CINNAMON, CARDAMOM AND GINGER IMPACTS AS EVALUATED ON HYPERGLYCEMIC RATS.

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ABSTRACT

Relative effectiveness of cinnamon, cardamom& ginger and their mixture as fed to diabetic rats was investigated (at 7% level) using alloxan injected Sprague Dawley male rats. Spices diets showed maximum improvement of BWG& FER of diabetic rats, in particular that of the ginger and combined spices formulation. Cinnamon & cardamom diets improved also BWG & FER of diabetic rats. These diets lowered the internal organs weight, previously raised by diabetes. Maximum decrease of lungs weight was recorded for cardamom diet. All spices and the combined formulation diets showed 12.07 to 23.42% reduction of serum glucose. In this connection, cardamom revealed diet 12.68% reduction of serum glucose, indicating its value for diabetics. Maximum improvement of the renal function occrued when feeding diabetic rats with cinnamon diet. Cardamom diet showed also pronounced decrease of serum creatinine, urea & uric acid levels. Spices treatments including cardamom lowered the liver enzymes activities; maximum reducation of GOT & GPT recorded for the liver function. Cardamom was active in reducing lipids profile of diabetic rats; meanwhile maximum decrease of TC, TG, TL, LDL, VLDL& AI in serum of diabetic rats was recorded for combined spices for mulation diet.

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INTRODUCTION

Diabetes mellitus is a descriptive term covering a heterogenous grop of chronic metabolic disorder, characterized by elevated blood glucose concentration. The complications result chiefly from the effect of diabetes on the arterial and nervous systems. They include diabetic retiropathy which may lead to blindness, diabetic neropathy potentially resulting in kidney failure, and foot ulceration which may lead to gangrene. In addition to these specific diabetes related complications, there is a substantially increased risk of cardiovascular disease in people with diabetes **(Mann and Truswell, 2000)**.

In 1997, an estimated 124 million people wordwide had diabetes, 97%of these having type 2 diabetes, otherwise known as non- insulin-dependent diabetes millotus **(NIDDM)**, or adult population, afflicting approximately 17% of people aged greater than 65 years **(Amos *etal.,* 1997)**.

Referring to estimates of the World Health Organization **(WHO)**, 80% of the world population is primarily reliant on traditional methods of healing which was empirical knowledge based on the use of medicinal plants **(Muller and Mechler, 2005)**.

Research on rats suggests that ginger may be useful for treating diabetes **(Al-Amin and Zainab,2006)**. According to **Goyal and Kadnur (2006)** treatment with 250 mg/kg of *Zigiber officinale* extracts for 8 weeks produces significant reduction in body weight, lipids levels and serum glucose as compared to obese control mice.

Tim *etal.,* (2006) showed that watersolbule cinnamon extract induced singnificant decrease in free blood glucose level. Also, **Hiebowicz *etal.*,(2007)** found that 69 cinnamon with rice pudding reduces postprandial blood glouse.

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As for cardamom, as for as the authors were aware nonthing published about its relation to diabetes mellitus. Meanwhile according to **Google (2009)** "Diabetes Dellitus Gospel", natural external foot patch clinica proved 100% sugar down to normal.

The purpose of present work is to evaluate diets containing cinnamon, ginger, candamom or a combined formulation of them on alloxan injected male albino rats.

MATERIALS AND METHODS

Cinnamon *(Cinnamomum zillanicum)*, cardamom *(Elettaria cardmomum)* andginger *(Zingiber officinale)* were obtained dry from a spices shop and milled. Experimental diets contained 7% of one of above powders and one treatment prepared with a blend of all spices at equal proportions. Cholesterol purchased from a drugs shop.

A total number of 30 Sprague Dawley male rats weighting 110±5 g each. Rats were housed in well aerated cages under hygienic conditions and fed on based diet for one week for adaptation. Five rats (control negative group) fed on basal diet all the time.

Other 25 rats were injected with 150 mg/kg body weight of alloxan (BDH, Sigma) to induce hyperglycemia **(Desai and Bhide, 1985)**. Six hours after injection, fasting blood samples having fasting serum glucose more than 200 mg/dl considered diabetic **(NDDG,1994)**. Hyperglycemic rats divided into 4 groups (5 rats each) and fed on either cinnamon, cardamom, ginger or blend of them (at 7% level).

Feeding experiment lasted for 28 days, then rats fasted overnight before sacrifieced and the blood samples were collected from each rat into clean dry centrifuge cuvetes, left to clot at room temperature, then centrifuged at 300 p.p.m to separate serum which was kept frozen at -20ºc until analysis.

Liver, kidney, heart, lungs & spleen carefully removed, cleaned & weighted.

The basal diet was according to **AIN(1993)**, vitamin mixture was as reported by **Campbell, 1963** and mineral mixture according to **Hegsted *etal.*, 1941)**

Feed intake (FI), body weight gain (BWG) and feed efficiency ratio (FER) determined according to **Chapman *etal.*,(1959)**. Glucose and uric acid in serum were determined as described by **Bahram and Trinder (1972)**. Creatinine was determined according to Henry (1974), while urea determined according to **Patton (1977)**. Determination of alkaline phosphatase (ALP) was carried out according to **REC. (1977)**, while GOT& GPT activities were estimated according to **Reitman and Franakel (1957)**. Determination of HDL was carried out according to the method of **Grodon and Amer (1977)**. VLDL and LDL calculated according to equation given by **Lee and Nieman (1996)** as follows:

VLDL (mg/dl) = TG/5.

LDL (mg/dl) = TC – HDL – VLDL

Total cholesterol (TC) **(NIHP, 1987)**, triglycerides (TG) **(Fassati and Principe 1982)** and total lipids (TL) **(Zollner& Kirsch, 1962)** were also determined.

Statistical analyses were performed using computer program Statistical Packages for Social Science **(SPSS, 1998)**, and values compared with each other using suitable tests.

RESULTS AND DISCUSSION

A- Body weight gain (BWG), feed intake (FI) and feed efficiency ratio (FER):

Results of table (1) indicated that hyperglycemia lowered BWG& FER, while raised FI. Similar results were reported by **Mohamed, Manal (2006)** due to hyperglycemia, while walnut & peanut diets reversed these changes, which was also recorded by feeding diabetic rats (Table 1) on spices diets.

Feeding of diabetic rats on spices diets raised BWG& FER while lowered the food intake. It is evident (Table 1) that the effect of different spices was so pronounced that FI& FER for different treatments were of less values than that recorded for the control (-) normal rats. Such desirable effect was found for ginger & combined formulation diet as regard the BWG. BWG of control (-) as well as 7% ginger & 7% combined formulation diets were 61, 77 & 75.3 g respectively. Difference between values of BWG for ginger & combined formulation diets was nonsignificant. Both treatments showed also highest FER.

B- Internal organs weight:

Data of table (2) revealed that diabete mellitus raised the weights of all the internal organs indicating inflammative changes. This was also found by **El- Malah, Maysa (2007)**. According to same author relative weights of the internal organs of diabetic rats decreased when feeding with broccoli diets indicating amelioration of inflammation.

Table (1): Effect of spices and their mixture on BWG, FI and FER of diabetic rats.

Groups / Parameters		BWG g	FI g	FER
control	(-)	61±2.00 b	16.69±1.14 b	0.130±0.017 c
	%	+60.53	-29.82	+ 80.70
	(+)	38±2.00 e	23.78±1.68a	0.057±0.011 e
	%			
Treatments	7% Cinnamon	54.3±2.07c	16.13±0.81 bc	0.120±0.020c
	%	+42.90	-32.17	+110.53
	7% Cardamom	42.8±2.43d	14.55±1.38c	0.105±0.005d
	%	+12.83	-38.81	+84.21
	7% Ginger	77±2.00 a	15.80±0.72bc	0.174±0.009a
	%	+102.63	-33.56	+205.26
	7% Combined formulation	75.3±1.54a	17.43±0.51b	0.154±0.002b
	%	+80.79	-26.70	+170.18
LSD		1.718	1.59597	0.0131

% : % of control (+).

Table (2): Effect of spices and their mixture on heart, lungs, liver, spleen and kidneys of diabetic rats.

Groups		Heart g	Lungs g	Liver g	Spleen g	Kidneys g
control	(-)	0.73±0.01 d	1.42±0.03 bc	5.77±0.06 b	0.75±0.02 d	1.55±0.05 c
	%	-32.41	-16.47	-24.58	-28.57	-14.37
	(+)	1.08± 0.11 a	1.7 ± 0.17 a	7.65 ± 1.27 a	1.05 ± 0.09 a	1.81±0.09 a
	%					
Treatments	7% Cinnamon	0.74±0.03 d	1.49±0.08 b	6.66±1.16 ab	0.89 ±0.08b	1.62±0.07c
	%	-31.48	-12.35	-12.94	-15.24	-10.50
	7% Cardamom	0.87±0.02 c	1.3± 0.23 c	6.59 ±1.22 ab	0.85±0.07 bc	1.77±0.06 b
	%	-19.44	-23.53	-13.86	-19.05	-2.21
	7% Ginger	0.89±0.04c	1.42±0.17bc	6.67±1.23ab	0.79±0.08cd	1.71±0.06ab
	%	-17.59	-16.47	-12.81	-24.76	-5.53
	7% Combined formulation	1.01±0.03b	1.44±0.05bc	5.87±0.81b	0.77±0.06d	1.57±0.05c
	%	-6.48	-15.29	-23.27	-26.67	-13.26
LSD		0.06798	0.16888	1.26671	0.0713	0.08389

% : % of control (+).

It could be observed (Table 2) that the internal organs weight of hyperglycemic rats decreased due to feeding with cinnamon, cardamom, ginger and combined spices formulation diets. Maximum reduction of liver, spleen & kidneys weight was found for the combined spices formulation, while maximum decrease of heart and lungs recorded for cinnamon &cardamom diets respectively. Such results indicated even for cardamom, which had minimum pharmacological studies **(Al- Zuhair *etal.*, 1996)**, this spice ameliorated inflamnation of the internal organs of diabetic rats.

In once case only table 2) the weight of lungs was even less than that of the control(-) healthy rats, this case observed for 7% cardamom diet.

C- Serum glucose

From results of table (3) it could be noticed that serum glucose was appreciably raised in alloxan injected rats (control "+") due to

hyperglycemia. This was also reported by **Wahba, Hala (2007)**, who found also that some herbal formulations could reduce the serum glucose of diabetic rats. According to the herbs used, serum glucose showed from 8.04 to 37.71% decrease compared to control (+) group. In present work (table 3) spices used showed 12.68 to 23.42% decrease in comparison with serum glucose of control (+) rats. Maximum reduction of formulation (23.42%). Reduction in serum glucose was reported by **Goyal& Kadnur(2006)**. **Islam and Haymie (2008)** found that the overall anti-diabetic effects of ginger were better than those of garlic. **Tim *etal.*, (2006) and Hiebowitz *etal.*, (2007)** found that cinnamon reduces blood glucose.

From results of table (3) cardamom diet showed 12.68% decrease of serum glucose, indicating that the hypoglycemic effect of this spice should not be neglected.

Table (3): Effect of spices and their mixture on serum glucose of diabetic rats.

Groups		Glucose Mg/dl
control	(-)	102.5±2.50 e
	%	-50
	(+)	205 ± 5.29 a
	%	
Treatments	7% Cinnamon	167 ± 0.08 c
	%	-18.54
	7% Cardamom	179 ±5.29 b
	%	-12.68
	7% Ginger	170 ±6.24 c
	%	-17.07
	7% Combined formulation	157 ± 4.36 d
	%	-23.42
LSD		5.363498

% of control (+)

D- Renal function parameters:

Data presented in table (4) show the levels of serum creatinine, urea & uric acid of diabetic rats as affected by feeding on cinnamon, cardamom, ginger and combined spices formulation diets. It is evident that

hyperglycemia was damaging for the renal function as creatinine, urea & uric acid greatly increased due to diabetics. This was also reported by **Mansour, Amira (2009)**, who reported that vegetative growths of tuberous plants reduced the levels of serum creatinine, urea & uric acid and improved remarkably the renal function of hyperglycemic rats.

It is evident that maximum improvement of the renal function was achieved when feeding diabetic rats with cinnamon diet. Cardamom diet showed also pronounced improvement of renal function. Data on the hypoglycemic effect of caradamom are slant.

On the other hand, **Mehrdad *etal.,* (2007)** concluded that ginger may have a beneficial effect of removal of urea from plasma and it may be considered as a therapeutic herb to manage renal function in patient.

Table (4): Effect of spices and their mixture on Creatinine, Urea and Uric acid of diabetic rats.

Groups		Creatinine Mg/dl	Urea Mg/dl	Uric acid Mg/dl
control	(-)	0.7±0.02 b	75±3.46 b	1.54±0.03 c
	%	-60.45	-36.62	-77.71
	(+)	1.77 ±0.06 a	118.33±5.78 a	6.73 ±0.64 a
	%			
Treatments	7% Cinnamon	0.65 ± 0.04 c	48.50 ±3.04 e	3.8 ± 0.04 c
	%	-63.28	-59.01	-43.54
	7% Cardamom	0.73 ±0.03 b	66.00±3.00 c	3.8 ±0.03 c
	%	-58.76	-44.22	-43.54
	7% Ginger	0.73 ± 0.05 b	54.75 ± 2.05 d	4.1 ± 0.26 c
	%	-58.76	-53.73	-39.08
	7% Combined formulation	0.68 ± 0.03 bc	50.75 ± 5.54 e	5.0 ± 0.10 b
	%	-61.58	-57.11	-25.71
LSD		0.0473	3.5321	0.48707

% : % of control (+).

E- Liver function parameters:

It could be observed that due to hyperglycemia liver inzymes (GOT, GPT& ALP) activities increased indicating liver function damage. This was

also reported by **Mohamed, Manal (2006)**, who found that feeding with peanut or walnuts diets corrected such changes, which was ascribed to the effect of dietary omega -6 & omega – 3 polyunsaturated fatty acids that regulated hepatic lipogenesis by reducing sterol regulatory element- binding protein -1 in liver as reported by **Seikya *etal.,* (2003)**.

It was found (table 5) that all spices treatments decreased the liver enzymes activies; maximum reduction of GOT& GPT was recorded for the combined spices formulation, this was also noticed for ALP in case of 7% cinnamon treatment. Appreciable decrease of liver enzymes was also observed for cardamom. Tim *etal.,* (2006) found that cinnamon diets lowered the liver enzymes of patients.

F- Lipids fractions of serum:

The results of tables (6&7) show the serum lipids fractions and atherogenic index (AI) of diabetic rats as affected by feeding with cinnamon, cardamom, ginger and combined spices formulation diets. It is evident that due to hypercholesterolemia TC, TG, TL, VLDL, LDL and AI levels in serum increased while the HDL decreased. This was also reported by **Mansour, Amira (2009)**, who found also that feeding of diabetic rats on tuberous plants leaves improved the lipidis status in serum. This was also found when diabetic rats fed with spices diets. According to **Liu *etal.,* (2003)** the ginger not only reduced plasma lipid level but also the mouse atherosclerotic lesion areas. Also, **Cao *etal.,* (2007)** reported that cinnamon improves the lipid profile of people with type 2 diabetes. Polyphenols of cinnamon may be responsible for these improvements. As for the hypolipidemic action of cardamom, as far as the author was aware, no information was available. In present work, however, cardamom diet showed 20.83% reduction in serum TC of diabetic rats; atherogenic index (AI) was also reduced (-21.19% of control "+" rats). Maximum reduction of TC,TG,TL,LDL, VLDL and AI was found for combined spices formulation.

Table (5): Effect of spices and their mixture on GOT, GPT and ALP activities in serum of hyperglycemic rats.

Groups		GOT U/L	GPT U/L	ALP U/L
control	(-)	27 ± 1.73 e	14 ± 1.00 e	65 ± 3.46 e
	%	-65.39	-78.13	- 60.61
	(+)	78 ± 4.36 a	64 ± 4.89 a	165 ± 6.08 a
	%			
Treatments	7% Cinnamon	59 ± 3.61 b	42 ± 3.46 b	134.5 ± 4.09 d
	%	-24.36	-34.38	-18.49
	7% Cardamom	34 ±1.73 c	28 ± 2.65 c	141.3 ± 3.24 c
	%	-56.41	-56.25	-14.36
	7% Ginger	32 ± 2.65 cd	20 ± 1.00 d	156.5 ± 3.04 b
	%	-58.97	-68.75	-5.15
	7% Combined formulation	29 ± 1.00 de	18 ± 0.78 d	140 ± 2.65 c
	%	-62.82	-71.88	-15.15
LSD		3.0260	3.4765	2.51537

% : % of control (+).

Table (6): Effect of spices and their mixture on Cholesterol (TC), Tri- glycerides (TG) and total Lipids (TL) on hyperglycemic rats.

Groups		Total cholesterol Mg/dl	Total glycerides Mg/dl	Total lipids Mg/dl
control	(-)	99 ± 3.46 e	71 ± 2.64 e	398 ± 8.54 f
	%	- 31.25	-61.83	- 30.90
	(+)	144 ± 5.19 a	186 ± 5.29 a	576 ± 14.00 a
	%			
Treatments	7% Cinnamon	114 ± 3.61 b	169 ± 5.15 c	523 ± 7.55 b
	%	-20.83	-9.14	-9.20
	7% Cardamom	109 ±3.64 d	174 ± 4.35 b	503 ± 6.08 c
	%	-24.31	-6.45	-12.67
	7% Ginger	112 ± 2.65 c	128 ± 2.57 d	437 ± 6.27 d
	%	-22.22	-31.18	-24.13
	7% Combined formulation	95 ± 4.36 f	125 ± 4.13 d	414 ± 4.36 e
	%	-34.03	-32.80	-28.13
LSD		1.8789	3.5774	8.48775

% : % of control (+).

Table (7): Effect of spices and their mixture on HDL, LDL, and VLDL on hyperglycemic rats.

Groups		HDL Mg/dl	LDL Mg/dl	VLDL Mg/dl	Atherogenic index (AI)
control	(-)	75 ± 3.46 a	9.8 ± 0.17 e	14.2 ± 0.72 d	0.32
	%	+13.60	-75.98	- 61.83	-72.88
	(+)	66 ± 2.65 c	40.8 ± 2.01 a	37.2 ± 2.55 a	1.18
	%				
Treatments	7% Cinnamon	74 ± 4.35 a	23.6 ± 1.51c	32.4 ± 2.50 b	0.76
	%	+12.12	-42.16	-12.90	-35.59
	7% Cardamom	75 ±3.64 a	35.2 ± 1.59 b	34.8 ± 3.36 ab	0.93
	%	+13.60	-13.73	-6.45	-21.19
	7% Ginger	72 ± 2.57 b	11.4 ± 1.22 d	25.6 ± 1.51 c	0.51
	%	+9.09	-72.06	-5.15	-56.78
	7% Combined formulation	70 ± 1.00 c	8.0 ± 0.19 f	25 ± 1.00 c	0.47
	%	+6.06	-80.39	-32.80	-60.17
LSD		2.8765	1.5869	2.64055	

% : % of control (+).

$$A.I. = \frac{LDL + VLDL}{HDL}$$

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تأثيرات القرفه و الحبهان و الزنجبيل عند تقييمها على الفئران المصابة بالسكرى

منى على سيف اليمانى
كلية العلوم الطبية التطبيقية
جامعة أم القرى-المملكة العربية السعودية

الملخص العربى

تمت دراسة التأثيرات النسبية للقرفة والحبهان والزنجبيل و مخلوطهم عند استخدامها فى تغذية الفئران (سلالة سبراجو دولى) المصابه بالسكرى. وقد حسنت التوابل من الوزن المكتسب و كفاءة الاستفادة من الغذاء للفئران المصابة بالسكرى وخاصة الزنجبيل والخليط. وقد حسنت أيضا التغذية على القرفة والحبهان من الوزن المكتسب و كفاءة الاستفادة من الغذاء. وهذه الأغذية خفضت من وزن الأعضاء الداخلية الذى كان قد زاد عند الإصابه بالسكرى.

وقد لوحظ أن جميع التوابل وكذلك مخلوطهم يؤدى إلى إنخفاض مقداره 12.07% إلى 23.42% من مستوى الجلكوز فى السيرم- وفيما يتصل بذلك أدى الحبهان إلى خفض 12.68% من مستوى جلوكوز السيرم فى عينة المقارنة الموجبة. ومعاملات التوابل بما فيها الحبهان خفضت من نشاط إنزيمات الكبد، وكان أكبر إنخفاض لنشاط GOT ، GPT وفى حالة معاملة خليط التوابل مما يدل على تحسن كبير فى وظائف الكبد ولقد كان الحبهان ذو نشاط ملحوظ لخفض دهون السيرم فى الفئران المصابة بالسكرى إلا أن أقصى إنخفاض للكولسترول الكلى ، والجلسريدات الثلاثية والليبيدات الكلية وليبوبروتين كولسترول منخفضة الكثافة ومنخفض الكثافة جدا وكذلك دليل التصاب للفئران المصابة بالسكرى قد لوحظ فى حالة معادلة خليط التوابل.