Bacteriological quality of frozen minced meat in Menofia Governorate

Hemmat El gendy[1], Faten Hasanine[1], Amani Mohamed Salem[1], Nahla Ahmed Abo Elroos[2]

[1]*Department of Food Hygiene, Faculty of Veterinary Medicine, Benha University*

[2]*Animal Health Research Institute, Shibin El Kom Branch, Egypt*

ABSTRACT

A total of one hundred random samples of frozen minced beef (340g of each) were collected from four different meat factories A,B,C and D their products marketed in Menofia Governorate(25 for each). Factory D, recorded the highest count of Aerobic plate count (APC), Enterobacteriaceae and coliform as 9.17×105±2.03×105,7.29×104±1.10×104 and 3.13× 104 ±0.62× 104cfu/g were recorded, respectively. Followed by factory C that recorded 4.90×105± 0.58×105, 5.42×104 ±0.83×104 and1.89× 104 ±0.35× 104cfu/g, respectively. In addition, factory D recorded the highest pathogenic load of staphylococci and staphylococcus aureus with 4.65× 104± 0.76 ×104 & 1.16 ×104 ±0.24×104 cfu/g, respectively. Followed by factory C which recorded 2.33 ×104± 0.49× 104 & 8.83× 103 ±1.91× 103 cfu/g, respectively. The highest incidence of Escherichia coli, Salmonella and S.aureus in factory D were 36%, 28%& 68% followed by factory C were 24%,20% &52%, then factory B were 20%,16% & 40%, finally factory A were 12%, 8% and 24%, respectively. Achieved results in the present study proved that minced meat samples at factory C and D were highly contaminated that may considered a reliable index of fecal contamination and improper handling during processing.

Keywords: *Frozen minced meat, APC, Enterobacteriaceae, Coliform, E.coli, S.aureus.*

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1. INTRODUCTION

Meat and meat products are sources of high quality protein and their amino acid composition usually compensate for shortcomings in the food. They supply easily absorbed iron and assist the absorption of iron from other foods, they also rich sources of B-complex vitamins (Speedy, 2003).

Poor hygienic practices in meat processing plants may result in the contamination of meat and meat products with pathogens causing a serious risk for human health. Moreover, the complete elimination of pathogens from food processing environments is a difficult, in part because bacteria can attach to meat contact surfaces where they survive even after cleaning and disinfection (Yang et al., 2012).

Aerobic plate count (*APC*) is the most reliable index of meat quality, sanitary processing and storage life of meat products (ICMSF, 1980). *Enterobacteriaceae* group has an epidemiological importance as some of its members are pathogenic and may cause serious infections and food poisoning. Moreover, the total number of Enterobacteriaceae considered as an indication of possible enteric contamination in the absence of coliforms (Mercuri et al., 1978).

Escherichia coli and *Staphylococcus aureus* are the most important bacterial pathogens in beef meat and meat products that are responsible for food-borne infections (Abdaslam, 2014; Ezzat et al. 2014 and Saif-Marwa, 2015).

Contamination of minced meat with *Salmonella* is still considered a major problem in food hygiene (Vipham, 2012). Salmonellosis is still one of the major global causes of gastroenteritis in humans and animals (Grimont and Weil 2007).The failure of the food manufacture to assure the production and distribution of safe food products lead to many serious food borne diseases which cause considerable morbidity & mortality as well as reduction in economic production (Alexandratos,2010). Therefore, this study was conducted to throw out a light on the bacterial quality of some processed meat products in processing plants in relation to different hygienic levels of these markets.

2. Materials and methods

2.1. Collection of samples:

One hundred samples (340g of each sample) of frozen minced beef were collected from four different meat factories (A, B, C& D) (25 of each) in Shibin El-kome, Al-Menofia Province, Egypt. All collected samples were put in sterile plastic bags, transferred under hygienic measures in ice box to the laboratory without undue delay and examined bacteriologically.

2.2. Preparation of samples :(ISO 6887-2003)

Twenty- five grams of the examined samples were stomached by using (stomacher 3,serial no.010410226,France) with 225ml of 0.1% sterile buffered peptone water to give a dilution of (1:10), from which decimal serial dilutions were prepared.

2.3. Bacteriological examination:

Determination of APC (APHA 2001), Coliform count (Feng et al 2002), Enterobacteriaceae count (ICMSF 1996), isolation and identification of *Escherichia coli* were carried by (ISO 16649-2001), *Salmonella* (ISO 6579: 2002) and *Staphylococcus aureus* (FDA 2001).

2.4. Statistical Analysis:

The obtained results were statistically analyzed by application of Analysis of Variance (ANOVA) test according to Feldman et al. (2003).

3. RESULTS

It is evident from the result recorded in table (1) that the APC counts (cfu/g) in the examined samples of frozen minced beef at different meat factories A, B, C and D were $7.85x10^4 \pm 1.26x10^4$,$2.31x10^5 \pm 0.19x10^5$,$4.90x 10^5 \pm 0.58x10^5$ & $9.17x10^5 \pm 2.03x10^5$cfu/g, respectively. Enterobacteriaceae counts were $8.05x10^3 \pm 1.67x10^3$, $1.14x10^4 \pm 0.20x10^4$, $5.42x10^4 \pm 0.83x10^4$&$7.29x10^4 \pm 1.10x10^4$ cfu/g at different meat factories A, B, C and D, respectively. Coliform counts were $3.96x10^3 \pm 0.48x10^3$, $6.01x10^3 \pm 1.12x10^3$, $1.89x10^4 \pm 0.35x10^4$&$3.13x10^4 \pm 0.62x10^4$ cfu/g at different meat factories A, B, C & D, respectively. Staphylococcus counts were $5.72x10^3 \pm 0.91x10^3$, $8.05x10^3 \pm 2.10x10^3$, $2.33x10^4 \pm 0.49x10^4$ & $4.65x10^4 \pm 0.76x10^4$. *Staphylococcus aureus* counts at different meat factories A, B, C & D were $9.29x10^2 \pm 2.06x10^2$, $3.51x10^3 \pm 0.73x10^3$, $8.83x10^3 \pm 1.91x10^3$ & $1.16x10^4 \pm 0.24x10^4$ cfu/g, respectively.

From the previous results, it's revealed that there are high significant differences between counts in different meat factories A, B, C& D ($P < 0.05$) as shown in table (2) results recorded that the incidence of E.coli, *Salmonella* and *S.aureus* in the examined samples of frozen minced beef were 12%, 8%

& 24% in (A), 20%, 16% & 40% in (B), 24%, 20% & 52% in (C) and 36%, 28% & 68% in (D) meat factories, respectively. The data recorded in table (3) indicated that the incidence of *E.coli* Serotypes in the examined frozen minced meat samples were *O26:H11(EHEC)* (4%), *O111:H2 (EHEC) (*4%)and *O119:H6* (4%) in (A), *O26:H11 (EHEC)* (8%), *O91;H21(EHEC)*(4%), *O111:H2 (EHEC)* (4%) and *O125:H21 (ETEC)* (4%) in (B), *O26:H11 (EHEC)* (4%),*O55:H7 (EPEC)* (4%), *O111:H2 (EHEC) (8%),O114:H4 (EPEC) (*4%) and *O124 (EIEC)* (4%)in(C) , *O26:H11(EHEC) (*12%), *O86 (EPEC) (4%), O91:H21 (EHEC)* (4%), *O111:H2 (EHEC)* (8%), *O119:H6 (EPEC)* (4%) and *O128:H2 (ETEC)* (4%) in(D). On the other hand, results in table (4) showed that the incidence of *Salmonella* serotypes in the examined samples were *S.* Enteritidis(4%) and *S.Montevideo*(4%) in (A),*S.*Enteritidis (4%), *S.Infantis* (4%) and *S.Typhimurium* (8%) in (B), *S.Heidlberg* (4%), *S.Montevideo* (8%), *S.Molade* (4%) and *S.Typhimiurium* (4%) in (C), *S.*Enteritidis (8%), *S.Infantis* (4%), *S.Molade* (4%), *S.Tamale* (4%) and *S.Typhimiurium* (8%) in (D). Table (5) declared that all the examined samples of minced meat in factory(A) were accepted, 4%, 16% & 36%, 12%, 20%, 24% &36%, 8%, 12%, 20% & 28% and 24%, 40%, 52% & 68% were unaccepted for *E.coli*, *Salmonella* and *S.aureus* in (A), (B), (C) & (D) meat factories according to E.S. (2005).

Table1: Mean values of bacterial counts (cfu/g) in the examined frozen minced beef samples from four different meat factories (n=25).

Meat factories / counts	A	B	C	D
APC	$7.85X10^4 \pm 1.26X10^4$	$2.31X10^5 \pm 0.19X10^5$	$4.90X10^5 \pm 0.58X10^5$	$9.17X10^5 \pm 2.03X10^5$
Enterobacteriaceae	$8.05x10^3 \pm 1.67x10^3$	$1.14x104 \pm 0.20x10^4$	$5.42x10^4 \pm 0.83x10^4$	$7.29x10^4 \pm 1.10x10^4$
Coli form	$3.96x10^3 \pm 0.48x10^3$	$6.01x103 \pm 1.12x10^3$	$1.89x10^4 \pm 0.35x10^4$	$3.13x10^4 \pm 0.62x10^4$
Staphylococcus	$5.72x10^3 \pm 0.91x10^3$	$8.05x103 \pm 2.10x10^3$	$2.33x10^4 \pm 0.49x10^4$	$4.65x10^4 \pm 0.76x10^4$
Staph.aureus	$9.29x10^2 \pm 2.06x10^2$	$3.51x10^3 \pm 0.73x10^3$	$8.83x10^3 \pm 1.91x10^3$	$1.16x10^4 \pm 0.24x10^4$

Highly significant difference between products at $P < 0.01$.

Table 2: Incidence of contamination in the examined minced meat samples (n=25).

Meat factories / counts	A		B		C		D	
	NO.	%	NO.	%	NO.	%	NO.	%
APC	0	0	1	4	4	16	9	36
E.coli	3	12	5	20	6	24	9	36
Salmonella	2	8	4	16	5	20	7	28
Staph.aureus	6	24	10	40	13	52	17	68

Table 3: Serotyping of *E.coli* in the examined frozen minced meat at different meat factories (n=25)

Meat factories / E.coli strains	A		B		C		D		Strains characteristics
	NO.	%	NO.	%	NO.	%	NO.	%	
O26:H11	1	4	2	8	1	4	3	12	EHEC
O55:H7	-	-	-	-	1	4	-	-	EPEC
O86	-	-	-	-	-	-	1	4	EPEC
O91:H21	-	-	1	4	-	-	1	4	EHEC
O111:H2	1	4	1	4	2	8	2	8	EHEC
O114:H4	-	-	-	-	1	4	-	-	EPEC
O119:H6	1	4	-	-	-	-	1	4	EPEC
O124	-	-	-	-	1	4	-	-	EIEC
O125:H21	-	-	1	4	-	-	-	-	ETEC
O128:H2	-	-	-	-	-	-	1	4	ETEC
Total	3	12	5	20	6	24	9	36	

Table 4: Serotyping of Salmonella in the examined frozen minced meat at different meat factories (n=25).

Meat factories / Salmonellae	A NO.	A %	B NO.	B %	C NO.	C %	D NO.	D %	Group	Antigenic O	Structure H
S. Enteritidis	1	4	1	4	-	-	2	8	D1	1,9,12	g.m:1,7
S. Heidlberg	-	-	-	-	1	4	-	-	B	1,4,5,12	r:1,2
S.Infantis	-	-	1	4	-	-	1	4	C1	6,7	r:1,5
S.Montevideo	1	4	-	-	2	8	-	-	C1	6,7	g.m.s:1,2,7
S.Molade	-	-	-	-	1	4	1	4	C1	6,7	Z10:z6
S.Tamale	-	-	-	-	-	-	1	4	C3	8,20	Z29:e,n,Z15
S.Typhimurium	-	-	2	8	1	4	2	8	B	1,4,5,12	I:1,2
Total	2	8	4	16	5	20	7	28			

Table 5: Acceptability of bacterial load in the examined samples of frozen minced meat according to permissible limits of E.S. (2005).

$m.o_s$ / meat factories	APC P.L	APC Unaccepted Samples No.	APC Unaccepted Samples %	E.coli P.L	E.coli Unaccepted Samples No.	E.coli Unaccepted Samples %	Salmonella P.L	Salmonella Unaccepted Samples No.	Salmonella Unaccepted Samples %	S.aureus P.L	S.aureus Unaccepted Samples No.	S.aureus Unaccepted Samples %
A	10^6	0	0	free	3	12	free	2	8	10^2	6	24
B	10^6	1	4	free	5	20	free	4	12	10^2	10	40
C	10^6	4	16	free	6	24	free	5	20	10^2	13	52
D	10^6	9	36	free	9	36	free	7	28	10^2	17	68

4. DISCUSSION

Minced meat and meat products are perishable foods and unless stored under proper conditions spoil quickly. In addition, if pathogens are present, meat products become hazardous for consumers. Therefore, assurance of meat safety and quality is the most important (Shimoni and Iabuza, 2000).

Results demonstrated agreed with those of (Biswas et al., 2008), where they reported that minced meat of high incidences to bacterial contamination. The clothes of workers, processing equipment and water used to wash carcass, hands and equipment were source of meat contamination during slaughter process (Upmann et al, 2000).The sources could be the animal, the environment or contamination during meat processing (McNamara 1998). The main sources of meat contamination are animal feces especially during processing at the slaughterhouse (Kudva et al., 1998).

The results revealed in table (1) reflected that the highest APC, *Enterobacteriaceae, Coliform, Staphylococcus* and *S.aureus* were in the examined frozen minced meat collected at meat factory (D), followed by (C) then (B) and finally(A) meat factories. High APC may be attributed to the contamination of the product from different sources or unsatisfactory processing as well as unsuitable condition during storage Zehran-Dalia (2008).

In general, *Enterobacteriaceae* count used to assess the general hygienic status of a food product and their presence in food indicates in adequate cooking or post-processing contamination (CFS, 2014). Members of this family have been considered a potent cause of food borne outbreaks (Centinkaya et al., 2008).

Coliform counts reflect inadequate sanitation during production and handling raw material, meat contact surfaces and employees. Meanwhile, the occurrences of large numbers of them on carcass surfaces are highly undesirable, mostly suggesting faecal contamination and points to potentially severe hazard (Eribo and Jay, 1985).

Presence of *Staphylococci* in minced meat samples may be attributed to inadequate heat treatment, unhygienic handling practices through the workers who can transfer staphylococci on their hands and using dirty equipment's for slicing and the most probable reason of minced meat contamination might be the poor hygienic quality of raw meat, inadequate storage and thawing conditions, contamination from grinder and the time between mincing and mixing Eisel et al. (1997).

According to results achieved in table(1) comparing the obtained values from the examined samples, higher result for APC, *Coliform* and*Staphylococci* count were reported by Tekinsen et al.(1980) ($8.4x10^7$cfu/g), Gonulalan and Kose (2003) ($5.3x10^9$cfu/g) and Baskaya et al. (2004) ($6.3x10^7$cfu/g) in minced meat in APC. While, Erdem et al. (2014) who found that *Coliform* counts (cfu/g) of minced meat were ($1x10^6$ cfu/g). Also, higher ones of *Staphylococci* showed by Ibrahim (2016) ($3.00x10^7 \pm 8.13x10^6$cfu/g) & ($5.83x10^5 \pm 1.06x10^5$cfu/g) and Talaat (2009) ($6.92x10^6 \pm 4.54x10^6$ cfu/g) in frozen minced meat.

On the other hand, lower results for APC were reported by Melngaile et al., (2014) (5.08log cfu/g) in minced meat. Ahmed (2018) revealed that *Enterobacteriaceae* counts varied from $4.0x10^2$ to $6.4x10^4$ with mean value of $5.82x10^3 \pm 1.02x10^3$ cfu/g in minced meat. Moreover, Morshdy et al. (2013) ($4.3x10^2$/g) and Erdem-Ayten et al. (2014) ($6.5x10^2$/g) for *S.aureus*in minced meat.

While, it is evident from the results in Table (1) that there is nearly similar results obtained by Amany et al. (2010) ($5.61x10^5$cfu/g) in minced meat for APC. In addition, Al-Mutairi (2011) revealed that *Enterobacteriaceae* count were ($37.8x10^4$ cfu/g) in minced meat. The obtained results of *Coliform* in (A) level were relatively similar to Al-kour (2001) ($2.34x10^3$cfu/g) & Amany et al. (2010) ($5.12x10^3$ cfu/g) in minced meat.

Table (2) revealed that high incidence of *APC, E.coli, Salmonella* and *S.aureus* at (D) and (C) but the lowest one in (A). Presence of *E.coli* in meat indicated a general lack of cleanness during slaughtering, evisceration, dressing, transportation and handling of meat ICMSF(1996b).As well as, *E.coli* may be used as an indicator microorganism of fecal contamination and poor sanitation during processing (Eisel et al.1997). Also, *Salmonella* % at (B) were nearly similar results obtained by Stock and Stolle (2001) (15.8%) and Ejeta et al. (2004) (14.4%) but % at (A) is nearly similar with White et al. (2001) (9%).Higher results founded by Fritzen et al. (2006) (48%) and Ahmed (2012) (40%). On the other hand, the lowest % reported by Fathi and Thabet (2001) (0%). Presence of *Salmonella* may reflect insufficient hygienic measures stock and Stolle (2001).

Presence of *S.aureus* is a leading cause of food poisoning resulting from the consumption of contaminated food with Staphylococcal enterotoxins Guven et al. (2010).

Table (3) showed that serotyping of *E.coli* which found the highest rate of contamination in (D) followed by (C) then(B) but the lowest one in (A).*Escherichia coli*% recorded in (C) were nearly similar to those obtained by Melngaile et al. (2014) (23%). While, higher ones (46%) were obtained by Shawish (2015). *Entero Hemorrhagic Escherichia coli* (*EHEC*) was implicated in outbreaks of diarrhea in young children and infants. Illness caused by *EHEC* is typically quit severe and characterized by sudden onset of severe crampy abdominal pain followed by watery diarrhea, which later on becomes grossly bloody, Lee et al. (2009).

As shown in Table (4) salmonella serotyping found high contamination in (D) then (C) then (A) but lowest one at (A). *S.Typhimurium* has been the most frequent serotype and *S.* Enteritidis acts as a causative agent of human gastroenteritis throughout the world Sharma et al., 1996)**.**

As shown in Table (5) results indicated that all examined minced meat samples in (A) were accepted, but APC in (B, C &D) were unaccepted. Also, *E.coli, Salmonella* and *S.aureus* in examined samples at A, B, C &D factories more than permissible limits of E.S(2005) in such meat products represent a high risk to consumer, cause health hazard and indicates inadequate sanitary conditions during stages of manufacturing, dirty equipment and improper handling.

5. Conclusion

Achieved results in the present study proved that the highest contaminated minced meat samples were collected in (D) factory followed by (C) that may considered a reliable index of fecal contamination and improper handling during processing.

Consequently, strict maintenance of good practices during processing, strengthened by maintaining the cold chain during transport, distribution and carcass commercialization is of central importance to ensure both public health and food quality.

6. REFERENCES

Abd El-Salam-Azza, S. (2014): Molecular detection of antimicrobial resistance for some food borne pathogens. ph.D. Thesis, Bacteriology, Mycology and Immunology, Fac.Vet. Med. Zagazig Univ. Egypt.

Alexandratos, N. (2010): World agriculture: towards 2010: an FAO study. Food & Agriculture Org.

Al-kour, M.S. (2001): Microbiological states of meat and some meat products in northen Jordan. M. V. Sc. Thesis, Fac.Vet. Med. Sci. and Tecnol. Jordan Univ.

Al- Mutairi, M.F. (2011): The Incidence of Enterobacteriaceae causing food poisoning in some meat products. J. of Food Sci. and Technol., 3(2):116-121.

Ahmed, M. H. Youness (2018): Bacteriological status of some meat products. M.V.S ci. Thesis (Meat Hygiene), Fac. Vet. Med., Benha Univ. Egypt.

Ahmed-Zeineb, A.M. (2012): Prevalence of Salmonella in poultry products and meat products in Luxor City. M.V.Sc. Thesis (Meat Hygiene), Fac. Vet. Med. South Valley Univ.

APHA (American Public Health Association) (2001): Compendium of Methods for the microbiological examination of Foods. 4th Ed. F.P. Downes and K. Ito (editors), APHA. Washington D.C., USA.

Baskaya, R., Karaca, T., Sevinc, I., Cakmak, O., Yildiz, A. and Yoruk, M. (2004): Istanbul'da satisa sunulan hazir kiymalarin histolojik, mikrobiyolojik ve serolojik kalitesi. YYU Vet Fak Derg., 15:41-46.

Biswas, A.K., Kondaiah,N., Bheilegaonkar, K.N., Anjaneyulu,A.S.R., Mendiratta, S.K., Jana,C., Singh, H. and Kuma, R.R.(2008): Microbial profiles of frozen trimming and silver sides prepared at Indian Buffalo meatpacking plants. Meat Sci., 80:418-422.

CFS (Center for Food Safety) (2014): Microbiological Guidelines for Food

(For ready - to- eat food in general and specific food items).Risk Assessment Section, Food and Environmental Hygiene Department 43/F, Queensway Government Offices,66 Queensway, Hong Kong.

Centinkaya, F., Cibik, G.I, Soyuteniz, E., Ozkin, C., Kayali, R. and Levent, B. (2008): Shigella and Salmonella contamination in various foodstuffs in Turkey. J. Food Control, 19:1059-1063.

E.S "Egyptian Standards" (2005): Egyptian Organization of Standardization and Quality of chilled poultry and rabbits.ES:1651/2005.

Eisel, W.G., Lintion, R.H., and Muriana, P.M. (1997): A survey of microbial levels for incoming raw beef, environmental sources and ground beef in a red meat processing plant. J.Food Microbial., 14:273-282

Erdem -Ayten, K., Saglam, D., Ozer, D. and Ozcelik, E. (2014): Microbiological Quality of Minced Meat Samples Marketed in Istanbul YYU Veteriner Fakultesi Dergisi., 25:67-70.

Eribo, E. and Jay, J.M. (1985): Incidence of Acinobacter species and other gram negative, oxidase negative bacteria in fresh and spoiled ground beef. J. Appl. Env. Microbiol., 49(1):256-257.

Ejeta, G., Molla, B., Alemayehu, D. and Muckle, A. (2004): Salmonella serotypes isolated from minced meat beef, mutton and pork in Addis Ababa, Ethiopia. Rev. Med. Vet., 155:547-551.

Ezzat, M., Shabana, I.I., Mohammed-Gihan, M.O., Abd El-Hak-Marwa (2014): "Molecular characterization of pathogenic E.coli isolated from meat and their products". SCVM.J. 21(1):103-113.

Fathi, S.H. and Thabet, El.R. (2001): Incidence of Salmonella and E. coli in packed meat products sold in Assiut city .Assiut.J.Vet.Med. 42:46.

Feng, P., Weagant, S.D., Grant, M.A., Burkhardt, W., Shelffish, M., Water, B. (2002): BAM: Enumeration of Escherichia coli and the Coliform Bacteria. Bacteriological analytical manual, 13-19.

Food and Drug administration (FDA) (2001): Foodborne illness, what consumers need to know.USDA Food Safety and Inspection Service, September 2001.

Fritzen, A.L., Schwerz, D.L., Gabiatti, E.C., Padilha, V. and Macari, S.M. (2006): Microbiological analysis of minced meat from slaughter houses in the 9th health region in Parana. /Portuguese]. Rev. Hyg. Alim., 20:81-83.

Gonulalan, Z. and Kose, A. (2003): Kayseri ilinde satisa sunulan sigir kiymalarinin mikrobiolojik kalitesi. FU Saglik Bil Derg., 17:49-53.

Grimont, P.D. and Weil, F.X. (2007): Antigenic formula of the Salmonella serovars. WHO Collaborating Centre for Reference and Research on Salmonella, 9th (Ed) Paris, France.

Guven, K., Mutlu, B.M., Gulbandilar, A. and Cakir, P. (2010): Occurrence and characterization of *Staph. aureus* isolated from meat and dairy products consumed in Turkey. J. FoodSafety, 30:196-212.

Ibrahim-Shimaa, M. A. (2016): Detection of Staph.aureus classic enterotoxin genes in some meat products using multiplex

PCR. Ph.D. Thesis (Meat Hygiene), Fac.Vet. Med. Kafr el-sheikh. Univ.

International Commission of Microbiological Specifications for Foods (ICMSF) (1980): “Microbial ecology of foods”. Vol. 1, Academic Press, New York, Toronto.

International Commission of Microbiological Specification for Foods ICMSF (1996b): Microorganisms in foods. Intestinally pathogenic *E.coli* .Blackie Academic and professional, London,UK.

International Commission of Microbiological Specifications for Foods (ICMSF) (1996): "Microorganisms in food".1- Their Significance and methods of enumeration.3rdEd.Univ.Of Toronto Press. Toronto, Canada.

International Standard Organization16649-2 "ISO" (2001): Microbiology of food and animal feeding stuffs. Horizontal method for the enumeration of B-glucuroniadase -positive Escherichia coli. Part 2: Colony count technique at 44ºC using 5 bromo-4- chloro-3-indolyl B-D-glucuronide.

International Standard Organization 6579"ISO" (2002): 4th Ed. Microbiology- General Guidance on methods for the detection of Salmonella, International Organization for Standardization, Genève, Switzerland.

International Standard Organization6887-2"ISO" (2003): Microbiology of food and animal feeding stuffs-preparation of testsamples, initial suspension and decimal dilution for microbiological examination – Part2: Specific rules for the preparation of meat and meat products, Switzerland, Vienna.

Kudva, T., Blanch, K. and Hovde, C.J. (1998): Analysis of Escherichia coli O157:H7 survival in ovine or bovine manure and manure slurry. Appl Environ Microb., 64:3166-3174.

Lee,G.Y., Jang.H.I., Hwang, I.G., Rhee. M.S. (2009): prevalence and classification of pathogenic *Escherichia coli* isolated from fresh beef, poultry, and pork in Korea. Int. J. Food Microbiol., 134; 196-200.

Madden, R.H., Espie, W. E., Loran, L., McBride, J. and Scates, P. (2001): Occurrence of Escherichia coli O157: H7, Listeria monocytogenes, Salmonella and Campylobacter spp. On beef carcasses in Northern Ireland. Meat Sci., 58:343-346.

McNamara, A. M. (1998): Foodborne pathogens. J Urban Health. 75:503-505. doi: 10.1007/BF02427690.

Melngaile, A., Ciekure, E. and Valcina, O. (2014): Microbiological quality of meat preservation and meat products. Food Balt.61:65.

Mercuri.A.J., Cox,N.A., Carson,M.O. and Tanner, D.A.(1978): Realtion of Enterbacteriaceae count to Salmonella contamination of Marker broiler. J. Food Protect, 42:427.

Morshdy, A.M., El-Atabany, L., Hussein, M.A.and Nasser, M.A. (2013): Detection of enterotoxigenic Staphylococcus aureus in some meat products.Assiut.Vet.Med.J. 59:100-106.

Saif- Marwa, Z. M.A. (2015): Bacterial Status of Fresh Marketed chicken cuts.M.V.Sc. Thesis, Meat Hygiene, Fac. Vet. Med., Benha Univ.Egypt.

Salem, Amany, M., Amin- Reham, A. and Afifi- Gehan, S.A. (2010): Studies on antimicrobial and antioxidant efficiency of some essential oils in minced beef. J. American Sci., 6:691-700.

Sharma, D., Sharma, V.D. and Kumar, A. (1996): Microbial quality of commercial pork products. Indian. J. Animal Sci., 66:211-213.

Shawish, R .R. (2015): Prevalence and biocontrol of shiga toxin producing Escherichia coli in some beef products. Ph.D. Thesis (Meat hygiene), Fac. Vet. Med., Menofia Univ, Sadat branch.

Shimoni.E. and Iabuza, T.P. (2000): Modeling pathogen growth in meat products: future challenges. Trends in food science and Technology 11(11):394.

Speedy, A.W. (2003): Global production and consumption of animal source foods. J. Nutr., 133(11):4048S-4053S.

Stock, K. and Stolle, A. (2001): Incidence of Salmonella in minced meat produced in a European Union-Approved cutting plant. J. Food Protect. 64:1435-1438.

Talaat- Nagwa, W. (2009): Bacteriological and histological evaluation of some meat products. M.V.Sc. (Meat hygiene), Fac. Vet. Med. Karelsheikh Univ.

Tekinsen, O.C., Yurteri, A. and Mutler,B. (1980) Ankara'dasatilan hazir kiymalarin bakteriyolojik kalitesi. AU Vet Fak Derg., 27:45-63.

Upmann, Jvl., Jakob, P. and Reuter, G. (2000): Microbial transfer during cutting and deboning of pork. Dairy food and Environmental Sanitation, 20:14-23.

Vipham, J.L., Brashears, M.M., Loneragon, G.H., Echeverry, A., Brooks, J.C., Chaney W.E. and Miller, M.F. (2012): *Salmonella* and *Campylobacter* baseline in retail ground beef and whole-muscle cuts purchased during 2010 in the United States. J. Food Protect, 75:2110-2115.

White, D.G., Zhao, S. and Sudler, R. (2001): The isolation of antibiotic-resistant Salmonella from retail ground meats. N. Engl. J. Med, 345:1147-1154.

Yang,L., Liu,Y., Wu,H., Song, Z., Hoiby, N., Molin,S. and Givskov, M. (2012): Combating biofilms. FEMS Immunol. Med.Microbiol., 65(2):146-157.

Zaharan–Dalia, A., Bassma, A.H. and El-Hifnawi, H.N. (2008): Incidence and radiation sensitivity of *Bacillus cereus, Listeria monocytogenes* and their toxins in some chicken products. World. J. Appl. Sci., 5:182-188