Ain Shams University
Faculty of Women for Arts, Science and Education
Biochemistry and Nutrition Department

Protective Effect of Clove and Ginger Extracts on the Biological and Biochemical Changes of Diabetic Rats

Thesis Submitted by

Enass El-Sayed Ahmed Abd El-Hamid

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Under Supervision of

Dr.Hanem Abd El- Sabour Seda
Prof. of food Technology
Biochemistry and Nutrition Dept.
Faculty of Women for Arts,
Science, and Education
Ain Shams University

Dr.Fatma Abd El-Hamid Khalil
Prof. of Nutrition and head of
Biochemistry and Nutrition Dept.
Faculty of Women for Arts,
Science, and Education
Ain Shams University

Dr. Nahla Hussein Ali
Assistant Prof. of Nutrition
Biochemistry and Nutrition Dept.
Faculty of Women for Arts, Science, and Education
Ain Shams University

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Abstract

The aim of the present study was to investigate the effects of oral administration of clove and/or ginger extracts at a level of 50 mg/kg b.wt./day of clove, 50 mg/kg b.wt./day of ginger and 25 mg/kg b.wt./day of each for a period of 6 weeks on streptozotocin (STZ) induced diabetic rats. Results showed that diabetic rats had significant increase in the levels of serum glucose by 134.06%, malondialdehyde (MDA) by 91.59%, liver enzymes activity, kidney functions as well as atherogenic index (AI) and lipids profile except HDL-C, while blood reduced glutathione (GSH) content, serum insulin, and liver glycogen were significantly lowered as compared to normal control rats. The elevated serum parameters were significantly reduced by treatment for 6 weeks with clove and/or ginger extracts except serum HDL-C, insulin, GSH and liver glycogen were significantly increased as compared with diabetic control rats.

It was concluded that, administration of clove and ginger at the tested doses had anti-diabetic and anti-hyperlipidemic properties as well as good antioxidant potential (eugenol, ellagic acid in clove and gingerols, shogaols in ginger).

List of Abbreviations

ACE: Angiotensin Converting enzyme

ADS: Antioxidant Defense System

AGE: Advanced Glycated End

AI: Atherogenic Index

AIN-93 M: American Institute of Nutrition

ALP: Alkaline Phosphatase

ALT: Alanine Aminotransferase

AO: Antioxidant

AST: Aspartate Aminotransferase

B. wt.: Body weight

CAT: Catalase

DM: Diabetes Mellitus

DMH: Di-Methyl hydrazine

DNA: Deoxyribo Nucleic Acid

E-Coli: *Escherichia Coli*

GDH: Glutamate Dehydrogenase

GDM: Gestational Diabetes Mellitus

GERD: Gastro-Esophageal Reflux Disease

G6Pase: Glucose 6 Phosphatase

G6 PD: Glucose 6 Phosphate Dehydrogenase

GPX: Glutathione Peroxidase

GR: Glutathione Reductase

GSH: Reduced Glutathione

GST: Glutathione-S- Transferase

HBA1C: Glycosylated Hemoglobin

HDL-C: High Density Lipoprotein Cholesterol

HMG-coA: 3-Hydroxy-3- Methyl Glutaryl CO Enzyme

4-HNE: 4-Hydroxy-2-Non Enal

HP: *Helicobacter Pylori*

5-HT3: 5-Hydroxy Tryptamine 3

IDDM: Insulin Dependent Diabetes Mellitus

LDL-C: Low Density Lipoprotein Cholesterol

MDA: Malondialdehyde

MDH: Malate Dehydrogenase

MODY: Maturity Onset Diabetes of Young

NAC: N-Acetyl Cysteine

NCV: Nerve Conduction Velocity

NIDDM: Non- Insulin Dependent Diabetes Mellitus

NIN: National Institute of Nutrition

NO: Nitric Oxide

NSAIDs: Non-Steroidal Anti Inflammatory Drugs

PEPCK: Phosphoenol Pyruvate Carbxy Kinase

PUFA: Polyunsaturated Fatty Acid

RBP: Retinoid Binding Protein

ROS: Reactive Oxygen Species

S.D.: Standard Deviation

SOD: Superoxide Dismutase

SPSS: Statistical Package for Social Science

St.: Standard

STZ: Streptozotocin

TAG: Triacylglycerols

TC: Total cholesterol

TL: Total lipid

VEGF: Vascular Endothelial Growth Factor

VLDL-C: Very Low Density Lipoprotein Cholesterol

Dedication

This work is dedicated to my beloved father, mother and brother whose affection, love and encouragement make me able to get such success.

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Introduction

Diabetes is a chronic metabolic disorder affecting a major proportion of the population worldwide. Diabetes mellitus is a disease due to abnormality of glucose metabolism and it is mainly linked with low plasma insulin level or insensitivity of target organs to insulin and results in chronic hyperglycemia, a clinical hallmark of diabetes ***(Veerapur et al., 2012)***. The sustained hyperglycemia leads to a further impairment of insulin production by beta cells the so-called glucose toxicity. Hyperglycemia occurring in diabetes does not only damage cellular proteins, membrane lipids and nucleic acids, but also increase the rate of onset of disease complications ***(Srinivasan et al., 2013)***. The acute complications of diabetes mellitus include hyperglycemia, diabetic ketoacidosis, lactic acidosis, hyperosmolar non-ketotic coma **(Andrew, 2010)**. The late complications include peripheral vascular disease, coronary heart disease, retinopathy, neuropathy, nephropathy and stroke ***(Chaudhry et al., 2013)***.

Oxidative stress has been reported to be a major factor in the pathogenesis of all diabetic complications. Free radicals are formed in diabetes by glucose oxidation, non-enzymatic glycation of proteins, and the subsequent oxidative degradation of glycated proteins. Abnormally high levels of free radicals and the simultaneous decline of antioxidant defense mechanisms can lead to damage of cellular organelles and enzymes and increased lipid peroxidation ***(Dominic et al., 2002)***. There is a great interest in the potential contribution of

increased oxidative stress to the pathogenesis of diabetes as well as its complications. Hyperglycemia is a widely known cause of enhanced free radical concentrations and decreased antioxidant defense system ***(Ahmed, 2005)***.

Humans have evolved with antioxidant systems to protect against free radicals. These systems include some antioxidants produced in the body (endogenous) and others obtained from diet (exogenous) **(Kangralkar *et al*., 2010)**. However, the lowering oxidative stress and activation of antioxidant defense mechanisms, using medicinal plants and dietary antioxidants, prevents endothelial dysfunction and cell damage in diabetes, atherosclerosis and cardiovascular diseases ***(Al-Azhary, 2011).***

Before the discovery of insulin in the 1920s and the development of oral hypoglycaemic agents, diabetes mellitus was treated mainly by a combination of fasting, diet control and plant therapeutics ***(Al-Amin et al., 2006)***. Oral hypoglycemic agents, drugs may be effective for glycemic control, but they come with their attendant side effects such as liver disorders, abdominal pain, renal tumors, hepatic injury, acute hepatitis and abdominal fullness ***(El Kaissi and Sherbeeni, 2011)***.

Herbs and spices have been widely used as a traditional medicine to treat various chronic or acute diseases since they contain high levels of various active phytochemicals, including, flavonoids, terpenoids, lignans, sulfides, polyphenolics and coumarins ***(Jin and Cho, 2011)***.