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Sources of bacterial contamination in slaughterhouses with special reference to the methods of their control

Thesis presented by

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Abstract:
A swab samples were collected from different suspected sources of bacterial contamination in El-Monieb slaughterhouse in Giza Governorate. The results showed that out of the 345 samples, *S. aureus* was detected in 40.6%. The mean count between the different sources of contamination was 4.9 ± 1.5 log^{10} CFU/ cm^2. The antimicrobial susceptibility pattern showed that all isolates of *S. aureus* have antimicrobial resistance. By PCR amplification, *mec*A was detected confirming the isolation of methicillin resistant *S. aureus* in percentage 13%. *E. faecalis* were isolated by 35.4% with an average mean count 5.73 ± 1.7 log^{10} CFU/ cm^2. The antimicrobial susceptibility pattern showed that all isolates were also resistant. The *van*A gene was detected confirming the isolation of vancomycin resistant *E. faecalis* in 21.3%. *Salmonella* was isolated in 1.4%. There were different sources of contamination in the slaughterhouse before, during and after the slaughtering process which could threaten public health and play a potential role in food safety. Different disinfectants were tested by spraying method to decrease the bacterial load on the surface of the utensils used in slaughtering, floor and walls inside the slaughterhouse. H_2O_2 plus peracetic acid was found to be the most effective disinfectant.

Key words: bacterial contamination - slaughterhouses – control of bacterial contamination in slaughterhouses – MRSA – VRE – *Salmonella* – *mec*A – *van*A – *inv*A – relative risk - disinfectants - H_2O_2 plus peracetic acid – CO_2 dry ice under pressure.

Dedication

I would like to express my sincere gratitude and thanks to ***My Family***

My Thanks and highest consideration for my Mother, my Father, my wife and my cute children Hana and Mostafa.

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List of abbreviations

AMR	Antimicrobial Resistance
AMHB	Aerobic Mesophilic Heterotrophic Bacteria
APC	Aerobic Plate Counts
CFU	Colony Forming Unit
FAO	Food and Agriculture Organization of the United Nations
GIS	Geographic Information System
HACCP	Hazard Analysis Critical Control system
MRSA	Methicillin Resistant *S. aureus*
QRA	Quantitative Risk Assessment
OIE	World Organization for Animal Health
TCC	Total Coliform Counts
TFC	Total Faecal Counts
TVC	Total Viable Count
VRE	Vancomycin Resistant Enterococci
WHO	World Health Organization

Chapter (1)

Introduction

Introduction

In Egypt, slaughtering of animals is challenged by severe hygienic problems with different sources of contamination which results in heavy bacterial loads in the slaughterhouse environment leading to contamination of the produced meat. The improper practices such as slaughtering on the ground, skinning and evisceration in the same place with the same equipment are considered a threat to food safety and consumers' health and have been implicated in many cases of foodborne illness. **(Zhao *et al.*, 2001).**

Many microorganisms are excreted in the feces and can be found on the hides and fleeces of the live animal. Bovine carcasses can be contaminated during the slaughter process through the contact with the animal's skin and hair, limbs, blood, stomach, gut contents, bile and other excretions, facilities, equipment and workers' hands and clothes **(Sofos, 2008).** Effluents from slaughterhouses are known also to contribute in contamination of both surface and groundwater during processing in abattoir. Blood, fat, manure, urine and meat tissues are discharged to the wastewater streams meaning that the abattoir environment and slaughtering processes play a vital role in meat safety **(Bello and Oyedemi, 2009)**.

The common bacterial contaminants in large animal slaughterhouses are *S. aureus*, *E. coli*, *B. cereus*, *P. aeruginosa*, *Klebsiella* species, *Enterococcus* species, *Enterobacter* species and *Citrobacter* species. The higher rate of contamination of meat with these organisms is an indication of unacceptable state of poor hygienic and sanitary practices during slaughtering, transportation, butcher shops and processing **(Haileselassie *et al.*, 2012).** It is also found that temperature abuses during distribution and meat contamination by infected handlers are important contributors to the post-slaughter contamination of bovine meat **(Eugene *et al*., 2015)**.

By understanding outbreak data which was published internationally from 1996 to 2005, it is noted that 12.7 % of reported foodborne outbreaks were attributable to bovine meat. *Salmonella* and pathogenic *E. coli*, respectively, were identified as the causal agents in 32.9 and 34.6 % of foodborne outbreaks of bacterial origin attributable to beef **(Scallan *et al*., 2011)**.

Staphylococci are ubiquitous in the environment. Natural populations of staphylococci are associated with skin, skin glands and mucous membranes of warm-blooded animals. They have been isolated from animal products such as meat, milk and cheese, and other sources such as soil, sand, seawater, fresh water, dust and air. Some *Staphylococcus* species are known to be frequently encountered in severe infections. *S. aureus* was considered to be pathogenic by production of variety of enzymes and toxins which are the best known and frequently implicated in the etiology of a series of infections and intoxications in animals and humans **(Harris *et al.*, 2002).** For a long time, *S. aureus* has been a devastating pathogen in hospitals, where it is known for its resistance to several antibiotics and for its ability to infect immunocompromised patients. The ability of *S. aureus* to survive under nutrient limiting and stressful conditions increases its ability to survive and spread in the hospital environment. The spreading of methicillin resistant *S. aureus* (MRSA) outside hospitals has been encountered recently as a major problem. This has been observed, for example, in veterinary staff and farmers. An increasing number of reports showed that food producing animals can be carriers of methicillin resistant *S. aureus* where, more than 4% of antimicrobial resistance in human is thought to be associated with animal sources (**Bergenstrahle, 2015).**

Enterococci can grow and survive in harsh environments, and can persist almost anywhere including soil, plants, water, and food. Enterococci can survive 5 days to 4 months on dry inanimate surfaces and it could be used as indicators of fecal contamination and implicated in outbreaks of foodborne illness.