Journal of Home Economics

4th International -18th Arab Conference of Home Economics
"Home Economics and Development Issues"
5-6 April, 2016

http://homeEcon.menofia.edu.eg ISSN 1110-2578

Potential Therapeutic Effects of Moringa (*Moringa oleifera*) Extracts on Diabetic Rats

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Abstract

This study was conducted to investigate the effect of *Moringa oleifera* leaves extracts on diabetes mellitus of injected rats with alloxan . Therity white male albino rats, weighting 197 ±2 g were used in this study. The rats were divided into 6 groups .Group 1 used as negative control group ,Group 2 used as positive control group, groups 3 and 4 received aqueous *Moringa oleifera* leaves extract ,orally, in doses of 250 and 500 mg/kg B.Wtrespectively and group 5 and group 6 received ethanolic *Moringa oleifera* leaves extract, orally, in a dose of 250 and 500 mg/kg B.Wt , respectively. Glucose , T.G ,T.C ,AI, LDL, HDL ,VLDL , Oxidant index and antioxidant enzymes (MDA, SOD, GSH, CAT and GST) have been evaluated. The obtained results of diabetic rats revealed that *Moringa oleifera* leaves extracts showed a significant increase in HDL and antioxidant enzymes (SOD, GSH, CAT and GST) , but with significant decreases in the rest of the parameters referred to previously , as compared with control (+ve) group . In conclusion , aqueous and ethanolic *Moringa oleifera*leaves extracts can improve serum glucose level in diabetic rats .

Keywords : Diabetes mellitus , aqueous *Moringa oleifera* leaves extract , ethanolic *Moringa oleifera* leaves extract.

Introduction

Diabetes mellitus, referred to a group of metabolic diseases in which a person has high blood sugar, either because the body does not

produce enough insulin, or because cells do not respond to the insulin that is produced. This high blood sugar produces the classical symptoms of polyuria (frequent urination), polydipsia (increased thirst) and polyphagia (increased hunger) **(Nabipour, 2009).**

Diabetes also induces damage to peripheral nerves, culminating in development of peripheral diabetic neuropathy, which occurs as a consequence of complex interactions among multiple hyperglycemia-initiated mechanisms, impaired insulin signaling, inflammation, hypertension and disturbances of fatty acid and lipid metabolism, being one of the most devastating complications of diabetes mellitus and a leading cause of foot amputation **(Obrosova, 2000).**

In the last few years there has been an exponential growth in the field of herbal medicines and these drugs are gaining popularity both in developing and developed countries because of their natural origin and less side effects. Many traditional medicines in use are derived from medicinal plants, minerals and organic matter **(Grover etal., 2002).** A number of medicinal plants, traditionally used for over 1000 years named rasayana present in herbal preparations of Indian traditional health care systems **(Scartezzini and Sproni, 2000).** India is the largest producer of medicinal herbs and is called as botanical garden of the world **(Seth and Sharma, 2004).**

Moringa oleifera is commonly used as healing herb to treat diabetes and liver diseases. *Moringa oleifera*is one of the best known and most widely distributed and naturalized species of a monogeneric family *Moringaceae*(**Nadkarni, 1976; Ramachandran *et al.*, 1980)** . The tree ranges in height from 5 to 10 m **(Morton, 1991)** .

Moringa oleifera , native of the western and sub- Himalayan tracts, India, Pakistan, Asia Minor, Africa and Arabia **(Somali et al., 1984; Mughal et al., 1999)** is now distributed in the Philippines, Cambodia, Central America, North and South America and the Caribbean Islands **(Morton, 1991).** In some parts of the world *M. oleifera* is referred to as the 'drumstick tree' or the 'horse radish tree', whereas in others it is known as the kelor tree (**Anwar and Bhanger, 2003).** While in the Nile valley, the name of the tree is 'Shagara al Rauwaq', which means 'tree

for purifying' **(Von Maydell, 1986)** . In Pakistan , *M. oleifera* is locally known as 'Sohanjna' and is grown and cultivated all over the country **(Qaiser, 1973; Anwar et al., 2005).**

Moringa oleifera leaves have been reported to be a rich source of β-carotene, protein, vitamin C, calcium and potassium, and act as a good source of natural antioxidants; and thus enhance the shelf-life of fat containing foods due to the presence of various types of antioxidant compounds such as ascorbic acid, flavonoids,phenolics and carotenoids **(Dillard and German, 2000; Siddhuraju and Becker, 2003).** In the Philippines, it is known as 'mother's best friend' because of its utilization to increase woman's milk production and issometimes prescribed for anemia **(Estrella et al., 2000; Siddhuraju and Becker, 2003).**

A number of medicinal properties have been ascribed to various parts of this highly esteemed tree . Almost all the parts of this plant: Root, bark, gum, leaf, fruit (pods), flowers, seed and seed oil have been used for various ailments in the indigenous medicine of South Asia, including the treatment of liver disease , inflammation and infectious diseases along with cardiovascular, diabetes, gastrointestinal and hematological and hepatorenal disorders **(The Wealth of India , 1962; Singh and Kumar, 1999; Morimitsu *et al.*, 2000; Siddhuraju and Becker, 2003).**Therefore, this study was carried out in order to study the potential therapeutic effects of moringa (*Moringa oleifera)* extracts on diabetic rats.

Materials And Methods

1- Materials:

Moringa (*Moringa oleifera*)was obtained from famous garden in Menoufia Governorate.Alloxan and ethanolwere obtained from Elgomhoria Company

2- Methods:

Biological Experiment

Preparation of basel diet:

The basel diet (Casein - basel diet) was composed of 12.3g casein (10% Protein), 10g corn oil (10% fat), 4g minerals (4% minerals),

1g vitamin mixture (1% Vitamin), 4g cellulose (4% fiber) , choline chloride (0.2 %) , methionine (0.3 %), and the remained is corn starch according to **Campbell (1961).**

The salt mixture in this experiment used as recommended by **Hegsted** *et al.*,**(1941)**, and the vitamin mixture used as recommended by **Muller (1964).**

Induction of experimental diabetes

Diabetes was induced in normal healthy mal albino rats by intro - Peritoneal injection of alloxan 150 mg/kg body weight, according to the method described by **Desai and Bhide, (1985).**

One week after the injection of alloxan, fasting blood samples were obtained to estimate fasting serum glucose. Rats contained 110 mg/dl levels were considered diabetic **(NDDG, 1994).**

Preparation of Moringa oleifera leaves extracts:

Preparation of aqueous Moringa oleifera leaves extract:

The leaves of Moringa oleifera were collected and dried in an airy room for about 3 days of drying , away from direct sunlight to avoid possible damage to their phyto-constituents and ground into powder. 10g of the leaves powder was soaked in 90 ml of distilled water, shaken for 10 minutes and then allowed to stay at room temperature for 72 hours. The mixture was then filtered using a filtered paper and the filtrate evaporated to dryness on water bath at 60°C. The aqueous extract was kept in air tight bottle in a refrigerator at 4°C until use and served as the stock crude extract.

Preparation of ethanolic Moringa oleifera leaves extract:

The leaves of Moringa oleifera were collected and dried in an airy room for about 3 days of drying , away from direct sunlight to avoid possible damage to their phyto-constituents and ground into powder. 10g of the leaves powder was soaked in 90 ml of ethanol alcohol (80%), shaken for 10 minutes and then allowed to stay at room temperature for 72 hours. The mixture was then filtered using a filtered paper and the filtrate evaporated to dryness on water bath at 60°C. The ethanolic

extract was kept in air tight bottle in a refrigerator at 4°C until use and served as the stock crude extract.

Experimental design and animal groups:
Therity white male albino rats, weighting 197 ± 2 g were used in the study. The rats were divided into 6 groups .Group 1 used as negative control group ,Group 2 used as positive control group, group 3 and group 4 received aqueous *Moringa* leaves extract ,orally, in a dose of 250 and 500 mg/kg B.Wt respectively, and groups 5 and 6 received ethanolic *Moringa* leaves extract, orally, in a dose of 250 and 500 mg/kg B.Wt , respectively.

Blood sampling collections:
At the end of experiment period blood (40 day) samples were collected after 12 hours fasting from the portal vein; the rats were scarified under ether anesthetized. Blood samples were received into clean dry centrifuge tubes and left to clot at room temperature, then centrifuged for 10 minutes at 3000 r.p.m to separate the serum. serum was carefully aspirated and transferred into clean covettee tubes and stored frozen at -20°C for analysis **(Malhotra, 2003)**.

Tissue sample collections:
The liver of each rat was divided into two parts, the first part was homogenized and used for biochemical assay (determination of antioxideant enzymes activities). The second part of liver was washed in saline and immediately fixed into 10% neutral buffered formalin for histipathological examination (**Drury and Wallington, 1980).**

Tissue Homogenate:
The tissue homogenate was prepared from the liver according to **Combes *et al.*,(1987).**

Biochemical parameters
Serum glucose was measured according to **Kaplan (1984).**Serum triglycerides (T.G) were measured according to the method described by **Fossati and Principe, (1982).** Serum cholesterol was measured using the modified kinetic method according to **Richmond, (1973).** Serum high density lipoprotein cholesterol (HDL-c) was measured using the modified kinetic method according to **Allain(1974)** .Serum low density

lipoprotein cholesterol (LDL-c) was calculated as mg/dl according to **Castelli *et al.*, (1977).** Serum very low density lipoprotein cholesterol (VLDL-c) was calculated as mg/dl according to **Lee and Nieman, (1996)**Superoxide dismutase (SOD) enzyme was estimated in liver tissue using spectrophotometer technique according to **Nishikimi et al., (1972).** GSH enzyme was measured in liver tissue using spectrophotometer technique according to **Beutler *et al.*, (1963).** Catalase enzyme (CAT) enzyme was estimated in liver tissue using spectrophotometer technique according to **Aebi (1984).**Malondialdehyde (MDA) was estimated in liver , using spectrophotometer technique according **Ohkawa *et al.*, (1979).** Glutathione-Stransferase activity was determined in liver tissue according to the method of **Habig *et al.*, (1974).**

Histopathological examination:

Specimens from liver was collected directly after scarification of animals at the end of experimental period (40 days), fixed in 10% neutral buffered formalin, dehydrated in ethyl alchohol, cleared in xylene and embedded in paraffin , 4 - 6 thick sections were prepared and stained with hemetoxlin and eosin **(Carleton, 1978).**

Statistical analysis:

The data were statistically analyzed using a computerized costat program by one way ANOVA. The results are presented as mean$\pm$SD differences between treatments at $P \leq 0.05$ were considered significant.

Results And Discution:

1-Effect of *Moringa oleifera* leaves extracts on serum glucose level of diabetic experimental rats

Table (1) illustrate the effect ofMoringa leaves extracts on serum glucose level in rats treated with Alloxan. As shown in this table , the mean value of serum glucose level of positive control group was significantly higher than negative control group , which was 234$\pm$4.58 and 87.33$\pm$4.72 (mg/dl), respectively. Also, the mean values of G3, G4,G5 and G6 indicated a significant decrease in serum glucose (mg/dl) when compared with positive control group . The percent of decrease for all groups 3,4,5 & 6 were – 7.12%, -18.8%, -31.77& -

56.55%,respectively as compared to positive control group. The best result was recorded from group (6)

Table (1) Effect of *Moringa oleifera* leaves extracts on serum glucose level of diabetic experimental rats

Groups / prameters	Control -ve (G1)	Control +ve (G2)	Aqueous Moringa extract 250 mg/kg B.Wt (G3)	Aqueous Moringa extract 500 mg/kg B.Wt (G3)	Ethanolic moringa extract 250 mg/kg B.Wt (G5)	Ethanolic moringa extracT 500 mg/kg B.Wt (G6)	LSD
Glucose (mg/dl) Mean ± SD	87.33^{f}±4.7	234^{a}±4.58	217.33^{b}±6.42	190^{c}±10	159.66^{d}±9.50	101.66^{e}±7.63	13.259
Percent of change (%)	-62.68%	---	-7.12%	-18.8%	-31.77%	-56.55%	

Values with different letters indicate significant differences between the groups ($P \leq 0.05$), and vice versa.

Ndong et al., (2007) reported that*Moringa oleifera* leaf powder contained about 12% (w/w) fibers which can reduce gastric emptying, and may partly explain the greater stomach content, the improved OGTT response in treated GK diabetic rats, as well as the progressive improvement of PPPG levels in treated T2DM patients **(Ghiridhari et al., 2011) . Kumari (2010)** reported that moringa leaves can improve glucose level . **Tende et al., (2011)** showed that *Moringa oleifera* have been shown to have glucose lowering effect only in hyperglycemic i.e.Streptozocin induced diabetic rats and not in hypoglycemia by possibly stimulating the B-cells and or due to its insulin-like activity. **Manohar et al., (2012)** showed a hypoglycemic and antihyperglycemic activity of aqueous extract of *Moringa oleifera* leaves in normal and alloxan induced diabetic rabbits respectively.**Ampa et al.,(2013)** showed that oral administration of *M. oleifera* aqueous leaf extract at doses of 100, 200 and 300 mg/ Kg B.Wt has been found to have anti-hyperglycemic properties by increasing blood glucose tolerance in the normal mice, which was less potent than those of streptozotocin induced mildly diabetic mice..**Ravi and Kumar (2013)** reported that *Moringa*

oleifera leaves have definite hypoglycemic and hypocholesterolemic activity in type 2 diabetes mellitus of obese people .

2- Effect of *Moringa oleifera* leaves extracts on total cholesterol (T.C.), triglyceride (T.G.) and atherogenic index (A.I) of diabetic rats

Table (2) indicate the mean value of T.cholestrol, triglyceride and atherogenic index in serum of diabetic rats. The results recorded that the mean value of T.C. of positive control group was significantly higher than negative control group, which was 145.660 ±2.081 and 83.813±4.278 mg/dl, respectively. The mean value of group (3) showed a significant difference decrease when compared with positive control group. Percent of decrease for group (3) was -9.151% as compared with positive control group. Feeding diabetic rats on aqueous Moringa leaves extract (500 mg /kgB.Wt.) caused a significant decrease in T.C level when compared with positive control group. The mean value of T.C of G5 showed a significant decrease when compared with positive control group. The mean value of group 6 indicated a significant decrease, which was 92.660 ±2.516 mg / dl when compared with positive control group. The percentage of decrease was -36.38 % when compared with positive control group. The best result was recorded for group 6. Concerning triglycerides, the results showed that the mean value of serum triglycerides of group 2 (positive control group) was significantly higher than negative control group. All treatments showed significant decreaseswhen compared with positive control group.The best result was recorded for group (6).As for A.I, the results showed that the A.I of positive control group was significantly higher than negative control group, whichwas 5.706±1.0 and 0.54±0.052, respectively, with percentage of decrease -90.53% as compared with positive control group. Results obtained for group 3 showed a significant decrease when compared with positive control group. The mean value of A.I of group 3 was 3.163+0.55 with percentage of decrease -44.56% when compared with positive control group. Feeding rats on aqueous moringa leaves extract (500mg/kg B.Wt.), showed a significant decrease in A.I which was -59.81% when compared with poitive control group. Groups 5and 6 have the largest effect on lowering A.I .

Table (2): Effect of *Moringa oleifera* leaves extracts on total cholesterol (T.C.), triglycerides (T.G.) of diabetic rats

Groups / Parameters	Control -ve (G1)	Control +ve (G2)	Aqueous Moringa extract 250 mg/kg B.Wt (G3))	Aqueous Moringa extract 500 mg/kg B.Wt (G4))	Ethanolic Moringa extract 250 mg/kg B.Wt (G5))	Ethanolic Moringa extract 500 mg/kg B.Wt (G6))	LSD
TC (mg/dl) Mean ± SD	83.813^{f} ±4.278	145.660^{a} ±2.081	132.333^{b} ±5.131	121.330^{c} ±3.214	102.000^{d} ±3.605	92.660^{e} ±2.516	6.440
Percent of change(%)	-42.45%	--	-9.151%	-16.70%	-29.97%	-36.38%	--
TG (mg/dl) Mean ± SD	65.66^{f} ±3.453	143.33^{a} ±4.163	132.33^{b} ±3.055	117.66^{c} ±2.51	102.00^{d} ±3.605	77.00^{e} ±2.645	5.851
Percent of change(%)	- 54.189%	--	-7.67%	-17.90%	-28.83%	-46.27%	--
Atherogenic Index (AI) (mg/dl) Mean ± SD	0.540^{c} ±0.052	5.706^{a} ±1.0	3.163^{b} ±0.553	2.293^{b} ±0.353	1.333^{c} ±0.290	0.820^{c} ±0.141	0.90
Percent of change(%)	-90.53%	--	-44.56%	-59.81%	-76.638%	-85.63%	--

Values with different letters indicate significant differences between the groups ($P \leq 0.05$)***, and vice versa.***

Effect of *Moringa oleifera* leaves extracts on high density lipoprotein (HDL), low density lipoprotein (LDL) and very low density lipoprotein (VLDL) of diabetic rat

Table (3) illustrate the mean values of HDL, LDL and VLDL in diabetic rats. The results indicated that the mean value of HDL for positive control group was significantly lower than negative control group. The mean values of HDL for groups 3, 4, 5 and 6 were higher than positive control group, which was 32± 3, 37±3, 41.33±2.309, and 51±3.605mg/dl, respectively, with percentage of increase +45.45, +68.18%, +87.86% and +131.81%, respectively..

Data showed a significant difference between all treatments and positive control group .The best result was recorded for group (6) showing nonsignificant difference between it and negative control group.As for LDLc, the results showed that the mean value for positive control group was significantly higher than negative control group. The obtained results obtained for group 3 showed a significant difference when compared to positive control group. The mean value of group 4 was lower than positive control group, whichwas 60.8±5.63 mg/dl with percentage of decrease -36% and showed a significant difference when compared with positive control group. Feeding rats on ethanolic Moringa leaves extract(250 mg/kg B.Wt.) showed a significant decrease in LDLc, the percentage of decrease was -57.614% . It could be noticed that the mean value of group 6 was lower than positive control group, it was 26.26±5.158 mg/dl with percentage of decrease -72.35% and showed a significant difference when compared with positive control group. The best result was recorded from group (6).Concerning VLDlc, the results indicated that the mean value of positive control group was significantly higher than negative control group, which was 28.66±0.832 and 13.13±0.690 mg/dl with percentage of decrease -54.18 % when compared with positive control group , respectively . The mean value of group (3) showed a significant difference when compared with positive control. Data showed that the mean value of group (4)was 23.53+0.503mg/dl, with percentage of decrease -17.906% when compared with positive control group. Feeding rats on ethanolic leaves extract (250 mg/kg B.Wt.) indicated a decrease in VLDL .The percentage of decrease was -28.83 % when compared to positive control group. There were significant differences between positive control group and groups 4, 5 and 6. The best result was recorded from group 6 (Ethanolic Moringa extract500 mg/kg B.Wt).

Table (3): Effect of moringa leaves extracts on HDL, LDL and VLDL of diabetic rats

Groups / Parameters	Control -ve (G1)	Control +ve (G2)	Aqueous Moringa extract 250 mg/kg B.Wt (G3)	Aqueous Moringa extract500 mg/kg B.Wt (G4)	Ethanolic Moringa extract 250 mg/kg B.Wt (G5)	Ethanolic Moringa extract500 mg/kg B.Wt (G6)	LSD
HDL (mg/dl) Mean ± SD	54.33^{a} ±4.041	22.00^{d} ±3.0	32.00^{c}±3.0	37.00^{bc} ±3.0	41.33^{b}±2.309	51.00^{a}±3.605	5.703
Percent of change (%)	+146.95%	--	+45.45%	+68.18%	+87.86%	+131.81%	--
LDL (mg/dl) Mean ± SD	16.34^{f} ±0.714	95.00^{a} ±5.211	73.86^{b} ±8.693	60.80^{c} ±5.632	40.26^{d}±4.50	26.26^{e}±5.158	9.793
Percent of change(%)	-82.79%	--	-22.24%	-36%	-57.614%	-72.35%	--
VLDL(mg/dl) Mean ± SD	13.13^{f} ±0.690	28.66^{a} ±0.832	26.46^{b} ±0.611	23.53^{c} ±0.503	20.40^{d}±0.721	15.40^{e}±0.529	1.170
Percent of change(%)	-54.18%	--	-7.6%	-17.906%	-28.83%	-46.27%	--

Values with different letters indicate significant differences between the groups (P≤0.05), and vice versa.

These results may indicate that administration of Moringa extracts at different doses canimprove the lipid profile of diabetic rats in a dose dependent manner.The obtained results are in agreement with those reported by**Chumark *et al.*, (2008)** who investigated the hypolipidaemic and antiatherosclerotic activities of *Moringa* leaf extract. They found that in hypercholesterol diet fed rabbits, at 12 weeks of treatment, the water extract of the plant significantly lowered the cholesterol levels and reduced the atherosclerotic plaque formation to about 50% and 86%, respectively. **Cho et al., (2010)** reported that chlorogenic acid which is a major phenolic acid in *M. oleifera* leaves has reduced plasma TC and TG in obese rats. **Kumari (2010)** reported that

Moringa oleifera leaves contain phytosterols such as sitosterol. These compounds can reduce intestinal uptake of dietary cholesterol .They could partly account for the decrease of plasma cholesterol and the increase of fecal cholesterol observed in rodents treated with *M. oleifera* leaves .These results are supported by the results published by **Dubey et al., (2013)** who mentioned that the crude extract of *Moringa* leaves has a significant cholesterol lowering actionin the serum of high fat diet fed rats which might be attributed to the presence of a bioactive phyto-constituents.**Ravi and Kumar (2013)** reported that *Moringa oleifera* leaves were found to lower the serum cholesterol, phospholipid, triglyceride, VLDL, LDL, cholesterol to phospholipid ratio and atherogenic index, but were found to increase the HDL ratio as compared to the corresponding control groups.

Effect of moringa leaves extracts on oxidant and antioxidant parameters in liver Tissue of diabetic rats

The effect of *Moringa* leaves extracts on liver MDA, SOD, GSH, GST and CAT enzymes are recorded in tables (4 -5). As for MDA, the results indicated that the mean value of positive control group was significantly higher than that of negative control group (healthy rats), whichwere 91±4 nmoi/g tissue and 50.66±3.055 nmoi/g tissue with persent of decrease – 44.32% , respectively . The mean values of groups 4, 5and 6 showed a significant decreases when compared with positive control group, which were 80±2.645, 66±5.567, and 55.33±3.785 nmoi/g tissue, respectively. The percentage of decrease were – 12.08%, -27.47% and -39.19% for groups 4, 5and 6, respectively when compared with positive control group. The mean value of G3 showed nonsignificant difference as compared with positive control group. The best result was recorded for group (6).Concerning SOD, the data revealed that the mean value of positive control group was significantly lower than the mean value of negative control group, whichwere 2.033±0.251 and 8.533±0.450 (u/mg tissue) , with percentage of increase +319.27%. The mean value of group 4, 5 and 6 indicated significant differences , when compared with positive control group. The percentage of increase was +68.86%, +162.17% and 268.91% for groups 4, 5 and 6, respectively as compared with positive control group. Rats fed on aqueous *Moringa* leaves extract (250mg/kg B.Wt) (G3) showed nonsignificant difference for SOD activity as compared with positive

control group. The best result was recorded for group (6). As regards to GSH, the data indicated that the mean value of positive control group was significantly lower than negative control rats , whichwere 60.533±2.458 and 96.13±2.87 (mg/g tissue), respectively with the percentage of increase +58.81%. Also, it could be noticed that the mean values of groups 3,4, 5 and 6 showed significant difference as compared with positive control group. Rats fed on ethanolic moringa leaves extracts (500mg/kg B.Wt.) (G6) showed non significant difference as compared with negative control group and recorded as the best treatment. As for CAT, the results indicated that the mean value of positive control group was significantly lower than negative control group (healthy rats), whichwere4.13±0.321 and 19.33+2.51 (u/g tissue) with percent of increase +367.77%. The mean values of groups 3,4, 5 and 6 showed significant difference when compared with positive control group as compared with positive control group . The best result was recorded for group (6).

Concerning GST, the data revealed that the mean value of positive control group was significantly lower than negative control group , which were 14.66±3.05 and 31±2 (u/g tissue) , with percentage of increase +111.37%. The mean values of group 3,4, 5 and 6 were higer than positive control group which were 18±2, 21±2.64, 25±2 and 28±2 (u/g tissue), respectively. The percent of increase for groups 3, 4, 5 and 6 was +22.73%, +43.18%, +70.46% and +90.91%, respectively when compared with positive control group. These results mayindicate that *Moringa* leaves extracts has a strong antioxidant and free radical scavenging effect. This finding suggests that *Moringa* leaves extracts may improve the disturbed metabolism associated with diabetes. Asimilar observation was reported by **Lalas and Tsaknis , (2002)** who showed during their study, reporting antioxidant property of freeze dried Moringa leaves from different extraction procedures, that methanol and ethanol extracts of Indian origin MO have the highest antioxidant activity with 65.1 and 66.8%, respectively .

Bharali *et al.*,(2003) investigated the antioxidants effects of hydro-alcoholic extract of *Moringa oleifera* at doses of 125 mg/kg body weight and 250 mg/ kg body weight for 7 and 14 days, respectively. **Kumar & Pari(2003)** investigated antioxidant potential of *Moringa*

oleifera on hepatic marker enzymes, lipid peroxidation, and antioxidants. The antioxidant property was investigated during antitubercular drug (isoniazid, rifampicin, and pyrazinamide)-induced toxicity in rats. Enhanced hepatic marker enzymes and lipid peroxidation of antitubercular drug treatment was accompanied by a significant decrease in the levels of vitamin C, reduced glutathione, superoxide dismutase, catalase, glutathione peroxidase, and glutathione S-transferase. Administration of Moringa oleifera extract and silymarin significantly decreased hepatic marker enzymes and lipid peroxidation with a simultaneous increase in the level of antioxidants. These results are supported by the results published by **Siddhuraju & Becker(2003)** whoreported the antioxidant and radical scavenging property from water, aqueous methanol, and aqueous ethanol extracts of freeze-dried leaves of *Moringa oleifera*.. **Bajpai *et al.*, (2005)** reported antioxidant activity from the leaves of *Moringa oleifera*. The antioxidant property was found due to presence of kaempferol. **Sreelatha & Padma (2009)** evaluated antioxidant effects of *Moringa oleifera* leaf extracts. **Singh *et al.*,(2009)** reported also the antioxidant potential of aqueous extracts of leaf, fruit and seed of *Moringa oleifera*. **Verma *et al.*,(2009)** tested in vitro and in vivo antioxidant properties of different fractions of leaves of *Moringa oleifera* using different in vitro systems, such as beta-carotene bleaching, reducing power, DPPH/superoxide/hydroxyl radical scavenging, ferrous ion chelation and lipid peroxidation. On the basis of in vitro antioxidant properties polyphenolic fraction of *M. oleifera* leaves was chosen as the potent fraction and used for the DNA nicking and in vivo antioxidant properties.

Table (4) : Effect of *Moringa oleifera*leaves extracts on oxidant and antioxidant parameters (MDA, SOD and GSH) in liver tissue *of diabetic rats*

Groups / Parameters	Control -ve (G1)	Control +ve (G2)	Aqueous moringa extract 250mg/kg B.Wt. (G3)	Aqueous moringa extract 250mg/kg B.Wt. (G4)	Ethanolic moringa extract 250mg/kg B.Wt. (G5)	Ethanolic moringa extract 500mg/kg B.Wt. (G6)	LSD
MDA (nmoi/gtissue) Mean ± SD	50.66^{d} ±3.055	91.00^{a} ±4	89.00^{a}±4	80.00^{b}±2.64	66.00^{c}±5.567	55.33^{d}±3.785	7.028
Percent of change(%)	-44.32 %	--	-2.19%	-12.08%	-27.47%	-39.19%	--
SOD (U/mg tissue) Mean ± SD	8.533^{a} ±0.450	2.033^{e} ±0.251	2.133^{e}± 0.351	3.433^{d}±0.351	5.333^{c}±0.376	7.500^{b}±0.4	0.656
Percent of change(%)	+319.72%	--	+4.91%	+68.86%	+162.17%	+268.91%	--
GSH (mg/g tissue) Mean ± SD	96.133^{a} ±2.874	60.533^{e}±2.458	70.066^{d}±3.256	76.200^{c}±4.1	84.330^{b}±4.329	91.660^{a}±3.055	6.067
Percent of change(%)	+58.81 %	--	+15.74%	+25.88%	+39.321%	+51.431%	--

Values with different letters indicate significant differences between the groups* (P≤0.05), *and vice versa.

Table (5): Effect of Moringa leaves extracts on antioxidant parameters (GAT and GST) in liver tissue of diabetic rats

Groups / Parameters	Control -ve (G1)	Control +ve (G2)	Aqueous moringa extract 250mg/kg B.Wt. (G3)	Aqueous moringa extract 500mg/kg B.Wt. (G4)	Ethanolic moringa extract 250mg/kg B.Wt. (G5)	Ethanolic moringa extract 500mg/kg B.Wt. (G6)	LSD
CAT (U/g tissue) Mean ± SD	19.33^{a} ±2.516	4.13^{e} ±0.321	8.33^{d}±1.527	12.00^{cd}±2	14.66^{bc}±3.055	17.00^{ab}±2	3.710
Percent of change(%)	+367.77%	--	+113.71%	+190.34%	+254.70%	+311.32%	--
GST (U/g tissue) Mean ± SD	31.00^{a}±2	14.66^{e} ±3.055	18.00^{de}±2	21.00^{cd}±2.645	25.00^{bc}±2	28.00^{ab}±2	4.129
Percent of change(%)	+111.37%	--	+22.73%	+ 43.18%	+70.46%	+ 90.91%	--

Values with different letters indicate asignificant differences between the groups (P≤0.05), and vice versa.

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التأثيرات العلاجية المحتملة لمستخلصات المورينجا على الفئران المصابة بالبول السكرى

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المستخلص العربى :

تم اجراء هذه الدراسة لمعرفة تأثير مستخلصات أوراق المورينجا على الفئران المصابة بالسكرى والمحقونة بالالوكسان ، وقد تم استخدام ٣٠ فأر بالغ تتراوح أوزانهم من ١٩٧±٢ جرام وتم تقسيمهم الى ٦ مجاميع . وقد اعتبرت المجموعة الاولى والثانية كمجاميع ضابطة سالبة وموجبة على التوالى أما المجاميع ثلاثة واربعة فقد تم اعطاؤهم المستخلص المائى لأوراق المورينجا بتركيز ٢٥٠ و٥٠٠ ملجم لكل كجم من وزن الفأرعن طريق الفم . وقد تم اعطاء المجموعة الخامسة والسادسة المستخلص الكحولى لأوراق المورينجا بتركيز ٢٥٠ و٥٠٠ ملجم لكل كجم من وزن الفأر عن طريق الفم . وتم قياسمستوى الجلوكوز الكلى – الجليسريدات الثلاثية – الليبوبروتينات و دليل الاكسدة (المالونالدهيد) والانزيمات المضادة للأكسدة للفئران المصابه بالسكرى وأوضحت النتائج أن استخدام مستخلصات أوراق المورينجا أدت الى زياده معنويه فى بعض التحاليل مثلاالليبوبروتين مرتفع الكثافة – الانزيمات المضادة للاكسدة ولكن مع انخفاض معنوى فى باقى التحاليل المشار اليها مسبقا وذلك بالمقارنة بالمجموعة الضابطة الموجبة وكانت الخلاصة أن المستخلصات المائية والكحوليه لأوراق المورينجا لها القدرة على تحسين مستوى السكر فى الدم فى الفئران .

الكلمات المفتاحية : البول السكرى- المستخلص المائى لأوراق المورينجا -المستخلص الكحولى لأوراق المورينجا