

**STUDYING THE MIGRATION AND REPLACEMENT OF
METALLIC ELEMENTS FROM SOME DIFFERENT
COOKWARES TO FOOD UNDER DIFFERENT CONDITIONS**

Submitted By

Attia Mohamed ShehtaAttia

B.Sc. (Chemistry) Faculty of Science- Zagazig University, 2003

A thesis Submitted in Partial fulfillment of

The Requirement for the

Master Degree

In

Environmental Science

Department of Environmental Basic Science

2019

Table of CONTENTS

Subject	page
Acknowledgment	I
Abstract	II
Table of contents	III
List of tables	V
INTRODUCTION	1
REVIEW OF LITERATURE	4
Kind of cookware's	5
Previous studies on the migration of elements from cookware's to food	14
Guideline of elements	28
Guideline for aluminum	28
Sources and levels of intake	29
Metallic food contact materials	30
Migration data	30
Guideline for chromium	36
Sources and levels of intake	36
Metallic food contact materials	37
Migration data	38
Guideline for copper	42
Sources and levels of intake	42
Metallic food contact materials	43
Migration data	43
Guideline for iron	47
Metallic food contact materials	48
Migration data	48
Guideline for lead	52
Sources and levels of intake	52
Metallic food contact materials	53
Migration data	54
Subject	Page
Guideline for nickel	57
Sources and levels of intake	58
Metallic food contact materials	58
Migration data	59
Guideline for silver	62
Sources and levels of intake	63

Metallic food contact materials	63
Migration data	64
Guideline for tin	66
Sources and levels of intake	66
Metallic food contact materials	67
MATERIALS AND METHODS	73
Material	73
Cookware's	73
Cereals and fruits	73
Food Stuffs	74
Cooked faba bean	74
Cooked diet strawberry jam	74
Storage Study	74
Statistical Analysis	75
Chemicals and reagents	75
Methods	75
Elemental analysis	75
pH of cooked food	76
RESULT AND DISSCUTION	77
Migration of iron from aluminum cookware to faba bean	77
Migration of aluminum from aluminum cookware to faba bean	78
Migration of nickel, chromium, cadmium and lead from aluminum cookware to faba bean	79
Migration of iron from enameled cookware to faba bean	81
Migration of aluminum from enameled cookware to faba bean	82
Migration of nickel, chromium, cadmium and lead from enameled cookware to faba bean	83
Migration of iron from stainless steel cookware to faba bean	85
Migration of aluminum from stainless steel cookware to faba bean	86
Migration of nickel, chromium, cadmium and lead from stainless steel cookware to faba bean	87
subject	Page
Migration of iron from aluminum cookware to strawberries	89
Migration of aluminum from aluminum cookware to strawberries	90
Migration of nickel, chromium, cadmium and lead from aluminum cookware to strawberries	91
Migration of iron from enameld cookware to strawberries	93
Migration of aluminum from enameld cookware to strawberries	93

Migration of nickel, chromium, cadmium and lead from enameld cookware to strawberries	94
Migration of iron from stainless steel cookware to strawberries	96
Migration of aluminum from stainless steel cookware to strawberries	96
Migration of nickel, chromium, cadmium and lead from stainless steel cookware to strawberries	97
- ENGLISH SUMMARY	100
- REFERENCES	103
- ARABIC SUMMARY	أ
- ARABIC ABSTRACT	ث

LIST OF TABLES

Table No.	LIST OF TABLES	Page
1	Concentration of Fe, Al, Ni, Cr, Cd and Pb metals in faba bean before and after cooking in aluminum utensil for three cycles and after storing for 7 days.	81
2	Concentration of Fe, Al, Ni, Cr, Cd and Pb metals in faba bean before and after cooking in enameled utensil for three cycles and after storing for 7 days.	85
3	Concentration of Fe, Al, Ni, Cr, Cd and Pb metals in faba bean before and after cooking in stainless steel utensil for three cycles and after storing for 7 days.	89
4	Concentration of Fe, Al, Ni, Cr, Cd and Pb metals in strawberries before, after cooking in aluminum utensil for three cycles and after storing for 7 days.	92
5	Concentration of Fe, Al, Ni, Cr, Cd and Pb metals in strawberries before, after cooking in enameled utensil for three cycles and after storing for 7 days.	95
6	Concentration of Fe, Al, Ni, Cr, Cd and Pb metals in strawberries before, after cooking in stainless steel utensil for three cycles and after storing for 7 days.	99

ABSTRACT

Metals supply for humans is fulfilled from food stuffs. This process is affected by many factors i.e. cooking, packaging and handling. The aim of this work is to investigate the migration of iron, aluminum, nickel, chromium, cadmium and lead from cookware to cooked faba bean and strawberries. Cookwares used for the experiment were aluminum, stainless steel and enameled steel, faba bean and strawberries were chosen for the study because they have high content of iron metal. Iron, aluminum, nickel, chromium, cadmium and lead metals were analyzed in faba bean and strawberries before and after cooking for three cycles and upon storage for one week. Results revealed that aluminum migrated from aluminum cookware to cooked faba bean and strawberries as it was increased from 22.29 to 43.2 mg/kg in faba bean at the second cooking cycle and it was increased from 20 to 39.4 in strawberries at third cooking cycle. For other cookwares no migration for aluminum metal after cooking and after storing. Also iron metal migrated from all cookwares to cooked faba bean and strawberries, iron migrated from aluminum cookware to cooked faba bean as it was increased from 53.5 to 66.96 mg/kg at the second cooking cycle and it was increased from 22.4 to 39.97 in strawberries at the first cooking cycle. In case of enameled and stainless steel cookwares iron migrated as it was increased from 53.5 to 115.5 mg/kg in cooked faba bean at the third cooking cycle and it was increased from 22.4 to 30.5 in strawberries at the third cooking cycle in enameled cookware and increased from 53.5 to 77.3 mg/kg at the first cooking cycle in stainless steel cookware in cooked faba bean and it was increased from 22.4 to 29.3 in strawberries at the second cooking cycle. Study the migration of iron and aluminum after storage for 7 days at 3°C the results indicated the occurrence of the migration of iron and aluminum metals in some cooking cycles and decreasing in some other cooking cycles. For other metals the migration was in some cycles and decreased in other cycles.

Key wards; Migration; Elements; Cookwares