Microbiological evaluation of food contact surfaces at red meat processing plants in Istanbul, Turkey

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ABSTRACT

A microbial survey was performed for different red meat processing plants produces retail cuts and ground beef in Istanbul, Turkey. Swab samples from 10 cm² of surface were obtained from food contact surfaces and environmental surfaces. Total mesophilic aerobic count (TMC), coliform count (CC), *Escherichia coli* count (ECC) and *Escherichia coli* O157:H7 were determined for each sample. Average surface counts for TMC from floor, wall, food contact surfaces were between 2.71 to 3.15 log₁₀ CFU / cm², 0.69 to 1.56 log₁₀ CFU/cm² , 2.23 to 3.0 log₁₀ CFU/cm² respectively. Coliforms and *Escherichia coli* were determined from floor and food contact surfaces. Samples taken from four different wall were negative for *Escherichia coli*. Any *E. coli* O157:H7 counts were observed at the samples. Microbial testing for red meat processing plants is one of the most important subject for identifying and monitoring potential hazards as part of HACCP and GMP programs.

Key words: Meat, Meat plants, Swab, Food contact surfaces, HACCP.

RIASSUNTO

VALUTAZIONE MICROBIOLOGICA DELLE SUPERFICI NEGLI IMPIANTI DI LAVORAZIONE DELLE CARNI ROSSE DI ISTANBUL, TURCHIA

Con il presente studio è stata valutata l’incidenza di alcune popolazioni microbiche in diversi impianti di lavorazione di carne rossa di Instanbul, dove vengono prodotti tagli commerciali e carne macinata. Sono stati effettuati tamponi su aree di circa 10 cm² da tutte le superfici ambientali comprese quelle a contatto con la carne. Per ogni campione sono state eseguite le conte di: mesofili totali (TMC), coliformi (CC), Escherichia coli (ECC) ed Escherichia coli O157:H7. Le TMC ottenute dal pavimento, parete e superfici di contatto con la carne hanno oscillato rispettivamente: da 2,71 a 3,15, da 0,69 a 1,56, da 2,23 a 3,0 log₁₀ CFU/cm². Coliformi ed Escherichia coli sono stati determinati da floor e superfici di contatto. I tamponi prelevati da diverse pareti sono risultati negativi per Escherichia coli. I tamponi sono risultati negativi per E. coli O157:H7. I test microbiologici per gli impianti di lavorazione delle carni rosse rappresentano uno dei migliori sistemi per identificare e monitorare potenziali rischi nei programmi GMP e HACCP.

Parole chiave: Carne, Impianti di lavorazione della carne, Tampone, Superfici di contatto, HACCP.
Introduction

Despite many advances in food technology, it is still difficult to ensure food safety from stable to table (Duffy and Schaffner, 2002). The most efficient way to produce safe food is to establish housefood programs such as Good Hygienic Practices (GHP) and Good Manufacturing Practices (GMP) (Eisel et al., 1997). These measures represent the pre-requisite conditions required in facilities preparing or manufacturing foods (Codex Alimentarius, 1997). Significant specific hazards are addressed applying the Hazard Analyse Critical Control Point (HACCP) principles developed about 30 years ago (Reij et al., 2004). HACCP is becoming an increasingly important component of commercial food production practices that can lead to food-borne outbreaks (Ropkins and Beck, 2003).

In Turkey, food plants have started to interest in these safety programs that are compulsory in EC member countries. Among these plants, meat producers are mostly interested in the programs monitoring above. Because, the meat is an ideal media for the development and reproduction of microorganisms, particularly bacteria, and rapid growth can be expected unless control is effected. Many changes occur in the handling, processing and packaging of meat in relation to microbiology. Microbial contamination causes spoilage of meat, reduces shelf life of meat and causes public health hazards (Rao, 1992). HACCP procedures developed in commercial–sector practices have tended to focus primarily upon microbiological hazards. Bacteria which are responsible for the most food-borne disease contaminate to meat directly or indirectly from animal excreta at the slaughter process; also they may be transferred from the surfaces, utensils and other equipment (Arnold International Students, 1993; Yen, 2003). Good hygienic practices and the implementation of rigorous sanitation standards in the abattoir would help, the latter processes should include thorough cleaning of items such as walls, floors, cutting tables, knives and other utensils. Unfortunately it is true that HACCP implementation is difficult to apply in the slaughterhouses. Slaughtering is suitable progress for the contamination of the carcass by potentially pathogenic bacteria (Forsythe and Hayes, 1998). So that all surfaces in contact with meat should be taken under control or kept clean to minimize the risk of bacterial contamination (Butterworth and Heinemann, 2000).

The aim of this study is to determine the microbiological quality of food contact surfaces and environmental sources before implementation of HACCP system.

Material and methods

Plant process

Istanbul, the biggest city, is located on the northwest of Turkey. The total surface of the city is approximately 40,000 km², or about 6%. In this study, seven visits made to the eight different plants in Istanbul. These plants located in the villages of Istanbul, namely Catalca, Hadimkoy, Ikitelli, Yenibosna, Gunesli, Avciyar, Tuzla and B. Cekmece. Among of these plants, four of them are established with government collaboration and have slaughterhouses. The slaughterhouses have a capacity of 2000-2500 sheep/day, 200-250 cattle/day. The other six are specialized commercial establishments. Each of the plants consist of a lairage, slaughter floor, dressing cradle, chilling room, cutting room and veterinary service office. All required equipment such as rail system, stunning devices, restraining equipments, stainless steel holding bins and tables were provided. In these plants carcasses were held in cold storage for 24 hours. After storage carcasses were trimmed then portioned in to retail cuts, packaged and then held at 0°C until they were shipped to the markets. In this survey, a total of 480 swabs were collected from food contact surfaces and environmental surfaces during processing.

Sampling

For food contact surfaces and environmental sources, surface swab technique was used as described in the Compendium of Methods for the Microbiological Examination of Foods (American Public Health Association, 1992). A sterile polypropylene template was used to sample each 10 cm² surface area. Before sampling sterile swabs
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were kept in 10 ml sterile pepton water in suitable conditions. The number and location of food contact surfaces, walls and floors are described in Table 1. After the sampling of 10 cm² area, the swabs were placed again aseptically back into pepton water.

Transport
After sampling, the tube that contains the swab was immediately placed in a mobile incubator. During transportation of the samples to the laboratory, the inner temperature of the incubator was provided to be at 4 °C. The list of food contact surfaces and environmental sources are indicated in Table 1.

Bacterial procedures
After the samples were delivered to the laboratory, each tube containing the swab was vortexed 10 seconds to assure mixture of the sample. After mixing, the samples were serially diluted with 0.1% pepton water. In this plan total mesophilic aerobic count (TMC), coliform count (CC), Escherichia coli count (ECC) and Escherichia coli O157:H7 were carried out according to the method specified in FDA (Food and Drug Administration, 1995). All bacteria counts are transformed to log₁₀ values.

Statistical analysis
Statistical software SPSS for Windows was
used for statistical analysis. Microbial levels at processing stages were analyzed by Friedman nonparametric repeated measures test, and Dunns multiple comparisons test was applied as post-test when significant differences were determined (SPSS Inc., 1992).

Results and discussion

Red meat is a significant source of bacteria. Microbial contamination results in spoilage of meat, reduced shelf life of meat and public health hazards. It is generally accepted that microbial loads on surfaces and equipment vary in different food plants depending on the microbial quality of the food (Evans et al., 2004).

The aim of this study was to examine the microbial contamination of contact surfaces and environmental sources to determine the acceptability of hygiene levels in red meat plants.

Swab samples were taken from food contact surfaces, floors and walls. All surfaces were analyzed for TMC, CC, ECC and E. coli O157:H7. Average microbial concentrations for TMC, CC, ECC and E. coli O157:H7 are shown in Table 2. Average microbial counts from retail packaging line, carcass receiving dock, carcass cooler and fabrication line is provided in Figure 1. Based on the data, the highest TMC (2.71 log_{10} CFU/cm²), CC (2.36 log_{10} CFU/cm²) and ECC (1.72 log_{10} CFU/cm²) levels found in the fabrication line area while the carcass cooler area got the smallest values of 2.56 log_{10} CFU/cm², 2.08 log_{10} CFU/cm², 1.04 log_{10} CFU/cm² respectively.

For floors in the retail packaging line, carcass receiving dock, carcass cooler and fabrication line TMC values were between 2.71 and 3.15 log_{10} CFU/cm². CC values of the floors were between
2.25 and 2.85 log_{10} CFU/cm\(^2\). ECC values differed from 1.34 to 2.23 log_{10} CFU/cm\(^2\). All samples were negative for Escherichia coli O157:H7. Fabrication floor got highest average microbial counts. Overall counts between floor and food contact surfaces were similar. No significant differences were observed (P>0.05). Eisel et al., (1997) sampled for floors and had a mean TMC of 3.0 to 3.6 log CFU/cm\(^2\), CC and ECC were rarely recovered. In the present study, unacceptable ECC values were seen in the environmental sources, similar to those reported by Legnani et al., (2004). ECC and CC values especially for retail packaging floor and fabrication floor must be decreased by applying GMP and HACCP procedures. Because E. coli and its some subspecies and coliform group bacteria can cause serious problems on public health, it is an obligation to eliminate or minimize the presence of the bacteria (Lowe et al., 2001). This can be provided that attention needs to be given to training and supervision to ensure proper hand washing and appropriate cleaning and sanitation procedures to reduce or eliminate cross-contamination (Kusumaningrum et al., 2003).

From wall samples, average concentrations of TMC and CC ranged from 0.69 to 1.56 log_{10} CFU/cm\(^2\) and 0.3 to 1.0 log_{10} CFU/cm\(^2\) respectively. 120 samples taken from four different wall were negative for Escherichia coli and Escherichia coli O157:H7. This study based on standards used in the food processing industry. A standard of less than 1.3 log_{10} CFU was used for aerobic plate count, less than 1.0 log_{10} CFU for Enterobacteriaceae count. According to this standard only the results for walls were in acceptable levels (Sneed, et al., 2004). In statistical analysis, differences between floor, food contact surfaces and wall was significant (P<0.05).

Food contact surfaces were sampled on many equipment (knives, cutting boards, plates and choppers) in the retail packaging line and fabrication line. TMC for food contact surfaces were between 2.23 and 3.7 log_{10} CFU/cm\(^2\). Using U.V. sterilizators and suitable chemical disinfection agents for equipments can be usefull. And also the staff educational program has certainly helped to increase the level of awareness and the sense of responsibility regarding food hygiene.

### Conclusions

The results of this study indicates that the microbiologic quality of the food contact surfaces and environmental sources analysed, and were
found highest average microbial counts. These high values show that the effective cleaning and sanitation programs and safe handling procedures cannot be applied as required at the plants. The production of good quality and safe meat products will be possible by HACCP procedures. One of the most important steps in developing a HACCP system is the establishment of critical control points. These are steps which control can be applied to eliminate, reduce or prevent food safety hazards. In terms of fresh meat processing, safety hazards cannot be eliminated but they can be prevented or reduce (Pearce et al., 2004).

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