



بِسْمِ اللَّهِ الرَّحْمَنِ الرَّحِيمِ



# شبكة المعلومات الجامعية التوثيق الالكتروني والميكروفيلم



شبكة المعلومات الجامعية

# جامعة عين شمس

التوثيق الالكتروني والميكرو فيلم

## قسم

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



## يجب أن

تحفظ هذه الأفلام بعيدا عن الغبار

في درجة حرارة من ١٥-٢٥ مئوية ورطوبة نسبية من ٢٠-٤٠%

To be Kept away from Dust in Dry Cool place of  
15-25- c and relative humidity 20-40%

# بعض الوثائق الأصلية تالفه

بالرسالة صفحات  
لم ترد بالأصل

# **STUDIES ON THE LEVELS OF POLYCYCLIC AROMATIC HYDROCARBONS IN SOME FOODS**

By

**Sayed Mohamed Mokhtar**

**B. Sc. in Agric. Sci. (Food Science and Technology)  
Suez Canal University, 1997**

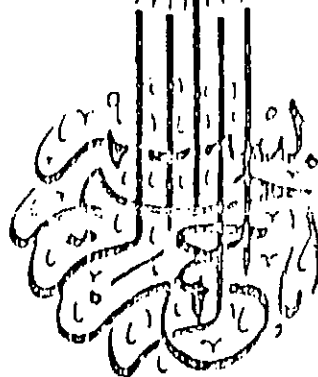
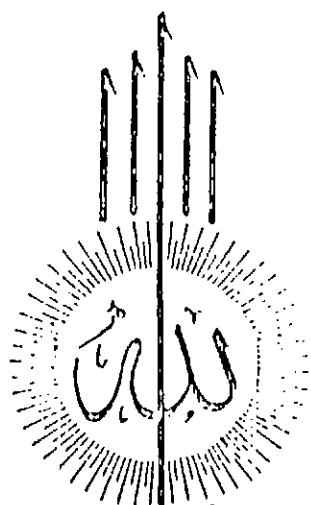
A thesis

**Submitted in Partial Fulfilment of the Requirement for  
the Degree of Master of Science in Agric. Sci.  
(Food Technology)**

To

**Food Technology Department  
Faculty of Agriculture  
Suez Canal University  
2001**

704  
J



قَالُوا سُبْحَانَكَ لَا عِلْمَ لَنَا إِلَّا مَا  
عَلَّمْتَنَا إِنَّكَ أَنْتَ الْعَلِيمُ الْحَكِيمُ

سُورَةُ الْآلَةِ الْكَافِيَةِ  
الْبَقَرَةُ - ٢٢١



## APPROVAL SHEET

# STUDIES ON THE LEVELS OF POLYCYCLIC AROMATIC HYDROCARBONS IN SOME FOODS

By

**Sayed Mohamed Mokhtar**

**B. Sc. in Agriculture (Food Science and Technology)**

**Suez Canal University, 1997**

This Thesis for M. Sc. degree has been approved by

**Prof. Dr. Magdy Ghanem Abdel-Fadeel**

Vice President of Education and Students Affairs

Prof. of Food Technology, Faculty of Environmental

Agricultural Sciences, Suez Canal University

*M.G. Abd EL-Fadeel*

**Prof. Dr. Salah Kamel El-Samahy**

Prof. of Food Technology, Food Technology Department,

Faculty of Agriculture, Suez Canal University

*S.K. EL Samahy*

**Prof. Dr. Refaat Amin Taha...**

Prof. of Food Technology, Food Technology Department,

Faculty of Agriculture, Suez Canal University

*R.A. Taha*

**Dr. Gamal Ali Mostafa**

Associate Prof. of Food Technology, Food Technology

Department, Faculty of Agriculture, Suez Canal University.

*Gamal Ali Mostafa*

Date 2 / 9 / 2001



# STUDIES ON THE LEVELS OF POLYCYCLIC AROMATIC HYDROCARBONS IN SOME FOODS

By

**Sayed Mohamed Mokhtar**

**B. Sc. in Agric. Sci. (Food Science and Technology)**  
**Suez Canal University, 1997**

**Under the supervision:**

**Prof. Dr. Refaat Amin Taha**

*R A Taha*

**Prof. of Food Technology, Food Technology Department,  
Faculty of Agriculture, Suez Canal University.**

**Dr. Gamal Ali Mostafa**

**Associate Prof. of Food Technology, Food Technology  
Department, Faculty of Agriculture, Suez Canal University.**

**Dr. Amal Abd El-Fatah Ali**

*Amal Galla*

**Associate Prof. of Food Technology, Food Technology  
Department, Faculty of Agriculture, Suez Canal University.**

*Gamal Mostafa*

*Awad B. Sarhan*  
16/10/2001



# Acknowledgement

## **ACKNOWLEDGEMENT**

A number of people have made facilities advice or their available time to me, and so helped the completion of this thesis.

The author wishes to express his appreciation to Prof. Dr. Refaat Amin Taha Professor of Food Technology, Food Technology Department, Faculty of Agriculture, Suez Canal University, for supervising the work and help during the different phases of thesis preparation.

Many thanks and grateful to Dr. Gamal Ali Mostafa Associate professor of Food Technology, Food Technology Department, Faculty of Agriculture, Suez Canal University, for his guidance, encouragement and his great help during planning the work and writing up of this thesis.

Grateful thanks to Dr. Amal Abd El-Fatah Gab Alla Associate Prof. of Food Technology, Food Technology Department, Faculty of Agriculture, Suez Canal University, for her great help during planning and writing up of this thesis.

Deep gratitudes are also extended to all staff members of Food Technology Department, Faculty of Agriculture, Suez Canal University.

The author feel greatly indebted to all members of his family; his parents, brother and his sisters.

## ABSTRACT

The effect of grilling, smoking and some methods of food processing on the formation of polycyclic aromatic hydrocarbons (PAHs) in meat, chicken and fish were studied. The results showed higher concentration of total and carcinogenic PAH in all tested samples. Level of PAHs increased with increasing fat contents. Market samples (meat and meat products, chicken products and smoked fish) detected large variation in levels of PAHs. Benzo[a]pyrene was found in 94% of all commercial tested samples, with levels varied from not detectable to 2445.6  $\mu\text{g kg}^{-1}$ . At the same time, the aforementioned samples indicated levels of benzo[a]pyrene above the maximum levels recommended by FAO/WHO (10  $\mu\text{g kg}^{-1}$ ).

# CONTENTS

	Page
<b>LIST OF TABLES</b>	<b>II</b>
<b>LIST OF FIGURE</b>	<b>III</b>
<b>1- INTRODUCTION</b>	<b>1</b>
<b>2- REVIEW OF LITERATURE</b>	<b>3</b>
2.1- Polycyclic aromatic hydrocarbons (PAHs)	3
2.1.1-Identification and structure	3
2.1.2-Physical and chemical properties of PAHs	4
2.1.3-Biological activities of PAHs after oral exposure	7
2.1.4-Metabolism of PAHs	7
2.1.5-Toxicity of PAHs	9
2.1.6-Sources of contamination of food with PAHs	11
2.1.6.1-Contamination from the air	12
2.1.6.2-Contamination from processing methods	14
2.1.7-Polycyclic aromatic hydrocarbons in fresh and processed fish	15
2.1.8-Polycyclic aromatic hydrocarbons in fresh and processed meat	21
2.1.9-Intake of PAHs from food	27
<b>3-MATERIALS AND METHODS</b>	<b>30</b>
3.1-Materials	30
3.2-Methods	30
3.2.1-Chemicals and reagents	30
3.2.2-Polycyclic aromatic hydrocarbons (PAHs) analysis	31
3.2.2.1-Extraction and clean-up	31
3.2.2.2-Gas chromatography	32
3.2.2.3-Quantification	33
<b>4- RESULTS AND DISCUSSION</b>	<b>34</b>
<b>5- SUMMARY AND CONCLUSION</b>	<b>75</b>
<b>6- REFERENCES</b>	<b>78</b>
<b>- ARABIC SUMMARY</b>	

## LIST OF TABLES

No.	Title	Page
1	Concentration of PAHs in some commercial chicken and turkey samples ( $\mu\text{g kg}^{-1}$ on dry weight basis).	35
2	Concentration of PAHs in some commercial meat and meat products ( $\mu\text{g kg}^{-1}$ on dry weight basis).	38
3	Concentration of PAHs in some commercial smoked fish sample ( $\mu\text{g kg}^{-1}$ on dry weight basis).	40
4	Effect of grilling on the concentration of PAH compounds in some fish varieties ( $\mu\text{g kg}^{-1}$ on dry weight basis).	44
5	Effect of grilling on the concentration of PAH compounds in meat and meat products ( $\mu\text{g kg}^{-1}$ on dry weight basis).	50
6	Effect of grilling on the concentration of PAH compounds in chicken with and without skin ( $\mu\text{g kg}^{-1}$ on dry weight basis).	56
7	Effect of smoking process on the PAHs concentration in fish, meat and chicken ( $\mu\text{g kg}^{-1}$ on dry weight basis).	62
8	Effect of grilling process on the PAHs concentration in fish, meat and chicken ( $\mu\text{g kg}^{-1}$ on dry weight basis).	66
9	Profiles and concentration of PAHs in smoked, grilled and roasted foods.	69
10	Estimated intake of PAHs $\mu\text{g}/250\text{ g/day}$ from smoked, grilled and roasted foods.	72
11	Estimated intake of benzo(a)pyrene in different countries.	74

## LIST OF FIGURES

No.	Title	Page
1	Concentration of PAHs in some commercial chicken and turkey samples.	36
2	Concentration of PAHs in some commercial meat and meat products.	39
3	Concentration of PAHs in some commercial smoked fish samples.	41
4	Effect of grilling on the concentration of PAH compounds in some fish varieties.	45
5	Chromatogram of authentic standard of PAHs.	46
6	Chromatogram of PAHs in sample of fresh eel .	47
7	Chromatogram of PAHs in sample of grilled eel .	48
8	Effect of grilling on the concentration of PAH compounds in meat and meat products.	51
9	Chromatogram of PAHs in sample of kofta 45% control.	52
10	Chromatogram of PAHs in sample of grilled kofta 45 %	53
11	Effect of grilling on the concentration of PAH compounds in chicken with and without skin.	57
12	Chromatogram of PAHs in sample of chicken with skin control.	58
13	Chromatogram of PAHs in sample of grilled chicken with skin	59
14	Effect of smoking process on the PAHs concentration in fish, meat and chicken.	63
15	Effect of grilling process on the PAHs concentration in fish, meat and chicken.	67
16	Mean concentrations of PAHs in smoked, grilled and roasted tested food samples .	70
17	Estimated intake of PAHs $\mu\text{g}/250\text{ g/ day}$ from smoked, grilled and roasted foods.	73