Content

	Pages
Introduction	1
Aim of the work	2
Review of literature	4
Classification of DM	5
Diagnosis	7
Types of DM	11
Diabetic neuropathy	17
Apoptosis	20
Mechanism and regulation	22
The Fas/FasL system	29
Importance of apoptosis	33
Apoptosis and diabetes mellitus	36
Free radicals and reactive oxygen species	39
Oxidative stress	41
Antioxidants	44
Antioxidant system	44
N-acetyl L-cysteine	54
Antioxidants and diabetes mellitus	56
Subjects and Methods	59
Results	77
Discussion	102
Summary	114
Conclusion	115
References	117
Arabic summary	

List of tables

No.		Pages
Table 1	Criteria for the diagnosis of diabetes mellitus	7
Table 2	Role of the laboratory in diabetes mellitus	10
Table 3a	Fasting blood glucose level in the studied groups	77
Table 3b	Comparison between fasting blood glucose levels	78
	among the studied groups	
Table 4a	Post prandial blood glucose level in the studied	80
	groups	
Table 4b	Comparison between post prandial blood glucose	80
	levels among the studied groups	
Table 5a	Glycohaemoglobin level in studied groups	82
Table 5b	Comparison between glycohaemoglobin levels	82
	among the studied groups	
Table 6a	Triglycerides level in the studied groups	84
Table 6b	Comparison between triglycerides levels among	84
	the studied groups	
Table 7a	Cholesterol level in the studied groups	86
Table 7b	Comparison between cholesterol levels among	86
	the studied groups	
Table 8a	HDL-C level in the studied groups	88
Table 8b	Comparison between HDL-C levels among the	88
	studied groups	
Table 9a	LDL-C level in the studied groups	90
Table 9b	Comparison between LDL-C levels among the	90
	studied groups	
Table 10a	Cholesterol / HDL ratio in the studied groups	92

Table 10b	Comparison between cholesterol / HDL ratio	92
	among the studied groups	
Table 11a	Malondialdehyde level in the studied groups	94
Table 11b	Comparison between malondialdehyde levels	94
	among the studied groups	
Table 12a	sFas level in the studied groups	96
Table 12b	Comparison between sFas levels among the	96
	studied groups	
Table 13	Correlation coefficient (r) and probability (p) of	98
	fasting blood glucose and other tested parameters	
	in diabetic groups before supplementation	
Table 14	Correlation coefficient (r) and probability (p) of	98
	glycohaemoglobin and other tested parameters in	
	diabetic groups before supplementation	
Table 15	Correlation coefficient (r) and probability (p) of	99
	malondialdehyde and other tested parameters in	
	diabetic groups before supplementation	
Table 16	Correlation coefficient (r) and probability (p) of	99
	sFas and other tested parameters in diabetic	
	groups before supplementation	

List of figures

No.		Pages
Figure 1	The intrinsic or mitochondrial pathway of apoptosis	26
Figure 2	Structure of Fas death receptor	30
Figure 3	Two CD95 signaling pathways	32
Figure 4	Interactions among antioxidants	45
Figure 5	Mean fasting blood glucose levels in the studied	79
	groups	
Figure 6	Mean post prandial blood glucose levels in the	81
	studied groups	
Figure 7	Mean glycohaemoglobin levels in the studied	83
	groups	
Figure 8	Mean triglycerides levels in the studied groups	85
Figure 9	Mean cholesterol levels in the studied groups	87
Figure 10	Mean HDL-C levels in the studied groups	89
Figure 11	Mean LDL-C levels in the studied groups	91
Figure 12	Mean cholesterol/HDL ration in the studied groups	93
Figure 13	Mean malondialdehyde levels in the studied groups	95
Figure 14	Mean sFas levels in the studied groups	97
Figure 15	Correlation between fasting blood glucose and post	100
	prandial glucose in diabetic patients before	
	supplementation	
Figure 16	Correlation between glycohaemoglobin and LDL-C	100
Figure 17	Correlation between malondialdehyde and HDL-C	101
Figure 18	Correlation between sFas and cholesterol	101
Figure 19	Correlation between sFas and HDL-C	101

List of abbreviations

ADA American diabetes association

ADP Adenosine diphosphate

AGEs Advanced glycation end products

AIDS Acquired immunodeficiency syndrome

AIF Apoptosis inducing factor

AP Amino Phenazone

Apaf-1 Apoptotic protease activity factor-1

Apo-1 Apoptosis 1

ATP Adenosine triphosphate

BAX BCL-2 associated X protein

Bcl-2 Product of B-cell lymphoma/leukemia-2 gene

Ca Ox Calcium oxidase

CARD Caspase recruitment domain

Caspase Cysteine aspartic acid specific protease

CD Cluster of differentiation

CHE Cholesterol esterase

CHOD Cholesterol oxidase

Co Q10 Coenzyme Q 10 = ubiquinone

DAP Dihydroxyacetone phosphate

DED Death effector domain

DHA Dehydroascorbate

DISC Death inducing signaling complex

DNA Deoxyribonucleic acid

EDTA Ethylene-diamine tetraacetic acid

ELISA Enzyme linked immunosorbent assay

EMG Electromyography

FADD Fas-associated death domain (also called Mort-1)

Fas Fibroblast associated cell surface

Fas L Fas ligand

Fas R Fas receptor

FBG Fasting blood glucose

FLIP FLICE inhibitor protein

G3P Glycerol 3 phosphate

GOD Glucose oxidase

GPO Glycerol phosphate dehydrogenase

GSH Reduced glutathione

GSSG Oxidized glutathione

H₂O₂ Hydrogen peroxide

HbA1c Glycohaemoglobin A1c

HbAo Non glycosylated Hb

HDL-c High density lipoprotein-cholesterol

HIV Human immunodeficiency virus

HLA Human leukocyte antigen

HNF Hepatocyte nuclear factor

IAA Insulin auto antibodies

IAPs Inhibitor of apoptosis proteins

ICA Islet cell antibodies

ICE Interlukin 1-β converting enzyme

IDLs Intermediate density lipoproteins

IL Interleukin

IPE Insulin promoter factor

Kd Kilo Dalton

LAK Lymphokine activated killer cell

LDL-c Low density lipoprotein cholesterol

LOO Lipid peroxyl radical

LPL Lipoprotein lipase

MAP Kinase Mitogen activated protein kinase

MDA Malondialdehyde

MGO Dicarbonyl-methyl-glyoxal

MGO-BSA MGO modified bovine serum albumin

MODY Maturity onset diabetes of the young

mRNA Messenger ribonucleic acid

NAC N-acetyl-L-cysteine

NADP Nicotinamide adenine dinucleotide phosphate

NADPH The reduced form of NADP

NGF Nerve growth factor

NO Nitric oxide

NOD Non obese diabetic

OGTT Oral glucose tolerance test

OH Hydroxyl

P53 Tumor suppressor protein 53

PKC Protein kinase C

POD Peroxidase

QST Quantitative sensory testing

r Correlation coefficient

RAGE Receptor for AGEs

RO Alkoxyl radical

ROI Reactive oxygen intermediate

ROO Peroxyl radical

ROS Reactive oxygen species

SAPK Stress activated protein kinase

SD Standard deviation

Se Selenium

sFas Soluble Fas antigen

sFas-L Soluble Fas ligand

SOD Superoxide dismutase

TBA Thiobarbituric acid

TC Total cholesterol

TCA Tricholroacetic acid

TG Triglycerides

THM Tam Horsfall mucoprotein

TMB Tetramethyl benzedine

TNF Tumor necrosis factor

TNF R TNF-receptor

TNF α Tumor necrosis factor-alpha

TRADD TNF receptor associated death domain

TRAIL TNF related apoptosis inducing ligand

VC Vitamin C

VE Vitamin E

VLDL Very low density lipoprotein