Cairo University

Faculty of Veterinary Medicine

Department of Food Hygiene and Control

Antibiotic residues in different chicken parts

Thesis presented by

Nehal Mohamed Mohamed Saleh

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Hygiene and Control of Meat and its Products

Under the supervision of

Dr. Mohamed K. Elmossalami

Professor of Meat Hygiene

Faculty of Veterinary Medicine- Cairo University

Dr. Hussein M. Hussein

Professor of Meat Hygiene

Faculty of Veterinary Medicine- Cairo University

Dr. Nabil M. Marzouk

Senior Researcher of Food Hygiene

Animal Health Research Institute Dokki, Giza

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Cairo University

Faculty of Veterinary Medicine

Department of Food Hygiene and Control

Name: Nehal Mohamed Mohamed Saleh

Date of birth: 14/9/1988

Degree:M.V.Sc

Nationality: Egyptian

Specialization: Hygiene and Control of Meat and its Products

Title of thesis: Antibiotic residues in different chicken parts.

Supervision

Dr. Mohamed K. Elmossalami: Professor of Meat Hygiene, Faculty of Veterinary Medicine, Cairo University

Dr. Hussein M. Hussein: Professor of Meat Hygiene, Faculty of Veterinary Medicine, Cairo University

Dr. Nabil M. Marzouk: Senior Researcher of Food Hygien Animal Health Research Institute Dokki, Giza

Abstract

A total of 120 freshly slaughtered broiler chickens (50 each of breast and thigh and 5 each of thigh with skin, breast with skin, liver and kidney) were collected from both Menufiya and Cairo governorates (25 chicken from each governorate while liver, kidney and thigh and breast with skin were from Menufiya governorate due to the higher incidence) for detection of the residual level of streptomycin, gentamicin, florfenicol, lincospectin and enrofloxacin. The detection and estimation of such antibiotics were applied by Micrbiological Inhibiotion Test & HPLC. The overall incidence of antibiotic residues positive samples resulted from microbiological inhibition test were 40% each of liver and kidney, it was also 40% for each of thigh with skin and breast with skin and 36% and 20% for thigh and breast, respectively. The mean concentrations (for positive samples) of antibiotic residues by HPLC at Menufiya governorate were higher than those in Cairo governorate. By HPLC, the arrangement of mean concentration from the highest to the lowest at Menufiya governorate will be streptomycin residues in examined samples by ppb were (1588.8± 488.92 for thigh) and (1048.75± 290.46 for breast) followed by the only lincospectin sample (259.2± 0 for thigh) then gentamycin (142.05±84.75 for thigh and 103.5±0 for breast) and after that florfenicol (26.34±7.52 for thigh and 11.24±3.06 for breast). For enrofloxacin, there wasn't any positive sample. At Cairo governorate, there weren't any neither lincospectin nor enrofloxacin residues in examined samples. The arrangement from the highest to the lowest will be streptomycin (1572±237 for thigh and 543±82 for breast), gentamicin (97.65±58.55 for thigh and 61.7±0 for breast), florfenicol (18.95±4.88 for thigh and 5.53±0.64 for breast), and finally lincospectin and enrofloxacin with zero value. Cooking methods (boiling, roasting and frying) reduced the antibiotic residues in the examined samples with different values for different cooking method and different antibiotic content.

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List of abbreviations

ADIs	Acceptable daily intakes
B. cereus	*Bacillus cereus*
B. subtilis	*Bacillus subtilis*
BGA	Bundesgesundheitsamt (Federal Health Office)
CAC	Codex Alimentarius Commission
CDC	Center of Disease Control and Prevention
E. coli	*Escherichia coli*
ELISA	Enzyme-Linkes ImmunoSorbent Assay
EU	European Union
FAO	Food and Agricultural Organization
FCR	Feed Conversion Ratio
FDA	Food and Drug Adminstration
FPT	Four plate Test
HPLC	High Performance Liquid Chromatography
JECFA	Joint FAO/WHO Expert Committee on Food Additives
LC	Liquid Chromatography
LC-ESI-MS/MS	LC-triple quadrupole MS
LC-MS/MS	Liquid Chromatography coupled with a tandem Mass Spectrometry
LOD	Limit of Detection
M. luteus	*Micrococcus luteus*
MIC	Minimum Inhibitiory Concentration

MIT	Microbiological Inhibition Test
MRL	Maximum residual limit
MRLs	Maximum Residual Limits
MS/MS	Tandem Mass Spectreometry
ND	Not detected
NTPT	New Two Plate Test
RSD	Reference Standard Dilution
SPE	solid phase extraction
STAR protocol	Study of Tamoxifen and Raloxifen protocol
TLC	Thin Liquid Chromatography
UHPLC	Ultra High Performance Liquid Chromatography
USDA	United States Department of Agriculture
WDT	Withdrawal Time
WDTs	Withdrawal Times
WHO	World Health Organization

Introduction

Poultry meat constitutes an excellent source of high quality animal proteins required for nutrition of young children, adult and convalescents. In addition, vitamins especially B complex and minerals such as potassium, magnesium and phosphorus are present in considerable amounts in the poultry meat (**Cahe et al., 2002**).

Poultry meat is more homogenous in composition, texture and color than mammalian meat, making easier to consistently formulate into products. It is also milder in flavor than beef meat so it is more readily complemented with flavoring and sauces (**Sams, 2001**).

The use of antimicrobial agents in food-producing animals has become a very important public health issue (**Jafari et al., 2007**).

Antimicrobial drugs are used to control, prevent and treat infection, and to enhance animal growth and feed efficiency (**Tollefson and Miller, 2000**; **Mumtaz et al., 2000** and **kirbis, 2007**).

The aim of antimicrobial therapy is to rapidly produce and then to maintain an effective concentration of drug at the site of infection for sufficient time to allow host specific and nonspecific defenses to eradicate the pathogen (**Prescott et al., 2000).**

Antibiotic residues usually attributed to unregulated and indiscriminate use of drugs and lack of awareness on the proper usage of these antibiotics. The presence of these residues is usually attributed to non-observance of withdrawal periods before sale of animal course food (**Shitandi, 2004**).

Subcutaneous and intramuscular administrations increased the potential for antibiotic residues at the injection sites (**Berends et al., 2001**).

The adverse effects on public health caused by the residues of the antibiotics are allergy and toxicity due to prolong exposure to low level of antibiotics. Antibiotic resistant bacterial strains that later cause difficulties in treatment of human infection and disruption of normal human intestinal flora is another major hazard. Antibiotics

may interfere with starter culture when used in food industry in food processing plants leading to economic losses (**Kirbis, 2007** and **Basyoni and Brr, 2009**).

The most serious problems of food residues are allergenic, organotoxic, mutagenic, teratogenic or carcinogenic. Streptomycin can cause varying degree of nephrotoxicity and ototoxicity (**Ibrahim et al., 2010**).

Antibiotic residues may cause many harmful effects in human such as transferring of antibiotic resistant bacteria to the human, immunopathological effects, autoimmunity, carcinogenicity (Sulphamethazine, Oxytetracycline, Furazolidone), mutagenicity, nephropathy (Gentamicin), hepatotoxicity, reproductive disorders, bone marrow toxicity (Chloramphenicol) or allergy (Penicillin) (**Nisha, 2008**).

To ensure food safety for the consumers, several regulatory authorities around the world such as the European Union (EU), Food and Drug Administration (FDA), Korean food code etc., have established Maximum Residual Limits (MRLs) for the varieties of used antibiotics (**Wen et al., 2006**).

Nisha (2008) reported that the residues of antibiotics are pharmacological active substances either active principle or their metabolites which remain in food stuffs above MRL. Thus, WHO and FAO establish tolerances (MRLs) for drugs in the relevant tissues of food producing animals. The tolerance is the tissue concentration below which a marker residue for the drug or chemical must fall in the target tissue before that animal edible tissues are considered safe for human consumption.

Accordingly, MRLs are standards that represent the maximum residual concentration expected to be found if a veterinary drug is administered according to good practice in the use of veterinary drugs (GVP) (**Maclachlan and muller, 2012**).

There are two types that used for detection of antibiotic residues, the screening methods, Microbiological Inhibition Test (MIT) (Disc assay, modified Premi and Delvo test methods) (**El Nasri et al., 2012 and De Wasch et al., 1998**) and the confirmatory techniques are such as High performance liquid chromatography

(HPLC) and Enzyme- Linked Immunosorbent Assay (ELISA) which are more complex, advanced and accurate technique (**Tajik et al., 2010**).

HPLC procedures are widely used to quantify various antibiotic residues in food products with a good sensitivity and specificity (**Muriuki et al., 2001**).

❋ **Therefore this study was performed in order to:**

- Determine the level of most important antibiotic residues in fresh chicken meat in market.
- Determine the distribution of antibiotic residues in different chicken parts in order to specify the safer part for human consumption especially for liver patients.
- Discuss the public health importance for these antibiotic and their MRLs.
- Study the effect of different cooking methods on the antibiotic residues.

Review of literature

1. Incidence of antibiotics

Srirod and Chunthanrm (1990): analyzed antibiotic drugs in 100 chicken sampled from several markets in Bangkok area by the microbiological antibiotic tracing method with high voltage electrophoresis, some antibiotic drugs were detected from liver, kidney and meat respectively at 37%, 32% and 25%.

Mansour (2000): recorded that a total of 144 living turkeys were accommodated for one month in ideal condition of clean water and food free from antibiotics. They were divided into five groups [24 turkey representing control group and 30 turkeys were used for each antibiotic]. Gentamicin was injected intramuscularly (0.3 mg/kg body weight) as recommended in treatment dose from manufacturer pamphlet for the same time. Turkeys were slaughtered in a processing plant at different periods. The mean values of antibiotics were arranged from highest to lowest as follow: fat, liver, skin, thigh and breast, respectively. Increasing duration before slaughtering resulted in reduction of antibiotic residues in examined samples.

Al-Mustafa and El-Ghamdi (2002) recorded that 29 antimicrobial agents were identified from 23 randomly selected poultry farms as being available for poultry use, of which 22 (75.9%) were important for the treatment of human infections.

Bintvihok and Davitiyananda (2002) examined chicken meat samples collected from 10 regions of Pangkok and near-by areas by means of multistage random sampling for gentamicin and streptomycin residues detection using ELISA technique. They recorded that 26 out of 40 chicken samples were found to contain streptomycin residue with mean value of 24.852±0.012 to 30.233 ppb whereas gentamicin residue wasn't found. The highest residual level in chicken meat of streptomycin residues was detected in Nonthaburi Province.

Donoghue (2003) recorded data from the federal monitoring program contradict the perception held by many consumers that harmful antibiotic residues are abundant in meats (including poultry). The four years of monitoring results from the