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Abstract

The condition known as diabetes is defined as one in which insulin's homeostasis of lipid and sugar digestion is incorrectly regulated. This study aimed to investigate the antidiabetic properties of bitter wood or silver orache leaves powder or their mixture on streptocetozen (STZ) induced diabetic rats. A total of 40 rats, weighted 160± 5g, were used. And a single streptozotocin (STZ) intraperitoneal injection at 65 mg/kg body weight was administered to induce diabetic rats. Rats were randomly separated to 8 groups: Group 1, healthy rats as control negative group that given basal diet; Group2, the diabetic rats served as the positive control that just given the regular diet, groups 3-8, the diabetic rats which received the standard diet plus 2.5 and 5% of silver orache or bitter wood leaves powder individually and in combination for 8 weeks. Samples of blood were collected and biochemical markers like glucose levels, insulin, liver enzymes, renal function, white blood cells, red blood cells, hemoglobin, fructoseamine and C-peptied were measured after the experiment ended. The obtained results of data confirmed that, in evaluation to the control positive group, the examined plants ($P \leq 0.05$) dropped serum sugar, additionally enhanced kidney and liver functions. According to the findings, silver orache and bitter wood leaves powder might be considered antidiabetic agents due to consist of a variety of active phytochemical compounds. Further studies on different animal models are needed to prove these finding and detect the perfect safe active dose, duration and form that can be used.

Keywords: Silver orache- bitter wood – glucose- insulin – liver enzymes- kidney function.

تقييم التأثير المضاد لمرض السكري لمسحوق أوراق الخشب المر (*Quassia amara*) وأوراق نبات الريش الفضي (*Atriplex halimus L.*) على مرض السكري الناجم عن الاستربتوزوتوسين

يعرف مرض السكري بانه اضطراب في تنظيم توازن الانسولين الازم لهضم الدهون والسكريات . نهدف هذه الدراسه الي التحقيق في الخصائص المضادة لداء السكري لمسحوق أوراق الخشب المر أو أوراق الريش الفضي أو خليط منهما على الفئران المصابة بداء السكري المستحث بواسطة الاستربتوزوتوسين. تم استخدام ٤٠ فأر وزن (١٦٠ + ٥) جم وتم اعطائهم حقنه واحده بالتجويف البطني (الصفاق) من الاستربتوزوتوسين بواقع ٦٥ ملجم /كجم من وزن جسم الفأر وذلك للاصابه بارتفاع مستوي السكر بالدم .تم تقسيم الفئران الي ٨ مجموعات المجموعه الاولي السليمه (الضابطه السالبه) والتي تغذت علي الغذاء الاساسي فقط . والمجموعه الثانيه وهي المجموعه المصابه بالسكر والتي تم تقسيمها الي ٧ مجموعات فرعيه المجموعه الثانيه (الضابطه الموجبه) والتي تغذت علي الغذاء الاساسي فقط ، والمجاميع من ٣ الي ٨ تغذت علي الغذاء الاساسي مضاف اليه مسحوق اوراق الريش الفضي واوراق خشب المر وخليطهما بالجرعات ٢.٥ و٥% علي التوالي وذلك لمده ٨ اسابيع ثم تم جمع عينات الدم وقياس المؤشرات البيوكيميائية، مثل مستويات الجلوكوز، والأنسولين، وإنزيمات الكبد، ووظائف الكلى، وخلايا الدم البيضاء، وخلايا الدم الحمراء، والهيموغلوبين، والفركتوزامين، وببتيد-C و أكدت النتائج المتحصل عليها أنه بالمقارنة مع المجموعة الضابطة الموجبه ، انخفضت نسبة السكر في الدم ($P \leq 0.05$) في النباتات المدروسة. بالإضافة إلى ذلك، عززت من وظائف الكلى والكبد. ووفقًا للنتائج، يمكن اعتبار نبات الريش الفضي ومسحوق أوراق الخشب المر عوامل مضادة لمرض السكري لاحتوائهما على مجموعة متنوعة من المركبات الكيميائية النباتية الفعالة. وهناك حاجة إلى مزيد من الدراسات على نماذج حيوانية مختلفة لإثبات هذه النتائج وتحديد الجرعة الفعالة الآمنة والمدة والشكل الأمثل للاستخدام.

الكلمات المفتاحيه: نبات الريش الفضي- الخشب المر - الجلوكوز - الأنسولين- إنزيمات الكبد- وظائف الكلى.

Introduction

Diabetes mellitus (DM) is a frequent long-term metabolic condition marked by continuous high levels of blood sugar and worsened metabolic abnormalities. DM included three main categories gestational diabetes, type-1 diabetes mellitus (T1-DM), and type 2 diabetes (T2-DM) **Nuckols *et al.*, 2018)**. It is anticipated that approximately 537 million individuals aged between 20 and 79 globally are currently afflicted with DM, and projections indicate that by the year 2045, the number of DM patients will escalate to 783 million. DM was responsible for 747,000 deaths within the South-East Asia region, with the financial implications amounting to 10.1 billion USD. Among these cases, a significant 90% were classified as T2-DM, which is characterized by elevated blood glucose levels stemming from insulin resistance and/or deficiencies in insulin secretion **(Magliano, 2021).** Overall, this provides a solid foundation for further discussion on diabetes mellitus, particularly focusing on its prevalence, impact, and the significance of type 2 diabetes. Consequently, there is an increasing trend towards the exploration and development of novel pharmacological agents aimed at the prevention and management of T2-DM **(Magliano, 2021).** This complex disorder is caused by insulin resistance and a malfunction in insulin release, which raises blood sugar levels in diabetics. DM has various causes, and each person's symptoms might vary, making management challenging **(Berbudi *et al.,* ,2020)**. Chronically elevated blood sugar can cause long-term injure, impairment, and failure of the kidneys, heart, blood vessels, nerves, and eyes, among other body organs. These cell changes are caused directly by a number of internal and environmental variables, including oxidative stress, obesity, and inactivity **(chen *et al* .,2017)** Commercially available medications for the diabetes mellitus treatment include oral hypoglycemic medications (metformin and glibenclamide) that demonstrate anti-hyperglycemic effects via reactive oxygen radical scavenging (**Ouslimani *et al.,* 2005).** Chemical medications of diabetes have different of side effects **(Yedjou *et al.,* 2023**). Therefore, scientists have turned to different treatments, leading to a surge in studies to discover better medications with reduced side effects. The relationship between dietary elements and health has always been known, but recent research has provided a deeper insight into how bioactive traditional foods affect human health through chemical and physiological mechanisms (**Kasole *et al.,* 2019).** In the quest for new treatments for T2-DM, having an appropriate animal model for preclinical studies is crucial in ensuring the effectiveness of later clinical trials (**Gheibi *et al.,* 2017).** Among the most frequently utilized animal models in diabetes is the streptozotocin-induced in rats. Streptozotocin (STZ), a compound containing glucosamine-nitrosourea, destroys pancreatic β cells by alkylation of DNA, leading to the development of hyperglycemia (**Szkudelski, 2001).** Nonetheless, STZ by itself cannot induce insulin resistance, being a crucial characteristic of T2-DM **(Bagaméry *et al.,* 2020).** Plants have consistently served as a remarkable source of pharmaceuticals, with numerous contemporary medications originating from herbal sources. A significant variety of spices, herbs, and other botanical substances have been documented for their use in diabetes treatment globally (**Marles and Farnsworth, 1995).** Continuously, various biologically active substances in fruits, vegetables, and other natural sources that is effective in treating diabetes **(Xiao, 2022).** A fantastic substitute for many medications is phytochemicals, which are organic substances present in therapeutic plants. These substances have intriguing biological properties as well as potential medical uses. Numerous fruits, cereals, and herbs have been shown to possess a variety of significant biological properties, including antioxidant, **(Azman *et al.,* 2016),** antidiabetic, inflammation inhibitory activity, anti-analgesic, antitumor, anticancer, antimicrobial, antimutagenic, antidementia, antileishmanial, and antimalarial effects. Natural antioxidant consumption lowers the danger of several kinds of illnesses, such as diabetes, heart disease, cancer, and other aging-related conditions **(Kanwal *et al.,* 2011 and Sarhan *et al.,* 2023).** Polyphenolics, the main constituents of certain ancient medicinal herbs, have captured attention for their biological properties **(Xiao, 2022).**

Silvery orache (*Atriplex halimus* L.) grows In North Africa and the Middle East (**Walker *et al.,* 2014).** It has been reported that *A. halimus* has therapeutic qualities in both modern pharmacology and traditional medicine **(Walker *et al.,* 2014).** Also, *A. halimus* was used for treatment of intestinal worms, stomach pains, gall bladder excretions, chest ailments, and as a laxative **(Chikhi et al., 2014).** Antidiabetic effects of *A. halimus*, due to its capability to lower insulin resistance and improve absorption of glucose via peripheral tissues. The plant contains various active biologically compounds like flavonoids, phenolic acids, and alkaloids, showing both hypoglycemic and antioxidant effects (**Walker *et al.,* 2014).** It *A. halimus's* abundance of secondary metabolites. It contains high concentrations of phenolics, flavonoids that have high antioxidant capacity suggests that they can be used as a natural source of nutritious and healthful food ingredients (**Guedri, *et al.,* 2024).**

Bitter wood (*Quassia amara)*, commonly known as bitter wood, that grown in Brazil, Peru, Venezuela, Suriname, Colombia, Argentina, and Guiana. Additionally, it is cultivated in gardens in India for its attractive leaves and vibrant flowers **(Krishnamurthi, 1969).** *Quassia amara* is extensively utilized by indigenous populations in South America and Costa Rica as a bitter tonic, primarily for the treatment of malaria, ulcers, and colic-related abdominal pain **(Felter, 1922).** Bitter wood contains a variety of chemicals, including cantin-6 alkaloids, β-carboline, and primarily "quassinoids." (**Remya , and Goyal, 2017).**
*Quassia amara*is recognized in the list of food additives that are authorized for direct incorporation into food intended for human consumption **,** extract of *Quassia amara*, are utilized to enhance appetite and serve as a tonic for lowering blood sugar levels. Traditionally, *Quassia amara* has been employed as an antidiabetic treatment in Costa Rica and Guatemala (**DeFilipps *et al.,* 2004; Van Andel and Westers, 2010).** The main treatment strategy for diabetes mellitus involves the use of a combination of hypoglycemic agents and insulin. Nevertheless, this approach is associated with various side effects and can be costly. Recently, natural products used as therapeutic options for illness, including diabetes, has gained favor due to their accessibility, safety, and cost-effectiveness **(Salehi *et al.,* 2019).**

Consequently, This investigation was carried out to evaluate the efficacy of natural products such as *A. halimus* and *Quassia amara* powder at concentrations of 2.5 and 5% individual and combination between them in treatment of diabetic rats induced by STZ.

Materials and Methods

Materials:

In Cairo Governorate, Egypt, samples of bitter wood (*Quassia amara*) and silver orache (*Atriplex halimus L.*) leaves were obtained from Agriculture Seeds, Spices, and Medical Plant Company (Harraz), El-Darb El-Ahmar. The Department of Agricultural Plants, Faculty of Agriculture, Menoufia University, Shebin El-Kom, Egypt, is where the samples were validated.

Chemicals

The assay kits for serum glucose, insulin level, alkaline phosphatase (ALP), aspartate aminotransferase (AST), and alanine aminotransferase (ALT) were acquired from BIODIAGNOSTIC, Dokki, Giza, Egypt. Sigma-Aldrich Inc. (St. Louis, Mo., USA) provided the streptozotocin (STZ), which was used to cause diabetes in rats. Morgan Chemical Co. in Cairo, Egypt, provided the casein. We bought organic solvents, food-grade vitamin and salt mixes, and other analytical-grade chemicals from El-Ghomhorya Company for Trading Drugs, Chemicals, and Medical Instruments in Cairo, Egypt. From Giza, Cairo, forty adult albino rats weighing 160± 5g were acquired.

Animals

The 40 adult male albino rats (Rattusnorvegic) weighing 160 ± 5 g were obtained from Animal House, National Research Institute (Cairo, Egypt). Rats were housed in groups in hygienic, well-ventilated cages at the Biological Laboratory, Home Economics Faculty, Nutrition and Food Science Department, ShibinElɕkom (Menoufia), Egypt. For a period of seven days, they were fed the normal diet **AIN-93**, as described by **Reeves *et al.*, (1993).** The Institutional Animal Ethics committee gave its ethical approval to this investigation. University of Menoufia (MUFHE /F/ NFS / 11/25) eithical protocol

Methods

Experimental protocol

A total of 40 rats were used and weighted (160± 5g) each group (n=5). A single streptozotocin (STZ) intraperitoneal injection at 65 mg/kg body weight was administered to induce diabetic rats after dissolved in a fresh 0.01 M citrate buffer (PH 4.5) as descripted by **Yanardağ *et al.* (2003).** Polydipsia, polyurea (visual observations), and fasting blood glucose levels measured 72 hours after STZ injection were used to diagnose diabetes. Rats utilized in this study were classified as diabetic if their levels of fasting blood glucose were greater than 200 mg/dl., that rats were randomly separated to 8 groups. Group 1 was served as control negative group (normal rats) (n=5) that given basal diet. The rats with diabetes in Group II (n=35) had been then split into seven subgroups at random: Group2, the group served as the positive control, that just given the regular diet; group3- 8, which received the standard diet plus 2.5 and 5% of silver orache and bitter wood leaves powder individually and combination of them of for 8 weeks .

Blood and tissue samples collection

At the experimental period end, all rats were fasted for the whole night. Following ether anesthesia scarification, blood samples were extracted from the liver's portal vein and placed in sterile centrifuge tubes. Serum samples were obtained by centrifuging blood at -40°C for 10 minutes at 4000 rpm. The sera were then kept frozen at -20°C in the plastic vial until analysis **(Schermer, 1967).** Pancrease tissues were promptly dissected on ice for biochemical tests.

Biological Evaluation

On the diet taken, records were kept daily for 56 days while the body weight was weighed every week. The parameters for body weight gain (BWG %), food intake (FI), and food efficiency ratio (FER) were assessed following the methodology outlined by **Chapman (1959).** The calculations were performed using the formulas: BWG (%) = [(Final weight – Initial weight)/Initial weight] × 100 and FER = grams of body weight gained (g over 56 days)/grams of feed consumed (g over 56 days).

Biochemical analysis

Via commercial kits, urea, uric acid and creatinine levels in serum were evaluated accordance to **Patton and Crouch (1977), Fossati *et al.,* (1980) and Tietz (1986),** regulatory. Blood glucose was detected as descripted by **Rojas *et al.,* (1999).** Serum insulin level was assayed by **Grinspoon *et al.,* (1996).** fructoseamine was determined according to **Scott (1935).** Liver functions were detected using specific methods as following: alkaline Phosphatases (ALP) pointed out by **Tietz (1976),** alanine aminotransferase (ALT), aspartate aminotransferase (AST) as described by **Henry *et al.,* (1974),** The concentration of red blood cell count (RBCs), hemoglobin (HB), hematocrit(HTC), white blood cell count (WBCs) and Platelets (PLT) were detected by the described method of **Dacie& Lewis (1998).**

Statistical analysis

The results were evaluated using the statistical software SPSS for Version 10 Windows and displayed as Means ± Standard Deviation. The variances between groups were analyzed using the one-way ANOVA test in the statistics package, and the levels of significance were assessed at a significance level of $P \leq 0.05$ using Duncan's multiple comparison test as a post hoc test **(Artimage and Berry, 1987).**

Results and Discussion

Effect off treatment with silvery orache leaves and bitter wood powder on body weight, food intake

and food efficiency ratio

The body weight gain (BWG), food intake (FI) and food efficiency ratio (FER) of negative control, diabetic control and diabetic rats treated by silver orache leaves and bitter wood powder at concentrations of (2.5 and 5%) individually and mixtures of them at the same concentrations are summarized in Table (1). From the obtained results, it was remarkable that there was highly significant reduction in BWG % as a result of diabetes caused via STZ at dose of (65 mg / kg body weight) that showed 4.55± 0.004 as compared to values of normal rats that showed 12.05± 0.003. The mean values of BWG showed highly significant increases in all treated groups except group 3 which treated silver orache leaves powder with 2.5 % that showed non-significant elevate compared to diabetic control group. All treated groups, except Group 3, showed statistically significant increases in BWG% compared to the diabetic control group, groups 8 (5% mixture) and 7 (2.5% mixture) exhibited the most significant increases in BWG% among the treated groups. With respect FI, all treated groups with silver orache and bitter wood leaves powder revealed an improvement in food intake (g/day) as compared to diabetic rats. Similarly, the administration of silver orache leaves and bitter wood powder led to highly significant increases in FER, indicating a better conversion of food to body mass in the treated groups compared to the diabetic control. These results suggest that treatment with both individual and combined silver orache leaves and bitter wood powder improved BWG, FI, and FER in STZ-induced diabetic rats, with the combination treatments showing particularly promising effects.

According to the obtained results, there was a correlation between hyperglycemia and the decreased body weight of diabetic animals. This is consistent with a previous study by **Soudamani *et al.*, (2005),** which found that insulin administration partially prevented the significant (53%), decrease in body weight gain of diabetic rats injected with STZ. According to **Zafar and Naqvi (2010),** rats treated with STZ-induced diabetes showed signs of ill health and weight loss due to the harmful effects of STZ, which resulted in DNA alkylation, hyperglycemia, and necrotic lesions. Additionally, **Wickramasinghe *et al.*, (2022)** found that whereas a significant decrease in body weight following STZ injection is typically the persistence of body weight comparable to normal control rats following STZ injection suggested the development of type 2 DM. According to a recent study by **Maaliah *et al.*, (2024),** rats given STZ saw a modest drop in body weight.

Chikhi *et al.*, (2014) reported aqueous leaf extract of *Atriplex halimus* L. could improve body weight in STZ–induced diabetes. **Husain *et al.*, (2011**) concluded that administration of STZ resulted in a significant decrease in the body weight of the rats in comparison to the normal rats. However, the diminished body weights were observed to be restored in the rats treated with *Quassia amara* extract when contrasted with the vehicle-treated diabetic rats. Recently, **Metawea and Shaheen, (2021)** reported that *A. halimus* improved the BWG, FI and FER in diabetic rats.

Table (1): Effect of silvery orache leaves and bitter wood powder on body weight, feed intake and feed efficiency ratio

Group	Parameters					
	BWG (g/56day)		FI (g/day)		FER (g/day)	
	Mean±SD	%	Mean±SD	%	Mean±SD	%
Group1(negative control)	12.05±0.003[a]	0	16.97±0.09[a]	0	2.32±0.004[a]	0
Group2(positive control)	4.55±0.004[b]	62.24	11.75±0.04[d]	30.76	1.61±0.002[c]	30.60
Group 3 (2.5 % SOLP)	5.65±0.004[b]	53.11	13.20±0.07[cd]	22.22	1.60±0.002[c]	31.03
Group 4 (5 % SOLP)	10.17±0.007[a]	15.60	13.62±0.02[c]	19.74	2.01±0.002[b]	13.36
Group 5 (2.5 % BWLP)	10.77±0.002[a]	10.62	14.52±0.03[bc]	14.44	2.12±0.002[ab]	8.62
Group 6 (5 % BWLP)	10.97±0.006[a]	8.96	15.25±0.05[b]	10.14	2.17±0.003[ab]	6.47
Group 7(2.5% Mix.)	11.17±0.005[a]	7.30	15.72±0.07[ab]	7.37	2.25±0.002[ab]	3.02
Group 8 (5 % Mix.)	11.90±0.007[a]	1.24	16.10±0.06[ab]	5.13	2.27±0.003[ab]	2.16

The values represented mean ± SD. The means that do not share the same letter are significantly different (*P*-value < 0.05)

BWG: Body weight gain, FI: Food intake, FER: Food efficiency ratio, SOLP: silvery orache leaves powder, BELP: bitter wood leaves powder.Mix: mixture.

Effect off treatment with silvery orache leaves and bitter wood powder on relative pancreas weight

The obtained results, presented in Table 2 (mean ± SD), indicated a hypertrophic enlargement of the pancreas in the diabetic control rats, showing a significantly higher relative weight (0.815 ± 0.13 g/100g body weight) compared to the normal control rats (0.517 ± 0.09 g/100g body weight). Treatment of diabetic rats for four weeks with silver orache and bitter wood leaves powder resulted in a statistically significant regression ($p < 0.05$, ANOVA) in pancreas relative weight, particularly with the 5% combination treatment. Group 8 (5% mixture) exhibited the most substantial reduction, recording a relative pancreas weight of 0.512 ± 0.06 g/100g body weight, approaching the level observed in the normal control group. These findings align with **Röder et al. (2016)**, who highlighted the pancreas as a key organ in blood glucose management through the secretion of insulin and glucagon. The observed reduction in relative pancreas weight in the treated groups suggests a potential protective effect against the diabetes-induced pancreatic hypertrophy, a phenomenon often associated with increased insulin demand and cellular stress in diabetes, as noted by **Guo et al. (2018)** regarding histopathological alterations in the pancreas. The findings by **Bounouar et al. (2022)** that A. halimus aqueous extract improved Langerhans islets in diabetic rats, potentially due to its phenolic compound content **(Deka et al., 2022)**, may offer a possible mechanism for the beneficial effects observed in our study. Further investigation into the histopathological changes in the pancreas in our treated rats could provide additional insights into these protective mechanisms.

Table (2): Effect silvery orache leaves and bitter wood powder on relative pancreas weight

Organs weight (g/100 g. B.Wt.)		
Groups	**Pancreas**	
	Mean ±SD	**%**
Group 1(negative control)	0.517±0.09[d]	0
Group 2 (positive control)	0.815±0.13[a]	(56.67)
Group 3(2.5% SOLP)	0.792±0.07[ab]	(53.19)
Group 4(5% SOLP)	0.720±0.13[abc]	(39.26)
Group 5(2.5%BWLP)	0.672±0.07[bc]	(29.98)
Group 6(5%BWLP)	0.652±0.05[c]	(26.11)
Group7(2.5%mix.)	0.629±0.08[cd]	(21.66)
Group 8 (5%mix.)	0.512±0.06[d]	0.97

The values represented mean ± SD. The means that do not share the same letter are significantly different (*P*-value < 0.05)

SOLP: silvery orache leaves powder, BELP: bitter wood leaves powder.Mix: mixture.

Effect of treatment with silvery orache leaves and bitter wood powder on serum glucose

It has been reported that, diabetes is considered among the most present endocrine diseases that affects negatively on human health. Induction of diabetes causes various metabolic disorders, including hyperglycemia, hyperlipidemia, hypertension, atherosclerosis, retinopathy, neuropathy, and nephropathy **Jörns, *et al.*, 2014** and **Wojciechowska, *et al.*, 2016).** Recently, **Alrasheedi, *et al.*, (2024)** mentioned that diabetes mellitus induced by STZ produced significant elevate in serum glucose levels. As a result of injection of (STZ) at dose 65 mg / kg body weight to induce diabetes mellitus that indicated in Table (3), the obtained results confirmed that highly significant raises in serum glucose levels of diabetic rats in comparable to negative control rats. The mean value of serum glucose level in diabetic rats was 225.4 ± 1.14 (mg/dl) while, the mean value of control group was 88.8± 1.14 (mg/dl).

Treatment with silvery orache leaves and bitter wood powder at various concentrations significantly reduced serum glucose levels in diabetic rats compared to untreated controls. Furthermore, it was observed that diabetic rats treated with bitter wood leaves powder at two doses of (2.5 and 5%) appeared significant reductions in blood glucose levels compared to diabetic rats treated with silvery orache and positive control group. Bitter wood was more effective as antidiabetic agent. From the above-mentioned data, it could be concluded that all diabetic treated groups revealed significant reductions in serum glucose levels especially at higher concentration (5%mixture) in group 8 that was 98.2±0.31 (mg/dl) that is near to normal rats that recorded 88.8 ± 0.42 (mg/dl).

Diabetiv rats induced by STZ- showed a significant raise in glucose levels plus a considerably lower of serum insulin. The results obtained are consistent with a prior study by **Szkudelski (2001),** who noted that among the most widely utilized animal models in diabetes mellitus is streptozotocin-induced rats. STZ is a glucosamine-nitrosourea component that causes hyperglycemia by alkylating DNA and destroying pancreatic β cells. Furthermore, these findings align with prior studies demonstrating STZ's efficacy in inducing hyperglycemia in animal models (**Zafar & Naqvi, 2010; Maaliah et al., 2024**) and its potential to cause compensatory pancreatic islet hypertrophy and damage leading to impaired glucose homeostasis (**Lebovitz & Banerji, 2004**).

A fantastic substitute for many medications is phytochemicals, which are organic substances present in therapeutic plants that have biological properties as well as potential medical uses. Vital biological effects, including antioxidant, inflammation inhibitory action, antidiabetic, antimutagenic, antitumor, anticancer, anti-analgesic, antidementia, antimicrobial, antileishmanial, and antimalarial activities **(Azman *et al.,* 2016).** Consuming natural antioxidants lowers the risk of a number of illnesses, such as diabetes, cardiovascular, cancer illness, plus other aging-related conditions **Greenwell and Rahman (2015).** Phytochemicals, also known as phytonutrients, are compounds derived from plants that are known to be good sources of natural antioxidants (**Hashmi *et al.,* 2023).** Previously**, Chikhi *et al.,* (2014)** reported the antidiabetic properties of *Atriplexhalimus L* aqueous extract in streptozotocin–caused diabetic rats that decreased serum glucose levels. *A. Halimus's* ability to enhance glucose absorption in peripheral tissues and reduce insulin resistance. Alkaloids, flavonoids, and phenolic acids are among the physiologically active substances found in the plant that have hypoglycemic plus antioxidant activities **(Walker *et al.,* 2014**). Recently, **Metawea and Shaheen, (2021)** reported that *A. halimus* improved the decreased serum glucose levels in diabetic rats. Similarly, **Bounouar *et al.* (2022)** conducted the effect of A. *halimus* extract on streptozotocin-caused diabetic diabetic rats prevented the development of complications from the disease and dramatically reduced their blood glucose levels. Additionally, *A. halimus* from Tunisia had a significant antidiabetic effect by inhibiting the enzymes α-amylase and α-glucosidase, which are linked to type-2 diabetes that may be related to its content of phenols such as terpenes, sterols, saponins (**Guedri *et al.,* 2024)**

Husain *et al.*, (2011) confirmed that treatment with bitter wood leaves extract (*Quassiaamara*) improved hyperglycemia and decreased blood glucose levels, which is consistent with the glucose-lowering effects of silvery orache and bitter wood leaves in streptozocin-induced diabetes mellitus in rats and its absence of serum glucose levels in hyperglycemic rats. Similarly, according to **Ferreira et al. (2013)** determined that the oral intake of the aqueous extract derived from wood powder of *Quassiaamara*exhibited an anti-hyperglycemic effect in diabetic rats induced by alloxan. The underlying mechanism of the anti-hyperglycemic activities of *Quassiaamara*is thought to be similar to that of metformin. It is suggested that diabetic individuals may benefit from the use of *Quassiaamara* as a supplementary treatment to assist in regulating blood glucose levels. The antihyperglycemic effect of *Quassiaamara*may be related to the phenolic of bitter leaf extract slows the breakdown of polysaccharides to sugar and, as a result, reduces the amount of sugar absorbed by the organs by inhibiting the amylase and glucosidase enzymes activity as **(Kianbakht *et al.*,2013).** Recently, El-**Kholie, *et al.*, (2024)** reported that treatment with (*Quassiaamara*) roots powder lowered glucose levels in serum of diabetic rats caused by alloxan.

Table (3): Effect of silvery orache leaves and bitter wood powder on serum glucose (mg/dl).

Groups	Parameters Glucose (mg/dl) Mean ± SD	%
Group 1(negative control)	88.8±0.42[f]	0
Group 2(positive control)	225.4±1.14[a]	(153.83)
Group 3 (2.5 % SOLP)	177.4±0.33[b]	(99.77)
Group 4 (5 % SOLP)	154.4±0.23[c]	(73.87)
Group 5 (2.5 % BWLP)	139.6±0.14[d]	(57.21)
Group 6 (5% BWLP)	129.6±0.21[de]	(45.95)
Group 7 (2.5% Mix.)	118.4±0.11[e]	(33.33)
Group 8 (5% Mix.)	98.2±0.31[f]	(10.59)

The values represented mean ± SD. The means that do not share the same letter are significantly
different (*P*-value < 0.05)SOLP: silvery orache leaves powder, BELP: bitter wood leaves powder.Mix: mixture.

Effect off treatment with silvery orache leaves and bitter wood powder on serum insulin

It well known that diabetes mellitus could be induced by STZ that is an antibiotic and used experimentally in mice and rats model that can causes destruction of pancreatic β-cell, insulin deficiency and hyperglycemia and this model could be used to evaluate the therapeutic options **(Wu and Huan, 2008).**

As indicated from the obtained data in Table (4) introduced the mean values of serum insulin (mg/dl) of normal, diabetic rats and diabetic treated rats. The results appeared that the insulin mean values of diabetic rats were considerably reduced as compared to normal rats that recorded 2.62±0.24 (mg/dl) while the corresponding value of normal rats was 19.3±4.16 (mg/dl). Dramatically, the serum glucose levels reduction associated with the imprudent in serum insulin levels. At the same table (4), the obtained results showed that, treatment of diabetic rats by administration of silvery orache leaves and bitter wood powder at different concentrations resulted in increasing secretion of insulin. Additionally, it was remarkable that treatment of diabetic rats with bitter wood leaves at different concentrations was more effective than silvery orache as compared to diabetic rats by increasing in insulin secretion. The highest values of insulin were observed in group 8 and group 7 that administered with (5% mixture) and (2.5% mixture), respectively of silvery orache and bitter wood leaves powder as compared to diabetic rats.

Regarding these results, it could be considered that **Koksal, (2015)** reported that STZ-induced diabetes in rats and causes reduction of insulin levels in animal model. Moreover, STZ-induced hyperglycemia and increased glucose intolerance indicating impaired β cell function **(Wickramasinghe *et al.*, 2022)**. **Alrasheedi *et al.*, (2024)** mentioned that diabetes mellitus induced by STZ produced significant lower in serum insulin levels. The reduction of serum insulinin diabetic rats by treatment with tested materials was consistent with previous study by **Metawea and Shaheen, (2021)** reported that *A. halimus* improved serum insulin levels in diabetic rats.

Additionally, Oral consumption of *Quassia amar* extract showed a notable drop in blood glucose levels when compared to the animals with diabetes. These findings show that the extract most likely helps peripheral tissues like muscle and adipose tissue use glucose. These results indicate that *Quassiaamara* extract achieves antihyperglycemic effect by various mechanisms. This antihyperglycemic activity might be due to an extra-pancreatic action *of Quassia amara* and improvement in insulin (**Rader, 2007**). Recently, **El-Kholie, *et al.*, (2024) reported** that treatment with (*Quassia amara*) powder increased serum insulin levels in diabetic rats caused by alloxan.

Table (4): Effectsilvery orache leaves and bitter wood powder on serum insulin (mg/dl).

Groups	Parameters	
	Insulin (mg/dl)	
	Mean ± SD	%
Group 1(negative control)	19.3±4.16[a]	0
Group 2(positive control)	2.62±0.24f	86.42
Group 3 (2.5 % SOLP)	3.60±0.38[fe]	81.35
Group 4 (5 % SOLP)	4.55±0.32[fe]	76.42
Group 5 (2.5 % BWLP)	5.70±0.73[ed]	70.47
Group 6 (5% BWLP)	7.77±1.45[d]	59.74
Group 7 (2.5% Mix.)	10.5±1.57[c]	45.60
Group 8 (5% Mix.)	14.2±2.59[b]	26.42

The values represented mean ± SD. The means that do not share the same letter are significantly
different (*P*-value < 0.05)SOLP: silvery orache leaves powder, BELP: bitter wood leaves powder.
Mix: mixture.

Effect off treatment with silvery orache leaves and bitter wood powder on liver functions

The liver, a key organ in blood glucose regulation, preserves glucose homeostasis by either storing glucose as glycogen (glycogenesis) or releasing it into the bloodstream through glucose synthesis (gluconeogenesis) or glycogenolysis (glycogenolysis) in response to insulin or glucagon, respectively **(Röder et al., 2016). Yazdi, *et al.,* (2019)** reported that hepatic dysfunction occurred in STZ-induced diabetes.

The presented data in Table (5) illustrated that serum liver enzymes activities of ALT, AST and ALP (U/L) values considerably increased in diabetic rats as compared to the corresponding values of negative control group. From mentioned data, it was remarkable that, treatment of STZ- diabetic rats with silvery orache and bitter wood leaves at different concentrations (2.5 and 5 %) showed significant reductions in serum AST, ALT activities and ALP (U/L) values as compared to diabetic rats. The best results were observed in groupss that treated with high concentration at 5% of silvery orache leaves and bitter wood that reduced serum AST, ALT activities and ALP (U/L) values comparing to treatment at concentration of 2.5% and diabetic rats. Similarly, combination of two materials at concentrations of 2.5 and 5% revealed improvements in liver functions that decreased serum AST, ALT activities and ALP (U/L) values comparing to diabetic rats. Regarding these findings, it could be considered that, administration of silvery orache leaves and bitter wood especially higher dose at 5% of mixture reduced values of serum ALT, AST enzymes activities and ALP (U/L) that recorded 49.4 ± 3.52, 35.6 ± 5.44 and 4.38±0.217 (mg/dl) respectively, while the respective values of diabetic rats were 236.4±19.01, 110.4±6.77 and 6.45±0.18 (mg/dl) in regular.

The obtained results are in line with previous study by **Khaoula and Ali, (2020)** who revealed the hepatoprotective of *A. halimus* extract as restored serum ALT and AST and ALP in rats with hepatic injury. Also, **Metawea and Shaheen, (2021)** who reported that *A. halimus* improved liver functions in diabetic rats as reducing serum enzyme activities of ALT and AST values. **Roubi, *et al.,* (2023)** reported that *A. halimus* contains phytochemical compounds that acts as antioxidant agent. Additionally, **Balkrishna, *et al.,* (2022)** reported that bitter wood improved liver functions and hepatic congestion is reduced. Additionally, **Obembe *et al.,* (2021)** demonstrated hepatoprotective effect *of Quassia amara* against cadmium-induced toxicity. Recently, **El-Kholie, *et al.,* (2024)** reported that treatment with (*Quassia amara*) powder decreased liver enzymes activities in diabetic rats caused by alloxan.

Table (5): **Effect off treatment with silvery orache and bitter wood leaves powder on liver functions (U/L)**

Groups	Parameters					
	AST (U/L)		ALT (U/L)		ALP (U/L)	
	Mean ± SD	%	Mean ± SD	%	Mean ± SD	%
Group1(negative control)	32.4±4.69[g]	0	28.2±5.69[h]	0	3.74±0.199[f]	0
Group2(positive control)	236.4±19.01[a]	(629.63)	110.4±6.77[a]	(291.49)	6.45±0.189[a]	(72.46)
Group3(2.5% SOLP	203.8±18.09[b]	(529.01)	95.2±4.78[b]	(237.59)	6.10±0.163[b]	(63.10)
Group4 (5% SOLP	124.2±8.25[c]	(283.33)	82.4±5.78[c]	(192.20)	5.77±0.174[b]	(54.28)
Group5(2.5%BWLP)	105.6±8.66[d]	(225.93)	69.5±7.19[d]	(146.45)	5.47±0.211[c]	(46.26)
Group6(5% BWLP)	77.6±6.08[e]	(139.51)	59.3±4.83[e]	(110.28)	5.23±0.210[c]	(39.84)
Group7 (2.5%mix.)	61.6±3.23[f]	(90.12)	49.4±5.01[f]	(75.18)	4.73±0.210[d]	(26.47)
Group8 (5%mix.)	49.4±3.52[f]	(52.47)	35.6±5.44[g]	(26.24)	4.38±0.217[e]	(17.11)

The values represented mean ± SD. The means that do not share the same letter are significantly
different (*P*-value < 0.05) SOLP: silvery orache leaves powder, BELP: bitter wood leaves powder.
Mix: mixture.ALT: alanine transaminase; AST: aspartate transaminase; ALP: alkalineposphatase

Effect off treatment with silvery orache leaves and bitter wood powder on renal functions

Diabetic nephropathy is characterized by diabetic glomerular lesions, elevated urine albumin excretion, and a reduction in the glomerular filtration rate (GFR) among individuals with diabetes. This serious microvascular complication necessitates effective management of blood pressure and blood glucose levels to mitigate its progression **(Lim, 2014). Alrasheedi, *et al.*, (2024)** revealed that diabetes mellitus induced by STZ produced impairment in renal function by significant increase in serum urea nitrogen, uric acid and creatinine levels. Impairment of renal functions as a complication of diabetes mellitus was illustrated in Table (6) that presented mean values of urea nitrogen, uric acid and creatinine (mg/dl) of normal, diabetic rats and diabetic rats that treated with silvery orache leaves and bitter wood powder at concentrations of 2.5 and 5% individual and combination. According to these findings, the mean values of urea nitrogen, uric acid and creatinine (mg/dl) of diabetic rats were significantly elevated comparing to the mean values of normal rats. The improvement of glucose levels in serum may be related to the improvement in renal functions as a result of therapeutic therapy by administration of silvery orache and bitter wood leaves powder at level of (2.5 and 5%). There were significant reductions in serum urea nitrogen, uric acid and creatinine (mg/dl) levels of all treated diabetic rats in comparable to diabetic rats. There were no significant changes between treated groups (group 3 and 4), group5 and 6 except serum creatinine levels comparing to diabetic rats. The highest reductions were noticed in group 8 and group7 respectively that depended on combination of silvery orache leaves and bitter wood powder at levels of (2.5 and 5%).

According to **Sharma and Ziyadeh (1995),** Renal hypertrophy in insulin-dependent diabetes mellitus is associated with the overexpression of transforming growth factor (TGF)-beta 1 in the renal specifically in proximal convoluted tubules and glomerular mesangial cells. **Landau *et al.* (2003)** reported that growth hormone and insulin-like growth factors caused renal hypertrophy, mesangial proliferation, elevated glomerular volume, and glomerular extracellular matrix buildup. There for the growth hormone and insulin-like growth factor may directly cause renal enlargement (**Kumar*et al.,* 2010**). Additionally, **Haffner *et al.* (2021)** suggested that both cell types made balanced contributions to the hypertrophic growth of the kidney cortex. With respect to tested materials, *A. halimus* has been reported that it reduced serum urea nitrogen and creatinine levels in diabetic rats Recently, **Metawea and Shaheen, (2021)** reported that *A. halimus* improved kidney function of diabetic rats. **Recently, El-Kholie, *et al.,* (2024)** reported that treatment with (*Quassiaamara*) powder improved kidney function of diabetic rats caused by alloxan.

Table (6): **Effect silvery orache leaves and bitter wood powder on renal functions (mg/dl).**

Groups	Parameters					
	Urea (mg/dl)		Uric acid (mg/dl)		Creatinine(mg/dl)	
	Mean ± SD	%	Mean ± SD	%	Mean ± SD	%
Group 1(negative control)	27.6±1.82[f]	0	2.65±0.256[f]	0	0.65±0.030[e]	0
Group 2(positive control)	78.6±3.01[a]	(184.78)	4.65±0.415[a]	(75.47)	1.02±0.141[a]	(56.92)
Group 3 (2.5% SOLP)	69.4±3.15[b]	(151.45)	4.35±0.198[ab]	(64.15)	0.95±0.043[b]	(46.15)
Group4(5% SOLP)	65.8±1.90[b]	(138.41)	4.12±0.195[b]	(55.47)	0.90±0.04[bc]	(38.46)

Group5 (2.5% BWLP)	55.2±2.18^{c}	(100.00)	3.68±0.245^{c}	(38.87)	0.86±0.04^{bcd}	(32.31)
Group6 (5% BWLP)	45.6±2.28^{d}	(65.22)	3.35±0.277^{d}	(26.42)	0.83±0.04^{cd}	(27.69)
Group7 (2.5%mix.)	36.0±1.87^{e}	(30.43)	3.19±0.210^{de}	(20.38)	0.77±0.04^{d}	(18.46)
Group8 (5%mix.)	34.2±1.73^{e}	(23.91)	2.89±0.135^{ef}	(9.06)	0.68±0.06^{e}	(4.62)

The value represented mean ± SD. The means that do not share the same letter are significantly
different (*P*-value < 0.05) SOLP: silvery orache leaves powder, BELP: bitter wood leaves powder. Mix: mixture

Effect off treatment with silvery orache leaves and bitter wood powder on hematological parameters

Previously, It has been proposed that inflammatory pathways act as the fundamental pathogenic mediators for diabetes mellitus and cardiovascular diseases (**Lontchi -Yimagou *et al.*, 2013; Boucher *et al.*, 2012).** The obtained results in Table (7) indicated significant association between red blood cells (RBC) and white blood cells (WBC) count and diabetes. The results showed the hematological parameters as RBCs count (**10^6**/mm^3) and white blood cells WBCs count (10^6/mm^3) as a result of diabetes induced by STZ. The mean value of serum RBCs count of diabetic rats decreased significantly as compared to normal rats that recorded 3.09±0.61 and 7.75±0.86 respectively. It was noticed that there were non-significant increases in serum RBCs between (group 3 and 4) that treated with 2.5 and 5% silvery orache , (group5 and 6) that treated with 2.5 and 5% bitter wood leaves. Administration of combination of silvery orache leaves and bitter wood powder at concentration of 2.5 and 5 % significantly increased RBCs count. The higher dose showed the best results as indicated in group 8 that treated with combination of silvery orache and bitter wood leaves powder at 5%. With respect to WBCs (10^3/mm^3) count, it was remarkable that there were significant increases in WBCs (10^3/mm^3) count in diabetic rats that injected as STZ as compared to normal rats. Treatment with silvery orache leaves at levels of 2.5 and 5% appeared considerable reductions in serum WBCs count comparing to diabetic rats. Otherwise, treatment with Bitter Wood leaves at 2.5 and 5% showed significant reduction WBCs count of rats with diabetes and that treated with silvery orache leaves at the same levels. Surprising data was noticed in treated diabetic rats with combination of these two tested materials at 2.5 and 5 % as compared to diabetic rats and all treated groups with 2.5 and 5% of silvery orache and bitter wood leaves powder individually. The obtained results are in accordance with (**Naziroğlu and**

Cay, 2001 and Kheradmand *et al.*, 2021) who reported that there was significant reduction in serum RBCs in STZ- diabetic rats**.** Numerous studies have indicated a relationship between WBCs, serving as an indicator of subclinical inflammation, and both insulin resistance and type 2 diabetes; however, this association remains contentious **(Oda, 2015 and Du et al., 2009).** There were no data related to the effect of *A. halimus* and *Quassiaamara*on white and red blood cells but the positive effect of our study is related the the content of *A. halimus* and *Quassiaamara*in phenolic compounds **Zambonin *et al.*, (2012)** stated that phenolic acids demonstrated a reduction of reactive oxygen species (ROS) in a leukaemia cell line while. These compounds were non-toxic to normal cells and effectively inhibited proliferation in leukaemia cells, leading to apoptosis. In the ongoing discussion regarding the most effective strategies in leukaemia cells advocate for the antioxidant approach that depletes ROS.

Table (7): **Effect of silveryorache and bitter wood leaves powder on hematological parameters**

Groups	Parameters			
	R.B.Cs(10^6/mm^3)		W.B.Cs(10^3/mm^3)	
	Mean ± SD	%	Mean ± SD	%
Group 1(negative control	7.75±0.86^a	0	5.69±1.01^f	0
Group 2(positive control)	3.09±0.61^g	60.13	13.13±1.00^a	(130.76)
Group 3 (2.5 % SOLP)	3.37±0.35^{fg}	56.52	11.75±0.64^b	(106.50)
Group 4 (5 % SOLP)	3.88±0.50^{ef}	49.94	10.88±0.70^b	(91.21)
Group 5 (2.5 % BWLP)	4.44±0.36^{ed}	42.71	9.83±0.56^c	(72.76)
Group 6 (5% BWLP)	4.81±0.49^d	37.94	8.19±0.70^d	(43.94)
Group 7 (2.5% Mix.)	5.58±0.62^c	28.00	7.21±0.45^e	(26.71)
Group 8 (5% Mix.)	6.48±0.45^b	16.39	6.13±0.73^f	(7.73)

The values represented mean ± SD. The means that do not share the same letter are significantly
different (*P*-value < 0.05) SOLP: silvery orache leaves powder, BELP: bitter wood leaves powder. Mix: mixture
R.B.C: Red blood cells; W.B.C$_S$:White blood cells

Effect off treatment with silvery orache and bitter wood leaves powder on platlet count and homoglubin

The total number of platelet count and hemoglobin levels were established in Table (8). The obtained results appeared that diabetic rats have low levels of hemoglobin as complication of diabetes comparing to normal control group. The mean values of hemoglobin in diabetic and normal rats were respectively. The obtained results are in accordance with previous study by **Mansi, (2006)** who confirmed that hemoglobin levels were reduced in diabetes. Red blood cell count, and packed cell volume may decrease in tandem with hemoglobin reduction **(Moss, 1999).** Anemia could be indicated by extremely low RBC, hemoglobin, and hematocrit values **(Muhammad and Oloyede, 2009).** Recently, **Sharifi-Rad et al., (2023)** reported that There is limited evidence of the antiplatelet aggregation potential of phenolic compounds in vivo, despite the demonstrated protective properties of phenolic compound-rich plant extracts and isolated compounds against CVD. There were no data the relation between *A. halimus* and*Quassiaamara* and hemoglubin and paltet counts. Based on the obtained results, natural products serve as agents for cancer treatment, diabetes management, and multiple sclerosis. The polyphenolic components found in plant-derived products have been the focus of numerous scientific investigations because of their possible health advantages **(Khurana *et al.*, 2013).** Indeed, diets rich in polyphenols have shown significant effects on the vascular system, enhancing both platelet and endothelial functions **(Bijak *et al.*, 2019).** Additionally, various medicinal plants have exhibited bioactive properties that contribute to the reduction of platelet aggregation through these mechanisms (**Hirsch *et al.*, 2017).**

Table (8): Effect of silvery orache and bitter wood leaves powder on platlet countand homoglubin

Groups	Parameters			
	Platelet ($10^6/mm^3$)		Hemoglobin (g/dl)	
	Mean ± SD	%	Mean ± SD	%
Group 1(negative control)	213.0±6.01^{e}	0	13.59±0.65^{a}	0
Group 2(positive control)	249±10.40^{a}	(16.90)	9.23±0.45^{f}	32.08
Group 3 (2.5 % SOLP)	245.0±3.03^{ab}	(15.02)	9.62±0.55^{ef}	29.21
Group 4 (5 % SOLP)	243.0±3.22^{ab}	(14.08)	10.19±0.63^{de}	25.02
Group 5 (2.5 % BWLP)	241.0±4.39^{ab}	(13.15)	10.93±0.34^{cd}	19.57
Group 6 (5% BWLP)	236.0±7.40^{bc}	(10.80)	11.62±0.66^{bc}	14.50
Group 7 (2.5% Mix.)	228.0±10.0^{cd}	(7.04)	12.04±1.20^{b}	11.41
Group 8 (5% Mix.)	223.0±7.01^{d}	(4.69)	12.43±0.75^{b}	8.54

The values represented mean ± SD. The means that do not share the same letter are significantly
different (*P*-value < 0.05)SOLP: silvery orache leaves powder, BELP: bitter wood leaves powder. Mix: mixture

Effect off treatment with silvery orache and bitter wood leaves powder on Fructsamine and and C-peptide.

Data are presented in Table (9) illustrated that the mean values of fructoseamine and C-peptide (mg/dl). It was remarkable that the mean values of fructsamine and C-peptide of diabetic rats were considerably elevated comparing to healthy rats. Treatment of diabetic rats with silvery orache and bitter wood leaves powder at all tested concentrations significantly reduced the elevated mean serum levels of both fructoseamine and C-peptide compared to untreated diabetic rats (as shown in Table 9). As indicated the higher concentration (5%) was more effective than the lower in all cases. The combination of these two materials was more effective than individual treatment.

Regarding these findings, it was noticed that both individual and combined treatments with silvery orache and bitter wood leaves powder at concentrations of 2.5% and 5% improved serum levels of fructoseamine and C-peptide in diabetic rats. Fructosamine serves as a reliable indicator of mid-term (previous two weeks) glycemic control by reflecting the serum levels of overall glycosylated proteins (**Shafi et al., 2013**). Additionally, it has been reported that β-cell dysfunction and increased insulin resistance are recognized as critical factors in the development of type 2 diabetes **(Cerf, 2013).** C-peptide levels are a direct measure of endogenous insulin production by pancreatic β-cells, as it is a byproduct of insulin synthesis (**Maddaloni et al., 2021**). Previous research indicates that phenolic compounds can contribute to the reduction of serum glucose and fructosamine levels (**Erejuwa, et al., 2010**). Similarly, **Cianciosi, et al., (2018)** specifically noting the effect of honey's phenolic compounds on reducing fructosamine in diabetes

Table (9): Effect of silvery orache and bitter wood leaves powder on Fructseamine and C-peptide values

Groups	Parameters			
	Fructsamine (mg/dl)		C-peptide(mg/dl)	
	Mean ± SD	%	Mean ± SD	%
Group 1(negative control)	1.96±0.19[e]	0	1.11±0.16[f]	0
Group 2(positive control)	4.96±0.28[a]	(153.06)	4.44±0.48[a]	(300.00)
Group 3 (2.5 % SOLP)	4.15±1.28[b]	(111.73)	3.50±0.57[b]	(215.32)
Group 4 (5 % SOLP)	3.88±0.44[b]	(93.88)	2.66±0.36[c]	(139.64)
Group 5 (2.5 % BWLP)	3.25±0.40[c]	(65.82)	2.18±0.32[d]	(96.40)
Group 6 (5% BWLP)	2.74±0.42[d]	(39.80)	1.77±0.23[de]	(59.46)
Group 7 (2.5% Mix.)	2.52±0.43[d]	(28.57)	1.50±0.23[ef]	(35.14)
Group 8 (5% Mix.)	2.25±0.44[ed]	(14.80)	1.34±0.35[ef]	(20.72)

The values represented mean ± SD. The means that do not share the same letter are significantly
different (*P*-value < 0.05) SOLP: silvery orache leaves powder, BELP: bitter wood leaves powder. Mix: mixture

Conclusion

Based on the obtained results, we concluded treatment with that silvery orache and bitter wood leaves revealed antidiabetic effect at concentrations of 2.5 and 5% in all cases either or individual or combination especially combination at 5%.

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