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RESEARCH ARTICLE

EFFECT OF HONEY ON BLOOD SUGAR LEVEL AND LIPIDS METABOLISM IN MALE RABBITS

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Abstract

The present work was done to investigate the ability of Yemeni Sider honey to ameliorate the level of blood sugar and lipid profile in rabbits. For this goal 36 rabbits were used, after adaptation period the animals were divided into 6 groups as follows: group 1 and 2 served as control, and other 4 groups were served as treatment groups. Metformin was used as comparison in alloxan –induced diabetic rabbits. After the end of experiment (day 27) our results showed stabilization of sugar level and lipid profile,cholesterol HDL, LDL and triglycerides. We concluded that the use of honey in addition to metformin is more effective and ability of this drug in dealing with the metabolism of carbohydrates and fats.

Keywords: Diabetes mellitus, Lipid profile, Blood sugar.

1. Introduction

Diabetes mellitus is a metabolic disorder associated with an increased risk of cardiovascular disease (CVD), a main cause of mortality in diabetes [1, 2]. Although several factors account for increased CVD risk in diabetes, abnormalities of lipid metabolism are important contributors [3, 4]. Hence, in addition to controlling hyperglycemia, treatment of dyslipidemia is inevitable to reduce cardiovascular events in diabetes [5]. While the current agents employed for the treatment of dyslipidemia are effective, these drugs are not easily affordable to many patients [6]. Besides, the use of some of these agents is associated with undesirable side effects. Some of these factors compel patients to seek alternative and complementary medicines. Even though complementary and alternative medicines are easily accessible and more affordable, their use is not without drawback. These agents are of unproven efficacy, and there are great concerns for safety and risk of untoward adverse effects [7, 8].

One such complementary medicine that has gained wide attention in the past decade is honey. The anecdotal use of honey dates back to 2100–2000 BC [9, 10]. Research in the past few years has provided convincing evidence in of antioxidant, antibacterial and the wound healing properties of honey [11, 12, 13]. With regard to other reported beneficial effects, especially metabolic and cardiovascular effects such as antihypertensive, hypolipidemic, hypoglycemic and antidiabetic effects of honey, data are limited and the findings remain inconclusive particularly in clinical studies [20]. At the moment, due to paucity of data, it remains unclear if these reported beneficial metabolic effects of honey can be reproduced using any honey sample or is restricted to a specific honey or certain honeys. Evidence has revealed that there is variation in the composition of honey [14].

This variation depends on certain factors including geographical origin and botanical sources of the nectar [15]. Other factors such as climate, environment and processing techniques also contribute to variation in honey composition [16, 17]. The variation in honey composition may influence the pharmacological effects derived from the honey samples. This leads to another uncertainty as to whether findings obtained with a honey sample from a particular geographical origin or floral source can be generalized to honey samples from other geographical parts or botanical sources of the world [18].

More worrisome is the evidence from a study which showed that honey increased glycosylated hemoglobin in diabetic patients [6]. This finding appears to suggest a potential deteriorating effect of honey on glycemic control. However, it was later explained that this particular finding should not be generalized to all honey samples as a result of two factors. These factors are: the administered high doses and the high glucose content of the administered honey [11, 19, 20]. In that particular study, graded doses of honey were administered orally to diabetic patients for eight weeks. The initial dose (1.0 g/kg/day) was increased by 0.5 g/kg/day every two weeks till the end of the study. Besides, the honey in

question had a considerably higher glucose content than that found in most honey samples [6]. It was suggested that these two factors would invariably enhance glycosylation and contribute to increased glycosylated hemoglobin in diabetic patients [21, 22]. This potential deterioration of glycemic control resulting from honey administration may also aggravate dyslipidemia in diabetes.

Metformin is a antidiabetic drug widely using for the balance of the sugar in the body [34], It is works by helping to restore your body's proper response to the insulin you naturally produce. It also decreases the amount of sugar that your liver makes and that your stomach,intestines absorb [35]. Therefore this study was carried out to investigate if Yemeni Sider honey could reduce hyperglycemia and ameliorate lipid abnormalities in alloxan-induced diabetic rabbits.

The aim of the present study was to investigate the ability of Sider honey to decrease or kept the level of sugar in diabetic induced animals in compare with metformin, and so investigate the ability of honey to correct the damage of lipid metabolism associated with diabetes mellitus.

2. Materials and Methods:

This experimental study was carried out at the faculty of Education –Aden in May 2018.Thirty six (local breed) male rabbits weighing 1000-1400gram. were used in the present study.

After the adaptation period the animals were divided into six groups as follows :

First group (n=6): Animals in this group served as control, they orally received only 5ml. of normal saline orally once a day period of 27 days [43].

Second group (n=6): Animals in this group were (i.p) injected 150mg/kg of alloxan in a single dose to induce the hyperglycaemia, then animals did not received any treatment except 5ml. of normal saline once a day period of 27 days.

Third group (n=6): Animals in this group were (i.p) injected 150mg/kg of alloxan in a single dose to induce the hyperglycaemia, then animals were treated with 2gm/kg. of honey once a day period of 27 days.

Fourth group (n=6): Animals in this group were (i.p) injected 150mg/kg of alloxan in a single dose to induce the hyperglycaemia, then animals were received 100mg/kg of metformin once a day period of 27 days.

Fifth group (n=6): Animals in this group were (i.p) injected 150mg/kg of alloxan in a single dose to induce the hyperglycaemia, then they were treated with 2gm/kg. of honey and of 100mg/kg metformin once a day period of 27 days.

Sixth group (n=6): Hyperglycaemia was not induced in these animals, but they were received 2gm/kg. of honey only once a day for 27 days.

The level of blood sugar was measured before inducing hyperglycaemia inducing and after the treatment with honey and metformin in days 2, 7, 12, 17 and 22 using the sugar tested apparat.

After the end of experiment (27 days) the animals were sacrificed, the blood was collected in a specific tubes to examination the following parameters:

- Glucose.
- Cholesterol.
- Low density lipoprotein (LDL).
- High density lipoprotein (HDL).
- Triglycerides.

3. Statistical analyzes:

The data obtained were analyzed using SPSS program, data expressed as Mean ±SE and SD, P<0.05 was taken as significant.

4. Results:

Table (1): The means (mg/dl) of blood sugar at the end of experiment (day 27).

Group	n	Mean	±SD	±SE	t-Value	P-Value	Significance
Control	6	111.5	6.86	2.81			
Group2	6	437.16	31.39	12.86			
Group3	6	304	24.48	10.03	8.0642	0.0010	S*
Group4	6	165	10.91	4.47	19.3875	0.000	HS*
Group5	6	157.16	7.35	3.01	20.5069	0.000	HS*
Group6	6	119	7.26	2.97			

*In comparison with the second group.

Table (2): The means (mg/dl) of Cholesterol TC at the end of experiment (day 27).

Group	n	Mean	±SD	±SE	t-Value	P-Value	Significance
Control	6	66.16	3.81	1.56			
Control2	6	88.83	5.30	2.17	8.4934	0.00695	S
Group3	6	78.00	2.36	0.96	6.4545	0.00073	S*
					4.5666	0.006020	LS**
Group4	6	69.66	1.21	0.49	2.1411	0.05792	NS*
					8.6245	0.000346	S**
Group5	6	62.16	2.22	0.90	2.2169	0.05096	NS*
					11.3478	0.00093	HS**
Group6	6	57.5	5.16	2.11	3.3047	0.00795	NS*
					10.3616	0.00014	S**

*In with comparison first group.

Table (3): The means (mg/dl) of HDL at the end of experiment (day 27).

Group	n	Mean	±SD	±SE	t-Value	P-Value	Significance
Control	6	30	2.00	0.81			
Control2	6	18.5	2.16	0.88	9.5502	0.0002	S
Group3	6	37.66	1.50	0.61	7.5018	0.00021	S*
					17.7873	0.00010	HS**

Group4	6	33.66	2.73	1.11	2.6523	0.2421	NS*
					10.6507	0.000126	S**
Group5	6	31.16	2.22	0.90	0.9543	0.81359	NS*
					9.9793	0.000173	S**
Group6	6	39	1.78	0.72	8.2158	0.0009	S*
					17.8655	0.00010	HS**

*In comparison with the first group.

Table (4): The means (mg/dl) of LDL at the end of experiment (day 27).

Group	n	Mean	±SD	±SE	t-Value	P-Value	Significance
Control	6	21.66	4.88	2.00			
Control2	6	50.33	3.72	1.52	11.4312	0.000	HS
Group3	6	30.83	2.92	1.19	3.9427	0.00276	NS*
					10.0847	0.00154	S**
Group4	6	25.66	3.14	1.28	1.687	0.12249	NS*
					12.4042	0.00061	HS**
Group5	6	19.83	3.12	1.27	0.7743	0.4566	NS*
					12.3933	0.00016	HS**
Group6	6	14.83	3.86	1.58	2.686	0.01142	NS*
					16.1941	0.00017	HS**

*In comparison with the first group.

Table (5): The means (mg/dl) of Triglycerides at the end of experiment (day 27).

Group	n	Mean	±SD	±SE	t-Value	P-Value	Significance
Control	6	72.16	3.65	1.49			
Control2	6	99.16	5.91	2.42	9.513	0.0003	S
Group3	6	48.16	4.30	1.76	10.4031	0.0001	HS*
					17.0739	0.00013	HS**
Group4	6	51.83	4.62	1.89	8.4511	0.0007	S*
					15.4467	0.00021	HS**
Group5	6	55.83	7.73	3.16	4.6784	0.00087	LS*
					10.9055	0.00113	S**
Group6	6	62.66	8.11	3.32	2.6142	0.02585	NS*
					8.9036	0.00298	S**

*In comparison with the firs group.

5. Discussion

In this study, a model of alloxan-induced diabetes was utilized to investigate the potential glucose lowering and hypolipidemic effect of Yemeni Sider honey alone or with metformin. The dose (2.0 g/kg BW) was shown to improve glycemic control and hyperlipidemia in streptozotocin-induced diabetic rats [23, 24, 25].

In the present study, honey treatment (2.0 g/kg BW) significantly reduced blood glucose levels in diabetic rabbits. These findings concur with previous results which demonstrated glucose lowering effect of honey in diabetic rats [7, 20, 22] and diabetic patients [26, 27].

The potential mechanisms by which honey mediates its glucose lowering effect have been elaborated [26]. Fructose, oligosaccharides, antioxidants and mineral elements are some of the numerous honey constituents that may contribute to its glucose lowering effect [28, 29, 30, 31]. Besides these individual constituents with glucose-lowering properties, their synergistic interactions will contribute considerably to glucose lowering effect of honey. In a previous study, 2.0 g/kg BW of honey did not produce significant reduction in blood glucose level but 1.2 or 2.4 g/kg BW significantly decreased hyperglycemia [32, 33]. As reported in that study, there was no additional benefit of doubling the dose of honey from 1.2 to 2.4 g/kg BW on hyperglycemia. Likewise, in this study, there was no significant difference in the glucose lowering effect of 2.0 g/kg BW of honey or metformin.

Considering that 2.0 g/kg BW of honey did not elicit significant glucose lowering effect, based on existing studies, it can be inferred that the therapeutic doses of honey range between 1.0 and 2.4 g/kg BW. In view of the fact that any dose of honey selected between 1.0 and 2.4 g/kg BW will exert glucose lowering effect without further glucose-lowering benefit, it would be plausible to propose 1.0 g/kg BW as the optimal dose of honey. This dose (2.0 g/kg BW) of honey has been investigated in several other studies involving various diseases and therapeutic effects have been reported [28, 23, 34, 35]. It is worth mentioning that even if 3.0 g/kg BW of honey had elicited considerable glucose lowering response, considering the lack of additional glucose-lowering response compared with 1.0 g/kg BW dose, it would still not be pharmacologically acceptable to utilize this dose.

Diabetes affects both glucose and lipid metabolism [36-48]. In the postprandial state elevated serum insulin increases lipoprotein lipase activity in adipose tissue and promotes fuel storage as triglycerides in normal metabolism [25]. The deficiency of insulin depletes the activity level of lipoprotein lipase, thus leading to deranged lipoprotein metabolism during diabetes [37, 38, 39].

Alloxan induced diabetic untreated rabbits showed significantly increased serum lipid profiles except HDL compared with the control rabbits. The elevated TG, TC, LDL level and decreased HDL level in alloxan-induced diabetic rabbits observed in this study is in agreement with the previous reports regarding alteration of these parameters under diabetic condition [40, 41, 42, 49, 50].

This may be due to the increase in the mobilization of free fatty acids (FFA) from the peripheral depots, since insulin inhibits the hormone sensitive lipase [43-44]. Serum FFA concentration is a result of the balance between the release from lipolysis, neosythesis and disposal and represent the major determinant of insulin effect on FFA oxidation and non-oxidative metabolism [32, 34, 45-51].

Oral administration of the honey to the diabetic rabbits significantly reduced the level of TG, TC, and LDL and significantly increases the level of HDL.

The results suggest that honey possesses potential therapeutic value in combating atherosclerosis, which is one of the major complications of diabetes by lowering serum lipids particularly total cholesterol, triglyceride and low density lipoprotein level.

Monosaccharides and oligosaccharides are a natural bioactive compound found in honey, that work to act as a defense system against diabetic or more accurately, to protect against disease [6, 39]. The performance of honey in reversing the negative effects of alloxan on diabetic rabbits may be due to the presence of another bioactive compound.

The most important of these bioactive constituents of honey are enzymes that regulate the sugar metabolism [20].

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مقالة بحثية

تأثير العسل على مستوى سكر الدم وميتابوليزم الدهون في ذكور الأرانب

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المُلخّص

هدفت هذه الدراسة إلى معرفة تأثير العسل على مستوى سكر الدم وميتابوليزم الدهون في ذكور الأرانب، وذلك من خلال استخدام عسل السدر اليمني لمعرفة مدى إمكانية قيامه في خفض أو الحفاظ على مستوى سكر الدم في الحيوانات التي تم افتعال مرض السكر فيها بالمقارنة مع المركب الدوائي ميتفورمين الخاص بعلاج مرض السكر، وكذلك معرفة إمكانية قيام عسل السدر بتصحيح اختلالات ميتابوليزم الدهون والتي تترافق مع ارتفاع السكر. ولتحقيق هذا الهدف تم استخدام 36 حيواناً من ذكور الأرانب بعد فترة التكيف، تم تقسيمها إلى ست مجموعات، كل مجموعة تحتوي على6 حيوانات وذلك على النحو الآتي:

المجموعة 1 و 2 خضعت كمجموعة ضابطة و 4 مجموعات أخرى خضعت كمجموعات علاجية .بعد انتهاء التجربة (اليوم 27) أظهرت نتائجنا استقرار مستوى السكر ومستوى الدهون والكوليسترول HDL و LDL والدهون الثلاثية.

ونستنتج من خلال هذه النتائج الى ان اضافة العسل لدواء السكر (ميتفورمين),ادى الى رفع كفاءة وقدرة هذا الدواء في التعامل مع الميتابوليزم الكربوهيدرات والدهون ايضا.

الكلمات المفتاحية: داء السكري، الدهون، سكر الدم.

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