

Effect Of Some Herbal Medicine On Some biochemical parameters In Diabetic Rats

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Abstract

The current study was planned to follow up the effect of famous mixture used as a hypoglycemic traditional medicine in Saudi Arabia on diabetic albino rats and their effects on some biochemical parameter as DHEA .This study also aimed to study the effect of each plants alone to illustrate the most powerful one of them.

The present study was carried out on eighty adult male albino rats (120 ± 20 gm b.wt). They were randomly divided into eight groups. First group conserved as control group. The others groups received alloxan to become diabetic .The second group conserved as diabetic, the third group treated with a mixture of plants (0.5 gm/ 120 gm b.wt). From the fourth to eight group, the rats treated with *Nigella sativa* (0.25 gm/ 120 gm b.wt), *Aloe vera*, *Ferula assa-foetida*, *Boswellia Carterii* Birdw and *Commiphora myrrha* respectively (0.5 gm/ 120 gm b.wt). Our result showed that the body weight was reduced significantly in diabetic group and *Nigella sativa* treated group. On the other hand, treatment with *commiphora myrrha* revealed significant increase in body weight gain, while mixture and *Aloe vera* treated rats recorded insignificant change. Diabetic rats revealed a significant decrease in serum glucose and DHEA-S levels and liver glycogen content, while insignificant difference was recorded in all treated groups. A significant decrease in serum insulin level was observed in diabetic group, *Nigella sativa* and *Ferula assa-foetida* treated groups, but insignificant difference was recorded in the rest treated groups throughout the experiment. A significant increase in LDH activities in diabetic and *Ferula assa-foetida* treated groups was recorded while rest treated groups recorded insignificant change During experimental period.

Introduction

Diabetes mellitus is a condition in which there is a chronically raised blood glucose concentration. It is caused by an absolute or relative lack of insulin, where insulin is not being produced from the pancreas or there is insufficient insulin or insulin action for the body's needs (Gareth-Williams *et al.*, 2000). Diabetes affects 20% of the population over the age of 65 years, and more than 90% of the older people with diabetes are type II diabetics (Dawson, 1998). Most patients of this form of diabetes are obese and their glucose tolerance improves if they lose weight, (Ganang, 2003).

The effects of insulin on glucose metabolism are that insulin stimulates glycerol synthesis and inhibits lipase

activity in adipose cells. Circulating insulin also increases the amount of amino acids taken up by the cell and inhibits protein catabolism. Insulin appears to be essential for normal cell growth and function (Micheal *et al.* 2003).

Dehydroepiandrosterone (DHEA) and its metabolite DHEA sulfate are the most abundant circulating adrenal steroids in humans. DHEA has been shown to modulate glucose utilization in humans and animals, but the mechanisms of DHEA action have not been clarified. The decline in circulating DHEA levels occurring with aging has been linked to the gradually increasing prevalence of atherosclerosis, obesity and diabetes in elderly individuals (Perrini *et al.*, 2004).

Dehydroepiandrosterone (DHEA) and its sulphate derivative (DHEA-s) have antidiabetic and antiobesity effects. Administration of 0.4%DHEA in the diet reversed hyperglycemia, preserved beta-cell function, and increase insulin sensitivity in genetically diabetic mice. DHEA increases m-RNA through binding to a specific factor in cultured human fibroblasts and there by stimulating glucose up take in these cells (Nakashima *et al.*, 1995). DHEA was shown to protect against the development of visceral obesity and muscle insulin resistance in rats feed a high-fat diet (Hansen *et al.*,1997) Recent study has report that DHEA increases glucose up take rates in human fibroblast and rat adiposities (perrini *et al.*,2004)

There are many plants and plants extracts which possess marked hypoglycemic activity. They appear to be the active hypoglycemic principles suggests different sites of action within the body polysaccharides feature (puri *et al.* 1994).

Nigella sativa (Black cumin) has long been used as a natural medicine for treatment of many acute as well as chronic conditions. It has been used in treatment of diabetes, hypertension and dermatological conditions (Meral *et al.*, 2001)

Aloe vera has been used all over the world of their various medicinal properties. There have been controversial reports on the hypoglycemic activity of Aloe species, probably due to differences in the parts of the plant used or to the model of diabetic chosen (Okyar *et al.*, 2001).

Ferula assa-Foetida is the best remedy for clearing gas and bloating. The volatile oil of it contain, disulphides, which have an expectorant action settles digestion. It also lowers blood pressure (Chevalier, 1996). Sulfur compound in the oil may protect against fat-induced hyperlipdemia (Duke, 2002).

Boswellia carterri has been used historically in medical system of India including arthritis and other inflammatory conditions .Hayashi (1998) confirmed that *B.carterri* contains actyl acetate and actanol as main constituents.

Commiphora myrrha (Myrrh) is one of the oldest known medicine. It useful for

skin problems, atherosclerosis, hemorrhoid, heptoses, high cholesterol, stomatosis, immunodepression and hyperglycemia (Duke, 2002).

There are many possible site of actions at which such previous plants could act to lower glucose level (Olefsky, 1981), for example agents which inhibit lipolysis and promote glucose uptake by active metabolizing tissues (Hales, 1986). Agents which sequester counterregulatory hormones such as growth hormone or binding protiens agents which increase thermogenesis by enhancing glucose utilization through futile cycling (Coleman *et al.*, 1982). Agents which increase physical activity (Vignati and Cunningham; 1985).Therefore ,the present study aimed to examine the influence of oral administration of this mixture and of each one of this herbs on the level of some biochemical parameters in serum and liver of alloxan-induced diabetic rats.

Material and Methods

The present work was carried out on eighty male albino rats, weight 120+20gm. They are obtained from NAMRU medical center. The experimental animals were randomly divided into eight groups (10/cage) and fed on rodent diet and some vegetables , the rats stayed for 2 weeks to adapte the place then began the experimental steps. Five antidiabetic plants extracts were used. These plants are: *Nigella sativa*, *commiphora myrrha*, *Boswellia carterii* Birdw, *Ferula assa-foetida* and *Aloe vera* which were brought from market. These plants were used as a mixture then each one was water extracted alone.

Rats were assigned randomly to eight groups. Seven of them are fasted over night, then rats were injected with a single subcutaneous dose of freshly prepared alloxan in adose 120mg/kg b.wt. Dissolved in 0.5 ml acetate buffer (ph 5.5) according to (Malaisse, 1982). Alloxan is a uric acid derivative used as acommon chemical for inducing diabetes. The first group served as control. After 48 hours of alloxan injection, blood glucose level was measured. Rats with fasting blood glucose level more thadn

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250 mg/dl considered diabetic. Seven days later, rats were treated with herbal medicine as the following:-

Group I : served as control.

Group II : rats treated with alloxan served as diabetic.

Group III: Diabetic rats treated with the mixture of the tested plants. The dose used were 1ml/100gm b.wt. where the plants were grinded and 10gm of each plant were mixed and boiled in 100ml dist. water for a period 10 min, so the plants concentration were 0.5gm/120gm b.wt.

Group IV: Diabetic rats treated with *Nigella Sativa*. (0.25gm/120gm b.wt.) in a dose 1ml/100gm b.wt.)

Group V: Diabetic rats treated with *Aloe Vera*. 0.5gm/120gm b.wt. in a dose 0.5ml/100gm b.wt (we used the half dose because some rats died).

Group VI: Diabetic rats treated with *Ferula assa- foetida* 0.5gm/120gm b.wt. In a dose 1ml/100gm b.wt.

Group VII: Diabetic rats treated with *Boswellia carterii* Birdw 0.5gm/120gm b.wt. In a dose 1ml/100gm b.wt.

Group VIII: Diabetic rats treated with *Commiphora myrrha* 0.5gm/120gm b.wt. In a dose 0.5ml/100gm b.wt (we used the half dose because some rats died)

After 30 days of treatment, animals of each group were decapitated. After animal dissection, the liver was obtained and stored at (-80c) for determination of glycogen. Blood samples were collected in dry centrifuge tubes, centrifuged at 500 rpm for 10min and serums were separated.

Biochemical analysis:-

-Assessment of serum glucose level: According to the enzymatic colorimetric method described by Tietz (1986).

-Determination of liver glycogen content: The technique adopted was described by Joseph (1955).

-Determination of serum insulin level: This method is carried out according to Reeves (1983).

-Determination of serum DHEA-s (Dehydroepiandrosterone) level by DHEA Elisa kit. (Yen *et al.*, 1977).

-Determination of serum LDH concentration according to the method of Kachmar and Moss (1976).

-Assessment of serum alkaline phosphatase concentration according to the method of John (1982).

Statistical analysis :-

Data of the studies were presented as means \pm standard error SE and T test according to Snedecor and Cochran (1980).

Results were considered significant when $p < (0.05)$ and highly significant when $p < (0.01)$.

Results

The results of this study showed that the body weight was reduced significantly in diabetic group and *Nigella sativa* treated group. On the other hand, treatment with *Commiphora myrrha* revealed significant increase in body weight gain, while mixture and *Aloe vera* treated rats recorded insignificant change (Table and Figure 1). Diabetic rats revealed a significant decrease in serum glucose and DHEA-S levels and liver glycogen content, while insignificant difference was recorded in all treated groups (Table and Figure 2, 3, 5) and a significant decrease in serum insulin level was observed in diabetic group, *Nigella sativa* and *Ferula assa-foetida* treated groups, but insignificant difference was recorded in the rest treated groups throughout the experiment in a comparison with the control group (Table and Figure 4). A significant increase in LDH activities in diabetic and *Ferula assa-foetida* treated groups was recorded while rest treated groups recorded insignificant change during experimental period as compared with normal rats. (Table and Figure 5, 6).

Table (1): Percentage of body weight change in control, diabetic and plant extracts treated

Parameter	groups	Treatment period (4 weeks)							
		Control	Diabetic	Mixture	Nigella Sativa	Aloe vera	Ferula assa-foetida	Boswellia Carterii Birdw	Commi Phora myrrha
body weight Change (%)	Mean	35.99	9.42	33.78	23.52	37.39	55.72	40.72	40.04
	± SE	1.02	0.96	1.87	0.82	0.37	0.77	0.95	0.49
	A		**		**		**	*	**
	B			**	**	**	**	**	**

rats after 4 weeks of treatment.

A – in comparison with control group.

B- in comparison with diabetic group.

* p < 0.05 .

** p < 0.01 .

Fig (1): Percentage of body weight change in control, diabetic and plant extracts treated

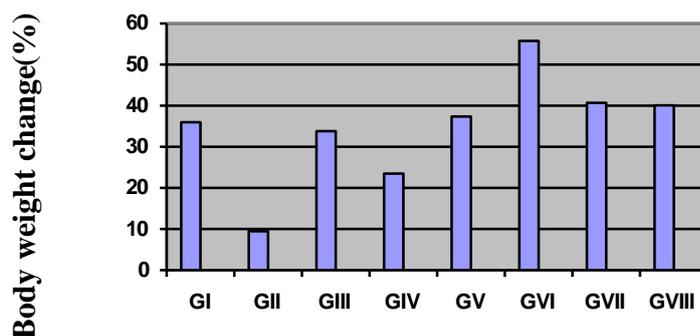


Table (2): Serum glucose level (mg/dl) in control, diabetic and plant extract treated rats after 4 weeks of treatment.

Parameter	Groups	Treated period (4 weeks)							
		control	diabetic	mixture	Nigella sativa	Aloe vera	Ferula assafoetida	Boswellia carterii birdw	Commiphora myrrha
Glucose Mg/ dl)	mean	136.8	266.8	134.8	131.2	139.2	135.0	137.8	135.6
	±se	0.86	0.41	0.37	1.99	0.75	0.32	0.58	0.51
	A		**						
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Fig (2) : serum glucose level in control, diabetic and plant treated male albino rats after 4 weeks of treatment.

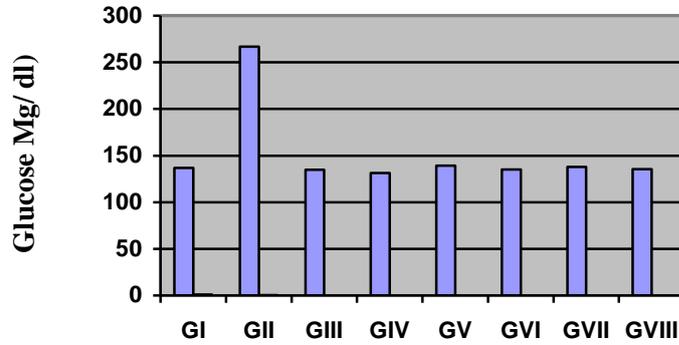


Table (3): Glycogen content in the liver (mg /dl) in normal diabetic and plant extract treated rats after 4 weeks of treatment

Parameter	Groups	Treated period (4 weeks)							
		control	diabetic	mixture	Nigella sativa	Aloe vera	Ferula assafoctida	Boswellia carterii birdw	Commiphora myrrha
glycogen (Mg/ dl)	mean	173.2	162.69	175.15	169.93	176.11	172.72	170.16	173.92
	±se	0.875	0.715	0.782	0.848	0.480	0.570	0.590	0.590
	A		**						
	B			**	**	**	**	**	**

Fig (3) : Glycogen content in the liver in control, diabetic and plant treated male albino rats after 4 weeks of treatment.

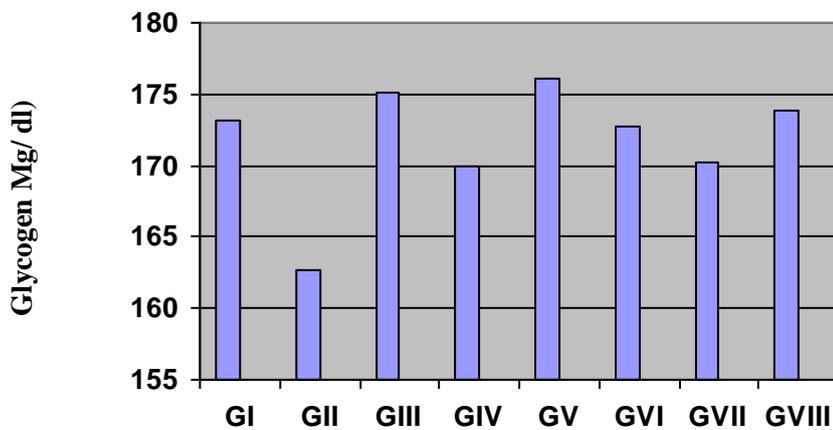


Table (4): Serum insulin level in normal, diabetic and plant extracts treated albino rats after 4 weeks of treatment .

Parameter	Groups	Treated period (4 weeks)							
		control	diabetic	mixture	Nigella sativa	Aloe vera	Ferula assafoctida	Boswellia carterii birdw	Commiphora myrrha
serum insulin uu/ml	mean	41.60	20.60	41.00	32.40	39.20	25.60	37.60	39.70
	±se	1.51	1.81	1.22	1.44	1.32	1.57	1.51	1.60
	A		**		**		**		
	B			**	**	**	**	**	**

Fig (4): Serum insulin level in control, diabetic and plant treated male albino rats after 4 weeks of treatment.

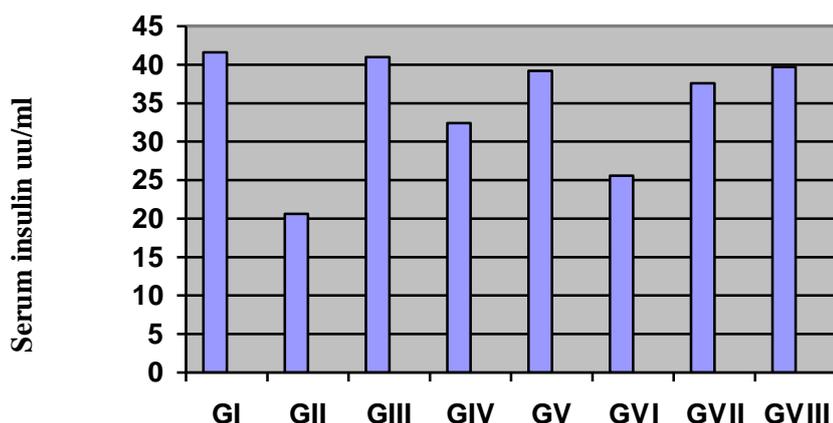


Table (5): Serum DHEA- S level in control, diabetic and plant extracts treated albino rats after 4 weeks of treatment.

Parameter	Groups	Treated period (4 weeks)							
		control	diabetic	mixture	Nigella sativa	Aloe vera	Ferula assafoctida	Boswellia carterii birdw	Commiphora myrrha
Serum DHEA-S mg/ ml	mean	0.32	0.26	0.34	0.31	0.34	0.33	0.33	0.35
	±se	0.05	0.08	0.08	0.29	0.15	0.17	0.06	0.09
	A		**						
	B			**	**	**	**	**	**

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Fig (5) : Serum DHEA-S level in control, diabetic and plant treated male albino rats after 4 weeks of treatment.

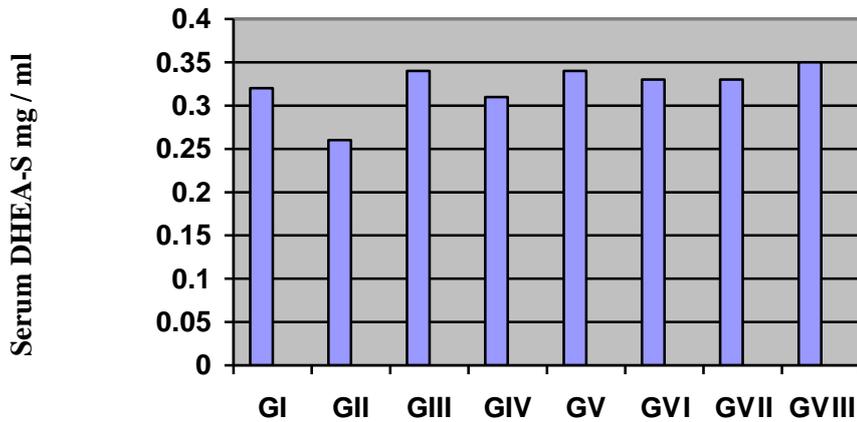


Table (6): Lactate dehydrogenase (LDH) activity in control, diabetic and plant extracts treated rats after 4 weeks of treatment.

Parameter	Groups	Treated period (4 weeks)							
		control	diabetic	mixture	Nigella sativa	Aloe vera	Ferula assafoctida	Boswellia carterii birdw	Commiphora myrrha
LDH(U/L)	mean	95.42	192.42	94.60	94.16	96.00	98.46	95.04	94.62
	±se	0.76	0.81	0.72	0.77	0.85	0.94	0.73	0.71
	A		**				*		
	B			**	**	**	**	**	**

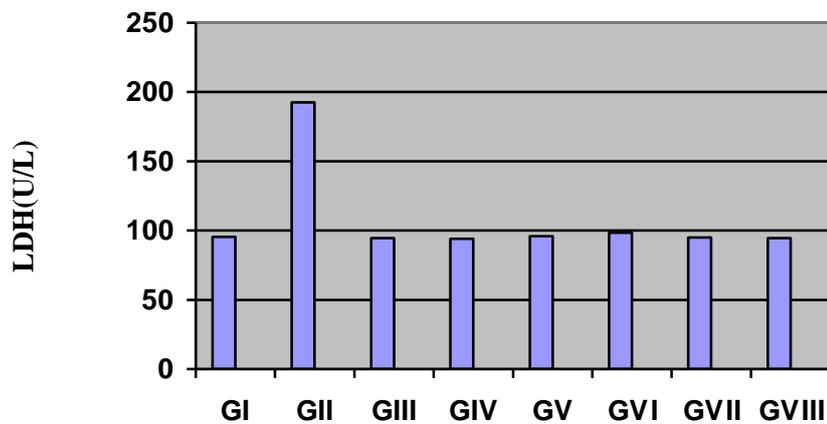
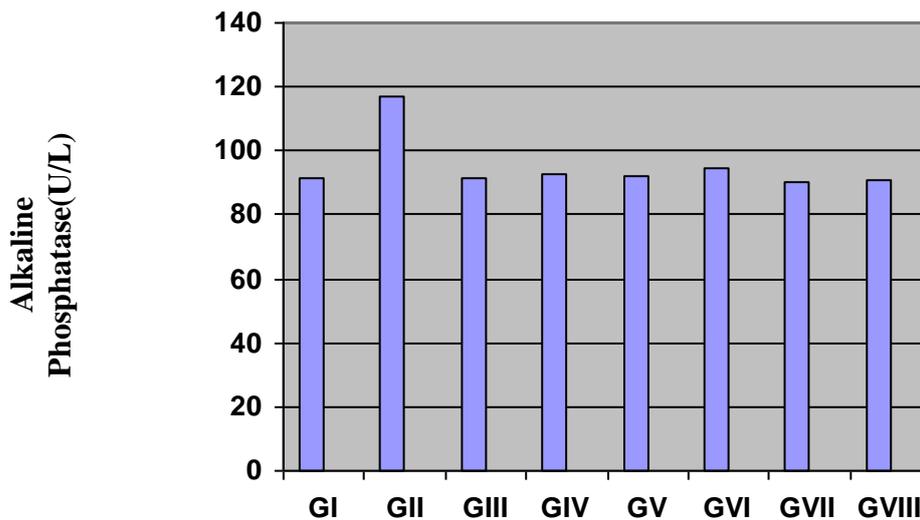


Fig (6) : Serum lactate dehydrogenase (LDH) activity in control, diabetic and plant treated male albino rats after 4 weeks of treatment.

Table (7): Alkaline phosphatase activity in control, diabetic and plant extracts treated rats after 4 weeks of treatment.

Parameter	Groups	Treated period (4 weeks)							
		control	diabetic	mixture	Nigella sativa	Aloe vera	Ferula assafoetida	Boswellia carterii birdw	Commiphora myrrha
Alkaline Phosphatase(U/L)	mean	91.38	116.84	91.64	92.98	92.30	94.30	90.32	90.92
	±se	0.33	0.45	0.40	0.96	0.51	1.08	0.83	0.74
	A		**				*		
	B			**	**	**	**	**	**

Fig (7) : Serum alkaline phosphatase activity in control, diabetic and plant treated male albino rats after 4 weeks of treatment.



Discussion

Traditional antidiabetic plants might provide useful source of new oral hypoglycemic compounds for development as pharmaceutical entities, or as simple dietary adjuncts to existing therapies.

A scientific investigation of traditional herbal remedies for diabetes mellitus may provide valuable leads for the development of alternative drugs and therapeutic strategies. Alternative are clearly needed because of the inability of current therapies to control high cost and poor availability of

current therapies for many rural population, particularly in developing countries. (*Morles and Farnsworth, 1995*).

Our data, showed an increase in the body weight gain in all treated groups when compared with diabetic one. Data recorded is in agreement with the findings of al-awadi *et al.* (1991). Where, they reported that the treatment with the antidiabetic plants mixture (Nigella sativa, Commiphora myrrha Geum urbanium, Ferula assafoetida and Aloie vera) used by Kuwaiti

diabetic individuals prevented reduction in body weight observed in diabetic animals.

This mixture may stimulate most aspects of carbohydrate metabolism, including rapid uptake of glucose by the cells, enhanced glycolysis, enhanced gluconeogenesis, increased rate of absorption from the gastrointestinal tract and even increased insulin secretion with its resultant secondary effects on carbohydrate metabolism (Guyton and Hall, 2000)

While, *Nigella sativa* treated group showed a decrease in the body weight gain when compared with control group. This probably rise from its claim to result in nutrient partitioning so that ingested calories will be directed to muscle, rather than fat and /or attempt to physically affect gastric satiety by filling the stomach (Heber, 2003). And possibly spring from its anti water retention action (Duke, 2002). Or may be attributed to increase plasma leptin concentration which travels to the appetite control center in the brain and tells it to stop eating (Ebihara *et al.*, 2001)

In the present investigation, the treatment of diabetic rats with mixture and *Boswellia carterii* Birdw caused a significant hypoglycemic effect with a significant increase in serum insulin level. In agreement with these findings Al-Awadi *et al.* (1988) reported that the mixture of previous plants is a potent hypoglycemic agent. The antidiabetic action of these plants extract may, at least partly, be mediated through decreased hepatic gluconeogenesis (Al-Awadi *et al.*, 1991). The decreasing of blood glucose level by the mixture and *Boswellia carterii* Birdw is secondary to enhanced insulin secretion, decreased insulin resistance and glycogen synthesis activation. It seems to have a direct action on insulin secretion through stimulation of secretion of the golgi complex (Bever and zahand, 1979) or it may stimulate insulin secretion through the B-cell receptor and possibly through a direct effect on intracellular calcium transport (Campbell *et al.*, 1991).

While the hypoglycemic and hyperinsulinemic activities of *Commiphora myrrha* may be attributed to its phytosterols, which have a hormonal action (Chevallier, 1996)

or, to its polysaccharides content which have hypoglycemic activity in animals (Evans, 2001). In contrast to the present data Duke *et al.*, (2002) reported that *Commiphora myrrha* had antihypoglycemic activities.

In the present study, the decrease in liver glycogen content of diabetic rats may be a result of increasing glucose output during insulin deficiency (Gold, 1970). And may be due to the loss of glycogen synthetase-activating system (Annamala and Augusti, 1980) and/or increased activity of glucose-6-phosphatase (Abdelmoniem *et al.*, 2001). It is possible that the increase in liver glycogen content after treatment with the extract of mixture is a result of increased insulin level which has a potent effect on glycogen synthetase activity as well as on hepatic hexokinase and glycogen-6-phosphatase activity (Sheela and Augusti, 1992).

The present data, showed highly significant decrease in serum dehydroepiandrosterone-sulfate (DHEA-S) level in diabetic group as compared with control one. This decrease in serum DHEA-S concentration may be due to the effect of alloxan on adrenal gland. Decreasing of DHEA-S concentration leads to decrease in serum insulin level which associated with serum insulin concentration (Aoki *et al.*, 2003). After the treatment of rats with mixture water extract, the serum concentration of DHEA-S was increased. This may be due to the ameliorating effect of plant extraction on the hazardous effect of alloxan and this leads to increasing serum insulin concentration. Where, DHEA decreased hyperglycemia in diabetic mice, which become insulin resistant by increasing not only insulin sensitivity due to its effects on the liver and muscle, but also on insulin secretion from B-cells (Aoki *et al.*, 2003).

Numerous studies show that insulin activity, DHEA levels, and glucose homeostasis are all important synergistic factors in the onset and progression of diabetes (Casson *et al* 1995).

Animal studies have shown that DHEA guards against and / or reduces insulin resistance providing a benefit similar to that of exercise (Hansen. *et al*,

1997) . In general, insulin resistance and hyperinsulin- emia are associated with low circulating levels of DHEA, especially in men (Loviselli *et al*, 1994) .

In the present work, there was a highly significant increase in the activity of LDH and alkaline phosphatase in alloxan diabetic rats . This finding was in agreement with that of Yadav *et al*. (1997), who stated that increased level of blood glucose in diabetes produce superoxide anions and hydroxyl radicals in the presence of transition metal ions which cause oxidative damage to cell membrane in alloxan diabetic rats . The present work revealed that treatment with the water extract of tested plants and their mixture decreased LDH activity in serum, and was decline to normal value except *Ferula assafoetida* which showed a significant increase which may be attributed to the dose used . Therefore, it is conceivable to assume that these plants may exert a protective role against the destructive effect of alloxan.

From the above mentioned results, it was clear that the present studied plants induced stimulation for insulin secretion .They have effective propitiators rather than initiators of insulin release. Metal ions contained in these plants and/or other constituents like ,alkaloids, play a role, not only in potentiating insulin release but also ameliorating hyperglycemia by increasing insulin secretion and/or insulin sensitivity and some damage effects of alloxan injection *in vivo*. More detailed studied on each plant and their mixture must be done at different dose and different periods of observation are needed before reaching a clear cut conclusion about the future of these plants for the treatment of diabetes mellitus.

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تأثير بعض النباتات الطبية على بعض المعايير الكيمياء الحيوية فى الجرذان البيضاء المصابة بمرض السكر.

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مرض السكر من الامراض التى تحتاج الى علاج مستمر كما ان تكلفتة مرتفعة. ويعد مرض السكر واحد من الأسباب المؤدية الى كثير من الامراض المزمنة ثم الى الوفاة وخاصة فى المجتمعات الفقيرة. لذلك فانه لابد من وجود العلاج البديل مما دفع العلماء للتحقيق بين النباتات التى تستخدم كمخفضات لسكر الدم فى الطب الشعبى وتناولها بالتحليل العلمى لمعرفة مدى فائدتها او اضرارها لعلهم يجدوا البديل. ولقد تم اجراء هذه الدراسة على ثمانين من ذكور الجرذان البيضاء البالغة يزن الواحد منهم حوالى (120+20 جم) ولقد تم توزيعها بصورة عشوائية الى ثمانى مجاميع (كل مجموعة تحتوى على 10 جرذان) كالاتى:-

المجموعة الاولى:- اعتبرت مجموعة ضابطة.
المجموعة الثانية:- اعتبرت مجموعة مصابة بالسكر.
المجموعة الثالثة:- جرذان مصابة بمرض السكر تم معالجتها بالمستخلص المائى للخليط (0.5 جم/120 جم من وزن الجسم).

المجموعة الرابعة:- جرذان مصابة بمرض السكر تم معالجتها بالمستخلص المائى لنبات حبة البركة (0.25 جم/120 جم من وزن الجسم).

المجموعة الخامسة:- جرذان مصابة بارتفاع سكر الدم تم معالجتها بالمستخلص المائى لنبات الصبر (0.5 جم/120 جم من وزن الجسم)

المجموعة السادسة:- جرذان مصابة بارتفاع سكر الدم تم معالجتها بالمستخلص المائى لنبات الحلثيت (0.5 جم/120 جم من وزن الجسم).

المجموعة السابعة :- جرذان مصابة بارتفاع سكر الدم تم معالجتها بالمستخلص المائى لنبات اللبان (0.5 جم/120 جم من وزن الجسم)

المجموعة الثامنة:- جرذان مصابة بمرض السكر تم معالجتها بالمستخلص المائى لنبات المر (0.5 جم/120 جم من وزن الجسم).

كل الجرذان عولجت عن طريق الفم يوميا لمدة ثلاثين يوما بالمستخلص المائى لخليط النباتات و المستخلص المائى لكل نبات على حدة .

وقد اظهرت النتائج التى تم الحصول عليها من هذه الدراسة الاتى:-

نقص حاد ذو دلالة احصائية فى نسبة زيادة وزن الجسم فى كل من الجرذان المصابة بمرض السكر التى لم يتم معالجتها والاخرى التى تم معالجتها بالمستخلص المائى لبذور حبة البركة. اما المجموعات الاخرى التى تم معالجتها بالمستخلص المائى لكل من الحلثيت واللبان والمر فقد اظهرت زيادة احصائية فى نسبة وزن الجسم.

ولقد اوضحت النتائج نقصا احصائيا فى معدل كل من محتوى الجليكوجين فى الكبد ونسبة كل من هرمونى الانسولين و DHEA-S فى مصل الجرذان المصابة بالسكر التى لم يتم معالجتها والجرذان المعالجة بحبة البركة والحلثيت ومن ثم اظهرت زيادة ملحوظة فى نسبة

سكر الدم اذا ما قورنت بالمجموعة الضابطة. اما فى الجرذان المعالجة باى من النباتات او الخليط فلم تظهر اى تغيير فى نسبة الجلوكوز ومحتوى الكبد من الجليكوجين ونسبة هرمونى DHEA-S والانسولين اذا ما قورنت بالمجموعة الضابطة. كما زادت نسبة انزيمات LDH,ALP فى المجموعة المصابة بمرض السكر والتي لم يتم معالجتها والمجموعة التي تم معالجتها من السكر بالمستخلص المائى لنبات الحلتيت بينما باقى المجموعات لم تظهر اى تغيير عن المجموعة الضابطة طوال فترة التجربة. من النتائج السابقة يتضح أن الحقن بعقار الألوكسان قد سبب اضطرابا فى مختلف القياسات الفسيولوجية فى الجرذان. أما العلاج بكل من حبة البركة،الصبر،الحلتيت،اللبان،المر على حده أو فى صورة خليط فقد أحدث تحسنا ملحوظا فى نسبة الانسولين والذى نتج عنه تحسن معدل سكر الدم و محتوى الكبد من الجليكوجين. هذا التحسن فى مستوى الانسولين فى مصل الدم ربما يعود الى محتوى هذه النباتات من أيونات المعادن و القلويات والتي لها دور هام ليس فقط فى زياده افراز هرمون الانسولين ولكن أيضا فى تحسن حساسية مستقبلات الانسولين فى كل الخلايا ومعاجة الخلل الذى يحدث نتيجة للحقن بعقار الالوكسان. لا بد من اجراء كثير من الدراسات الاكثر تفصيلا على كل النباتات و على الخليط باستخدام جرعات مختلفة لمدد مختلفة قبل الوصول الى رأى قاطع حول مستقبل هذه النباتات لعلاج مرض السكر لكنها مبدئيا اوضحت فاعلية عالية.