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Estimation of Olibanum Effect on Blood Glucose, Oxidation, and Lipid Profile in Diabetes-Induced Rats

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Abstract

This study was done at the Biotechnology Research Center/Al-Nahrain University to elucidate the activity of aqueous extract of olibanum after twenty days on glucose, lipids, and oxidation in diabetes-induced rats by using Alloxan (100 mg/kg). Twenty male rats aged 6 weeks and weighing 180±3g were categorised into four groups, five rats for each: group 1 (control) given distilled water, group 2: diabetic (no treatment), group 3: diabetic group given (150 mg\kg) of olibanum aqueous extract and group 4: healthy rats (non-diabetic) given aqueous extract. The results revealed that the rise in blood glucose was accompanied by an increase in triglycerides, cholesterol, very low-density lipoprotein, and low-density lipoprotein in diabetic rats. Groups 3 and 4 showed a significant decrease in blood glucose and ketone bodies. Also, the results showed an increase in insulin level on the 20th day of the experiment in group 3, and the levels of triglycerides, cholesterol, very low-density lipoprotein, and low-density lipoprotein decreased. Malondialdehyde showed a significant increase in group 2 compared to the control group and a decrease in group 3. Superoxide dismutase increased in groups 2 and 3 compared with control. Catalase enzyme value increased in the diabetic group compared with control, while in group 3 this value decreased with significant differences compared with the diabetic group. These results have shown that the consumption of olibanum aqueous extract has an important role in decreasing hyperglycemia, hyperlipidemia and free radicals.

Keywords: Antioxidants, Olibanum, Hyperlipidemia, Diabetes, Insulin

تقدير تأثير لبان الذكر على سكر الدم والأكسدة والدهون في الجرذان المستحثة لداء السكري

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الخلاصة:

تم اجراء هذه الدراسة في مركز بحوث التقنيات الاحيائية في جامعة النهرين لتقييم فعالية المستخلص المائي للبان الذكرعلى سكرالدم والدهون والأكسدة في الجرذان المستحثة بداء السكري بأستخدام مركب الوكسان (100 ملغم/ كغم) .تم تقسيم 20 من ذكور الجرذان بعمرستة أسابيع ووزن 3± 180 غرام الى اربعة مجاميع , خمسة جرذان لكل مجموعة .المجموعة الاولى (السيطرة)اعطيت ماء مقطر والثانية الجرذان المصابة بالسكري والثالثة مصابة بداء السكري وتم اعطاؤها المستخلص المائي للبان الذكر والرابعة غير مصابة وتم اعطاؤها

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المستخلص.اظهرت النتائج ارتفاع السكروالدهون الثلاثية والكوليسترول والبروتينات الدهنية في مجموعة الجرذان المستحثة وكذلك اظهرت المجموعتين 3 و 4 انخفاض معنوي في سكر الدم والكيتونات.ومن ناحية اخرى ارتفع الانسولين في اليوم العشرون من التجربة للمجموعة الثالثة ترافق مع انخفاض في مستوى الكوليسترول والدهون الثلاثية والبروتينات الدهنية . اظهر المالونديالديهايد زيادة معنوية في المجموعة 2 ونقصان في المجموعة 3. اما انزيم سوبر اكسيد الديسميوتيز فقد ارتفعت نسبته في المجموعتين 2 و3 مقارنة مع مجموعة السيطرة. قيمة انزيم الكاتاليزارتفعت في المجموع المصابة بينما انخفضت في المجموعة 3 بفروق معنوية مقارنة بالمجموعة المصابة بالسكري.اظهرت النتائج اهمية دور المستخلص المائي للبان الذكر في خفض السكر والدهون والجذور الحرة.

1. Introduction

Frankincense (Oleo-gum resin) or olibanum is an economically valuable product obtained from the *Boswellia* genera trees. This product is used in several industries, including food flavors, pharmacology, beverages, cosmetics, and perfumery [1]. The extract from the resins of *Boswellia* trees has been used as a medicine to treat different diseases, including arthritis, cancer, and asthma [2]. Oleogum resins of *Boswellia* species contain about 200 phytochemicals. The important compounds represent resin, essential oil, and mucus [3; 4]. *Boswellia papyrifera* found in Sudan, Ethiopia, and Eritrea is considered one of the sources of olibanum [5]. The various extracts from *B. papyrifera* in addition to essential oils, can be potentially used as antimicrobial agents [6 ,7]. The activity of *B. papyrifera* may be attributed to the presence of some active compounds such as saponins, alkaloids, and flavonoids. In some studies, these compounds showed an immunomodulation effect in rats [8]. Medicinal plants contain many natural compounds that can promote health and alleviate illness. Diabetes is considered an important metabolic disorder as a result of insulin resistance or a defect in insulin secretion [9]. In diabetes, chronic high blood glucose leads to the production of reactive oxygen species. Free radicals are produced due to cell membranes and lipid peroxidation damage, which affects the liver, kidneys, and other parts of organs [10]. On the other hand, Insulin insufficiency leads to significant changes in lipid metabolism and lipoproteins. Hypolipidemia occurs from the decrease of lipids in blood serum, while the increase in lipids is called hyperlipidemia. These lipids include triglycerides (TG), cholesterol (CHO), very low-density lipoprotein (VLDL), and low-density lipoprotein(LDL) [11]. In Iraq, many researchers suggested that medicinal plants could be used to lower high lipids and glucose[12-15]. Numerous animal research projects also focused only on *Boswellia serrata* gum resin as an anti-oxidant and anti-diabetic. Therefore, this research aimed to investigate the activity of *B. papyrifera* on lipid profile and diabetes in laboratory rats.

2.Material and methods

Preparation of Boswellia papyrifera aqueous extract

Ethiopian Oleo-gum resin of *B. papyrifera* was purchased from the local market. Resins were cleaned with tap water, and the aqueous extract was obtained by shaking (100 gm) of resin with (1000 ml) distilled water for two hours at 50°C. A freeze-dryer was used to dry the extracts after filtration [6]. The dosage of this extract was (150 mg\kg) given orally by stomach tube at a dose of 1 ml/day for 20 days.

Animals management

All guidelines for the care and use of laboratory animals were followed, and the ethics committee approved the study protocol (CSEC ⁄0724/ 0054 on 28/7/2024). Healthy mature male rats were obtained from the animal house of Biotechnology Research Center/Al-Nahrain University. Twenty male rats were utilised in this experiment. Their age at the beginning of

the experiment was between 5-6 weeks, and their weight was about 180±3g. They were classified into four groups randomly, and 5 rats were kept in each cage. They were kept under suitable environmental conditions of 20-25°C, water and diet were freely available for the rats.

Experimental design

Rats were classified into four groups, as follows: group 1: given distilled water and served as control; group 2: diabetic group (no treatment); group 3: diabetic group given 150 mg\kg aqueous extract of *B. papyrifera* ; group 4: healthy group (non-diabetic) given 150 mg\kg aqueous extract of *B. papyrifera*

Diabetes induction

Blood glucose levels (baseline) were tested before the treatments. Animals had induction of diabetes by intraperitoneal injection of Alloxan (100 mg/kg) [16], which was produced from (Sigma/ AldrichUSA) and dissolved in normal saline. After 24 hours of Alloxan injection, the glucose analysis was done according to Al-Hamdani [17], and diabetes was confirmed with (>250 mg/dl) from glucose level. These animals were only selected for this study and received treatment for 20 days.

Blood collection

Blood was collected from all groups, and the rats were anesthetized using chloroform. 5 ml of blood was collected from the heart via cardiac puncture by using a 3 ml syringe and a 22-gauge needle. On the other hand, the tubes without anticoagulant were left at room temperature. Sera were collected in gel test tubes and centrifuged for 15 min. at 3000 rpm, then kept in (-18˚C) [18].

Biochemical analysis

Insulin measurement

Insulin level was determined using an Insulin hormone kit \cobas\Roche, Germany.

Ketone body

Quantitative determination of the ketone body was done using the Ketone Body Assay Kit (EKBD-100), USA.

Lipid profile

Total cholesterol (CHO), triglycerides(TG), High-density lipoprotein (HDL) cholesterol, and Low-density lipoprotein (LDL) were assessed using the methodology of a commercially available kit (Linear Chemicals, Spain) [19], while very low-density lipoprotein VLDL concentration was calculated using the following equation [20].

VLDL Cholesterol = Triglycerides / 5 .

Measurement of Malondialdehyde (MDA)

The lipid Peroxidation Assay Kit from BioVision, USA, was used to determine Malondialdehyde (MDA) in serum. The principal determination is derived from the interaction between MDA and thiobarbituric acid (TBA), which forms an MDA-TBA2 product that absorbs strongly at 532 nm.

Superoxide Dismutase (SOD) Activity and Catalase enzyme(Cat.)

SOD was determined using the method previously described in Sumanth and Rana [21]. Redox dye was used in Bioassay Systems' improved assay directly to measure the catalase degradation of H_2O_2. A change in the color intensity at 570 nm directly referred to the catalase activity in the sample.

Statistical analysis

The statistical analysis system-SAS (2018) program was utilized to detect the effect of different groups in this study. Least significant differences-LSD were used to significantly compare between means.

3. Results and discussion

Effect of olibanum water extract on blood sugar, ketone body, and insulin

As demonstrated in Table 1, the diabetic (positive control) rats show a significant increase in blood glucose and ketone bodies as compared to the control group. The diabetic group that received 150 mg\kg aqueous extract of *B. papyrifera* shows a significant decrease in blood glucose and ketone bodies compared to the diabetic group. Conversely, the healthy group that consumed olibanum aqueous extract showed decreased blood glucose and normal ketone body values compared to the control group.

Table 1: Effect of aqueous extract of *Boswellia papyrifera* on glucose level and ketone body in healthy and diabetic rats.

Groups	First day Glucose mg\dl	10th day Glucose mg\dl	20th Glucose mg\dl	Ketone body\Mm
Group 1	105±3.65 C	98±3.89 C	91±1.33 C	1.09 C
Group 2	383±6.58 A	388±4.45 A	368±7.52 A	6.43 A
Group 3	370±5.73 B	242±5.90 B	186±2.79 B	4.86 B
Group 4	95± D	89±2.43 D	80±1.34 D	2.03 C

Means having the different letters in the same column differed significantly. * (P≤0.05).

The results in Table 2 also revealed that the insulin level in the control group was not changed during the first 20th day of the experiment, while in the positive control (diabetic) group, the insulin level decreased because beta cells that produce insulin were affected by Alloxan. Conversely, the results show an increase in insulin level on the 20th day of the experiment in a group of diabetic rats that received 150 mg\kg aqueous extract of *B. papyrifera*, which may reveal the activation of the pancreas by olibanum extract. Mahdian *et al*., referred to the fact that *Boswellia* species decrease blood glucose by restoring beta cells and lowering the resistance to insulin [22]. Azemi *et al.,* reported in their study on another *Boswellia* species that *B. serrata* extract has the anti-diabetic action and can prevent high blood glucose problems in the kidneys and liver [23].

Table 2: Effect of aqueous extract of *Boswellia papyrifera* on insulin level in healthy and diabetic rats.

Groups	First day Insulin u U\ml	10th day Insulin u U\ml	20th day Insulin u U\ml
Group 1	6.22± 1.43 A	5.94±1.09 B	5.33±0.87 A
Group 2	3.34±0.87 C	2.02±0.23 C	1.88±0.05 C
Group 3	3.53±0.23 C	3.94±0.34 C	4.60±0.55 A
Group 4	5.06±1.60 B	6.97±1.43 A	4.04±0.39 B

Means having the different letters in the same column differed significantly. * (P≤0.05).

Effect of olibanum aqueous extract on Lipid profile and oxidative stress

Results in Table 3 exhibit that the cholesterol, triglyceride, LDL, and VLDL in diabetic groups of rats have significantly increased compared with control, in addition to a decrease in HDL value, while in the diabetic group treated with olibanum aqueous extract, the levels of TG, CHO, LDL and VLDL are decreased with increasing in HDL value as compared with diabetic rats. On the other hand, the healthy group with olibanum extract administration shows no significant differences in all lipid parameters compared to the control group except for the cholesterol value, which shows a significant decrease. Ahmed *et al.,* [24] reported that *Boswellia* gum resin enhances the lipid profile by lowering liver lipids and activating liver function tests through its anti-oxidant and cytoprotective properties.

Table 3: Effect of aqueous extract of *Boswellia papyrifera* on lipid profile concentration in healthy and diabetic rats.

Groups	Cholesterol mg\ dl	Triglyceride mg\ dl	HDL mg\ dl	LDL mg\ dl	VLDL mg\ dl
Group 1	84±3.65 C	85 ±2.90 C	30±2.56 B	37±2.63 C	17±1.98 B
Group 2	102±4.87 A	115±5.67 A	26±3.96 C	56±4.68 A	20±2.05 A
Group 3	90±4.20 B	92±3.40 B	38±3.45 A	44±3.06 B	18±1.59 B
Group 4	86±3.86 C	80±4.94 D	32±2.67 B	38±5.23 C	16±1.70 B

Means having the different letters in the same column differed significantly. * (P≤0.05).

Oxidative stress is recently considered one of the processes in diabetes that influences protein, carbohydrate metabolism, and lipids. Table 4 shows that Malondialdehyde (which is an indicator of free radicals presence) has a significant increase in the diabetic group compared with the control and decreasing in the diabetic group that received 150 mg\kg aqueous extract of *B. papyrifera* compared with diabetic group. The results also show non-significant differences between the control and healthy group that received olibanum aqueous extract. SOD enzyme, which is an efficient anti-oxidant component, increased in both the diabetic group and the diabetic group that received 150 mg\kg aqueous extract of *B. papyrifera*

compared with control. The results also show that CAT enzyme value increased in the diabetic group compared with the control group, while in a group that received 150 mg\kg of the olibanum aqueous extract, the value decreased with significant differences compared with the diabetic group. Mahdian *et al*. [22] referred that the anti-oxidant activity of *Boswellia* species enhances the profile of blood lipids by reducing the percentage of TNF-α and IL-1β. The investigation on another species of *Boswellia* illustrated the anti-diabetic actions, the anti-oxidant capacity of gum resin powder, and its ability to ameliorate liver and pancreas functions in diabetic rats [25]. On the other hand, the crude flavonoids extracted from *Boswellia* could be used for protection from oxidative stress [26].

Table 4: Effect of *Boswellia papyrifera* extract on MDA, SOD, and CAT concentration in healthy and diabetic rats.

Groups	MDA nmol\ mL	SOD IU\L	CAT IU\L
Group 1	1.3±0.04 C	4.25±1.6 AB	3.01 ±0.98 B
Group 2	4.8±0.34 A	6.33±1.3 A	7.10±1.09 A
Group 3	2.82±0.65 B	5.6.06±1 A	3.83±0.90 B
Group 4	1.59±0.05 C	3.54±0.85 AB	3.31±0.78 B
Means having the different letters in the same column differed significantly. * (P≤0.05).			

4. Conclusions

Olibanum aqueous extract could be considered an important natural material for decreasing hyperglycemia, hyperlipidemia, and free radicals.

Conflict of interest

The author declares no conflict of interest in this study

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