Bacteriological Evaluation of Meat Contact Surfaces at Egyptian Hypermarkets

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Abstract
A bacteriological survey was performed on different food contact surfaces in meat processing sectors at selected Egyptian hypermarkets. A total of 288 swab samples from meat contact surfaces were obtained. Total aerobic count (TAC) and the presence of *Staphylococcus aureus* - coliform, *Escherichia coli* and *Salmonella* spp. were determined. The mean values of TAC counts from working table, weighting scale, packing machine, vacuum machine, bone saw, meat mincer, worker hands, and cutting knife were 3.7, 2.2, 2.5, 2.8, 2.6, 3.3, 3.4, and 2.5 $\log_{10}$ CFU / cm^2 respectively. *Staphylococcus aureus was detected in meat mincer worker hand and working tables* while Coliform and *Escherichia coli* could be detected in bone saw cutting knife meat mincer and working tables. *Salmonella* species could not be detected in all examined swab samples. The results revealed that the examined meat contact surfaces were subjected to inadequate hygienic practices during processing and after day work.

Introduction

Inadequate hygienic practices within food processing plants lead to contaminate the produced products with a wide variety of pathogens and therefore may constitute a potential risk hazard to food safety ***(Metaxopoulos et al., 2003).*** It is difficult to eliminate completely the pathogenic microorganisms from raw materials and food processing environment because many pathogens are still attached and remain viable even after cleaning ***(Eisel et al., 1997; Fonnesbech-Vogel et al., 2001; Tompkin, 2002; Jessen and Lammert, 2003 and Deza et al., 2005).*** Food contact surfaces is any surface of equipment, utensil, knives, spoons, grater, scoops, spatulas, pots, mixing bowls,

cutting boards, preparation boards, preparation tables, sinks, scales, mixers, kettles, slicer, food processor containers and wrappings that direct or indirect contact with food during processing , preparation , serving, holding and cooking processes ***(Holah and Kearney, 1992).*** Food borne pathogens cause economic losses as well as loss of productive man hours. Several food borne disease outbreaks have been reported throughout the world and the most frequently identified factors are cross-contamination, contaminated ingredients/equipments and poor personal hygiene. ***(Altekruse et al., 1998; Vought and Tautine, 1998; Shapiro et al., 1999)***

The clean food contact surfaces are reducing the likelihood of transmission of food borne diseases ***(Cunningham et al., 2011)***

It is still difficult to guarantee food safety from farm to fork in spite of many advances which occurred in food technology, ***(Duffy and Schaffner, 2002).*** In order to produce safe food the most efficient methods is to implement the Good Hygienic Practices and Good Manufacturing Practices as food programs ***Codex Alimentarius (1997) and Eisel et al. (1997).*** The application of HACCP with the prerequisite points are efficient to prevent ,reduced and even eliminate the causative agents responsible for food-borne outbreaks ***Ropkins and Beck (2003) and Reij et al. (2004).***

Due to the nature of meat for its supporting the rapid growth and multiplication of a wide variety microorganism which contaminate it during processing. the Egyptian hypermarkets, specially meat sectors have started to implement the Good Manufacture and Hygienic practices in addition to HACCP that are compulsory in European Commission member countries.

Bacteriological contamination lead to spoilage of meat, decrease the shelf life and may cause `health risk ***(Rao, 1992).*** The iplemintation of HACCP system in commercial food turf have faced specially to focus upon the microbial meat hazards. Therefore the GMP and the inforcement of strict sanitation standards in the meat processing sectors are necessary, and should include efficient cleaning of floors ,walls, knives , cutting tables, so that all meat contact surfaces are protected clean in order to minimize the

danger of microbial contamination ***(Butterworth and Heinemann, 2000).***

In this study, the bacteriological profile of different food contact surfaces in meat processing sectors in a number of Egyptian hypermarkets were investigated, aimed at the consideration of consumer safety.

Materials and methods

A total number of 288 swabs 36 each of working table, weighting scale, packing machine, vacuum machine, bone saw, meat mincer, worker hands, and cutting knife were taken. For meat and meat products contact surfaces the swab technique was used in which a sterile template was used to sample 10 cm^2 surface area ***(A.P.H.A, 1992)***

Aerobic plate count: aerobic plate count was determined by plate count agar as described by ***(Bell, 1997).***

Staphylococcus aureus: was determined by Baird Parker agar. A selective medium for the isolation and counting of coagulase positive *staphylococci* as described by ***(Bhandare et al., 2007).***

Escherichia coli: was determined by using Eosin Methylene Blue agar according to ***(Bhandare et al., 2007).***

coliforms*:* coliforms were detected on VRBA agar according to ***(Bhandare et al., 2007).***

Isolation of *Salmonella:* Was carried out according to ***(ISO 6579:2002)***

Statistical software SPSS was carried out according to ***(SPSS Inc., 1992).***

Results and discussion

The results showed in Table 1& figure 1 revealed that the mean values of TAC from working table, weighting scale, packing machine, vacuum machine, bone saw, meat mincer, worker hands, and cutting knife were 3.7, 2.2, 2.5, 2.8, 2.6, 3.3, 3.4, and 2.5 log_{10} CFU / cm^2 respectively. The highest counts were found in working table , followed by the workers hands and the meat mincer swabs samples. The lowest counts were found form the weighting scale followed by packing machine and cutting knife swabs samples.

The ANOVA results at ($P<0.05$) no significant difference between the bacterial counts for weighting scale, packing machine, vacuum machine, bone saw samples, and cutting knives. Meanwhile there was a

significant difference between the bacterial counts for meat mincer, workers hand, working table swabs from one side and all the rest samples

The results given in Table (2) & Fig (2) revealed that *Staphylococcus aureus* was detected in meat mincer worker hand and working t*ables* while Coliform and *Escherichia coli* could be detected in bone saw cutting knife meat mincer and working tables. Meanwhile, *Salmonella* spp. could not be detected in all examined swab samples.

Escherichia coli is taken as indicator of faecal contamination of food. However, certain species are pathogenic and cause abdominal pain and diarrhea ***(Ray, 2004 and Lawely et al., 2008).***

Staphylococcal food poisoning arises from the consumption of food which containing the already performed Enterotoxin which is primarily a consequences of contamination by food handlers ***(Bryan, 1992; and Bergdoll, 1989).***

The results obtained in this study revealed that working table, bone saw, meat mincer, worker hands, and cutting knife constitute a risks correlated with the insistences of critical organisms. These findings were nearly similar to the results mentioned by ***(Eisel et al., 1997; Gill and McGinnis 2004 and Temelli et al., 2006).***

Table 1: *Total aerobic counts log_{10}cfu//cm^2 in examined Swab samples (n = 288).*

Swab site 36 swab of each	Mean ± SD log_{10}cfu/cm^2	Min.	Max.
Bone saw	2.6 ^{ab} ± 1.12	1.0	4.2
Cutting knife	2.5 ^{a} ± 1.07	1.0	4.9
Meat mincer	3.3 ^{bcd} ± 1.06	1.0	4.8
Packing machine	2.5 ^{a} ± 1.22	1.0	5.1
Vacuum machine	2.8 ^{abc} ± 0.98	1.2	4.8
Workers hand	3.4 ^{cd} ± 0.56	2.4	4.5
Weighting scale	2.2 ^{a} ± 0.86	1.0	3.7
Working table	3.7 ^{d} ± 1.47	1.0	5.4

n: number of analyzed samples

Means have different letter in the same column were significantly different (P<0.05).

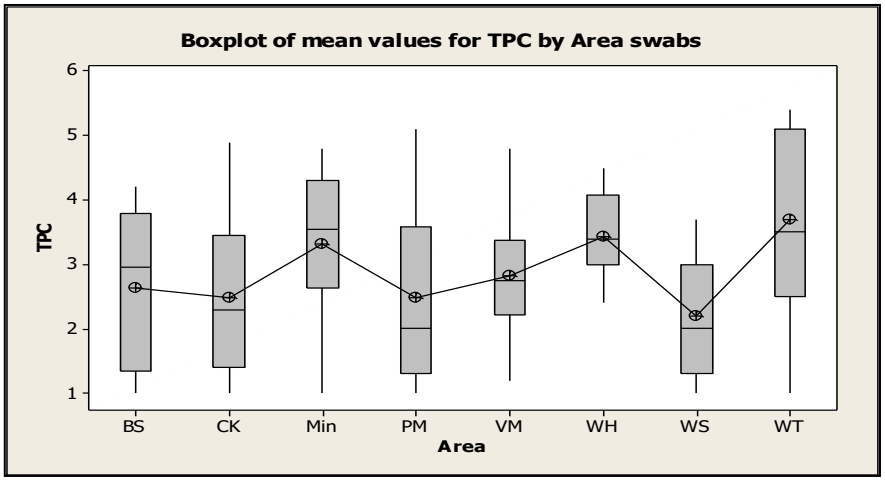


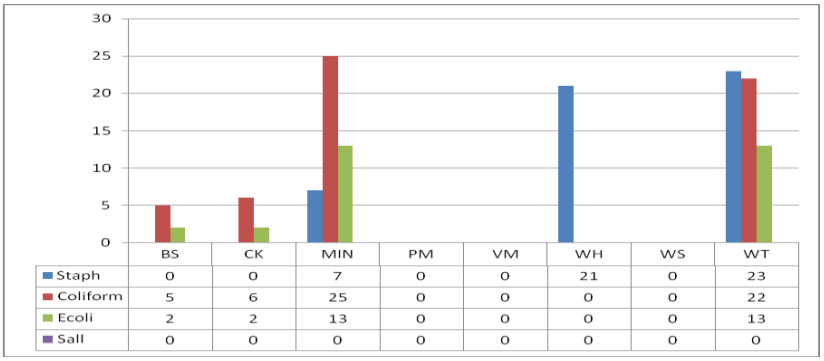
Figure 1: *mean values of total aerobic counts $log_{10}cfu/cm^2$ by area swabs (n = 288).*

BS= Bone saw, CK= Cutting knife, Min=Meat mincer, PM=Packing machine, VM=Vacuum machine, WH=Workers hand, WS=Weighting scale, WT=Working table

Table 2: *Incidence of bacterial group in examined swab samples (n = 288).*

Swab site 36 swab of each	***Staph. aureus***		***Coliform***		***E. coli***		***Sal.* spp.**	
Bone saw	0	0.0%	5	13.9%	2	5.6%	0	0.0%
Cutting knife	0	0.0%	6	16.7%	2	5.6%	0	0.0%
Meat mincer	7	19.4%	25	69.4%	13	36.1%	0	0.0%
Packing machine	0	0.0%	0	0.0%	0	0.0%	0	0.0%
Vacuum machine	0	0.0%	0	0.0%	0	0.0%	0	0.0%
Workers hand	21	58.3%	0	0.0%	0	0.0%	0	0.0%
Weighting scale	0	0.0%	0	0.0%	0	0.0%	0	0.0%
Working table	23	63.9%	22	61.1%	13	36.1%	0	0.0%

n: number of swab samples



	BS	CK	MIN	PM	VM	WH	WS	WT
Staph	0	0	7	0	0	21	0	23
Coliform	5	6	25	0	0	0	0	22
Ecoli	2	2	13	0	0	0	0	13
Sall	0	0	0	0	0	0	0	0

Figure 2: *Incidence of bacterial group in examined swab samples (n = 288).*

BS= Bone saw, CK= Cutting knife, Min=Meat mincer, PM=Packing machine, VM=Vacuum machine, WH=Workers hand, WS=Weighting scale, WT=Working table

Conclusion

The results obtained highlight the inadequacy of visual examination as a mean of assessing the cleanliness of food contact surfaces. Periodic swab sampling evaluation is important to check the effectiveness of the hygienic practices. Presence of *coliforms, Escherichia coli* and *Staphylococcus aureus* in samples underlines the need to establish and enforce bacteriological specifications for meat contact surfaces.

The production of high quality and safety meat products will be conceivable by application of Good Manufacturing and Hygienic practices with the implementation HACCP system.

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الملخص العربي

تقييم الجودة البكتريولوجية للاسطح الملامسة للحوم فى الاسواق المركزية المصرية

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تم اجراء الفحص البكتريولوجى للاسطح الملامسة للحوم داخل اماكن تجهيز و تصنيع اللحوم فى عدد من الاسواق المركزية المصرية و لهذا الغرض تم تجميع عدد اجمالى 288 مسحة من مختلف الاسطح الملامسة للحوم لفحص العد الكلى للميكروبات الهوائية, الاستافيلوكوكس أورياس, السالمونيلا, الإيشريشيا كولَاي والمجموعة القولونية. و قد اظهرت النتائج ان متوسط العد الكلى للميكروبات الهوائية لمسحات كل من منضدة التجهيز, الميزان, جهاز التعبئة, جهاز التفريغ من الضغط, منشار العظام, ماكينة الفرم, ايادى العمال و سكاكين القطع كان: 3.7, 2.2,2.5, 2.8, 2.6, 3.3, 3.4 و 2.5 لوغاريتم وحدة مكونة لمستعمرة لكل سم^2, على التوالى. كما تم عزل ميكروب الاستافيلوكوكس أورياس من مسحات منضدة التجهيز, ماكينة الفرم و ايادى العمال وعزل ميكروبات الإيشريشيا كولَلي, و المجموعة القولونية من مسحات منضدة التجهيز, منشار العظام, ماكينة الفرم, وسكاكين القطع. بينما لم يتم عزل ميكروب السالمونيلا من اى من المسحات. و قد اكدت نتائج هذة الدراسة على ان عمل المسحات البكتريولوجية الدورية للاسطح الملامسة للحوم داخل اماكن تجهيز و تصنيع اللحوم فى الاسواق المركزية المصرية واحدة من الاجراءات الهامة و الفعالة لمراقبة المخاطر البيولوجية والتحكم بها كجزء من نظام الهاسب.