

# **BIOCHEMICAL STUDIES ON BY-PRODUCTS OF SOYA INDUSTRIALIZATION**

**By**

**EMAN RASHAD MOHAMED ABBAS**

**B.Sc. Agric. Sci. (Biochemistry), Fac. Agric., Cairo Univ., 1996**

**M.Sc. Agric. Sci. (Biochemistry), Fac. Agric., Cairo Univ., 2009**

**THESIS**

**Submitted in Partial Fulfillment of the  
Requirements for the Degree of**

**DOCTOR OF PHILOSOPHY**

**In**

**Agricultural Sciences  
(Agricultural Biochemistry)**

**Department of Agricultural Biochemistry  
Faculty of Agriculture  
Cairo University  
EGYPT**

**2019**

**Format Reviewer**

**Vice Dean of Graduate Studies**

**Name of Candidate:** Eman Rashad Mohamed      **Degree:** Ph. D.  
**Title of Thesis:** Biochemical Studies on by-products of soya industrialization  
**Supervisors:** Prof. Dr. Emam Abdel- Mobdy Abdel-Rahim  
                         Prof. Dr. Ebtessam Abdel-Moneim  
                         Dr. Nahed Lotfy Zaki  
**Department:** Biochemistry  
**Date:** 20 /11/ 2019

### **ABSTRACT**

Okara, the soybean residue from soy milk production, contains nutrients and functional components. The proximate analysis was found to be 33.64% crude protein , 21.08% total lipid and 45.03% total dietary fiber in okara . The risk of development of diabetes type 2 is increasing worldwide in which the lifestyle and diet preference are primary responsible. In the current study, okara (rich source of fiber) has been manufactured into okara crackers which can be used to investigate its dietary role in controlling diabetes in STZ diabetic rats with and without high fat diet. 48 male albino rats were divided into eight groups (six rats in each group). G1, G2, G3 and G4 were healthy rats and fed on basal diet, basal diet with 30% okara crackers , high fat diet, and high fat diet with 30% okara crackers respectively. G5, G6, G7 and G8 were diabetic groups which fed on similar diets respectively as previous groups for 60 days. Blood glucose, liver function, kidneys function and lipid pattern of experimental animals in addition to pancreas and liver histopathology and insulin immunohistochemistry were carried out. Okara crackers diet has decreased the serum glucose level. The activity of AST, ALT and ALP were inhibited in diabetic rats fed on diets containing okara crackers. Uric acid , urea and creatinine content of diabetic rats which were significantly decreased after feeding on okara crackers compared with diabetic control. Total cholesterol ,triglycerides , HDL and LDL were improved when diabetic rats fed on okara crackers. There were cellular changes, a decrease in the number of  $\beta$  cells, a number of islands, and the pancreatic change in the pancreas of the diabetic group, as well as degeneration of liver cells, necrosis and central vein congestion. But rats feeding on the okara crackers have improved tissue and restored parts of the islands. In conclusion, the use of 30% okara crackers in diet has improved the hyperglycemia and hyperlipidemia associated with diabetes.

**Key words:** okara, diabetes, fiber diet, proximate analysis, crackers.

## LIST OF TABLES

<b>No.</b>	<b>Title</b>	<b>Page</b>
1.	Composition of the control diet (g/100g diet).....	33
2.	Composition of salt mixture (g/kg mixture).....	33
3.	Composition of vitamin mixture.....	34
4.	Proximate analysis of okara(%dry weight).....	51
5.	Mineral contents in okara.....	52
6.	Fatty acid contents in okara.....	53
7.	Chemical composition of essential amino acid of okara.....	54
8.	Chemical composition of non- essential amino acid of Okara.....	55
9.	Vitamins Composition of Okara (mg/100gm).....	56
10.	Phenolic compounds of okara.....	57
11.	Flavonoid compound contents in okara.....	58
12.	Proximate composition of okara crackers (%).....	58
13.	Physical properties of crackers.....	60
14.	Sensory evaluation of crackers.....	61
15.	Effect of feeding different experimental diets on body weight of male albino rats.....	63
16.	Serum glucose level (mg/dl) in male albino rats during the experimental period.....	66

## LIST OF TABLES (Continued)

No.	Title	Page
17.	Effect of feeding different experimental diets on cholesterol, triglycerides, HDL-c, LDL-c and vLDL of male albino rats.....	70
18.	Effect of feeding different experimental diets on T. Protein and Albumin of male albino rat.....	73
19.	Effect of feeding different experimental diets on serumalkaline phosphatase (AP), AST and ALT activites of male albino rats.....	75
20.	Effect of feeding different experimental diets on uric acid, urea and creatinine of male albino rats.....	78

## LIST OF FIGURES

No.	Title	Page
1.	The different groups of the experimental rats .....	35
2.	Proximate composition of okara crackers (%).....	59
3.	Sensory evaluation of crackers.....	62
4.	Effect of feeding different experimental diets on body weight of male albino rats.....	64
5.	Serum glucose level (mg/dl) in male albino rats during the experimental period.....	67
6.	Effect of feeding different experimental diets on cholesterol and triglycerides of male albino rats.....	71
7.	Effect of feeding different experimental diets on HDL-c, LDL-c and vLDL of male albino rats.....	71
8.	Effect of feeding different experimental diets on T. Protein and Albumin of male albino rats.....	74
9.	Effect of feeding different experimental diets on serumalkaline phosphatase (AP), AST and ALT activites of male albino rats.....	76
10.	Effect of feeding different experimental diets on uric acid, urea and creatinine of male albino rats.....	79
11.	Histopathological examination of pancreas in experimental treatment.....	81
12.	Histopathological examination of liver in experimental treatment.....	84
13.	Immunohistochemical findings of insulin staining.....	86

# CONTENTS

	<b>Page</b>
<b>INTRODUCTION</b> .....	<b>1</b>
<b>REVIEW OF LITERATURE</b> .....	<b>3</b>
<b>1. Soy milk processing and okara production</b> .....	<b>3</b>
<b>2. Chemical composition of okara</b> .....	<b>5</b>
<b>3. Biological activities of okara</b> .....	<b>10</b>
a. Hyperglycemia.....	<b>10</b>
b. Hyperlibedimia .....	<b>13</b>
c. Effect on other diseases.....	<b>16</b>
<b>4. Utilization of okara</b> .....	<b>20</b>
<b>MATERIALS AND METHODS</b> .....	<b>25</b>
<b>RESULTS AND DISCUSSION</b> .....	<b>51</b>
<b>1. Chemical investigation</b> .....	<b>51</b>
<b>2. Technological investigation</b> .....	<b>58</b>
<b>3. Biological investigation</b> .....	<b>62</b>
<b>4. Histopathological findings</b> .....	<b>79</b>
<b>SUMMARY</b> .....	<b>91</b>
<b>REFERENCES</b> .....	<b>97</b>
<b>ARABIC SUMMARY</b> .....	