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Effects of *Baccharis dracunculifolia* Extract on Lipid Profile and Dietary Patterns in Diabetic Rats

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Authors' contributions

This work was carried out in collaboration among all authors. All authors read and approved the final manuscript.

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ABSTRACT

Aims: This study aimed to evaluate the effects of *Baccharis dracunculifolia* extract on glycemic regulation, lipid profile, and metabolic parameters in diabetic rats, as well as its potential as a complementary therapeutic intervention for diabetes management.
Study Design: Experimental study using a controlled animal model of diabetes.

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Place and Duration of Study: The study was conducted at UNICENTRO between 2017 and 2018.
Methodology: Fifty-six male Wistar rats (120 days old) were divided into eight groups: Tween Control (CT), *Baccharis* Control (CB), Diabetic Control (CDT), Diabetic Sulfonylurea (DS), and diabetic groups treated with *B. dracunculifolia* extract at doses of 50 mg (DB50), 100 mg (DB100), 200 mg (DB200), and 200 mg combined with sulfonylurea (DB200S). The extract was administered daily via gavage. Diabetes was induced using streptozotocin (STZ). Body weight, food intake, water consumption, and biochemical parameters (glucose, triglycerides, cholesterol, creatinine, and urea) were monitored over four weeks. Insulin levels and histological analyses of the liver, kidney, and pancreas were also evaluated. Statistical analysis was performed using ANOVA and post-hoc tests.
Results: The *B. dracunculifolia* extract significantly reduced fasting and postprandial blood glucose levels (54.3% to 63.4% and 37.9% to 45.0%, respectively) and triglyceride levels (45.0% to 45.3%) in treated groups (p<0.05). Body weight loss in diabetic rats was attenuated in groups treated with the extract, particularly at lower doses (DB50 and DB100). Water intake was also minimized in treated groups compared to the untreated diabetic group (CDT). Additionally, the extract increased plasma insulin levels by 81.1% to 94.4% in treated groups. Histological analysis revealed reduced tissue damage in the liver, kidney, and pancreas of treated animals. No significant differences were observed in creatinine and urea levels among treated groups (p>0.05).
Conclusion: The *Baccharis dracunculifolia* extract demonstrated notable hypoglycemic, antioxidant, and tissue-protective effects, suggesting its potential as a complementary therapy for diabetes management. These findings highlight its role in mitigating oxidative stress and improving metabolic parameters, which may help prevent diabetes-related complications. Further studies are needed to identify specific bioactive compounds and their mechanisms of action.

Keywords: Diabetes; lipid profile; Baccharis; food intake; natural compounds.

1. INTRODUCTION

Diabetes mellitus (DM) is a growing public health concern worldwide, with significant implications for local communities. In Brazil, the prevalence of diabetes has been steadily increasing, reflecting global trends. According to the Brazilian Diabetes Society (SBD, 2014), approximately 10 million Brazilians are affected by diabetes, placing the country among the top 20 nations with the highest number of cases relative to its population. This alarming prevalence is driven by factors such as urbanization, sedentary lifestyles, and dietary changes, which contribute to the rising incidence of type 2 diabetes. The economic and social burden of diabetes is substantial, highlighting the urgent need for effective prevention and management strategies, including the exploration of complementary therapies derived from natural sources like *Baccharis dracunculifolia*.

The increasing incidence of diabetes mellitus has spurred the search for effective therapeutic interventions, highlighting the potential of medicinal plants in managing this condition. In this context, the extract of Baccharis dracunculifolia, known for its rich phytochemical composition, emerges as a promising source of bioactive compounds. Studies, such as those by Oliveira et al. (2018) and Santos et al. (2020), emphasize the anti-hyperglycemic and antioxidant effects of similar plant extracts, underscoring the relevance of this approach.

The role of B. dracunculifolia extract in glycemic regulation, liver and kidney function, and lipid profile represents an area of growing interest, given the urgent need for complementary therapeutic strategies to conventional diabetes treatment. Epidemiological studies, such as that by Silva et al. (2019), indicate the rising prevalence of diabetes-related complications, highlighting the pressing need for new therapeutic approaches.

Although previous research suggests potential benefits, there is a lack of comprehensive studies that integrate the evaluation of these effects across different biological systems, enabling a more holistic understanding of the extract's impacts. Studies such as that by Almeida et al. (2021) have predominantly focused on isolated effects, emphasizing the need for an integrated analysis, as sought by this research.

Studies like that of Lima et al. (2020), while investigating the effects of an extract from another Baccharis species, highlight the need for analyses that go beyond isolated parameters. The absence of studies integrating metabolic evaluation, histological analysis, and correlation with dietary indicators creates a gap in the global understanding of the potential benefits of B. dracunculifolia extract. This knowledge gap is particularly relevant, considering that the progression of diabetes is often associated with multifactorial changes in various physiological systems.

Previous studies have focused on specific aspects, such as fasting glucose, but have not provided a comprehensive view of the effects of B. dracunculifolia extract on glycemic regulation, liver and kidney health, and lipid profile. Furthermore, the incorporation of histological analysis in studies is crucial to understanding the morphological basis of biochemical outcomes. The systematic review by Souza et al. (2022) highlights the scarcity of research integrating multiple parameters in these investigations.

The experimental model of diabetes induced by streptozotocin (STZ) is widely used in research to mimic both type 1 and type 2 diabetes. STZ, a cytotoxic glucose analog, selectively destroys pancreatic β-cells, leading to insulin deficiency and hyperglycemia, which are hallmark features of type 1 diabetes. Additionally, the model exhibits insulin resistance, a key characteristic of type 2 diabetes, making it a versatile tool for studying diabetes-related complications and therapeutic interventions (Szkudelski, 2012). In this study, we employed the STZ-induced diabetic rat model to evaluate the effects of *Baccharis dracunculifolia* extract on glycemic control, lipid metabolism, and tissue protection, providing insights into its potential as a complementary therapy for diabetes management.

The individual articles aim to fill this gap by comprehensively exploring the effects of B. dracunculifolia extract on different organ systems. The first focuses on glycemic regulation, the second addresses impacts on liver and kidney health, while the third concentrates on antioxidant activity and its effects on the lipid profile, including dietary intake. This integrated approach aims to significantly contribute to the understanding of the potential benefits of B. dracunculifolia extract in managing diabetes and its associated complications.

Given the rising prevalence of diabetes and its associated complications, there is an urgent need for effective and accessible therapeutic strategies (Clemente-Suárez et al., 2023). Conventional treatments, while beneficial, often come with limitations such as side effects, high costs, and limited accessibility, particularly in low-resource settings (Aware et al., 2022; . This underscores the importance of exploring alternative and complementary therapies, particularly those derived from natural sources like medicinal plants. *Baccharis dracunculifolia*, with its well-documented antioxidant and anti-inflammatory properties, represents a promising candidate for diabetes management. However, comprehensive studies evaluating its effects on glycemic control, lipid metabolism, and tissue protection in diabetic models are still limited. This study aims to fill this gap by providing a detailed investigation of the therapeutic potential of *B. dracunculifolia* extract, offering valuable insights into its role as a complementary intervention for diabetes and its complications. By doing so, this research contributes to the growing body of knowledge on natural products and their potential to improve the quality of life for individuals living with diabetes.

2. MATERIALS AND METHODS

2.1 Preparation of the Extract

The methanolic extract of *Baccharis dracunculifolia* was prepared from leaves that were naturally dried in the shade. The dried leaves were ground and sieved to obtain a uniform powder. To ensure the quality and consistency of the drying process, a residual moisture test was conducted to determine the appropriate solvent concentration. Approximately 4 g of dried leaves were subjected to the drying method described in the Brazilian Pharmacopoeia (1988), with the drying process performed in triplicate to ensure reproducibility. The samples were heated at 100°C for three days and then re-weighed. The difference in weight was considered as the residual moisture content, which was approximately 10%. This method complies with current pharmacopoeia standards, ensuring the removal of excess moisture while preserving the integrity of the plant's bioactive compounds.

The extraction process was carried out using orbital shaking, with 50 g of ground leaves mixed in 220 mL of methanol. This mixture was agitated on a shaker for one week, totaling 1100 g of plant material. The solution was subsequently filtered, and the filtrate was evaporated using a rotary evaporator at a controlled temperature (60°C). To completely remove the solvent (methanol), the extract was further evaporated in a water bath at 40°C for three days. The resulting extract was diluted in a Tween 80 solution (vehicle) and distilled water in a 1:8 ratio to facilitate administration via gavage. The final extract was stored in amber containers at 5°C to maintain stability.

2.2 Animal Model and Study Groups

A total of 60 male Wistar rats (120 days old) with an average weight of 374 g ± 3.12 g were used in this study. The animals were housed in cages (3 to 4 animals per cage) with controlled temperature (26 ± 1°C), a 12/12 h light-dark cycle, and access to water and feed (PURINA®) ad libitum. All experimental procedures were approved by the Animal Ethics Committee (protocol no. 006/2014), and efforts were made to minimize animal suffering.

The animals were divided into groups: Tween Control (CT), *Baccharis* Control (CB), Diabetic Control (CDT), Diabetic Sulfonylurea (DS), Diabetic *Baccharis* 50 mg (DB50), Diabetic *Baccharis* 100 mg (DB100), Diabetic *Baccharis* 200 mg (DB200), and Diabetic *Baccharis* 200 mg + Sulfonylurea (DB200S).

2.3 Administration of the Extract

Throughout the experiment, the animals were administered *Baccharis dracunculifolia* or saline solution, depending on the experimental groups, via gavage. The doses were administered once daily at 9:00 AM. Any form of stress on the animals in the CT group was avoided, so the gavage procedure was not performed on them.

2.4 Body Weight Evolution, Food Intake, and Water Consumption

To monitor development, the rats were weighed weekly from the start of the experiment until euthanasia. Food intake and water consumption were also measured weekly.

2.5 Evaluation of Biochemical Parameters

After 12 hours of fasting, the rats from all groups were anesthetized with ketamine and xylazine (55 and 8 mg/kg of body weight, respectively) and euthanized by cervical dislocation; whole blood samples were collected to measure total cholesterol (mg/dL), HDL-cholesterol (mg/dL), LDL-cholesterol (mg/dL), and triglycerides (mg/dL) levels, which were analyzed by Labtest Diagnóstica SA®.

2.6 Statistical Analysis

All results are presented as mean ± S.E.M. Statistical analyses were performed using one-way ANOVA and repeated measures ANOVA. Differences were considered statistically significant when P<0.05. The Newman-Keuls post-hoc test was used to identify differences between groups when appropriate.

3. RESULTS

3.1 Evaluation of Body Weight

From the 7th day of weighing after the start of treatment, a statistically significant difference in body weight increase was observed (Fig. 1), ranging from 5.3% to 15.0% in the control group (CT) (376.1 g; p<0.05) and from 13.4% to 23.8% in the *B. dracunculifolia* control group (CB) (405.0 g; p<0.05) compared to the untreated diabetic group (CDT) (346.8 g; p<0.05). The diabetic groups treated with doses of 50 mg (DB50) (339.4 g; p<0.05), 100 mg (DB100) (357.0 g; p<0.05), 200 mg (DB200) (327.0 g; p<0.05), and 200 mg combined with sulfonylurea (DB200S) (334.0 g; p<0.05) also showed significant differences compared to the CDT group. Only the group treated with sulfonylurea (DS) (372.7 g) showed no statistical difference compared to the non-diabetic groups at this evaluation stage.

On days 14 and 21 of body weight evaluation, the non-diabetic control groups (CT and CB) continued to show higher body weight values, with variations of 4.1% to 21.1% (day 14) and 11.8% to 29.9% (day 21) for CB (p<0.05), and 11.5% to 29.7% (day 14) and 18.3% to 37.5% (day 21) for CT (p<0.05), when compared to the other diabetic groups (Tween, sulfonylurea, and plant extract).

At the end of the treatment (day 28), the non-diabetic groups CT (16.7% to 41.1%; 390.9 g; p<0.05) and CB (21.9% to 47.3%; 408.0 g; p<0.05) still exhibited higher body weight compared to the other evaluated diabetic groups.

The CDT group, from day 14 until the end of the experiment, showed an average reduction in body weight ranging from 3.6% to 27.4% (p<0.05) compared to the other groups. On day 28, the DB50 (14.8%; 318.0 g; p<0.05) and DB100 (15.9%; 321.0 g; p<0.05) groups exhibited higher body weights than the diabetic CDT group (277.0 g; p<0.05), demonstrating an attenuation of body weight loss in these groups treated with *B. dracunculifolia* extract, especially at lower doses.

3.2 Modulation of the Lipid Profile

The extract positively influenced the lipid profile, with a significant reduction in triglycerides in all treated groups. The DB200S group showed the highest reduction, with a 43% decrease.

Analysis of the diabetic groups (CDT, DB50, DB100, DB200, DB200S, and DS) revealed (Table 1) a statistically significant difference favoring the reduction of triglycerides (p<0.05), creatinine (p<0.05), and urea (p<0.05) when comparing the treated groups DB50, DB100, DB200, and DB200S with the untreated diabetic group (CDT).

For triglycerides, the DB50 (45.0%; 104.3 mg/dL; p<0.05), DB100 (45.3%; 103.8 mg/dL; p<0.05), and DS (40.6%; 112.7 mg/dL; p<0.05) groups showed a reduction in triglyceride levels compared to the untreated diabetic group - CDT (189.8 mg/dL; p<0.05). The aforementioned groups exhibited triglyceride values close to those of the non-diabetic groups CT (106.8 mg/dL) and CB (94.2 mg/dL).

Regarding the aforementioned parameters, it is worth noting that the groups treated with lower doses of the plant extract (DB50 and DB100) demonstrated the best results, both in comparison with the CDT group and with the CT and CB groups. However, there were no differences (p>0.05) when comparing the diabetic groups treated with the plant extract among themselves for the parameters of triglycerides, creatinine, and urea.

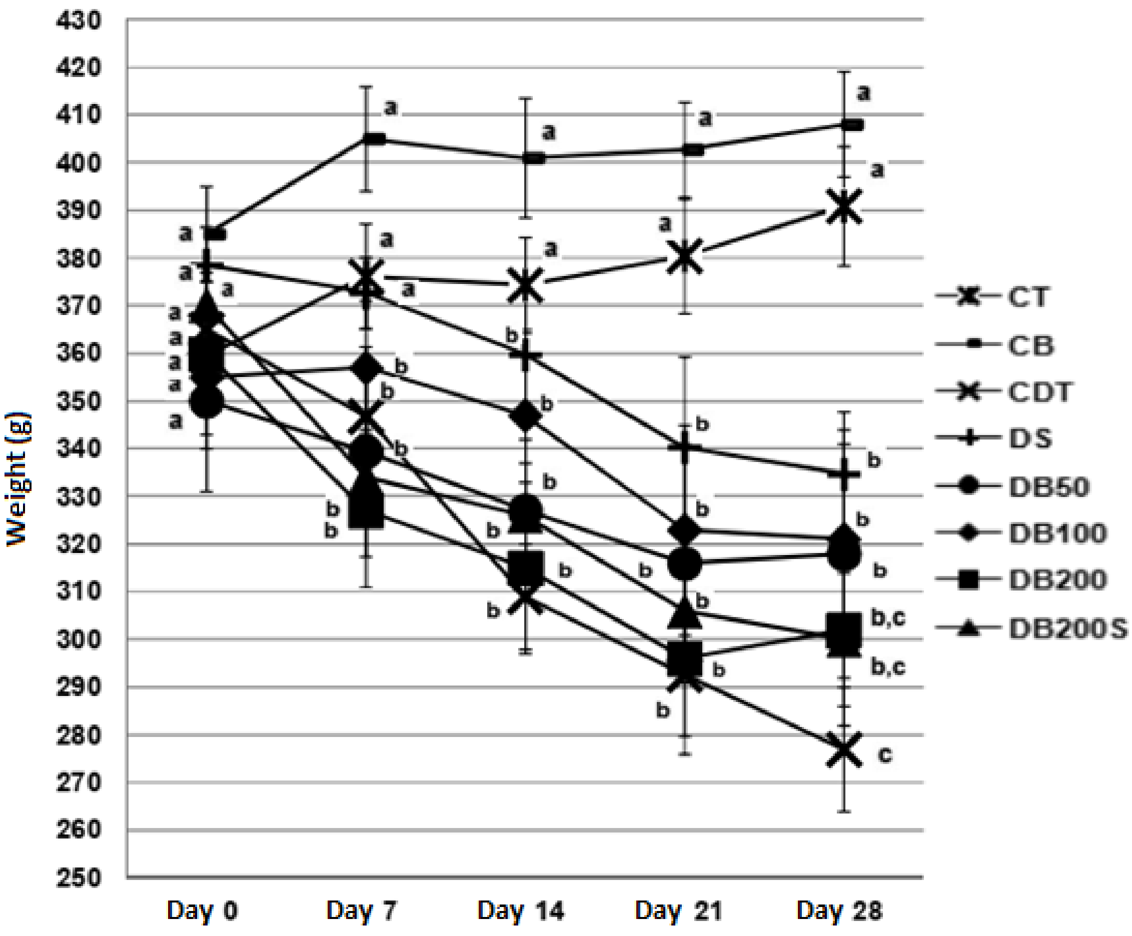

Fig. 1. Effect of *Baccharis dracunculifolia* on the body weight of the animals

- CDT; Diabetic Sulfonylurea - DS; Diabetic Baccharis 50 mg - DB50; Diabetic Baccharis 100 mg - DB100; Diabetic Baccharis 200 mg - DB200; and Diabetic Baccharis 200 mg + Sulfonylurea - DB200S. Body weight values in grams during the experiment; Day 0 represents the start of treatment. Data represent the mean ± SD (n=56). (a, b, c) Different letters indicate statistically significant differences between groups (p<0.05; Student-Newman-Keuls following one-way ANOVA)

Table 1. Effects of Baccharis dracunculifolia on the lipid profile of the animals (Mean ± SD, n=7 per group)

Biochemical parameters	CT	CB	CDT	DS	DB50	DB100	DB200	DB200S
Cholesterol (mg/dl)	76,6 ± 19,2	84,3 ± 16,3	89,2 ± 10,7	84,2 ± 11,1	78,2 ± 9,2	78,3 ± 11,1	79,7 ± 12,6	79,2 ± 7,6
HDL-cholesterol (mg/dl)	22,1 ± 9,8	24,8 ± 9,5	20,3 ± 9,2	23,4 ± 6,1	21,4 ± 5,5	20,1 ± 6,3	21,6 ± 9,2	26,5 ± 5,4
LDL-cholesterol (mg/dl)	31,3 ± 20,4	40,7 ± 14,7	41,1 ± 16,5	44,1 ± 13,6	33,9 ± 12,3	31,5 ± 9,1	31,4 ± 20,9	31,04 ± 7,7
Triglicerides (mg/dl)	106,8 ± 25,6$^{b,\#}$	94,2 ± 37,2$^{b,\#}$	189,8 ± 39,6$^{a,\#}$	112,7 ± 24,5$^{b,\#}$	104,3 ± 33,5$^{b,\#}$	103,8 ± 60,6$^{b,\#}$	103,6 ± 40,1	107,8 ± 36,7

*Tween Control - CT; Baccharis Control - CB; Diabetic Control - CDT; Diabetic Sulfonylurea - DS; Diabetic Baccharis 50 mg - DB50; Diabetic Baccharis 100 mg - DB100; Diabetic Baccharis 200 mg - DB200; and Diabetic Baccharis 200 mg + Sulfonylurea - DB200S. The data were expressed as mean and SD. (a, b, c) Different letters indicate statistically significant differences between groups (the symbols above the numbers indicate statistical differences using ANOVA with the Student-Newman-Keuls post-test; where # = p < 0.05 and * = p < 0.01). Measurements were taken after 12 hours of fasting.*

3.3 Food Intake

The analysis of food intake revealed a correlation between the reduction of blood lipids and certain dietary patterns, highlighting the importance of diet in the response to treatment.

Regarding food intake (week 1), there was no (Fig. 2) statistical difference between the evaluated groups at this initial stage. However, in week 2, a statistical difference was observed in the CB group (116.0 g; p<0.05) compared to the other groups, favoring a reduction of 5.7% to 20.5% (p<0.05) in food intake by the CB group in this comparison. In week 3, statistical differences were observed between the DB50 (125.0 g; p<0.05) and CDT (148.0 g; p<0.05) groups, with an 18.4% increase (p<0.05) in food intake in the diabetic CDT group compared to the DB50 group.

At the end of the treatment (week 4), the CB group (121.0 g; p<0.05) again demonstrated a 14.8% lower food intake in grams compared to the DB200 group (142.0 g; p<0.05) in this evaluation.

3.4 Water Intake

In week 1, no statistical difference was observed among all the diabetic groups analyzed. However, a lower water intake was noted in the CB (169.0 ml; p<0.05) and CT (162.0 ml; p<0.05) groups compared to the diabetic groups in this evaluation. In week 2, a statistical difference was observed between the diabetic groups treated with the plant extract—DB50 (435.0 ml; p<0.05), DB100 (425.0 ml; p<0.05), DB200 (455.0 ml; p<0.05), and DB200S (405.0 ml; p<0.05)—and the non-diabetic groups CT (172.0 ml; p<0.05) and CB (157.0 ml; p<0.05), as well as the untreated diabetic group CDT (590.0 ml; p<0.05). The groups treated with *B. dracunculifolia* extract (DB50, DB100, DB200, and DB200S) showed a minimization of water intake, especially when compared to the untreated diabetic group (CDT).

From week 3 onward, the DB50 (395.0 ml; p<0.05), DB100 (385.0 ml; p<0.05), and DB200S (370.0 ml; p<0.05) groups were statistically different from the other groups, presenting intermediate values between the non-diabetic groups CT (167.0 ml; p<0.05) and CB (159.0 ml; p<0.05) and the diabetic control group CDT (560.0 ml; p<0.05) until the end of the experiment (week 4).

It is noteworthy that the CDT group (570.4 ml; p<0.05), from week 2 to week 4, showed a higher water intake compared to the other groups analyzed, with an increase in water consumption of 39.6% (p<0.05), 45.0% (p<0.05), and 47.7% (p<0.05) when compared to the DB50 (408.6 ml; p<0.05), DB100 (393.3 ml; p<0.05), and DB200S (386.0 ml; p<0.05) groups, respectively.

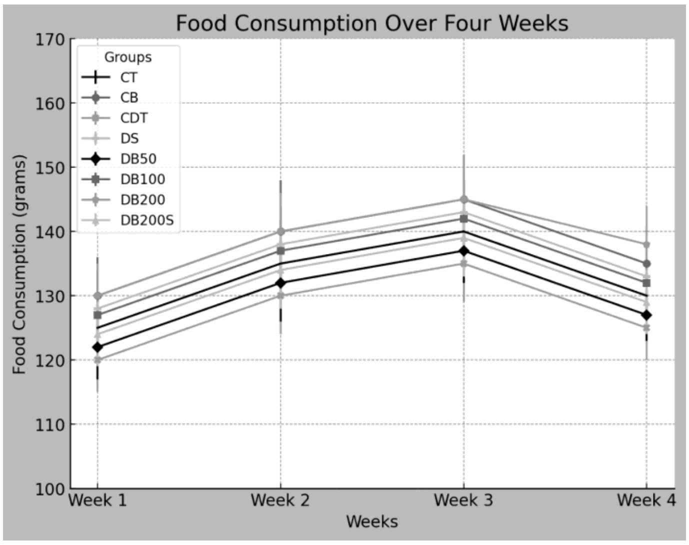

Fig. 2. Effect of *Baccharis dracunculifolia* on the food intake of the animals

Tween Control - CT; Baccharis Control - CB; Diabetic Control - CDT; Diabetic Sulfonylurea - DS; Diabetic Baccharis 50 mg - DB50; Diabetic Baccharis 100 mg - DB100; Diabetic Baccharis 200 mg - DB200; and Diabetic Baccharis 200 mg + Sulfonylurea - DB200S. Values of food intake in grams during the 4 weeks of the experiment. Data represent the mean ± SD (n=56). (a, b) Different letters indicate statistically significant differences between groups (p<0.05; Student-Newman-Keuls following one-way ANOVA).

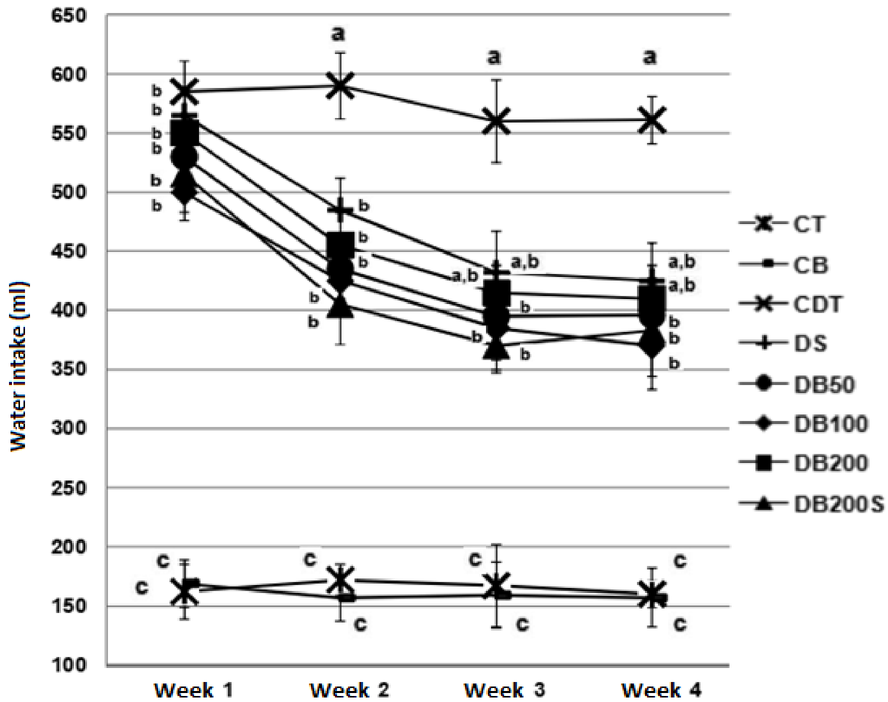

Fig. 3. Effect of *Baccharis dracunculifolia* on the water intake of the animals

Tween Control - CT; Baccharis Control - CB; Diabetic Control - CDT; Diabetic Sulfonylurea - DS; Diabetic Baccharis 50 mg - DB50; Diabetic Baccharis 100 mg - DB100; Diabetic Baccharis 200 mg - DB200; and Diabetic Baccharis 200 mg + Sulfonylurea - DB200S.Values of water intake in milliliters during the 4 weeks of the experiment. Data represent the mean ± SD (n=56). (a, b, c) Different letters indicate statistically significant differences between groups (p<0.05; Student-Newman-Keuls following one-way ANOVA).

4. DISCUSSION

The results demonstrated a relationship between the *Baccharis dracunculifolia* extract and its effects on the lipid profile. Previous studies, such as that by Hernández Zarate and colleagues (2018), have documented the antioxidant activity of plant extracts and their role in modulating blood lipids, suggesting that antioxidants can positively influence triglyceride and cholesterol levels (Hernández Zarate et al., 2018). This modulation may be due to the ability of antioxidants to neutralize free radicals, reducing oxidative stress, a significant contributing factor to chronic complications in conditions such as diabetes (An et al., 2023).

The observed effects of *Baccharis dracunculifolia* extract on glycemic control, lipid metabolism, and tissue protection can be attributed to its rich composition of bioactive compounds, particularly phenolic acids and flavonoids. These compounds are known to exert antioxidant and anti-inflammatory effects, which play a crucial role in mitigating oxidative stress and inflammation, both of which are central to the pathogenesis of diabetes and its complications (Veiga et al., 2017). For instance, the reduction in blood glucose levels may be linked to the ability of flavonoids to enhance insulin secretion and improve insulin sensitivity by modulating signaling pathways such as PI3K/Akt and AMPK (Ansarullah et al., 2011).

Additionally, the improvement in lipid profile, particularly the reduction in triglyceride levels, may result from the inhibition of lipogenesis and the promotion of fatty acid oxidation, processes regulated by compounds like artepillin C, a major phenolic component of *B. dracunculifolia* (Resende et al., 2012). Furthermore, the protective effects on liver, kidney, and pancreatic tissues are likely mediated by the antioxidant properties of the extract, which reduce lipid peroxidation and cellular damage caused by reactive oxygen species (ROS) (Rezende et al., 2014). These mechanistic insights align with previous studies and provide a plausible explanation for the therapeutic potential of *B. dracunculifolia* in diabetes management.

The lipid profile, including total cholesterol, HDL (high-density lipoprotein), and LDL (low-density lipoprotein), is crucial for understanding the biochemical responses to the *B. dracunculifolia* extract. Scientific literature indicates that the phenolic compounds and flavonoids present in this plant possess antioxidant activities, which may contribute to the observed effects on the lipid profile (Veiga et al., 2017).

A comparative analysis of the results with other studies underscores the consistency and relevance of these findings, reinforcing the notion that *B. dracunculifolia* extract has remarkable antioxidant properties. This consistency is evidenced in studies such as that by Tomazzoli et al. (2021), who also reported significant antioxidant activities in *Baccharis dracunculifolia* extracts.

In the study, a significant reduction in triglyceride (TG) levels was observed in the groups treated with Baccharis dracunculifolia extract, particularly at doses of 50 mg and 100 mg, compared to the untreated diabetic group (CDT). However, no significant changes were observed in LDL-cholesterol levels among the groups. A possible explanation for this selective effect on TGs, rather than LDL, may be related to the mechanisms of action of the bioactive compounds present in the plant extract. Flavonoids and phenolic compounds, such as artepillin C, found in B. dracunculifolia extract, are known to modulate the activity of enzymes involved in lipid metabolism, such as lipoprotein lipase, which plays a crucial role in the hydrolysis of triglycerides. Additionally, these compounds may influence fatty acid oxidation and the synthesis of very low-density lipoproteins (VLDL), which are precursors of TGs. On the other hand, LDL-cholesterol is more influenced by metabolic pathways related to hepatic cholesterol uptake and LDL receptor regulation, which may not be directly affected by the compounds in the extract. Therefore, the reduction in TG levels may be attributed to the antioxidant and lipid-modulating effects of the extract, while LDL levels remain unchanged due to the extract's limited influence on specific cholesterol regulatory mechanisms (Silva et al., 2021).

The connection between antioxidant activity and the improvement of the lipid profile is a crucial point, indicating the potential benefits of the extract in modulating various metabolic mechanisms. The influence of antioxidants on the lipid profile may have important implications for cardiovascular health, highlighting the clinical significance of these findings (Mohamed et al., 2010).

Furthermore, it is essential to consider the limitations of the study, such as the absence of direct analysis of antioxidant compounds in the extract, which may hinder the attribution of the observed effects to specific components. The lack of a control group for evaluating food intake may also introduce bias into the results (Gouveia et al., 2022).

Future perspectives should focus on the identification and quantification of specific bioactive compounds in the *B. dracunculifolia* extract to gain a deeper understanding of its mechanisms of action. The interaction of the extract with the gut microbiome may be another relevant field of study, given the growing evidence of a significant relationship between bioactive compounds, microbiota, and metabolic health (Faria Ghetti et al., 2018).

5. CONCLUSION

The conclusion of this study highlights the relevance of *Baccharis dracunculifolia* extract as a potential complementary therapeutic intervention in diabetes management. The results demonstrate its notable antioxidant activity, reflected in the significant reduction in triglyceride levels and beneficial changes in the lipid profile. These findings underscore the importance of the antioxidants present in the plant in mitigating oxidative stress associated with diabetes, suggesting promising implications for the prevention of cardiovascular complications.

ETHICAL APPROVAL

Animal Ethic committee approval has been collected and preserved by the author(s)

DISCLAIMER (ARTIFICIAL INTELLIGENCE)

Author(s) hereby declare that NO generative AI technologies such as Large Language Models (ChatGPT, COPILOT, etc.) and text-to-image generators have been used during the writing or editing of this manuscript.

COMPETING INTERESTS

Authors have declared that no competing interests exist.

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