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Microbiological Criteria of Some Meat Products

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Key words

Microbiological Criteria, Meat products, Salmonella spp., Staphylococcus aureus and Yersinia enterocolitica.

ABSTRACT:

A total of two hundred of meat product samples (Beef burger, Luncheon, Pasterma and Sausage) were collected randomly from different retail shops at Alexandria province and examined for their microbiological criteria. All the examined samples found to be contaminated with different types of microorganisms with the mean values of 8.20×10^2, 6.29×10^2, 5.40×10^2 and 8.28×10^2 , respectively for total *aerobic* bacterial counts; total 5.57×10^2, 4.96×10^2, 5.83×10^2 and 7.64×10^2, respectively for *Psychotrophic* bacterial count; 5.27×10^2,4.65×10^2, 3.74×10^2 and 7.47×10^2, respectively for total *Enterobactericeae* count; 2.92×10^2, 3.50×10^2, 4.19×10^2 and 7.64×10^2, respectively for total *Coliforms* count and at last 4.7×10^2, 1.21×10^2, 1.22×10^2 and 1.00×10^2, respectively for total *Yeast* and *Mold* count. The incidence of identified *Staphylococcus aureus* was 68, 80, 60 and 88%, respectively and the incidence of identified *Salmonella spp* was 20, 26, 6 and 40%, respectively, while the incidence of identified *Yersinia enterocolitica* was 46, 40, 54 and 34, respectively.

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1. INTRODUCTION

The increasing number and severity of food poisoning outbreaks worldwide has considerably increased public awareness about food (Forsythe, 2008), especially meat and meat products which are one of the most important sources of human infections with a variety of foodborne pathogens (Norrung, et al. 2009). However, meat and meat products continues to be an important food group in the diet for many consumers (Rosegrant et al., 1999; Delgado, 2003 and Speedy, 2003).

Staphylococcus aureus is considered to be one of the most important foodborne diseases worldwide due to its ability to produce wide arrays of toxins (Balaban and Rasooly, 2000 and Argudin, et al. 2010).

Meat products like luncheon, burger and minced meat are considered important sources of pathogenic *Salmonella spp.* which caused sever gastroenteritis in human, especially products manufactured from raw and minced meat and not subjected for heat treatment (Karmi, 2013).

Yersinia enterocolitica in meat and meat products is a special concern since those organisms are capable of growth at refrigerator temperatures.(Johnson, 1998). *Yersinia enterocolitica* is by far the most frequent cause of *yersiniosis* worldwide. *Yersinia enterocolitica* occurs in several biotypes and serotypes, which differs in pathogenicity to humans, geographical distribution and animal reservoirs (EFSA, 2007). So, the aim of this study is to evaluate some meat products through microbiological criteria.

2. MATERIAL AND METHODES

Collection of the samples: A total number of 200 meat product samples (50 each of traditional frozen beef burger, Egyptian luncheon, pasterma, and sausages) were collected randomly from different retail shops in Alexandria Governorate.

Preparation of samples (ICMSF, 1978): Ten grams of each meat products samples were weighted aseptically into a sterile homogenizer flask containing 90 ml of sterile peptone water 0.1%. the contents of the homogenizer flask were homogenized for 2.5 minutes at 14000 rpm and allowed to stand for about five minutes at room temperature. Subsequent 10^{th} fold serial dilution of the homogenate was prepared up to 10^{-6} from the original dilution (1:10). The prepared dilutions were used for microbiological examination.

A. Enumeration procedures:

A.1. Total *Aerobic* bacterial count **(**ICMSF, 1982).

A.2. Total *Psychotrophic* bacterial count (ICMSF, 1982).

A.3. Total *Enterobactericea*e count (ICMSF, 1982).

A.4. Total *Coliforms* count (ICMSF, 1978).

A.5. Total *Yeast* and *Mold* count (FAO, 1992).

B. Isolation and Identification of some pathogenic bacteria:

B.1. Isolation and Identification of *Staphylococcus aureus* (ICMSF, 1978 and APHA, 1992).

B.2. Isolation and identification of *Salmonella* (ICMSF, 1978 and APHA, 1992) as well as serological identification of *Salmonellae* (Edwards and Ewing, 1972; ICMSF, 1978).

B.3. Isolation of *Yersinia enterocolitica* (Walker and Gilmour, 1986 and APHA, 1992) as well as bio-typing of identified *Yersinia enterocolitica* (Barker and Farmer, 1982).

2. RESULTS and DISCUSSION

Meat and meat products are considered as a major vehicle of most reported food poisoning outbreaks. Therefore, it is important to use the microbiological criteria as it gives guidance on the acceptability of meat products and their manufacturing, handling and distribution processes.

According to results showed in Table (1) which indicated the total Aerobic bacterial count in the examined meat products samples. In beef burger samples, the total Aerobic bacterial count ranged from 9.0 X 10 to 4.39 X 10^3 with a mean value of 8.20 X 10^2 ± 0.19 X 10. Luncheon ranged from 2.0 X 10 to 3.71 X 10^3 with a mean value of 6.29 X 10^2 ± 0.16 X 10. Pasterma ranged from 9.0 X 10 to 3.30 X 10^3 with a mean value of 5.40 X 10^2 ± 0.13 X 10. Sausage ranged from 3.0 X 10 to 4.72 X 10^3 with a mean value of 8.28 X 10^2 ± 0.18 X 10 cfu/g, respectively.

The total Aerobic bacterial count of any food articles is not only a sure indicator of its safety for consumption, yet it is of importance in judging the hygienic conditions under which it has been processed and handled (Saad, 1976). Also the presence of numerous mesophilis bacteria which grow successfully at or near body temperature would stimulate the multiplication of microorganisms (Gill, et al. 2000).

Psychtrophic bacteria are the main cause of spoilage of meat products which are kept under refrigeration temperature due to their ability to grow at low temperature. Total *Psychtrophic* bacterial count can provide useful information about the keeping quality of some meat products. Table (2) revealed the total *Psychotrophic* bacterial count of the examined meat products samples. In beef burger ranged from 2.0 X 10 to 3.29 X 10^3 with a mean value of 5.57 X 10^2 ± 0.47 X 10. Luncheon ranged from 5.0 X 10 to 3.66 X 10^3 with a mean value of 4.96 X 10^2 ± 0.36 X 10. Paterma ranged from 2.2 X 10 to 3.43 X 10^3 with a mean value of 5.83 X 10^2 ± 0.51 X 10 and at last sausage ranged from 1.2 X 10 to 3.71 X 10^3 with a mean value of 7.64 X 10^2 ± 0.76 X 10 cfu/g.

Enterobacteriaceae is a group of organisms are used in food testing as hygiene indicator organisms and can give advance warning of failures in hygiene procedures in your food manufacturing site. In Table (3) it is evident that the total *Enterobactericeae* count of examined meat products samples, was ranged from 7.0 X 10 to 3.83 X 10^3 with a mean value of 5.27 X 10^2 ± 1.52 X 10 in beef burger. In luncheon ranged from 4.0 X 10 to 3.62 X 10^3 with a mean value of 4.65 X 10^2 ± 1.43 X 10 while pasterma ranged from 3.0 X 10 to 4.49 X 10^3 with a mean value of 3.74 X 10^2 ± 1.34 X 10 while sausage ranged from 1.0 X 10 to 3.20 X 10^3 with a mean value of 7.47 X 10^2 ± 1.61 X 10 cfu/g. The presence of *Enterobacteriaceae* as an indicator of food sanitation has received an attention of most scientists. The presence of *Enterobacteriaceae* shows the possibilities of microbiological and toxigenic bacteria in meat and lead to public health hazard (Mira, 1989).

Table (1): Total *Aerobic* bacterial count (cfu/g) of examined meat product samples.(n=50)

Meat product samples	*Positive Samples %*	*Minimum*	*Maximum*	*Mean*	*SEM*
Beef burger	100%	9.0 X 10	4.39 X 10^3	8.20 X 10^2 A	0.19 X 10
Luncheon	100%	2.0 X 10	3.71 X 10^3	6.29 X 10^2 B	0.16 X 10
Pasterma	100%	9.0 X 10	3.30 X 10^3	5.40 X 10^2 C	0.13 X 10
Sausage	100%	3.0 X 10	4.72 X 10^3	8.28 X 10^2 A	0.18 X 10

Means within the same column of different litters are significantly different at ($P < 0.05$).
SEM= Standard error of Mean

Table (2) Total *Psychotrophic* bacterial count (cfu/g) of examined meat product samples(n=50).

Meat product samples	*Positive Samples %*	*Minimum*	*Maximum*	*Mean*	*SEM*
Beef burger	87%	2.0 X 10	3.29 X 10^3	5.57 X 10^2 B	0.47 X 10
Luncheon	100%	5.0 X 10	3.66 X 10^3	4.96 X 10^2 C	0.36 X 10
Pasterma	86%	2.2 X 10	3.43 X 10^3	5.83 X 10^2 B	0.51 X 10
Sausage	100%	1.2 X 10	3.71 X 10^3	7.64 X 10^2 A	0.76 X 10

Means within the same column of different litters are significantly different at ($P < 0.05$)
SEM= Standard error of Mean

Table (3): Total *Enterobactericeae* count (cfu/g) of examined meat product samples (n=50).

Meat product samples	*Positive Samples %*	*Minimum*	*Maximum*	*Mean*	*SEM*
Beef burger	73%	7.0 X 10	3.83 X 10^3	5.27 X 10^2B	1.52 X 10
Luncheon	80%	4.0 X 10	3.62 X 10^3	4.65 X 10^2C	1.43 X 10
Pasterma	80%	3.0 X 10	4.49 X 10^3	3.74 X 10^2D	1.34 X 10
Sausage	100%	1.0 X 10	3.20 X 10^3	7.47 X 10^2A	1.61 X 10

Means within the same column of different litters are significantly different at ($P < 0.05$).
SEM= Standard error of Mean

Table (4): Total *Coliforms* count (cfu/g) of examined meat product samples (n=50).

Meat product samples	*Positive Samples %*	*Minimum*	*Maximum*	*Mean*	*SEM*
Beef burger	66%	9.0 X 10	1.98 X 10^3	2.92 X 10^2D	0.82 X 10
Luncheon	65%	4.0 X 10	3.71 X 10^3	3.50 X 10^2C	1.30 X 10
Pasterma	57%	1.0 X 10	4.84 X 10^3	4.19 X 10^2B	1.52 X 10
Sausage	100%	2.0 X 10	3.84 X 10^3	7.64 X 10^2A	1.79 X 10

Means within the same column of different litters are significantly different at ($P < 0.05$).
SEM= Standard error of Mean

Table (5). Total *Yeast and Mold* count (cfu/g) of examined meat product samples.(n=50)

Meat product samples	*Positive Samples %*	*Minimum*	*Maximum*	*Mean*	*SEM*
Beef burger	93%	1.0 X 10	6.40 X 10^3	4.7 X 10^2B	0.17 X 10
Luncheon	100%	4.0 X 10	1.71 X 10^4	1.21 X 10^2A	0.52 X 10
Pasterma	86%	2.0 X 10	1.47 X 10^4	1.22 X 10^2A	0.49 X 10
Sausage	100%	1.0 X 10	9.70 X 10^3	1.00 X 10^2A	0.33 X 10

Means within the same column of different litters are significantly different at ($P < 0.05$).
SEM= Standard error of Mean

Coliforms is a group of organisms is also used as hygiene indicator organisms. Table (4) showed the total *Coliforms* count of examined meat products samples. In beef burger ranged from 9.0 X 10 to 1.98 X 10^3 with a mean value of 2.92 X 10^2 ± 0.82 X 10, luncheon ranged from 4.0 X 10 to 3.71 X 10^3 with a mean value of 3.50 X 10^2 ± 1.30 X 10, pasterma ranged from 1.0 X 10 to 4.84 X 10^3 with a mean value of 4.19 X 10^2 ± 1.52 X 10 and finally sausage ranged from 2.0 X 10 to 3.84 X 10^3 with a mean value of 7.64 X 10^2 ± 1.79 X 10 cfu/g. The presence of *Coliforms* in meat and meat products indicates a potable fecal source of contamination which begin from slaughter house as a result of skinning of animals by knives and workers, also during evisceration. Contamination may come from animal intestine, air and water used for washing and rinsing of carcasses. Also, the plant itself may be due to difference in manufacture practice, handling from producers to consumers and the effectiveness of hygienic measures applied during production (Gaafer, 2009).

Table (6): Incidence of identified *Mold* isolated from examined meat product samples (n=50).

Identified isolates	Beef burger (n=50)		Luncheon (n=50)		Pasterma (n=50)		Sausage (n=50)	
	No.	%	No.	%	No.	%	No.	%
Aspergillus flavus	34	68.0	33	66.0	34	68.0	40	80.0
Aspergillus fumigates	10	20.0	0	0.0	13	26.0	33	66.0
Aspergillus fusarium	17	34.0	13	26.0	10	20.0	0	0.0
Aspergillus nidulans	0	0.0	0	0.0	7	14.0	4	8.0
Aspergillus niger	33	66.0	37	74.0	30	40.0	37	74.0
Aspergillus ochraceus	3	6.0	7	14.0	0	0.0	10	20.0
Aspergillus terreus	3	6.0	3	6.0	0	0.0	4	8.0
Mucor spp.	0	0.0	3	6.0	0	0.0	0	0.0
Penicillium spp.	4	8	13	26.0	0	0.0	0	0.0
Rhizopus spp.	3	6.0	3	6.0	0	0.0	13	26.0

$Chi^2 = 56.55^{**}$ ** = Significant at ($P < 0.01$)

Table (7): Incidence of identified *Yeast* isolated from examined meat product samples (n=50).

Identified isolates	Beef burger (n=50)		Luncheon (n=50)		Pasterma (n=50)		Sausage (n=50)	
	No.	%	No.	%	No.	%	No.	%
Candida albicans	13	26.0	13	26.0	7	14.0	13	26.0
Candida Kruesi	0	0.0	0	0.0	3	6.0	0	0.0
Candida neoformans	0	0.0	0	0.0	6	13.0	0	0.0
Candida tropicalis	0	0.0	3	6.0	0	0.0	0	0.0
Cryptococcus spp.	3	6.0	0	0.0	0	0.0	14	28.0
Rhodotorula spp.	0	0.0	0	0.0	7	14	10	20.0
Saccharomyces Cerevisiae	3	6.0	6	12.0	10	20.0	0	0.0

$Chi^2 = 39.55^{**}$ ** = Significant at ($P < 0.01$)

Table (8): Incidence of identified *Staphylococcus aureus* isolated from examined meat products samples. (n=50)

Staphylococcus aureus	Beef burger (n=50)		Luncheon (n=50)		Pasterma (n=50)		Sausage (n=50)	
	No.	%	No.	%	No.	%	No.	%
Negative Coagulase Test	16	32	10	20.0	20	40.0	6	12
Positive Coagulase Test	34	68	40	80.0	30	60.0	44	88

$Chi^2 = 9.45^{**}$ ** = Significant at ($P < 0.01$)

Table (9): Incidence of identified *Salmonella species* isolated from examined meat products samples (n=50).

Identified isolates.	*Beef burger*		*Luncheon*		*Pasterma*		*Sausage*	
	No.	%	No.	%	No.	%	No.	%
Salmonella spp. Positive.	10	20.0	13	26	3	6	20	40.0

$Chi^2 = 10.66^{**}$ ** = Significant at (P < 0.01)

Table (10): Incidence of serotype of *Salmonella* spp. Isolated from examined meat product samples (n=50).

Identified isolates.	*Beef burger*		*Luncheon*		*Pasterma*		*Sausage*	
	No.	%	No.	%	No.	%	No.	%
Salmonella Enteritidis	1	2.0	2	4.0	0	0	2	4.0
Salmonella Paratyphi	2	4.0	3	6.0	0	0	3	6.0
Salmonella Typhi	3	6.0	4	8.0	2	4.0	9	18.0
Salmonella Typhimurium	4	8.0	4	8.0	1	2.0	6	12.0

$Chi^2 = 18.66^{**}$ ** = Significant at (P < 0.01)

Table (11): Incidence of identified *Yersinia enterocolitica* isolated from examined meat product samples (n=50).

Identified isolates.	*Beef burger*		*Luncheon*		*Pasterma*		*Sausage*	
	No.	%	No.	%	No.	%	No.	%
Yersinia enterocolitica	23	46	20	40.0	27	54	17	34

$Chi^2 = 8.55^{**}$ ** = Significant at (P < 0.01)

Table (12): Incidence of biotyping of *Yersinia enterocolitica* isolated from examined meat product samples: (n=50)

Identified isolates	*Beef burger*		*Luncheon*		*Pasterma*		*Sausage*	
	No.	%	No.	%	No.	%	No.	%
IA	5	10.0	6	12.0	8	16.0	8	16.0
IB	5	10.0	3	6.0	3	6.0	1	2.0
2	2	4.0	3	6.0	2	4.0	1	2.0
3	3	6.0	2	4.0	3	6.0	2	4.0
4	2	4.0	4	8.0	2	4.0	1	2.0
5	6	12.0	2	4.0	9	18.0	4	8.0

$Chi^2 = 39.56^{**}$ ** = Significant at (P < 0.01)

Yeasts and *Molds* can play an important role in the spoilage of food, some *molds* can also produce mycotoxins that can be harmful to humans. In Table (5) revealed the total *Yeast* and *Molds* count of examined meat products samples. In beef burger ranged from 1.0 X 10 to 6.40 X 10^3 with a mean value of 0.47 X 10^2 ± 0.17 X 10, luncheon ranged from 4.0 X 10 to 1.71 X 10^4 with a mean value of 1.21X 10^2 ± 0.17 52X 10, patserma ranged from 2.0 X 10 to 1.47 X 10^4 with a mean value of 1.22 X 10^2 ± 0.49 X 10, while in sausage ranged from 1.0 X 10 to 9.70 X 10^3 with a mean value of 1.0 X 10^2 ± 0.33 X 10 cfu/g.

Table (6) showed that the incidence of identified *Mold* isolated from examined beef burger, luncheon, pasterma and sausage were (68, 66,68 and 80%) for *Aspergillus flavus*, (20, 0, 26 and 66) for *Aspergillus fumigates*, (34, 26, 20 and 0%) for *Aspergillus fusarium,* (0, 0, 14 and 8%) for *Aspergillus nidulans*, (66, 74, 40 and 74%), for *Aspergillus niger*, (6, 14, 0 and 20%) for *Aspergillus ochraceus*, (6, 6, 0 and 8%) for *Aspergillus terreus*, (0, 6, 0 and 0%) for *Mucor* spp., (8, 26, 0 and 0%) for *Penicillium* spp. and (6, 6, 0 and 26%) for *Rhizopus* spp.

On the other hand, Table (7) indicated the incidence of identified *Yeast* isolated from examined beef burger, luncheon, pasterma and sausage were (26, 26, 14 and 26%) for *Candida albicans*, (0, 0, 6 and 0%) for *Candida kruesi*, (0, 0, 13 and 0%) for *Candida neaformans*, (0, 6, 0 and 0%) for *Candida tropicalis*, (6, 0, 0 and 28%) for *Cryptococcus spp.*, (0, 0, 14 and 20%) for *Rhodotorula spp.* and (6, 12, 20 and 0%) for *Saccharomyces cerevisiae*.

Staphylococcus aureus could cause food poisoning and if it grows in large numbers can leave toxins in the product, which may survive heating. It lives on the skins of humans and animals and can easily be transferred to food products. Table (8) showed the incidence of identified *Staphylococcus aureus* isolated from examined meat products samples (Beef burger, luncheon, pasterma and sausage). The positive coagulase *Staphylococcus aureus* of the examined meat product samples was 68, 80, 60 and 88%, respectively.

The higher incidence of *Staphylococcus aureus* may be due to very bad hygienic measures in many supermarkets (Hayes, 1992).

Salmonella spp. is probably the best known food poisoning organism and can be found in a wide variety of foods. Cases and incidence of Salmonellosis have reduced but it is still one of the major causes of outbreaks of food poisoning. Table (9) revealed the incidence of identified *Salmonella spp.* isolated from meat product samples (Beef burger, luncheon, pasterma and sausage) as it was 20, 26, 6 and 40%, respectively.

Table (10) indicated the isolated serotypes of *Salmonella spp.* from examined beef burger, luncheon, pasterma and sausage were (2, 4, 0 and 4%) for *Salmonella Enteritidis*, (4, 6, 0 and 6%) for *Salmonella Paratyphi*, (6, 8, 4 and 18%) for *Salmonella Typhi* and (8, 8, 2 and 12%) for *Salmonella Typhimurium*.

Also table (11) indicated the incidence of identified *Yersinia enterocolitica* isolated from meat product samples (beef burger, luncheon, pasterma and sausage) as it was 46, 40, 54 and 34%, respectively, while in Table (12) showed that the incidence of biotyping of *Yersinia enterocolitica* isolated from examined beef burger, luncheon, pasterma and sausage were (10, 12, 16 and 16%) for biotype IA, (10, 6, 6 and 2%) for biotype IB, (4, 6, 4 and 2%) for biotype2, (6, 4, 6 and 4%) for biotype3, (4, 8, 4 and 2%) for biotype4 and (12, 4, 18 and 8%) for biotype5.

We conclude that high microbiological quality is associated with premises where the personal is trained in food hygiene and those that had hazard analysis in place. In contrast, low microbiological quality is associated with storage above 8Cº, presliced meats, infrequent cleaning of the equipment and poor control practice that likely lead to cross contamination (Elson, et al. 2004).

The result demonstrates the fact that the unhygienic and poor sanitary conditions under which the meat and meat products are handled and processed are not acceptable from sanitary point of view. It has further evidenced that the undesirable level of contamination which might have acquired from the environment and agents and to obtain wholesome, safe and sound meat products, the principles Good Manufacturing Practices (GMP) and Hazard Analysis and Critical Control Point (HACCP) must be adopted.

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