شبكة المعلومات الجامعية

بسم الله الرحمن الرحيم

شبكة المعلومات الجامعية

شبكة المعلومات الجامعية

التوثيق الالكتروني والميكروفيلم

شبكة المعلومات الجامعية

جامعة عين شمس

التوثيق الإلكتروني والميكروفيلم

قسم

نقسم بالله العظيم أن المادة التي تم توثيقها وتسجيلها
علي هذه الأقراص المدمجة قد أعدت دون أية تغيرات

يجب أن

تحفظ هذه الأقراص المدمجة بعيدا عن الغبار

Cairo University
Faculty of Veterinary Medicine
Department of Food Hygiene and Control

Staphylococcus aureus Enterotoxins in Chicken Meat Products

A Thesis Presented

By

Dina Ahmed Mohamed Gamil
(B.V.Sc., Cairo University, 2012)

For Master Degree in
Veterinary Medical Sciences, Meat Hygiene and Control

Under The Supervision Of

Prof. Dr.
Munir Mahmoud Hamdy
Professor of Meat Hygiene and Control
Faculty of Veterinary Medicine,
Cairo University

Prof. Dr.
Nabil Abdel-Gaber Yassien
Professor of Meat Hygiene and Control
Faculty of Veterinary Medicine,
Cairo University

Dr.
Hoda Amin Mohamed
Chief Researcher in Food Hygiene Department
Animal Health Research Institute,
Dokki- Giza

2021

Cairo University
Faculty of Veterinary Medicine
Department of Food Hygiene and Control

APPROVAL SHEET

This is to approve that thesis presented by: Dina Ahmed Mohamed Gamil

Entitled: *Staphylococcus aureus* Enterotoxins in Chicken Meat Products
For the Degree of M.V.Sc. (Hygiene and Control of Meat and its Products)

APPROVAL COMMITTEE

Dr. Fathi A. Khalafallah
Professor of Meat Hygiene and Control
Faculty of Veterinary Medicine
Beni suif University

Dr. Heba Hussien Abdel-Naiem
Assistant Professor of Meat Hygiene and Control
Faculty of Veterinary Medicine
Cairo University

Dr. Nabil Abdel-Gaber Yassien
Professor of Meat Hygiene and Control
Faculty of Veterinary Medicine
Cairo University

Dr. Hoda Amin Mohamed Aideia
Chief Researcher of Meat Hygiene Department
Animal Health Research Institute,
Dokki, Giza

Cairo University

Faculty of Veterinary Medicine

Department of Food Hygiene and Control

Supervision Sheet

Dr. Munir Mahmoud Hamdy

Prof. of Meat Hygiene and Control
Faculty of Veterinary Medicine
Cairo University

Dr. Nabil Abdel-Gaber Yassen

Prof. of Meat Hygiene and Control
Faculty of Veterinary Medicine
Cairo University

Dr. Hoda Amin Mohamed Aideia

Chief Researcher
Animal Health Research Institute
Dokki, Giza

2021

Cairo University
Faculty of Veterinary Medicine
Department of Food Hygiene and Control

كلية الطب البيطرى
جامعة القاهـــرة

Name : **Dina Ahmed Mohamed Gamil**
Date of birth : **5-12-1989**
Nationality : **Egyptian**
Degree : **M.V. Sc**
Specification : **Meat Hygiene and Control**
Title : ***Staphylococcus aureus* Enterotoxins in Chicken Meat Products**

Supervision:

Prof. Dr. Munir Mahmoud Hamdy
Prof. Dr. Nabil Abdel-Gaber Yassin.
Dr. Hoda Amin Mohamed.

Abstract

Chicken meat products are one of the most popular primary food products throughout the world due to the relative ease of its production. Chicken meat is a very good source of proteins, numerous of vitamins (especially B12) and minerals. However, Chicken products can be contaminated by pathogenic bacteria such as *Staphylococcus aureus.* Cross contamination occurs during the handling of raw meat, especially chicken meat, because of the presence of more liquid in raw meat than cooked meat. As consumers become more interested in food safety and the consumption of chicken products increase, contamination of those bacteria is a major concern of poultry related industries, consumers, and government agencies such as US Department of Agriculture (USDA) and the Food Safety and Inspection Service. During this study 100 different samples of chicken fillet, deboned thigh, wing, mechanically deboned meat (MDM) and chicken burger (20 each) were collected from different markets in Cairo governorate and investigated for their *S. aureus* count and ability of the isolated strains to produce enterotoxins using conventional plating and isolation technique as well as using SET-RPLA toxin detection kit. Results revealed that mean values of *S. aureus* count in all samples were unacceptable and exceeded the permissible limits described by ESS 2910 / 2005. The incidence of *S. aureus* isolated from chicken fillet, chicken deboned thigh, chicken wings, MDM and chicken burger were 15%, 20%, 10%, 25%, and 30% respectively. *S. aureus* isolated from MDM exhibited staphylococcal enterotoxins (SEs) production of three different types SEA, SEC and SED. Meanwhile, *S. aureus* isolated from chicken burger produced only SEA and SEC enterotoxins. While isolated *S. aureus* from chicken wings exhibited staphylococcal enterotoxins (SEs) production of only one type SEB. On the other hand, isolated *S. aureus* from chicken fillet and deboned thigh didn't exhibit any enterotoxin production activity. It's recommended to follow the hygienic practices during different processing stages to avoid the risk of *S. aureus* and its enterotoxins.

Key words: Chicken, Staph, MDM, Enterotoxin, Burger, SEA, SEC, SEC.

Dedication

To
My Father and my
Mother

To
my Husband, daughter
and my son

ACKNOWLEDGEMENT

First and foremost, I would like to thank ***"ALLAH"*** *who made me able to accomplish this work.*

I would like to express my sincere appreciation and deepest gratitude to ***Prof. Dr. Munir M Hamdy,*** *Professor of Meat Hygiene and Control, Fac. of Vet. Med., Cairo University, for his sound supervision, continuous interest, helpful advice, guidance, and actual co-operation, encouragement in preparing and proposing the subjects of this work.*

Very special thanks are extending to ***Prof. Dr. Nabil Abdel-Gaber Yassin,*** *Professor of Meat Hygiene and Control, Fac. of Vet. Med., Cairo University, for his advice throughout the study and for the valuable direction in all steps throughout this research.*

I wish to express my deep gratitude to my advisor ***Dr. Hoda Amin Mohamed,*** *Chief Researcher of Meat Hygiene Department, Animal Health Research Institute, Dokki, Giza, for her great help in this thesis.*

I would like to thank ***Prof. Dr. Mohamed K. Elmossalami,*** *Professor of Meat Hygiene and Control, Fac. of Vet. Med., Cairo University, for his advice and help throughout the study.*

I would like to express my deepest thanks to ***Dr. Hamdy Zaki,*** *lecturer of Meat Hygiene and Control, Fac. of Vet. Med., Cairo University, for his help, support advices, and encouragement during all stages of this work.*

List of Contents

Subject	No.
1.Introduction	1-3
2.Review of Literature	4-19
2.1. Characters of *S. aureus*	4
2.2. Incidence of *S. aureus* in chicken meat products	5
2.3. Public health hazards of *S. aureus*	6
2.4. Toxins of *S. aureus*	12
2.5. Detection of *S. aureus* enterotoxins by reverse passive latex agglutination test (RPLA)	18
3.Published paper	20-24
4.Discussion	25-29
5.Conclusion and recommendation	30-32
6.Summary	33
7.References	34-59
Arabic Summary	

List of Abbreviation

CFU	Colony Forming Unit
CPS	Coagulase positive staphylococcus aureus
DNase	Deoxyribonuclease
ELISA	Enzyme linked immunosorbant assay
FDA	Food and Drug Administration
PCR	Polymerase Chain Reaction
RPLA	Reversed passive latex agglutination
S. aureus	Staphylococcus aureus
SEA	Staphylococcal enterotoxin A
SEB	Staphylococcal enterotoxin B
SEC	Staphylococcal enterotoxin C
SED	Staphylococcal enterotoxin D
SEF	Staphylococcal enterotoxin F
SEG	Staphylococcal enterotoxin G
SEI	Staphylococcal enterotoxin I
SER	Staphylococcal enterotoxin R
SES	Staphylococcal enterotoxins
SFP	Staphylococcal Food Poisoning
TSS	Toxic shock syndrome
TSST-1	Toxic shock syndrome toxin - 1

Chapter (1)
Introduction

Introduction

Globally, both developed and developing countries predominantly consume chicken as a meat product. According to the report of Global Livestock Counts, there are around 19 billion chickens in the world **(Mpundu *et al.*,2019).** Poultry production is dominated by chicken in many parts of the world due to the relative ease of its production **(Mottet, and Tempio, 2017)** and serve as a major source of animal protein ***(*Cadudal, 2017)**.

Chicken meat is white meat, which makes it distinct from other meats like lamb and beef, owing to its low iron content and its lack of trans-fat. Moreover, no trans-fats make it a healthier option as they are associated with cardiovascular disease, whereas beef and lamb meat contains a high amount of trans-fat **(Wieneke *et al.*, 1993)**.

Over the past few decades, different countries have undergone substantial changes in eating habits. With changing lifestyles, people now frequently go out for meals, and middle-class people most often consume chicken meat. Additionally, the relocation of people from rural to urban areas has also contributed to the change in eating patterns, innovative distribution, preparation and food production techniques have also been found to be responsible for these changes **(da Silva, 2019)**.

Meanwhile, chicken meat is known to cause many zoonotic foodborne infections in the world ***(Rouger et al., 2017*)**. Poultry and poultry meat are however prone to contaminations with potentially pathogenic microorganisms such as Salmonella, Campylobacter, *S. aureus*, *E. coli* and Listeria ***(Castañeda-Gulla et al.,* 2020).**

Cross contamination occurs during the handling of raw meat, especially poultry meat, because of the presence of more liquid in raw meat than cooked meat **Javadi and Saeid, 2011; Darshana *et al.*, 2014).**

Contamination is a common process seen all over the world on carcasses in abattoirs **(Kumar *et al.* 2012).**

Contaminated foods with pathogenic bacteria is one of the main causes of digestive illnesses in developing countries and could be counted as one of the major causes for morbidity and mortality **(Edwards *et al.*, 2012).** Meat may be contaminated with Staphylococci spp. during slaughter or later during the meat preparation **(Doyle *et***

***al.*, 2012)**. The presence of *S. aureus* in food can be considered as an indicator for poor hygiene and improper storage conditions **(Gundogan *et al.*, 2005)**.

Food processing with poor hygienic practice is highly associated with infection of *S. aureus* enterotoxin **(Hassanien and Abdel-Aziz 2017).** Outbreaks can be contributed to many factors including improper cooking, inadequate preparation of food and contaminated water or raw materials used for food preparation **(Ritter and Tondo 2014)**

If necessary preventive measures are not taken into account during marketing, processing and production of chicken, there are chances that chicken meat can get contaminated via infectious agents which could be pathogenic to humans **(da Silva, 2019).** Global food production and consumption systems, therefore, required that food quality and safety be scrutinized and examined for public health safety. **(Wahyono and Utami, 2018 and Baltic *et al;* 2019)**

The Gram-positive *S. aureus* is a major bacterial pathogen often involved in food poisoning due to their high rate of human skin and nasal carriage, efficient airborne spread, and strong survival in fomites, which allow them to eliminate competing microorganisms that are less able to endure elevated temperatures, high osmotic pressure, and relatively low humidity **(Le Loir *et al.*,2003; Kim *et al.*, 2018; and Wu *et al.*, 2018).** The presence of multiple enterotoxins is the exact reason for foodborne disorders by this bacterium **(Argudin *et al.*, 2010 and Madahi *et al.*, 2014)**

Ingestion of staphylococcal enterotoxins produced in food by *S. aureus* enterotoxigenic strains will result in staphylococcal food poisoning that can be considered as one of the most common foodborne diseases **(Doyle *et al.*, 2012).**

Staphylococcal enterotoxins (SES) are low-molecular-weight and single-chain proteins with boost resistance against high temperature and stomach enzymes, they are classified to twenty-three kinds. SEA, SEB, SEC, SED and SEE are the most imperative types with advanced clinical impacts **(Argudin, *et al.*, 2010 and Madahi et al., 2014).** There are serologically several distinct enterotoxins that *S. aureus* produces including staphylococcal enterotoxins (SEs, SEA to SEE, SEG to SEI, SER