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Protective Effect of Turmeric and Garlic Powder on hypercholesterlemia Level in Rats.

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ABSTRACT

The present studyis conducted to evaluate the preventive effects of some natural plants such as Turmeric (*Curcuma Longa Linn*) powder and garlic*(Allium sativum)*powder on rat feed on high fat diet. Twenty fourmale albino rats each weighing 130±10 g,was divided into 4 groups .Group (1) negative control group feeding basal diet, Group (2) positive control group fed in high fat diet,Group (3)hypercholesterolemic rats fed on basal diet containing 10% garlic andGroup (4) hypercholesterolemic rats fed onbasal diet containing 10% turmeric. At the end of experiment, the four groups were compared in terms of the proportion of fat in the blood , serum biomarkers of liver tissue injury and the activities of antioxidant enzymes in liver tissue. The results indacted that,high fat diet caused deleteriousmetaboliceffects, includinghypertriglyceridemia,hypercholesterolemia and liver dysfunction. Rats fed high fat diet alone showed increased activities of hepatocellular enzymes in plasma, significant decline in antioxidants, and elevated lipid peroxidation indices in liver. Turmeric treatment significantly reduced elevated markers of liver tissue injury and lipid peroxidation product , and brought back the liver antioxidants and the over accumulation lipids in serum towards normal. The results obtained showed turmeric powder had a protective effects against hepatic steatosis. Also results showed that garlic significantly reducedtotal cholesterol (TC), plasma triglyceride (TG), LDL-c, VLDL-c, liver triglyceridesand elevated plasma antioxidant in garlic treated rats groups (3) compared to group (2). Also, liver activity was decreased in group (3) than group (2) .Therefore, the results are clearly indicative of the beneficial effects of turmeric and garlic in reducing lateral side effects of hyperlipidemia.

Keywords : High fat fed diet , Turmeric (*Curcuma longa Linn*.), Garlic (*Allium sativum*) and Hepatic steatosis .

INTRODUCTION

Liver disease is considered any disturbance of liver function that causes illness. The liver is responsible for many critical functions within the body and should it become diseased or injured, the loss of those functions can cause significant damage to the body. Liver disease is also referred to as hepatic disease (Fauciand Harrison , 2008) . Also the liver is the location of the production of "new" glucose (gluconeogenesis), cholesterol and triglycerides . When the liver becomes fatty and enlarged, metabolism of these important substrates becomes altered. This explains the impaired glucose and cholesterol metabolism along with very high triglycerides that often coexist with alcoholism or obesity and diabetes. Morever, individuals with diabetes progress to heart disease 70 percent faster than those without diabetes (Mahan *et al* ., 2004). Hypercholesterolemia is a world-wide problem faced by many societies and is a cause critical concern for health professionals, since it constitutes one of the major risk factors for the development of cardiovascular diseases and liver injury such as atherosclerosis and its complication (Banerjee *et al.*,2003).Moreover, there is a close correlation between these diseases and lipid abnormalities, especially high level of plasma cholesterol, and blood pressure (Mohammadi and Oshaghi, 2014). Cholesterol-enriched diet has been reported to adversely affect the health of humans and animal species. High level of blood cholesterol is a contributory factor of atherosclerosis and many lipid associated ailments like obesity and kidney failure (Sathivel, *et al*., 2008). Natural plant products have been used throughout human history for various purposes. Having co-evolved with animal life, many of the plants from which these natural products are derived are billions of years old. Tens of thousands of these products are produced as secondary metabolites by higher plants as a natural defense mechanism against disease and infection. Many of these natural products have pharmacological or biological activity that can be exploited in pharmaceutical drug discovery and drug design. Medicines derived from plants have played a pivotal role in the health care of many cultures, both ancient and modern (Newman *et al*., 2003; Balunas and Kinghorn , 2005; Gurib-Fakim , 2006 and Newman and Cragg , 2007). Spices used since stone age times have unique biological properties. They were traditionally valued for their health benefits as well as their taste(Bellamy and Pfister ,1992 andChevallier ,1996).Recent studies have presented information about the healthy properties of some herbs and spices, and we are learning more about how these spices can help us. For example, recent studies show that garlic has medicinal properties similar to some drugs prescribed by (Tapsell*et al* ., 2006). Eating about one clove of garlic per day has been shown to lower cholesterol, blood pressure, and possibly have cancerfighting properties (Tapsell ,*et at* ., 2006 andKaefer and Milner , 2008)).Garlic has played an important dietary and medicinal role throughout the history of mankind. (Banerjee *et al*., 2003). Garlic health promoting perspectives have been proven and recommended worldwide as a dietary supplement (Suleria*et al* ., 2013). Additionally, spices like turmeric have been noted for their healing properties and great taste. and demonstrated the benefits of turmeric for treatment of diseases (Funk , *et al* ., 2006). Another similar study on turmeric reported the anti- cancer effects of the powerful yellow spice (Wright *et al* ., 2013).In recent years, many studies have indicated that curcumin plays important roles in treatment of liver diseases (Li, 2014).Curcumin attenuates liver injury and non-alcoholic fatty liver disease by lowering the release of inflammation cytokines, minimizing oxidative stress, enhancing the sensitivity of insulin and altering lipid metabolism (Sengupta *et al.*, 2011).

MATERIALS AND METHODS

MATERIALS

Garlic (*Allium Sativum*) and Turmeric *(Curcuma longa)* , were obtained from a local market , of Mansoura City ,El Dukhlia governorate , Egypt.

All chemicals and reagents used , in this study, were purchased fromGomhouria company , Dokki , Giza , and AlamanaCompany, Cairo City, Egypt.

Male albino rats (Sprague Dawley strain) weighing (100g- 130g) were obtained from the Medical Experimental Research Central in the Faculty of Medicine , Mansoura University, Egypt.

METHODS

Analytical Methods

Determination of total flavonoids in garlic and turmeric samples:

Flavonoid compounds were determined according to by the method of(Zhisen , 1999).

Fraction of flavonoids compounds in garlic and turmeric samples:

Flavonoid compounds were determined by HPLC according to the methoddiscribed by(Mattila , *et al* ., 2000).

Determination of total phenolic compounds in garlic and turmeric samples .

The total phenolic content of sample was determined using Folin-Ciocalteau reagent according tothe method discribed by (Velioglu , *et al*., 1998).

Fractionation of phenolic compounds in garlic and turmeric samples:

Phenolic compounds were determined by HPLC according to the method of (Goupy, *et al* ., 1999).

Determination of Antioxidant activity (DPPH) in garlic and turmeric samples:

Antioxidant activity were determined by HPLC according to the method of(Brand – Willims, *et al*., 1995).

AA DPPH (%) = ($A_{DPPH} - A_{sample}$)/ A_{DPPH} × 100

A_{DPPH} **;** The absorbance of the methanolic DPPH solution ,

A_{sample}; The absorbance in the presence of the baked powder

All analytical determination and Identification of phenolic compounds , flavonoid compounds , antioxidant activity , total phenolic compounds , total flavonoids , and total antioxidant activity (DPPH) were carried out at the Central lab . of Food Technology Res. Inst., Agric.Res . Center . Giza . Egypt.

Biological evaluation

Experimental Animals

Twenty four adult albino rats weight between (100 - 130 g) were kept under normal healthy conditions, all animals were housed in bottomed cages, fresh and clean drinking water was supplied through specific nipple. Rats were kept at a constant environmental and nutritional conditions throughout the period of the experiment (temp 24 ± 2°C) and (12 hour light- dark cycle). Rats were fed on basal diet for acclimatization, for 10 days (adaptation period). The composition of basal diet (mg/ 100 g) as described by A.O.A.C (1990) was given in Table (1), salt and vitamins mixture were described by Abo-El naga(2002).

After adaptation animals were randomly divided to four groups of equal number (six animals each) .The body weight was measured on every week of the experiment. All procedures conformed to the guidelines of the Medical Experimental Research Center in the faculty of Medicine, Mansoura University. El.mansoura ,Egypt.

Experimental design

Rats were fed a basal diet Table (1) for ten days (adaptation period), the rats were fed for eight weeks according to the following scheme:

Group (1): Rats fed on basal diet (negative control group).

Group (2): hypercholesterolemic rats fed on basal diet (positive control group).

Group (3):hypercholesterolemic rats fed on basal diet containing 10% garlic powder.

Group(4):hypercholesterolemic rats fed onbasal diet containing 10% turmeric powder.

After hypercholesterolemic period (21 days) and at the end of experiment(64 days), rats were fasted overnight and anesthetized using diethyl ether and blood samples were collected from the vein plexus eye by capillary tube into a clean dry centrifuge tubes. The serum was separated by centrifuge at 4000 rpm for 10 minutes and kept at- 18^{o}C until analysis.

Table1.composition of basal diet and hypercholesterolemic diets (mg/100g).

Ingredients	* Basal diet %	** Hypercholesterolemic %
Casein	11.2	11.2
Corn starch	66.5	47
Salt mix	4	4
Vitamins mix	1	1
Cellulose	4	4
Bile salt	-	0.23
Corn oil	13.3	11.32
Choline chloride	-	0.25
Cholesterol	-	1
Beef tallow	-	20
Total	100	100

***The composition of basal diet (mg/100g) according to (A.O.A.C ., 1990).**

****The composition of different experimental hyper cholesterol diets according to (Osman , 2001).**

Determination of body weight (BWG)and feed efficiency ratio (F.E.R):

Feed and growth parameters of hypercholesterolemic rats were determined. These parameters were food intake body weight gain (BWG) and food efficiency ratio (FER) according to Chapman *et al*., (1950).

$$B.W.G\ \% = \frac{\text{Final body weight - initial body weight}}{\text{Initial body weight}} x\ 100$$

$$F.E.R) = (Daily\ body\ weight\ gain)/(Daily\ food\ intake)\ x\ 100$$

Biochemical analysis of serum:

Serum samples were analyzed at Medical Research Center , Experimental lab, in the Faculty of Medicine, Mansoura University. Elmansoura-Egypt

Lipid profile

Blood picture

White blood cells (WBCs) count, red blood cells (RBCs) count, hemoglobin (HGB) concentration and blood platelets (PLT) count were determined according to the method of discribed by Cynthia *et al*., (1993).

Determination of serum total cholesterol (TC.):

Serum total cholesterol was determined by enzymatic colorimetric method using kits according to AIlain*et al*., (1974).

Determination of serum triglycerides (TG):

Triglycerides (TG) were determined according to the method discribed by Fossati and Principe (1982).

Determination of high density lipoprotein cholesterol (HDL-c) in serum :

Serum HDL-c cholesterol was determined according to (Lopez ,*et al*., 1977).

Determination of low density lipoprotein cholesterol(LDL-c)in serum:

Serum Low Density Lipoprotein (LDL-cholesterol) was calculated by the difference between total cholesterol, HDL-c and very low density lipoprotein according to Friedewald*et al*., (1972).

Determination of kidney functions :

Determination of blood Urea :

Urea was determined by colorimetric enzymatic method according toTabacco*etal*.,(1979).

Determination of Creatinine

Creatinine was determined according to the method discribed by(Henry,1974).

Determination of liver functions (ALT&AST) by enzymatic colorimetric test:

Serum Alanine amino transferees (ALT) and Aspartate aminotransferees (AST) activites were calorimetric have been identified according to the method discribed by (Reitman and Frankel , 1957)

Determnation of albumin :

Colorimetric determination of albumin in serum or plasma samples was done according to Doumas, *et al* ., (1971**).**

Statistical analysis:

Data were statistically analyzed according to the technique of analysis variance (ANOVA), the least significant difference (L.S.D) and Duncan's methods was used to compare the deference between the means of treatment values to the methods described by Gomez and Gomez , (1984). All statistical analyses were performed using analysis of variance technique by means of Co STATE Computer Software.

RESULTS AND DISCUSSIONS

Phenolic compounds in aqueous and ethanol extract of garlic and turmeric (mg/100g):

Phenolic compounds of garlic and turmeric powder are tabulated in Table (2). From these results, it is evident that these plants have considerable amounts of phenolic compounds . Data in Table (2) showed thatphenolic compounds appear in garlic water extract and recorded the highest Value of E-vanillic 870.07mg/100g ,while results showed that the lowest concentration coumarin3.54mg/100g .In addition the highest content in phenolic compound in garlic ethanol extract was E-vanillic1629.05mg/100g , while 4-amino-benzoic recorded the lowest concentration 2.49 mg/100g.These result is in agreement with those reportedby(Lanzotti ,2006 and Vinson, 1998) .that garlic is also characterized as containing by phenolic compoundwhich have interesting pharmacological properties and are present in relatively high amounts .Garlic has been ranked second in ranking of total phenoliccompounds content.The resultsat the same Table (2) showed. that turmeric water extract contained the highest concentration of E-vanillic69.93mg /100g followed bysalycilic 67.92mg/100g , while results showed ,that the lowest is 3-OH-Tyrosolconcentration(1.33 mg/100g).On the other hand, turmeric ethanol extract recorded the highest value of salycilic 297.77 mg /100g , while iso-ferulicrecorded the lowest concentration (2.31 mg /100g).Also these finding in agreement with those reported by(Halliwell,1994).Turmeric containing antioxidant compounds, especially phenolic compounds such as gallic acid, tannins , vanillic, curcumin, ellagic acid and eugenol, are of considerable interest from the viewpoint of dietary antioxidant supplementation.

Table 2. Phenolic compounds in aqueous and ethanol extracts of garlic and turmeric powder (mg/100g) (DW.basis).

Phenolic compound Extracts	Samples			
	Turmeric Water extract	Turmeric Ethanole xtract	Garlic Water extract	Garlic Ethanol extract
Gallic	11.66	3.19	52.70	43.35
Pyrogallol	44.35	6.54	106.05	80.37
4-Amino-benzoic	4.68	3.73	6.53	2.49
3-OH-Tyrosol	**1.33**	6.94	7.91	4.89
Protocatechuic	10.48	2.65	65.38	18.40
Catechein	11.19	14.89	-	9.94
Chlorogenic	36.27	20.03	151.82	42.14
Catechol	5.21	4.81	43.92	8.04
Epi-Cateechein	36.30	14.18	145.60	7.82
Caffeine	5.63	66.05	64.88	7.20
P.OH-.benzoic	21.08	11.73	47.92	20.27
Caffeic	7.53	3.78	29.80	7.57
Vanillic	8.54	9.56	19.22	5.15
P-coumaric	37.29	44.44	25.10	12.84
Ferulic	22.21	37.14	23.46	11.25
Iso-Ferulic	5.15	**2.31**	14.72	4.42
Reversetrol	1.70	8.52	11.51	7.61
Ellagic	26.87	103..35	65.40	77.73
E-vanillic	69.93	238.76	870.07	1629.05
Alpha-coumaric	8.25	31.85	25.51	22.71
Benzoic	39.08	65.40	67.53	90.02
Salycilic	67.92	297.77	106.76	98.15
Coumarin	1.52	3.06	3.54	3.42
3,4,5.methoxy cinnamic	8.25	10.44	12.54	26.70
Cinnamic	5.20	47.25	6.92	5.26

Flavonoids compounds in aqueous and ethanol extract of garlic and turmeric powder (mg/100g)(DW.basis).

Flavonoids compounds of garlic and turmeric powders are tabulated in Table (3). From these results, it could be noticed that these plants have considerable amounts of flavonoids compounds .

Table (3):. flavonoids compounds in aqueous and ethanol extract of garlic and turmeric powder (mg/100g)(DW.basis).

Flavonoids compounds Extracts	samples			
	Turmeric Water extract	Turmeric Ethanol extract	Garlic Water extract	Garlic Ethanol extract
Luteolin	148.32	186.21	7.74	25.12
Narengin	-	-	47.64	15.85
Rutin	14.33	67.69	16.10	3.57
Hisperidin	100.54	-	226.92	37.22
Rosmarinic	57.17	143.13	926.76	51.69
Quercetrin	9.18	27.70	48.17	19.53
Quercetin	1.35	12.76	9.24	14.56
Hispertin	44.18	280.59	10.16	77.93
Kampferol	0.98	100.98	1.49	3.33
Apegnin	0.57	300.03	1.86	3.50
7-OH-Flavone	0.01	13.32	0.03	0.09

Date in Table (3) showed that flavonoid compounds appear in garlic water extract and recorded the highest value of rosmarinic 926.76 mg/100g ,while results showed that the lowest concentration 7-OH-flavon 0.03mg/100g.In addition the highest content in flavonoid compounds in garlic ethanol extract was Hispertin(77.93mg/100g) followed by rosmarinic 51.69mg/100g ,while 7-OH-Flavone recorded the lowest concentration 0.09mg/100g.The results at the same Table (3) indicated that turmeric water extract contained the highest concentration of luteolin 148.32 mg /100g followed by hisperidin 100.54 mg/100g , while the same results showed that the lowest 7-OH-flavoneconcentration 0.01mg/100g , On the other hand turmeric ethanol extract recorded the highest value ofapegnin 300.03 mg /100g while qurcetin recorded the lowest concentration 12.76mg /100g .

Total Phenolic compounds , Total flavonoids and Total Antioxidant activity in aqueous and ethanol extract of garlic and turmeric powder (mg/١٠٠g)(DW.basis).

Total phenolic compounds,Total flavonoids and antioxidant activityof garlic and turmeric in water and ethanol extracts are tabulated in Table (4). From data presented in Table (4), it is evident that these plants have considerable amounts of total phenolic compounds , total flavonoids compounds and antioxidant activity.Data in Table (4) showed that turmeric water extract and ethanol extract had a highest concentration of total phenolic compounds , total flavonoids and antioxidant activity20.00mg/g , 18.4mg/g ,36.37% and46.073mg/g,40.485mg/g, 49.909% respectively. While garlic recorded the lowest concentration 7.24mg/g , 5.3mg/g ,26.86% and 21.453mg/g , 12.838mg/g , 16.998% respectively.

Table (4) :- Total phenolic compounds , Total flavonoids and TotalAntioxidant activity % in aqueous and ethanol extracts of garlic and turmeric(mg/100g)(DW.basis). .

samples	Test results					
	Water extract			Ethanol extract		
	Total Phenolic (mg/g)	Total flavonoids (mg/g)	Total antioxidant activity(%)	Total Phenolic (mg/g)	Total flavonoids (mg/g)	Total antioxidant activity(%)
Turmeric	20.00	18.4	36.37%	46.073	40.485	49.909%
Garlic	7.24	5.3	26.86%	21.453	12.838	16.998%

Effect of feeding on garlic and turmeric on body weight gain , food intake and food efficiency ratio of rats :

Table (5)showed that the mean values initial of body weight (g), Final body weight gain (g), daily food intake (g) and food efficiency ratio (g), of rat fed onhypercholesterolemicdietes containing 10% garlic or 10%turmeric.The obtained results illustrated that there are significant difference of initial weight with all groups.Body weight gain showed significant difference between negative control(G1) and positive control (G2)(113.33 ± 0.94 g/rat) and (132.00 ± 0.01 g/rat)respectively.There are significant difference in body weight gain between positive control (G1) and all groups .While , the highest value in body weight gain and daily body weight gain were 132.00g and 2.00 g/day respectively in (G2) , While the lowest value were 90.00g and1.41 g /day respectively in (G4) . Food efficiency ratio , showed significant difference between the negative control (G1) and positive control (G2) 10.41 ± 0.09 ratio and 11.80, While , lowest value were 10.08 in (G4) , followed by (G3)and (G1) which recorded 10.27 and 10.41, respectively.These result are in agreement with Madkor *et al*, (2011)andBanerjee *et al* . (2003)whosefound that prolonged feeding of high levels of raw garlic to rats resulted weight loss and failure to grow due to lysis of red blood cells. However, Deshpande *et al*. (1998) and (Kandarkar*et al*.,1998) reported decreased body weights and hepatotoxic effects expressed as focal necrosis, in rats and mice fed turmeric or ethanolicturmeric extract, especially in high doses for prolonged periods.

Effect of feeding on garlic and turmericon cholesterol profile ,triglycerides levels ,high density lipoprotein cholesterol(HDL-c),low density lipoprotein cholesterol(LDL-c),and very low density lipoprotein cholesterol(VLDL-c) in rats :

Data in Table (6) revealed that the highest value of total cholesterol (TC) was 152.6mg/dlin positive control(G2)followed by(G3)139.3mg/dl, while the lowest value of total cholesterol was 103.6mg/g in negative control (G1)rats fed on basal diet , followed by (G4)117.6 mg/dl . From the same table (6) , it could be seen that highest value of triglycerides is 136.3mg/dl for (G2) followed by (G3)is 122.6mg/dl . The lowest value of triglycerides is 90.0mg /dl for (G1)followed by (G4)116.0mg/dl. The results listed in Table (6) showed that negative control(G1) had the highest HDL-c value 48.66mg/d compared with positive control (G2) 35.00 mg/dl. Also ,(G3)and(G4)showed higher HDL-c values.The values of LDL-c levels of the negative control (G1)and experimental groups are present in the same Table (6).

Table(5):.Effect of feeding on garlic and turmeric on body weight gain , food intake and food efficiency ratio of rats.

Rat groups	Initial body weight(g)	Final body weight (g)	Body weightgain			Food intake g/day	*FER
			g	%	g/day		
$G1^-$	121.00 ±1.7 abc	235.00±0.82 b	113.33±0.94b	93.17±2.05 b	1.77±0.01b	17.00±0.01a	10.41±0.09b
$G2^+$	123.3 ±0.8 ab	255.3±0.82 a	132.0±0.01a	107.09±0.71a	2.00±0.01a	16.85±0.01ab	11.80±0.01bc
G3	120.00 ±0.8 bc	225.0±0.82 c	105.00±1.41c	87.51±1.73c	1.64±0.02c	16.00±0.01abc	10.27±0.12bc
G4	125.00 ±0.8 a	215.0±0.82 d	90.00±0.01d	72.00±0.47de	1.41±0.01d	14.11±0.01d	10.08±0.01bc
F.test	**	**	**	**	**	**	**
LSD at 5%	2.3	1.4	1.64	2.68	0.02	0.85	0.58
LSD at 1%	3.2	1.9	2.26	3.69	0.03	1.17	0.80

G1- = Basal diet (control negative). G2= hypercholesterolemia diet (control positive).
G3= Basal diet + 10% garlic. G4 = Basal diet + 10% turmeric .
***FER= Food efficiency ratio .**

The data revealed that the highest value of LDL-c is 90.40mg/dl for positive control (G2) followed by (G3) is 65.13mg/dl .While the lowest value of LDL-c levels of the negative control (G1)is 37.00mg/dl followed by (G4) 42.86mg/dl.The other groups with additives showed that lower values of LDL-c as compared with the positive control(G2).The date also , showed that (G2)recorded the highest value of VLDL-c 27.26mg/dl and followed by (G3) 24.53mg/dl. The lowest value of VLDL-c is 18.00 for (G1)followed by (G4)23.20 mg/dl.These results in parallel with those of other researchers (Jang et al., 2008).The hypercholesterolemic effect may be ascribed to the increased dietary cholesterol intake , andAbdel-Maksod., (2002) who reported that mice and rats received cholesterol-enriched diet showed hypercholesterolemia, elevated plasma serum LDL-c and VLDL- c compared with those fed a normal diet.Regarding garlic extract, our findings going with Mohammadi and Oshaghi (2014) .study , they conducted a trial to compare effect of garlic with hypercholesterolemic mice, they concluded treatment with garlic extract significantly decreased total cholesterol, low-density lipoprotein cholesterol (LDL-c), triglycerides, very low density lipoprotein-cholesterol (VLDL-c), atherogenic index, alanine aminotranferease (ALT) and aspartate aminotransferase (AST) . Change in HDL-c levels was not significant in garlic extract treated animals compared with hypercholesterolemic group. Presence of garlic in (G3) improved HDL levels, this is consistent with (Lee, 2012). Also Aouadi ,(2000) showed that adding 10% fresh crushed garlic and 2% cholesterol to diet led to significant reduction in LDL-c levels, and increased HDL-c levels in rats. Luthra *et al*. (2001)studied spices including turmeric stimulate the conversion of cholesterol to bile acids, which is an important pathway of elimination for cholesterol from the body. as well as liver triglycedcles. Wistar rats fed with 0.5% curcumin for 3 months showed significant increase in the choiesterol7a-monooxygenase, the rate limiting enzyme of the bile acid biosynthesis in liver .Turmeric's protective effects on the cardiovascular system include lowering cholesterol and triglyceride levels, decreasing susceptibility of low density lipoprotein (LDL)tolipids peroxidation ,andinhibiting platelet aggregation. These effects have been noted even with low doses of turmeric (Reuter , 2011; Gupta et al., 2012).

Table (6) :-Effect of feeding on garlic and turmeric on total cholesterol (TC) ,triglycerides levels(TG) ,high density lipoprotein cholesterol(HDL-c),low density lipoprotein cholesterol(LDL-c),and very low density lipoprotein cholesterol(VLDL-c) in rats .

Rat groups	T.G		T.C		HDL-c		LDL-c		VLDL-c	
$G1^-$	90.0 ±2.2 c		103.6 ±2.4 e		48.66 ±1.70 ab		37.00 ±3.21 d		18.00 ±0.43 c	
$G2^+$	136.3 ±9.0 a		152.6 ±7.8 a		35.00 ±1.63 c		90.40 ±7.29 a		27.26 ±1.80 a	
G3	122.6 ±2.1 b		139.3 ±0.5 b		49.66 ±2.17 ab		65.13 ±1.47 b		24.53 ±0.41 b	
G4	116.0 ±2.9 b		117.6 ±2.1 d		51.60 ±1.14 a		42.86 ±1.47 cd		23.20 ±0.59 b	
F.test	**		**		**		**		**	
LSD at5%	7.5		6.2		4.47		6.44		1.51	
LSD at 1%	10.4		8.6		6.16		8.88		2.08	

G1- = Basal diet (control negative). G2+ = hypercholesterolemia (control positive). G3 = Basal diet + 10% garlic. G4 = Basal diet + 10% turmeric . TG = Total glycerides . TC = Total cholesterol . HDL-c = High density lipoprotein cholesterol LDL-c = Low density lipoprotein cholesterol VLDL-c = Very low density lipoprotein cholesterol

Effect of feeding on garlic and turmeric on liver functions (AIT , AST) and albuminin rats.

Results in **Table (7)** showed that the serum ALT and AST for positive control (G2)recorded significant higher values 66.63 U/L and 81.00U/L respectively ,while results showed thealbumin recorded lowest values for (G2)3.00U/Lcompared with negative control (G1)3.90U/L . ALTand AST values for (G3)and different groups various with additive showed significant lower values compared with positive control

(G2),While albuminvalues for (G3)and (G4) showedrecorded highest values compared with positive control(G2).these results agreed with Sudhahar et al. (2007) whose reported that high fat diet intake caused a highly significantly ellevated serum urea and creatinine concentrations and (ALT),(AST) of hypercholesterolemic control rats (G2) as compared to normal rats(G1)(Table 7).Li et al. (2014)found that rat models treated with Con A to induce liver injury and elevated ALT (233 U/L) showed marked decrease after addition of curcumin oil (93 U/L). Regarding garlic extract, our findings going with Mohammadi and Oshaghi (2014) study , they conducted a trial to compare effect of garlic with hypercholesterolemic mice, they concluded treatment with garlic extract significantly decreased , alanine aminotransferase (ALT) and aspartate aminotransferase (AST) .

Table 7. Effect of feeding on garlic and turmeric on liver functions (AIT , AST) and albumin in rats.

Rat groups	Albumin			ALT			AST		
$G1^-$	3.90	±0.22	a	35.63	±1.70	e	44.00	±2.94	e
$G2^+$	3.00	±0.08	c	66.63	±2.05	a	81.00	±3.27	a
G3	3.70	±0.08	ab	48.00	±0.82	b	64.66	±3.30	b
G4	3.42	±0.05	b	45.00	±0.82	bcd	63.00	±3.27	bc
F .test		**			**			**	
LSD at 5%		0.16			4.03			4.77	
LSD at 1%		0.22			5.55			6.57	

G1- = Basal diet (control negative). G2+ = hypercholesterolemia (control positive). G3 = Basal diet + 10% garlic. G4 = Basal diet + 10% turmeric . **ALT = alanine aminotransferase AST = aspartate aminotransferase**

Effect of feeding on garlic and turmeric on kidney functions, creatinine and urea in rats :-

Results inTable (8) showed that the serum urea andcreatinine for positive control (G2)recorded significant higher values 61.00mg/dl and 0.81 mg/dl respectively compared with negative control (G1) 31.00mg/dl and 0.5mg/dl respectively. These results agreed with Hassan ,(2011). high fat diet intake caused a highly significantly elevated serum urea and creatinine concentrations of hypercholesterolemic control rats.as compared to normal rats. Enhanced protein catabolism and accelerated amino acid deamination for gluconeogenesisis possible,an acceptable postulate to interpret the elevated levels of urea, where elevated creatinine concentration is associated with abnormal renal function.Creatinine and urea values for (G3) and (G4)sample control and different groups with various additives showed significant lower values compared with positive control (G2)these results agreed withUda , (2006)who found that no significant difference in creatinine levels between experiment group and control group while addition of garlic powder.WhileEl-Shenawy and Hassan, (2008) conclude that oral administration of either selenium or garlic produced a significant protection against liver and kidney damage induced by the $HgCl_2$ injection, but garlic appeared to be more protective.His experiment was the same as ours in rats, rats were given garlic in combination with HgCl (2) injection showed a significant decrease in BUN, Serum creatinine, ALT and AST levels.

Effect of feeding on garlic and turmeric on hematological parameters in rats

Results in Table (9) show the feeding effect of different diets on blood plasma profile (HB, RBCs, WBCs and Platelets) of normal and hypercholesterlemic rats. From the obtained data,in Table (9) it could beobserved that, the initial level of HB, RBCs and WBCs and platelets were recorded average amount of 13.62, 6.450,8.260, and 979 in blood plasma respectively for negative control (G1). While,after feeding of experimental groups on hypercholesterolemic, the above mentioned levels were recorded an average 9.89, 4.030 , 5700 and 450 in blood plasma respectively(G2). At the end of experimental period it could be observed ,hypocholesterolemic group which fed only on hypercholesterolemic diet during all experimental period and the group which fed on control basal diet were significant decrease in HB, WBCs , RBCs and platelets. Through statistical analysis of showed that, there was statistically significant difference in hemoglobin , RBCs , WBCs and plateletsamong groups. Generally, it could be concluded that rats feeding on feeder treated with plants were able to improve blood plasma profile compared with feeding of hypercholesterolemic rats.

Table 8. Effect of feeding on garlic and turmeric on kidney functions , (creatinine and urea) in rats :

Rat groups	Urea			Creatinine		
$G1^-$	31.00	±0.82	c	0.500	±0.008	b
$G2^+$	61.00	±1.63	a	0.811	±0.008	a
G3	41.00	±1.63	d	0.633	±0.054	ab
G4	44.00	±0.82	b	0.510	±0.070	b
F .test		**			**	
LSD at 5%		0.97			0.135	
LSD at 1%		1.34			0.187	

G1- = Basal diet (control negative).
G2+ = hypercholesterolemia diet (control positive).
G3 = Basal diet + 10% garlic. **G4** = Basal diet + 10% turmeric

Table (9):-Effect of feeding on garlic and turmeric on hematological parameters in rats.

Rat groups	HB	RBCs	WBCs	Plate
$G1^-$	13.62 a	6.450 a	8260 a	979 a
$G2^+$	9.89 c	4.030 c	5700 c	450 c
G3	10.80 bc	5.440 ab	7360 ab	653 bc
G5	13.00 ab	5.770 ab	6930 bc	673abc
f.test	**	**	**	**

G1- = Basal diet (control negative).
G2+ = hypercholesterolemia diet (control positive).
G3 = Basal diet + 10% garlic. G4 = Basal diet + 10% turmeric .
HB: Hemoglobin . RBCs : Red blood cells count .
WBCs : White blood cells count .

REFERENCES

A.O.A.C. (1990): Official method of analysis, Association of officinal Analytical chemists, 15th ed. Washington, D.C., USA.

Abdel-Maksod , (2002):Effects of ethanolic extract of green tea on decreasing the level of lipid profile in rat 3(1): 98–105.

Abo-Elnaga,M.M.(2002): Dietary fiber of barley and oat as hypercholesterolemic action and source of fat replacement in foods Ph.D.thesis,Fac. Of Agric., Cairo University.

Allain, C.C.; Poon, L.S.; Chan, C.S.; Richmond, W. and Fu, P.C.,(1974): Enzymatic Determination of Total serum cholesterol ClinChem, 20:4, 470-475

Aouadi, R., (2000): Effect of fresh garlic (allium sativum) on lipid metabolism in male rats. Nutr Res 2000, 20:273–280.

Balunas , M. J, and Kinghorn , A, D., (2005): Drug discovery from medicinal plants. Life Sci;78:431–41.

Banerjee, S.K.,; Mukherjee, P.K.; and Maulik, S.K., (2003) : Garlic as an antioxidant: the good, the bad and the ugly. Phytotherapy research : PTR, 17(2), pp.97–106.

Bellamy D, and Pfister A.(1992): World medicine: plants, patients and people. Oxford: Blackwell Publishers.

Brand-Williams,W.; Cuvelier,M.E. and Berset, C., (1995): Use of a free radical method to evaluate antioxidant activity. LebensonWiss.Technol. 28:25 – 30.

Chapman, D.G.; R. Gastilla and Campbell , T.A.(1950): Evaluation of protein in food . I.A. Method for the determination of protein efficiency ratio . Can.J. Biochem.Physio .137, 679-686.

Chevallier A.(1996): The encyclopedia of medicinal plants. London: Dorling Kindersley.

Cynthia, C. C.; Ruth, L. K. and Barbra, J. B., (1993): Laboratory Tests and Diagnostic Procedures. W. R. Saunders Company.

Deshpande, S.S.; V.S. Lalitha, A.D. Ingle, A.S. Raste, S.G. Garde and G.B. Maru, (1998): Subchronic oral toxicity of turmeric and ethanolic turmeric extract infemale mice and rats. Toxicol. Letters, 95:183-193.

Doumas , B.T.;Watson ,W.A. and Biggs, H.G.(1971):Albumin standerds and the measurement of serum albumin with bromcresol green . Clin . Chim Acta.31-87.

El-Shenawy, S.M.A. and Hassan, N.S. (2008): Comparative evaluation of the protective effect of selenium and garlic against liver and kidney damage induced by mercury chloride in the rats. *Pharmacological reports : PR*, 60(2), pp.199–208.

Fauci, Anthony S., and . Harrison 's (2008) : Principles of Internal Medicine . 17th ed. United States : McGraw-Hill professional

Fossati, P. and Principe, L. (1982): Serum triglycerides determined colorimetrically with an enzyme that produces hydrogen peroxide. Clin. Chem.28: 2077-2080.

Friedewald, W. T.; Levy, R. I. and Fredrickson, D. S. (1972): "Estimation of the concentration of low–density lipoprotein cholesterol in plasma, wthout use of preparative ultracentrifuge," Clin Chem., vol. 18, pp. 499-02.

Funk, J.L., Frye, J.B., Oyarzo, J.N., Kuscuoglu, N., Wilson, J., McCaffrey, G., Stafford, G., Chen, G., Lantz, R.C., Jolad, S.D., Sólyom, A.M., Kiela, P.R., and Timmermann, B.N (2006) . Efficacy and Mechanism of Action of Turmeric Supplements in the Treatment of Experimental Arthritis. Arthritis & Rheumatism. 54 (11): 3452–3464.

Gomez, K.A. and Gomez,A.A. (1984): Statistical Procedures for Agricultural Research. 2nd Ed., Jhon Wiley and Sons Inc., New York, pp: 95-109

Goupy, P.; Hugues, M.; Boivin,p. and Amiot, M.J., (1999): Antioxidant and activity of barley(Hordeumvulgare) and malt extracts and of isolated phenolic compound.JSci Food Agric. 79:1625-1634.

Gupta, S.C., Patchva, S. and Aggarwal, B.B.(2012): Therapeutic Roles of Curcumin: Lessons Learned from Clinical Trials. *The AAPS Journal*, 15(1), pp.195–218.

Gurib-Fakim A. ,(2006) : Traditions of yesterday and drugs of tomorrow. Mol Aspects Med.27:1–93.

Halliwell, B. (1994): Free radicals and antioxidants: a personal view. Nutr.Res. 52: 253-265.

Hassan, S. (2011):Improvement of lipid profile and antioxidant of hypercholesterolemic albino rats by polysaccharides extracted from the green alga Ulva lactuca Linnaeus. *Saudi Journal of* Biological Sciences, 18(4), pp.333–340.

Henry , R. J. (1974) : Clinical chemistry , principles and Technics , 2nd Edition , Horper and Row , p. 525 , 19 74 .

Jang, A., Srinivasan, P., Lee, N.Y., Song, H.P., Lee, J.W., Lee, M., and Jo, C., (2008). Comparison of hypolipidemic activity of synthetic gallic acid-linoleic acid ester with mixture of gallic acid and linoleic acid, gallic acid, and linoleic acid on high-fat diet induced obesity in C57BL/6 Cr Slc mice. Chem. Biol. Interact. 174 (2), 109–117

Kaefer, C. M. and Milner, J.A. (2008) :The Role of Herbs and Spices in Cancer Prevention. Journal of Nutritional Biochemistry. 19(6): 347–361.

Kandarkar, S.V. , Sharda S Sawant, A.D. Ingle, S.S.Deshpande and G.B. Maru, (1998):Subchronic oral hepatotoxicity of turmeric in mice – Histopathological and ultrastructural studies., Ind. J. Exp. Biol., Vol. 36, July, pp: 675-679.

Lanzotti,V., (2006): The analysis of onion and garlic. J Chromatogr A 1112:3–22

Lee, S. (2012): High hydrostatic pressure extract of garlic increases the HDL cholesterol level via up-regulation of apolipoprotein A-I gene expression in rats fed a high-fat diet. *Lipids in health and disease*, 11(1), p.77.

Li, Y.(2014): Hepatic protection and anticancer activity of curcuma: A potential chemopreventive strategy against hepatocellular carcinoma. International Journal of Oncology, 44(2), pp.505–513.

Lopez-Virella, M. F.; Stone, P.; Ellis, S. and Colwell, J. A. (1977): Cholesterol determination in high density lipoproteins separated by three different methods. Clin Chem,23:882-884.

Luthra, P.M., Singh, R. and Chandra, R., (2001): Therapeutic uses of Curcuma longa (turmeric). *Indian Journal of Clinical Biochemistry*, 16(2), pp.153–160.

Madkor, H.R., Mansour, S.W. and Ramadan, G., (2011): Modulatory effects of garlic, ginger, turmeric and their mixture on hyperglycaemia, dyslipidaemia and oxidative stress in streptozotocin–nicotinamide diabetic rats. *British Journal of Nutrition*, 105(08), pp.1210–1217.

Mahan LK, Escott-Stump S., and Krause's (2004): Food, Nutrition, & Diet Therapy, 11th edition. Philadelphia, PA: Saunders.

Mattila, p . Astola , J. and Kumpulainen , J. (2000) : Determination of flavonoids in plant material by Hplc with diode-array and electro-array detection . J . Agric , food chem ., 48:(58) 34-58 41

Mohammadi, A. and Oshaghi, E.A., (2014): Effect of garlic on lipid profile and expression of LXR alpha in intestine and liver of hypercholesterolemic mice. Journal of diabetes and metabolic disorders, 13(1), p.20.

Newman , D. J, Cragg G. M, and Sander, K. M.,(2003) : Natural products as sources of new drugs over the period 1981-2002. J Nat Prod;66::1022–37

Newman , D. J, and Cragg, G. M., (2007): Natural products as sources of new drugs over the last 25 years. J Nat Prod.70:461–77.

Osman, S. A., (2001): Biochemical studies on chickpea (Cicerarietinum L) utilized in african food products. Ph.D. Thesis, Fac of Agric. Cairo Univ.

Reitman, S. and Frankel, S. (1957): Determination of glutamate pyruvate tranamines and glutamate oxaloacetate transaminase. Amer. J. Clin.Path., 28:56

Reuter, S. (2011): Epigenetic changes induced by curcumin and other natural compounds. *Genes and Nutrition*, 6(2), pp.93–108.

Sathivel, A., Raghavendran, H.R., Srinivasan, P., and Devaki, T.,(2008): Anti-peroxidative and anti-hyperlipidemic nature of Ulvalactuca crude polysaccharide on D-galactosamine induced hepatitis in rats. Food Chem. Toxicol. 46 (10), 3262–3267.

Sengupta, M., Sharma, G.D. and Chakraborty, B., (2011): Hepatoprotective and immunomodulatory properties of aqueous extract of Curcuma longa in carbon tetra chloride intoxicated Swiss albino mice. Asian Pacific Journal of Tropical Biomedicine, 1(3), pp.193–199.

SudhaharV, Kumar SA, and Varalakshmi P (2007):Role of lupeol and lupeollinoleate on lipemic-oxidative stress in experimental hypercholesterolemia. Life Sci 78:1329–1335

Suleria HAR, Butt , MS, Anjum FM, Ashraf , M, and Qayyum MMN, (2013): Aqueous garlic extract attenuates hypercholesterolemic and hyperglycemic perspectives; rabbit experimental modeling. J Med. Plants Res 7: 1709-1717.

Tabacco , A.;Meiattini , F. and Moda, E., (1979): Simplified enzymic/colorimetric serum urea nitrogen determination .ClinChem .;25:336-337

Tapsell, L.C., Hemphill, I., Cobiac, L., Patch, C.S., Sullivan, D.R., Fenech, M., Roodenrys, S., Keogh, J.B., Clifton, P.M., Williams, P.G., Fazio, V.A., and Inge, K.E. (2006): Health Benefits of Herbs and Spices: The Past, the Present, the Future. Medical Journal of Australia. 185(4 Suppl):S4-S24.

Uda, N. (2006):Significance of Garlic and Its Constituents in Cancer and Cardiovascular Disease Aged Garlic Extract Inhibits Development of Putative Preneoplastic. *the Journal of Nutrition*, 136, pp.855–860.

Velioglu, YS , Mazza G , Gao L , and Oomah , B.D.D.(1998): Antioxidant activity and total phenolics in selected fruits , vegetables , and grain products . Journal of Agricultural and Food Chemistry. 46:41 13-41 17

Vinson JA, Hao Y, Su X, and Zubik L (1998): Phenol antioxidant quantity and quality in foods: Vegetables. J Agric Food Chem 46:3630–3634

Wright, L.E., Frye, J.B., Gorti, B., Timmermann, B.N., and Funk, J.L. (2013): Bioactivity of Turmeric-Derived Curcuminoids and Related Metabolites in Breast Cancer. Current Pharmaceutical Design. 19(34): 6218–6225.

Zhisen, J. (1999):The determination of flavonoid contents in mulberry and their scavenging effects on superoxide radicals. Food chemistry.65:555-559.

التأثيرالوقائي لمسحوق الكركم والثوم على ارتفاع مستوى الكوليسترول في الفئران .

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أجريت هذه الدراسة لتقييم الآثار الوقائية لبعض النباتات الطبيعية مثل الكركم ومسحوق الثوم على الفئران المصابة بارتفاع الكوليسترول في الدم . أربعة وعشرون من ذكور الفئران البيضاء تزن كل منها ١٣٠±١٠جم تم تقسيمها الى ٤ مجموعات تجريبية والمجموعة رقم (١) مجموعة الكونترول السالبة التي تغذت على نظام الغذائي القياسية ,المجموعة رقم (٢) المجموعة الكونترول الموجبة التي تغذت الفئران على نظام غذائي عالي الكوليسترول,المجموعة رقم (٣) تغذت الفئران المصابة بارتفاع الكوليسترول في الدم على الوجبة الاساسية والتي يحتوى على ١٠% مسحوق الثوم ,المجموعة رقم (٤) تغذت الفئران المصابة بارتفاع الكوليسترول في الدم على الوجبة الأساسية والتي يحتوى على ١٠% مسحوق الكركم . في نهاية التجربة ، تمت مقارنة المجموعات الأربعة من ناحية نسبة الدهون في الدم ، ثم قياس المؤشرات الحيوية في الدم من حيث إصابة أنسجة الكبد وأنشطة الإنزيمات المضادة للأكسدة في أنسجة الكبد.وأظهرت النتائج الى أن النظام الغذائي مرتفع الكوليسترول تسبب في التأثيرات الأيضية الضارة، بما في ذلك زيادة دهون الدم، زيادة كوليسترول الدم وضعف الكبد. كما في المجموعة رقم (٢)حيث أن الفئرانالتي تغذت على نظام غذائي عالي الكوليسترول فقط أظهرت زيادة أنشطة انزيمات الكبد في البلازما، وانخفاض كبير في المواد المضادة للأكسدة، وارتفاع مؤشرات بيروكسيد الدهون في الكبد. اما العلاج بالكركم أدى الى انخفاضا كبيرا فى علامات الإصابة من أنسجة الكبد و المنتج بيروكسيد الدهون ، وإعادة المواد المضادة للأكسدة في الكبد والدهون المتراكم في أكثر من بلازما الدم نحو المعدل الطبيعي. أظهرت النتائج التي تم التوصل اليها ان مسحوق الكركم كانت له آثار وقائية ضد تشحم الكبد.واظهرت النتائجأيضا الى أن مسحوق الثوم أدى إلى انخفاض كبير في الكوليسترول الكلى الدم (TC)، الدهون الثلاثية البلازما TG، LDL-c، VLDL-c، الدهون الثلاثية في الكبد وارتفاع مضادات الأكسدة في البلازما للفئران المعالجة بالثوم المجموعة رقم (٣) مقارنة بالمجموعة رقم (٢) . ولذلك ، فإن النتائج تظهر بوضوح الآثار المفيدة للثوم و الكركم في خفض آثار الجانبية من الدهون.