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Effect of Sanitary Status of Meat Processing Plants on Some Meat Products

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ABSTRACT

A total of (160) fresh luncheon and Kofta samples were collected from two different meat processing plants from Alexandria province. Twenty samples at two different processing stages, homogenate and final stage from each product. These samples were examined bacteriologically for Total aerobic and Psychrotrophic count, isolation and identification of Staphylococcus aureus, Total Enterobacteriaceae, Total Coliform, Total Mould and Yeast count. The bacterial investigation carried out to luncheon homogenate at plant I and plant II revealed that there was a clear significance between the plants in the total Psychrotrophic count, total Staphylococcus aureus count, total coliform count, total mould and yeast count. While there was no significance between the plants in the total aerobic count and total enterobacteriaceae count. At the final luncheon product stage, there was significance between all previous types of counts except in total Staphylococcal count. While in case of Kofta homogenate there was a significant variation between the plants in case of all mentioned counts except in TAC and total Enterobacteriaceae where there was no significance. For the final product of Kofta there was no significance between the plant I and plant II in all counts except in the TAC and total mould and yeast count, where there was a significant variation. This mainly due to the final heat treatment. Coagulase positive Staph.aureus was 19 samples (24.38 %) out of 80 examined samples. The public health significance of these types of bacteria must be regarded and studied.

INTRODUCTION

Meat is considered as an important source of animal protein and the most necessary for human to be obtained, manufactured and stored well. Meat is considered as an essential food, tasty, from the beginning a commitment to sanitation is a must. Not all the meat could be eaten at once. The remaining part was processed in order to preserve the meat for later consumption. Processing meat to meat products is away to preserve meat. Meat processing plants have a significant variation in degree of sanitation. Construction of facility for ease of sanitation and proper equipment must be available to employees to ensure successful completion of sanitation objectives.

Products such as luncheon and Kofta, surly are subjected to many hazards at two different stages of processing (homogenate and final product form) this was done in a two different native plants in Alexandria. Mainly there were many sources of contamination to raw meat and at slaughter houses, as well as plant workers.

Kitehell et al. (1973) counted viable bacteria at 20 ^{0}C on plate count agar, the samples obtained from different sites of six cattle surface. They recorded log means ranged from 2.64 to 3.52. Psychrotrophs could be used as an indicator for microbiological safety and sanitation conditions during processing and keeping quality of the product. Enterobacteriaceae group had an

epidemiological interest and importance as some of which were pathogenic and may cause serious intestinal and food poisoning.

Eid (1999) examined bacteriologically 50 samples of precooked meat taken from different butchers at Damanhour city. He found that the total bacterial count, total Enterobacteriaceae and total Staphylococci count were $5.8 \times 10^5 \pm 1.1 \times 10^4$, $3.2 \times 10^4 \pm 9.8 \times 10^3$ and $1.4 \times 10^4 \pm 3.1 \times 10^3$ cfu/g, respectively.

Nel et al., (2004) stated that Enterobacteriaceae were defined as, amongst others, members of the genera Salmonella, Shigella, Yersinia, Proteus and Klebsiella, and therefore present a holistic view of presence of these organisms on hands and aprons of food handlers.

Ismail and Zaky (1999) reported that the luncheon meat samples analyzed, which were produced locally by the two main luncheon meat producing companies in Egypt were relatively highly contaminated either by mould and yeast.

The objectives of the present survey was done in order to give an information about the effect of sanitary status of meat processing plants on meat quality, this was done though close examination of meat

MATERIALS AND METHODS

1. Materials:

1.1. **Samples**:

A total of 160 samples of luncheon were collected from two different meat processing plants of different sanitary levels in Alexandria governorate. 20 samples were taken from each product at homogenization stage and 20 samples at final product stage at the two plants, each sample was about 250 g. The collected samples were transferred directly with a minimum of delay to the laboratory in an insulating refrigerated container under complete aseptic condition to avoid any changes in the quality of samples due to chemical and/or microbial actions. The collected samples were examined immediately after arrivals to the laboratory, samples were prepared according to **ICMSF, (1978).**

1.2. Media used:

1. Standard plate count agar medium (Oxoid).
2. Baired Parkeragar medium (Oxoid).
3. Violet red bile glucose agar medium (Oxoid).
4. Violet red bile agar (Oxoid).
5. Sabouraud's dextrose agar medium (Difco).
7. Nutrient agar (Oxoid).
8. Brain heart infusion broth (Oxoid).
9. Egg yolk emulsion (Oxoid).
10. Peptone water (Oxoid).
11. Semisolid Agar media (Oxoid).
12. Mannitol Salt Agar medium(Oxoid).

1**.3. Reagents**

1. 3% Hydrogen peroxide (Difco).
2. Citrated rabbit plasma (Difco).
3. Gram's stains (Gibco).
4. Alcohol (Gibco).

2. Methods:

2.1. Sampling techniques:

2.2. Bacteriological examinations:

2.2.1. Total aerobic bacterial count was carried out according to (**Cruickshank et al.,** 1975):

2.2.2. Determination of total psychrotrophic count, the technique was recommended by **ICMSF (1978):**

2.2.3. Total staphylococcal was carried out according to **(ICMSF, 1978**).

2.2.3.1. Isolation and identification of staphylococcus aureus. **(ICMSF, 1978**).

2.2.4. Total Enterobacteriaceae count **(ICMSF (1978)**):

2.2.5. Coliform count **(ICMSF, 1978**):

2.2.6. Total Mould and Yeast count **(Cruickshank et al.,1975)**::

RESULTS

Table (1): Statistical analytical comparative results of microbiological quality (count as cfu/gm) of examined samples of Luncheon homogenate between plant (I) and plant (II).

	Plant	Minimum	Maximum	Mean ± SE	Significance
TAC	**I**	$4.8x\ 10^4$	$4.3x\ 10^5$	$1.51 \times 10^5 \pm 1.27 \times 10^4$	**NS**
	II	6.3×10^4	3.8×10^5	$1.56 \times 10^5 \pm 1.31 \times 10^4$	
Psychrotrophic	**I**	$3.7x\ 10^3$	2.8×10^4	$1.09 \times 10^4 \pm 0.97 \times 10^3$	**
	II	2.5×10^3	2.0×10^4	$8.18 \times 10^4 \pm 0.78 \times 10^3$	
Staphylococci	**I**	4.0×10^2	1.2×10^4	$4.06 \times 10^3 \pm 0.50 \times 10^3$	**
	II	6.0×10^2	1.9×10^4	$6.80 \times 10^3 \pm 0.63 \times 10^3$	
Enterobacteriaceae	**I**	1.4×10^3	8.0×10^3	$3.93 \times 10^3 \pm 0.34 \times 10^3$	**NS**
	II	1.4×10^3	8.1×10^3	$3.32 \times 10^3 \pm 0.26 \times 10^2$	
Coliforms	**I**	5.0×10^2	4.2×10^3	$1.34 \times 10^3 \pm 0.14 \times 10^3$	**
	II	9.0×10^2	6.3×10^3	$2.01 \times 10^3 \pm 0.18 \times 10^3$	
Mould and Yeast	**I**	1.4×10^4	1.1×10^6	$4.17 \times 10^5 \pm 3.86 \times 10^4$	**
	II	2.1×10^4	1.1×10^5	$6.01 \times 10^5 \pm 4.01 \times 10^4$	

Table(2): Statistical analytical comparative results of microbiological quality (count as cfu/gm) of examined samples of Luncheon Final product between plant (I) and plant (II).

	Plant	Minimum	Maximum	Mean ± SE	Significance
TAC	**I**	2.0×10^3	$2.8x\ 10^4$	$8.54 \times 10^3 \pm 9.14. \times 10^2$	**
	II	2.4×10^3	1.8×10^5	$7.45 \times 10^4 \pm 6.04 \times 10^3$	
Psychrotrophic	**I**	$1.1x\ 10^3$	1.1×10^4	$4.61 \times 10^3 \pm 0.46 \times 10^3$	**
	II	1.1×10^3	8.0×10^3	$3.55 \times 10^3 \pm 0.28 \times 10^3$	
Staphylococci	**I**	5.0×10^2	6.0×10^3	$2.28 \times 10^3 \pm 0.33 \times 10^3$	**NS**
	II	2.0×10^2	7.0×10^3	$2.32 \times 10^3 \pm 0.34 \times 10^3$	
Enterobacteriaceae	**I**	8.0×10^1	6.0×10^2	$2.38 \times 10^2 \pm 0.24 \times 10^2$	**
	II	1.2×10^2	9.0×10^2	$3.15 \times 10^2 \pm 0.27 \times 10^2$	
Coliforms	**I**	4.0×10^1	6.0×10^2	$1.71 \times 10^2 \pm 0.25 \times 10^2$	**
	II	1.0×10^2	7.0×10^2	$2.75 \times 10^2 \pm 0.29 \times 10^2$	
Mould and Yeast	**I**	6.0×10^3	1.1×10^5	$3.08 \times 10^4 \pm 3.44 \times 10^3$	**
	II	1.8×10^4	2.1×10^5	$5.46 \times 10^4 \pm 5.41 \times 10^3$	

Table (3): Statistical analytical comparative results of microbiological quality (count as cfu/gm) of examined samples of kofta homogenate between plant (I) and plant (II).

	Plant	Minimum	Maximum	Mean ± SE	Significance
TAC	**I**	8.3×10^5	5.3×10^5	$1.44 \times 10^6 \pm 1.45 \times 10^5$	**NS**
	II	6.3×10^4	3.8×10^5	$1.66 \times 10^6 \pm 1.31 \times 10^5$	
Psychrotrophic	**I**	1.1×10^4	9.2×10^5	$3.33 \times 10^4 \pm 3.75 \times 10^3$	**
	II	1.2×10^3	1.1×10^4	$5.00 \times 10^4 \pm 3.88 \times 10^3$	
Staphylococci	**I**	1.7×10^4	1.4×10^5	$4.56 \times 10^3 \pm 4.56 \times 10^3$	**
	II	2.2×10^3	1.4×10^4	$6.79 \times 10^4 \pm 5.14 \times 10^3$	
Enterobacteriaceae	**I**	6.1×10^3	4.0×10^4	$2.13 \times 10^4 \pm 1.44 \times 10^3$	**NS**
	II	1.6×10^4	1.1×10^5	$4.58 \times 10^4 \pm 3.87 \times 10^3$	
Coliforms	**I**	6.1×10^3	4.0×10^4	$1.58 \times 10^4 \pm 1.54 \times 10^3$	**
	II	7.2×10^3	8.0×10^4	$2.81 \times 10^4 \pm 3.14 \times 10^3$	
Mould and Yeast	**I**	1.1×10^5	1.1×10^6	$4.34 \times 10^5 \pm 3.58 \times 10^4$	**
	II	4.0×10^5	3.0×10^6	$1.43 \times 10^6 \pm 1.16 \times 10^5$	

Table (4): Statistical analytical comparative results of microbiological quality (count as cfu/gm) of examined samples of kofta Final product between plant (I) and plant (II).

	Plant	Minimum	Maximum	Mean ± SE	Significance
TAC	**I**	1.6×10^5	1.3×10^6	$5.01 \times 10^5 \pm 4.00 \times 10^5$	**
	II	3.2×10^4	1.3×10^5	$6.94 \times 10^5 \pm 3.79 \times 10^4$	
Psychrotrophic	**I**	8.0×10^2	1.0×10^4	$4.17 \times 10^3 \pm 4.01 \times 10^2$	**NS**
	II	1.0×10^3	9.0×10^3	$3.92 \times 10^3 \pm 3.10 \times 10^2$	
Staphylococci	**I**	1.4×10^3	9.1×10^3	$4.17 \times 10^3 \pm 3.65 \times 10^2$	**NS**
	II	1.6×10^3	8.3×10^3	$3.86 \times 10^3 \pm 3.17 \times 10^2$	
Enterobacteriaceae	**I**	1.9×10^3	1.6×10^4	$5.37 \times 10^3 \pm 5.36 \times 10^2$	**NS**
	II	2.2×10^3	1.2×10^4	$4.64 \times 10^3 \pm 3.72 \times 10^2$	
Coliforms	**I**	1.1×10^3	1.1×10^4	$4.27 \times 10^3 \pm 4.11 \times 10^2$	**NS**
	II	9.0×10^3	1.2×10^4	$4.33 \times 10^3 \pm 3.86 \times 10^2$	
Mould and Yeast	**I**	9.1×10^4	5.1×10^5	$2.50 \times 10^5 \pm 1.98 \times 10^4$	**
	II	1.3×10^5	1.1×10^6	$4.57 \times 10^5 \pm 3.62 \times 10^4$	

Total number of examined Luncheon homogenate samples for each plant (n) = 20.
SEM = standard error of the mean.
** Significant level at ($p<0.05$)
NS= non-significant level at ($p<0.05$)

DISCUSSION

The Total Aerobic Count (TAC) is considered as an index of sanitary quality, organoleptic quality, safety and utility of foods. As shown in table (1) the mean value of the TAC in luncheon homogenate were ($1.51 \times 10^5 \pm 1..2 \times 10^4$ and $1.56 \times 10^5 \pm 1.3 \times 10^4$) and for luncheon final product were ($8.54 \times 10^3 \pm 9.14 \times 10^2$ and$7.48 \times 10^4 \pm 6.04 \times 10^3$) cfu/g for plant I and plant II respectively.

For Kofta, the homogenate form mean of TAC was ($1.44 \times 10^6 \pm 1.45 \times 10^5$ and $1.7 \times 10^6 \pm 1.31 \times 10^5$) and the final Kofta product was ($5.013 \times 10^5 \pm 4.0 \times 10^5$ and $6.94 \times 10^5 \pm 3.79 \times 10^4$) cfu/g plant I and plant II, respectively.

Shalaby (1992) noticed that the total aerobic count of examined luncheon samples was ranged from 2×10^4 to 4×10^6 cfu/g

The increase of the total aerobic count in plant 2 in both processing stages of production (homogenate and final product), it can be attributed to many sources of contamination especially washing water, meat source, workers factors and sanitary measures applied to each plant.

(Gada and **Mohamed(2001).** The mean aerobic plate count value of examined Kofta samples from different fast food services in Assiut city were 15.3×10^3 cfu/g

The total psychrotrophic mean value at homogenate was ($10.92 \times 10^3 \pm 0.97 \times 10^3$ and $8.18 \times 10^3 \pm 0.78 \times 10^3$) cfu/g in table 1, while at the final luncheon product it was($4.61 \times 10^3 \pm 0.46 \times 10^3$ and $3.55 \times 10^3 \pm 0.28 \times 10^3$) in plant I and plant II respectively. In case of Kofta, the homogenate mean value was ($3.3 \times 10^4 \pm 3.75 \times 10^3$ and $5.00 \times 10^4 \pm 3.88 \times 10^3$) and at final product the mean was ($4.17 \times 10^3 \pm 4.01 \times 10^2$ and $3.92 \times 10^3 \pm 3.10 \times 10^2$) cfu/g in plant I and plant II, respectively.

The sources and types of psychrotrophic bacteria which gain access to meat were studied. Gram negative psychrotrophs were recovered from the hides, from structural and work surfaces within the abattoir, and from carcasses and meat at all stages of processing.

The previous results explained that there was a significant variation in the total psychrotrophic count between the two plants in luncheon homogenate (table 1), luncheon final product (table 2) and kofta homogenate (table 3), but there was no significant variation between plant I and plant II in case of kofta final product (table 4). To some extent the total psychrotrophic count in plant I was higher than that In plant II (and the vice versa in other microbiological counts carried out in this study), however the plant 1 have a better sanitary state than plant II comparatively.

Thieulin et al. (1966) reported that the count of mesophilic and psychrotrophic bacteria were $<10^6$ per gram in 98% of the hamburger samples examined, and they added that although aerobic psychrotrophic bacteria are generally non pathogenic to man, they are important to the hygienists because they are almost common cause of refrigerated food spoilage.

Total Enterobacteriaceae count results as shown in table (1) for luncheon homogenate were ($3.93 \times 10^3 \pm 0.34 \times 10^3$ and $3.32 \times 10^3 \pm 0.26 \times 10^2$) cfu/g, for plant I and plant II respectively. Showing a moderate difference in between. At the final products a clear significance between the two plants table (2) as ($2.38 \times 10^2 \pm 0.24 \times 10^2$ and $3.15 \times 10^2 \pm 0.27 \times 10^2$) in plant I and plant II, respectively.

In case of Kofta , the mean value in homogenate was($2.13 \times 10^4 \pm 1.44 \times 10^3$ and $4.58 \times 10^4 \pm 3.87 \times 10^3$) and in final product was ($5.37 \times 10^3 \pm 5.36 \times 10^2$ and

4.6 x 10^3 ± 3.72 x 10^2) cfu/g in plant I and plant II, respectively.

The presence of such counts in both plants indicates that there was a poor sanitary conditions during handling of such products mainly at homogenate form. But plant II had a higher contamination and count than plant I, also water source and contamination affects sanitary status of plants.

Mira,(1987) The occurrence of Enterobacteriaceae shows microbiological and toxigenic bacteria in meat and lead to public health hazard.

Total Staphylococcal count : From table (1) the result of plantI and plantII respectively were (in plantI 4.06 × 10^3 ± 0.05 ± 10^3 and in plantII 6.80 × 10^3 ± 0.63 × 10^3) cfu/ gfor luncheon homogenate.While the table 2 showing results of final product with a significant difference between the two plants as plant 1 was (2.28 x 10^3± 0.33 x 10^3) and in plant 2 was (2.28 x 10^3± 0.33 x 10^3) cfu/g

In case of Kofta, the mean value of homogenate was (4.56 x 10^4 ± 4.56 x 10^3 and 6.79 x 10^4 ± 5.14 x 103) and in final product it was (4.17 x 10^3 ± 3.65 x 10^2 and 3.86 x 10^3 ± 3.17 x 10^2) in plant I and plant II, respectively. On the other hands Coagulase positive Staph.aureus was 24.38 % which is less than that obtained by **Kilai et al.,(2005**), and near that results obtained by **El-Bassiouny** and **Samaha (1991), Zeftawy Hoda (2000), Bystron (2005) and Purabi and Joshi (2010).**

Staph. aureus food poisoning is diagnosed based on a medical history and a physical examination Your doctor will ask you questions about your symptoms, your work and home environments, and foods you have recently eaten and whether other people have become ill from eating the samethings. A stool culture and blood tests may be done if your symptoms are severe or to rule out other causes **(Healthwise 2011).**

In the total psychrotrophic count/g there was a significant variation between the plant I and plant II in case of luncheon homogenate, luncheon final product and kofta homogenate, while at final product of kofta there was no significant variation between the two plants.

Total Coliform count : From table 1 results of luncheon homogenate was (1.34 × 10^3 ± 0.14 × 10^3 and 2.01 × 10^3 ± 0.18 × 10^3) and at final product it was (1.71 x 10^2± 0.25 x 10^2 and 2.75 x 10^2 ± 0.29 x 10^2) cfu/g in plant I and plant II, respectively**.** This shows a clear significance between plant I and plant II in case of the final product**.**

The coliform count significally ($p<0.05$) between the two plants in case of luncheon and kofta homogenate, while in the final product of kofta there was no significance between plant I and plant II.

In case of Kofta the mean value was in homogenate (1.58 x 10^4 ± 1.54 x 10^3 and 2.81 x 10^4 ± 3.14 x 10^3) and in final product was (4.27 x 10^3 ± 4.11 x 10^2 and 4.33 x 10^3 ± 3.86 x 10^2) cfu/g in plant I and plant II, respectively**.**

Edris (1993) examined bacteriologically 35 luncheon samples collected from kalyobia markets for the presence of E.coli and Salmonella.He could isolate E.coli from 7 samples (20 %) and failed to detect Salmonella from any sample.

Chahed et al. (2006) 230 carcasses were examined microbiologically for presence of pathogenic E. coli. The count with a 75th percentile of4.45 × 10^2 cfu/cm^2. 7 % of tested carcasses were positive for E. coli O157.

Total Mould and Yeast count : From table 1 the count was (41.73 × 10^4 ± 3.86 × 10^4 and 60.08 × 10^4 ± 4.01 × 10^4) cfu/g showing agreat significance between the two plants mainly in table(1) which shows a clear difference

in luncheon homogenate.In the final product of luncheon it was ($3.08 \times 10^4 \pm 3.44 \times 10^3$ and $5.46 \times 10^4 \pm 5.41 \times 10^3$) cfu/g in plant I and plant II respectively**.**

In case of Kofta , the mean was in homogenate ($4.34 \times 10^5 \pm 3.58 \times 10^4$ and $1.43 \times 10^6 \pm 1.16 \times 10^5$) and in final product was ($2.503 \times 10^5 \pm 1.98 \times 10^4$ and $4.57 \times 10^5 \pm 3.62 \times 10^4$) cfu/g in plant I and plant II, respectively**.**

Amany (2000) discuses total of 75 samples of meat products (25 from each luncheon, minced meat and beef burger) were collected from Assiut markets and examined for mycological quality using Sabourauds dextrose agar. The mean count varied from product to another according to the culture medium used. 177 fungal isolates were tested for their proteolytic activity and most of them were proteolytic species of various degrees.

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