CENTRAL ASIAN JOURNAL OF MEDICAL AND NATURAL SCIENCES
https://cajmns.centralasianstudies.org/index.php/CAJMNS
Volume: 05 Issue: 04 | October 2024 ISSN: 2660-4159

CENTRAL ASIAN STUDIES

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Article

High Cholesterol Diet and Its Effect on Lung Tissue and the Protective Role of *Malva Parviflora* Seed Extract in Male Albino Rats

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Abstract: Obesity, driven by high-fat diets, is a global health concern that contributes to various chronic diseases, including respiratory disorders. Despite extensive research, the impact of high-fat diets on lung tissue remains underexplored, particularly regarding potential protective interventions. This study aimed to investigate the effects of a high-fat diet on lung tissue in male rats and assess the protective role of *Malva parviflora* seed extract and rosuvastatin. Thirty male rats, aged 8-10 weeks and weighing 210-230 g, were divided into six groups: a control group, a high-cholesterol diet group (3% cholesterol), a group receiving *Malva parviflora* seed extract (100 mg/kg body weight), a group receiving rosuvastatin (2 mg/kg body weight), a group fed a high-cholesterol diet and *Malva parviflora* seed extract, and a group fed a high-cholesterol diet and rosuvastatin. Histological analysis of lung tissue revealed significant fibrosis and inflammatory cell infiltration in the high-cholesterol diet group. Notably, rats treated with *Malva parviflora* seed extract exhibited a protective effect against lung fibrosis and inflammation, suggesting its potential as a therapeutic agent. In contrast, rosuvastatin did not demonstrate a protective role in preventing lung tissue damage induced by the high-cholesterol diet, either alone or in combination with the extract. These findings indicate that *Malva parviflora* seed extract may offer a novel approach to mitigating lung damage associated with high-fat diets, while the efficacy of rosuvastatin in this context remains questionable. This study highlights the need for further investigation into dietary interventions for lung health, particularly in the context of obesity and high-fat diets.

Keywords: High-cholesterol Diet, Malva Parviflora, Lungs Tissues

Citation: Al Yakthan Ali Salih. High Cholesterol Diet and Its Effect on Lung Tissue and the Protective Role of Malva Parviflora Seed Extract in Male Albino Rats. Central Asian Journal of Medical and Natural Science 2024, 5(4), 582-590.

Received: 10th July 2024
Revised: 10th August 2024
Accepted: 17th August 2024
Published: 24th August 2024

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1. Introduction

These days herbal products or their extracts are used to control disease. The plant kingdom is still resilient in many species that contain substances of medicinal value that have not yet been discovered, and that large numbers of them It is constantly checked for its potential, and its pharmacological value, especially for anti-inflammatory, antioxidants, and others [1]. Herbal medicines are defined as raw materials or extracts Products isolated from plants , which have become widely used in prevention and treatment of many chronic diseases, including Obesity, because it has fewer side effects compared to pharmacological drugs [2]. M. parviflora contains different amounts of phenols, flavonoids, saponins, alkaloids, resins and tannins. pharmacological studies showed that M. parviflora possesses antidiabetic, antifungal, and high antioxidant potential [3,4].

Fat is one of the most calorie-dense nutrients, obesity and type 2 diabetes are associated with eating high fat diet. [5] Several trials have shown that obesity or being overweight due to a high-fat diet may cause asthma, lead to the development of a respiratory airway hyperresponsiveness and affect lung function in research conducted in humans and animals [6,7] .

One of the most prominent negative effects in particular is hypercholesterolemia, as it is one of the main causes of lipid metabolism disorders, and is the largest risk factor for cardiovascular disease [8]. Hence the role of different dietary patterns in modifying risk factors, atherosclerosis and cardiovascular disease. The presence of fats in the diet. Which relates not only to the quantity, but also to the type of fat consumed in food. [9]. The nature of genes and blood lipid profile are associated with a variety of pathological conditions, especially those related to liver tissue, which is a vital organ responsible for receiving, storing and directing lipid compounds towards other body tissues [10,11].

Obesity is associated with many diseases that result in many chronic medical conditions, including cardiovascular disease, hypercoagulable states, low back pain, osteoporosis, and cancer. It is also closely related to respiratory symptoms and diseases, including exertion , Shortness of breath, sleep apnea syndrome, hypoventilation syndrome, chronic obstructive pulmonary disease, asthma, pulmonary embolism and aspiration pneumonia and other negative effects of obesity on respiratory functions.[12,13].

2. Materials and Methods

A. Animal preparation :

Use in this study 35 female albino rats. Their weights ranged between (190-200 grams) and ages ranged between (2-3) months. The animals were raised in the animal house of the College of Veterinary Medicine, Tikrit University. The animals were subject to standard laboratory conditions in terms of temperature of (20-25) degrees Celsius, as well as good ventilation, and the duration of illumination was 12 hours of light and 12 hours of darkness (natural lighting), and their feeding was according to laboratory standards .

B. Experience design :

The animals were distributed into seven groups (5 animals in each group) randomly, and left to acclimatize for a period of two weeks, and the dosage was determined as follows :

1. The first group: This group was dosed with distilled water for 35 days and returned as a control group.
2. The second group: This group was given a high-cholesterol diet with 3% cholesterol for 35 days, and a high-cholesterol group was returned [14].
3. Fourth group: This group received a dose of rosuvastatin 3 mg / kg body weight for 35 days.
4. Group Four : This group dosed Malva parviflora extract at a dose of 100 mg/kg body weight for 35 days.
5. The fifth group: This group was dosed with Malva parviflora seed extract and the animals were fed a high cholesterol diet for 35 days.
6. Sixth group: This group of animals dosed rosuvastatin 3 mg / kg of body weight and fed them with high cholesterol diet for 35 days.
7. Sixth group: This group of animals dosed with Malva parviflora seed extract as well as 3 mg/kg body weight together and fed a high cholesterol diet for 35 days.

C. Histological preparation:

After the animals were dissected, lung tissues were obtained, cleaned with water and then fixed in 10% formalin for 24 hours, after which they were dehydrated with increasing concentrations of alcohol (70%, 80%, 95%, 100% and 100%), after which they were purified with xylene. And mixed with paraffin. . Tissue samples were cut by rotary microtome containing paraffin at 5 μm, and finally stained with eosin and hematoxylin. These samples were examined under a light microscope with a magnification power of 400X [15].

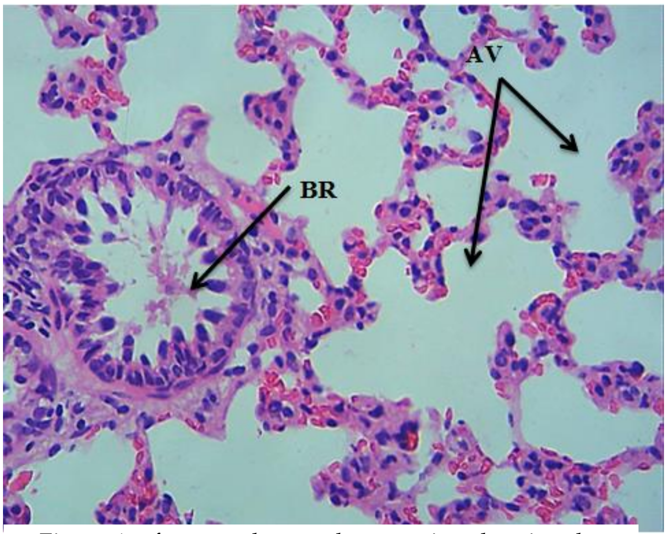

Figure 1. of a control group lung section showing the bronchioles (BR) and alveoli (AV) within the H&E 400X lung tissue.

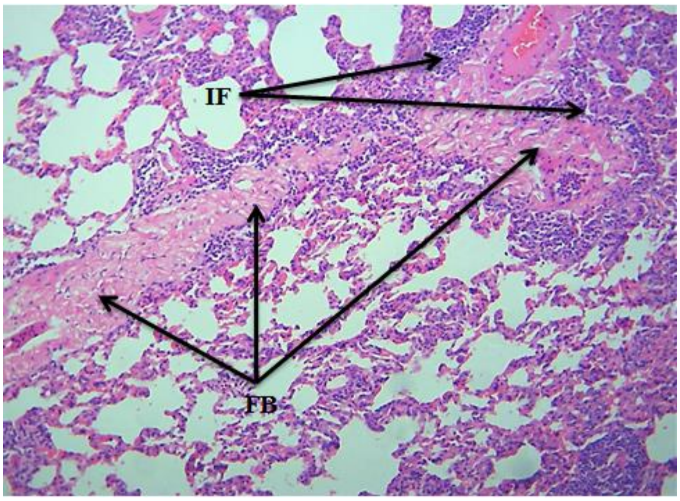

Figure 2. of the cholesterol-treated group's lung shows the presence of fibrosis within the lung tissue (FB) and a clear infiltration of inflammatory cells (IF) H&E 100X.

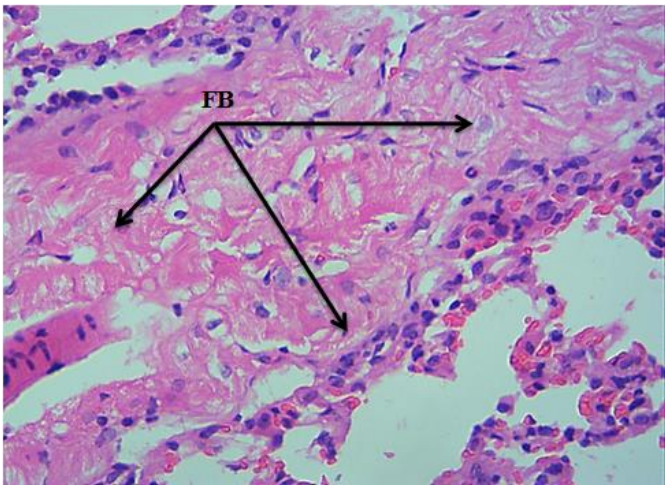

Figure 3. of the cholesterol-treated group's lung showing the presence of fibrosis within the lung tissue (FB) H&E 400X.

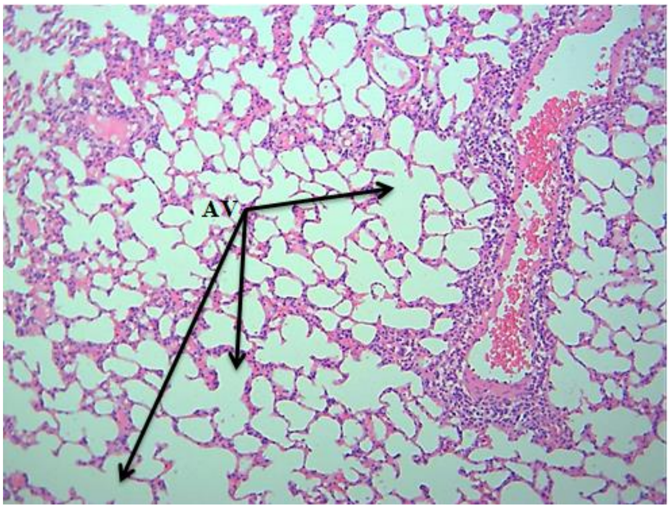

Figure 4. a section of the lung of the group treated with Malva parviflora seed extract showing the normal alveoli (AV) H&E 100X

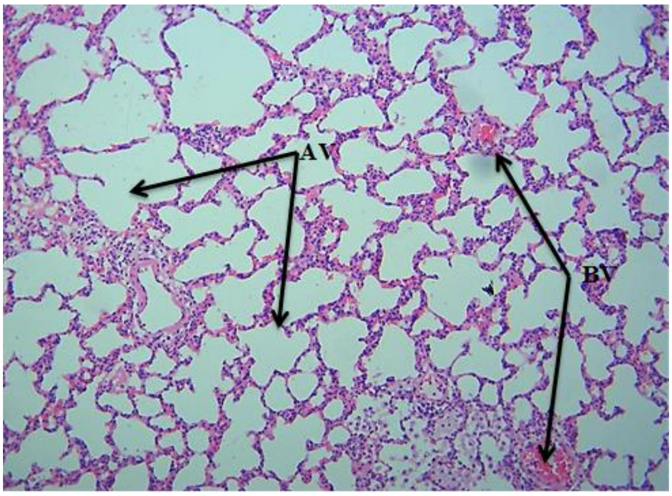

Figure 5. a section of the lung of the group treated with rosuvastatin, showing the normal pulmonary alveoli (AV) and some blood vessels (BV) H&E 100X.

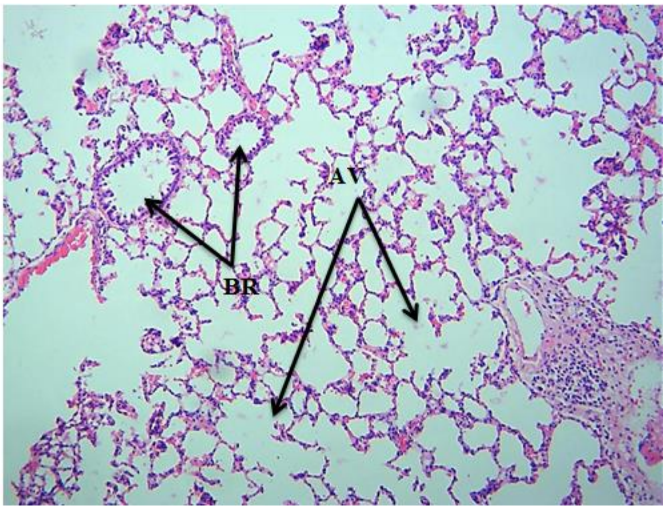

Figure 6. a section of the lung of the group treated with cholesterol and Malva parviflora seed extract showing the alveoli (AV) and bronchiolitis (BR) as normal H&E 100X.

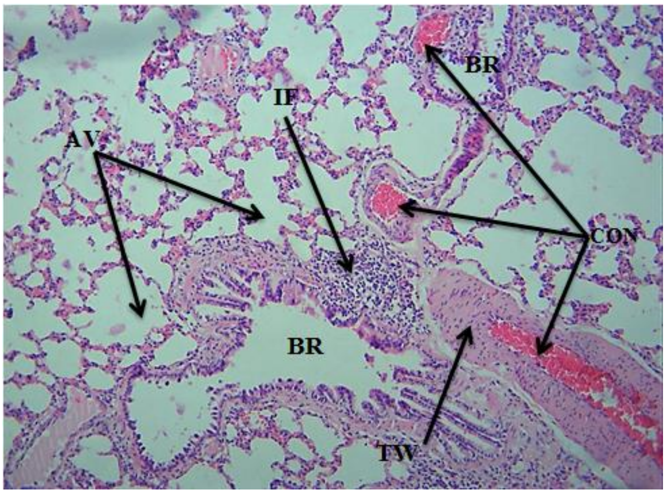

Figure 7. a section of the lung of the group treated with cholesterol and rosuvastatin, showing the normal alveoli (AV) and bronchioles (BR) with blood congestion (CON) in the blood vessels, and noting the thickening of the walls of some blood vessels (TW) and focal infiltration of inflammatory cells (IF) H&E 100X

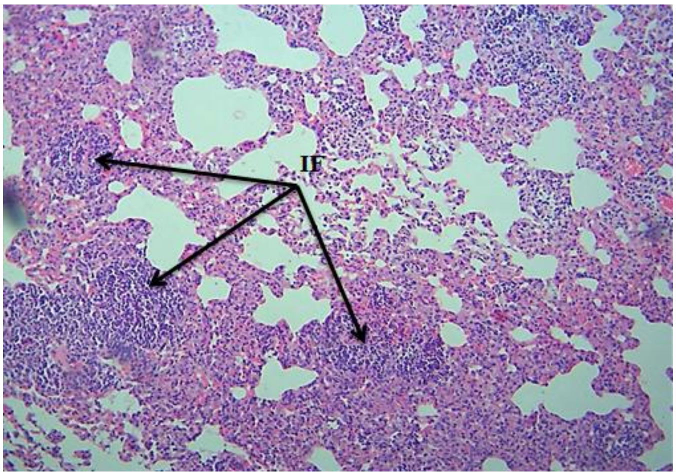

Figure 8. of the group's lung section treated with cholesterol and rosuvastatin and in the resumption area located in the inflammatory region (IF) within the lung tissue H&E 100X.

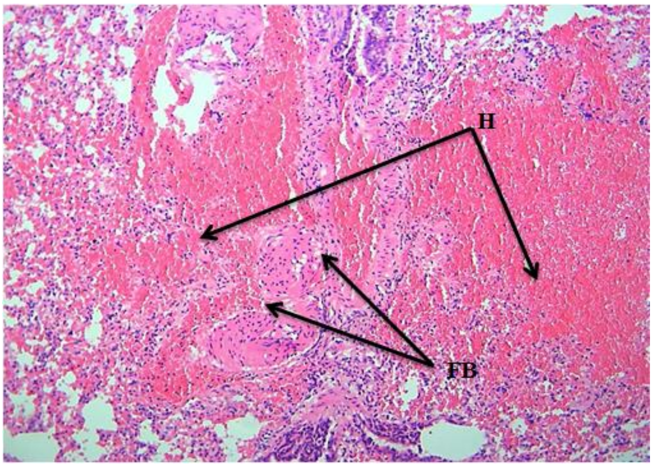

Figure 9. of the lung section of the group treated with cholesterol, rosuvastatin and Malva parviflora seed extract shows the presence of severe hemorrhage (H) within the lung tissue with fibrosis (FB) in the walls of some blood vessels H&E 100X.

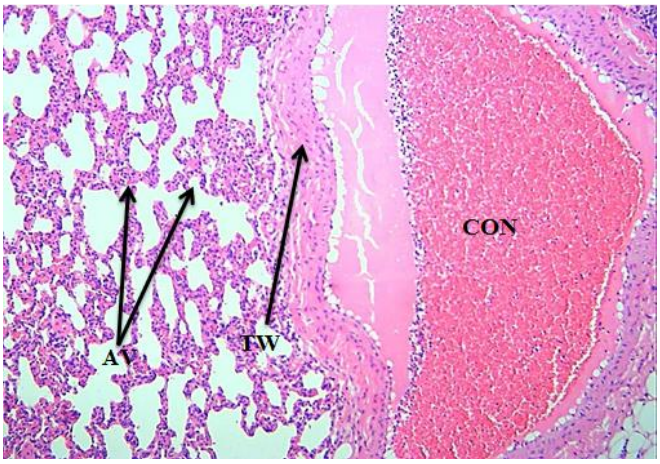

Figure 10. of a section of the lung of the group treated with cholesterol, rosuvastatin and Malva parviflora seed extract shows acute blood congestion (CON) and lysis of blood cells with thickening of the walls of blood vessels (TW) and thickening of the walls of the alveoli (AV) H&E 100X.

3. Results and Discussion

It is noted from the tissue sections that the high-fat diet caused significant histological changes in the lung tissue, Among the most prominent effects were the presence of fibrosis within the lung tissue (FB) and a clear infiltration of inflammatory cells (IF). These results were consistent with Laag et al [16] and Al-Hayder et al [17] .

Numerous studies have been conducted on humans the high-fat diet that causes obesity is linked to an inflammatory state, which in turn leads to the induction of oxidative processes in the body [18,19]. Also, exposure to more levels of reactive oxygen species have been shown to facilitate adipocyte differentiation in vitro [20] . In addition, previous studies showed that feeding mice with a high-fat diet leads to increased absorption of cholesterol and thus leads to an increase in the proportion of cholesterol and triglycerides in the blood [21]. Hyperlipidemia may also be due to a decrease in the level of catecholamine, which leads to a decrease ß2-adrenergic receptors function and reduce body lipolysis and this helps reduce lipolysis and increase body fat levels [22].

Increased fat deposition in the body causes oxidative stress in the lungs by increasing the levels of free radicals and in turn leads to an increase in hydrogen peroxide, and a decrease from the activities of antioxidant enzymes such as SOD, CAT is a sign of oxidative stress in the body [23] .

In addition, a high-fat diet reduces the activity of lipase in the lung and this Corresponds to the accumulation of triglycerides and increased fat content in the lung as well as increased lung weight. [24] . The release of ROS due to obesity from a high-fat diet leads to oxidation and damage to mitochondrial DNA, which subsequently leads to cell induction , Death and this causes damage to the epithelial cells of the alveoli [25] as well as the high-fat diet causes lung tissue to swell due to the accumulation of fat cells the alveolar epithelium is damaged and pulmonary fibrosis occurs [26] .

While it is noted from the tissue sections (6) of the lung that the extract of the Malva parviflora plant had a high protective role against the damage caused by high-fat food to the lung tissue when the extract was dosed to animals fed a high-fat diet , Phenolic compounds are among the most important antioxidants that protect the body from damage caused by oxidative stress, and these compounds are found in plants, including the Malva parviflora plant [27]. Studies indicate that the GSH content is depleted in rats with obesity caused by a high-fat diet, while it can be restored after administration of the plant extract, including : Enzymatic antioxidants, such as superoxide dismutase, catalase or GPx , that scavenge or inhibit reactive oxygen species and free radicals their formation [28]. Through the antioxidants contained in the Malva parviflora plant seeds, they had a protective role that was caused by a high-fat diet by leading to oxidative stress.

While the tissue sections (7) , (8) , (9) and (10) . did not have a protective role for rosuvastatin against the damage caused by high fat diet, as well as inhibiting the protective role of Malva parviflora seed extract when they were dosed together to the experimental animals. He noticed acute blood congestion (CON) and lysis of blood corpuscles with thickening of the walls of blood vessels (TW), thickening of the walls of the pulmonary alveoli (AV), severe hemorrhage and tissue fibrosis within the lung tissue [29].

Although this drug is one of the drugs that are used to lower the level of cholesterol, it is among the best drugs that can be used to treat conditions associated with hyperlipidemia [30]. It also reduces the risk of primary cardiovascular disease. In addition, rosuvastatin can raise the level of good cholesterol in the blood and reduce the levels of bad cholesterol to the normal range [31]. Studies also indicate that rosuvastatin, has a lipid-lowering role in clinical practice, has anti-inflammatory, anti-coagulant and antioxidant effects in addition to anti-atherosclerotic activity [32, 33].

4. Conclusion

The study's findings demonstrate that *Malva parviflora* seed extract exerts a significant protective effect against lung tissue damage induced by a high-cholesterol diet, as evidenced by reduced fibrosis and inflammatory cell infiltration in treated rats. Conversely, rosuvastatin, despite its established role in managing cholesterol levels, failed to confer similar protective benefits on lung tissue, either independently or in conjunction with the extract. These results underscore the potential of *Malva parviflora* as a therapeutic agent in mitigating pulmonary complications associated with high-fat diets, particularly in the context of obesity-related respiratory disorders. The differential outcomes between *Malva parviflora* and rosuvastatin also highlight the necessity for further research to elucidate the mechanisms underlying the protective effects of the extract and to explore its broader applicability in clinical settings. Future studies should investigate the long-term effects of *Malva parviflora* and evaluate its efficacy in conjunction with other therapeutic agents to establish a comprehensive strategy for lung health preservation in individuals at risk of diet-induced respiratory damage.

REFERENCES

[1] Qadir, M. I., and S. A. Malik, "Effect of *Eugenia Jambolana* Leaves Extracts on Blood Glucose Levels of Experimental Diabetic Rabbits," *Pharmacology Online*, vol. 3, pp. 829-835, 2009.

[2] J. P. Park, J. H. Kim, M. K. Park, and J. W. Yun, "Potential Agents for Cancer and Obesity Treatment with Herbal Medicines from the Green Garden," *Biotechnology and Bioprocess Engineering*, vol. 16, pp. 1065-1076, 2011.

[3] H. Farhan, H. Rammal, A. Hijazi, and B. Badran, "Preliminary Phytochemical Screening and Extraction of Polyphenol from Stems and Leaves of a Lebanese Plant *Malva Parviflora* L.," *International Journal of Current Pharmaceutical Research*, vol. 4, pp. 55-59, 2012.

[4] R. M. P. Gutierrez, "Evaluation of Hypoglycemic Activity of the Leaves of *Malva Parviflora* in Streptozotocin-Induced Diabetic Rats," *Food & Function*, vol. 3, pp. 420-427, 2012.

[5] J. A. Mendoza, A. Drewnowski, and D. A. Christakis, "Dietary Energy Density is Associated with Obesity and the Metabolic Syndrome in U.S. Adults," *Diabetes Care*, vol. 30, pp. 974-979, 2007.

[6] D. A. Beuther, "Obesity and Asthma," *Clinics in Chest Medicine*, vol. 30, no. 3, pp. 479-488, 2009.

[7] R. A. Johnston, M. Zhu, Y. M. Rivera-Sanchez, F. L. Lu, T. A. Theman, L. Flynt, and S. A. Shore, "Diet-Induced Obesity Causes Innate Airway Hyperresponsiveness to Methacholine and Enhances Ozone-Induced Pulmonary Inflammation," *Journal of Applied Physiology*, vol. 102, pp. 2030-2036, 2007.

[8] K. Al Rasadi, W. Almahmeed, K. F. Al Habib, M. Abifadel, H. A. Farhan, S. AlSifri, et al., "Dyslipidaemia in the Middle East: Current Status and a Call for Action," *Atherosclerosis*, vol. 252, pp. 182-187, 2016. doi: 10.1016/j.atherosclerosis.2016.07.925.

[9] J. Pavlisova, K. Bardova, B. Stankova, E. Tvrzicka, J. Kopecky, and M. Rossmeisl, "Corn Oil Versus Lard: Metabolic Effects of Omega-3 Fatty Acids in Mice Fed Obesogenic Diets with Different Fatty Acid Composition," *Biochimie*, vol. 124, pp. 150-162, 2016. doi: 10.1016/j.biochi.2015.07.001.

[10] G. Serviddio, F. Bellanti, R. Villani, R. Tamborra, C. Zerbinati, M. Blonda, et al., "Effects of Dietary Fatty Acids and Cholesterol Excess on Liver Injury: A Lipidomic Approach," *Redox Biology*, vol. 7, pp. 296-305, 2016.

[11] V. Tufarelli, G. Bozzo, A. Perillo, and V. Laudadio, "Effects of Feeding Different Lipid Sources on Hepatic Histopathology Features and Growth Traits of Broiler Chickens," *Acta Histochemica*, vol. 117, no. 8, pp. 780-783, 2015.

[12] S. M. Koenig, "Pulmonary Complications of Obesity," *American Journal of the Medical Sciences*, vol. 321, pp. 249-279, 2001.

[13] A. J. Stunkard, "Current Views on Obesity," *American Journal of Medicine*, vol. 100, pp. 230-236, 1996.

[14] N. M. Abd El-Mageed, "Hepatoprotective Effect of Feeding Celery Leaves Mixed with Chicory Leaves and Barley Grains to Hypercholesterolemic Rats," *Pharmacognosy Magazine*, vol. 26, pp. 151-156, 2011.

[15] L. M. Anthony, *Basic Histology: Text and Atlas*, 14th ed., Indian University, School of Medicine, pp. 1-4, 2016.

[16] E. M. Laag, S. M. Tawfik, and B. I. El-Shafey, "Effect of Obesity on the Lung of Adult Male Albino Rat with Evaluation of the Possible Protective Role of Pomegranate: Light and Electron Microscope Study," *Egyptian Journal of Histology*, vol. 42, pp. 335-345, 2019.

[17] M. N. Al-Hayder, R. S. Al-Mayyahi, and R. M. O. Hraishawi, "The Effects of High Fat Diet on Kidney and Lung Histopathology in Experimental Rats," *Open Journal of Science and Technology*, vol. 3, no. 1, pp. 40-45, 2020.

[18] S. Sen and R. A. Simmons, "Maternal Antioxidant Supplementation Prevents Adiposity in the Offspring of Western Diet-Fed Rats," *Diabetes*, vol. 59, pp. 3058-3065, 2010.

[19] S. Furukawa, T. Fujita, M. Shimabukuro, M. Iwaki, Y. Yamada, Y. Nakajima, et al., "Increased Oxidative Stress in Obesity and Its Impact on Metabolic Syndrome," *Journal of Clinical Investigation*, vol. 114, pp. 1752-1761, 2004.

[20] H. Lee, Y. J. Lee, H. Choi, E. H. Ko, and J. W. Kim, "Reactive Oxygen Species Facilitate Adipocyte Differentiation by Accelerating Mitotic Clonal Expansion," *Journal of Biological Chemistry*, vol. 284, pp. 10601-10609, 2009.

[21] D. W. Lim, Y. T. Kim, Y. J. Jang, Y. E. Kim, and D. Han, "Anti-Obesity Effect of *Artemisia Capillaris* Extracts in High Fat Diet-Induced Obese Rats," *Molecules*, vol. 18, pp. 9241-9252, 2013.

[22] J. H. H. Al-Awadi, K. H. Rashid, and A. J. Hassen, "High Fat Diet Induces Hyperlipidemia Incidences with Severe Changes in Liver Tissue of Male Albino Rats: A Histological and Biochemical Study," *Kerbala Journal of Pharmaceutical Sciences*, vol. 6, pp. 21-32, 2013.

[23] I. Talior, M. Yarkoni, N. Bashan, and H. Eldar-Finkelman, "Increased Glucose Uptake Promotes Oxidative Stress and PKC-Delta Activation in Adipocytes of Obese, Insulin-Resistant Mice," *American Journal of Physiology-Endocrinology and Metabolism*, vol. 285, pp. E295-E302, 2003.

[24] J. Kim, X. Jia, P. D. Buckett, S. Liu, C.-H. Lee, and M. Wessling-Resnick, "Iron Loading Impairs Lipoprotein Lipase Activity and Promotes Hypertriglyceridemia," *FASEB Journal*, vol. 27, pp. 1657-1663, 2013.

[25] M. L. Circu and T. Y. Aw, "Reactive Oxygen Species, Cellular Redox Systems, and Apoptosis," *Free Radical Biology and Medicine*, vol. 48, pp. 749-762, 2010.

[26] F. Drakopanagiotakis, A. Xifteri, V. Polychronopoulos, and D. Bouros, "Apoptosis in Lung Injury and Fibrosis," *European Respiratory Journal*, vol. 32, pp. 1631-1638, 2008.

[27] M. G. L. Hertog, E. J. M. Feskens, P. C. H. Hollman, M. B. Katan, and D. Kromhout, "Dietary Antioxidant Flavonoids and Risk of Coronary Heart Disease: The Zutphen Elderly Study," *The Lancet*, vol. 342, pp. 1007-1011, 1993.

[28] Y. M. Ahmed and R. Z. Sulaiman, "Detection of Some Active Compounds in the Leaves and Stems of Local Coriander Plant *Coriandrum Sativum* L.," *Tikrit Journal of Pure Science*, vol. 23, no. 3, pp. 6-15, 2018.

[29] R. Z. Suleiman, "A Comparative Approach to Understanding Bacterial Pathogenicity: The Role of Enzymatic and Hemolytic Virulence Factors," *Journal of Medical Genetics and Clinical Biology*, vol. 1, no. 6, pp. 150-161, 2024.

[30] K. Husain, J. Mejia, J. Lalla, and S. Kazin, "Dose Response of Alcohol-Induced Changes in Blood Pressure, Nitric Oxide, and Antioxidants in Rat Plasma," *Pharmacological Research*, vol. 51, pp. 337-343, 2005.

[31] A. Luvai, W. Mbagaya, and A. Hall, "Rosuvastatin: A Review of the Pharmacology and Clinical Effectiveness in Cardiovascular Disease," *Clinical Medicine Insights: Cardiology*, vol. 6, pp. 17-33, 2012.

[32] H.-Y. Qu, Y.-W. Xiao, G.-H. Jiang, Z.-Y. Wang, Y. Zhang, and M. Zhang, "Effect of Atorvastatin Versus Rosuvastatin on Levels of Serum Lipids, Inflammatory Markers, and Adiponectin in Patients with Hypercholesterolemia," *Pharmacological Research*, vol. 26, pp. 958-964, 2009.

[33] S. Rondi, R. Peddolla, and R. Venisetty, "Neuro, Cardio, and Reno Protective Activities of Rosuvastatin in Streptozotocin-Induced Type 2 Diabetic Rats Undergoing Treatment with Metformin and Glimepiride," *Journal of Advanced Pharmaceutical Technology & Research*, vol. 5, pp. 78-82, 2014.