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Research Article

Comparative study on the effects of *Portulaca oleracea* extract and a commercial dietary supplement in spontaneously hypertensive rats with induced type 2 diabetes

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Abstract

This study aimed to compare the antimetabolite effects of *Portulaca oleracea* (purslane) extract (EPO) and a commercial dietary supplement composed of chromium, cinnamon, and purslane extract in streptozotocin-induced diabetic spontaneously hypertensive rats (SHR). The study evaluated the impact of these bioactive substances on body weight and serum and liver biomarkers. Treatment of diabetic SHR with EPO or the food supplement significantly reduced blood glucose, but without reaching the control level. EPO showed the most pronounced effects on hepatic oxidative markers, as it reduced the amount of MDA by 31% and increased GSH levels by 24% compared to the pathological group. The present study is a piece of evidence of the health-promoting effects of edible *P. oleracea*. As a rich source of oleraceins, flavonoids, hydroxybenzoic, hydroxycinnamic, and caffeoylquinic acids, it could be considered a practical approach to managing the diverse elements of metabolic disorders and for its applications as additives in alternative or conventional therapy.

Keywords

Blood glucose, cinnamon, oxidative stress, *Portulaca oleracea*, type 2 diabetes

Introduction

Type 2 diabetes mellitus (T2DM) is one of the most prevalent metabolic disorders worldwide. Its pathogenesis is primarily driven by defective secretion of pancreatic β-cells and an inadequate insulin response of insulin-sensitive tissues. Since insulin production, release, and signaling are fundamental to maintaining glucose homeostasis, the molecular pathways governing insulin biosynthesis, secretion, and receptor-mediated detection are tightly regulated. Disruption at any stage of these tightly coordinated processes can result in metabolic dysregulation, contributing to the onset and progression of T2DM (Galicia-Garcia et al. 2020).

Type 2 diabetes accounts for more than 90% of all diabetes cases worldwide and currently ranks as the eighth leading cause of global disease burden. Epidemiological projections indicate that it may become the second

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leading cause by 2050, underscoring the urgent need for improved preventive and therapeutic strategies. According to the 11th edition of the International Diabetes Federation (IDF) Diabetes Atlas, the global prevalence of diabetes in 2024 is estimated at 589 million adults aged 20–79 years, corresponding to 11.1% of this population group. These estimates include both diagnosed and undiagnosed cases. By 2050, the number of affected individuals is projected to increase to 852.5 million. While the global population is expected to expand by approximately 25% over the next 25 years, the prevalence of diabetes is anticipated to rise disproportionately by 45%, reflecting the accelerating burden of this condition (https://diabetesatlas.org/resources/idf-diabetes-atlas-2025/).

Among the sixteen identified risk factors analyzed worldwide, elevated body mass index (BMI) has emerged as the predominant contributor to T2DM, accounting for 52.2% (95% UI 25.5–71.8) of global disability-adjusted life years (DALYs) attributed to the disease (Ong et al. 2023).

Obesity is another major risk factor for the development and progression of type 2 diabetes mellitus, reaching pandemic levels. Sustained moderate weight loss has been consistently shown to improve glycemic control, enhance insulin sensitivity, and reduce the need for pharmacological therapy. These findings underscore the ongoing need to identify effective and safe strategies for weight management as a fundamental approach to diabetes prevention (Blüher 2019).

Dyslipidemia has been proven to have a central role in T2DM pathophysiology. Elevated plasma triglyceride levels represent another significant risk factor, with growing evidence supporting their critical role in disease development. According to Barrera Echegoyen et al. (2023), circulating triglyceride concentrations ≥ 150 mg/dL are reported in 40–55% of patients with T2DM. In another study, higher fasting triglyceride levels are associated with an increased diabetes-related mortality risk (Wang 2021).

Alterations in cholesterol metabolism are also frequently observed in individuals with diabetes. Reduced levels of high-density lipoprotein cholesterol (HDL-C) are common: approximately 50% of women with diabetes exhibit low HDL-C concentrations, while one in four diabetic men presents with markedly reduced HDL-C levels. These lipid abnormalities further exacerbate cardiometabolic risk in affected populations (Bruckert et al. 2007).

These considerations, together with the adverse effects associated with conventional therapy, have prompted the scientific community to shift its focus toward the exploration and development of novel pharmacotherapeutic strategies for glycemic control, primarily based on plant-derived bioactive compounds, aiming to achieve comparable therapeutic efficacy with an improved safety profile.

Portulaca oleracea (purslane) L., (Portulacaceae) is a well-known ethnomedicinal and edible plant in Europe, Asia, and the Mediterranean regions. Purslane is a succulent annual herb, with reddish, glabrous (smooth) stems forming mats up to 25 cm or more. It features fleshy, obovate-spatulate leaves, small yellow flowers with five petals, and a dry, dehiscent capsule fruit filled with tiny black seeds (World Flora Online). *P. oleracea* is among the eight most widespread plants in the world (Mohamed Ahmed et al. 2025), making it an affordable and accessible source for investigating its biologically active compounds. A previous study revealed the presence of flavonoids, polyphenols, polysaccharides, and saponins by spectrophotometric methods (Gevrenova et al. 2016). Afterwards, Voynikov et al. (2019) developed a UHPLC-HRMS method for the simultaneous determination of phenolic acids and flavonoids in purslane, with emphasis on the structural characterization of oleraceins. Recently, on the basis of differential metabolomic analysis data on 38 purslane accessions originating from Bulgaria and Greece, 50 secondary metabolites were identified, and 29 of them were reported for the first time (Balabanova et al. 2020). Additionally, after an in-depth MS2 analysis, a total of 51 oleracein compounds were tentatively identified in *P. oleracea* hydromethanolic extract of the aerial parts. Among them, 26 had structures matching one of the already known oleraceins, and the other 25 were new, undescribed compounds belonging to the oleracein class (Voynikov et al. 2021).

A substantial portion of purslane's phytochemical composition has already been characterized, and numerous studies have demonstrated its antidiabetic and hypolipidemic effects. In type II diabetic mice, its administration has been associated with reductions in total cholesterol, triglycerides, fasting blood glucose, low-density lipoprotein cholesterol (LDL-C), and liver enzymes including alanine aminotransferase (ALT), aspartate aminotransferase (AST), and gamma-glutamyl transferase (GGT); total and direct bilirubin; fasting and postprandial glucose levels; circulating insulin; body weight; and BMI have been observed, accompanied by a significant increase in HDL-C levels (El-Sayed 2011).

There are a large number of dietary supplements on the market containing chromium, cinnamon, zinc, and different plant extracts that are formulated to maintain euglycemia and reduce body weight and serum lipids. Some of these dietary supplements have also been studied in humans, and randomized clinical trials have been conducted (Liu et al. 2015; Zhang et al. 2026). In addition to purslane, cinnamon has been studied for its antidiabetic, hypolipidemic, and anti-inflammatory properties (Zhang et al. 2026). Furthermore, individuals with T2DM have been reported to exhibit lower chromium levels (Rajendran 2015). Chromium picolinate can contribute to improving glycemic control (Asbaghi et al. 2020) and lipid metabolism (Cefalu et al. 2002), as well as HbA1c and total cholesterol (Anderson et al. 1997). Studies also show reductions in body weight, body mass index, and body fat percentage in overweight or obese individuals with T2DM (Tsang et al. 2019). Nevertheless, findings reported in the literature are not fully consistent, and additional well-designed studies are required to clarify these effects and draw definitive conclusions.

The purpose of this study was to compare the effects of a hydroalcoholic extract of purslane (EPO) prepared in

the Faculty of Pharmacy and the commercial dietary supplement composed of chromium, cinnamon, and purslane extract in streptozotocin-induced diabetic spontaneously hypertensive rats (SHR). The investigation assessed their impact on body weight, serum cholesterol, triglycerides, blood glucose, aspartate aminotransferase (AST), alanine aminotransferase (ALT), reduced glutathione (GSH), and malondialdehyde (MDA). In addition, hematological parameters, including platelet, erythrocyte, and leukocyte counts, were analyzed to provide a comprehensive evaluation of metabolic and oxidative alterations associated with the experimental model.

Materials and methods

Plant materials

Portulaca oleracea aerial parts were collected from Orizovo village (Stara Zagora district) during the full flowering stage in August 2018. The extract (EPO) was prepared with 80% methanol and sonication (Voynikov et al. 2019; Voynikov et al. 2021). Then, the water residue was lyophilized.

Food supplement

A food supplement containing EPO (350 mg), chromium picolinate (100 μg), and cinnamon (100 mg) was bought from a local pharmacy in Sofia, Bulgaria.

Experimental animals

Twelve male spontaneously hypertensive rats (SHR) of the same age were used in the study. All animals were housed under standard laboratory conditions in plexiglass cages with free access to food and water and maintained on a 12 h/12 h light–dark cycle at a temperature of 20–25 °C. Before the initiation of the experiment, all selected animals exhibited normal baseline levels of blood glucose (5.2 mmol/L), triglycerides (4.9 mmol/L), and total cholesterol (2.5 mmol/L). The SHR strain has been used as a model of hypertension and metabolic disease, insulin resistance, and defects in lipid metabolism (Chakraborty et al. 2020). During the procedure, rats were given *ad libitum* access to food and water. All studies were carried out in accordance with the principles stated in the European Convention for the Protection of Vertebrate Animals used for Experimental and other Scientific Purposes (ETS 123) (Council of Europe 2007) and approved by the Bulgarian Agency of Food Safety (permission was provided under No. 185, Statement No. 101).

Chemicals and reagents

Streptozotocin, beta-nicotinamide adenine dinucleotide 2'-phosphate reduced tetrasodium salt (NADPH), thiobarbituric acid, and trichloroacetic acid were purchased from Sigma Chemical Co. (Taufkirchen, Germany). 2,2-Dinitro-5,5-dithiodibenzoic acid (DTNB) and methanol were obtained from Merck (Darmstadt, Germany). All reagents were of analytical grade. Kits for the measurement of hematological (WBC and platelets) and biochemical (ALT and AST) parameters were provided by the manufacturer (Mindray, China).

Induction of type 2 diabetes mellitus (DT2)

Experimental diabetes was induced in male SHR rats (mean body weight 400 g) by a single intraperitoneal (i.p.) injection of streptozotocin (40 mg/kg body weight), dissolved in citrate buffer (pH 4.5), following a 24-hour fasting period. Animals in the control groups received an equivalent volume of citrate buffer i.p. without streptozotocin.

Forty-eight hours after streptozotocin administration, fasting blood glucose levels were measured using a drop of blood obtained from the tail vein and analyzed with a portable glucose monitoring device (MultiCare In, Italy). Rats with persistently elevated fasting blood glucose levels above 12 mmol/L were considered diabetic and were included in the experiment. Twelve male spontaneously hypertensive rats (SHR) of the same age were divided into the following groups (Fig. 1):

Group 1: Control SHR, orally treated with the citrate buffer at 5 mL/kg b.w. per day for 14 days.

Group 2: SHR challenged with 40 mg/kg, i.p. STZ dissolved in citrate buffer 0.1 M, pH 4.4.

Group 3: diabetic SHR, treated by oral gavage with FS (800 mg/kg, based on purslane content, dispersed in water and dissolved by ultrasound) for 14 days.

Group 4: diabetic SHR treated orally with EPO (250 mg/kg) for 14 days.

On Day 0 (baseline), blood glucose, cholesterol, and triglyceride levels were measured (before diabetes induction) with MULTICARE IN. After diabetes induction on the first day, the same markers were measured on Day 3, Day 7, Day 11, and Day 14. At the end of the experiment, on Day 15, all rats were euthanized by decapitation, and blood was taken for hematological and biochemical analysis of WBC, platelets, AST, and ALT. Livers were excised and homogenized for further biochemical analysis of oxidative stress markers, malondialdehyde (MDA), and reduced glutathione (GSH).

Measurement of hematological and biochemical parameters

Blood glucose, total cholesterol, and triglyceride levels were measured from tail vein blood samples using a portable multi-parameter analyzer (glucose, cholesterol, and triglycerides) on days.

Additional biochemical parameters were analyzed using a Mindray BS-120 biochemical analyzer (China) at the end of the experiment. Hematological parameters were determined using a semi-automated analyzer (Mindray, China).

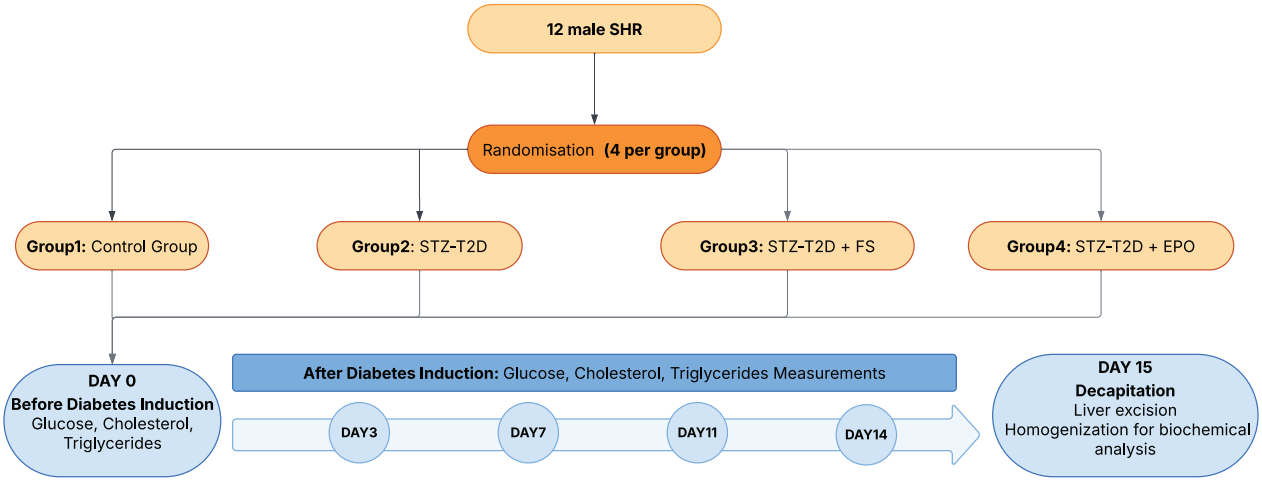

Figure 1. Experimental design. *0, 3, 7, 11, and 14 after diabetes induction.

Measurement of hepatic biochemical parameters

Determination of malondialdehyde (MDA) in liver (Héctor Polizio and Peña 2005)

Liver homogenate was prepared using 0.1 M potassium–sodium phosphate buffer (pH 7.4). For MDA determination, 1 mL of liver homogenate was mixed with 1 mL of 25% trichloroacetic acid (TCA) and 1 mL of 0.67% thiobarbituric acid (TBA). Samples were heated at 100 °C for 20 minutes and then centrifuged at 4,000 rpm for 20 minutes. After cooling, MDA levels were determined spectrophotometrically at 535 nm (Spectro UV/VIS Auto). MDA concentration was calculated using a molar extinction coefficient of 1.5 mM^{-1} cm^{-1} for the MDA–TBA complex and expressed as nmol/g tissue.

Determination of reduced glutathione (GSH) in liver homogenate (Bump et al. 1983)

Liver tissue was homogenized in 5% trichloroacetic acid at a ratio of 1:4. The homogenate was centrifuged at 4,000 rpm for 20 minutes, and the supernatant was used for GSH determination. The reaction mixture contained 3 mL of 0.1 M potassium–sodium phosphate buffer (pH 8.0), 50 µL of sample, and 20 µL of DTNB solution. GSH levels were determined spectrophotometrically by measuring non-protein thiol groups forming a colored complex with DTNB at 412 nm (Spectro UV/VIS Auto). Calculations were performed using a molar extinction coefficient of 13.6 M^{-1} cm^{-1}, and results were expressed as nmol/g fresh tissue.

Statistical analysis

Statistical analysis was performed using Student's *t*-test. Results are presented as mean ± standard deviation (SD). Differences were considered statistically significant at $P < 0.05$.

Results and discussion

The phytochemical composition of EPO was previously described by Voynikov et al. (2019) and Voynikov et al. (2021). A UHPLC-Orbitrap-MS method in parallel-reaction monitoring mode was developed for the simultaneous identification and quantification of 14 compounds comprising hydroxybenzoic, hydroxycinnamic, and caffeoylquinic acids, as well as two flavonol glycosides. The raw extracts presented the highest concentration of bioactive compounds, as well as higher antioxidant and radical scavenging values (Fernández-Poyatos et al. 2021).

Body weight

Changes in body weight are presented in Fig. 2A. At the end of the experimental period, on Day 15, in the experimental animals treated with FS, a 21.6% reduction in body weight was observed compared to the diabetic animals. SHR treated with EPO did not change their body weight significantly compared to diabetic animals but decreased their weight by 23% compared to the control group. Compared to the beginning of the experiment, body weight decreased in all groups except in the control. In the diabetic animals without treatment, the b.w. decreased by 22%; in diabetic animals treated with FS, the weight decreased by 27.5%; and in the EPO-treated group, by 23%. The present findings are consistent with the results of other groups that reported that STZ-induced diabetes causes a significant reduction in the body weight of diabetic animals (Carpéné et al. 2022). Administration of STZ reliably causes substantial body weight loss in experimental rodent models. This occurs because STZ selectively destroys pancreatic β-cells, resulting in pronounced hyperglycemia, insulin deficiency, and a metabolic shift toward catabolism. The consequent decline in body weight serves as an indicator of successful diabetes induction and is typically associated with depletion of fat stores and the development of muscle atrophy (Zafar and Naeem-ul-Hassan Naqvi 2010). A previous study performed by Djellouli et

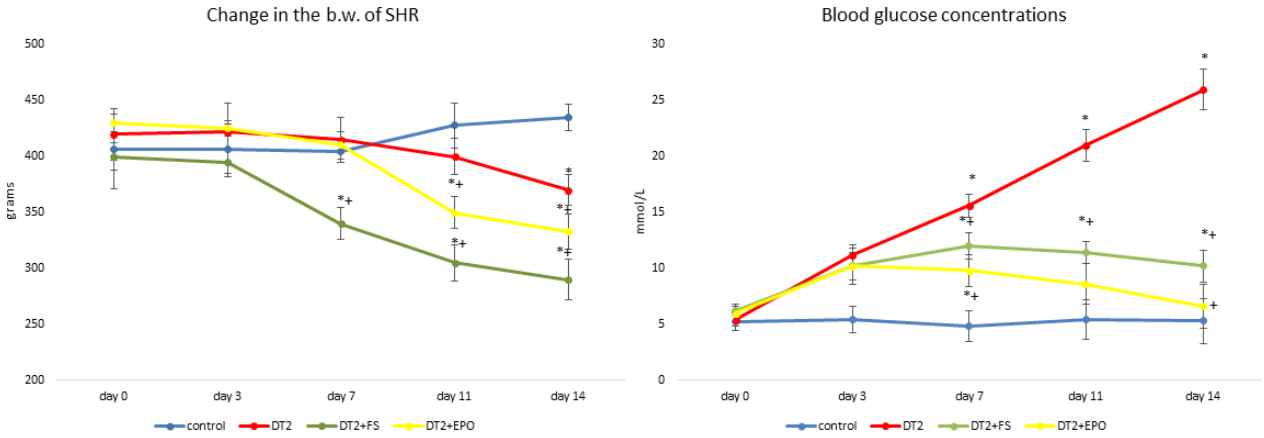

Figure 2. Changes in body weight and blood glucose level in experimental groups. $^{*}p < 0.05$ compared to the control group; $^{+}p < 0.05$ compared to the diabetic group.

al. (2018) has reported a significant increase in final body weight in rats with streptozotocin-induced diabetes; however, a distinguishing feature of that experimental design was the administration of a high-cholesterol diet, which likely contributed to the observed weight gain. In contrast, accumulating evidence in the literature demonstrates that *Portulaca oleracea* has the potential to reduce body weight and body mass index (BMI), supporting its prospective role as an adjunctive agent in body weight management. In contrast, accumulating evidence supports the role of *Portulaca oleracea* as a promising adjunctive agent in body weight management, with studies demonstrating its potential to reduce both body weight and body mass index (BMI) (Ebrahimian et al. 2022).

Blood glucose

The changes in blood glucose levels in experimental groups are presented in Fig. 2B. STZ induced a sharp increase in blood glucose level by 380% on the last day of the experiment compared with the first day. FS demonstrated a statistically significant decrease in blood glucose levels by 61% compared to diabetic animals. It is likely that the cinnamon contained in this dietary combination also contributes to the statistically significant reduction in blood sugar. A systematic review and meta-analysis show that cinnamon significantly reduces blood sugar levels (De Moura et al. 2025). Cinnamon is thought to exert its effects by enhancing insulin sensitivity, activating insulin receptors, and suppressing enzymes that deactivate these receptors, thereby promoting more efficient cellular uptake of glucose (Mohsin et al. 2023). The active polyphenols in cinnamon, particularly type-A polymers, act by promoting insulin receptor phosphorylation, activating the PI3K/Akt signaling pathway, and facilitating glucose transporter GLUT-4 translocation. Additionally, it may slow gastric emptying, which helps reduce the rate at which carbohydrates are absorbed (Silva et al. 2022). EPO also significantly lowered blood glucose levels by 75% compared to the diabetic group. These findings are consistent with previous reports on the hypoglycemic properties of *Portulaca oleracea*, which has been shown to exert significant glucose-lowering effects in both experimental and clinical settings. The pronounced reduction observed in the present study may be attributed to the plant's rich content of bioactive compounds, including omega-3 fatty acids, flavonoids, alkaloids, and polysaccharides (De Souza et al. 2022), known to enhance insulin sensitivity and modulate carbohydrate metabolism (El-Sayed 2011; Djellouli et al. 2018; Donglin et al. 2024).

Lipid profile

The effects of the studied extracts on lipids are presented in Fig. 3. FS lowered triglycerides significantly by 46% compared to the SHR diabetic group. EPO did not show statistically significant results on triglyceride levels. No statistically significant differences in cholesterol levels were detected across any of the experimental groups.

Although these results are supported by some reports in the literature (Esmaillzadeh et al. 2015), there is substantial evidence demonstrating the beneficial effects of *Portulaca oleracea* on the lipid profile in diabetic and hypercholesterolemic models (Jafari et al. 2023; Donglin et al. 2024; Ahmed et al. 2025; Makangali et al. 2025).

The relatively short duration of the present study may explain the lack of significant lipid-lowering effects of the extract. The significant reduction in triglycerides observed only in the FS-treated group could be attributed to a potential synergistic interaction between purslane, *Cinnamomum verum* (Azimi et al. 2014), and chromium (Lee and Reasner 1994), known to exert positive effects on lipid metabolism.

Hematology

Fourteen days of oral administration of FS led to a slight increase in WBC (leucocytes) count (Fig. 4) and a pronounced decrease in platelet count, by approximately 60% compared with the control and diabetic groups

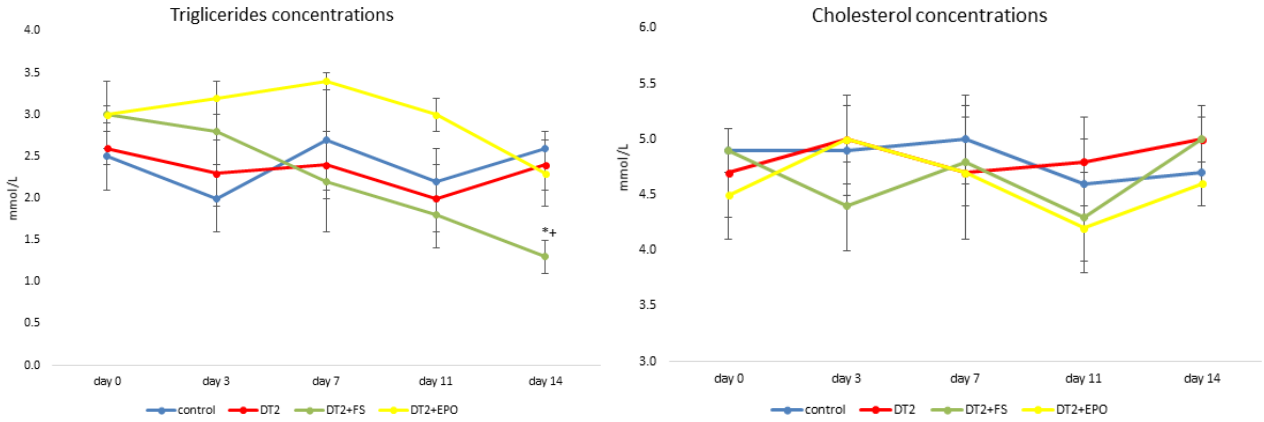

Figure 3. Changes in triglycerides and cholesterol levels in experimental groups. $^{*}p < 0.05$ compared to the control group; $^{+}p < 0.05$ compared to the diabetic group.

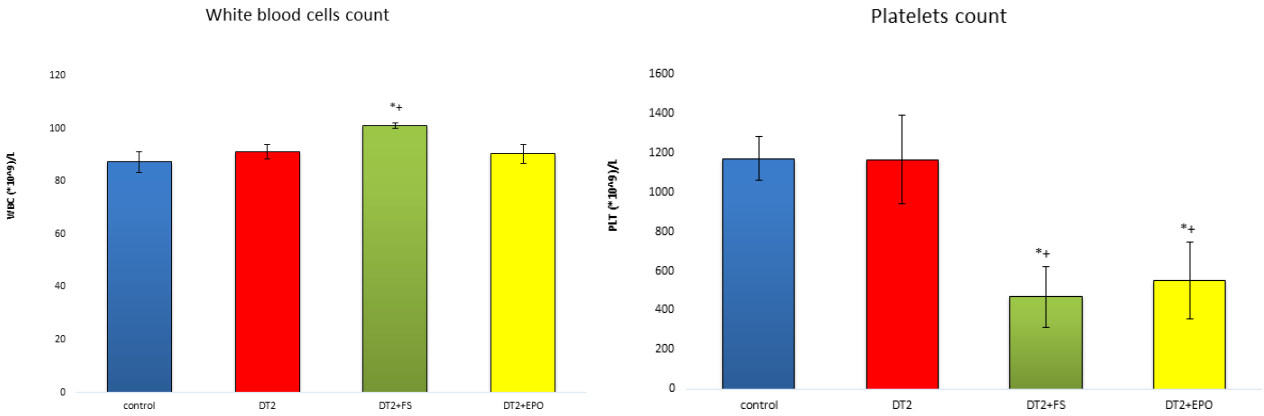

Figure 4. Changes in WBCs and platelet count in experimental groups. $^{*}p < 0.05$ compared to the control group; $^{+}p < 0.05$ compared to the diabetic group.

(Fig. 4). In the EPO-treated group, platelets were also decreased by around 53% compared with the control and diabetic groups. These findings provide a basis for considering the potential adverse effects associated with the dietary supplement, including thrombocytopenia and leucocytosis. Accordingly, its concomitant use with anticoagulant or antiplatelet agents may increase the risk of bleeding. This potential risk could be explained by the anticoagulant activity reported for the individual components of the formulation, namely *Portulaca oleracea* (Anon 2024), cinnamaldehyde, the principal bioactive constituent of cinnamon (Huang et al. 2007), and chromium picolinate (Seif 2015). Collectively, the combined effects of these compounds may potentiate alterations in hemostatic parameters, warranting careful consideration of safety, particularly in individuals receiving anticoagulant therapy.

No changes in erythrocyte counts were observed in any of the studied groups, which is why the results are not presented. This could also be a positive result, indicating that with repeated administration of the studied substances, there is no risk of developing anemic conditions, which, of course, needs to be confirmed in larger and longer studies.

Markers of oxidative stress

The results on the oxidative stress markers are shown in Fig. 5. Diabetes is characterized by increased oxidative stress, which was proven in the present investigation. In the livers of diabetic SHRs, MDA was increased by 50%, and GSH was decreased by 31% compared to the control group. Only the experimental animals treated with EPO showed a statistically significant increase in GSH by 24% and a decrease in MDA by 31% compared with diabetic SHRs. The antioxidant activity observed for the purslane extract may be attributed to its rich phytochemical composition, including phenolic compounds such as total flavonoids, polyphenols, and phenolic alkaloids, as well as its high content of vitamin A, tocopherols, ascorbic acid, and beta-carotene. These bioactive constituents are known to exert potent free radical–scavenging and redox-modulating effects. Our findings are consistent with data reported in a systematic review demonstrating that supplementation with *Portulaca oleracea* is associated with increased levels of reduced glutathione (GSH) and decreased malondialdehyde (MDA), further supporting its significant antioxidant potential (Samarghandian et al. 2017; Nkhumeleni et al. 2024). In a study investigating

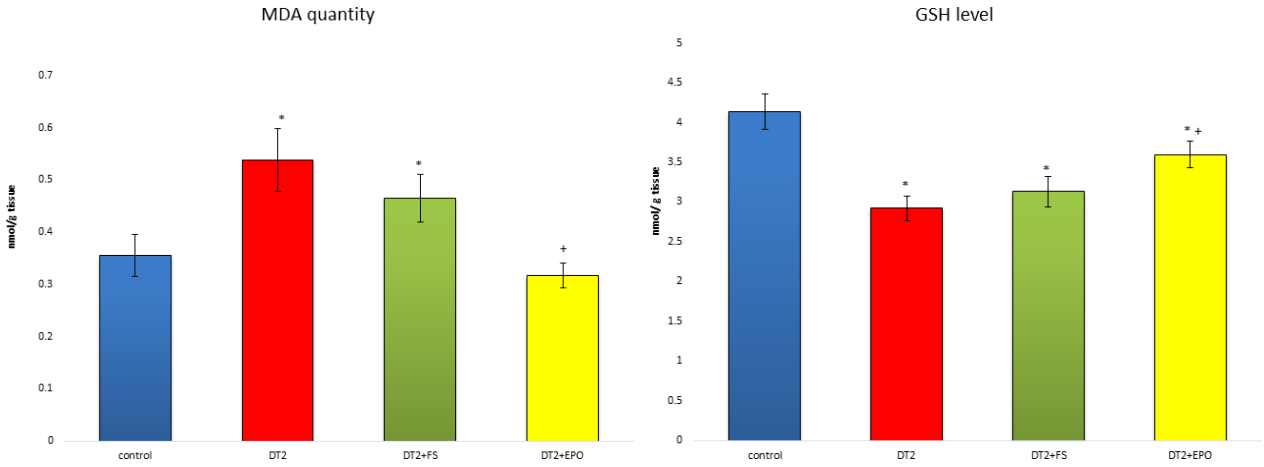

Figure 5. Changes in MDA quantity and GSH level in experimental groups. $^{*}p < 0.05$ compared to the control group; $^{+}p < 0.05$ compared to the diabetic group.

the antioxidant activity of extracts derived from *Portulaca oleracea*, both raw and steamed samples demonstrated significant antioxidant potential. However, the extract obtained from the raw plant material exhibited greater results compared to its thermally processed counterpart. This enhanced activity may be attributed, at least in part, to the higher phenolic content detected in the extract. Nevertheless, phenolic compounds are unlikely to represent the sole contributing factor, and other bioactive constituents may also play a role in the observed antioxidant effects (Fernández-Poyatos et al. 2021).

Markers of hepatic toxicity

The results of liver transaminase activity are presented in Fig. 6. In diabetic SHRs and diabetic rats treated with the food supplement, a statistically significant increase of 210% and 408%, respectively, in liver ALT enzyme activity was observed, raising concerns about the potential hepatotoxicity induced by the dietary supplements. FS also increased the AST activity significantly by 260% compared with the control group. One possible contributing factor is chromium picolinate, for which cases of hepatotoxicity have been reported in individuals using it as part of weight-loss regimens (Lança et al. 2002).

Although such adverse outcomes are not universally documented, the existing evidence indicates that chromium picolinate may, under certain conditions, induce hepatic dysfunction, thereby necessitating cautious evaluation of its safety profile.

These findings also raise concerns regarding the quality of the cinnamon used in the supplement. Elevated coumarin content, particularly in *Cinnamomum cassia*, may negatively impact the safety profile, as high coumarin intake has been associated with hepatotoxicity (Pitaro et al. 2022). Recent research has identified a concerning hidden hazard: contamination with lead. Recently, studies found that more than one-third of tested spices, including cinnamon, contained elevated concentrations of heavy metals such as lead, arsenic, and cadmium, all of which present significant health risks (Yánez-Jácome et al. 2024; FDA 2024).

Exposure to heavy metals is closely associated with elevated transaminase activity, an important biomarker of liver injury. Research shows that heavy metals can damage the liver, commonly through mechanisms involving oxidative stress and inflammatory responses, which result in increased liver

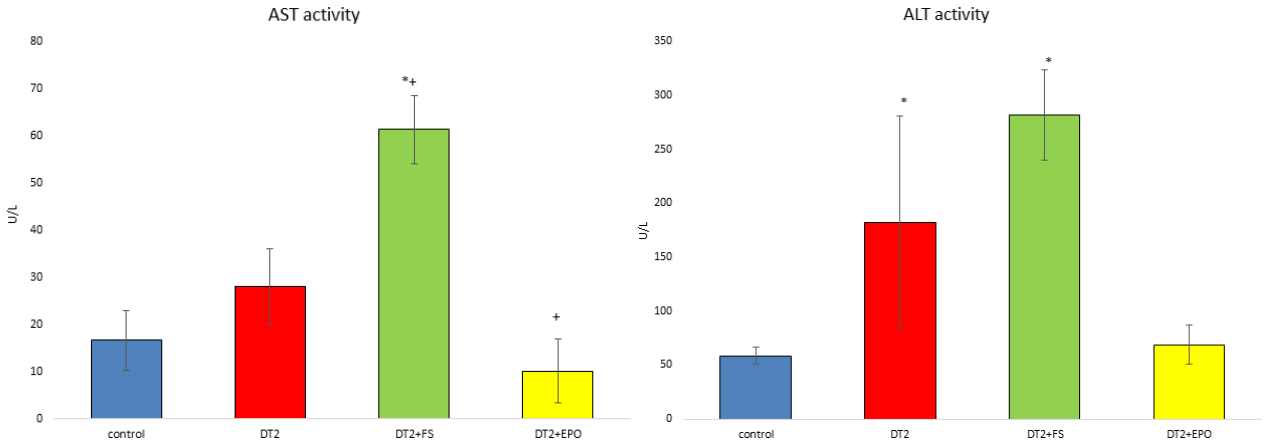

Figure 6. Changes in AST and ALT activity in experimental groups. $^{*}p < 0.05$ compared to the control group; $^{+}p < 0.05$ compared to the diabetic group.

enzyme levels in both humans and animal models (Renu et al. 2021). This consideration underscores the importance of rigorous quality control and standardization of botanical raw materials used in combined formulations.

Taken together, these results highlight the need for further investigation into the potential hepatotoxicity of the dietary supplement, as well as a comprehensive assessment of the quality and composition of its constituents.

In contrast, the EPO alone demonstrated a favorable safety profile in the present study, which is in line with previous reports suggesting hepatoprotective properties of *Portulaca oleracea* (Anusha et al. 2011; Qian et al. 2023). Recently, it was found that the major alkaloids in *P. oleracea* (oleracein O and L), at low to moderate concentrations, have a considerable stimulating effect on insulin secretion and improve glucose uptake. High doses of oleracein derivatives are associated with increasing ceramide generation and cellular toxicity and decreasing insulin secretion (Roozi et al. 2021). Another group of metabolites responsible for the effects of *P. oleracea* are polysaccharides. Previous results indicated that the oral administration of *Portulaca* polysaccharides could significantly increase body weight and improve glucose tolerance in diabetic rats. Meanwhile, they significantly reduce fasting blood glucose (FBG) levels and elevate fasting serum insulin (FINS) levels and insulin sensitivity index (ISI) values in diabetic rats. In addition, they significantly reduce TNF-α and IL-6 levels in diabetic rats; polysaccharides also reduced MDA and SOD activities in the liver tissue of diabetic rats (Bai et al. 2016). The present findings indicate that plant-derived bioactive compounds (BACs) may modulate selected biochemical parameters; however, current evidence does not support replacing established pharmacological therapies for diabetes mellitus and dyslipidemia with preparations containing plant BACs.

Plant-derived BACs may be considered as adjuncts to standard therapy when their use is evidence-based and clinically justified. Careful evaluation of product origin, composition, and quality is essential, as the use of preparations with unknown or unverified content may pose significant health risks.

Compared with dietary supplements, standardized plant-based medicinal products represent a safer alternative. However, they must also be used cautiously and tailored to the individual patient's clinical status and concomitant pharmacotherapy.

Reducing the growing prevalence of diabetes mellitus remains a major global challenge. Effective management requires not only appropriate pharmacological treatment but also comprehensive socio-economic and public health strategies addressing this socially significant disease.

Conclusion

Administration of streptozotocin induces diabetes in rats, leading to a progressive and sustained increase in blood glucose levels above 12 mmol/L. Oral treatment of diabetic SHR with *Portulaca oleracea* extract (EPO) or the dietary supplement (FS) reduced blood glucose levels. However, in both cases, the levels did not reach those of the control group. Both treatments influenced body weight. FS promoted weight reduction, whereas the extract led to weight gain. FS lowered triglyceride levels, whereas EPO did not significantly affect the lipid profile. Neither EPO nor FS alters total cholesterol levels. EPO decreased MDA levels and increased GSH levels, while FS did not produce significant changes in these parameters. FS treatment resulted in elevated liver enzymes (AST and ALT), indicating potential hepatotoxicity, and additionally, it carries a risk of thrombocytopenia and leucocytosis.

In conclusion, the uncontrolled intake of dietary supplements without medical supervision carries a risk of serious adverse reactions, especially in combination with polydrug conventional drug therapy.

Additional information

Conflict of interest

The authors have declared that no competing interests exist.

Ethical statements

The authors declared that no clinical trials were used in the present study.

The authors declared that no experiments on humans or human tissues were performed for the present study.

The authors declared that no informed consent was obtained from the humans, donors or donors' representatives participating in the study.

Experiments on animals: Bulgarian Agency of Food Safety (permission was provided under № 185, Statement № 101)

The authors declared that no commercially available immortalised human and animal cell lines were used in the present study.

Use of AI

The authors accept full responsibility for the content of the manuscript, including the disclosure of any use of AI.
No AI tools were used in the preparation of this manuscript.

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Author contributions

R. Simeonova - experimental design, Supervision. Y. Vladimirova - writing the draft of the MS. D. Zheleva-Dimitrova - preparing the plant extract, writing the final MS.

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Data availability

All of the data that support the findings of this study are available in the main text.

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