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Induced hyperlipidaemia in adult male rates treated by using *Salvia officinalis* activity

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Abstract

Objective of this study was to investigate the medicinal activities of *Salvia officinalis* extractions. Twenty adult male rats were randomly divided into four groups (A, B, C, and D), with five rats assigned to each group. Group A received no treatment (control group), Group B was induced with hyperlipidemia via an aqueous solution containing 0.5% H₂O₂ and 1% cholesterol in the feed for two months, Group C was induced with hyperlipidemia and treated with 50 mg/kg/day of *Salvia officinalis* extract, and Group D was induced with hyperlipidemia and treated with 100 mg/kg/day of the extract. Results showed significant increases ($p < 0.05$) in ALT and AST levels, cholesterol, triglycerides, and malondialdehyde (MDA), along with a significant decrease in HDL and glutathione (GSH) levels in Group B compared to Group A. Treatment with *Salvia officinalis* extract (Groups C and D) resulted in non-significant changes ($p < 0.05$) in liver enzymes, lipid profiles, MDA, and GSH levels compared to Group A.

Keywords: *Salvia officinalis*, hyperlipidemia, antioxidants, oxidative stress, liver enzymes

Introduction

Hypolipoproteinemia refers to elevated blood concentrations of lipoproteins and is often assessed through lipoprotein measurements [1-2]. Traditional medicinal plants have gained attention for their antihyperlipidemic properties due to their potential to reduce cholesterol biosynthesis and promote cholesterol excretion. The search for safer antihyperlipidemic drugs from natural sources remains a priority [3]. *Salvia officinalis*, a member of the mint family (Lamiaceae), comprises 700-900 species with reported medicinal properties, including anti-inflammatory, antimicrobial, hypoglycemic, antioxidant, and antitumor activities [4-7]. This plant is native to the Middle East and Mediterranean regions. Today, it has been widely naturalized across the globe, particularly in Europe and North America [8-10]. The leaves of *Salvia officinalis* contain bioactive compounds such as ursolic acid, carnosic acid, chlorogenic acid, caffeic acid, and flavonoids [11]. In traditional European medicine, *Salvia officinalis* (commonly known as sage) has been utilized to address mild digestive issues, such as heartburn and bloating, as well as excessive sweating, age-related cognitive decline, and inflammatory conditions affecting the throat and skin [12-15].

Materials and Methods

Twenty adult male albino rats (weighing 200-250 g and aged 4-6 months) were procured from the College of Veterinary Medicine at Kirkuk University. The rats were maintained on a standard pellet diet for two weeks to ensure their health and absence of infections before the experiment. Fifty grams of dried *Salvia officinalis* leaves were combined with 1000 mL of distilled water and incubated at 35°C for 24 hours with continuous stirring. The mixture was then filtered and centrifuged at 2500 rpm for 10 minutes. The resulting filtrate was evaporated at 40°C until completely dry [16].

Experimental Design

The rats were divided into four groups (n=5 per group):

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- **Group A:** Standard pellet diet for seven days, followed by euthanasia.
- **Group B:** Induced with hyperlipidemia using 0.5% H₂O₂ and 1% cholesterol in the feed for two months.
- **Group C:** Induced with hyperlipidemia and treated with 50 mg/kg/day *Salvia officinalis* extract for one month.
- **Group D:** Induced with hyperlipidemia and treated with 100 mg/kg/day *Salvia officinalis* extract for one month.

Blood Sample Collection

Blood samples were collected via cardiac puncture then transferred to test tubes. After allowing the samples to clot, they were centrifuged for 10 minutes to separate the serum. The serum was then stored at -20 °C for analysis.

Tissue Homogenization

Testis samples were washed with 0.9% NaCl buffer to remove blood. For oxidative stress analysis, 10% (w/v) of tissue was homogenized in buffer (pH 7.4) using a ceramic

mortar, centrifuged for 10 minutes, and the supernatant was stored at -20°C [17].

Measurements

Liver Enzymes and Lipid Profile: ALT, AST, total cholesterol (TC), and triglycerides (TG) were measured using Randox kits.

Oxidative Stress Markers: MDA was measured using a thiobarbituric acid (TBA) reaction, and GSH levels were determined using DTNB reagent [18, 19].

Statistical Analysis: Data were analyzed using the Minitab program. Differences between experimental groups were assessed using one-way ANOVA.

Results

Liver Enzymes (ALT, AST)

Group B showed significantly elevated AST (89.3 ± 7.32) and ALT (74.11 ± 5.4) levels compared to Group A (13.08 ± 3.8 and 11.93 ± 3.57 , respectively). Groups C and D demonstrated no significant differences compared to Group A ($p < 0.05$), as shown in figure (1).

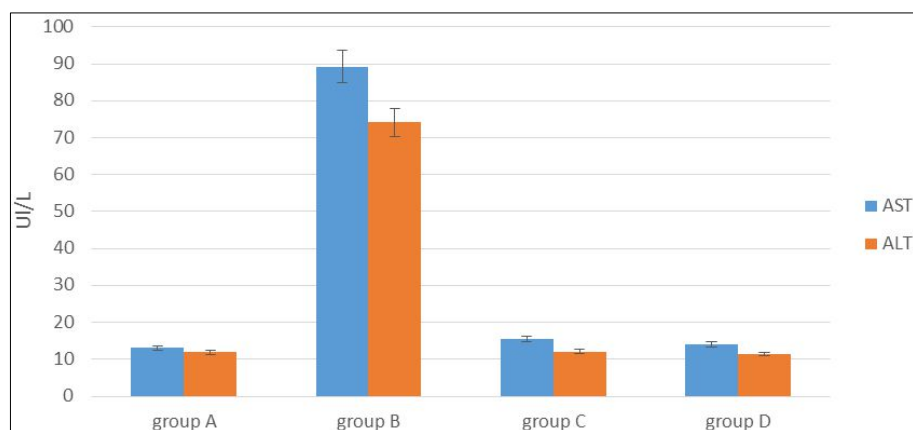


Fig 1: shows levels of AST and ALT in all groups.

Lipid Profile (TC, TG): Group B exhibited significantly increased TC (294.4 ± 12.93) and TG (208.43 ± 13.2) levels compared to Group A (87.32 ± 9.4 and 68.2 ± 8.3 ,

respectively). Groups C and D showed no significant changes compared to Group A ($P < 0.05$), as shown in figure (2).

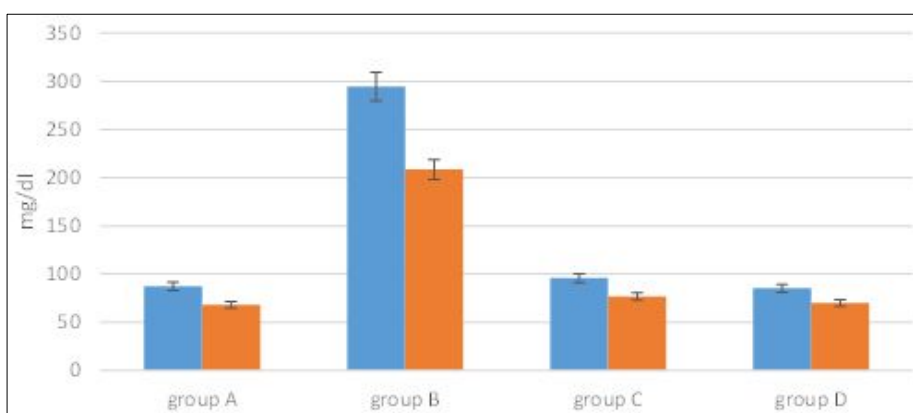


Fig 2: Shows levels of TC and TG in all groups.

Oxidative Stress Markers (MDA, GSH): Group B had significantly elevated MDA (2.57 ± 0.25) and reduced GSH (0.283 ± 0.032) levels compared to Group A (1.74 ± 0.21

and 0.383 ± 0.032 , respectively). Groups C and D displayed no significant differences compared to Group A ($P < 0.05$), as shown in figure (3).

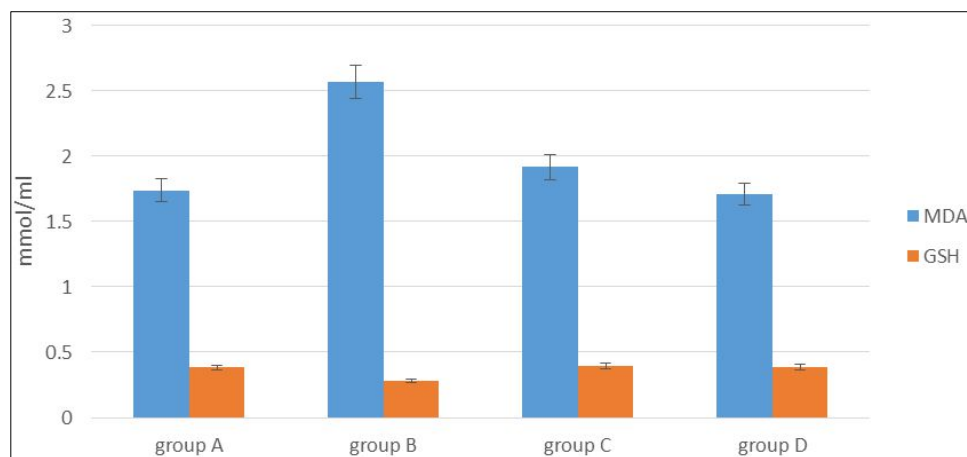


Fig 3: shows levels of MDA and GSH in all groups

Discussion

In the study demonstrated that *Salvia officinalis* extracts reduced hyperlipidemia-induced oxidative stress and liver damage. The findings align with Shahrzad *et al.* [20], who noted that *Salvia officinalis* extracts reduce liver enzyme levels and exhibit antioxidant activities, likely due to flavonoid content. The extract's radical-scavenging ability and its phenolic constituents, such as rosmarinic acid and carnolic acid, contribute to its protective effects [21-25]. These compounds effectively scavenge free radicals, mitigate lipid peroxidation, and enhance endogenous antioxidant enzymes [26-27].

Conclusion

We concluded that *Salvia officinalis* extract exhibits protective effects against hyperlipidemia-induced oxidative stress and liver damage in rats.

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