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Study the Effect of Consumption of Coriander and Vitamin B6 on Rats Suffering from Hyperlipdemia

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Abstract: The present work was conducted to study the effect of coriander and vitamin B6 and their combination on the nutritional value, lipid parameters, liver function and antioxidant enzymes of rats suffering from hyperlipidemia. Sixty (60) rats consumed hyperlipidemic diet for 21 days then divided into 6 groups (n=10 rats of each) as followed: The first group consumed basal diet as a control positive group. The second, fourth and fifth groups consumed the basal diet containing coriander powder, vitamin B and coriander powder plus vitamin B, respectively. The third and sixth groups consumed the basal diet with coriander extract and coriander extract plus vitamin B. The results revealed that, all treated groups reduced serum cholesterol (CHO), triglycerides (TG), low density lipoprotein cholesterol (LDLc), very low density lipoprotein (VLDLc), liver function enzymes activity and liver cholesterol and also atherogenic indices, while increased in serum high density lipoprotein cholesterol (HDLc). Furthermore, all treated groups showed a significant increase in superoxide dismutase (SOD), catalase (CAT) and glutathione transferase (GST) enzymes activity however malondialdehyde (MDA) was decreased compared to control +ve group. Coriander powder plus vitamin B6 and coriander extract plus vitamin B6 rat groups showed improvement of nutritional results and increasing levels of antioxidant enzymes and also that gave the desirable hypolipidemic effect. The most improvement of liver enzymes activities was appeared in coriander extract plus vitamin B6 rat group.

Key words: Antioxidant · Coriander · Hyperlipidemia · Liver enzymes · Rats · Vitamin B

INTRODUCTION

Hyperlipidemia is characterized by abnormally high levels of any or all lipids and/or lipoproteins in the blood. The high levels of total cholesterol, triglyceride and low density lipoprotein cholesterol is mainly responsible for the onset of coronary heart disease and atherosclerosis and coronary heart disease. Atherosclerosis is one of the most common causes of mortality and morbidity worldwide [1, 2]. Vitamin B6 is water soluble, which means the body cannot store it. It is therefore important to ingest vitamin B6 through food sources (whole grains, meat, beans, nuts, fortified breads and cereals) or a balanced multivitamin or B-complex formula when dietary restrictions are involved. Vitamin B6 occurs in three closely related compounds with similar physiological actions, pyridoxine, pyridoxal and pyridoxamine. Pyridoxine is a water-soluble nutrient that is part of the B vitamin family and found in large quantities in plant sources and the other two in animal tissues [3, 4]. B vitamins help support adrenal function, help calm and maintain a healthy nervous system and are necessary for key metabolic processes. Vitamin B6 acts as a coenzyme in the breakdown and utilization of carbohydrates, fats and proteins. Vitamin B6 is involved in the regulation of mental function and mood. Supplementation with B vitamins including vitamin B6 has been shown to reduce blood homocysteine levels [5].

Coriander (*Coriandrum sativum* L) belonging to family Umbelliferae. Its plant seeds, leaves and roots are edible and have a light and fresh flavour. Fresh leaves can be used for garnishing and are common ingredient in many foods like salads. Both the leaves and seeds of the plant are used for medicinal purpose. Coriander has immense value for the treatment of abdominal problems, especially stomach ulcers beside hypotensive and

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hypoglycaemic properties of coriander. Moreover, this plant is used to cure diseases like digestive tract disorders, respiratory tract disorders, urinary tract infections [6, 7]. People today consume saturated fat and cholesterol excessively due to a change in lifestyle and the increased demands on their time that are often less healthy. Excessive saturated fat and cholesterol intake leads to obesity, hyperlipidemia and cardiovascular diseases [1]. Hence, this study was planned to evaluate the hypolipidemic activity of coriander and vitamin B6 in experimental rats.

MATERIALS AND METHODS

Plant Materials and Chemicals: Coriander plants were purchased from the local market in Riyadh. Kits for biochemical analysis were purchased from the Gamma Trade Company for Pharmaceutical and Chemicals. Vitamin B6 was purchased from El-Gomhoriea Company. Sixty Sprague Dawley strain rats weighing 120±5g provided from experimental animals centre in Medicine Collage of King Saud University in Riyadh.

Preparation of the Experimental Diets: The basal diet was formulated according to Reeves *et al.* [8]. The basal diet consisted of 140 g casein (83 % protein), 100 g sucrose, 50 g corn oil, 50 g cellulose, 35 g mineral mixture, 10 g vitamin mixture, 1.8 g L-cystine, 2.5 g choline bitartrate and the remainder (610.6 g) corn starch. The hyperlipidemic diet consisted of 10 g cholesterol, 2.5 g bile salt and 150 g beef tallow were added to the same amounts ingredients in basal diet but corn starch was 448.1 g according to Zulet *et al*. [9].

Preparation of the Coriander Powder and Extract: Coriander leaves were dried with hot air (40–60°C) and grinded to powder which used in preparation of methanolic extract and also added as 5 % of the basal diet. 500 g of coriander powder was extracted with ethanol (99%) and distilled water in 1: 1 proportion at room temperature by cold maceration method. The filtrate was collected and concentrated on a heating mantle at 45°C. The extract was successively dried by using a rotary evaporator for preparation of methanolic coriander extract. After a period of adaptation on basal diet (one week), rats were fed on hyperlipidemic diet for 21 days. Then, hyperlipidemic rats were divided into six groups (ten rats each) as following:

- Control +ve group: rats fed on basal diet only.
- Coriander powder group: rats fed on basal diet with 5% coriander powder.
- Coriander extract group: rats fed on basal diet and coriander extract (300 mg/kg bodyweight by stomach tube).
- Vitamin B6 group: rats fed on basal diet with 3 mg vitamin B6 per kg basal diet.
- Coriander powder plus vitamin B6 group: rats fed on basal diet with 5% coriander powder and 3 mg vitamin B6 per kg basal diet.
- Coriander extract plus vitamin B6 group: rats fed on basal diet with 3mg vitamin B6 per kg basal diet and coriander extract (300 mg/kg bodyweight by stomach tube).

Biological Determination: Food intake (FI) was calculated every day. The biological value of the different diets was assessed by the determination of its effect on body weight gain (BWG) and feed efficiency ratio (FER) at the end of the experimental period according to Chapman *et al*. [10].

Biochemical Analysis: At the end of the experimental period (60days), rats were starved for 12 hr and then sacrificed under ether anesthesia. Blood samples were collected and centrifuged at 3500 g for 15min to obtain serum. The levels of serum cholesterol (CHO), triglycerides (TG) and high density lipoprotein cholesterol (HDLc) were estimated according to Cohn *et al*. [11], Foster and Dumns [12] and Young [13], respectively. Low density lipoprotein cholesterol (LDLc) and very low density lipoprotein cholesterol (VLDLc) were calculated by the method described by Fruchart [14] and Friedwald *et al*. [15], respectively. Atherogenic indexes (CHO/HDL-c & LDL-c/HDL-c) were calculated according to Castelli and Levitar [16]. Liver functions were evaluated by determination of serum activities of aspartate and alanine amino transferase (AST&ALT), ã-glutamyltransferase and lactate dehydrogenase (LD) were measured according to the method described by Reitman and Frankel [17], Henry [18] and Rec [19], respectively. The level of serum superoxide dismutase (SOD), catalase (CAT) and glutathione transferase (GST) enzymes activity and malondialdehyde (MDA) were determined according to Dechatelet *et al.* [20], Sinha [21], Moran *et al.* [22] and Draper and Hadley [23], respectively. Livers of rats were rapidly removed and perfuse with 50 to 100 of ice cold 0.9% NaCl solution for estimation of cholesterol and total lipids according to Abell *et al*. [24] and Folch *et al*. [25], respectively.

Statistical Analysis: Collected data were subjected to analysis according to SPSS program according to Gomez and Gomez [26].

RESULTS

The growth performance and nutritional results shown in Table 1 indicated that coriander powder group showed significant decrease in BWG,BWG% and FI while coriander extract group showed significant decrease in BWG and BWG% compared to control +ve group. Vitamin B6 group showed significant decrease in FI and FER while Coriander powder plus vitamin B6 showed significant decrease in BWG and BWG% but coriander extract plus vitamin B6 group showed significant decrease in BWG% compared to control +ve group. Variations in the overall serum lipid parameters were monitored in the control and treated groups. Data presented in Table 2 showed that there were significant decreases in serum cholesterol, TG, LDLc and VLDLc and significant increases in serum HDLc in all treated rats groups compared to control +ve group. Those biomarkers were significantly decreased in groups treated with coriander powder plus vitamin B6 and coriander extract plus vitamin B6 groups and that gave the desirable hypolipidemic effect. There was significant decrease in the levels of atherogenic indexes (CHO/HDLc & LDLc/HDLc) of the treated groups compared to control +ve group as shown in Table 3.

The liver enzymes activities are shown in Table 4 indicated that there was significant decrease in serum ALT, AST, ãGT and LD enzymes in all treated rat groups that administered coriander and vitamin B6 compared to control +ve group. The most reduction was appeared in coriander extract plus vitamin B6 rat group. The liver cholesterol and total lipids as shown in Table 5 indicated that there was significant decrease in cholesterol in all rat groups that treated with coriander and vitamin B6 compared to control +ve group. Furthermore, liver total lipids were reduced in rat groups treated with coriander extract, vitamin B6, coriander powder plus vitamin B6 and coriander extract plus vitamin B6 compared to control +ve group. Coriander extract plus vitamin B6 rat group showed the most lower in liver cholesterol and total lipids. In the present study, the treated groups with Coriander and vitamin B6 showed a significant increase in SOD, CAT and GST compared to control +ve group. However, MDA was decreased in all treated groups. Coriander powder plus vitamin B6 and Coriander extract plus vitamin B6 rat groups showed the higher elevated levels of antioxidant enzymes as shown in Table 6.

Table 1: Mean values ± SD of BWG, BWG %, FI and FER of experimental rat groups.

	Groups					
Variables	Control +ve	Coriander powder	Coriander extract	Vitamin B6	Coriander powder plus vitamin B6	Coriander extract plus vitamin B6
BWG(g)	103.95 ± 9.96^{a}	$87.14\pm8.14^{b*}$	$85.19\pm6.71^{b*}$	95.31 ± 9.70^{ab}	$88.31\pm8.84^{b*}$	91.21 ± 8.14^{ab}
BWG%	86.54 ± 8.87^{a}	$71.07\pm7.64^{b**}$	$68.84\pm6.60^{c***}$	76.73 ± 7.80^{ab}	$70.59\pm7.57^{bc**}$	$73.49\pm7.61^{b**}$
FI(g/d)	22.17 ± 2.41^{a}	$17.87\pm1.36^{b*}$	18.25 ± 1.68^{ab}	$17.66\pm1.59^{b*}$	18.61 ± 1.49^{ab}	19.16 ± 1.70^{ab}
FER	0.078 ± 0.005^{b}	0.081 ± 0.002^{ab}	0.077 ± 0.004^{bc}	$0.089\pm0.001^{a**}$	0.079 ± 0.003^{b}	0.079 ± 0.002^{b}

Significant with control group * P<0.05 ** P<0.01 *** P<0.001.

Mean values in each raw having different superscript (a, b &c) are significant.

Table 2: Mean values ± SD of some serum lipid patterns of experimental rat groups.

	Groups					
Variables	Control+ve	Coriander powder	Coriander extract	Vitamin B6	Coriander powder plus vitamin B6	Coriander extract plus vitamin B6
CHO (mg/dl)	250.14 ± 28.61^{a}	$159.60\pm15.64^{c***}$	$169.61\pm19.21^{b***}$	$174.21\pm15.96^{b**}$	$147.14\pm15.66^{d***}$	$165.66\pm16.71^{b**}$
TG (mg/dl)	184.31 ± 19.25^{a}	$112.13\pm8.75^{c***}$	$116.73\pm9.61^{c***}$	$130.65\pm12.11^{b**}$	$107.44\pm9.65^{cd***}$	$105.67\pm8.46^{cd***}$
LDLc (mg/dl)	191.03 ± 21.14^{a}	$105.07\pm9.08^{c***}$	$115.06\pm10.17^{b***}$	$118.12\pm12.15^{b***}$	$90.46\pm9.18^{cd***}$	$110.12\pm10.16^{bc***}$
HDLc (mg/dl)	22.25 ± 2.61^{c}	$32.11\pm3.21^{a***}$	$31.21\pm3.50^{ab***}$	$29.96\pm2.99^{ab**}$	$35.20\pm3.17^{a***}$	$34.41\pm3.61^{a***}$
VLDLc (mg/dl)	36.86 ± 3.51^{a}	$22.42\pm3.01^{c***}$	$23.34\pm2.80^{bc**}$	$26.13\pm3.17^{b**}$	$21.48\pm2.61^{c***}$	$21.13\pm2.22^{c***}$

Significant with control group * P<0.05 ** P<0.01 *** P<0.001.

Mean values in each raw having different superscript (a, b &c,) are significant.

Table 3: Mean values ± SD of atherogenic indexes of experimental rat groups.

	Groups					
Variables	Control+ve	Coriander powder	Coriander extract	Vitamin B6	Coriander powder plus vitamin B6	Coriander extract plus vitamin B6
CHO/HDLc	11.24±1.66^{a}	4.97±1.30^{b***}	5.43±1.24^{b**}	5.81±1.11^{b**}	4.18±1.31^{b***}	4.81±1.21^{b***}
LDLc/ HDLc	8.58±1.31^{a}	3.27±0.36^{bc**}	3.68±0.48^{b***}	3.94±0.55^{b***}	2.56±0.26^{b***}	3.20±0.55^{b***}

Significant with control group * P<0.05 ** P<0.01 *** P<0.001.

Mean values in each raw having different superscript (a, b &c,) are significant.

Table 4: Mean values ± SD of serum ALT, AST, ãGT and LDH enzymes of experimental rat groups.

	Groups					
Variables	Control+ve	Coriander powder	Coriander extract	VitaminB6	Coriander powder plus vitamin B6	Coriander extract plus vitamin B6
ALT (µ/ml)	60.96±7.14^{a}	50.61±5.15^{b**}	45.21±5.19^{bc**}	48.33±6.10^{b**}	45.49±5.11^{bc**}	38.99±3.33^{d***}
AST(µ/ml)	70.36±7.11^{a}	45.99±5.68^{b**}	55.60±5.48^{b**}	52.14±5.61^{b***}	49.11±5.30^{bc***}	45.61±4.41^{c***}
ãGT (µ/ml)	9.65±1.41^{a}	7.17±1.21^{b*}	6.55±1.01^{b**}	7.33±1.10^{b*}	7.11±1.02^{b*}	6.44±1.03^{b**}
LD (µ/l)	275.40±21.30^{a}	150.51±12.14^{cd***}	175.67±15.71^{bc**}	180.50±18.24^{b**}	140.31±13.61^{d***}	120.14±11.77^{d***}

Significant with control group * P<0.05 ** P<0.01 *** P<0.001.

Mean values in each raw having different superscript (a, b & c) are significant.

Table 5: Mean values ± SD of liver cholesterol and total lipids of experimental rat groups.

	Groups					
Variables	Control+ve	Coriander powder	Coriander extract	Vitamin B6	Coriander powder plus vitamin B6	Coriander extract plus vitamin B6
CHO (mg/g)	6.95±1.41^{a}	4.05±0.31^{b**}	3.88±0.36^{cd***}	4.55±0.45^{b**}	3.91±0.33^{bc***}	3.66±0.22^{cd***}
Total lipids (mg/g)	52.51±4.39^{a}	46.68±5.96^{ab}	44.43±6.22^{c**}	45.11±6.14^{bc**}	41.21±5.66^{cd**}	39.66±5.18^{d***}

Significant with control group * P<0.05 ** P<0.01 *** P<0.001.

Mean values in each raw having different superscript (a, b &c) are significant.

Table 6: Mean values ± SD of serum SOD, CAT and GST antioxidant enzymes and MDA of experimental rat groups.

	Groups					
Variables	Control+ve	Coriander powder	Coriander extract	Vitamin B6	Coriander powder plus vitamin B6	Coriander extract plus vitamin B6
SOD (µ/mg)	0.45±0.01^{d}	0.84±0.04^{c***}	0.99±0.05^{ab***}	0.88±0.03^{c***}	1.15±0.21^{a***}	1.35±0.60^{a***}
CAT (µ/mg)	0.52±0.02^{d}	0.90±0.07^{bc**}	0.92±0.08^{ab**}	0.85±0.07^{bc**}	0.97±0.06^{a***}	0.99±0.05^{a***}
GST (µ/mg)	0.83±0.03^{d}	1.06±0.14^{bc***}	1.20±0.11^{ab***}	1.11±0.22^{ab***}	1.08±0.33^{bc***}	1.59±0.44^{a***}
MDA(nmol/g)	9.21±1.67^{a}	6.66±1.31^{b***}	6.51±1.20^{b***}	6.40±1.49^{b***}	6.26±1.14^{b***}	6.14±1.15^{b***}

Significant with control group * P<0.05 ** P<0.01 *** P<0.001

Mean values in each raw having different superscript (a, b &c) are significant

DISCUSSION

Several animal and human studies have confirmed the nutritional benefits of coriander and vitamin B6. Coriander leaves are a rich source of vitamins and minerals. Leaves contain high amount of vitamin A (â-carotene) and vitamin C. It is very low in saturated fat and cholesterol and a very good source of thiamine, zinc and dietary fiber. The main essential fatty acids present in coriander include linoleic and linolenic acids. Linoleic acids belong to polyunsaturated fatty acid group that are very important for growth and for proper functioning of brain [27]. Vitamin B6 (pyridoxine) helps the body break down protein and helps maintain the health of red blood cells, the nervous system and parts of the immune system [28]. Lipids are a group of naturally occurring fatty substances that are present in the blood and tissues of the body. They include cholesterol, cholesterol esters, triglycerides and phospholipids.

Hyperlipidemia is manifested as hypercholesterolemia and hypertriglycerolemia. LDL is strongly associated with a higher risk and HDL is associated with a lower risk, of

coronary heart disease. Hyperlipidemia often results from delayed or defective clearance, or overproduction of VLDL by the liver, which is subsequently transformed into LDL. Also, it increases the risk for generation of lipid oxidation products, which accumulate in the subendothelial spaces of vasculature and bone [29]. From obtained result it was observed that coriander and vitamins B6 have hypolipidemic effects and lower risk of chronic heart disease. Coriander can be used as preventive and curative herbal against hyperlipidemia. Coriander plants could decrease the uptake and enhances the breakdown of lipids [7, 30]. Therapeutic doses of vitamins B12, B6 and folic acid may be effective in decreased plasmatic homocysteine levels and lipids, mainly triglycerides, with a reduction of coronary risk [31]. Vitamin B6 is required as an essential cofactor in homocysteine metabolism through a trans-sulphuration pathway. Particularly the active form of vitamin B6 plays a key role as a coenzyme of cystathionine synthase and cystathioninelyase. Both enzymes are required for the metabolism of homocysteine to cysteine. Deficiency of vitamin B6 is associated with increase in blood homocysteine levels [32, 33].

Liver cell destruction shows itself as impairment in the permeability of AST and ALT, which are marker enzymes in the liver. Measurement of enzymatic activities of aminotransferase (AST and ALT) and ALP is of clinical and toxicological importance, as changes in their activities are indicative of tissue damage by toxicants or in disease condition. There is an increasing interest in the use of herbal drugs for therapeutic purposes. There was a significant increase in serum liver biochemical parameters (AST and ALT ALP) compared with normal human control group. Vitamin B6 is the coenzyme of transaminases. It has been shown in various studies that there is a decrease in the activities of AST and ALT in case of vitamin B6 deficiency and an increase in the AST values in tissue damage and heart diseases occur [34, 35]. The average diet contains a great number of antioxidant activities, such as polyphenols that are plant metabolites occurring widely in plant food and possess outstanding antioxidant and free radical scavenging properties. Phenolic substances such as flavonoids, cumarins, cinnamic acid and caffeic acids are believed to have antioxidant properties, which may play an important role in protecting cells and any organ from oxidative degeneration [36, 37]. Coriander is a good source of polyphenols and phytochemicals due to its high antioxidant activity. Its antioxidant content is attributed to its high content of pigments particularly carotenoids. The carotenoids of its extract were found to show higher hydroxyl radicals scavenging potential thereby protecting cells from oxidative damage [38]. It was concluded that administrating hyperlipidemic rats with the combination of coriander powder plus vitamin B6 and coriander extract plus vitamin B6 realized the best effect on lipid profile, liver functions and antioxidant enzymes.

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