Research Article

# Impact of Coriander Seed Extract on Blood Sugar Levels and Histopathological Alterations of the Liver and Kidneys in Male Rats Affected by Alloxan-Induced Diabetes

**Maha Mustafa Assim[1], Assala Arkan Jawad[2], Ammar Jawad Kadhim[1], Zainab Haytham Razooki[2], Ahmed Flayyih Hasan[3,4]***

*[1]Ibn Sina University of Medical and Pharmaceutical Sciences, Baghdad, Iraq; [2]Department of Biology, College of Science, Al-Nahrain University, Jadiriya, Baghdad, Iraq; [3]Biotechnology Research Center, Al-Nahrain University, Baghdad, Iraq; [4]Department of Medical Laboratory Techniques, College of Health and Medical Technology, Al-Farabi University, Baghdad, Iraq.*

**Abstract** | Diabetes mellitus, commonly referred to as diabetes, is a widespread endocrine disorder characterized by long-term high glucose levels (hyperglycemia) in the blood. Coriander (*Coriandrum sativum*) is a nutritious plant containing a rich supply of vitamin C, calcium, potassium, magnesium, and iron, while its essential oil is also known to have antibacterial activity. A total of twenty male albino rats were used in this study and were assigned to four groups of five rats each. The first group served as the control (Group 1), Group 2 received coriander seed extract, Group 3 were diabetic animals, and Group 4 received both diabetes and coriander seed extract. The results demonstrated that the liver and kidney tissues from the diabetic rats had extensive histologic damage, and their glucose levels were significantly elevated on day one of the study following alloxan administration. However, treatment of the diabetic rats with the coriander seed extract produced a statistically significant decrease in glucose levels ($p < 0.05$) on the last day of the study, as well as marked improvement in the structure of the liver and kidneys when compared to those diabetic animals that did not receive coriander seed extract. In conclusion, the results of this study suggest that the coriander seed extract has a protective effect on the liver and kidney tissues of male rats with alloxan-induced diabetes by lowering their blood glucose levels and repairing damage to these organs.

**Keywords** | Diabetic, Coriander Seed extract, Hematoxylin, Eosin, Blood sugar

**Received** | December 04, 2025; **Accepted** | January 27, 2026; **Published** | May 06, 2026
***Correspondence** | Ahmed Flayyih Hasan, Biotechnology Research Center, Al-Nahrain University, Baghdad, Iraq; **Email:** ahmed_flayyih@nahrainuniv.edu.iq
**Citation** | Assim MM, Jawad AA, Kadhim AJ, Razooki ZH, Hasan AF (2026). Impact of coriander seed extract on blood sugar levels and histopathological alterations of the liver and kidneys in male rats affected by alloxan-induced diabetes. J. Anim. Health Prod. 14(2): 720-725.
**DOI** | https://dx.doi.org/10.17582/journal.jahp/2026/14.2.720.725
**ISSN (Online)** | 2308-2801



## INTRODUCTION

Diabetes, also called diabetes mellitus, is a common endocrine disorder diagnosed by chronically elevated blood sugar levels (hyperglycemia). Diabetes occurs either due to insufficient production of insulin by the pancreas or because body cells become resistant to the effects of insulin (Lee *et al*., 2010). Diabetes symptoms include frequent urination, excessive thirst, inexplicable weight loss, increased hunger, vision problems, dry skin, wearness, and tingling or numbness in the hands and feet (Al-Masri *et al*., 2024). Diabetes type 1 is brought on by the immune system erroneously damaging insulin-producing beta cells in the pancreas. Genetic predisposition and environmental factors such as living conditions, lifestyle, and exposure to external agents play a significant role in triggering immune-mediated beta-cell destruction (Alum *et al*., 2022; Ibrahim *et al*., 2023). Dietary management is an essential component of diabetes control. Recommended foods for diabetic patients include veggies and fruits, whole grains (including barley, quinoa, brown rice, oats, and whole wheat), protein sources (low-fat or non-fat dairy products) as well as poultry, lean meats, fish, eggs, beans, nuts, tofu, and lentils (Fajarwati *et al*., 2023; Hussain *et al*., 2022).

Coriander (*Coriandrum sativum*) is a highly nutritious plant that is a good source of vitamin C, potassium, calcium, magnesium, iron, and vitamin K. Additionally, its essential oil has been reported to have antibacterial properties, while other bioactive compounds may help reduce blood pressure by promoting vasodilation and exerting mild diuretic effects (Hanafi and Hardiany, 2024). Coriander has also been traditionally used in Ayurvedic medicine, where coriander seed infusion is believed to exert cooling and protective effects on the body (Hassan *et al*., 2022). Additionally, vitamin K present in coriander leaves and seeds plays a vital role in blood coagulation and bone health, perhaps lowering the chance of cardiovascular illnesses and osteoporosis (Alqudah *et al*., 2024).

Thus, the present study's goal is to investigate the preventive and therapeutic effects of coriander seed extract against alloxan-induced diabetes by evaluating its impact on blood glucose levels and histopathological changes in the liver and kidneys of laboratory animals.

## MATERIALS AND METHODS

### Animals and experimental design

The male, albino adult rats used in this experiment (twenty total, males were 200-225 g) were received from the Biotechnology Research Centre at Al-Nahrain University; all were housed under controlled environmental conditions in the laboratory (temperature: 20-25 °C, relative humidity: 50 %±10%, 12 hour light/dark environmental cycles); set access to foodstuff (standard laboratory pelleted) and water ad libitum during the duration of the study; and appropriately housed in cages. The rats were divided into four experimental groups at random (n=5).

- Group 1 (Control): Male, healthy, non-diabetic rats were administered normal saline (0.9% NaCl).
- Group 2 (Coriander Seed Extract): Male, healthy, non-diabetic rats will receive 250 mg/kg of coriander seed extract (coriandrum sativum) (Barotyha *et al*., 2021).
- Group 3 (Diabetic): Male rats were administered alloxan (a dose of 150 mg/kg) and subsequently had their blood sugar levels elevated (induced diabetes) (Dahiru and Musa, 2024).
- Group 4 (Diabetic + Coriander Seed Extract): Male rats were administered 250 mg/kg of coriander seed extract to determine if there was an effect on blood glucose levels.

### Alloxan-induced diabetes in male rats

Twenty male rats were used in this study. Rats were separated into two groups (10 rats in each group), where one group of rats was deprived of food for 24 hours and injected intraperitoneally with 150 mg/kg body weight of alloxan monohydrate to induce diabetes, while the other group was used as a control. Alloxan works by inducing diabetes through the selective destruction of beta cells of the pancreas, resulting in insulin leakage and subsequent hypoglycemia (Dahiru and Musa, 2024). On the 24$^{th}$ hour following the injection of alloxan, rats whose blood glucose levels were measured using a blood glucose meter (PreciChek Autocode, AC-302, Germany) were classified as diabetic and had significant elevations in their blood glucose levels. These diabetic rats were assigned to the designated experimental treatments.

### Biochemical and histopathological investigations

Following the four-week trial period, all of the trial animals were anesthetized and then euthanized, and blood samples were collected and spun in a centrifuge for biochemical analysis. The liver and kidney from each animal of the study were removed and placed in 10% neutral buffered formalin for histopathology analysis. Tissues were dehydrated (using increasing ratios of ethanol (70-100%)) and then cycled through xylene prior to being embedded in paraffin wax. Tissues were cut on a microtome and stained with hematoxylin and eosin (H and E), and all tissues were examined and photographed through the use of an optical microscope and according to the proper histological techniques (Yahya *et al*., 2024; Al-Khuzaay *et al*., 2024).

### Statistical analysis

The statistical analysis for this project was carried out using the Statistical Package for Social Sciences (SPSS®) v26 for Windows. Statistical analysis was conducted using one-way analysis of variance (ANOVA) to examine the data, with a statistical significance level set at $p < 0.05$. All results were presented as mean ± standard deviation (SD).

## RESULTS

### Effect of coriander seed extract on blood sugar levels

As shown in Table 1, statistical analysis revealed a marked increase in blood glucose levels in diabetic animals on the first day, with only a slight decrease observed on the final day in Group 3. In contrast, diabetic animals treated with coriander seed extract (Group 4) exhibited a significant ($p < 0.05$) reduction in blood glucose levels by day 30.

**Table 1:** Effect of coriander seed extract on blood sugar levels in male rats (mg/dL).

| Experimental groups | First day (Mean ± SE) | Last day (Mean ± SE) |
|---|---|---|
| Control | 115.0 ± 0.41[c] | 117.8 ± 0.48[c] |
| Coriander seed extract | 119.0 ± 0.53[c] | 121.7 ± 0.67[c] |
| Diabetic | 449.8 ± 2.29[a] | 394.8 ± 1.31[a] |
| Diabetic + Coriander extract | 270.5 ± 1.85[b] | 136.5 ± 1.94[b] |

[a-c]: Means with different superscript letters within the same column are significantly different at $p \leq 0.05$.

### Effect of coriander seed extract on liver histology

Liver sections from the control group and the coriander seed extract-treated group displayed normal hepatocyte architecture (Figure 1A, B). The hepatocytes were polygonal with vesicular basophilic nuclei and eosinophilic granular cytoplasm. Binucleated hepatocytes were occasionally observed. Narrow hepatic sinusoids, lined by Kupffer cells and endothelial cells, separated the liver cords, which were radially arranged.

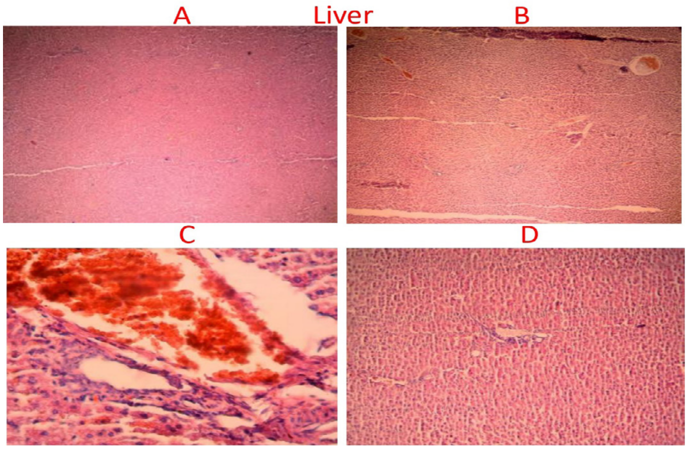


**Figure 1:** Histological examination of rat liver sections. A and B (control and coriander seed extract groups): Hepatocytes exhibited normal polygonal morphology with eosinophilic granular cytoplasm and vesicular basophilic nuclei; some hepatocytes were binucleated. Liver cords were radially arranged and separated by narrow sinusoids lined with endothelial and Kupffer cells. C (diabetic group): Liver sections showed disorganized hepatocyte cords, marked sinusoidal congestion extending from centrilobular to periportal regions, focal hemorrhage, severe hydropic degeneration, numerous apoptotic bodies, and pronounced leukocytic infiltration. D (diabetic + coriander seed extract group): Liver sections displayed moderate hydropic degeneration, mild vacuolation of hepatocytes, moderate hemorrhage, and moderate leukocytic infiltration, indicating partial improvement compared with the untreated diabetic group.

Liver sections from diabetic rats (Group 3) had significantly disorganized hepatocyte cords extending from centrilobular to periportal areas. Notable characteristics included sinusoidal congestion, localized bleeding, severe hydropic degeneration, many apoptotic bodies, and heavy infiltration of leukocytes (Figure 1C).

Coriander seed extract treatment improved diabetic rat liver tissue characteristics (Group 4) by moderately reducing hepatocyte vacuolation, slightly reducing hemorrahge, slightly reducing leukocyte infiltration, and showing reduced hydropic degeneration compared with untreated diabetic rats (Figure 1D).

### Effect of coriander seed extract on kidney histopathology

Kidney sections from both control and coriander seed extract-treated groups had normal histological architecture, including intact Bowman's capsules and renal tubules (Figure 2A, B). Kidneys from diabetic rats (Group 3) had significant histopathological changes compared to controls, including coagulative necrosis (as shown by black arrows), dilation and degeneration of renal tubules (as shown by white arrows), and vessel congestion due to the presence of red blood cells (Figure 2C).

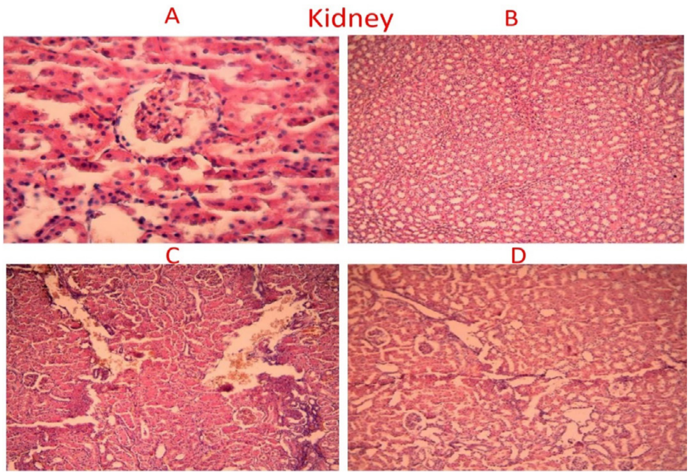


**Figure 2:** Histological examination of rat kidney sections (H and E stain). A and B (control and coriander seed extract groups): Normal renal architecture was observed, with intact Bowman's capsules and renal tubules. C (Diabetic group): Kidney sections showed tubular degeneration and dilatation (white arrows), coagulative necrosis (black arrows), and congestion of blood vessels with red blood cells. D (Diabetic + coriander seed extract group): Kidney sections exhibited mild intertubular hemorrhage, moderate leukocytic infiltration, and partial tubular degeneration (white arrows), indicating improvement compared with untreated diabetic rats.

Kidney sections from coriander seed extract-treated diabetic rats (Group 4) showed moderate improvement but continued to display some histopathological changes.

Compared to Group 3, histopathological findings included mild tubular degeneration (white arrows), minimal intertubular hemorrhage, and moderate leukocyte infiltration, suggesting coriander seed extract provided some protective effects against alloxan-induced kidney damage.

## DISCUSSION

Diabetes has become a major global health problem throughout the world with an estimated 366 million people expected to have the disease by 2030 more than double the number of people (171 million) who were reported to have diabetes by 2000 (Hamadjida *et al*., 2023). The two primary organs involved in maintaining the homeostasis of glucose in the body are the liver and kidney. Changes in these two organs due to diabetes have directly impacted how the body metabolizes and maintains its levels of glucose (Daniel *et al*., 2022).

Multiple animal models have established the causal link between diabetes and hyperglycemia (high levels of blood sugar), oxidative stress and the inability to generate or synthesize adequate amounts of antioxidants, as well as producing reactive oxygen species as by-products of the process (Olorunsola *et al*., 2022). Alloxan (a compound frequently used for inducing diabetes in laboratory animals) has been shown to have an extremely high level of toxicity on pancreatic β-cells ultimately leading to the failure of the β-cells. In this experiment, administration of alloxan produced hyperglycemia, along with severe damage to the islets of Langerhans, including necrosis (death of cells), degeneration (breakdown of cells), and hypocellularity (decrease in the number of β-cells) (Utami *et al*., 2024; Frolova *et al*., 2022). All our findings are consistent with previous studies that support the use of medicinal plants as alternatives for preventing or reducing the incidence and severity of diabetes, and therefore warrant additional research regarding the clinical use of these plants (Huda *et al*., 2024; Abd El-Emam *et al*., 2024). As with prior studies (Aleem *et al*., 2022), we also observed a significant increase in blood glucose levels after administering alloxan on day 1 of experimentation, followed by a minimal decrease by the end of the experiment (Table 1). Histopathological examination of the islets of Langerhans demonstrated significant necrosis, degeneration, and hypocellularity in alloxan-treated animals (Table 1).

Medicinal plants have been shown to exert protective effects against diabetes-induced organ damage over the past decade (Opara *et al*., 2021). Among these, coriander (*Coriandrum sativum*) seed extract has demonstrated significant therapeutic potential (Hanafi and Hardiany, 2024). In the present study, treatment with coriander seed extract significantly lowered blood glucose levels in diabetic rats and improved liver and kidney histology compared with untreated diabetic animals. These findings are consistent with previous studies reporting the beneficial effects of coriander seed extract on glucose metabolism and organ protection in rats (Mahran *et al*., 2023; El-Hennamy *et al*., 2025; Shalaby *et al*., 2023).

## CONCLUSION

The current research indicates that male rats with alloxan-induced diabetes exhibit substantial hyperglycemia and severe damage to the liver and kidneys. The blood glucose-lowering effects of a coriander (*Coriandrum sativum*) seed extract also improved liver and kidney histology in the alloxan-treated rats. Therefore, this study provides evidence that the extract of coriander seed has both significant antidiabetic and organ protecting properties and may be useful as a natural agent for treating diabetes and its complications. Further studies are needed to elucidate the molecular mechanisms of action associated with these protective effects.


## ACKNOWLEDGEMENT

Thanks are due to the authors for funding the entire article.


## NOVELTY STATEMENT

Our study provides strong and positive results indicating that coriander seed extract is highly effective in reducing blood sugar levels and improving liver and kidney tissue quality in diabetic rats.

## AUTHOR'S CONTRIBUTION

M.M.A and A.A.J.: Study Design. A.J.K and Z.H.R.: Methodology and Language Editing. H.M.A. and A.F.H.: Writing and Corresponding Author.

### Ethical approval

Approval to conduct the study was given by the Biotech Research Centre at the University of Nahrain in November 2024 for ethical approval for the purpose of performing this work.


### Funding

None.


### Generative AI and AI-assisted technology statement

The authors acknowledge that no artificial intelligence tools were used in this article.

## Conflict of interest

The authors have declared no conflict of interest.

## REFERENCES

Abd El-Emam MM, Behairy A, Mostafa M, Khamis T, Osman NM, Alsemeh AE, Mansour MF (2024). Chrysin-loaded PEGylated liposomes protect against alloxan-induced diabetic neuropathy in rats: The interplay between endoplasmic reticulum stress and autophagy. Biological Research, 57: 45. https://doi.org/10.1186/s40659-024-00521-1

Aleem A, Shahnaz S, Javaid S, Ashraf W, Rasool M F, Ahmad T, Imran I (2022). Chronically administered Agave americana var. marginata extract ameliorates diabetes mellitus, associated behavioral comorbidities and biochemical parameters in alloxan-induced diabetic rats. Saudi Pharma. J., 30: 1373-1386. https://doi.org/10.1016/j.jsps.2022.06.003

Aljazzaf B, Regeai S, Elghmasi S, Alghazir N, Balgasim A, Hdud Ismail I M, Alghazeer R (2023). Evaluation of antidiabetic effect of combined leaf and seed extracts of Moringa oleifera (Moringaceae) on Alloxan-induced diabetes in mice: A biochemical and histological study. Oxid. Med. Cell. Longev., 2023: 9136217. https://doi.org/10.1155/2023/9136217

Al-Khuzaay HM, Al-Juraisy YH, Hasan AF, Tousson E (2024). Antitumor activity of β-glucan isolated from date fruits on cancer cells in vivo. Opera Med. Physiol., 11: 41-48.

Al-Masri A A, Ameen F, Davella R, Mamidala E (2024). Antidiabetic effect of flavonoid from Rumex vesicarius on alloxan induced diabetes in male albino Wistar rats and its validation through in silico molecular docking and dynamic simulation studies. Biotechnol. Genet. Eng. Rev., 40: 4479-4494. https://doi.org/10.1080/02648725.2023.2213042

Almuttairi RS (2023). The effects of metformin treatment on diabetic albino rats' pancreas, liver, and kidney histology. Arch. Razi Inst., 78: 459.

Alqudah A, Qnais E, Sabi SH, Bseiso Y, Gammoh O, Wedyan M (2024). Effects of Coriandrum sativum seeds on memory, anxiety, depression, and sleep quality in students: A randomized controlled study. Nutr. Food Sci., 54: 377-390. https://doi.org/10.1108/NFS-08-2023-0193

Alum EU, Umoru GU, Uti DE, Aja PM, Ugwu OP, Orji OU, Orinya FO (2022). Hepato-protective effect of ethanol leaf extract of Datura stramonium in alloxan-induced diabetic albino rats. J. Chem. Soc. Niger., 47(5).

Barotyha E, Shafaroodi H, Asgarpanah J (2021). Effect of the essential oil from coriander (*Coriandrum sativum* seeds) on morphine antinociception tolerance and withdrawal syndrome in mice. Farmacia, 69: 718-723. https://doi.org/10.31925/farmacia.2021.4.12

Dahiru M M, andMusa N (2024). Antidiabetic activity of *Diospyros mespiliformis* on alloxan-induced diabetic rats. J. Fund. Appl. Pharma. Sci., 5: 11-20.

Daniel AI, Gara TY, Ibrahim YO, Muhammad FM, Salisu FE, Tsado R, Agboola AM (2022). *In vivo* antidiabetic and antioxidant activities of chloroform fraction of Nelsonia canescens leaf in alloxan-induced diabetic rats. Pharmacol. Res. Modern Chinese Med., 3: 100106. https://doi.org/10.1016/j.prmcm.2022.100106

El-Hennamy RE, El-Yamany NA, Moneim AA, Mahmoud SE, El Adawy HA, Elmasry HA (2025). Coriander seed oil extract abrogates hepatic biochemical and histopathological alterations associated with acrylamide intoxication in rats. J. Agric. Food Res., 102218. https://doi.org/10.1016/j.jafr.2025.102218

Fajarwati I, Solihin DD, Wresdiyati T, Batubara I (2023). Self-recovery in diabetic Sprague Dawley rats induced by intraperitoneal alloxan and streptozotocin. Heliyon, 9(5). https://www.cell.com/heliyon/fulltext/S2405-8440(23)02740-8 https://doi.org/10.1016/j.heliyon.2023.e15533

Frolova S, Gordienko O, Yarmolenko O (2022). The effect of alloxan-induced hyperglycemia on the renal cortex. Eastern Ukrain. Med. J., 10: 268-273. https://repo.odmu.edu.ua:443/xmlui/handle/123456789/17535, https://doi.org/10.21272/eumj.2022;10(3):268-273

Hamadjida A, Metechie LC, Tchiengang FDT, Otto GLN, Eteme ON, Njintang NY, Mingoas JPK (2023). Antidiabetic potential of Hibiscus sabdariffa extract in alloxan-induced diabetic rats. GSC Biol. Pharma. Sci., 23: 193-203. https://doi.org/10.30574/gscbps.2023.23.1.0158

Hanafi M, Hardiany NS (2024). The effect of ethanol-based coriander (*Coriandrum sativum* L.) seed extract on oxidative stress, antioxidant level and cellular senescence in the heart of obese rat. J. Pharma. Pharmacogn. Res., 12: 1111-1120. https://doi.org/10.56499/jppres24.1957_12.6.1111

Hassan ZM, Afify AA, Elsayed FI, El-Mahmoudy AM (2022). Lipid profile improving effect of *Coriandrum sativum* seed extract in rats. Int. J. Basic Clin. Pharmacol., 11: 356. https://doi.org/10.18203/2319-2003.ijbcp20222130

Huda NU, Ahmed M, Mushtaq N (2024). Bio-fabrication and characterization of nano-silver using Kickxia elatine plant and its anti-diabetic effect on alloxan-induced Sprague Dawley rats. An *in vivo* approach. Appl. Organomet. Chem., 38: e7288. https://doi.org/10.1002/aoc.7288

Hussain A, Kausar T, Jamil MA, Noreen S, Iftikhar K, Rafique A, Ali A (2022). *In vitro* role of pumpkin parts as pharma-foods: Antihyperglycemic and antihyperlipidemic activities of pumpkin peel, flesh, and seed powders, in alloxan-induced diabetic rats. Int. J. Food Sci., 2022(1): 4804408. https://doi.org/10.1155/2022/4804408

Ibrahim RM, Abdelhafez HM, El-Shamy SAEM, Eid FA, Mashaal A (2023). Arabic gum ameliorates systemic modulation in Alloxan monohydrate-induced diabetic rats. Sci. Rep., 13: 5005. https://doi.org/10.1038/s41598-023-31897-x

Lee JH, Yang SH, Oh JM, Lee MG (2010). Pharmacokinetics of drugs in rats with diabetes mellitus induced by alloxan or streptozocin: Comparison with those in patients with type I diabetes mellitus. J. Pharma. Pharmacol., 62: 1-23. https://doi.org/10.1211/jpp.62.01.0001

Mahran MZ, Elsherif FEZ, Hussein AI (2023). Potential effects of curry (*Murraya koenigii*) and walnut leaves (*Juglans regia*) on diabetic rats induced by alloxan. J. Home Econ. Menofia Univ., 33: 15-33.

Olorunsola EO, Davies KG, Essien EB, Alozie MF, Adedokun MO, Ahsan F (2022). Orally administered Prosochit®-based nanoparticles of insulin ameliorates alloxan-induced diabetes in rats. Sci. Pharma., 90: 66. https://doi.org/10.3390/scipharm90040066

Opara PO, Enemor VHA, Eneh FU, Emengaha FC (2021). Blood glucose–lowering potentials of Annona muricata leaf extract in alloxan–induced diabetic rats. Eur. J. Biol. Biotechnol., 2: 106-113. https://doi.org/10.24018/ejbio.2021.2.2.178

Shalaby SY, Akela MA, Karhib M, Hussein Y, Rabea M, Tousson

E (2023). Prophylactic effects of coriander aqueous extract on carbendazim-induced renal toxicity in male rats. Biomed. Pharmacol. J., 16: 2113-2121. https://doi.org/10.13005/bpj/2786

Utami W, Laksono YD, Setiawibowo SNF, Sunarsih ES, Wulandari F, Rohana E (2024). Antidiabetic and antioxidant activity of *Clitoria ternatea* flower extracts and fractions on blood glucose and MDA in rats induced by alloxan. Pharma. Educ., 24: 21-27. https://doi.org/10.46542/pe.2024.246.2127

Yahya A, Alsadee SA, Adil Obaid W, Hameed MO, Hasan AF (2024). Histopathological and immunohistochemical studies on the effects of silver oxide nanoparticles (AgNPs) on male rats' liver. J. Biosci. Appl. Res., 10: 392-398. https://www.scopus.com/pages/publications/85204747064