Effect of Cloves (Syzygium Aromaticum) on Serum Biomarkers of Some Common Complications and Oxidative Stress on Alloxan-Induced Diabetic Rats

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Effect of Cloves (Syzygium Aromaticum) on Serum Biomarkers of Some Common Complications and Oxidative Stress on Alloxan-Induced Diabetic Rats

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Abstract:

Objectives: This research aimed to find out the potential effect of cloves *(Syzygium aromaticum)* on hyperglycemia, hyperlipidemia, hepato-renal disorders and oxidative stress as the known complications related to diabetes. **Materials and Methods:** forty male rats were divided into 5 groups (n=8), including the healthy control group (NC) and four diabetic groups. Alloxan- monohydrate (BDH) was used for prompting diabetes (100mg/kg b.w.). Rats with diabetes were put into a control group (DC), diabetic treated with clove oil (200mg\kg) (G3), clove extract (200mg\kg) (G4) and clove powder (20g\kg) (G5). After 4 weeks of the treatment, the blood samples were taken for measuring the fasting blood glucose, insulin, lipid profiles, liver and kidney functions and some antioxidant/oxidative stress markers. **Results:** The therapeutic groups (clove oil, extract and powder) statistics had low levels of fasting blood sugar, total cholesterol, LDL-c, VLDL-c, triglycerides, AST, ALT, urea, uric acid, creatinine, bilirubin and MDA in comparison with the DC group. Contrarily, serum insulin levels, HDL-c, SOD and GSH actually were higher in the clove oil, extract and powder groups compared to the DC group. **Conclusion:** it could be concluded that the clove oil or extract or powder proved antioxidant qualities and has potential as a functional food ingredient to protect against the complications caused by diabetes.

Keywords: Cloves, Diabetes, Lipid profile, Antioxidant status, Liver and kidney functions.

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INTRODUCTION

Diabetes mellitus (DM) , is a systemic metabolic disease, distinguished by hyperglycemia, vascular troubles and neuropathic complications **(Inzucchi and Sherwin, 2011)**. International Diabetes Federation **(IDF)** (2021) stated that 10.50% people all over the world suffer from diabetes and this number is predicted to be reach 11.30% by 2030 and 12.20% by 2045,(**Sun *et al*. , 2022**) . The chief reasons for hyperglycemia and hyperlipidemia which expose diabetic patients to risk for further cardiovascular diseases **(Rajasekaran *et al.*, 2005** and **Mokashi *et al.*, 2017)**, and some other complicated problems **(Sheetz and King, 2002)**. Chronic hyperglycemia can result in extended and irrecoverable harm to the eyes, nerves, kidneys, heart, and blood vessels, and other organs of the body **(Mohamed *et al.*, 2016)**.

Nowadays, the approved cure for diabetes are lifestyle actions for example exercise, weight control, diet therapy **(Kempf *et al.*, 2008** and **Yeh *et al.*, 2016)** and the use of some natural herbs for diabetes management **(Manukumar *et al.*, 2017)**. As some of these plants may contain insulin-like materials in glucose utilization **(Gray and Flatt, 1999** and **Gruenwald *et al.*, 2010)** or activate the regeneration of pancreatic beta cells **(Singh *et al.*, 2001** and **Adewole and Ojewole, 2007)**. One of these plants is the cloves (*Syzygium aromaticum)* a fragrant sprout plant that is a member of the Myrtaceae family **(Bisset, 1994),** is originated in Asia **(Cortés-Rojas *et al.*, 2014).** Commercially, it is used widely in applications in food, pharmaceutical, tobacco, cosmetic and agricultural production (**Nurdjannah and Bermawie, 2012; Cortés-Rojas *et al.*, 2014** and **El-Saber Batha *et al.*, 2020**). It is **plentiful** in some phytochemicals like sesquiterpenes, monoterpenes, hydrocarbon, and phenolic combinations **(El-Saber *et al.*, 2020)**. Traditionally, *S. aromaticum* has several therapeutic values in curing vomiting, nausea, cough, dyspepsia, flatulence, liver, and bowel and stomach **troubles**. **Moreover**, it helps relief in pain, dental care and stimulant for nerves **(Phyllis and James, 2000; Elujoba *et al.*, 2005; Sulieman *et al.*, 2007** and **Tanko *et al.*, 2008)**. More recently, **Pourlak *et al.* (2020)** and **Abtahi-Eivari *et al.* (2021)** demonstrated that cloves extract

may urge renal and hepatoprotective activities in diabetic rats, enhances glycemic control and lipid profile. *S. aromaticum* is well-known for having anti-mutagenic **(Miyazawa and Hisama, 2003),** antioxidant **(Chaieb *et al.*, 2007** and **Astuti *et al.*, 2019)**, anti-carcinogenic **(Miyazawa and Hisama, 2001)**, antibacterial **(Oshomoh *et al.*, 2015** and **Bharadwaj, 2020)**, antiviral **(Saeed and Tariq, 2015),** antifungal **(Park *et al.*, 2007)** and antiparasitic activities **(Yang *et al.*, 2005)**. Moreover, it can be used as, anti-inflammatory **(Kim *et al.*, 1998)**, anti-ulcerogenic **(Li *et al.*, 2005)** and antithrombotic **(Srivastava and Malhotra, 1991).** These biological activities of *S. aromaticum* L. may be due to its high content of phenolic compounds (**Golmakani *et al.*, 2017; Hatami *et al.*, 2019; Tunç and Koca, 2019** and **El-Saber Batiha *et al.*, 2020). Shukri *et al.*, (2010),** reported that clove treatment reduced blood sugar increases and lipid peroxidation in diabetic rats.

This research to assess the impacts of cloves *(S. aromaticum)*, oil, extract and powder on fasting blood glucose, insulin, lipid profile, liver and kidney functions and some antioxidant/oxidative stress indicators of diabetic rats.

MATERIALS AND METHODS

Materials:

- Clove*(Syzygium aromaticum)* powder and oil were bought from the community market in Cairo City, Egypt.
- Casein, minerals, vitamins mixture and L-arginine were purchased from El- Gomhoria Company.
- Alloxan, it was pure chemical fine product (DBH) were purchased from SIGMA Chemical Co., (USA), and was used for induction of diabetes among rats.
- Adult Sprague Dawley albino male rats were brought from The Animal Colony, Food Technology Research Institute, Agriculture Research Center, Giza, Egypt.

Methods:

Preparation of clove aqueous extract:

Twenty five grams of clove powder were extracted with 500 ml boiled distilled water for 5 min ,cooled for 30 min and filtrated twice .the extract was kept in the fridge . Rat dose of aqueous extract was (200 ml / kg /b.w. day) and was given orally by stomach tube according to the method of **(Tahereh *et al.*, 2014)**

Biological evaluation

Forty adult male white rats weighing (69-74g) were used in this study. The whole rats were kept under standardized conditions (12h light/ dark cycle, 22°C) and were given free access to the standard diet and water according to **NRC (1995)**.

Composition of the standard diet.

Ingredients	g/kg diet
Casein	200
Corn starch	497
Sucrose	100
Vitamin mixture	020
Mineral mixture	100
Corn oil	050
Cellulose	030
Methionine	003

Induction of Diabetes:

Rats were injected with alloxan- monohydrate (BDH) (100mg/kg b.w.) dissolved in normal salt water. Seven days after alloxan administration, blood was taken from the rat eye by means of Haematocrit tubes in EDTA tubes. Plasma was separated by centrifugation and analyzed for blood glucose. Animals with fasting blood glucose higher than 300mg/dl were chosen and used as diabetic rats.

After 4 weeks, the animals were prevented from food overnight and sacrificed by decapitation. Blood was taken in two different tubes, one with

anticoagulant (potassium oxalate and sodium fluoride) for plasma and another without anticoagulant for serum separation. Plasma and serum were separated by centrifugation.

After the adaptation period, rats were put into 5 groups (8 rats each) as follows:

- **Group (1):** Fed on basal diet *(Negative control).*
- **Group (2):** Fed on basal diet and injected with alloxan- monohydrate (BDH) (100mg/kg bw) (Diabetic control).
- **Groups (3):** Diabetic rats fed on basal diet that contained clove oil (200mg\kg).
- **Groups (4):** Diabetic rats fed on a diet with clove extract (200mg/kg).
- **Groups (5):** Diabetic rats fed on a diet with clove powder (20g/kg).

The rats' body weight was measured three times every week for four weeks. Daily changes in body weights were recorded in percentage**.** Daily changes percentage in body weights was calculated in accordance with the following formula:

Change in body weights (%) = 100 X (Final weight -Initial weight) / Initial weight

Feed efficiency ratio (FER) was calculated at the end of the experiment as follows: FER= Body weight gain (gm) / Food intake (gm) according to **(Chapman *et al*., 1950).**

Biochemical Analysis:

Fasting blood glucose was evaluated by the enzymatic colorimetric method **(Siest *et al.*, 1981).**

Plasma insulin level was tested by Enzymatic Linked Immunosorbent Assay (ELISA) Kit as described by **Nakagawa *et al.*, (1973)**.

Total cholesterol, HDL-cholesterol and triglyceride content were **set** by the enzymatic colorimetric method according to **Allian *et al.*, (1974); Richmond (1973)** and **Fassati and Principle (1982)**, respectively.

LDL-cholesterol and VLDL-cholesterol were calculated by the Friedewald Formula according to **Friedewald (1972).**

Bilirubin, Plasma alanine and aspartate aminotransferase enzymes activities (ALT and AST) were also determined according to the method of **Reitman and Frankel (1957).**

Plasma total protein was decided by an enzymatic method according to **Henry (1964)**.

Plasma uric acid was evaluated by an enzymatic method according to **Trinder (1969).**

Plasma creatinine was determined according to **Henry (1974).**

Determination of some antioxidant parameters

Superoxide dismutase (SOD) activity according to **(Dechatelet *et al.*, 1974)**. Determination of malondialdehyde (MDA) in red blood cells RBCs by the method described by **Stocks and Donnandy (1971).** Glutathione (GSH) according to **Beutler (1984).**

Statistical analysis:

All data were exposed to one–way analysis of difference (ANOVA) and regarded as mean ± SD and the normality of data was performed by the Kolmogorov-Smirnov test. The comparisons among different groups were performed using Tukey post hoc **(Snedecor and Cochran, 1967).**

RESULTS AND DISCUSSIONS

Effect of the clove oil, extract and powder on nutritional parameters:

Data from Table (1) showed that all groups had similar initial body weights and all of them gave positive body weight gain (BWG) at the end of the experiment. Meanwhile, the injection of BDH to rats significantly decreased BWG%, daily food intake and food efficiency ratio (FER) compared to the NC group. It was noticed that four weeks of feeding the clove oil, extract and powder at 200mg\kg, 200mg\kg and 20g\kg, respectively result in a marked improvement in all these nutritional parameters. The treated rats with clove oil were the best mitigating ability against BDH toxicity.

These results keep up with **Kota *et al.*, (2012) and Narasimhulu *et al.*, (2014)** who stated that hunger and the weight loss of the body in rats with diabetes because of the body's incapacity to keep or use glucose and due to protein losing as a consequence of carbohydrate inexistence **(Al-Attar, 2010)**. The reduction in BWG of diabetes, the increment of food and water intake and urine volume may be due to β- cells damage and insulin secretion disorder **(Kang *et al.*, 2006)**. However, **Al- Attar and Zari, (2007)** stated that clove oil produced a notable increment in the body weight in comparison with the DC group, which may be because of the insulin-like action of clove. In addition, eugenol supplementation exhibited significant glycemic control improvement by preventing body weight loss and increasing food and fluid intake in rats which suffer from diabetes. **Chaudhry *et al.*, (2013)** and **Srinivasan *et al.*, (2014).** Also, **Rabeh *et al.*, (2021)** found that treating rats with clove extract led to a notable raise in body weight gain and feed efficiency ratio in comparison with the DC group.

Table (1): Effect of the clove oil, extract and powder on nutritional parameters

Groups	Initial weight(g)	Final weight(g)	weight gain(g)	weight gain %	Daily food intake	feed efficiency ratio %
G1:Negative Control (NC)	70.3±2.7	149.40±20.7	79.1.0±8.27	112.53±10.3	13.66±3.63	0.08±0.02 ***
G2: Diabetic control (DC)	72.1±3.49	103.94±15.3	31.8±5.32*	44.14	10.28±2.97	0.03±0.01
G3: Clove oil (200mg\kg)	71.5±2.9	135.8±18.2	64.3±7.2***	89.9	12.0±3.6	0.07±0.01***
G4:Clove extract (200mg \kg)	71.8±2.7	131.7±21.7	59.99±7.31*	83.55	12.0±4.1	0.07±0.02***
G5: Clove powder(20g\kg)	69.9±3.5	132.7±19.7	62.8±6.1**	89.8	11.55±2.3	0.08±0.01***

Effect of the clove oil, extract and powder on the insulin and fasting blood glucose levels:

Compared with the NC group, the mean fasting blood glucose had a significantly higher level in the DC group, as it was increased more than 3-fold (Table 2), which indicates hyperglycemia. However, after 4 weeks of clove (oil, extract and powder) treatment, the blood glucose levels were extremely lower in comparison with the DC group. Moreover, the serum insulin level decreased in the DC group significantly compared to the NC group. It could be noticed that there was no considerable difference between the clove-treated groups (G3, G4 and G5) on the serum insulin levels and they had lower serum insulin levels compared to the NC group although they were still significantly higher than the DC group, suggesting that the clove (either oil or extract or powder) is effective for the diabetes amelioration.

These results are consistent with **Hamza and El shahat (2011)** who indicated that alloxan administration elevated glucose levels and decreased insulin levels in rats, however, raw or irradiated clove extract improved these alterations towards the normal levels. **Kuroda *et al.*, (2012)** demonstrated that clove extract significantly diminished the increase of blood glucose levels in type 2 diabetic KK-Ay mice. Also, (**Pourlak *et al.*, 2020)** and(**Rabeh *et al.*, 2021)** showed that the fasting blood sugar of rats treated with cloves extract significantly decreased whereas insulin levels increased compared to the DC group where the cloves extract can lead to the remnants of beta cells secreted insulin or regenerate beta cells. In addition, **Abd El-Rahman (2015)** and (**Abtahi-Eivari *et al.*, 2021)** revealed that clove can control glycemic by decreasing the serum glucose level and increasing the serum insulin. (**Prasad *et al.*, 2005)** showed that clove may suppress the "Phosphoenolpyruvate carboxykinase" and "Glucose 6-phosphatase" genes expression, which plays an enzymatic role in gluconeogenesis. These were in line with **Tu *et al.*,(2014)** hypothesis that clove extract has the ability to enhance muscle glycolysis and mitochondrial function via phosphorylating AMP-activated protein kinase and controlling sirtuin 1, which regulates genes involved in metabolic pathways. **Adefegha**

***et al.*,(2014)** assured that the clove hypoglycemic impacts may be explained by a reduction in intestinal alpha-glucosidase activity, which causes greater blood glucose levels in diabetic rats. As a result, clove exerts actions similar to those of insulin, can lower glucose absorption, and can minimize the need for insulin. Additionally, S. aromaticum's ability to reduce blood sugar may activate beta cells, which would enhance the production of the hormone insulin **(Chaudhry *et al*., 2013).** Moreover, some phenolic chemicals, such eugenol and eugenyl acetate, may be the cause of this hypoglycemic impact **(Shukri *et al*., 2010).** While eugenol may inhibit the body from producing glucose when glucagon is present by lowering the activity of the enzyme glycogen phosphorylase **(Sanae *et al*., 2014).**

Table (2): Effect of the clove oil, extract and powder on the insulin and fasting blood glucose levels.

Groups	Insulin(u\ l)	Fasting blood glucose (mg/dl)
G1:Negative Control (NC)	12.6 ±1.85	113.40±15.8
G2: Diabetic control (DC)	4.8±0.99	329.4±63.50
G3: Clove oil (200mg\kg)	9.01±1.2**	228.14±35.7*
G4:Clove extract (200mg \kg)	9.4±1.8**	299.2±67.3***
G5: Clove powder(20g\kg)	9.51±1.1**	209.4±42.96**

Effect of the clove oil, extract and powder on lipid profiles

Table (3) showed the variation in serum lipid profiles in all the treatment groups. It could be observed that the DC group represented remarkable increases in serum total cholesterol (TC), triglyceride (TG), LDL-c and VLDL-c as in comparison with the NC group. On the contrary**,** the DC group proved significant decreases in serum HDL-c as in comparison with NC and all treated groups with clove. The increment in serum TC, TG, LDL-c and VLDL-c were ameliorated in all groups that had the clove (oil, powder and extract). However, G 4 of treated rats with clove extract (200mg\kg) showed the lowest effect in the lipid improvement

compared to the NC group. From these data, it is clear that the clove powder (20mg\kg) had the greatest effect in the decrement of TC, TG, LDL-c and VLDL-c and the increment of HDL-c as compared with the DC group and in some parameters it had no significant changes as compared with the NC group.

One of the frequent side effects of diabetes is hyperlipidemia, which is characterised by an increase in serum levels of total cholesterol, TG, and LDL-c and a decrease in HDL-c**. (Yasuda *et al.*, 2017** and **Abtahi-Eivari *et al.*, 2021)**, these may be due to the reduction of insulin level or insulin resistance **(Fayad and Schentag, 2017)**, which resulting in a decrease of the lipoprotein lipase activity, the key enzyme of lipoproteins hydrolysis including TG **(Taskinen and Nikkilä, 1979)**. Alloxan administration increased blood total cholesterol, TG, LDL and VLDL levels and lowered HDL levels, according to **(Hamza and Elshahat 2011).** However, raw or irradiated clove extract improver these changes to their normal values. **Abd El-Rahman (2015)** found that cloves powder reduced the serum total cholesterol, triglycerides, LDL-c and VLDL-c levels however increased the HDL-c level significantly compared to the DC group.

By regulating lipid metabolism, **Pourlak *et al.*, (2020)** and **Rabeh *et al.*, (2021)** demonstrated that cloves extract significantly decreased plasma cholesterol, triglycerides, and LDL levels while increasing HDL levels in co mparison to the DC group. Also, *S. aromaticum* reduced the MDA level therefore can prevent lipid peroxidation **(Yadav and Bhatnagar, 2007** and **Adefegha *et al.*, 2014)**, because of the capability of *S. aromaticum* to restore beta cell activities and increase serum insulin levels subsequently, improving the lipoprotein lipase activity, which may increase the serum HDL level whereas reducing the TG, LDL, and TC levels of diabetes.

Table (3): Effect of the clove oil, extract and powder on lipid profiles

Groups	T.C. (mg/dl)	TG (mg/dl)	HDL-c (mg/dl)	LDL-c (mg/dl)	VLDL-c (mg/dl)	T.C /HDLc	LDL/ HDLc
G1:Negative Control (NC)	77.0 ±9.08	90.6 ±9.8	38.0 ±1.5	23.6 ±5.7	18.12±1.7	2.02	0.62
G2: Diabetic control (DC)	110.0 ±9.82	175.6 ±13.76	23.0 ±4.69	40.8 ±17.97	35.12±2.8	4.78	1.77
G3: Clove oil (200mg\kg)	76.80 ±5.63**	100.6 ±8.2**	33.3 ±2.1**	28.20 ±4.81**	20.12± 1.6 **	0.76	0.84
G4:Clove extract (200mg \kg)	83.8 ±5.9***	120.0 ±11.2***	29.8 ±3.7*	33.6 ±9.6***	24.0±2.1 ***	2.81	1.12
G5: Clove powder(20g\kg)	68.4 ±14.7*	94.3 ±7.1**	34.0 ±2.34**	26.7 ±5.9**	18.86±1.3**	2.01	0.78

Cholesterol (TC), triglyceride (TG), Low density lipoprotein (LDL-c), Very low density lipoprotein (VLDL-c), High density lipoprotein (HDL-c).

Effect of the clove oil, extract and powder on the liver and renal functions:

It can be seen that the BDH administration led to a significant increase in some indicators of liver damage (serum aspartate transaminase (AST) and alanine transaminase activities (ALT)) in comparison with the NC group. Also, a significant increase in serum urea, creatinine, uric acid and bilirubin levels had been shown in BDH -treated rats. Meanwhile, treatment with clove either oil or powder or extract nearly restored the levels of these parameters towered the NC group level (Table 4). It could be noticed that clove powder fulfilled this role with slightly more competence than clove oil and extract.

These results are parallel to **Hamza and Elshahat (2011)** who indicated that alloxan administration elevated serum AST, ALT, ALP, urea and creatinine levels in rats, however, raw or irradiated clove extract improved these alterations towards the normal levels. Which indicated that

the oxidative stress associated with diabetes may result in liver and renal functions impairment and damage **(Forbes *et al.* 2008 and Pourlak *et al.*, 2020)**. **Abd El-Rahman (2015); Pourlak *et al.* (2020)** and **Rabeh *et al.* (2021)** revealed that the treatment with *S. aromaticum* significantly extract decrease the AST and ALT levels compared to the DC group**.** According to **Sharma *et al.*, (2006),** diabetes can elevate serum urea and creatinine levels.. On the contrary, **Rabeh *et al.*, (2021)** and **Abtahi-Eivari *et al.* (2021)** found that therapy with S. aromaticum can prevent oxidative damage to renal tissue and lower serum urea and creatinine levels in diabetic rats; these effects may be caused by the herb's potent antioxidant qualities (**Abtahi-Eivari *et al.*, 2017)**.Moreover, **Bakour *et al.*, (2018)** reported that *S. aromaticum* can decrease kidney and liver damage caused by hydrogen peroxide. Also, **Adam *et al.* , (2013)** found that *S. aromaticum* lowered the serum urea level.

Table (4): Effect of the clove oil, extract and powder on the liver and renal functions:

Groups	ALT	AST	Urea	Creatinine	Uric Acid	Bilirubin
G1:Negative Control (NC)	12.6 ±5.85	28.40 ±4.8	12.2 ±2.9	0.8 ±0.10	2.8 ±0.38	0.45 ±0.03
G2: Diabetic control (DC)	30.8 ±4.29	45.4 ±3.50	29.70 ±3.2	2.64 ±0.15	4.04 ±0.58	1.0 ±0.03
G3: Clove oil (200mg\kg)	26.2 ±7.2***	29.4 ±2.96*	24.2 ±3.32*	1.86 ±0.43**	2.8 ±0.5**	0.55 ±0.09**
G4:Clove extract (200mg \kg)	29.9 ±5.0***	41.2 ±7.3***	26.1 ±3.6*	2.2 ±0.17**	3.1 ±0.5**	0.62 ±0.05**
G5: Clove powder(20g\kg)	21.4 ±7.4**	26.0 ±3.93**	23.7 ±2.6*	1.7 ±0.11**	2.54 ±0.6**	0.44 ±0.06**

Aspartate transaminase: AST alanine transaminase activities: ALT

Effect of the clove oil, extract and powder on some plasma oxidative/antioxidant biomarkers:

The information in Table (5) demonstrated that BDH injection decreased levels of glutathione reductase (GSH) and superoxide dismutase (SOD), but that it increased levels of malondialdehyde (MDA) in comparison to the NC group. Contrarily, rats fed a diet containing clove showed considerably higher levels of SOD and GSH when compared to the DC group. It is obvious that clove oil, powder, or extract significantly reversed the changes in biochemical parameters brought on by BDH. Clove powder treatment on G (5) resulted in a considerable drop in SOD and GSH levels as well as a reduction in the increase in MDA brought on by the administration of BDH.

Hamza and Elshahat (2011) published similar findings, showing that diabetic rats given raw or irradiated clove extract had decreased MDA concentrations and the level of GSH increased significantly toward the normal value in comparison to the alloxan group. Furthermore, according to(**Pourlak *et al.*, 2020)** and **(Shukri *et al.*, 2010)**, diabetic rats treated with clove extract had higher levels of SOD, GPx, and GSH and lower levels of MDA. Additionally, **(Abtahi-Eivari *et al.*, 2021**) shown that S. aromaticum therapy significantly raised blood levels of SOD and GPx while statically lowering serum levels of MDA in comparison to the DC group.. Its phenolic and flavonoid components, including eugenol, eugenol acetate, and thymol, are responsible for this antioxidant action (**Nassar *et al.*, 2007 and Pulikottil and Nath, 2015)**. According to **Qar *et al.*, (2022)**, treatment with eugenol boosted myocardial SOD activity, which may protect the diabetic heart by strengthening antioxidant defence mechanisms. In more recent research, Ali et al. (2022) found that clove flower extract reduced MDA, a measure of lipid peroxidation, and improved GPx, SOD, and CAT antioxidant activity in streptozotocin-induced diabetic mice.

Table (5): Effects of clove oil, extract, and powder on several plasma oxidative/antioxidant biomarkers

Groups	MDA U/mL	SOD mg/L	GSH U/mL
G1:Negative Control (NC)	11.26±1.4	1.54±0.12	9.27±0.6
G2: Diabetic control (DC)	19.2±0.8	0.26±0.09	4.22±1.54
G3: Clove oil (200mg\kg)	14.0±1.2*	0.67±0.05***	6.25±0.03*
G4:Clove extract (200mg \kg)	14.45±2.5*	0.65±0.17***	5.66±0.79*
G5: Clove powder(20g\kg)	12.5±1.7*	0.75±0.2***	7.7±0.88**

Superoxide dismutase (SOD)

Glutathione reductase (GSH),

Malondialdehyde (MDA)

Conclusions:

Cloves *(S. aromaticum)* can be used as effective herbal medicines has several beneficial effects on the management of diabetes-induced complications. Thus it can be considered as a good candidate for further research in patients with diabetes.

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تأثير القرنفل على بعض العوامل الحيوية للمضاعفات الشائعة و الإجهاد التأكسدي في الجرذان المصابة بداء السكري التي يسببها الألوكسان

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الملخص العربي:

يهدف هذا البحث إلى معرفة التأثير المحتمل للقرنفل على ارتفاع السكر وزيادة دهون الدم والاضطرابات الكبدية الكلوية والإجهاد التأكسدي باعتبارها المضاعفات المعروفة المتعلقة بمرض السكري. وقد تم استخدام ٤٠ فأرا من ذكور الفئران قسمت إلى ٥ مجموعات (كل مجموعة ٨ فئران) تشتمل المجموعات على مجموعة ضابطة سليمة و٤ مجموعات مصابة بالسكرى ، تم إصابة الفئران بواسطة مادة الألوكسان بتركيز (١٠٠ مجم / كجم من وزن الجسم). وقد تم تقسيم الفئران المصابة بالسكرى الى مجموعة (ضابطة مصابة)، وثانية عوملت بزيت القرنفل (٢٠٠ملجم /كجم) ،وثالثة مستخلص القرنفل (٢٠٠ملجم /كجم) ورابعة مسحوق القرنفل (٢٠ جم /كجم) . وبعد اربعة اسابيع تم تجميع عينات الدم لتقدير الجلوكوز –الأنسولين صورة الدهون –وظائف الكلى والكبد وكذلك بعض مضادات الاكسدة وعلامات الاجهاد التأكسدى . وقد أظهرت النتائج أن المجموعات المعالجة ب (زيت – مستخلص – مسحوق)القرنفل قد أظهرت مستويات منخفضة من سكر الدم الصائم –الكوليستيرول الكلى – الليبوبروتين المنخفض جدا فى الكثافة –الليبوبروتين المنخفض الكثافة –الدهون الثلاثية –انزيمات الكبد –اليوريا – حمض اليوريك –الكرياتينين – البيلبيروبين –المالونالدهيد) مقارنة بالمجموعة الضابطة المصابة ، على العكس فان مستويات الأنسولين والليبوبروتين مرتفع الكثافة وفوق أكسيد الديسموتيز والجلوتاثيون كانت أعلى فى المجموعات المعاملة بزيت ومستخلص ومسحوق القرنفل مقارنة بالمجموعة الضابطة المصابة .

لذا فقد خلصت هذه الدراسة الى أن زيت أو مستخلص أو مسحوق القرنفل ثبتت صفاته كمضاد للأكسدة وله القدرة كمكون غذائى وظيفى للحماية من المضاعفات التى يسببها مرض السكرى

الكلمات المفتاحية : القرنفل ، السكري ، دهون الدم ، مضادات الأكسدة ، وظائف الكبد والكلى

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