. Max. Mean ±SE	0.001 0.923 0.227 0.003	0.001 0.878 0.162 0.001
	Cadmium	Min. Max. Mean ±SE	0.001 0.518 0.071 0.003	0.001 0.418 0.052 0.001

Permissible limits (ppm) according to EOSQC (1993)

	Roe	Caviar
Lead	0.1	0.1
Mercury	0.5	0.5
Cadmium	0.1	0.1

Table (5):Percentage of accepted and rejected fish roe and caviar samples due to chemical examinations (n = 35 for each) according to EOSQC (1993 &1996).

Parameter			Fish roe		Caviar	
			No.	%.	No.	%.
PH		A< 6	30	85.7	32	91.4
		R > 6	5	14.3	3	8.6
Moisture%		A< 40%	30	85.7	31	88.6
		R>40%	5	14.3	4	11.4
Nacl %		A < 8% * < 6% ** R > 8% * > 6% **	30 5	85.7 14.3	32 3	91.4 8.6
Heavy metals	Lead	A<0.1 Δ	31	88.6	33	94.3
		R > 0.1 Δ	4	11.4	2	5.7
	Mercury	A< 0.5 Δ	32	91.4	33	94.3
		R >0.5 Δ	3	8.6	2	5.7
	Cadmium	A < 0.1 Δ	34	97.1	35	100
		R > 0.1 Δ	1	2.9	0	0

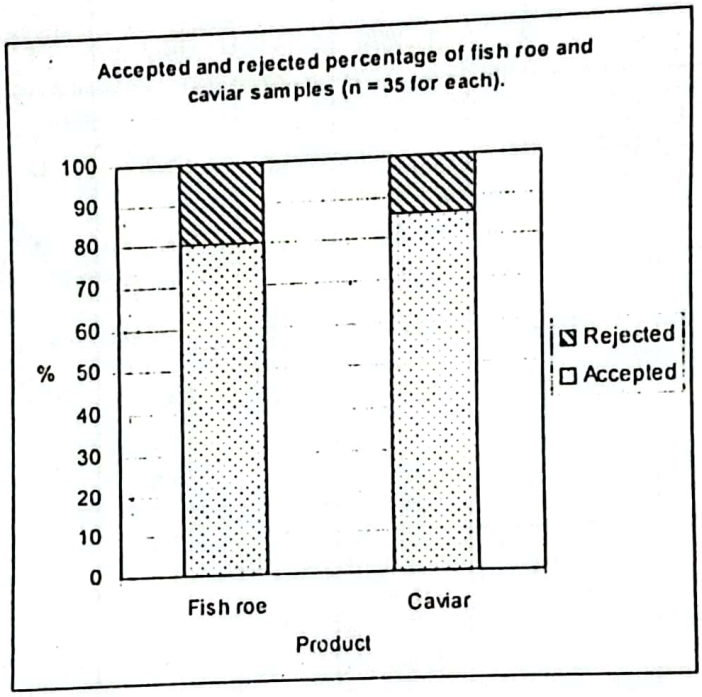
A = Accepted
R = Rejected

* Fish roe limit
**Caviar limit

Δ ppm (part per million)

Table (6): Finally (Accepted and Rejected) examined fish roe and caviar samples (N= 35 for each).

Judgment / Samples	Accepted		Rejected	
	No.	%	No.	%
Fish roe	28	80	7	20
Caviar	30	85.7	5	14.3



examined for cadmium residues.

Figure (1) was cleared the final judgment of accepted and rejected percent of examined fish roe and caviar samples due to either microbiological or chemical examinations or due to both of them. The total accepted percent were 80 and 85.7 for fish roe and caviar samples while the total rejected samples were 20 and 14.3% respectively. So, the caviar samples are higher quality than fish roe samples.

The concentration of metals in edible portions of the aquaculture product is a relevance of public health rather than concentrations in the water in which the fish were raised (Dallinger et al. 1987). The metals are accumulated in tissues but the degree of bioaccumulation differs among metals, species and tissues (Carbonell & Tarazona, 1995; Miller et al. 1992 and de Wet et al. 1994).

It has been observed that low levels of lead exposure are correlated with irreversible fetal brain damage, hypertension, cardiovascular disease, kidney dysfunction, impaired bone synthesis, impaired sperm production and osteoporosis (USNRC, 1993).

Absorbed inorganic mercury is stored in the liver and kidney but inorganic preparations are more widely distributed. The metal is excreted slowly in the urine, but too smaller extent in faeces, saliva and milk. (Gracey et al. 1999).

Cadmium (Cd) is highly toxic element. Its side effects include kidney dysfunction, hypertension, hepatic injury, reproductive toxicity, lung damage after inhalation exposure and bone effects. (Robards and Worsfold, 1991).

Finally, to obtain high quality of fish roe and caviar, it was recommended for the application of HACCP system in food processing plant.

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خصائص جودة البطارخ والكافيار المعروضه بالاسواق

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معهد بحوث صحة الحيوان – الدقى – جيزة

أجريت هذه الدراسة على عدد سبعين عينة عشوائية من البطارخ والكافيار (٣٥ عينة بطارخ، ٣٥ عينة كافيار) تم تجميعها من عدة سوبر ماركت مختلفة فى محافظة القاهرة والجيزة وذلك لاستبيان الحالة الصحية لهذه المنتجات وتأثيرها على صحة المستهلك.

- وقد خضعت العينات للفحوص البكتريولوجية والكيميائية.
- أوضحت الفحوص البكتريولوجية أن متوسط العد البكتيرى الكلى للميكروبات الهوائية ، العد البكتيرى الكلى للميكروبات اللاهوائية ، العد الإحتمالى للميكروبات القولونية والعد الكلى المعوية ، الميكروب المكور العنقودى الذهبى ، العد الكلى للفطريات (الخمائر والعفن) هو: ٤.٧ X ١٠^٢ ، ٢.٢X١٠^٢ ، ٣.٤٩ ، ١.٥ X ١٠^٢ ، ٠.٨ X ١٠^٢ ، ١.٦ X ١٠^١ خلية /جم من العينة بالنسبة لعينات البطارخ و ٢.٩ X ١٠^٢ ، ١ X ١٠^٢ ، ٠.٩ ، ١.٢X ١٠^١ ، ٠.٠٠٦ X ١٠^١ ، ٠.٨X ١٠^١ خلية/جم ن العينة بالنسبة لعينات الكافيار على التوالى. وكانت القيم أعلى من الحدود المسموح بها طبقا للمواصفات القياسية المصرية لسنة ١٩٩٦.
- بالفحص الكيميائى وجد أن متوسط نسبة الأس الأيدروجينى لعينات البطارخ والكافيار ٥.٩ ، ٥.٨ على التوالى وأنها فى الحدود المسموح بها طبقا للمواصفات القياسية المصرية لسنة ١٩٩٦.
- كان متوسط نسبة الرطوبة لعينات البطارخ والكافيار ٤٢.٥٥٪ ، ٥٠.١٠٪ على التوالى وأنها أعلى من الحدود المسموح بها طبقا للمواصفات القياسية المصرية لسنة ١٩٩٦
- وكان متوسط نسبة ملح الطعام لعينات البطارخ والكافيار ٧.٤٥٪ ، ٥.٣٥٪ على التوالى وأنها فى الحدود المسموح بها طبقا للمواصفات القياسية المصرية لسنة ١٩٩٦.
- بالإضافة إلى ذلك كان متوسط نسبة متبقيات الرصاص ، الزئبق والكادميوم لعينات البطارخ ٠.٠٠٥ ، ٠.٠٠١ ، ٠.٠٠٢٢٧ جزء فى المليون على التوالى.

كانت متبقيات الرصاص أعلى من الحدود المسموح بها بينما كانت متبقيات الزئبق والكادميوم فى الحدود المسموح بها طبقا للمواصفات القياسية المصرية لسنة ١٩٩٣.

- بالنسبة لعينات الكافيار كان متوسط نسبة متبقيات الرصاص ، الزئبق والكادميوم ٠.٠٠٦٤ ، ٠.٠٠١٦٢ ، ٠.٠٠٠٥٢ جزء فى المليون على التوالى وكانت فى الحدود المسموح بها طبقا للمواصفات القياسية المصرية لسنة ١٩٩٣.
- وأخيرا كان الحكم النهائى للعينات المقبولة والمرفوضة للبطارخ ٨٠٪، ٢٠٪ وللكافيار ٨٥.٧٪ و١٤.٣٪ على التوالى . لذلك كانت عينات الكافيار أكثر جودة من عينات البطارخ فى هذه الدراسه.