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Effects of Dietary Supplementation of Turmeric (*Curcuma longa*) and Black Cumin Seed (*Nigella sativa*) in Streptozotocin Induced Diabetic Rats

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Authors' contributions

Author SME carried out experimental design, induction of diabetes, statistical analysis and participated in blood sampling, biochemical analysis and drafted the manuscript. Author AAA participated in blood sampling, biochemical analysis, statistical analysis and drafted the manuscript. Both authors read and approved the final manuscript.

Original Research Article

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ABSTRACT

Aim: The objective of the present study was to investigate the antidiabetic effects of Turmeric *(Curcuma longa)* and Black cumin seed *(Nigella sativa)* either alone or in combination on blood glucose concentration, body weight, water and food intake and selected biochemical parameters of streptozotocin (STZ) induced diabetic rats.
Study Design: Thirty five healthy adult albino rats kept on ordinary ration, received water *ad libitum* and divided into five groups (7 rats in each). Rats of first and second groups were non diabetic and diabetic respectively. Rats of 3-5 groups were diabetic and received Turmeric (1g/kg b.wt.), Black cumin seed (2g/kg b.wt.), half dose of black cumin seed and Turmeric as a mixture, respectively. All treatments were orally administered by intra-gastric intubations once a day for six weeks.
Results: The present study revealed that, STZ experimental diabetes induced significant

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elevation of glucose level, water and food intake, TAG and total cholesterol level with significant reduction of body weight gain of the affected rats. However, dietary supplementation of either Turmeric or Black cumin seed significantly *(P≤0.05)* corrected the values of these parameters near to control levels. In addition, liver and kidney function were disturbed in STZ-diabetic rats and restored whenever treated with the examined medicinal plants.

Conclusion: The present study can concluded that, dietary supplementation of either Turmeric or Black seed to diabetic rats were effective in reducing blood glucose, water and food intake, TAG and cholesterol accompanied by an increase in body weight gain. Regarding to Body weight gain, food intake, water intake, blood glucose level and TAG level, Turmeric was more effective than black cumin seed and mixture of both plants.

Keywords: Diabetes mellitus; biochemical parameters; black cumin seed; turmeric.

1. INTRODUCTION

Diabetes is one of the most common chronic diseases affecting more than 100 million people worldwide. The two major types of diabetes mellitus are characterized by hyperglycemia, abnormal lipid and protein metabolism along with specific long term complications affecting the retina, kidney and nervous system [1]. Hyperglycemia is an important factor in the development and progression of the complications of diabetes mellitus [2]. There are many anti-diabetic plants, which might provide useful sources for the development of drugs, in the treatment of diabetes mellitus. The literature on medicinal plants with hypoglycemic activity is vast. As many of these plants were used for many centuries and sometimes as regular constituents of the diet, it is assumed that they do not have many side effects. However chronic consumption of large amounts of traditional remedies must always be taken with caution as toxicity studies have not been conducted for most of these plants [3].

Turmeric *(Curcuma longa)* is a perennial herb that grows to a height of three to five feet and is cultivated extensively in Asia (India and China) and other countries with a tropical climate. *Curcumin*, the active ingredient from the spice turmeric is a potent antioxidant and anti-inflammatory agent with hepatoprotective, anticarcinogenic and antimicrobial properties [4,5]. *Curcumin* also has a beneficial effect on blood glucose in diabetics and increases gastric mucosal secretion in rabbits [6]. The Turmeric rhizomes have been reported to possess antidiabetic properties as its alcohol extract possesses active constituents showing blood glucose lowering activity in alloxan induced diabetic rats [3]. Black cumin seed *(Nigella sativa)* is herbaceous plant which is a member of the *Ranunculocea* family. Black cumin seed has been found to rank high among the antidiabetic medicinal plants [7,8]. Many studies have also examined the antidiabetic effect of Black cumin seed *(Nigella sativa)* in normal and in diabetic animal models [9,10]. Aside from the effect of its crude aqueous extract to restore glucose homeostasis [9] *Nigella sativa* petroleum ether extract significantly lowered fasting plasma levels of insulin and triglycerides and normalized HDL-cholesterol [10].

The effect of Black cumin seed and Turmeric mixture, hereafter, abbreviated as BTM on the blood glucose level are not available and to the authors knowledge this is the first report in rats. Therefore, the present research work was conducted to study the comparative efficacy of both plants alone or as a mixture (BTM) on blood glucose level, water and food intake, body weight and some biochemical parameters in STZ induced diabetic rats.

2. MATERIALS AND METHODS

2.1 Plant Materials

Turmeric *(Curcuma longa)* and Black cumin seed *(Nigella sativa)* were purchased from a local market in Al-Ahsa, Saudi Arabia and identified by botanists in the faculty of Agriculture, King Faisal University, Saudi Arabia. Both plants were analyzed and their ingredients are presented in Table 1.

Table 1. Proximate analysis of ingredients used in the diets of the experiment, dry matter basis

Ingredients	Moisture %	CP%	EE%	CF%	NFE*%	Ash%
Black cumin seed	5.8	19.54	34.4	6.1	36.16	3.8
Turmeric	13.5	11.74	6.4	7.2	70.07	4.59

*CP (crude protein), EE (ether extract), CF (crude fiber)*NFE (Nitrogen free extract) is calculated by differences*

2.2 Preparation of Plant Suspension

The whole Black cumin seeds were crushed in a blender and 12.5g of the seeds was added to 100ml distilled water at room temperature to prepare a crude suspension a few minutes before experiment [11]. The Black cumin seed was used in a dose of 2g/kg body weight daily [9,10,12]. Turmeric powder was mixed with distilled water [13] to obtain a dose of 1g/kg body weight [6].

2.3 Experimental Animals

Thirty-five adult albino rats weighing between 185–200g were obtained from the laboratory animal house, College of Veterinary Medicine and Animal Resources, King Faisal University, Saudi Arabia. They were maintained as performed by national guidelines and protocols that approved by the University Scientific Research Ethics Committee. They were housed in clean and disinfected cages. Commercial basal diet and water were provided ad libitum. Rats were subjected to natural photoperiod of 12hr light: dark cycle throughout the experimental period (6 weeks). All rats received basal diet for two weeks before the start of the experiment for adaptation and to ensure normal growth and behavior. They were maintained in their respective groups for 6 weeks, monitored closely every day and weighed every week. The rat food was weighed every day before and after feeding the animals to determine the daily food intake.

2.4 Induction of Experimental Diabetes

Diabetes was induced by administering intraperitonial injection of a freshly prepared solution of STZ (60mg/kg b. w.) in 0.1 M cold citrate buffer (pH 4.5) to the overnight fasted rats [14]. Because of the instability of STZ in aqueous media, the solution was made using cold citrate buffer (pH 4.5) immediately before administration. Control rats were injected with citrate buffer alone. The rats were allowed to drink 5% glucose solution overnight to overcome the drug-induced hypoglycemia. After 72 hours, fasting blood glucose levels were monitored. Animals having blood glucose levels 145mg/dl were excluded from the experiment and animals having blood glucose values above 250mg/dl on the third day after STZ injection

were considered as diabetic rats [15]. Then the treatment was started on the third day after STZ injection and it was considered as first day of treatment.

2.5 Experimental Design and Sampling Analysis

The rats were divided into five groups (7 rats each).

Group 1: non diabetic control rats (negative control).
Group 2: Diabetic control rats (Positive control).
Group 3: Diabetic rats treated with turmeric (1g/kg b.wt. per day) in aqueous solution orally for six weeks [6].
Group 4: Diabetic rats treated with black cumin seed (2g/kg b.wt. per day) in aqueous solution orally for six weeks [12].
Group 5: Diabetic rats treated with black cumin seed (1g/kg b.wt. per day) mixed with turmeric (0.5g/kg b.wt. per day) in aqueous solution orally for six weeks.

Daily measurements of body weight, and water and food intake were recorded. For blood glucose level estimation, blood samples were collected from the fasted rats of five groups prior to the treatment with plants and three times per weeks after oral administration of the treatments up to 6 weeks. Blood samples were collected by snipping tail with sharp razor and blood glucose level was then measured immediately by glucose strips (haemo-glucotest). In addition, blood samples were collected without anticoagulant for serum separation. Serum was separated by centrifugation for 10min at 1200g and was immediately frozen at–20ºC until the time of analysis. The sera were used for spectrophotometric determination of the activities of Aspartate Transaminase (AST) and Alanine Transaminase (ALT) [16]. In addition, total protein [17], albumin [18], globulin, uric acid [19], creatinine [20], triacylglycerol (TAG) [21] and total cholesterol [22] were also determined. Very low density lipoprotein cholesterol (VLDL-c) was calculated by division of TAG by 5 [23]. Calcium, phosphorus and magnesium were determined by using commercial kits on chemistry analyzer according to the manufacturer instructions.

2.6 Statistical Analysis

All the grouped data were statistically evaluated and the significance of changes caused by various treatments was determined using one way analysis of Variance ANOVA [24]. The results have been expressed as means±SD from seven rats in each group. The level of statistical significance was set at $P \leq 0.05$.

3. RESULTS

The present findings (Table 2) showed that the control rats (group I) gained weight over the six weeks of the experimental period, with the mean body weight increasing by 60 grams. Moreover, the untreated diabetic rats (group II) lost an average of 30 grams of their weight after six weeks ($P \leq 0.05$). When these diabetic rats treated with Turmeric alone, they did not lost their weight but gained 25 grams of body weight which represented 41.7% of weight gained by normal non diabetic control rats. Also, diabetic rats treated with BTM did not lost their weight but gained 20 grams of body weight which represented 33.3% of weight gained by normal non diabetic control rats. Loss of body weight observed in non-treated diabetic rats was improved by 50% when they treated with Black cumin seed only.

Table 2. Effect of oral administration of Turmeric and/or Black cumin seed for six weeks on body weight gain (g) in streptozotocin diabetic rats

Groups	Body weight (g)		Gain in body weight (g)
	Initial	Sixth weeks	
I	195±5.1	255±6.2[a]	60
II	194±7.2	164±7.1[d]	-30
III	196 ±4.2	221±3.1[b]	25
IV	190±5.2	175±8.1[d]	-15
V	194±6.1	214±5.2[c]	20

I (non diabetic), II (diabetic), III (diabetic treated with turmeric), IV (diabetic treated with Black cumin seed), V (diabetic treated with plant mixture; BTM)Values are mean±SD of 7 rats, Means within the same column with different letters are significantly differed (P≤0.05)Note: a, is the highest value, decreased via b, c to the lowest one is d

Data summarized in Table 3 revealed that, water intake in untreated diabetic groups (Group II) were significantly (*P*≤0.05) increased by 100% than non-diabetic normal rats (group I). When these diabetic rats treated with Turmeric alone, this increase in water intake was decreased significantly (*P*≤0.05) till reached the control value. However, 30% of the increase in water intake in diabetic rats was decreased (*P*≤0.05) whenever treated with Black cumin seed only or BTM throughout the entire intervals of the experiment.

Table 3. Effect of oral administration of turmeric and/or black cumin seed for six weeks on water intake (ml/day) in streptozotocin diabetic rats

Groups	Water intake (ml/day)			
	1st week	2nd week	4th week	6th week
I	50±3.3[c]	51±5.1[c]	55±4.1[c]	60±4.6[c]
II	100±5.2[a]	95±5.2[a]	90±5.1[a]	87±4.7[a]
III	40±4.1[d]	45±4.3[c]	45±5.3[c]	50±3.9[c]
IV	70±6.2[b]	75±3.2[b]	75±4.4[b]	75±3.4[b]
V	70±5.5[b]	75±2.1[b]	75±5.1[b]	75±2.9[b]

I (non diabetic), II (diabetic), III (diabetic treated with turmeric), IV (diabetic treated with Black cumin seed), V (diabetic treated with plant mixture)Values are mean±SD of 7 rats, Means within the same column with different letters are significantly differed (P≤0.05) Note: a, is the highest value, decreased via b, c to the lowest one is d

Data summarized in Table 4 revealed that feed intake in untreated diabetic groups (Group II) were significantly (*P*≤0.05) increased by 153% than non-diabetic normal rats (group I). When these diabetic rats treated with Turmeric alone this increase in feed intake was decreased significantly (*P*≤0.05) till reached the control value. However, 39.5% of the increase in feed intake in diabetic rats was reduced (*P*≤0.05) whenever treated with Black cumin seed only or BTM throughout the entire intervals of the experiment.

The results for the effects of Turmeric and/or Black cumin seed on blood glucose concentration of diabetic rats are shown in Table 5. At the start of the experiment or at zero time, there were no statistically significant (*P*>0.05) differences in the mean values of blood glucose level between all experimental groups. After injection of STZ, the mean values of blood glucose levels in untreated diabetic rats (group II) were remained above 350 mg/dl during the entire period of the study, which were significantly (*P*≤0.05) higher than those of the non-diabetic normal control rats by 253.3%. The percentage of increase in glucose level

of diabetic rats (253.3%) has been reduced by 45.6% (201mg/dl), 25.7% (260mg/dl) and 28.6% (250mg/dl) when rats have been treated with Turmeric, Black cumin seed and BTM, respectively.

Table 4. Effect of oral administration of turmeric and/or black cumin seed for six weeks on feed intake (g/day) in streptozotocin diabetic rats

Groups	Food intake (g/day)			
	1st week	2nd week	4th week	6th week
I	15±2.1^{c}	17±1.2^{c}	20±1.1^{c}	22±2.1^{c}
II	38±1.9^{a}	40±1.5^{a}	39±1.4^{a}	41±1.7^{a}
III	17±1.1^{c}	19±1.0^{c}	21±1.3^{c}	25±1.2^{c}
IV	23±1.2^{b}	24±2.1^{b}	28±2.1^{b}	32±1.1^{b}
V	22±1.7^{b}	26±1.1^{b}	25±2.1^{b}	30±1.4^{b}

I (non diabetic), II (diabetic), III (diabetic treated with turmeric), IV (diabetic treated with Black cumin seed), V (diabetic treated with plant mixture)Values are mean±SD of 7 rats, Means within the same column with different letters are significantly differed (P≤0.05)Note: a, is the highest value, decreased via b, c to the lowest one is d

Table 5. Effect of oral administration of turmeric and/or black cumin seed for six weeks on blood glucose concentration (mg/dl) in streptozotocin diabetic rats

Groups	Blood glucose concentration (mg/dl)			
	1st week	2nd week	4th week	6th week
I	99±2.1^{e}	100±1.2^{e}	98±1.1^{e}	96±2.1^{e}
II	350±1.9^{a}	355±1.5^{a}	360±1.4^{a}	355±1.7^{a}
III	201±1.1^{d}	190±1.0^{d}	188±1.3^{d}	200±1.2^{d}
IV	260±1.2^{b}	255±2.1^{b}	250±2.1^{b}	244±1.1^{b}
V	250±1.7^{c}	240±1.1^{c}	245±2.1^{c}	240±1.4^{c}

I (non diabetic), II (diabetic), III (diabetic treated with turmeric), IV (diabetic treated with Black cumin seed), V (diabetic treated with plant mixture)Values are mean±SD of 7 rats, Means within the same column with different letters are significantly differed (P≤0.05)Note: a, is the highest value, decreased via b, c and d to the lowest one is e

The results presented the effect of Turmeric and/or Black cumin seed on protein patterns, lipid profile, liver and kidney functions and electrolytes were presented in Table 6. These findings indicated that, STZ induced significant (P≤0.05) increase in total cholesterol values by 31.3% compare with normal non diabetic rats. Turmeric and Black cumin seed administration reduced this increase till reached lower than the normal control level. Moreover, BTM also restored the cholesterol to normal level. The present findings indicated also that, STZ induced significant (P≤0.05) increase in TAG values by 9% (142±3.4mg/dl) compare with normal non diabetic rats (130±4.1mg/dl). Turmeric, Black cumin seed and BTM administration reduced this increase till reached 50.8% (64±4.1mg/dl), 30.8% (90±4.1mg/dl) and 41.5% (76±4.1mg/dl) lower than the normal control level (130±4.1mg/dl). The other examined biochemical values remained unchanged throughout the experimental period.

Table 6. Effect of oral administration of turmeric and/or black cumin seed for six weeks on blood biochemistry in streptozotocin diabetic rats

Parameters	Group I	Group II	Group III	Group IV	Group V
Total Protein (g/l)	5.5±0.2	5.4±0.1	5.4±0.2	5.4±0. 2	5.6±0.1
Albumin (g/l)	3.2±0.2	3.3±0.1	3.1±0.1	3.2±0.1	3.4±0 .2
Globulin (g/l)	2.3±0.2	2.1±0.1	2.3±0.1	2.2±0.2	2.2± 0.1
A/G ratio	1.4±0.1	1.6±0.1	1.3±0.2	1.5±0.1	1. 5±0.1
Total cholesterol (mg/dl)	48±2.2[b]	63±3.5[a]	39±2.1[c]	37±1.2[c]	49±2.3[a]
TAG (mg/dl)	130±4.1[b]	142±3.4[a]	64±4.1[e]	90±4.4[c]	76±4.4[d]
ALT (U/l)	19±1.2	18±1.4	19±2.1	19±2.1	20±2.4
AST (U/l)	100±4.5	102±4.1	99±5.2	105±3.4	100±4.4
BUN(mg/dl)	4.1±1.6	3.8±2.1	3.3±2.2	4.2±1.9	5.1±2.0
Uric acid (mg/dl)	2.1±0.3	2.3±0.2	1.6±0.4	1.6±0.3	2 .0±0.1
Creatinine(mg/dl)	0.5±0.1	0.6±0.2	0.7±0.2	0.7±0.1	0 .6±0.1
Calcium	10.6±2	11.5±0.8	10.7±0.7	9.9±1.4	10.5±1
Phosphorus	2.1±0.2	4.5±1.9	2.0±0.1	2.3±0.6	2.6±0.8
Magnesium	1.5±0.9	0.8±0.2	1.0±0.1	0.8±0.3	1.0±0.3
Chloride	109.6±16	104.6±5.5	114±7.7	107.7±13	107.2±4.5

I (non diabetic), II (diabetic), III (diabetic treated with turmeric), IV (diabetic treated with Black cumin seed), V (diabetic treated with plant mixture) Values are mean±SD of 7 rats Means within the same row with different letters are significantly differed (P≤0.05) Note: a, is the highest value, decreased via b, c and d to the lowest one is e

4. DISCUSSION

Growth promoters are commonly added to the animals feed for growth enhancement and efficient feed utilization. They are chemical products, antibiotics, enzymes and/or natural extractives. Since the use of chemical products antibiotics might have some unfavorable side effects, therefore researchers tended to use natural additives which meet the requirements of good growth promoting agents [25]. Medicinal plants have received increasing attention as spices for human and additive in diets for animals. In the present study, we tried to examine the antidiabetic effect of Black cumin seed and Turmeric alone or as a mixture in experimentally induced diabetic rats, since the publication concerning this issue are limited. Injection of STZ in rats caused significant increase in blood glucose level. Using 60mg/kg STZ dose induced an autoimmune process that resulted in the destruction of the ß-cells of the islets of Langerhans and 60mg/kg STZ dose resulted in the toxicity of ß-cells with emergence of clinical diabetes within 2-4 days [26]. Previous articles [27,28] indicated that, STZ diabetic rats are hyperglycemic and have increased oxidative stress. This is also in consistent with the fact that blood glucose level might have increased due to gluconeogenesis in the absence of insulin [29]. In other hand, the present study revealed that Turmeric and/or Black cumin seed were effective in reducing blood glucose concentration. The hypoglycemic effect of Turmeric observed in the current study comes in accordance with those obtained in rats [6,30]. Authors reported that *curcumin*, the active principles of Turmeric had a beneficial effect on blood glucose in diabetics and increases gastric mucosal secretion in rabbits. The inclusion of *curcumin* at 0.6-0.9g/kg diet improved the adverse effect of aflatoxins in blood glucose values of broiler chicken [31]. The present results concerned the hypoglycemic effect of Turmeric agrees with that reported the antidiabetic effect of Turmeric rhizomes in alloxan induced diabetic rats [3]. The antidiabetic effect of Turmeric perhaps attributed to the antioxidant activity of *curcumin* against oxidative tissue damage [32]. In consistence with the previous studies [8,9,33], the present study

confirmed that, Black cumin seed had hypoglycemic effect. The antidiabetic effect of Black cumin seed perhaps explained by an insulin-like stimulation of glucose uptake by muscle and adipose tissue [34] or inhibition of intestinal glucose absorption [12]. Interestingly, the present study revealed for the first time that Turmeric was effective in lowering blood glucose concentration than Black cumin seed and the mixture of both plants (BTM). The first possibility to interpret such effect is that the active ingredients in Turmeric that affecting blood glucose level might be antagonized with Black cumin seed active ingredients in the mixture. The second possibility is that the efficiency of Turmeric active ingredients might be lower beyond 1g/kg body weight/day. The third possibility is that the antioxidant activity of Turmeric might be is more potential than those of Black cumin seed to reverse the toxic action of STZ which necessitate molecular study of antioxidants.

The present study also showed that, injection of rats with STZ lead to reduction of mean value of body weight accompanied by an increase in the mean values of food and water intake. These results further support the fact that the most classic symptoms for diabetes mellitus are Polyuria, Polydipsia and Polyphagia. Poor or defect of glucose utilization can also lead to weight loss and sense of fatigue despite of normal or even increased of food intake [35]. In addition, body weight loss and fatigue can also result due to loss of fluid. To compensate for loss of body weight and fluid, the animals should increase food and water intake as a consequence to such changes [35]. On other hand, the present data also revealed that treatment of diabetic rats with Turmeric and/or Black cumin seed appears to have positive effects on body weight gain as well as in reduction of both food and water intake. These improvements might be explained by the partial reduction in blood glucose levels in STZ induced diabetic rats. As Turmeric was the best in lowering blood glucose concentration over Black cumin seed and their mixture (Table 5), this was reflected in body weight and water and food intake. However, another study [31] reported that, oral administration of Turmeric (0.3 or 0.6g/kg diet) had no effect on growth performance of broiler chicken. An increase in body weight gain in rats fed different concentration of Black cumin seed was reported [33] whereas in the contrary, oral administration of methanol extracts of Black cumin seed lowered body weight in mice [36]. Interestingly, the effect of combined mixture of Black cumin seed and Turmeric was investigated only in fish [37]. The authors concluded that dietary supplementation of Black cumin seed and Turmeric (5g/kg diet) improved performance and biochemistry of *Mugil Cephalus* [37]. The synergistic effect of BTM reported above was not correct in the present study as Turmeric was superior over BTM regarding performance and biochemical parameters in rats.

The unchanged serum total proteins, albumin and globulin values in STZ diabetic rats treated with BTM disagree with the findings observed in *Mugil cephalus* fish [37] when the same dose of BTM was used. The present results concerning biochemistry disagree with previous researches demonstrating the positive effect of Black cumin seed in biochemical parameters of Nile tilapia [27], Catfish [38] and Pekin ducklings [39] and *Mugil Cephalus* fish [37] and disagree also with the results concerning the positive effect of Turmeric in biochemical values of mice [40], rats [41] and *Mugil Cephalus* fish [37]. However, this difference perhaps attributed to different species, dose and experimental period. The increased activity of AST in STZ induced diabetic rats indicated liver dysfunction as reported before in rats [42]. Liver damage was observed after oral administration of aqueous extract of *Nigella sativa* (10ml/kg of body weight for 14 consecutive days) in rats [43] or in mice after oral administration of an aqueous extract of the Black cumin seeds in 4 different doses, 6, 9, 14 and 21g/kg [36]. In addition the same liver damage was observed in ducklings kept on powdered Black cumin seed (20gm/kg diet) [37]. The liver damage observed in the previous studies [36,39,43] disappeared in the present study and that might be attributed to difference

in plant source, dosage, route of administration, species, age and administered ingredients. The present study reported non-significant changes in liver and kidney function in all groups. These results come in accordance with the previous findings [44] demonstrated that diabetes induction caused insignificant changes in serum levels of ALT, AST, urea and creatinine. In the contrary, the present findings also disagree with others [42] demonstrated an increase in blood urea nitrogen and uric acid in STZ induced diabetic rats indicated kidney dysfunction.

Diabetes induced many changes in lipid profile as hyperlipidemia and hypercholesterolemia observed in STZ diabetic rats come in accordance with the previous studies in rats [27,45]. The antihyperlipidemic and antihypercholesterolemic effect of Turmeric was reported before in rats [27,46]. Administration of 500mg Curcumin to human volunteers for one week did not produce significant change in serum cholesterol level, with Curcumin tending to lower serum cholesterol and TAG levels [47]. Contrary to these results, consumption of Curcumin (1 and 4g/day) over 1 month or 6 months was reported not to affect blood concentrations of TG, or TC, LDL, and HDL-c [48]. The hypocholesterolemic effect of Turmeric reported to be due to up-regulation of cholesterol 7α-hydroxylase in rats [46]. Hypolipidemic and hypocholesterolemic effect of Black cumin seed observed in the present study come in accordance with previous research in rats [33,49,50]. In the contrary, demonstrated hypercholesterolemic and hyperlipidemic effect followed oral administration of Black cumin seed (2%) in Pekin ducklings was recorded [37]. The hypolipidemic effect of Black cumin seed may be attributed to the synergistic effect of its different constituents, soluble fiber, sterols, flavenoids and high content of polyunsaturated fatty acids. Hypolipidemic effect of soluble fibers contents of Black cumin seed might be related to decreased cholesterol absorption and increased bile acid synthesis and degradation [51]. The hypocholesterolemic effect of black cumin seed may relate to up-regulation of low density lipoprotein receptors and inhibition of 3-hydroxy 3-methylglutaryl coenzyme A reductase [52].

5. CONCLUSION

The present study can concluded that, dietary supplementation of either Turmeric or Black seed to diabetic rats were effective in reducing blood glucose, water and food intake, TAG and Cholesterol accompanied by an increase in body weight gain in STZ diabetic rats. Based on its effect on body weight gain, food intake, water intake, blood glucose level and TAG level, Turmeric was more effective than black cumin seed and mixture of both plants as antidiabetic drug.

COMPETING INTERESTS

The authors have declared that no competing interests exist.

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