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Effect of Ginger Extract on Lipid Profile and Liver Function in Uterine Fibroids Rats

تأثير مستخلص الزنجبيل علي مستوى الدهون ووظائف الكبد في الفئران المصابة بالورم الليفي الرحمي

Taghreed Mohamed Galal
Lecturer of Home Economics Department Assistant
Faculty of Specific Education, Assiut University
Submitted in Partial Fulfillment of the Requirements for
the Philosophy Doctor Degree in Specific Education
(Nutrition and Food Sciences)

Prof. Seham Ahmed Farrag
Emeritus Professor of Food Sciences,
Department, Faculty Home Economics,
of Specific Education, Assiut
University

Dr. Mahmoud Ashry Ibrahim
Assistant Professor of Physiology,
Zoology Department, Faculty of
Science Al-Azhar University - Assiut
Branch

Dr. Reham Ragab Abd-El Maboud
Lecturer of Nutrition and Food Science
Home Economics Department,
Faculty of Specific Education- Assiut University

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Abstract

Uterine fibroids (UFs) are non-cancerous tumors of the uterus that often lead to significant health issues such as bleeding, pain, and infertility. This study aimed to evaluate the effects of ginger extract on the lipid profile and liver function in uterine fibroid-induced rats. Thirty adult female Wistar albino rats were divided into three groups: a negative control group, a UF group, and a UF group treated with ginger ethanolic extract (GEE) at a dose of 100 mg/kg/day for six weeks. The results showed that rats with uterine fibroids exhibited significant biochemical alterations. Serum total cholesterol (T.C) was significantly elevated (273.3±7.4 mg/dl), along with triglycerides (T.G) (245.8±16.9 mg/dl), and low-density lipoprotein (LDL) (186.3±10 mg/dl), while high-density lipoprotein (HDL) levels were significantly decreased (37.3±1.02 mg/dl). Moreover, glucose levels were elevated (181.4±40.3 mg/dl), indicating metabolic dysfunction. In terms of liver function, there was a notable increase in liver enzyme activities: alanine aminotransferase (ALT) (74.2±7.11 U/L), aspartate aminotransferase (AST) (98.8±8.6 U/L), alkaline phosphatase (ALP) (164.4±7.4 U/L), and gamma-glutamyl transferase (GGT) (14.6±1.7 U/L), suggesting liver damage and dysfunction. Treatment with GEE (100 mg/kg/day) led to significant improvements in these parameters. Serum T.C was reduced to (127.7±6.6 mg/dl), T.G to (120.6±15 mg/dl), and glucose to (102.9±0.7 mg/dl). Furthermore, liver enzyme levels decreased significantly: ALT (40±3.3 U/L), AST (70.5±8.6 U/L), ALP (89±5.7 U/L), and GGT (7.5±0.6 U/L), suggesting the therapeutic potential of GEE. These results indicate that ginger extract has a beneficial effect in managing lipid metabolism and liver function in uterine fibroid-induced rats, demonstrating its potential as a therapeutic agent for uterine fibroids.

Keywords:

Uterine fibroids, ginger extract, lipid profile, liver function, biochemical parameters.

Introduction

The uterus "womb", it is organ in the reproductive system of female **(Boer et al., 2023 and Klein et al., 2023),** is a hollow pear-shaped organ that is responsible for a variety of functions, such as gestation (pregnancy), menstruation, and labor and delivery **(Harmsen et al., 2023),** is located within the pelvic region immediately behind and almost overlying the bladder, approximately 7.6 cm long, 4.5 cm wide, 3.0 cm thick, and weighs about 60 grams **(Juan et al., 2023),** the uterus can be divided anatomically into three regions: the fundus, the cervix, and the cervical canal **(Alson et al., 2024).** Estrogen and progesterone work together to prepare/maintain the endometrium for pregnancy and control the menstrual cycle **(Mohamed et al., 2023).** A depression in these hormones leads to uterine bleeding, irregular menstrual cycle, recurrent miscarriage, and an increase in the risk of uterine cancer and uterine fibroids **(Cabral-Pacheco et al., 2020).**

Uterine fibroids (UFs) are non-cancerous growths of the uterus that most often appear during the childbearing years. Uterine fibroids aren't associated with an increased risk of uterine cancer and rarely become cancer **(Quaker et al., 2024).** Fibroids range in size from the size of a seed, which cannot be seen with the human eye, to huge masses that can distort and enlarge the uterus. It can be a single fibroid or multiple fibroids. In extreme cases, multiple fibroids can enlarge the uterus so much that it reaches the rib cage **(Derk et al., 2024).** Although considered benign, these lesions are often associated with significant morbidity. About 30% of affected patients become symptomatic with the most common manifestations: Abnormal uterine bleeding, pelvic pain, gastrointestinal issues, voiding problems, bulk symptoms, obstetric complications, and infertility **(Hong et al., 2024).** No effective medical treatment is currently available, partly due to the poor understanding of the underlying pathobiology. Major therapy strategies are based on the inhibition of estrogen or progesterone, but UF tends to regrow once treatment is stopped **(Krishnan et al., 2024).** Surgical treatment is currently the primary; means of treatment of uterine fibroid, and hysterectomy is the only definitive cure for uterine fibroid **(Mici et al., 2024; Jarosław et al., 2024).**

Blood lipid levels refer to the concentrations of fats and fat-like substances in the bloodstream, which are crucial metabolic health indicators. The primary lipids measured include low-density lipoprotein cholesterol (LDL-C), high-density lipoprotein cholesterol (HDL-C), and triglycerides (TG) **(Huang et al., 2020).** The liver is a vital organ performing many essential functions, such as metabolism regulation, detoxification, and bile production **(Zidan et al., 2012)**.

In recent decades, there has been a resurgence of interest in medicinal plants, with numerous species being studied for their pharmacological activities and contributing to advances in drug discovery, and there has been significant improvement in symptoms and few side effects with these interventions **(Zhenjiang et al., 2024; Roberta et al., 2024).**

Ginger "Zingier officinal" is a popular herb and medicinal plant belonging to the ginger species. It contains many volatile oils with an attractive aroma, in addition to its many therapeutic benefits. It is useful in many diseases **(Neni and Mira., 2024).** The cultivation and use of ginger early, date back thousands of years to ancient civilizations such as Mesopotamia, India, and China and native to East and South Asia **(Srinivasan, 2017; Manoj et al., 2024).** Now it is grown in many parts of the world, including India, China, Nigeria, and Jamaica, which are among the largest producers today **(Ghasemzadeh et al., 2010; Nuning et al., 2024).**

Ginger is also a versatile and widely used spice in cooking across many cultures around the world. Its unique, slightly spicy, and aromatic flavor has made it a staple in both savory and sweet dishes **(Sari et al., 2024).** Ginger is rich in carbohydrates, lipids, terpenes, and phenolic compounds; high levels of chemical components and nutrients in ginger are essential for many physiological and biochemical processes in the human body **(Cristian et al., 2024).** Ginger has been used in folk medicine to treat and relieve a variety of ailments, including pain, vomiting, indigestion, cold symptoms, and upper respiratory tract infections **(Ballester et al., 2022).** With its ability to alleviate gastrointestinal ailments and its potential anti-inflammatory and antioxidant effects, ginger played a prominent role in traditional medicinal practices **(Musa et al., 2024).** Wherefore, the present study was conducted to evaluate the effect of ginger extract on uterine fibroid in experimental rats.

MATERIALS AND METHODS

Materials

Raw materials

One kilogram of Ginger "zingier officinal" was obtained from agricultural research center, Giza, Egypt.

Experimental rats

Thirty adult female Wistar albino rats (Rattus norvegicus) weighing 120±160 g, were obtained from the Animal Colony, National Research Centre, Egypt.

Chemicals

- Progesterone® drug was obtained from United Company for drugs, Assuit, Egypt.
- Kits were used to determine total cholesterol (T.C), triglycerides (T.G), high density lipoprotein-cholesterol (HDL-C), low density lipoprotein-cholesterol (LDL-C), complete blood count (CBC), alanine aminotransferases (ALT), aspartate aminotransferases (AST), alkaline phosphatase (ALP), gamma glutamyl transaminase (GGT), were obtained from Sigma Aldrich, AL- Fayoum, Egypt.

Ethical approval

The researchers got the approval of the Ethical Committee, (NO, AZHAR 17/2023) Faculty of Science, El Azhar University, Assiut, Egypt, and it complies with the International Guidelines for Research Ethics.

Methods

Preparation of ginger ethanolic extract (GEE)

Ginger ethanolic extract of dry powder was carried out according to the modified method of **Anosike et al. (2009)**; 100 g powder was suspended in 500 mL of 95% ethanol for 3 days, and then the mixture was filtered through sterile filter paper (Whatman number 42, England). The solvent was evaporated using a rotary evaporator, and then the extract was stored at -20 °C until further use. Extractions were performed in triplicate. In the Aroma and Flavoring Department, National Research Center, the filtrates were subjected to a lyophilization process through a freeze drier (Snijders Scientific-Tilburg, Holland) under pressure (0.1 to 0.5 m bar) and temperature (-35 to -41°C) conditions. The dry extract was stored at -20°C until further investigation as quickly as possible.

Chemical composition of ginger

Moisture, crude protein, ash, and crude fat contents were determined according to official methods **A.O.A.C (2010)** in laboratories of the Faculty of Agriculture, Assiut University; the results were an average of three replicates. The carbohydrate content of ginger

was calculated by difference according to **Turhan et al. (2005)** as follows:

% Carbohydrate =100 - (% moisture +% protein +% fat+ % ash)

Caloric value was calculated as described by **Seleet (2010):**

Caloric value = (% carbohydrate x 4) + (% protein x 4) + (% fat x 9).

Progesterone® drug and dose

Progesterone® solution was prepared separately in sterile distilled water and female Wistar albino rats was injected with bleomycine progesterone 1.0 mg/Kg animal body weight of progesterone through the lower limb lateral muscle on Sundays, Mondays, and Thursdays for 5 weeks to induction of uterine fibroid according to **Zhu et al. (2018)**.

Experimental design

The rats were housed in suitable plastic cages for one week for acclimation to the new room conditions. Fresh tap water and standard rodent food pellets (proteins, lipids, fibers, NaCl, lysine, methionine, vitamins, salts, and wheat; Agricultural-Industrial Integration Company, Giza, Egypt) were always available. All animals received human care in compliance with the standard institutions' criteria for the care and use of experimental animals. Depending on the duration of treatment, the animals were randomly subdivided into the following groups: **Group (1):** Negative control group, they were fed standard rodent food pellets and fresh tap water for six weeks. **Group (2):** Uterine fibroid group + fed standard rodent food pellets, as a positive control group, for six weeks. **Group (3):** Uterine fibroid group + 100 mg/kg/day of GEE for six weeks.

Body weight gain

At the beginning and the end of the experimental study, each rat was weighed, and the changes in body weight were calculated according to **A.O.A.C. (2000)** from the following formula:

Body weight gain (%) = [(final body weight – initial body weight) / initial body weight] * 100

Biochemical determinations

Cell blood counter (full automatic –Model PCE – 210 N, Japan) was used for measuring the complete blood count, according to the method of **Diehl et al.(2001)**.

Serum total cholesterol (T.C), triglycerides (T.G), high-density lipoprotein-cholesterol (HDL-c), low-density lipoprotein-cholesterol

(LDL-c), and serum glucose were determined according to **(Artiss and Zak, 1997; Cole et al., 1997; Lopes-Virella et al., 1977; Wieland and Seidel, 1983; Young, 2001).**

Serum alanine aminotransferases (ALT), aspartate aminotransferase (AST), gamma-glutamyl transaminase (GGT), and alkaline phosphatase (ALP) were determined according to **(Schumann and Klauke, 2003; IFCC, 1983; Moss and Henderson, 1999).** Serum urea activity, creatinine, and uric acid were determined according to **Husdan and Rupoport (1969); Chaney et al. (1960), and Trinder (1969).**

Statistical analysis

Statistical analysis was carried out according to **(Steel and Torrie, 1960).** Data was analyzed using the Statistical Package for Social Science **(SPSS)**, and the data was reported as mean ± standard error of means (n=10). Differences between means were determined by analysis of variance **(ANOVA)**, A t-test was used to calculate the statistically significant difference in body weight of male rats before and after treatment. Significance was declared at $p \leq 0.05$ **(Pallant, 2005)**.

RESULTS AND DISCUSSION

1- Gross chemical composition and caloric value of ginger

Table (1) shows the chemical composition and caloric value of ginger powder. The results recorded a higher percentage of carbohydrates, crude fibers, and moisture (48.82%, 23.5%, and 15.02%) respectively. While the percentage was recorded for crude fat, ash, and protein (3.72%, 3.85%, and 5.09%) respectively, and it contains low-calorie value.

Table (1): Gross chemical composition and caloric value of ginger (on dry weight basis mg/100g)

Sample	Moisture (%)	Ash (%)	Crude Fat (%)	Protein (%)	Crude Fiber (%)	Carbohydrates (%)	Caloric value (K/cal/100g)
Ginger	15.02 ± 0.4	3.85 ± 0.61	3.72 ± 0.03	5.09 ± 0.09	23.5 ± 0.06	48.82 ± 0.02	249.12±0.04

− Mean of three replicates (M±SD).

The results were consistent with **Tchiaze et al. (2024)** who showed that ginger contained a high percentage of moisture (16.03%) while the lower was for ash (3.50%); the higher fiber content refers to the benefits of ginger. Ash refers to its mineral content, which is very low. This is because ginger is mainly made up of roots, which are not the

most mineral-rich part of plants in general. The leaves and fruits are usually rich in minerals. While results of fat, protein, and carbohydrates of ginger were consistent with **Cristian et al. (2024)** who showed this element recorded (3.50%, 5.66% and 47.30%) respectively, the fats in ginger are mainly volatile oils that give ginger a distinctive smell and flavor. The reason for the increase in the percentage of carbohydrates may be due to the type of soil, as soil rich in organic matter and water may stimulate root growth and increase starch storage in it, thus increasing the percentage of carbohydrates. The result of caloric value consistent with **El-Ghorab et al. (2010)** who showed percentage is recorded (261.05cal), decreasing in calories is due to contains a very small amount of fat, also not rich in simple sugars such as fructose or sucrose, which reduces its calorie content.

2- Body weight gain of experimental rats

The Effect of Progesterone® and ginger ethanolic extract (GEE) on the rats' body weight is shown in Fig. (1); the figure showed that rats administered with Progesterone® uterine fibroid (UF) group; had a significant decrease in body weight compared with the rats of control (-)group. GEE extract showed a slight decrease in body weight compared to mice in the control (-) group, and a significant recovery of lost body weight when compared with the animal group treated with Progesterone® alone (UF group).

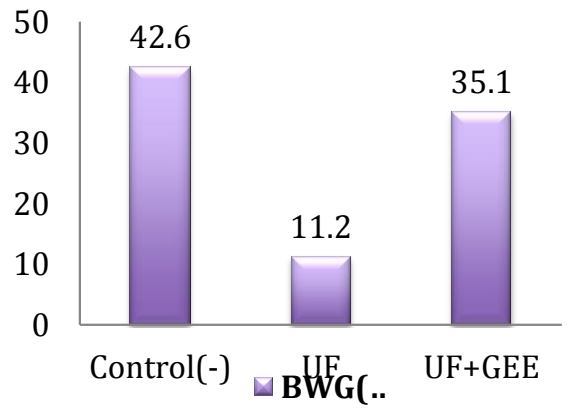

Figure (1): Effect of Progesterone® and GEE on body weight gain of UF rats

In a study, **Uchishiba et al. (2024)** found that the effect of progesterone on body weight, appetite, and subcutaneous fat mass was significantly decreased compared to the negative control group. Contrary to previous studies regarding the effects of estrogen, the effects of progesterone on the body weight regulation system. Some studies have reported that progestogen treatment causes weight gain

due to its side effects **Palacios and Mejía (2016)**, whereas other studies reported that it does not affect body weight **Lopez et al. (2016)**. A study of **Bamigboye et al. (2024)** showed that uterine fibroids (UF) in mice led to significant weight loss. **Abd Almajeed and Ibrahim (2024)** observed decreases in body weight in mice fed a high-fat diet treated with ginger, particularly those fed high-fat diets, ginger contains bioactive compounds like gingerols and shogaols, which may enhance metabolism, reduce fat absorption, and improve lipid profiles. On the other hand, **Seo et al. (2021)** found that ginger supplementation reduces slightly high-fat diet-mediated obesity and adipocyte remodeling in mice by modulating adipocyte metabolism, the reduction effect could be due to low doses, short experimental periods, or specific dietary conditions under which ginger's metabolic effects are less pronounced.

2- Effect of GEE on complete blood count (CBC) in UF rats

Table (2) shows the mean values of blood hemoglobin (Hb), red blood corpuscles(RBCs), Hematocrite (HCT),mean corpuscular volume (MCV), mean corpuscular hemoglobin (MCH), mean corpuscular hemoglobin concentration (MCHC), platelets (PLT), total leucocytes (TLC), lymphocytes (Lymph), monocytes (Mono) and granulocytes (Gran) of rats. The obtained results revealed that the UF group showed a significant decrease in Hb level, RBCs count, PLT, HCT, MCV, MCH, MCHC, WBCs (monocytes and granulocytes), with significant elevation in lymphocytes and total leucocytes when all were compared to control (-). While, group (3) showed a significant increase in same parameters, with significant decrease in lymphocytes and total leucocytes when all were compared to UF group.

Table (2): Effect of GEE on CBC in UF rats

- All data are expressed as mean ± standard error (M±SE).

Parameters / Group	Hb (g/dl)	RBCs (10^6/cmm)	HCT (%)	MCV (fl)	MCH (pg)	MCHC (g/dl)	PLT (10^3/ cm^3)	WBCs			
								TLC (10^3/cm^3)	Differential Count (%)		
									Lymph.	Mono.	Gran.
Control (-)	14.3± 0.1	5.4±0.3	44±0. 8	81.8± 4.1	26.7± 1.4	32.6±0.6	1058.2±11 1	11.6±0. 9	58.1±4. 3	8.9±0.7	33±4. 6
UF	10.1± 0.3*	4.4±0.1*	29.7± 0.8*	68.1± 0.8*	18.2± 0.4*	28.1±0.3 *	725.1±206. 8*	21.1±1.4*	82.7±0.6*	6.5±1.4*	9.6±2*
UF+GEE	14.3± 0.2#	5.5±0.1	44.2± 0.1#	83.5± 0.8#	22.6± 0.7#	32.5±0.6 #	934.7±49.0 2#	12.11±1.4#	49.3±3.4#	8.2±1.5#	44.2± 2.4#

- At $p \leq 0.05$ level Symbol (*) is significantly different from control (-) group; symbol (#) is significantly different from UF group.
- Within the same column, means that different superscripts symbols are significantly different at the $p \leq 0.05$ level.

The results obtained from the study of **Cottrell et al. (2021)** revealed that progesterone can modulate blood physiology, as it interacts with erythrocytes by altering their membrane properties and aggregation and modifying platelet function. This led to changes in the viscoelastic properties of blood, which might be reflected in the CBC parameters. High doses of progesterone can result in influence hematological parameters by causing oxidative stress and inflammatory responses, potentially altering white blood cell counts and hemoglobin levels.

While **Memudu and Oluwole, (2021)** reported a decrease in levels of hemoglobin, platelets, red blood corpuscles, total leucocytes and lymphocytes in female Wistar rats with uterine fibroids. Our results agreement with **Yakubu et al. (2024)** they noticed an increase in Hb level, RBCs count, PLT, HCt, MCV, MCH, HCHC value, WBCs, monocytes and granulocytes, when giving ginger extract orally for six weeks and explained that increase in red blood cell (RBC) count and hemoglobin concentration, suggesting its role in improving oxygen-carrying capacity. Additionally, it enhances white blood cell (WBC) count, indicating a potential immune modulatory effect that boosts immune response. **Abd Almajeed and Ibrahim, (2024)** detected that ginger extract does not significantly alter platelet count in rats but extends clotting time and prothrombin time. This suggests mild anticoagulant properties and consumption ginger maintains hematological parameters within normal ranges without causing adverse effects like anemia. This reflects its safety and potential therapeutic value in improving blood health.

4- Effect of GEE on liver enzymes in UF rats

Table (3) shows the mean values of serum alanine aminotransferases (ALT), aspartate Aminotransferases (AST), gamma glutamyl transaminase (GGT), and alkaline phosphatase (ALP) activities. The obtained data showed that the UF group showed a significant ($p \leq 0.05$) increase of serum ALT, AST, GGT, and ALP activities recorded (74.2, 98.8, 14.6, and 164.4) U/L respectively when compared to the control (-). Moreover, group (3) showed significant ($p \leq 0.05$) decreases in the same parameters recorded (40, 70.5, 7.5, and 89) U/L respectively when all compared to the UF group. The UF group had significantly higher enzyme levels compared to the control (-).

Table (3): Effect of GEE on liver enzymes in UF rats

- All data are expressed as mean ± standard error (M±SE).

Parameters / Groups	ALT (U/L)	AST (U/L)	GGT (U/L)	ALP (U/L)
Control (-)	26.9±2.9	62±6.5	7±0.96	80.9±11.1
UF	74.2±7.11*	98.8±8.6*	14.6±1.7*	164.4±7.4*
UF+ GEE	40±3.3#	70.5±8.6#	7.5±0.6#	89±5.7#

- At $p \leq 0.05$ level Symbol (*) is significantly different from control (-) group; symbol (#) is significantly different from UF group.
- Within the same column, means that different superscript symbols are significantly different at $p \leq 0.05$ level.

Elevated ALT suggests hepatocellular damage, the high AST level supports hepatocyte injury or metabolic stress, increased GGT is linked to cholestasis or oxidative stress and ALP elevation suggests bile duct obstruction or cholestasis. These findings confirm liver damage by UF **(Imade et al., 2024).** Group (3) treated with GEE, showed improved liver enzyme levels compared to the UF group, a significant decrease indicates hepatoprotective effects of GEE, reduced ASAT reduction supports mitigation of liver stress and reduced oxidative stress or cholestasis. GGT improvement is a significant normalization supports better bile flow and reduced obstruction **(Sana et al., 2024).**

5- Effect of GEE on serum lipid profile and glucose in UF rats

Table (4) shows the mean values of serum total cholesterol (T.C), triglycerides(T.G), high-density lipoprotein-cholesterol (HDL-c), low-density lipoprotein-cholesterol (LDL-c) and glucose levels (mg/dl) of rats. UF group showed a significant ($p \leq 0.05$) increase in T.C, T.G, LDL-c and glucose (273.3, 245.8, 186.3 and 181.4) mg/dl respectively and a significant decreased of HDL-c, when compared to control (-). On the other hand, group (3) showed a significant decrease in serum T.C, T.G, HDL-c and glucose (127.7, 120.6, 43, and 102.9) mg/dl respectively, and an increase in LDL-c value, when compared to the UF group.

Table (4): Effect of GEE on serum lipid profile and glucose in UF rats

Parameters / Groups	T.C (mg/dl)	T.G (mg/dl)	HDL-c (mg/dl)	LDL-c (mg/dl)	Glucose (mg/dl)
Control (-)	133.4±4.5	154.2±6.6	44.8±0.3	57.6±4.3	87.8±13.8
UF	273.3±7.4*	245.8±16.9*	37.3±1.02*	186.3±10*	181.4±40.3*
UF+ GEE	127.7±6.6#	120.6±15#	43±0.4#	60.5±9.8#	102.9±0.7#

- All data are expressed as mean ± standard error (M±SE).
- At $p \leq 0.05$ level Symbol (*) is significantly different from control (-) group; symbol (#) is significantly different from UF group.
- Within the same column, means that different superscripts symbols are significantly different at $p \leq 0.05$ level.

In studies by **Kayode et al. (2021)** and **Bamigboye et al. (2024)**, there was a significant increase in the serum of LDL-c, T.C, and T.G levels of the UF group compared with the normal group. A deregulated lipid metabolism is indicated by changes in triglycerides, total cholesterol levels, and glucose; the study showed that uterine fibroids may cause lipolysis and the release of free fatty acids from peripheral depots causing an increase in the level of LDL-c, T.C, and T.G in the blood. In a study by **Ali et al. (2017)** demonstrated that diabetic rats treated with ginger extract exhibited notable decreases in TC and TG, (HDL) cholesterol because ginger intake has been linked to associated with increased HDL cholesterol levels, and a significant decrease in LDL cholesterol was observed, which are beneficial for cardiovascular health, ginger's antioxidant properties may contribute to this improvement. Diabetic rats receiving ginger extract showed significant reductions in blood glucose levels, indicating ginger's potential role in blood sugar regulation.

Conclusion

In conclusion, the findings of this study highlight the potential therapeutic benefits of ginger extract (GEE) in ameliorating the biochemical alterations associated with uterine fibroids. The results demonstrated that uterine fibroid-induced rats exhibited significant disturbances in lipid metabolism and liver function, these therapeutic effects of ginger ethanolic extract can be attributed to their antioxidant properties due to their containing phenolic compounds.

REFERENCES

A.O.A.C (2010): official methods of analysis. Association of official analytical chemists. 18th edition Washington, DC., USA.

A.O.A.C. (2000): Official methods of analysis of AOAC International (17th ed.). Gaithersburg, MD: AOAC International.

Abd Almajeed, M. and Ibrahim, N. (2024): The effectiveness of aqueous extract of ginger on some sex hormones and biochemical parameters in female laboratory mice (Mus musculus L.). *Veterinary Medicine and Public Health Journal*, 5(2): 153-157.

Ali, H.; Farrag, S.; Abd AlAziz, M.; and Helmy, O. (2017): The influence of cinnamon and ginger on serum glucose, triglycerides and cholesterol fractions in albino induced diabetic rats. *Research Journal Specific Education*, 47(38): 29120-29130.

Alson, S.;Ligita, J.; Emir, H. and Povilas, S.(2024): Prevalence of adenomyosis features in women scheduled for assisted reproductive treatment, using the morphological uterus sonographic assessment group definitions. *Acta Obstet Gynecol Scand Journal*,9(9):1113.

Anosike, C.; Obidoa, O.; Ezeanyika, L. and Nwuba, M.(2009): Anti-inflammatory and anti-ulcerogenic activity of the ethanol extract of ginger (Zingiber officinale). *Afr. J. Biochem. Res*, 3 (12): 379-384.

Artiss, J. and Zake, B. (1997): Measurement of cholesterol concentration, in N. rifai, Eds., Handbook of Lipoprotein Testing, AACCPress. *Washington*,(6):99-114.

Ballester, P.; Cerdá, B.; Arcusa, R.; Marhuenda, J.; Yamedjeu, K. and Zafrilla, P.(2022): Effect of ginger on inflammatory diseases. *Molecules*, 27(21):7223.

Bamigboye, J.; Adeyemi, O.; Odukoya, S.; Bamigboye-Taiwo, O.; Obagunle, F. and Animasahun, T. (2024): Evaluation of a volunteered herbal recipe employed for the treatment of uterine leiomyoma (fibroid) in south-west Nigeria. *The Nigerian Journal of Pharmacy*, 58(2): 239-249.

Boer, A.; Rees, M.; Mischi, H.; Van V. and Huirne, B.(2023): The influence of uterine abnormalities on uterine peristalsis in the non-pregnant uterus: A systematic review. *Journal of Endometriosis and Uterine Disorders*,90(8):590.

Cabral-Pacheco, G.; Garza-Veloz, I.; Castruita-De,C.; Ramirez-Acuna, J.; Perez-Romero, B.; Guerrero-Rodriguez, J.;Martinez-Avila, N. and Martinez-Fierro, M.(2020): The Roles of matrix metalloproteinase and their inhibitors in human diseases. *International Journal of Molecular Sciences*, 21(7):9739.

Chaney,A.;Marbach,C. and Fowcett,J.(1960):A colorimetric method for determination of blood urea concentration. *J.clin.chem*,8(2):130-135.

Cole, T.; Klotzsch, S. and Namara, J. (1997): Measurement of triglyceride concentration, in: rifai, N.,warnick,GR. And dominiczak,M.H,Eds., Handbook of Lipoprotein Testing, Washington: AACCPress, (9):115-126.

Cottrell, J.; Witcher, A.; Comley, K.; Cunningham, M.; Ibrahim, T.; Cornelius, D.; LaMarca, B. and Amaral, L.(2021): Progesterone-induced blocking factor improves blood pressure, inflammation, and pup weight in response to reduced uterine perfusion pressure (RUPP). *American Journal of Physiology-Regulatory, Integrative and Comparative Physiology*, 320(2):719-727.

Cristian, J.; Cláudia, M.; Giovanna, C.;Helen, T.and Luciano, T.(2024): Influence of drying parameters and methods of fractionation in the chemical composition of dehydrated ginger (zingiber officinale roscoe). *journal Food Science and Engineering* ,5(1):155.

Derk, J.; Lambertus, W.; Ingrid, M.; Nijholt, J.; Huirne, C. and Martijn, F.(2024): Development and validation of a deep learning-based method for automatic measurement of uterus, fibroid, and ablated volume in MRI after MR-HIFU treatment of uterine fibroids. *European Journal of Radiology*,178(7):111602.

Diehl, K.; Hull, R.; Morton, D.; Pfister, R.; Rabemampianina, Y.; Smith, D.; Vidal, J. and van, d. (2001): A good practice guide to the administration of substances and removal of blood, including routes and volumes. *Journal of Applied Toxicology*, 21(1): 15–23.

El-Ghorab, A.; Nauman, M.; Anjum, F.; Hussain, S. and Nadeem, M. (2010): A Comparative Study on Chemical Composition and Antioxidant Activity of Ginger (Zingiber officinale) and Cumin (Cuminum cyminum). *Journal of Agricultural and Food Chemistry*, 58(14): 8231–8237.

Ghasemzadeh, A.; Jaafar, H. and Rahmat, A.(2010): Identification and concentration of some flavonoid components in Malaysian young ginger (zingier officinal) varieties by a high performance liquid chromatography method. *Molecules*,15(2): 31- 6243.

Harmsen, M.;Trommelen, R.;DeLeeuw, T.;Tellum ,L.;Juffermans,A.;Griffioen,I. ;Thomassin ,T. ;Van, D. and Huirne, J.(2023): Uterine junctional zone and adenomyosis: comparison of MRI, transvaginal ultrasound and histology. *Journal of Ultrasound Obstet Gynecol*, 17(4):404.

Hong, L.; Zhonghua, H.; Yuyan, F. and Yingying, H.(2024): The influence of uterine fibroids on adverse outcomes in pregnant women: a metaanalysis. The *Journal of BMC Pregnancy and Childbirth*, 10(1):1186.

Huang, M., Mathew, N., & Zhu, Y. (2020): Assessing Whole-Body Lipid-Handling Capacity in Mice. *Journal of Visualized Experiments*, 165(14):61927.

Husdan, H. and Rupoport, A.(1969): Estimation of creatinine by jaffes reactions comparison of three method. *J.Clin. Chem*, 138(17): 459-470.

IFCC (1983): The Methods for measurement of catalytic concentration of enzymes; IFCC, methods for alkaline phosphatase. *J. Clin. Chem. Clin. Biochem*, 21(2):731-748.

Imade, R.; Ayinde, B.; Uchendu, A.; Innih, S.; Umar, A.; Agoreyo, O. and Adesina, J.(2024): Chemical characterization, safety profile and antileiomyoma effects of tetrapleura tetraptera taubert (fabaceae) fruit ethanol extract in sprague dawley rats. *Future J Pharm Sci*,10:(41):600-612.

Jarosław, K.; Tomasz, P.;Piotr, S. and Sławomir, W. (2024): Advancements and Emerging Therapies in the Medical Management of Uterine Fibroids: A Comprehensive Scoping Review. *Journal of Med Sci Monit*,30(4): 43614.

Juan, L.; Isabel, C.;María, B.; Susana, C.; Sofia, F.; Maria,C.;Elena, C.; Aida, T.;María, V.; Alba, M.; Irene, M.; Maria,I.;Elena, H.; Cristina, C.; Agustin, O.;María, Á.and Stefano, G. (2023): Diagnostic performance of two-dimensional ultrasound, two-dimensional sonohysterography and three-dimensional ultrasound in the diagnosis of septate uterus-a systematic review and meta-analysis. *Journal of diagnostics*,18(7):809.

Kayode, O.; Kayode, A.; Mgbojikwe, I. and Rotimi, D. (2021): Effect of ketogenic diet on monosodium glutamate-induced uterine fibroids in female wistar rats. *J Babol Univ Med Sci*, 23(3):1-8.

Klein, S.;Meuleman, N.; Min, W.;Hehenkamp,E.;Post, J.and Huirne , R. (2023): The definition, diagnosis, and symptoms of the uterine niche e A systematic review. *Journal Best Practice and Research Clinical Obstetrics and Gynaecology*,24(5):101.

Krishnan, M.; Brenda, N.; Ying, C.; Cheong, M.; Lumsden, J.; Martha, H.; Janesh, K. and Mostafa, M.(2024): Surgery and minimally invasive treatments for uterine fibroids. *The Journal of Cochrane Gynaecology and Fertility*, 146(5):1858.

Lopes-Virella, M.F.; Stone, P.; Ellis, S. and Colwell, J.A. (1977): Cholesterol determination in high-density lipoproteins separated by three different methods. *Clinical Chemistry*, 23(1):882.

Lopez, L.; Ramesh, S.; Chen, M.; Edelman, A.; Otterness, C.; Trussell, J. and Helmerhorst, F. (2016): Progestin-only contraceptives effects on weight Cochrane database. *Syst Rev*, 28(8):6012.

Manoj, B.;Akash, K.; Sanjay, G. and Gaffar, S. (2024): Exploring the multiple uses of ginger: a comprehensive review. *International Journal of Progressive*, 4(4): 371-376.

Memudu, A. and Oluwole, T. (2021): The contraceptive potential of Carica papaya seed on oestrus cycle, progesterone, and histomorphology of the Utero-ovarian tissue of adult wistar rats. *JBRA Assisted Reproduction*, 25(1):34-43.

Mici´,J.;Maja, M.;Mladen, A.; Katarina, I.;Jelena, D.;Dušan, M.;VladimirArsenijevi´;JelenaStojni´; Jovan Bila; Sandra Babi´;Una, Š.;Danka, M. and Milan, D.(2024): Currently available treatment modalities for uterine fibroids. *Medicina*, 9(60):868.

Mohamed, A.;Michał, C.;Vafaei, S.;Alkhrait, S.;Hsin, C.;Yi-Fen, C.;Ko-Chieh, H.;Stepan, F.; Shih, H.and Ayman, A.(2023): Progesterone signaling and uterine fibroid pathogenesis; molecular mechanisms and potential therapeutics. *Cells journal*,9(13):409.

Moss, R. and Henderson, A. (1999): Clinical enzymology. In: burtis,C.A. and ashwood, E.R., Eds., tietz textbook of clinical chemistry, 3rd Edition, Saunders. *Philadephia*, 8(3): 617-677.

Musa, Y.;Twan, S.;Ansar, B.;Kabiru, B.;Hylalibiya, A. and Aminu, A.(2024): Exploring the chemical properties and mechanisms of herbal remedies in moringa, and ginger in managing chronic diseases: review. *African Journal of Biochemistry and Molecular Biology Research*,1(1):193-201.

Neni, F. and Mira, F.(2024):A new insight into toxicity of database compounds from ginger (zingiber officinale) by modelling study. *The Journal of Riset Kimia*,15(1): 638.

Nuning, R.;Ika, Y.;Dyah, S.;Fanie, I.; Sari, H.;Harto, W.; Rohmat, M.;Anshary, M. and Yuli,W.(2024): Traditional uses of ginger (Zingiber officinale Roscoe) based on ethno medicine study in 254 Indonesia ethnic groups, Medicinal Plant and Traditional Medicine Research and Development Center, Ministry of Health. *Indian Journal of Traditional Knowledge*, 23(5):464-472.

Palacios, S. and Mejía, A.(2016): Progestogen safety and tolerance in hormonal replacement therapy. *Expert Opin Drug Saf*, 15(11):1515-1525.

Pallant, J. (2005):SPSS Survival manual. Open University Press, Mc. Mc Graw Hill Education,2nd Ed., P336.

Quaker, E.; Stacy, P.; Sheri, D.; Ganesa, W. and Donna, D (2024): Body Mass Index and Uterine Fibroid Development: A Prospective Study Get access Arrow. *The Journal of Clinical Endocrinology and Metabolism*,36(10):1210.

Roberta, V.;Andrea, S.; Lukes, R.; Rachel, M.;Viatcheslav, G. and Ayman, A.(2024): Quality of life improvements in women with uterine fibroids treated with relugolix combination therapy during the LIBERTY long-term extension study: A descriptive subgroup analysis in women with anemia at baseline. *International Journal of Hyperthermia*, 165(2):15505.

Sana, S.; Sultan, M.; Noman, A.; Israr, M.; Azhar, R.; Ciorescu, C. and Necula, R. (2024). Zingiber officinale and azadirachta indica partially ameliorates paracetamol-induced liver damage: rodent modeling study.*Preprints*,4(1):938.

Sari, D.;Saputro, N.;Ulfa V.;Sukanta, S.;Wagiono, W. and Hasyim, M.(2024): Utilization of Ginger and Its Waste. *International Conference on Eco Engineering Development*, 56(4):1279.

Schumann, G. and Klauke, R. (2003): New IFCC reference procedures for the determination of catalytic activity concentrations of five enzymes in serum: preliminary upper

reference limits obtained in hospitalized subjects, Clinica. *Chimica. Acta*., (327): 69-79.

Seleet, R. (2010): Assessment of gross chemical composition, mineral composition, vitamin composition and amino composition acids of wheat biscuits and wheat germ fortified biscuits. *Food and Nutrition Science*, 6(10):229-444.

Seo, S. Fang, F. and Kang, I. (2021): Ginger (Zingiber officinale) attenuates obesity and adipose tissue remodeling in high-fat diet-fed C57BL/6 mice. *International Journal of Environmental Research and Public Health*, 18(6): 631.

Srinivasan, K.(2017): Ginger Rhizomes (Zingiber officinale): A Spice with Multiple Health Beneficial Potentials. *Journal Pharma Nutrition*, 5(1):18–28.

Steel, R. and Torrie, J. (1960): Principle and procedures of statistics with special reference to the biological sciences. *Mc Graw Hill, New York*,66(7):187-287.

Tchiaze, I.; Moo, M.; Dongho, D.; Ngueuleu, D.; Tefouet, V. and Gouado, I.(2024): Bio fertilizers effects on some agro morphological parameters and harvest stage on nutrients composition of ginger (Zingiber officinale Rosc.). *International Journal of Agriculture and Nutrition*, 6(1): 121-128.

Trinder, P. (1969): Enzymatic determination of glucose in blood serum. *Annals of Clinical Biochemistry*, 6(4): 24.

Turhan, S.; Sagir, I. and Ustun, N.(2005): Utilization of hazelnut pellicle in low-fat beef burgers. *Meat Sci*, 71:312-316.

Uchishiba, M.; Yamamoto, S.; Takeda, A.; Arakaki, R.; Arata, M.; Noguchi, H.; Aoki, H.; Tamura, K.; Maeda, T.; Minato, S. and Iwasa, T. (2024): Progesterone treatment reduces food intake and body weight in ovariectomized female rats. *Steroids*, 203(30):109367.

Wieland, H. and Seidel, D. (1983): A Simple specific method for precipitation of low density lipoproteins. *Journal of Lipid Research*, (24): 904-909.

Yakubu, M.; Jimoh, A.; Uwais, I.; Danbala, A.; Timothy, M.; Abbas, M. and Chindo, B.(2024): Effect of 90-day oral administration of ginger extract on hormonal, hematological, and biochemical parameters of Wistar rats: A toxicity study. *Journal of Pharmaceutical Negative Results*, 15(2): 1-8.

Young, D. (2001): Effect of Sodium Metabisulphite on Blood Metabolic Status of Wistar Rats. *Food and Nutrition Sciences*, 5 (15): 77-290.

Zhenjiang, L.;Feng, X.;Yuan, Y.;Jiaojiao, P.;Jin, L. and Chunmei, G.(2024): Risk factors affecting long-term efficacy of ultrasound-guided high-intensity focused ultrasound treatment for multiple uterine fibroids. *International Journal of Hyperthermia*, 41(1): 1080.

Zhu, J.; Yu, S.; Long, H.; Chang, H.; Liu, Y. and Gao, H. (2018): New application of dydrogesterone as a part of a progestin-primed ovarian stimulation protocol for IVF: a randomized controlled trial including 516 first IVF/ICSI cycles. Hum Reprod, 33(2):229–237.

Zidan, A. and Ismail, F. (2012): Protective and Therapeutic Effects of Some Natural Products Against Radiation-Induced Biochemical Disorders in Rats. *Assiut Journal of Environmental Studies*, 36(7): 1-13.

تأثير مستخلص الزنجبيل على مستوى الدهون ووظائف الكبد في الفئران المصابة بالورم الليفي الرحمي

الأورام الليفية الرحمية هي أورام غير سرطانية في الرحم تؤدي غالبًا إلى مشاكل صحية كبيرة مثل النزيف والألم والعقم. هدفت هذه الدراسة إلى تقييم تأثير مستخلص الزنجبيل على مستوى الدهون ووظائف الكبد في إناث الفئران المصابة بالأورام الليفية الرحمية. تم تقسيم ثلاثين أنثى بالغة من فئران ويستار البيضاء إلى ثلاث مجموعات: مجموعة سلبية ضابطة، ومجموعة مصابة بأورام ليفية رحمية، ومجموعة مصابة بأورام ليفية رحمية عولجت بمستخلص الزنجبيل الإيثانولي (GEE) بجرعة١٠٠مجم/كجم/يوم لمدة ستة أسابيع. أظهرت النتائج أن الفئران المصابة بالأورام الليفية الرحمية أظهرت تغيرات كيميائية حيوية كبيرة. ارتفع مستوى الكوليسترول الكلي في المصل (T.C) بشكل ملحوظ (٢٧٣,٣ ± ٧,٤ مجم/ديسيلتر)، إلى جانب الدهون الثلاثية (T.G) (٢٤٥,٨ ± ١٦,٩مجم/ديسيلتر)، والبروتين الدهني منخفض الكثافة (LDL) (١٨٦,٣ ± ١٠مجم/ديسيلتر)، في حين انخفضت مستويات البروتين الدهني عالي الكثافة (HDL) بشكل ملحوظ (٣٧,٣ ± ١,٠٢مجم/ديسيلتر). وعلاوة على ذلك، ارتفعت مستويات الجلوكوز، مما يشير إلى خلل في التمثيل الغذائي. من حيث وظائف الكبد، كان هناك زيادة ملحوظة في أنشطة إنزيمات الكبد: ألانين أمينوترانسفيراز (ALT)، وأسبارتات أمينوترانسفيراز (AST)، والفوسفاتيز القلوية (ALP)، وجاما غلوتاميل ترانسفيراز (GGT)، مما يشير إلى تلف الكبد واختلال وظائفه. أدى العلاج بـ GEE (١٠٠ مجم / كجم / يوم) إلى تحسينات كبيرة في هذه المعايير. انخفض تركيز السكر في الدم، وTG، والجلوكوز. علاوة على ذلك، انخفضت مستويات إنزيمات الكبد بشكل ملحوظ مما يشير إلى الإمكانات العلاجية للكبد لـ GEE. تشير هذه النتائج إلى أن مستخلص الزنجبيل له تأثير مفيد في إدارة التمثيل الغذائي للدهون ووظائف الكبد في الفئران المصابة بالأورام الليفية الرحمية، مما يدل على إمكاناته كعامل علاجي للأورام الليفية الرحمية.

الكلمات المفتاحية:

الأورام الليفية الرحمية، مستخلص الزنجبيل، ملف الدهون، وظائف الكبد، المعايير الكيميائية الحيوية