



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



Sensory, chemical and bacteriological quality of locally produced smoked herring

Thesis presented by

Eillia Youssef Mehawed Abd El-Shahid
B.V.Sc. Assiut University (1992)

For the Degree of M.V.Sc.
Hygiene and Control Meat and its product

Under the supervision of
Dr. Nada K. M. Mansour
Professor of Meat Hygiene
Faculty of Veterinary Medicine
Cairo University

Dr. Mohamed M. T. Emara
Professor of Meat Hygiene
Faculty of Veterinary Medicine
Cairo University

Dr. Mohamed A. El. Shater
Head Researcher
Food Hygiene Department
Animal Health Research Institute,
Agriculture Research Center

2015



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



APPROVAL SHEET

**Title of the thesis: Sensory, chemical and bacteriological quality of
locally produced smoked herring**

Name of Candidate: Eillia Youssef Mehawed Abd El-Shahid

APPROVAL COMMITTEE

Prof. Dr. Adel Ibrahim Mohamed Elatabany
Professor of Meat Hygiene
Faculty of Veterinary Medicine
Zagazig University

21- AA Elatabany

Prof. Dr. Nabil Abd-Elgaber Yassien
Professor of Meat Hygiene
Faculty of Veterinary Medicine
Cairo University

N. Yassien
02.11.2015

Prof. Dr. Nada K.M. Mansour
Professor of Meat Hygiene
Faculty of Veterinary Medicine
Cairo University

N. Mansour
02.11.2015

Prof. Dr. Mohamed M. T. Emara
Professor of Meat Hygiene
Faculty of Veterinary Medicine
Cairo University

M. T. Emara



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



Supervision Sheet

Prof. Dr. Nada K.M. Mansour
Professor of Meat Hygiene
Faculty of Veterinary Medicine
Cairo University

02.14.2015
Nada

Prof. Dr. Mohamed M. T. Emara
Professor of Meat Hygiene
Faculty of Veterinary Medicine
Cairo University

M. T. Emara

Prof. Dr. Mohamed A. El Shater
Head researcher
Food Hygiene Department
Animal Health Research Institute
Agriculture Research Center

M. A. El Shater



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

Name: Eillia Youssef Mehawed Abd El-Shahid

Date of birth: 17/9/1969

Nationality: Egyptian

Degree: Master of veterinary medical sciences

Specialization: Hygiene and Control of Meat and its products

Title of thesis: Sensory, chemical and bacteriological quality of locally produced smoked herring

Supervisors:

1. Dr. Nada K. M. Mansour
Professor of Meat Hygiene Faculty of Veterinary Medicine Cairo University
2. Dr. Mohamed M. T. Emara
Professor of Meat Hygiene Faculty of Veterinary Medicine Cairo University
3. Dr. Mohamed A. El. Shater
Head Researcher Food Hygiene Department Animal Health Research Institute.

Abstract

In this study a grand total of 180 samples of locally produced smoked herring and ovaries (90 of each) were collected from different markets in Giza Governorate, Egypt, the samples were subjected to organoleptic examination (skin condition, skin color, taste of fish, odor of flesh and condition of the belly), chemical examination (pH, TBA and TVBN) and microbiological examination (Total bacterial count, MPN, *Staph.aureus* count, Total mold & Yeast count, Proteolytic count, Lipolytic count, isolation of *Salmonella*, *E. coli* and *L. monocytogenes*). The study proved that, the percentage organoleptically of accepted samples was 95.5%. The mean values of pH, TBA and TVBN in muscles of smoked herring samples were 5.95, 8.042 and 22.195 respectively while in ovaries they were 5.49, 7.952 and 22.698 respectively. The mean count log₁₀cfu/g of TBC, MPN, *Staph.aureus* and total mold & yeast count in muscles of smoked herring samples were 4.33, 0.698, 0.126 and 2.905 respectively and in ovaries they were 4.29, 0.640, 0.472 and 2.70 respectively.

Key words: Smoked herring, microbes, *Salmonella*, *E. coli*, *L. monocytogenes*, pH, TBA and TVBN

ACKNOWLEDGEMENT

First of all, my gratitude and prayerful to **ALLAH** who gives me the power not only to carry out this work but also during my wholelife.

I wish to express my sincere gratitude to **Dr. Nada K. M. Mansour** professor of Meat Hygiene, Faculty of Veterinary Medicine, Cairo University, for his stimulating supervision, guidance, continuous help and interest during supervision this work.

My grateful appreciation and thanks are to **Dr. Mohamed M. T. Emara**. Professor of Meat hygiene, Faculty of Veterinary Medicine, Cairo University for his continuous help, advice, guidance during this study.

My sincere thanks gratitude are to **Dr. Mohamed A. El-Shater**, Head researcher, Animal Health Research Institute, Dokki, Giza.

My sincere gratitude is to **Dr. Mai Atef**, lec. of meat hygiene Fac. of Vet. Med, Cairo University for her help in this study.

My deepest thanks are also to **Dr. Abd El-Aziz EL-Moaaz**. Head Researcher, Manager of Giza Local Veterinary Laboratory.

CONTENTS

	Page
1. INTRODUCTION.....	1
2. REVIEW OF LITERATURE	4
• Organoleptic profile of smoked fish	4
• Chemical quality indices of smoked fish	7
• Microbiological profile of smoked fish.....	10
3. MATERIAL AND METHODS.....	18
• Samples.....	18
• Organoleptic examination	18
• Chemical quality indices of smoked fish.....	20
• Microbiological examination	21
• Statistical analysis.....	32
4. RESULTS	33
5. DISCUSSION	47
6. SUMMARY	56
7. CONCLUSION AND RECOMMENDATION	59
8. REFERNCES	61
المخلص العربي.....	١

LIST OF TABLES

No.	Item	Page
Table (1):	Organoleptic examination of smoked fish samples (n = 90)	33
Table (2):	Statistical analysis of pH value of examined smoked fish (muscle & ovary) (n = 90)	34
Table (3):	Statistical analysis of thiobarbituric acid (TBA) value of examined smoked fish (muscle & ovary) (n = 90)	35
Table (4):	Statistical analysis of total volatile basic nitrogen (TVBN) of examined smoked fish (muscle & ovary) (n = 90)	36
Table (5):	Statistical analysis of total bacterial count $\log_{10}\text{cfu/g}$ (TBC) of examined smoked fish (muscle & ovary) (no. = 90)	37
Table (6):	Statistical analysis of most probable number(MPN) $\log_{10}\text{cfu/g}$ of examined smoked fish (muscle & ovary) (n = 90)	38
Table (7):	Statistical analysis of <i>Staph. aureus</i> count $\log_{10}\text{cfu/g}$ of examined smoked fish (muscle & ovary) (n = 90)	39
Table (8):	Statistical analysis of total mold and yeast count $\log_{10}\text{cfu/g}$ of examined smoked fish samples (muscle & ovary) (n = 90)	40
Table (9):	Statistical analysis of Proteolytic count $\log_{10}\text{cfu/g}$ of examined smoked fish (muscle & ovary) (n = 90)	41
Table (10):	Statistical analysis of lipolytic count $\log_{10}\text{cfu/g}$ of examined smoked fish (muscle & ovary) (n = 90)	42
Table (11):	Pearson correlation between some examined variables (bacteriological and chemical) of 90 samples of muscle of smoked fish (n = 90)	43
Table (12):	Pearson correlation between some examined variables (bacteriological and chemical) of 90 samples of ovary of smoked fish (n = 90)	44

Table (13)	Deterioration criteria acceptance percentage of locally smoked fish (n=90) according to ESS, (2005) No; 288	45
Table (14)	Bacteriological analysis acceptance of locally smoked fish (n=90) according to ESS, (2005) No:288	46

LIST OF FIGURES

No.	Item	Page
Figure (1):	Organoleptic examination of smoked fish samples (n = 90)	33
Figure (2) :	Mean value of pH of examined smoked fish (muscle & ovary)(n= 90)	34
Figure (3):	Mean value of thiobarbituric acid (TBA) value of examined smoked fish (muscle & ovary) (n = 90)	35
Figure (4):	Mean value of total volatile basic nitrogen (TVBN) of examined smoked fish (muscle & ovary) (n = 90)	36
Figure (5):	Mean value of total bacterial count (TBC) $\log_{10}\text{cfu/g}$ of examined smoked fish (muscle & ovary) (n = 90)	37
Figure (6):	Mean value of most probable number (MPN) $\log_{10}\text{cfu/g}$ of examined smoked fish (muscle & ovary) (n = 90)	38
Figure (7):	Mean value of <i>Staph. aureus</i> count $\log_{10}\text{cfu/g}$ of examined smoked fish (muscle & ovary) (n = 90)	39
Figure (8):	Mean value of total mold and yeast count $\log_{10}\text{cfu/g}$ of examined smoked fish (muscle & ovary) (n = 90)	40
Figure (9):	Mean value of Proteolytic count $\log_{10}\text{cfu/g}$ of examined smoked fish (muscle & ovary) (n = 90)	41
Figure (10):	Mean value of lipolytic count $\log_{10}\text{cfu/g}$ of examined smoked fish (muscle & ovary) (n = 90)	42
Figure (11):	Pearson correlation between some examined variables (bacteriological and chemical) of 90 samples of muscle of smoked fish (n = 90)	43
Figure (12):	Pearson correlation between some examined variables (bacteriological and chemical) of 90 samples of ovary of smoked fish (n = 90)	44

LIST OF ABBREVIATIONS

APC	Aerobic Plate Count
CFU	Colony Forming Count
MPN	Most Probable Number
TBA	Thiobarbibturic Acid
TVBN	Total Volatile Basic Nitrogen
LC	Lipolytic Count
PC	Proteolytic Count
ESS	Egyptian Standards Specifications
ICMSF	International Commission on Microbiological Specification for foods
AOAC	Association of Official Analytical Chemists
APHA	American Public Health Association
GMP	Good Manufacture Practice
LST	Lauryl Sulplate Tryptose broth
TSI	Triple Sugar Iron agar

1-INTRODUCTION

Fish is considered an important source of animal protein, fish contain protein of high biological value, vitamins, fat, essential minerals such as iron, copper, iodine fluorine, as well as appreciable amounts of trace elements such as cobalt, magnesium and phosphours **(Krause, 1966)**.

Fish and fishy products are considered as perishable foods. Therefore, the prevention methods are traditionally have been widely spread **(Hobbs, 1983)**.

Quite large amount of fish are still treated by smoking process. In the industrialized countries, this process is primarily designed to produce a product of desirable appearance, odor and flavor

Herring is a kind of fish which may be held in brine and freshened prior to smoking. Herring which is subjected to various risks of contamination either primary contamination from skin, inadequately cleaned fish cases and the hands of those preparing and handling the fish or post contamination attributed to inadequate processing recontamination or incorrect storage of herring after processing. Such contaminants may render the smoked fish either unfit for human consumption or even harmful to consumers **(Turnbull and Gilbert, 1982, Vanden Broek *et al.*, 1984 and Saddik *et al.*, 1985)**.

Smoking permits lengthily preservation by removing moisture, which is essential for bacteriological and enzymatic spoilage.

Smoked fish products can be a source of microbial hazards including *Listeria monocytogenes*, *Salmonellae* spp. and *Clostridium botulinum* (Heintiz and Johnson, 1998).

Microorganisms may be present indicating the potential presence of the pathogen whose present in a given number points to inadequate processing for safety (Mossel *et al.*, 1995).

As fish and other free flora swimming marine animals do not usually carry those organisms particularly of the mammalian microflora including *Escherichia coli*, faecal coliforms, their presence on processed sea food is a clear evidence of the contamination from terrigenous source (ICMSF, 1986), thus the presence of these organisms may not only indicate the hygienic condition under which the processing establishment operates but also the presence of potential microorganisms that may be harmful to the consumer.

The smoking process retards the microbial activity of fish by showing a slight decrease in bacterial count. The action of smoke and dehydration however is not sufficient to reduce the bacterial count significantly (Deng *et al.*, 1974). A very large reduction in aerobic plate count reaching more than 99% after smoking due to antibacterial effect of smoke (Hammad, 1985) while Southcott and Bazzel (1973) reported that, salt contributed to the quality of smoked fish did not appear to prevent bacterial growth or spoilage at concentration which would be acceptable to most consumers.

The smoked fish processing in Egypt based on the importation of raw material as herring fish which considered the fish of choice for smoking purpose followed by macrel and salmon.

The problem of smoked fish is the importation process which gives chance for spoilage process to be done. There is no local fish for smoking purposes.

So, the main aim of this study was to evaluate the quality of locally smoked herrings organoleptically, chemically and microbiologically.

I. Organoleptic examination

- Skin condition.
- Skin color
- Taste of fish.
- Odor of flesh.
- Condition of the belly

II. Chemical examination

- pH Value.
- TBA reactive substance.
- Total volatile basic nitrogen (TVBN)

III. Microbiologically examination

- APC
- Coliforms count.
- Faecal coliforms.
- *Staph. aureus*.
- Lipolytic bacteria.
- Proteolytic bacteria.
- *E. coli*.
- *Salmonellae*.
- *Listeria monocytogenes*.
- Total mold and yeast count.

2. REVIEW OF LITERATURE

2.1 Organoleptic profile of smoked Fish:

Deng *et al.* (1974) stated that, cold smoking, hot smoking or combination of hot and cold smoking did not significantly affect saltiness smoke flavor and color. However, significant differences were observed on texture and appearance and those were sufficient to give significant difference in overall acceptance of the product.

Steephen and Marcia (1975) reported that, smoking is one of the method of fish preservation, which inhibit fat oxidation, bacterial growth and may extends the storage life of the finished product. The primary purpose of smoking is to enhance the flavor of the product as well as to improve the aroma and appearance. Heating stabilizes the cured product color, while smoking gives an attractive glossy brown finish.

Tilgner (1977) reported that, smoked fish products had an attractive surface coloring ranging from light yellowish, golden to dark brown shade. This surface coloring involved complicated carbonyl amino reactions and was directly connected with the loss of the carbonyl groups of smoke.

Daun (1979) recorded that, chemical cross lining of the surface proteins caused by smoking produces a firm stable outside. The drying that occurs during smoking will also affect the textural properties to an extent relative to the degree of drying as the rate of smoking, salt content and other variables. The author further added

that some components of smoke have been found to prevent spore production and fungal growth and inhibit viral activities on the surface of the product.

Gerasimov and Antonova (1979) stated that, smoke curing is the most complex method of preparing food products. Smoke curing takes place in a mixture of air and smoke, which gives the fish a specific flavor and smoke cured taste and imparts to the surface of the fish a golden yellow color

Wheaton and Lawson (1985) stated that, smoke contains antioxidative and bactericidal properties which impart color and flavor of the product.

Shiau and Char (1985) found that, the temperature and heating time during smoking process were the two major factors affecting the quality of smoked dogfish fillets. The rapidly increasing temperature with short heating time produced a lower quality of smoked fish with non uniform texture, very soft on the inside and hard on the surface. The surface of smoked fish fillets also contained many cracks and was inconsistent in appearance. The slowly increasing temperature with the long heating time process produced high quality smoked dogfish fillets with firm texture and consistent appearance.

Connell (1990) reported that, the quality of smoked fish depended to a great extent upon the raw material rather than strong flavors introduced by salt and smoke constituents.