FOOD POISONING MICROORGANISMS IN Fried SEAFOOD

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A B S T R A C T

A total of 140 random samples of fried seafood including Mugil cephalus, Saurus, Sepia, Shrimp (35 of each) to evaluate their bacterial quality. The bacteriological examination of M. Cephalus samples revealed that the mean values of APC, *Enterobacteriaceae, Coliform, and Staphylococcus* counts were $5.04x10^3$, $3.79x10^2$, $2.03x10^2$, and $3.68 x 10^2$, respectively. For Saurus, they were $5.02x10^3$, $3.53x10^2$, $2.26x10^2$, and $3.32 x 10^2$, respectively. Further, such counts were $6.30x10^3$, 5.34x102, $2.62x10^2$, $4.65x10^2$, for Sepia, and $5.41x10^3$, $4.45x10^2$, $2.41x10^2$, $5.22x10^2$ for shrimp, respectively. The results declared that 12 isolates of *E.coli* were isolated from examined fried seafood represented as 38.6% from the M. cephalus with serotypes O_{55}:H_7 2.9%, O_{125}:H_{18}, 2.9% & untypable 2.9%, 25.7% Saurus with serotype O_{55}:H_7 only, 411.4% Sepia with serotypes O_{55}:H_7 5.7% & O_{125}:H_{18} 5.7%, 38.6% from Shrimp with serotypes O_{55}:H_7 5.7% & untypable 2.9%. Also,24 isolates of coagulase positive *S.aureus* were isolated from the examined fried seafood represented as 514.3% from M. cephalus, 411.4% Saurus, 925.7% Sepia , 617.1% from Shrimp samples. On the other hand, four isolates of *L. monocytogenes* were detected from the examined fried seafood represented as 25.7% Sepia, 25.7% from Shrimp samples. Meanwhile, all examined samples of *M. cephalus*, Saurus were free from *L. monocytogenes*, In contrast, *and Salmonellae* were not isolated from all examined fried seafood samples.

Key words: seafood, food poisoning, microorganisms.

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1. INTRODUCTION

Seafood are appreciated worldwide for their high nutritional value, increasingly popular among consumers (Abisoye et al., 2011). Fish , seafood are susceptible to a wide variety of bacterial pathogens, most of which are capable of causing disease , considered by some to be saprophytic in nature, meanwhile, others as Mycobacterium, Streptococcus, Vibrio, Aeromonas , Salmonella species, *S. aureus*, *L. monocytogenes* are pathogenic, potentially pathogenic bacteria (Lipp, Rose, 1997). The bacterial pathogens associated with fish, seafood are classified as indigenous, non- indigenous. The non-indigenous bacterial pathogens contaminate the fish, seafood as *E. coli*, *Clostridium botulinum, Shigella dysenteria, S. aureus, L. monocytogenes*, Salmonellae. Meanwhile, the indigenous ones are found naturally living in the fish's habitat as Vibrio, Aeromonas spp. that become pathogens when fish are physiologically unbalanced, nutritionally deficient, or there are stressors, i.e., poor water quality, over stocking, which allow opportunistic bacterial infections to prevail (Lyhs,2009). Other studies have also demonstrated the presence of indicator microorganisms of fecal pollution, opportunistic , pathogenic bacteria to humans in fish samples , transmission of them can be through consumption of contaminated food or the handling of the fish resulting in great economic losses due to food borne illness such as dysentery , diarrhea (Mhango *et al.*, 2010). Most outbreak of food poisoning associated with fish, seafood derive from the consumption of raw or insufficiently heat treatment, insufficient cooking, cross-

contamination during processing. About 12% of food borne outbreaks related to consumption of fish , seafood are caused by bacteria including Salmonella Amagliani et al., 2011, *E.coli* (Ethelberg *et al.*,2004), *S. aureus* (Vazquez- Sanchez *et al.*,2012) , *Listeria spp.* (Scoglio *et al.* ,2002), (Lyhs,2009).

Therefore, the present study was carried out on determination of APC, *Enteroacteriacae*, coliform & *Staphylococcus* counts, isolation, identification of *Staph. Aureus, E. coli, Salmonellae, Listeria monocytogenes* on fried samples of Mugil cephalus, saurus, Sepia and shrimp.

2. MATERIAL and METHODS

2.1. Samples collection

140 random samples of ready to eat fried seafood at restaurants level represented as *M. cephalus*, Saurus fish, Sepia, Shrimp 35 of each were collected from different restaurants in Kaliobia Governorate. Each sample was kept in a separate sterile plastic bag, put in an icebox then transferred to the laboratory under complete aseptic conditions without undue delay for bacteriological examination.

2.2. Bacteriological examination

2.2.1.Preparation of samples (APHA, 1992):

Twenty five grams of the samples were taken under aseptic condition to sterile Stomacher bag then add 225 ml sterile 0.1% peptone water, the contents were homogenized at Stomacher for 2 minutes, the mixture was allowed to settled, for 5 minutes at room temperature .The contents were transferred into sterile flask, thoroughly mixed, 1 ml was transferred into separate tube, each containing 9 ml sterile 0.1% peptone water, from which tenth- fold serial dilutions were prepared. The prepared samples were subjected to the following bacteriological examination:

2.2.2. Determination of Aerobic Plate Count following FDA, 2001*:*

2.2.3. Determination of Enterobacteriaceae count:

The technique recommended by (ICMSF, 1996) using Violet Red Bile Glucose agar medium VRBG.by the surface plating method was carried out.

2.2.4. Coliform count:

The technique recommended by (ICMSF, 1996) using the surface plating method using Violet Red Bile agar medium was applied.

2.2.5. Isolation & identification of E.coli (ISO, 2001):

Ten grams of sample were homogenized in a sterile polyethylene bag with 90 ml peptone water then take 1ml, spread on Tryptone Bile x-Glucornic TBX, then incubate at 44.5°C for 24 hrs, appearance of bluish colonies with bluish halo zone suspect *E.coli*. Suspected colonies were purified, inoculated into slope nutrient agar tubes for further identification.

2.2.5.1. Morphological, biochemical identification according to (Quinn et al., 2002).

2.2.5. 2. Serological Identification:

The isolated strains of *E.coli* were identified serologically by using diagnostic sera "Welcome *E.coli*" agglutinating sera for diagnosis of the pathogenic types according to (Varnam-Evans, 1991).

2.2.6. Determination of Staphylococci count using Mannitol agar plates (ICMSF, 1996).

2.2.7. Isolation of S. aureus using Baired Parker agar (ICMSF, 1996):

Black, shiny colonies with yellow halo zone around them suspected *S. aureus* were picked up, purified on Semi-solid agar slopes for morphological examination, biochemical identification, according to (Quinn *et al.*, 2002).

2.2.8. Isolation, identification of Listeria (FDA, 2011):

Listeria Enrichment Broth, Palcam, Oxford agar plates were used. The Listeria as colonies were picked, streaked onto Tryptic Soy agar with 0.6 % yeast extract. Following incubation at 35°C for 48 hours, the isolates were subjected to morphological identification, biochemical tests according to the criteria, procedures recommended by the U.S. FDA, (Hitchins, 2001).

2.2.9. Isolation and identification of Salmonellae (ISO 6579, 2002):

Rappaport Vassilidis broth tubes were used as enrichment in selective broth, then Xylose lysine Desoxychoclate (XLD) agar, Brilliant Green agar were used. The purified suspected colonies were selected, streaked onto slope nutrient agar for morphological, biochemical identification Quinn et al., 2002.

3. RESULTS

The results of bacteriological examination of the fried seafood samples revealed that APC, Enterobacteriacae, and coliform were highest in sepia then shrimp then M. cephalus then saurus. While, staphylococcal count was highest in shrimp, then sepia then M. cephalus then saurus, in which the incidence of co-agulase positive *S. aureus* is highest in sepia, then shrimp, then M. cephalus, then saurus. Isolation and identification of *E. coli* in the examined fried seafood samples revealed that the incidence of *E. coli* was highest in sepia, followed by M. cephalus, shrimp and saurus, strains of *E. coli* identified as O_{55}:H_7, O_{125}:H_{18}, noticed that one sample was untypable. Isolation and identification of *Listeria monocytogenes* in the examined fried seafood samples revealed that *L. monocytogenes* positively isolated from sepia and shrimp, while could not isolated from M. cephalus and saurus. *Salmonellae* could not be isolated from the examined fried seafood samples.

Table 1. Aerobic plate counts /g (APC) in the examined samples of ready to eat fried seafood (n=35).

Sample	Negative		Positive		Min.	Max.	Mean ± SEM
	No.	%	No.	%			
M. cephalus	0	0.0	35	100.0	1.7×10^3	1.81×10^4	$5.04\times10^3\pm0.63\times10^{3a}$
Saurus	0	0.0	35	100.0	1.0×10^3	1.77×10^4	$5.02\times10^3\pm0.79\times10^{3a}$
Sepia	0	0.0	35	100.0	2.5×10^3	1.91×10^4	$6.30\times10^3\pm0.94\times10^{3a}$
Shrimp	0	0.0	35	100.0	1.9×10^3	1.92×10^4	$5.41\times10^3\pm0.67\times10^{3a}$

Min.: minimum, Max.: maximum, SEM: Standard error of mean. a: Mean value in the same column followed by difference letter where significant difference ($p \leq 0.05$).

Table 2. *Enterobacteriaceae* counts/g in the examined samples of ready to eat fried seafood.

Sample	Negative		Positive		Min.	Max.	Mean ±SEM*
	No.	%	No.	%			
M. cephalus	2	5.7	33	94.3	1.0×10^2	10.3×10^2	$3.79\times10^2\pm0.37\times10^{2b}$
Saurus	6	17.1	29	82.9	0.5×10^2	9.5×10^2	$3.53\times10^2\pm0.39\times10^{2b}$
Sepia	0	0.0	35	100.0	2.5×10^2	12.1×10^2	$5.34\times10^2\pm0.54\times10^{2a}$
Shrimp	1	2.9	34	97.1	2.0×10^2	13.1×10^2	$4.45\times10^2\pm0.48\times10^{2ab}$

Table 3: Coliforms counts/g in the examined samples of ready to eat fried seafood.

Sample	Negative		Positive		Min.	Max.	Mean ±SE*
	No.	%	No.	%			
M.cephalus	11	31.4	24	68.6	0.5×10^2	3.2×10^2	$2.03\times10^2 \pm 0.20\times10^{2a}$
Saurus	13	37.1	22	62.9	0.5×10^2	3.1×10^2	$2.26\times10^2 \pm 0.14\times10^{2a}$
Sepia	6	17.1	29	82.9	1.0×10^2	5.7×10^2	$2.62\times10^2 \pm 0.26\times10^{2a}$
Shrimp	6	17.1	29	82.9	0.5×10^2	5.0×10^2	$2.41\times10^2 \pm 0.19\times10^{2a}$

Table 4. Incidence of *E. coli* in examined samples of ready to eat fried seafood (n=35 for each product).

Sample	No.	Positive		No. of accepted samples**
		No.	%*	%
M. cephalus	35	3	8.6	91.43
Saurus	35	2	5.7	94.28
Sepia	35	4	11.4	88.57
Shrimp	35	3	8.6	91.43
TOTAL	140	12	8.6	91.43

* Percentage in relation to total number of sample in each row.
**Accepted: refused samples according to EEC, 2005.

Table 5. Incidence and serotyping of *E.coli* isolated from the examined samples of ready to eat fried seafood.

Products	M. cephalus		Saurus		Sepia		Shrimp		Strain characteristic
E.coli strains	No.	%*	No.	%*	No.	%*	No.	%*	
O_{55}:H_7	1	2.86	2	5.71	2	5.71	2	5.71	EPEC
O_{125}:H_{18}	1	2.86	0	0.0	2	5.71	0	0.0	ETEC
Untypable	1	2.86	0	0.0	0	0.0	1	2.86	-
Total	3	8.57	2	5.71	4	11.42	3	8.57	-

* Percentage in relation to total number of each sample 35. EPEC: Enteropathogenic *E.coli*
ETEC: Enterotoxigenic *E.coli*

Table 6. Staphylococci counts/g in the examined samples of ready to eat fried seafood.

Sample	Negative		Positive		Min.	Max.	Mean ±SE*
	No.	%	No.	%			
M.cephalus	4	11.4	31	88.6	2.5×10^2	8.8×10^2	$3.68\times10^2 \pm 0.41\times10^{2b}$
Saurus	6	17.1	29	82.9	1.5×10^2	5.6×10^2	$3.32\times10^2 \pm 0.17\times10^{2b}$
Sepia	3	8.6	32	91.4	2.5×10^2	13.9×10^2	$4.65\times10^2 \pm 0.33\times10^{2a}$
Shrimp	1	2.9	34	97.1	2.5×10^2	9.5×10^2	$5.22\times10^2 \pm 0.38\times10^{2a}$

Min.: minimum, Max.: maximum, SEM: Standard error of mean. a-b: Mean value in the same column followed by difference letter where significant difference ($p \leq 0.05$).

Table 7. Incidence of Coagulase Positive *S. aureus* in examined samples of ready to eat fried seafood.

Sample	No.	Positive		No. of accepted samples**
		No.	%*	%
M.cephalus	35	5	14.28	85.71
Saurus	35	4	11.42	88.57
Sepia	35	9	25.71	74.28
Shrimp	35	6	17.14	82.85
TOTAL	140	24	17.14	82.85

* Percentage in relation to total number of sample in each row.
**Accepted, refused samples according to EEC, 2005.

Table 8. Incidence of *L. monocytogenes* in examined samples of ready to eat fried seafood.

Sample	No.	Positive		No. of accepted samples**
		No.	%*	%
M.cephalus	35	0	0.0	100
Saurus	35	0	0.0	100
Sepia	35	2	5.7	94.28
Shrimp	35	2	5.7	94.28
TOTAL	140	4	2.9	97.14

* Percentage in relation to total number of sample in each row.
**Accepted, refused samples according to EEC, 2005.

4. DISCUSSION

The presence of human pathogenic bacteria in fish, seafood may be attributed to contamination during processing. Several bacteria are however reported to cause infection, mortality in both fish, humans (Hastein *et al.*, 2006). Therefore, the present study was carried out on fried samples of *M. cephalus*, Saurus fish, *S. pharaonis*, Shrimp collected from different restaurants in Kaliobia Governorate to evaluate the bacterial quality of them, to evaluate the hygienic health hazard of seafood contaminated with some food borne pathogens. The total aerobic bacterial count is important for evaluation of sanitary condition of fried fish, seafood. Limits suggested for total aerobic bacterial count in various foods range from 10^5 to 10^7 microbes /g. (EEC, 2005). The data shown in Table (1) revealed that, the mean value of aerobic plate counts APC in the examined fried M. cephalus, Saurus fish, S. pharaonis , Shrimp were $5.04\times10^{3}\pm0.63\times10^3$, $5.02\times10^3\pm0.79\times10^3$, $6.30\times10^3\pm0.94\times10^3$, $5.41\times10^3\pm0.67\times10^3$, respectively. These results were lower than those suggested by EEC (2005). Nearly similar results were obtained by Hatha *et al.*, (1998) who found that a mean value of APC ranged from 1.0×10^2 to 6.4×10^4, (Valdimarsson *et al.*, 1998) under 1000 per g in cooked shrimp, (Soliman *et al.*, 2002) less than 2.5×10^4 in fried fish, (Subramanian, 2007) 9.9×10^4 in cooked cutlet fish, *S. pharaonis* , (Salim, 2008) 2.53×10^4, 1.7×10^4 in fried *M. cephalus*, Shrimp. Meanwhile, higher figures were recorded by (Abd El-Rahman *et al.*, 2003) 6.4×10^4, Abd Allah 2010 from 9.3×10^2 to 4.7×10^6 in fried fish. The results in Table (2) appeared that, the mean value

of *Enterobacteriaceae* count in the examined fried M. cephalus, Saurus fish,Sepia , Shrimp were 3.79×10^2 $\pm0.37\times10^2$, 3.53×10^2 $\pm0.39\times10^2$, 5.34×10^2 $\pm0.54\times10^2$, 4.45×10^2 $\pm0.48\times10^2$, respectively. These results were slightly lower than those of (Tessi *et al.*, 2002, Little *et al.*, 2003, Salim, 2008). Meanwhile, they disagreed with those of (Abd Allah, 2010) who cannot detected *Enterobacteriaceae* in all examined fried fish samples. The Coliform counts were low in fried fish, seafood; this may be due to the attained temperature for frying was sufficient to kill vegetative bacteria on the surface of fish, beside superficial thin layer, most deep regions. Data presented in Table 3 showed that, the mean value of coliform count in the examined fried M. cephalus, Saurus fish, S. pharaonis, Shrimp were 2.03×10^2 $\pm0.20\times10^2$, 2.26×10^2 $\pm0.14\times10^2$, 2.62×10^2 $\pm0.26\times10^2$, 2.41×10^2 $\pm0.19\times10^2$ respectively. These results came in parallel with those of (Soliman *et al.*, 2002, Abd El-Rahman *et al.*, 2003, Vigano *et al.*, 2007). Meanwhile, they disagreed with those of Altug, (Bayrak, 2003) who cannot detected Coliforms in all examined smoked fish samples. The results in Tables (4&5) revealed that, 12 isolates of *E.coli* were isolated from examined fried seafood represented as 38.6% from *M. cephalus* with serotypes O_{55}:H_7 2.9%, O_{125}:H_{18} 2.9% & untypable 2.9%, 25.7% Saurus with serotype O_{55}:H_7 only, 411.4% *S. pharaonis* with serotypes O_{55}:H_7 5.7% & O_{125}:H_{18} 5.7% , 38.6% from Shrimp with serotypes O_{55}:H_7 5.7% & untypable 2.9%. These results came in accordance with those obtained by Soliman *et al.*, (2002), Abd El-Rahman *et al.*, (2003) , Little *et al.*, (2003), Ahmed and Anwar, (2007), Sagoo *et al.*, (2007), Vigano *et al.*, (2007), Subramanian, (2007), and Hosein *et al.*, (2008). Meanwhile, Soliman and Shalby, (2001) and Salim (2008) reported that, all examined fried fish, shrimp were free from *E.coli*. Certain serotypes of *E.coli* play an important role as human pathogens, which give rise to gastroenteritis outbreaks, severe diarrhea in infants, coli-bacillosis in adults, meningitis, enteritis (Youssef *et al.*, 1992). *Staphylococci* were a part of normal flora of animal , man, because their ubiquitous occurrence in nature, they were found in various raw foods, at the mean time foodborne illness from *Staphylococcus* enterotoxins remains a major problem worldwide (Normanno *et al.*, 2005). The obtained results in Table 6 revealed that, the mean value of *Staphylococcus* count in the examined fried *M. cephalus*, Saurus fish, *S. pharaonis*, Shrimp were 3.68×10^2 $\pm0.41\times10^2$, 3.32×10^2 $\pm0.17\times10^2$, 4.65×10^2 $\pm0.33\times10^2$, 5.22×10^2 $\pm0.38\times10^2$, respectively. These results were nearly agreed with those reported by (Hefnawy, 1990) who reported that mean Staphylococcus count were 1.84×10^2 in fried fish. Meanwhile, they were lower than those obtained by (Abd El-Rahman *et al.*, 2003) who reported 1.1×10^3 in fried fish, (Sagoo et al., 2007) >103cfu/g from cooked crustaceans. The results obtained in Table 7 revealed that, 24 isolates of coagulase positive *S. aureus* were isolated from examined fried seafood represented as 514.3% from *M. cephalus*, 411.4% Saurus, 925.7% *S. pharaonis* , 617.1% from Shrimp samples. Nearly similar results were recorded by (Soliman and Shalby 2001, Soliman *et al.*, 2002, Abd El-Rahman *et al.*, 2003, Sagoo *et al.*,2007 , Subramanian, 2007, Vazquez – Sanchez *et al.*, 2012, Atanassova *et al.*, 2014).These results were disagreed with those of (Ahmed and Anwar, 2007, Abd Allah, 2010) who found that all examined fried fish , shrimp samples were free from coagulase positive *S. aureus*. *S. aureus* existed in fish, seafood samples may be due to food handlers, particularly, those suffering from infected wounds or sores on their hands, or coughing, sneezing near food (Kraft, 1992). Moreover, the *S. aureus* recovered from fried fish, seafood may be due to that the cocci usually more heat resistant than rods, could be used as target microorganism in designing mild thermal treatments for foods (Kennedy *et al.*, 2005). The results obtained in Table 8 revealed

that, 4 isolates of *L. monocytogenes* were isolated from examined fried seafood represented as 25.7% *S. pharaonis* , 25.7% from Shrimp samples. Meanwhile, all examined samples of *M. cephalus* , Saurus fish were free from *L. monocytogenes*. (Younis, 2013) reported nearly similar results. The results for *S. pharaonis*, Shrimp were similar to that of Scoglio et al., 2000.While, they disagreed with those of Ahmed and Anwar, (2007), Hosein *et al.*, (2008) who failed to isolate *L. monocytogenes* from ready to eat fish, shrimp. *Salmonella* organisms are not ordinary very heat resistant , normal cooking operations will destroy the organisms , the contamination of cooked food with *Salmonella* usually occurs as a results of mishandling (Flower, 1998). The present study failed to detect *Salmonella* serovars from all examined fried samples. These results were agreed with those recorded by Abd El-Rahman *et al.*, (2003, Altug and Bayrak (2003), Ahmed and Anwar, (2012), Sagoo *et al.*, (2007) ,Vigano *et al.*, (2007), Subramanian, (2007), Hosein *et al.*, (2008), Salim, (2008), Abd Allah, (2010) who failed to isolate *Salmonella* from samples of fried fish, fried shrimp, fried seafood , cooked crustaceans. Meanwhile, disagreed with those of Soliman *et al.*, (2002), Younis, (2013) who isolated *Salmonella* from fried fish, shrimp, and ready to eat food sandwiches.

Finally, the present study proved that fried ready to eat seafood are considered public health hazard , the presence of negligible percentages of aerobic bacteria, *Enterobacteriaceae*, coliforms, *E.coli*, Staphylococci mainly Coagulase Positive *S. aureus, L. monocytogenes*, absence of *Salmonella* due to the post-cooking contamination with bad handling, spices added, during packing .

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ميكروبات التسمم الغذائي في الوجبات البحريه المعده للأكل

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الملخص العربي

تم إجراء هذه الدراسة على 140 عينه عشوائية من المأكولات البحرية المعده للأكل من المطاعم ممثلة في عينات مقليه من كلا من اسماك البوري، اسماك المكرونه، السبيط والجمبري بواقع 35 عينة لكل منها للتقييم البكتريولوجي لهم. وقد أظهرت نتائج الفحص البكتيريولوجى أن متوسط العدد البكتريولوجي بالنسبه للميكروبات الهوائيه و الميكروبات المعويه و ميكروبات القولون والمكور العنقودي لأسماك البوري المقلية كانت 5,04 × 10 ^{3} و 3,79 ×10 ^{2} و 2,03 × 10 ^{2} و 3,68 × 10 ^{2} وكذلك أسماك المكرونه المقليه كانت02 .5×10^{3}و 53 .3×10^{2}و 26. 2×10^{2} و 32 .3×10^{2}اما بالنسبة للسبيط المقلي فكانت 6×10^{3} و 34 .5×10^{2} و 62 .2×10^{2} و 65 .4×10^{2} .بينما فى عينات الجمبرى فكانت 41 . 5×10^{3} – 45 .4×10^{2} – 41 .2×10^{2} و 22 .5×10^{2} علي التوالي. ولقد تم عزل ميكروب الايشيريشيا كولاي من 12 عينه 8.357٪ من البوري المقلي وكانت العترات المعزوله هي 271 .5٪ من المكرونه المقلي وكانت العترات المعزوله هي $O_{55}:H_7$ فقط. 4 43 .11٪ من السبيط المقلي وكانت العترات المعزوله هي71 .5 ٪ H_{18} : O_{125} - 71 .5 ٪ : O_{55} 357 .8٪ H_7 من الجمبري المقلي وكانت العترات المعزوله هي 71 .5 ٪ H_7 : O_{55} وعترات غير مصنفه بنسبة 86 .2 ٪. ولقد امكن عزل الميكروب المكور العنقودي الذهبي من 24 عينه علي النحو الاتي: 528 .14٪ لاسماك البوري المقليه – 442 .11٪ لاسماك المكرونه المقليه – 971 .25٪ للسبيط المقلي و 614 .17٪ للجمبري المقلي. كما تم عزل ميكروب الليستريا مونوسيتوجين من 4 عينات علي النحو الاتي: 271 .5٪ من عينات السبيط المقلي و 5.271٪ من عينات الجمبري المقلي ولكن عينات البوري والمكرونه المقليه كانت خاليه من هذا الميكروب. بينما لم يتم عزل ميكروب السالمونيلا من اي من عينات الوجبات البحريه المعده للاكل، وقد تم مناقشة النتائج وبيان اهمية الميكروبات المعزولة وخطورتها على صحة الانسان.

(مجلة بنها للعلوم الطبية البيطرية: عدد 27(2):116-125 ، ديسمبر2014)