ACRYLAMIDE IN SOME EGYPTIAN FOODS: LEVELS, FORMATION, BIOCHEMICAL EFFECTS AND PREVENTION

By

RANDA SAAD HASAN MOHAMED

B.Sc. Agric. Sci. (Biochemistry), Fac. Agric., Cairo Univ., 2010

THESIS

Submitted in Partial Fulfillment
Of the Requirements for the Degree of

MASTER OF SCIENCE

In

Agricultural Sciences

(Biochemistry)

Department of Agricultural Biochemistry
Faculty of Agriculture
CairoUniversity
EGYPT

2015

APPROVAL SHEET

ACRYLAMIDE IN SOME EGYPTIAN FOODS: LEVELS, FORMATION, BIOCHEMICAL EFFECTS AND PREVENTION

M.Sc. Thesis
In
Agric. Sci. (Biochemistry)

By

RANDA SAAD HASAN MOHAMED

B.Sc. Agric. Sci. (Biochemistry), Fac. Agric., Cairo Univ., 2010

APPROVAL COMMITTEE

Dr. HOSNY MOHAMED SHAFIK ABD ELSALAM ……...
Professor of Biochemistry, Fac. Agric., Menia University

Dr. EMAM ABDEL MOBDEA ABDEL RAHIM.....
Professor of Biochemistry, Fac. Agric., Cairo University

Dr. MOHYE ELDEIN ALI OSMAN….....…….....
Professor of Biochemistry, Fac. Agric., Cairo University

Date: 11 / 8 /2015

SUPERVISION SHEET

ACRYLAMIDE IN SOME EGYPTIAN FOODS: LEVELS, FORMATION, BIOCHEMICAL EFFECTS AND PREVENTION

M.Sc. Thesis
In
Agric. Sci. (Biochemistry)

By

RANDA SAAD HASAN MOHAMED

B.Sc. Agric. Sci. (Biochemistry), Fac. Agric., Cairo Univ., 2010

SUPERVISION COMMITTEE

Dr. MOHYE ELDEIN ALI OSMAN
Professor of Biochemistry, Fac. Agric., Cairo University

Dr. RAMY MOHAMED ROMEILAH
Associate Professor of Biochemistry, Fac. Agric., Cairo University

Dr. MOHAMED HASSANIN ELGAMMAL
Senior Researcher of Pollution, RCFF, Agric. Res. Centre, Giza, Egypt

Name of Candidate: Randa Saad Hasan Mohamed **Degree:** M.Sc.
Title of Thesis: Acrylamide in Some Egyptian Foods: Levels, Formation, Biochemical Effects and Prevention
Supervisors: Dr. Mohye El Dein Ali Osman
Dr. Ramy Mohamed Romeilah
Dr. Mohamed Hassanin El Gammal
Department: Agricultural Biochemistry **Approval: 11/8/2015**

ABSTRACT

The objective of the present study was to estimate acrylamide levels in some different food samples obtained from Egyptian local market and home made samples , also the levels of acrylamide formation during different processing conditions, and effects of pre-frying treatments on acrylamide reduction in some Egyptian foods, and to investigate the biological effects of acrylamide. Results showed that in market samples, the highest mean acrylamide level value was found in dark coffee (5181.61 μg/kg). The mean of acrylamide concentration of all potato market samples was 25.97 μg/kg. The highest mean levels in prepared meals was found in fried onion (309.35 μg/kg), while in homemade samples, the highest mean value of acrylamide content was in fried noodles at 120°C/6 min (310.75 μg/kg). The effect of different temperatures and/or times on acrylamide formation in fried rice and fried potatoes results were recorded. The highest acrylamide value for fried rice was 3066.38 μg/kg at 180°C/20 min. The effects of different pre-frying treatments on reduction of acrylamide formation in fried rice at 180°C for 10 min were studied. Soaking rice in acetic acid (1%) for 20 min caused the highest significant ($p \leq 0.05$) in reduction acrylamide formation (94.65%) followed by soaking rice in citric acid (1%) for 20 min (93.7%), while soaking rice in water or different solutions caused significant reduction in acrylamide formation between (89.1 to 94.65%). Results indecated that rats adminstrated acrylamide in drinking water between 1-6 ppm or fed on 30% fried rice (3066 ppm) led to a significant decrease in body weight gain, hemoglobin, red blood cells,white blood cells,hematocrit, platelet, T3, T4 and HDL cholesterol; however TSH, liver and kidney function and lipid profile were significantly increased .These biomarkers were improvemed when rats fed on 5% grape leaves in combination with fried rice compared with rats fed fried rice only. These may be due to contain extract of grape leaves on antioxidant phenols and flavinoads as chemical analysis proved. These results were documented by histopathological investigations of the liver, kidney, brain, pancreas, lymph nodes and thyroid gland.

Key words: Acrylamide, Potato, Rice, Reduction, Soaking, Frying temperature, Grape leaves, Drinking water, Biochemical changes, Histopathological analysis.

DEDICATION

*I dedicate this thesis firstly to **Allah** for giving me the courage and the determination, as well as guidance in conducting this research study, despite all difficulties and then to **my lovely Parents** whom support me in everything who helped me to finish my master thesis.*

ACKNOWLEDGEMENT

I wish to extend my utmost gratitude to my respected supervisors, ***Dr. Mohye El- Dein Ali Osman*** *Professor of Biochemistry Department, Faculty of Agriculture, Cairo University. His invaluable comments and suggestions enhanced the quality of this thesis. He was very tolerant. His patience and support helped me overcome many crisis situations and finish this thesis. It has been honour for me to be his M.Sc. student.*

This thesis could not have been done without the support and patience of the ***Dr. Ramy Mohamed Romeilah*** *Assistant Professor of Biochemistry Department, Faculty of Agriculture, Cairo University. He encouraged and guided me throughout the different steps and stages of this thesis.*

Special thanks to ***Dr. Mohamed Hassanin El-Gammal*** *Head of Organic Pollutants Laboratory, Regional Centre for Food and Feed, Agriculture Research Centre, Giza. Thanks for his valuable time and continuous help and most of all patience throughout the entire process, your optimistic attitude and encouragement, and understanding.*

I Sincere thanks to ***Dr. Gehan Gamil Ahmed Shehab****, Head Research in Pathology Department, Animal Health Institute, Doki, for performing histopathological examinations and interpretations.*

My sincere thanks are also due to ***Dr. Gehan M. El-Moghazy,*** *Head Regional Centre for Food and Feed for her support and providing all the possibilities and colleagues in the Department of Agriculture Biochemistry, Faculty of Agriculture, Cairo University and the Regional Center for Food and Feed-ARC and Egypt.*

LIST OF ABBREVIATIONS

NO.	Abbreviation	
1	**α**	Alpha
2	**A**	Absorbance
3	**AAMA**	Acrylamide mercapturic acid
4	**Ab** c.w.	Monospecific immobilized Antibody
5	**ABTS**	2,2-azino-bis-3-ethylbenzothiazoline-6-sulphonic acid
6	**AChE**	Acetylcholinesterase
7	**ADP**	Adenosine-5-diphosphate
8	**Ag**	Native antigen
9	**ALP**	Alkaline phosphatase
10	**ALT/GPT**	Alanine aminotransferase
11	**ANN**	Artificial neural network
12	**AOPP**	Advanced oxidation protein product
13	**AP-1**	Transcription activator-1
14	**4-AP**	4-Aminophenazone
15	**3-APA**	3-aminopropionamide
16	**AST/GOT**	Aspartate aminotransferase
17	**ATSDR**	Agency for Toxic Substances and Disease Registry
18	**AUC**	Area under the curve
19	**β**	Beta
20	**BHT**	Butylated hydroxytoluene
21	**BMD**	Benchmark dose
22	**$BMDL_{05}$**	95% lower confidence limit on the BMD0.5
23	**Btn**	Biotinylated
24	**b.w.**	Body weight
25	**CHE**	Cholesterol esterase
26	**CHOD**	Cholesterol oxidase
27	**Cig.**	Cigarette
28	**Cmm**	Cubic millimeter
29	**CNS**	Central nervous system
30	**CO_2**	Carbon dioxide
31	**CPF**	Carica papaya fruit
32	**Cyp**	Cytochrome
33	**D**	Day

Continued.

34	**DA**	Dopamine
35	**DAP**	Dihydroxyacetone phosphate
36	**DNA**	Deoxyribonucleic acid
37	**DPPH**	1,1-diphenyl-2-picrylhydrazyl
38	**DTEAC**	Trolox equivalent antioxidant capacity
39	**EC**	European Commission
40	**EDTA**	Ethylene diamine tetra acetic acid
41	**EDM**	Egyptian Diagnostic Media
42	**EFSA**	European Food Safety Authority
43	**ELCR**	Excess lifetime cancer risk
44	**Enz**	Enzyme
45	**EPA**	Environmental Protection Agency
46	**ESCN**	Embryonic stem cells
47	**EU**	Eugenol
48	**FFQ**	Food frequency questionnaire
49	**FRAP**	Ferric reducing ability power
50	**GAMA**	Glycidamide mercapturic acid
51	**GPO**	Glycerol phosphate dehydrogenase
52	**GK**	Glycerol kinase
53	**G3P**	Glycerol-3-phosphate
54	**GPx**	Glutathione peroxidase
55	**GR**	Glutathione reductase
56	**GST**	Glutathione S-transferase
57	**h**	Hour
58	**H and E stain**	Hematoxylin and eosin stain
59	**Hb**	Hemoglobin
60	**HCT**	Haematocrit
61	**HDL-C**	High Density Lipoprotein
62	**HEC**	Human equivalent concentration
63	**HED**	Human equivalent dose
64	**H_2O_2**	Hydrogen peroxide
65	**HP-5ms**	5%-phenylmethylpolysiloxane
66	**HRP**	Horseradish peroxidase
67	**HSDB**	Hazardous Substance Data Bank
68	**5-HT**	Serotonin
69	**IARC**	International Agency for Research on Cancer
70	**IE**	Isoeugenol