

A study of the effects of crude extract of purslane (rigla) on some aspects of lipid and carbohydrate metabolism in normal and diabetic male albino rats

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ABSTRACT

This work was performed to study the effect of crude purslane extract on some aspects of lipid and carbohydrate metabolism in normal and streptozotocin induced diabetic male albino rats. Twenty four male albino rats, were categorized into four equal groups. Group (1): normal control rats, group (2): purslane treated rats in which the rats were administrated by purslane extract in a dose of 5 gm/kg orally for three weeks, group (3):diabetic control rats and group(4): diabetic rats treated by purslane, in which the rats were administrated by purslane extract for three weeks. At the end of the experiment, the rats were scarified and blood samples were collected .The results showed significant reduction in blood levels of triglyceride, total cholesterol, LDL-cholesterol with significant increase in blood level of HDL-cholesterol, $P<0.05$, and non significant change in glucose or insulin level in purslane treated group compared with normal control group. There were significant reduction in blood level of triglyceride, total cholesterol, LDL-cholesterol with significant increase in blood level of HDL-cholesterol, and non significant change in insulin level compared with the significant reduction in blood glucose level in purslane treated diabetic group compared with diabetic control group. It is concluded that crude purslane extract has beneficial effects on lipid and carbohydrates parameters both in normal and diabetic condition.

INTRODUCTION

Fresh purslane (*Portulaca oleracea*) has been used for thousands of years throughout the world as medicinal herb⁽¹⁾. Purslane belongs to portulacaceae purslane family, genus portulaca and olearacea species⁽²⁾. It is known as parsley or purslane in united state and Rigla in Egypt⁽³⁾

Analysis of purslane indicated that it contain many macronutrient and micronutrients⁽⁴⁾ as lipid, protein, carbohydrates, Omega 3 and Omega 6, fibers and pectin as macronutrients.

Also glutathione, Alphatocopherol, β carotene, vitamin C, selenium, Cupper, Zinc and potassium⁽⁵⁾. In addition purslane is considered to be a good source of coenzyme 10 (Q₁₀) and melatonin⁽⁶⁾. Purslane has many medicinal uses in the ancient times, it is used as bronchodilators⁽⁷⁾ antiulcerogenic⁽⁸⁾ diuretic⁽⁹⁾, in treatment of colitis and as a choleric⁽¹⁰⁾. Also it was used as antidiabetic⁽¹¹⁾. The primary antioxidant vitamins A, E and C have the power to bring free radicals under control and have the power to act as

catalyst and help to get ride of continuously formed free radicals⁽¹²⁾. Alphatocopherol is a chain breaking antioxidant that prevent the propagation of free radicals⁽¹³⁾. Beta carotene is converted to vitamin A, which acts as a powerful antioxidant that decrease low density lipoprotein oxidation⁽¹⁴⁾. Vitamin C is antioxidant vitamin that protects low density lipoprotein cholesterol from oxidative damage⁽¹⁵⁾. The antioxidant minerals of purslane are essential in protection of the body from continues formation of free radicals that cause tissue damage. Selenium is one of the most important mineral acting as antioxidative enzyme modulator for the formation of selenium dependant glutathione peroxidase⁽¹⁶⁾. Also zinc, manganese and copper form part of the production of superoxide dismutase enzyme⁽¹⁷⁾

The aim of the present work was to study the effect of crude alcoholic extract of purslane on some aspects of lipid and carbohydrate metabolism in normal and streptozotocin- induced diabetic male albino rats.

MATERIAL & METHODS

1. Preparation of crude plant materials:

5 kilograms of the fresh leaves of purslane (*Rigla*) were spread on paper sheets and dried under shade at room temperature for 14 days, then crushed and stored.

2. Preparation of the 10% ethanol extract:

The whole amount of dried plant was mixed with aqueous ethanol (90% H₂O+10% ethanol) for four hours and filtered, then ethanol was removed by

evaporation⁽¹⁸⁾. The extract was weighted and suspended in water where each 100 gram were suspended in 100 mL water so each 1mL contain 1 gram purslane extract and administrated orally in a doe of 5 gm/kg body weight daily⁽⁴⁾, by intragastric tube.

The animals:

This study was conducted on 24 male albino rats weighting 200-250 gm. The rats were housed in an isolated animal cages in a standard animal laboratory room and had free access to water and food.

Experimental protocol:

The rats 24 were randomly divided into four equal groups each containing 6 rats:

1) Normal control group: The rats had free access for water and food for three weeks.

2) Purslane group: The rats received crude purslane extract in a dose of 5 gm/kg body weight orally for three weeks.

3) Diabetic control group: Diabetes was induced by a single intraperitoneal injection of streptozotocin 50 mg/kg⁽¹⁹⁾, and the rats received water for three weeks.

4) Purslane treated diabetic group: The streptozotocin induced diabetic rats received crude purslane extract orally in a dose of 5 gm/kg daily for three weeks.

At the end of experimental period, the rats were anaesthetized by intraperitoneal injection of pentobarbital sodium in a dose of 50 mg/kg body weight⁽²⁰⁾. The rats were scarified and blood samples were collected and serum was separated for determination of:

1. Determination of triglycerides by the method described by Fossati and Principe⁽²¹⁾.
2. Determination of total cholesterol according to the method of Ratliff and Hall⁽²²⁾.
3. Determination of high density lipoprotein cholesterol by the method of Richmond⁽²³⁾.
4. Determination of low density lipoprotein cholesterol by the method of Fruchart⁽²⁴⁾.
5. Determination of serum insulin level according to the method of Burrin⁽²⁵⁾.
6. Determination of blood glucose level according to the method of Tietz⁽²⁶⁾.

Statistical analysis:

Results were tabulated, and analysis was performed with statistical package for social science (SPSS version 13). Comparison between the studied groups was performed with independent samples student t-test for comparison means. F value of analysis of variance (ANOVA) was calculated. P value of <0.05 were considered statistically significant

RESULTS

The results of the present work showed that, the crude purslane extract was administrated orally in a dose of 5gm/kg body weight daily for three weeks to normal and streptozotocin induced diabetic male albino rats showed significant reduction of blood triglycerides and low density lipoprotein and significant increase in high density lipoprotein, (P<0.05) in relation to normal control rats. Also there were significant reduction of high density lipoprotein and insulin and significant increased in blood triglycerides, cholesterol, low density lipoprotein and blood glucose levels (P<0.05) in streptozotocin induced diabetic rats in relation to normal controls rats. Administration of crude purslane extract to streptozotocin induced diabetic rats showed significant reduction in blood level of triglyceride, cholesterol, low density lipoprotein, glucose in relation to diabetic control group (P<0.05). Also there was significant increased in blood levels of high density lipoprotein (P<0.05) and non significant increase of blood insulin, table (1).and figures (1-6).

Table (1): Effect of oral administration of crude purslane extract on the serum levels of some lipid parameters, glucose and insulin in normal and streptozotocin induced diabetic albino rats

Group (Mean of $\bar{x} \pm SD$)	Control	Purslane	Diabetic control	Diabetes with Purslane
Triglycerides mg/dl	143.36 \pm 6.43	135.28 \pm 3.63*	200.6 \pm 5.95	172.1 \pm 7.3*
Cholesterol mg/dl	110.05 \pm 7.91	108.91 \pm 8.24	238.1 \pm 10.34	190.6 \pm 9.24*
High density lipoprotein mg/dl	65.1 \pm 3.16	73 \pm 2.76*	30.95 \pm 2.45	34.82 \pm 2.89*
Low density lipoprotein mg/dl	48.24 \pm 3.6	39.43 \pm 2.45*	87.4 \pm 5.14	69.6 \pm 3.57*
Glucose mg/dl	93.84 \pm 1.78	92.77 \pm 3.68	206.8 \pm 4.34	174.7 \pm 8.52*
Insulin IU/dl	11.02 \pm 1.09	11.14 \pm 1.49	7.05 \pm 0.75	7.34 \pm 0.74*

*=denotes statistical significance

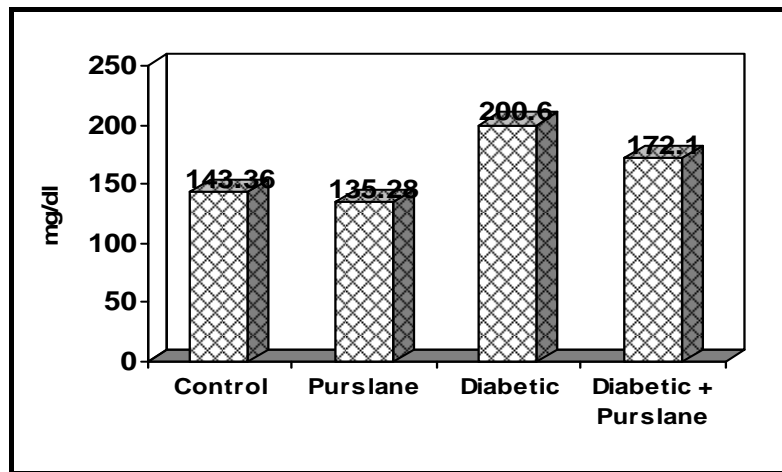


Fig. (1): Effect of oral crude purslane extract administration on triglyceride normal and streptozotocin induced diabetic level (mg/dl) in male albino rats.

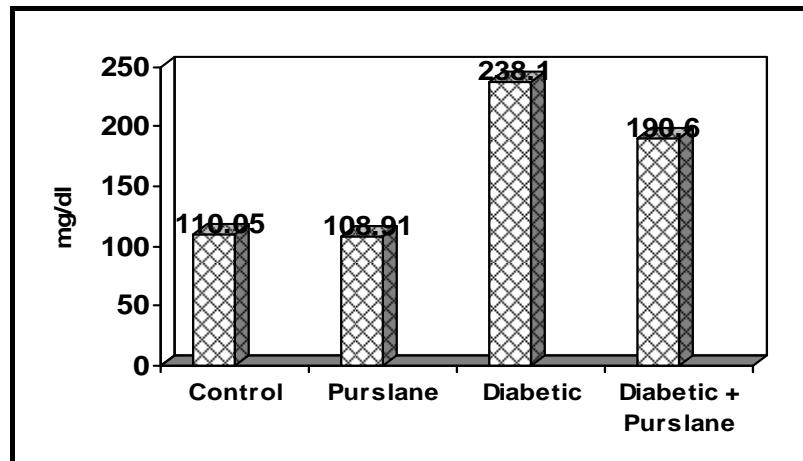


Fig. (2): Effect of oral crude purslane extract administration on cholesterol level (mg/dl) in normal and streptozotocin induced diabetic male albino rats

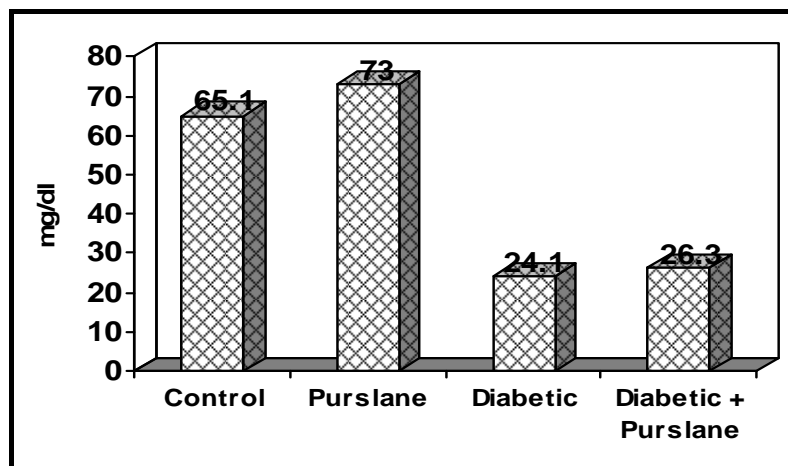


Fig. (3): Effect of oral crude purslane extract administration on high density lipoprotein level (mg/dl) in normal and streptozotocin induced diabetic male albino rats.

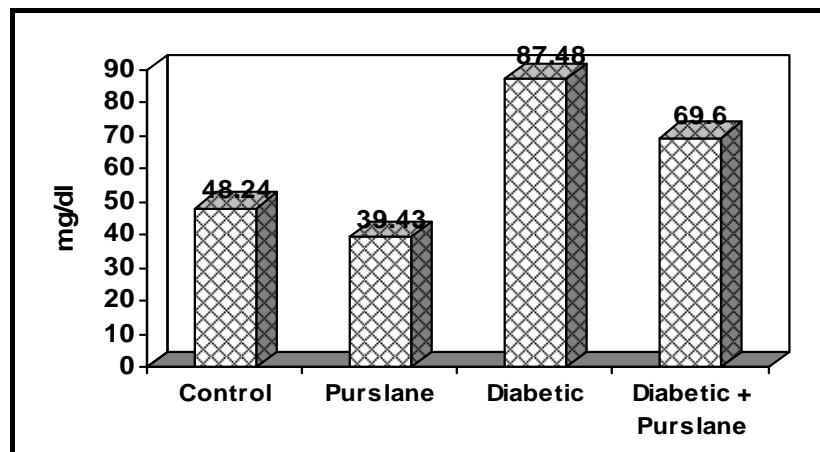


Fig. (4): Effect of oral crude purslane extract administration on low density lipoprotein level in normal and streptozotocin induced diabetic male albino rats

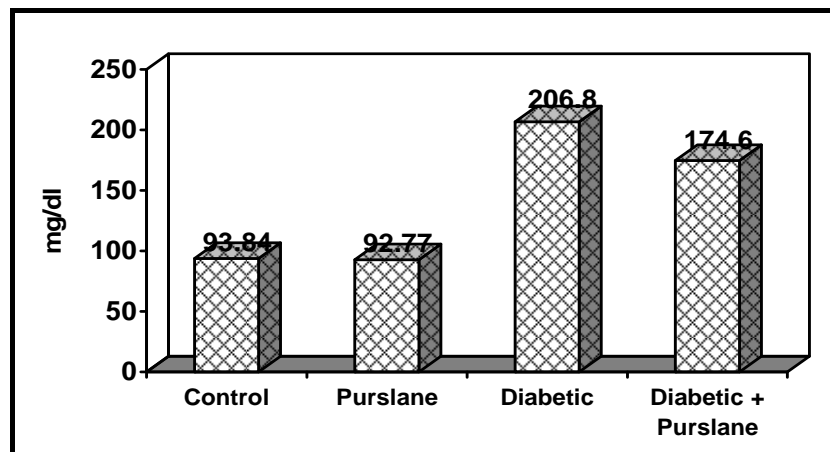


Fig. (5): Effect of oral crude purslane extract administration on blood glucose level (mg/dl) in normal and streptozotocin induced diabetic male albino rats

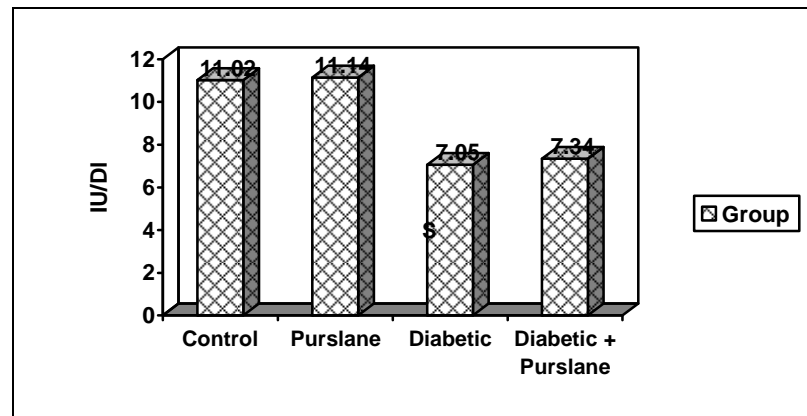


Fig. (6): Effect of oral crude purslane extract administration on blood insulin level (IU/dl) in normal and streptozotocin induced diabetic male albino rats

DISCUSSION

Purslane is nutritious plant representing not only a major source of nutrient but also contain many protective factors. In many countries as in Turkey, purslane is considered as one of the medicinal herb used by diabetics⁽²⁷⁾.

The results of the present work showed that the administration of crude purslane extract orally to normal and streptozotocin induced diabetic rats caused hypolipidemia with reduction in the total cholesterol, triglyceride, low density lipoprotein and significant increase in high density lipoprotein.

The hypolipidemic effect of purslane may be attributed to melatonin content of crude extract⁽⁶⁾. The effect of melatonin on lipid profile could be attributed to its direct scavenger of free radical⁽²⁸⁾. Also it could be due to indirect stimulation of the expression and activity of

antioxidant enzymes⁽²⁹⁾. It was reported that melatonin cause significant reduction in cholesterol, triglyceride, low density lipoprotein and significant increase in high density lipoprotein with decrease in atherogenic index⁽³⁰⁾. Moreover, melatonin improved the diabetes mellitus and its related complication, such as impaired lipid profile⁽³¹⁾. Moreover, purslane extract caused significant decrease in blood glucose without change in insulin level in streptozotocin induced diabetic rats, which may be due to its melatonin content that improved the insulin resistance⁽³²⁾. In addition, melatonin had antioxidative effect on insulin receptors, and also counteract tumor necrosis alpha that associated with insulin resistance⁽³³⁾.

Coenzyme 10(Q₁₀) has a hypolipidemic effect on normal and diabetic rats. This may be due to its action as electron carrier in oxidative phosphorylation and stabilizing the

cell membrane with a potent scavenger of free radical⁽³⁴⁾, It is also used in hypercholesterolemia⁽³⁵⁾. Moreover, the alpha tocopherol content of purslane may have a role in the hypolipidemic and hypoglycemic effects of purslane. This effect occurs through a chain breaking antioxidant that prevent propagation of free radical activities⁽¹³⁾. Also alpha tocopherol may causes hypolipidemia through stimulation of lipoprotein lipase, that clears chylomicrons from the circulation⁽³⁶⁾. In addition to β carotene content of purslane increases the fecal excretion of cholesterol and normalizes the lipid metabolism⁽³⁷⁾.

In addition, vitamin C content of purslane causes reduction in total cholesterol and improved the amount of low density lipoprotein, and also increased the action of insulin, due to non oxidative glucose metabolism⁽³⁸⁾.

The hypolipidemic effect of purslane may be explained by selenium content of purslane which has an important role in formation and function of selenium dependent glutathione peroxidase, which prevent the accumulation of the oxidized low density lipoprotein⁽¹⁶⁾. Also zinc, manganese and copper form a part of the production of antioxidant enzymes⁽¹⁷⁾. The hypolipidemic effect of crude purslane extract, may be attributed to its content of polyunsaturated fatty acids, omega 3⁽³⁹⁾. The mechanism by which omega 3 caused hypolipidemia may be due to reduction of hepatic secretion of very low density lipoprotein⁽⁴⁰⁾, or stimulation of fatty acid oxidation in the liver and skeletal muscles⁽⁴¹⁾, and so caused shift of triglyceride from

storage to oxidation. Moreover omega 3 caused activation of lipoprotein lipase that catalyzes the break down of triglyceride to fatty acids and glycerol⁽⁴²⁾. In addition omega 3 has antioxidant effect by decreasing oxidative stress⁽⁴³⁾.

The results of the present work showed significant reduction of blood glucose level in diabetic rats which were treated by purslane extract, which can be explained by the presence of omega 3 that are preventing the depletion of glucose transporter 4 in the muscle and adipose tissue⁽⁴⁴⁾, and are improving insulin sensitivity and decreasing insulin resistance⁽⁴⁵⁾. Moreover, omega 3 promote the glucose uptake and oxidation⁽⁴⁶⁾.

Conclusion:

It is concluded that, the administration of crude purslane extract has beneficial effects on lipid and carbohydrates parameters both in normal and diabetic conditions. It is recommend to consume greater amounts of this plant regularly.

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تأثير مستخلص نبات الرجلة على بعض أوجه الأيض الغذائي للدهون والكاربوهيدرات في الفئران البيضاء الطبيعية والمصابة بمرض السكر

سلمى علوى نصار - رزق الخولى - روميساء على الشربيني
قسم الفسيولوجيا كلية الطب جامعة طنطا

يهدف البحث إلى دراسة تأثير الملخص العربي مستخلص نبات الرجلة على بعض أوجه الأيض الغذائي للدهون والكاربوهيدرات في فئران التجارب البيضاء الطبيعية و المستحدثت إصابتها بمرض البول السكري بواسطة عقار الإستربتوزوتوسين. وقد تم إجراء البحث على (٢٤) فأراً، قسمت إلى أربع مجموعات ، تحتوي كل منها على ستة فئران.

- (١) المجموعة الأولى:- المجموعة الضابطة
- (٢) المجموعة الثانية:- وتم إعطاؤها مستخلص نبات الرجلة بجرعة خمسة جرامات لكل كيلو جرام من وزن الجسم يومياً عن طريق أنبوبة المعدة.
- (٣) المجموعة الثالثة: المجموعة الضابطة لمرض البول السكر:- تم حقنهم بعقار الإستربتوزوتوسين داخل التجويف البريتوني بجرعة ٥٠ مليجرام لكل كيلو جرام من وزن الجسم مرة واحدة
- (٤) المجموعة الرابعة:- تم استحداث مرض البول السكري فيهم تم معالجتها بمستخلص نبات الرجلة بجرعة ٥ جرامات لكل كيلو جرام من وزن الجسم يومياً عن طريق أنبوبة المعدة، وذلك لمعرفة تأثير مستخلص نبات الرجلة على القياسات الأيضية للمواد الدهنية والكاربوهيدراتية في الفئران المستحدثت إصابتها بمرض البول السكري. وقد استغرقت مدة البحث ثلاثة أسابيع . وقد تم أخذ عينات الدم، وتم تحليلها لحساب معدل كل من:- الدهون الثلاثية، الكليستيرول، البروتينات الدهنية عالية الكثافة، البروتينات الدهنية قليلة الكثافة، الأنسولين والجلوكوز.

وقد دلت نتائج هذا البحث على وجود تأثير فعال لمستخلص نبات الرجلة. فبالنسبة لتأثيره على الفئران الطبيعية: فقد أوضحت النتائج تحسن ملحوظ بالنسبة لقياسات الدهون، حيث أظهرت انخفاض - ذو دلالة إحصائية - في مستوى كل من الدهون الثلاثية والكليستيرول والبروتينات الدهنية قليلة الكثافة مع ارتفاع - ذو دلالة إحصائية - في مستوى البروتينات الدهنية عالية الكثافة وذلك في المجموعة التي تمت معالجتها بمستخلص نبات الرجلة إذا تمت مقارنتها بالمجموعة الطبيعية الضابطة. أما بالنسبة لتأثير مستخلص نبات الرجلة على الأيض الغذائي للكاربوهيدرات ، فقد أوضحت النتائج عدم وجود تغيير ذو دلالة إحصائية في مستوى الجلوكوز أو الأنسولين بالدم وذلك في المجموعة التي تمت معالجتها بمستخلص نبات الرجلة . أما الفئران المستحدثت إصابتها بمرض البول السكري: فقد أوضحت نتائج البحث انخفاض - ذو دلالة إحصائية - في مستوى كل من الدهون الثلاثية والكليستيرول والبروتينات الدهنية قليلة الكثافة مع ارتفاع - ذو دلالة إحصائية - في مستوى البروتينات الدهنية عالية الكثافة وذلك في مجموعة الفئران المصابة بمرض البول السكري بعد معالجتها بمستخلص نبات الرجلة إذا تمت مقارنتها بالمجموعة الضابطة. كما أظهرت نتائج هذا البحث انخفاض - ذو دلالة إحصائية - في مستوى الجلوكوز على الرغم من عدم وجود تغير ذو دلالة إحصائية في مستوى الأنسولين وذلك في مجموعة الفئران المصابة بمرض البول السكري بعد معالجتها بمستخلص نبات الرجلة إذا تمت مقارنتها بالمجموعة الضابطة لمرض البول السكري.

ويستخلص من نتائج هذا البحث أن مستخلص نبات الرجلة له تأثير مفيد على التمثيل الغذائي للدهون والكاربوهيدرات في الحالات الطبيعية والمصابة بمرض البول السكري. ويوصى بأن يتم توجيه الدراسات والأبحاث في المستقبل لمعرفة واكتشاف المزيد من آليات عمل هذا المستخلص على مستوى كل من الخلايا والجزيئات، والمسؤولة عن تأثيراته الأيضية الفعالة سواء في الحالات الطبيعية أو المرضية.