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Original Research Article

The Effects of Chamomile Extract on Immunoglobulin and Enzyme Markers and Weight in Male Laboratory Rats with Diabetes

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Abstract: This research evaluated how chamomile extract affects male laboratory rats with type 2 diabetes through changes in immunoglobulin measurement, enzyme activity and weight management. The research took place at the College of Agriculture and Veterinary Medicine part of Tikrit University during a 28-day period. The results showed that diabetic rats treated with chamomile extract experienced improved immunity through increased IgG and IgM levels together with decreased liver enzyme levels of AST, ALT and ALP. The consumption of chamomile extract prevented diabetes-related weight reduction since it helped control body mass. The administration of chamomile extract results in these effects because of its antioxidant and anti-inflammatory nature, which enables enhanced liver function combined with metabolic control and improved immune system operation. These results indicate that chamomile extract might function as an additional therapeutic approach to manage diabetes by preventing metabolic and immune complications of the disease.

Keywords: Chamomile, Diabetes, Enzymes, Immunity, Antioxidants.

INTRODUCTION

Medical practitioners have relied on chamomile plants for thousands of years because of their numerous health advantages, which traditional medicine has recognized. Traditional medicine was originally deployed chamomile to help people manage stress and ease their indigestive problems. The extensive use of chamomile flowers is used to treat multiple health conditions and diseases (Ompal Singh *et al*., 2010). German chamomile (Matricaria recutita) and Roman chamomile (Chamaemelum nobile) are the main types of chamomile that belong to the Asteraceae family according to Kumar *et al*., (2001). Chamomile is an annual plant that has smooth leaves that are continuously divided while holding straight branches. A pleasurable fragrance arises from a plant that smells like pineapple or apples. German chamomile plants usually reach heights between 60 and 91 cm, whereas their flower blossoms remain at a size of 2.5 cm across. According to Franke *et al*., (2005), it has a hollow conical center and is covered in tiny yellow blooms that are encircled by silver to white flowers. Owing to its unique, slightly sweet flavor and lack of caffeine, the beverage known as chamomile tea stands out as an alternative to black tea and green tea (Kobayashi *et al*., 2005) because it provides various health advantages. The advised quantity of daily chamomile intake ranges between 150 and 200 mg per kilogram of patient body weight. The consistent consumption of chamomile tea helps decrease blood sugar levels, thereby assisting in diabetes control and preventing diabetes-associated health problems. Chamomile has antiestrogenic effects to combat osteoporosis, and its antioxidant and anti-inflammatory actions assist in the treatment of mild eczema and help cold symptoms (Janmejai *et al*., 2010).

This research demonstrated the importance of chamomile extract through its effects on immunoglobulin levels together with enzyme marker changes and weight measurements in male diabetic laboratory rats.

- The effects of chamomile extract on immunoglobulin levels were investigated to evaluate the ability of chamomile extract to support the immune system.
- Research has evaluated how chamomile extract alters the expression of enzyme markers that perform metabolic functions and handle inflammatory responses.

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- Research has evaluated whether chamomile extract alters the body weight of diabetic rats, which could reveal the ability of chamomile extract to control metabolism.
- This research examines the dual advantages of chamomile extract for diabetes patients, as it lowers blood sugar levels and helps fight complications from the disease.

Future scientific investigations into chamomile can progress through enhanced knowledge of its advantages coupled with research into new treatment approaches for diabetes management.

2. Chemical Composition of Chamomile

The biological properties of chamomile are derived from its abundant chemical compounds that are absorbed by both fresh and dried flowers of the plant. The chemical composition of chamomile varies noticeably because it depends on various environmental factors alongside different soil types. Organic acids represent the most critical chemical substances found in chamomile. Chamomile contains 26 organic acids, four of which serve as metabolites, whereas the other acids act as secondary metabolites (Hu J.S. *et al*., 2014).

The primary active compounds in chamomile include more than 120 chemical constituents from volatile oils, including flavonoid terpenoids and hexyl alcohol. Scientists extract these compounds at a 2% concentration from chamomile flowers. The antibacterial, antioxidant and anticancer properties of these compounds make them well recognized in scientific circles. The flavonoid compounds that exist in chamomile include quercetin, apigenin and luteolin, with rutin as another essential compound. The solubility of flavonoids enables them to work effectively in the body when drinking chamomile such as tea because they dissolve in water. (Yun-Lei *et al*., 2023). Coumarin compounds: Chamomile contains approximately 10 types of coumarin compounds, examples of which are Skimmin and Daphnin (Seyedjavadi *et al*., 2019).

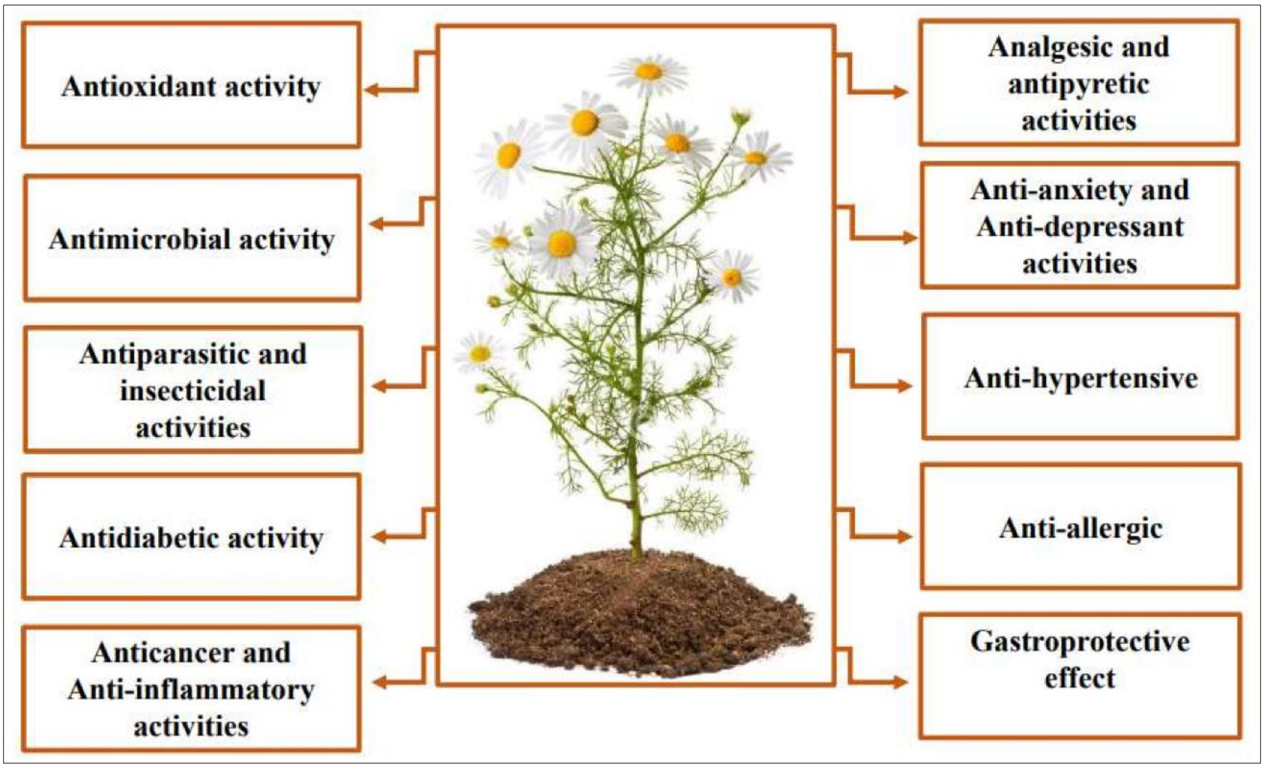

Figure 1: Properties of Matricaria chamomilla El Mihyaoui *et al.,* (2022)

3. METHODOLOGY

An experimental approach has been adopted to test the effects of chamomile extract on several physiological and biochemical parameters in diabetic male rats. Research has implemented a controlled design to explore the potential therapeutic effects of chamomile in the modulation of immune responses, enzyme activity and metabolic regulation. As illustrated below:

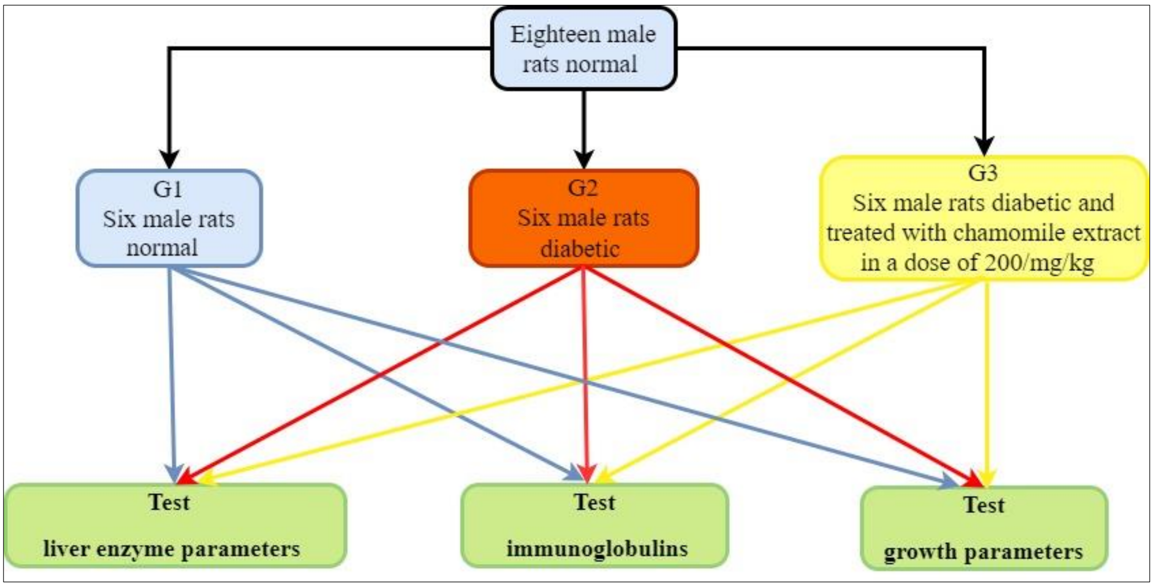

Figure 2: Methodology steps

3.1. MATERIALS AND METHODS

Animal Selection and Experimental Design

A total of eighteen adult Sprague–Dawley male rats weighing 175–180 g were utilized throughout this research. The College of Veterinary Medicine at Tikrit University provided laboratory animals whose temperature was controlled at 25°C with a light/dark cycle lasting 12 hours. Eighteen rats (six from each group) were divided into three distinct groups.

1. The control rats (G1) received normal feed alongside their usual amount of water.
2. The rats in G2 received normal feed and water while remaining diabetic.
3. The diabetic rats in group G3 consumed 200 mg/kg chamomile extract daily.

The diabetic condition was established through subcutaneous alloxan monohydrate (100 mg/kg) treatment. The blood glucose levels of the rats were tested through urine reagent strips from MACHEREY-NAGEL Germany, which led to classification of diabetic rats when their glucose levels exceeded 200 mg/dL.

3.2. Sample Preparation

Research carried out by Rachael (2024) guided the extraction process for German chamomile samples collected from local markets in Tikrit. The extraction process requires 100 millilitres of water to be heated at 40 to 45°C to add 8 grams of chamomile plant material to the flask. A filtering process is used to reach the mentioned extract quality before placing the samples inside a refrigerator.

3.3. Preparation of Laboratory Animals

Adult male Sprague albino rats of the Sprague–Dawley strain, weighing between 175 and 180 g and aged 5–6 weeks, were used in this investigation. They were acquired from Tikrit University's College of Veterinary Medicine and housed in metal cages with sawdust flooring and metal covers. The sawdust was changed twice a week, and the cages were meticulously cleaned and sterilized. Under laboratory conditions, the animals received 12 H/D light followed by 12 H of darkness while the temperature remained at 25°C. The researchers conducted disease screenings after two days of adaptation before starting the study. The subjects at the study received unrestricted food supply and water access while researchers provided adequate amounts of both substances over the complete research period.

3.4. Induce Diabetes Experimentally

A subcutaneous injection of alloxan (BDH UK) at a dose of 100 mg/kg body weight was used to induce experimental diabetes in male rats. One gram of alloxan was dissolved in ten milliliters of immediately prepared normal saline solution (Owoyele *et al*., 2005).

The animals received both food and 5% glucose solution in their drinking water immediately after fasting for 24 hours while preparing for diabetes development. Boundless insulin release was avoided after beta-cell destruction by providing a 24-hour supply of edible food and 5% glucose solution through the drinking water. Healthy control animals were injected with only 1 ml of the physiological mixture, which allowed them to consume water and food normally. Diabetes was confirmed in the animals prepared for the study by treating them with alloxan and monitoring their glucose levels via a urine reagent strip (MACHEREY-NAGEL, Germany) every two days over a ten-day period. The presence of glucose in the urine indicated the development of diabetes. Animals with glucose levels exceeding 200 mg/100 ml were classified as diabetic, as they presented symptoms such as severe fatigue and increased urination (Alarcon-Aguilara *et al*., 1998).

3.5. Experimental Design: Eighteen adult rats were split into three groups at random, with six individuals in each group:

G1: Control Group
G2: The second group, known as the infected control group, was given food and water continuously during the trial while having diabetes intentionally induced and untreated.
G3: (diabetic) was fed standard feed supplemented with 200 mg/kg chamomile extract daily.

3.6. Blood Sampling

The animals were placed within a sealed glass container and starved for ten hours as soon as the trial ended. Using a syringe, blood was extracted from the heart. Approximately 4–5 millilitres of blood were extracted and put into plastic tubes, which were then centrifuged for 15 minutes at 3000 rpm to extract the serum. The serum was then stored at $^{2°C}$ until the analyses were completed (Tietz, 2005).

4. RESULTS AND DISCUSSION

The findings of this study focused on the effects of chamomile extract on diabetes-related physiological parameters. As explained below:

4.1. Effects of Chamomile Extract on Liver Enzyme Parameters in Diabetic Rats

Table (1-1) presents the effects of chamomile extract on the enzyme parameters. The values of AST, ALT, and ALP enzymes were significantly greater (P<0.05) in the infected control treatment participants (79.15, 52.22, and 67.23 IU/L, respectively) than in the healthy control participants (51.23, 40.15, and 134.35 IU/L, respectively).

Table 1-1: Effects of chamomile extract on the levels of liver enzymes in the blood serum of healthy male rats and induced diabetic model rats

Groups	AST IU/l	ALT IU/l	ALP IU/l
G1	51.23±0.5 e	40.15± 3.2 d	134.35±0.4 g
G2	79.15± 0.3 a	52.22±1.3 a	167.23± 0.4a
G3	44.20± 0.7 c	43.25 ±2.1c	144.20±1.6 c

Different letters in the same column indicate significant differences between the rates at p ≤0.05.

The research results from Maral *et al*., (2020) confirmed that diabetic mice exhibited elevated enzyme activities of AST, ALT and ALP. The elevation of enzyme levels results from liver cell damage that leads to heart tissue loss based on Rajendra *et al*., (2024). A diabetes-related metabolic disorder results in elevated enzyme levels because it accelerates liver cell metabolism toward the elevation of AST, ALT and ALP concentrations (Magbolah *et al*., 2020). The release of enzymes into bloodstream occurs when liver membrane damage happens and serum enzyme level elevation shows liver damage (Martha *et al*., 2015).

Sahar *et al*., (2023) discovered that active compounds from chamomile extract act as natural antioxidants since they reduce AST, ALT and ALP enzyme activity. The radical-scavenging compounds in chamomile extracts work to stabilize membrane cells by preventing damage which helps maintain enzyme quantity. According to Magbolah's (2020) study chamomile extract performed as a liver-protective agent resulting in improved enzyme levels. Chamomile extract demonstrates potent properties that help protect the liver from oxidative stress-induced damage and function enhancement and protect against tissue oxidation. This observation is further supported by Emad (2020).

4.2. Effect of Chamomile Extract on Immunoglobulins in Diabetic Rats

The effects of chamomile extract on immunoglobulin levels are displayed in Table (1-2). IgE and IgG levels were significantly lower in the diabetic animal group (612 and 807 mg/dl, respectively) than in the healthy control group (887 and 1002 mg/dl, respectively) at the 0.05 probability level.

Table 1-2: Effects of chamomile extract on IgE and IgG levels in the blood serum of experimental animals.

Groups	IgG mg/dl	IgM mg/dl
G1	a 1002 ±9.7	a 887 ±1.00
G2	c 807 ± 16.7	c 612 ± 4.1
G3	b 959 ±20.8	b 843 ±2.1

Different letters in the same column indicate significant differences between the rates at p ≤0.05.

This aligns with Afiat *et al*., (2020), who asserted that diabetes is an immunosuppressive condition that is characterized by a decrease in immunoglobulin (IgA and IgG) synthesis. These findings corroborated those of Mayada (2023), who reported that the high immune values in the groups given chamomile extract were caused by the coumarin, flavonoids, and polyphenols found in chamomile, which increase immunity levels and activate the immune system and liver defenses against illnesses.

The results also agreed with those of Nahla (2019), who reported that the use of chamomile extract as an antioxidant improved the values of immunoglobulins in diabetic laboratory rats, supported the body's immune system, provided energy, and protected cells from damage.

4.3. Effects of Chamomile Plant Extract on Growth Parameters

The examination of male rat growth parameters exposed to chamomile plant extract appears in Tables (1-3). Untreated diabetic-induced rats weighed less than both treatment groups together with control rats throughout the observation period. The weight of diabetic-induced rats rose significantly after receiving chamomile plant extract directly during the experimental period.

Table 1-3: Effects of chamomile plant extract on growth parameters (g/kg) in male rats with induced diabetes that were orally administered for 28 days

Tretments	Initial Weight	Final Weight	Weight Gain
	Gm		
G1	175.3±0.02	182.63±0.05	7.33±0.01
G2	180.12±.1.11	158.04±1.07	22.07± 1.05
G3	180.02 ±0.02	172.02±1.07	8.00 ±1.05

Different letters in the same column indicate significant differences between the rates at p ≤0.05.

Research findings by Carlos (2018) support the conclusion that rat weight loss emerges from insulin hormone deficiency which drives cells toward fat utilization and triggers animal oxidative stress (Ali, 2006). Body weights in diabetic animals who received chamomile extract treatment exceeded the measurements taken from diabetic control group animals. The primary active components of chamomile extract known as terpenoids and flavonoids cause this effect. The antibacterial together with antioxidant and anticancer properties define these compounds (Yun-Lei *et al*., 2023). The metabolic function of pancreatic cells becomes better protected by chamomile extract while the natural anabolic return improves as a result. The substance helps achieve proper body weight management according to Riccardo Fontana *et al*., (2023).

5. CONCLUSION AND FUTURE WORK

The anti-diabetic benefits of chamomile extract make this drug effective for diabetic rats through its enzyme-lowering properties alongside immune system strengthening actions and weight management abilities. The liver health benefits of chamomile extract occurred through its antioxidant properties in combination with its anti-inflammatory activities that strengthened immune responses. Additional research on chamomile extract for diabetes treatment needs to be conducted to determine its efficacy when applied with human patients.

Future Recommendations

Additional research should pursue multiple directions to better understand the beneficial effects of chamomile extract for the treatment of diabetes. Scientists need to conduct 8- to 12-week-long tests to understand how chamomile impacts both glucose metabolism and immune system function. Awareness regarding chamomile extract as an antidiabetic treatment would be strengthened through research that evaluates its effectiveness compared with that of standard drugs such as metformin. A comprehensive investigation of the metamolecular processes that link chamomile effects to glucose control and the immune response may clarify its operational system. The clinical applications and efficacy of chamomile as a diabetes and metabolic disorder treatment can be validated through randomized controlled trials with human subjects.

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