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Effect of Antioxidants of Ginger on Blood Lipids of Rats

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Abstract

Effect of antioxidant of ginger (*ZingiberOfficinale*) on blood lipids of rats was studied. Forty adult male albino rats weighing from 180 to 190 gwere divided into five groups each of them was eight rats. The experiment was, the first one for three weeks and the second at six weeks.In the first period the normal control group was fed on basal diet, while the other four groups were fed on hyperlipidemic diets supplemented with 0.5,1.5% and 1.5 dried ginger respectively. Results indicated that chemical composition values of ginger were as follows: protein (9.0%) ,ash (7.0%), fiber (3.0%), fat (3.4%) and carbohydrates(67.9%), while total phonic compounds (11.3± 1.6 mg tannic acid / g dry mater ; total flavonoids (1.4± 0.11 mg quercetin/g) and total flavonols (1.1 ± 0.09 mg /g quercetin dry mater). There were significant differences between organs weight and also relative organs weight of rats (liver, kidney, spleen and heart) comparing with untreated group (G2). Significant reduction in plasma levels of total lipids, triglycerides, total cholesterol, LDL-c and VLD-c of rats fed on dried ginger as comparing with (G2).

Liver functions (AST, ALT and ALP activities) of rats which fed on ginger were improved as comparing with (G2). Kidney functions results (Serum urea, urea, uric acid and creatinine) showed no significant differences between (G2) and groups other of rats.

Key words: Ginger, Antioxidant activity, Blood Lipids, hyperlipidemic diets, phyto chemicals.

Introduction

Keith Scett(2011)found that not only ginger is considered one of the most popular of all the spices, but also is the top of five antioxidant foods. Numerous studies investigating gingers medicinal properties have also shown that it was used for treatment diabetes, cancer, inflammatory and cardiovascular. **Akhani et al.,(2004)** found that ginger treatment significantly decreased both serum cholesterol and triglycerides. In addition, **Fuhrman and Avirma., (1998)** reported that ginger decreased LDL_c,VLDL_c and triglyceride levels in APO lipoprotein E deficient mice. **Furthermore, Bhandari et al.,(2005)** found that ethanolic extract of ginger significantly reduced serum total cholesterol and triglycerides and increased the HDL_c levels in the experenental animals.

Ajith et al., (2007) found that ginger extract significantly protected the elevation of serum creatinine and urea level.

The objective of this is to study the effect of different levels of ginger intake on hyper lipidemi crats.

Materials and Methods

Materials:

This study was carried out using ginger (*Zingiberofficinals rose*). Ginger was obtained from local market, Cairo, Egypt.

Chemical analysis:

Moisture, protein, fat, ash, carbohydrate and crude fiber of ginger were determined according to the method described by **AOAC, (2000).** Also, phenolic contents of ginger extracts were determined according to the method of **Wolf et al. (2003)**, while total flavonoids and total flavones were determined according to **Ordonez et al., (2006) and Kumaran and Karunakaran, (2007),** respectively.

Biological experiment of hyperlipidemic rats:

A) Animals:

Forty adult male albino rats (Sprague Dailey Strain) weighing (180 – 190 g) were obtained from Institute of Nutrition, Cairo, Egypt.

B) Experimental design:

The rats were divided into five groups each of 8 rats.

The experiment was carried out in two periods, the first one for three weeks and the second was for six weeks. In the first period, the normal control group was fed on basal diet, while the other groups fed on hyper lipidemic diet.

Animals were divided into 5 homogenous groups (8) rats as follows:

G1: Control group fed on standard diet;
G2: Untreated group fed on hyperlipidemic diet;
G3: Fed on hyperlipidemic diet with 0.5 dried ginger;
G4: Fed on hyperlipidiemic diet with 1.0% dried ginger; and G5: Fed on hyperlipidemic diet with 1.5% dried ginger.

The composition of the control and hyperlipidemic diets were shown in table (1):At the end of experiments, rats were fasted overnight and anesthetized, A samples of blood were collected in dry centrifuge tube from hepatic portal vien, the organs (liver, kidney, spleen and heart) were taken, then stored at 20° C until analysis.

Table.1 The composition of hyperlipidemic diets

Ingredients	Control diet (G1)g	Hyperlipidemic diets			
		Untreated (G 2)g	0.5% Ginger (G3)g	1 % Ginger (G4)g	1.5% Ginger (G5)g
Corn starch	72.8	71.8	66.8	61.8	56.8
Casein	12.5	12.5	12.5	12.5	12.5
Corn oil	10	-	-	-	-
Vit. Mix. *	1.0	1.0	1.0	1.0	1.0
Salt mix. *	3.5	3.5	3.5	3.5	3.5
Choline chloride	0.2	0.2	0.2	0.2	0.2
Animal fat	-	10	10	10	10
Cholesterol	-	1	1	1	1
Ginger	-	-	5	10	15

** salt mixtures (A.O.A.C, (1990).

Biological evaluation:

At the end of experiment, biological evaluation of the tested diets was carried out by determining total feed intake, body weight gain (BWG) according to **Chapman et al., (1959)**, relative organ weight (%), also calculated according to **Angervall and Carlstrom , (1963)**, Feed efficiency ratio (FER) calculated as the following equation:

$$FER = \frac{\text{Mean daily weight gaine (g)}}{\text{Mean daily feed consumption (g)}}$$

Biochemical analysis:

Lipid profiles in serum including, total lipids were determined as the method described by **Zollner and Kirck (1962)**, triglyceride (TG) according to **Wahlelfeld(1974),** total cholesterol (TC) according to **Allianet** al., (1974), high, low and very low density liporprotein – cholesterol (HDL-c, LDL-c and VLDL-c) according to **Friedwald et al., (1972).**Liver function in serum including aspartate amino transferase (AST) and alanine amino transferase (ALT) activities were determined according to **Gella et al., (1985).**Kidney functions including uric acid were measured according to the method described by **Garawy (1980),** Urea according **Tabacco et al. (1979),** creatinine was measured according **Bohmer (1971)** and alkahline phosphatase was determined according to **Kind** and **King (1954).**

Statistical analysis of results are expressed as mean ± SD. The differences among groups where analyzed by two way analysis of variance (ANOFA, F. Test). The analysis were carried out using statistical package for the social science **SPSS (1998)** Computer programs variation (11).

Results and Discussion

Table 2. Chemical composition of ginger

Constituents	**Moisture content**	**Protein***	**Fat***	**Ash***	**Crude Fiber***	**Carbohydrate***
	9.7	9.0	3.4	7.0	3.0	67.9

* g/100 g on dry weight basis.

Table 3. Antioxidant content in ginger (mg/ g on dry weight basis).

Constituents	**Total phenolic (mg/g)**	**Total flavonoids (mg/g)**	**Total flavonols (mg/g)**
Ginger	**11.3 ± 1.6**	**1.4 ± 0.11**	**1.1 ± 0.09**

From table (2), the chemical composition of dried ginger is as the following: 9.7% moisture, 3.4% fat, 9.0% portion, 7.0% ash, 3.0% crude fiber and 67.9% carbohydrates. These results were in agreement with those obtained by **Mustafa et al., (1993)**.

From table (3) ginger contained total phonelic compounds under, namely (11.3 ±1.6 mg) tannic acid

/g dry mater), total flavonoids (1.4±0.11 mg)querecetin /g dry mater and the total flavonols was (1.1 ±0.09 mg) / quercetin /g drymater,These results were confirmed that obtained by **Tytti et al.,2002).**

Table (4) shows the mean values of feed intake, gain in body weight, daily feed intake and feed efficiency ratio of hyperlipidemic rats fed on different levels of ginger, Results showed that there is no significant difference between the daily feed intake of normal group(G1) and untreated group (G2).On the other hand, there was no significant difference among rats fed on 0.5%ginger (G3),1%ginger (G4)and 1.5%ginger (G5). The higher value in body weight gain per day had been accurred for the group of rats fed on 1.5%dried ginger(G5)than other groups, while the lowest value in body weight gain had been obtained for the group of rats fed on normal diet (G2), Meanwilefeed efficiency ratio indicated that rats which had been given 1.5% dried ginger (G5) had the highest weight gain in 42 days of experiment.

Table (5) illustrats the mean value of organs weights (liver, kidney, spleen and heart) of rats fed on different levels of ginger. Data indicated that, There was significant difference in all relative organs weight of liver, kidney,spleen and heart comparing with untreated group(G2).

Table (6) illustrates mean values of relative weights (liver, kidney, spleen and heart) of rats fed on different levels of ginger. Results showed that, there was significant difference in all organs weight of liver, kidney, spleen and heart, except through 42 only of the experiment comparing with untreated group (G2).

Table 4. Feed intake, gain in body weight, daily food intake, daily body gain and feed efficiency ratio of hyperlipidemic rats fed on different levels of ginger.after the end of experimental period .

Evaluation Groups of animals	Total feed intake (g / rat)	Body gain (g / rat)	Daily feed intake (g / rat)	Daily body weight (g / rat)	Feed efficiency ratio
Control Group (G1)	205.38±41.59	29.25±30.91	7.33±1.48	1.04±1.03	0.124±0.138
Untreated group hyperlipidemic diet (G2)	230.25±31.89	35.00±12.28	8.22±1.13	1.28±0.43	0.155±0.059
Hyperlipidemic diet +0.5% ginger (G3)	226.75±35.71	37.12±15.31	8.09±1.27	1.32±0.54	0160±0.043
Hyperlipidemic diet +1% ginger (G4)	246.25±39.93	37.00±25.11	8.79±1.42	1.32±0.89	0.156±0.099
Hyperlipidemic diet +1.5% ginger (G5)	214.5±16.93	38.25±15.5	7.66±0.60	1.36±0.55	0.176±0.066

L. S. D = P $\leq$ = 0.05

Table 5. Organs weight (liver, kidney, spleen and heart) of rats fed on different levels of ginger**.**

Organs Weight(g) Group of Animals	Organs Weight(g) of liver	of kidney	of spleen	of heart
Control group (G1)	5.98±1.19 ***	1.18±0.44	0.55±0.17 ***	0.54±0.18 ***
Hyperlipidemic diet (G2)	9.01±0.69	1.96±0.11*	1.54±0.15	1.43±0.10
Hyperlipidemic diet + 0.5% ginger (G3)	8.79±1.05 ***	1.11±0.18	0.75±0.15 *	0.66±0.13
Hyperlipidemic diet + 1% ginger (G4)	8.22±1.34 ***	1.16±0.12	0.75±0.14 *	0.60±0.13
Hyperlipidemic diet +1.5% ginger (G5)	8.48±1.21 ***	1.14±0.15	0.77±0.18 **	0.58±0.07

* (P $\leq$ 0.05) **(p$\leq$0.01) *** (p$\leq$0.001)

Table 6. Relative weights (liver, kidney, spleen and heart) of rats fed on different levels of ginger.

Experimental Group of Animals	Relative liver weight (%)	Relative kidney weight (%)	Relative spleen weight (%)	Relative heart weight (%)
Control group (G1)	0.0281±0.0017 **	0.0059±0.0012	0,0026±0.0007 *	0.0026±0.0008*
Hyperlipidemic diet (G2)	0.0347±0.0017	0.0076±0.0002	0.0059±0.0004	0.0055±0.0004
Hyperlipidemic diet + 0.5% ginger (G3)	0.0351±0.0041 **	0.0044±0.0007*	0.0030±0.0007 *	0.0026±0.0004*
Hyperlipidemic diet +1% ginger (G4)	0.0321±0.0018 **	0.0046±0.0003*	0.0029±0.0005 *	0.0024±0.0004*
Hyperlipidemic diet +1.5% ginger (G5)	0.0341±0.00312 **	0.0046±00.0005*	0.003±0.0007 *	0.0023±0.0002*

* (p < 0.05) **(p < 0.01)

Table (7) shows serum total lipids, triglycerides and total cholesterol of rats fed on hyperlipidemic diet with different levels of ginger. Results indicated that serum total lipids, triglycerides and total cholesterol were significant difference ($p \leq 0.001$) between untreated group (G2) and all group of animals under investigation. Total lipids decreased by 26%, 23.6% and 27.66, while triglycerides decreased by 34.35%, 33.17 and 28.76% and serum total cholesterol decreased by 42.43%, 39% and 36.3% for groups of rats fed on hyperlipidemic diet supplemented with 0.5, 1.0 and 1.5 ginger, respectively.These results were in agreement with those obtained by **Bhandari et al (2005) and Soltan and Abdel Wahab (2006).**

Table (8) shows the mean value of HDL, LDL. and VLD cholesterol of rats fed on hyperlipidemic with different levels of ginger. The HDL-cholesterol indicated that there were no significant difference between untreated group G2 and other groups of rats fed on hyperlipidemia diet supplemented with three levels of ginger under investigation. The highest value of serum LDL-cholesterol was noticed in untreated group (G2), it significantly ($p \leq 0.001$) decreased up on treatment with 0.5%,1% and 1.5% dried ginger, respectively.

The results indicated that HDL /LDL ratio were increased in rats fed on diet 0.5%,1.0%and 1.5% ginger comparing with untreated diet (G2). LDL cholesterol was directly proportional to total cholesterol, while HDL cholesterol was inversely related to total cholesterol. These results are inharmony with the result of **Fuhrman and Averma (1998)**. Also, increased HDL-c / LDL-c ratio may be beneficial for the prevention of atheroseclerosis and coronary heart disease.

Table 7. Serum total lipids, triglycerides and total cholesterol of rats fed on hyperlipidemic diet with different levels of ginger**.**

Evaluation Group of animals	Total lipids (mg/ dl)	Triglycerides (mg/ dl)	Total cholesterol (mg/ dl)
Control group G1	351.45±25.67 ***	77.06±6.35 ***	80.24±5.20
Untreated group Hyper lipidemicG2	518.85±57.57	160.95±24.29	164.93±16.57
Hyper lipidemic diet +0.5% ginger G3	381.95±42.71 ***	105.66±7.38	94.94±12.50 ***
Hyper lipidemic diet +1% ginger G4	395.92±29.27 ***	107.56±3.06 ***	100.60±15.18 ***
Hyper lipidemic diet +1.5% ginger G5	375.29±25.56 ***	114.65±7.71 ***	105.05±15.17 ***

* ($P \leq 0.05$) ** ($p \leq 0.01$) *** ($p \leq 0.001$)

Table 8. Mean value of HDL, LDL and VLD cholesterol of rat fed on hypelipidemicwith different levels of ginger**.**

Group of Animals	**Evaluation**	**HDL cholesterol (mg/dl)**	**LDL – cholesterol (mg/dl)**	**VLDL cholesterol (mg/dl)**	**HDL / LDL ratio**
Control group (G1)		49.96±3.05	18.84±6.26***	11.43±4.17 ***	3.04±1.44 ***
Untreated group hyperlipidemic (G2)		49.02±6.07	40.42±3.20	42.56±5.28	1.22±0.21
Hyperlipidemic diet +0.5% ginger (G3)		45.82±11.17	24.73±9.01 ***	24.38±5.52***	2.07±0.89 N.S.
Hyperlipidemic diet +1.0% ginger (G4)		46.97±4.88	22.06±5.09 ***	24.01±3.12***	2.19±0.39 *
Hyper ipidemic diet +1.5% ginger (G5)		55.09±11.53	18.96±4.88 ***	22.25±6.12***	3.06±1.03 ***

*($P \leq 0.05$) **($p \leq 0.01$) ***($p \leq .001$)

Table (9) illustrates the effect of ginger consumption on liver function. The highest value of serum AST was acquired by rats fed on hyperlipidemic diets with 0.5%ginger (G3),while the lowest ASTvalue in the group of rats fed on control diet (G1).

Serum alanine aminotransferase(ALT) showed no significant difference between group of rats fed on hyperlipidemic diet (G2) comparing with groups of rats fed on hyperlipidemic diet with different levels of ginger under investigation.Serum ALP of control group G1 recorded the lowest value,while the highest value of (ALP) was recorded in group of rats fed on hyperlipidemic diet supplemented with 1.5% ginger.There was highly significance ($p \leq 0.001$) between untreated group (G2)and group of rats fed on hyperlipidemic diet with 0.5% ginger (G2). Such results were in agreement with those found by **Mohamed** et al., (2005).

Table (10) shows the effect of ginger consumption on kidney function of rats. Statistical analysis showed that no significant difference of serum urea; uric acid and creatinine between untreated (G2) and other groups of rats fed on different levels of ginger. These results were inagreement with those found by **Ajith et al., (2007)**

Table 9. Serum AST, ALT and ALP activities of rats fed on hypelipidemic diet with different levels of ginger**.**

Evaluation Group of animals	ALT (M/l)	AST (M/l)	ALP (M/l)
Control group (G1)	36.25±4.33 N.S.	107.12±4.67 *	44,75±6.96 ***
Untreated group hyper lipidemic (G2)	41.00±4.69	142.37±14.54	94.25±6.34
Hyperlipidemic diet +0.5% ginger (G3)	41.25±15.65 N.S	152.37±15.58 N.S	99.37±16.44*** N.S
Hyperlipidemic diet +1% ginger (G4)	36.87±7.43 N.S	117.00±12.41 ***	89.12±15.90*** N.S
Hyperlipidemic diet +1.5% ginger (G5)	41.12±10.71 N.S	151.5±6.48 N.S	130±33.03*** 3.4 N.S **

*(P ≤ 0.05) 3, 4, 5 N.S **(p ≤ 0.01) ***(p ≤ 0.001)

Table 10. Serum urea, uric acid and creatinine of rats fed on hypelipidemic diet treated with different levels of ginger.

Evaluation Group of animals	Serum urea (mg/dl)	Serum uric acid (mg/dl)	Serumcreatinine (mg/dl)
Control group G1	28.36±6.09 N.S	2.5±0.42 *	0.510±0.126 N.S
Untreated group hyperlipidemic (G1)	29.16±4.91	3.57±1.06	0.655±0.301 N.S
Hyperlipidemic diet +0.5% ginger (G2)	26.38±6.04 N.S	3.87±1.13 N.S	0.552±0.190 N.S
Hyperlipidemic diet +1.0% ginger (G3)	25.68±4.94 N.S	2.82±0.51 N.S	0.586±0.156 N.S
Hyperlipidemic diet +1.5% ginger (G4)	28.36±4.39 N.S	3.12±0.97 N.S	0.517±0.054 N.S

* (P ≤ 0.05) ** (p ≤ 0.01)

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تأثير مضادات الأكسدة في الزنجبيل علي ليبدات الدم في الفئران

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الملخص العربى

تم دراسة تأثير مضادات الأكسدة فى الزنجبيل على ليبدات الدم فى الفئران وقد استخدم 40 فأر من ذكور الألبينووالتى يتراوح وزنها من 180–190 جرام وقسمت إلى 5 مجموعات كل مجموعة تضم 8 فئران وقد أجريت التجربة على مرحلتين الأولى لمدة 3 أسابيع والثانية لمدة 6 أسابيع، فى المرحلة الأولى تم تغذية المجموعة العادية (الضابطة) على وجبة غذائية عادية بينما تغذت المجموعات الأربعة الأخرى على وجبات تحتوى على دهن حيوانى 10%، كوليستيرول 1% وفى المرحلة الثانية تم التغذية على نفس الوجبة وتدعيم الوجبات بمسحوق الزنجبيل بنسب 0.5,1.0,1.5%.

وقد دلت النتائج على أن نسبة البروتين في الزنجبيل 9%، العناصر المعدنية 7% ، والألياف 3%، الدهون 3.4% والكربوهيدرات 67.9% بينما كانت نسبة المركبات الفينولية (11.3± 1.6 مللجرام / جرام كوزن جاف) الفلافونيدات (1.4± 0.11 مللجرام / جرام) والفلافونات (1.1± 0.09 مللجرام/جرام)، دلت النتائج على وجود فروق معنوية فى وزن أعضاء الفئران (الكبد،الكلى،الطحال،القلب) وكذلك الوزن النسبى لها سواء بين المجموعة الضابطة أو المغذاة على الزنجبيل بنسب مختلفة، كما لوحظ انخفاض معنوىفاللبيدات الكلية، الدهون الثلاثية،الكوليسترول منخفض وعالى الكثافة فى المجموعات المغذاة على مستويات مختلفة من الزنجبيل بالمقارنة بالمجموعة الضابطة (2)، وقد أوضحت النتائج أن إضافة مسحوق الزنجبيل في وجبة الفئران خلال مدة التجربة أدت إلى تحسين وظائف إنزيمات الكبد (ALP, ALT, AST) بالمقارنة بالمجموعة الضابطة، ولم توجد أي فروق معنوية في وظائف الكلى (اليوريا، حمض اليوريك، الكرياتين) بين الفئران المغذاة على مسحوق الزنجبيل بنسب مختلفة والمجموعة الضابطة (2).