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Assessing the Therapeutic Potential of *Cinnamon zeylanicum* (Cinnamon) and *Syzygium cumini* (Jamun) Seeds on Hyperglycemia in Diabetic Rats

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Abstract

Many traditional plants have been used to combat fatal diseases such as diabetes mellitus. These plants have been shown to possess antioxidant activities, improving the diabetes complications. Chemical, minerals and phytochemical analyses of cinnamon and jamun seeds were done and bio-evaluation trials were conducted on diabetic rats by feeding cinnamon and jamun seeds extracts for a period of 60 days. The impact of cinnamon and jamun seeds administration was observed. Blood glucose, insulin level, lipid profile, liver and kidney functions were assessed. Diabetic rats revealed an increase in the levels of blood glucose, total cholesterol and triglycerides. In contrast, the levels of insulin and high density lipoprotein cholesterol (HDL-cholesterol) were reduced. It is found that the oral administration of cinnamon and jamun seeds showed a reduction in glucose level, total cholesterol and triglycerides whereas an increase in insulin level and HDL-cholesterol were noted. Also cinnamon and jamun seeds restored the altered liver and kidney function (aspartate transaminase (AST), alanine transaminase (ALT), alkaline phosphatase (ALP), and serum urea and serum creatinine) levels to near normal.

Keywords: Cinnamon; Jamun; Diabetes mellitus; Cholesterol; Serum

Introduction

Plants have a long history in traditional medicine mostly as their extracts and chemical bioactive compounds for producing drugs. These drugs could play important role in treating various infectious diseases [1]. Medicinal plants considered as plant materials such as foliage, root, flower and seed using in the form of their extracts and chemical compounds to produce human drugs or veterinary medicine [2]. Medical plants also forming the basis of traditional or indigenous health systems that's why populations used them for their physiological and physical health care requirements [2,3].

Cinnamon zeylanicum is considering as world's oldest spices and used as herbal remedy. The genus *Cinnamomum* consists of 250 species of aromatic evergreen trees and shrubs and it is primarily located in Asia and Australia [4]. Cinnamon has many pharmacological properties such as antioxidant activity, antibacterial effects, insulin sensitizer and as bioactive product involve in controlling the glucose level in human body [5,6]. *Syzygium cumini* from the family Myrtaceae. Some other general names of jamun are Indian Blackberry, Java Plum, Black Plum, Jamblang and Jambul. It has been stated that different parts of the jamun have anti-diabetic, anti-oxidant, anti-microbial, anti-diarrheal, gastro-protective, anti-inflammatory and anti-hyperlipidaemic activities [7]. Glycoside is one of the most important constituent in jamun seeds having anti-diabetic properties and helps in lowering of high blood glucose level [8].

Diabetes mellitus is very complicated disorder that is characterized by high blood glucose level in body due to the problem in insulin action or defects in insulin secretion or both. There are two types of diabetes which are referred to as type-1, which is insulin dependent and type-2, which is non-insulin dependent. Major complications in diabetic patients are dangerously high blood glucose level and unusually low blood glucose level that cause damage to blood vessels. Type-2 diabetes is a persistent metabolic disorder that characterized by high blood glucose level resulting from derangement in glucose utilization and metabolism [9].

In diabetic patients insulin receptor function is improve by inhibiting the action of insulin receptor phosphatase and activating the action of insulin receptor kinase, that are very helpful in increasing the insulin sensitivity with the help of using cinnamon [10,11].

The active compounds of cinnamon that are cinnamaldehyde, eugenol, micronutrients and other compounds have anti-hyperglycemic properties [1]. Moreover considerably high amount of type-A polyphenols which is present in aqueous extract of cinnamon, have shown improvements in fasting glucose, glucose tolerance and insulin sensitivity in humans with insulin resistance [12]. For the treatment of diabetes ½ teaspoon of cinnamon powder is given to patients on daily bases [13].

Jamun seeds which are used for the treatment of diabetes and in different pharmaceutical preparations that decrease blood glucose levels in diabetic animals [14]. Jamun seeds are rich source of important components such as ellagitannins including corilagin, 1-galloylglucose, 3-galloylglucose, ellagic acid and gallic acid [15]. These marker compounds have anti-hyperglycemic properties. And there were a significant decrease in blood glucose level, blood urea level and lipid level when diabetic rats were fed with jamun seeds extract [8]. The objective of this study to determine the effect of cinnamon and jamun seeds on blood glucose level and on health status of rat's model.

Materials and Methods

Procurement of raw materials

Cinnamon barks and jamun were procured from local market of Faisalabad. All of the reagents were made available in fruits and

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vegetables laboratory in National Institute of Food Science and Technology, University of Agriculture, Faisalabad. Sprague Dawley rats used in the efficacy trials were acquired from National Institute of Health (NIH) Islamabad.

Sample preparation

Cinnamon barks were washed with water to eliminate dust and stone pieces. Cinnamon sticks were dehydrated and grinded into fine particles by the help of electric grinder machine. On the other hand jamun seeds were separated from jamun pulp and sun dried for one week. Then grinded into fine powder in electric grinder machine. Finally obtain powder of cinnamon and jamun seeds were examined for their biochemical characteristics.

Chemical analysis

Analysis of cinnamon and jamun seeds powder for moisture, ash content, crude protein, crude fat, crude fiber and nitrogen free extract (NFE) were carried out according to their respective methods of AOAC (2006).

Moisture content

Moisture content of cinnamon and jamun seeds powder were determined by following the method AOAC (2006) Method No. 934-01. Accordingly 5 grams sample of each powder were dried in hot air oven (Model: DO-1-30/02, PCSIR, Pakistan) at 105 ± 5°C till constant weight.

Crude protein

Protein content of cinnamon and jamun seeds powder were determined using kjeldhal apparatus as per procedure described in AOAC (2006) Method No. 984-13. Thus,% of nitrogen was estimated by titrating the distillate against 0.1 N H_2SO_4 solutions till light golden coloration. Crude protein content was calculated by multiplying nitrogen% (N%) with factor (6.25).

Crude fat

Crude fat content in both sample were determined by using hexane as solvent in Soxhlet apparatus following the protocol stated in AOAC (2006).

Crude fiber

After fat extraction of cinnamon and jamun seeds powder crude fiber content were determined by following the procedure mentioned in AOAC (2006) Method No. 978-10.

Total ash

Total ash in each dry sample were determined by direct incineration in a muffle furnace (MF-1/02, PCSIR, Pakistan) at 550 to 600°C after charring, till grayish white residue (AOAC, 2006; Method No. 942-05).

Nitrogen free extracts (NFE)

NFE in a cinnamon and jamun seeds powder sample were calculated according to given expression:

NFE (%)=100-(moisture%+crude protein%+crude fat%+ash+crude fiber%)

Mineral analysis

The powder of both sample were analyzes for minerals by using wet digestion method. The minerals content of the sample were determined by using the respective standard curve prepared for each element. All composition were analyzed for sodium and potassium contents using flame photometer (Sherwoo Flame Photometer 410, Cambridge, UK) according to method given in AOAC (2006).

Preparation of cinnamon and jamun seeds extracts

Cinnamon barks and jamun seeds were both washed separately under running tap water followed by sterile distilled water. These were dried at room temperature (30°C) for 2 days and ground to fine powder then stored in air-tight bottles. Ethanolic extraction was done by dissolving 10 g of bark or seed powder in 100 ml ethanol with shaking then kept for 24 h. The suspension was filtered then extract was concentrated under vacuum below 40°C using Rotary Evaporator System (Cole-Parmer). UV rays for 24 h were applied on the dried extract that was checked for sterility on nutrient agar plates. The extract was stored in a freezer at 4°C, in labeled sterile bottles until use.

Phytochemical screening tests

Total phenolic contents: By using Folin-Ciocalteu total phenolic contents (TPC) of cinnamon and jamun seeds powder were estimated according to the method as described by Ghasemzadeh and Jaafar [16]. The procedure is based on the decrease of phosphotungstic acid to phosphotungstic blueish and as a consequence denseness upsurges due to increase in the no of sweet-smelling phenolic groups.

Flavonoids: By using the spectrophotometer TFC were measured in extract of cinnamon and jamun seeds were estimated according to the method as described by Ghasemzadeh and Jaafar [16]. On the expansion of flavonoid-aluminum complex the procedure was based. To measure total flavonoids in cinnamon and jamun seeds powder extracts quercetin was used as standard.

DPPH assay: Using the method of Wiczkowski et al. [17] the cinnamon and jamun seeds extracts were investigated for 2, 2-diphenyl-1-picrylhydrazyl free radical scavenging activity.

In vivo study

Animal: Thirty healthy adult rats weighing 150-200 g, 2-3 months of age were acquired from National Institute of Health and kept in animal room of National Institute of Food Science and Technology, University of Agriculture Faisalabad. Animals were caged individually under controlled standard conditions of light, temperature and humidity. All experiments were conducted according to the ethical guidelines of the International Association and the standard guidelines for animal use. Selected data were subjected to different statistical analysis to determine the level of significance.

Efficacy study plan: Thirty animals were grouped into five trials as follows:

1. Normal Control rats (6 rats) administered normal diet.
2. Diabetic Control rats (6 rats) which were high sucrose fed diabetic rats.
3. Cinnamon fed rats (6 rats). High sucrose fed diabetic rats were administered 250 mg cinnamon /kg body weight 14 days after induction of diabetes.
4. Jamun seeds fed rats (6 rats). High sucrose fed diabetic rats was administered 250 mg jamun seeds /kg body weight 14 days after induction of diabetes.
5. Cinnamon+jamun seeds fed rats (6 rats). High sucrose fed

diabetic rats were administered 500 mg cinnamon+jamun seeds/kg body weight 14 days after induction of diabetes.

Hyperglycemia induction: The experimental rats were fed with high sucrose diet (30-40%) for a period of 3 to 4 weeks. After 3 to 4 weeks blood glucose level was checked to confirm hyperglycemia with the help of glucometer. Hyperglycemic rats were kept for one week under standard condition for stabilizing blood glucose levels. After one week blood glucose levels was rechecked, it was higher than 125 mg/dL then these rats were picked out for the current experiment.

Biochemical tests

Blood glucose level: The blood glucose level was measured at about every 7 days interval. Blood samples were obtained by tail vein puncture of both the normal and high fructose diet fed diabetic rats. Blood glucose level was measured by single touch glucometer [11].

Serum insulin levels: In each study, the sera obtained from rats were also be evaluated for insulin level using the guidelines of Ahn et al. [18].

Measurement of serum lipid profile: The serum lipid profile; high density lipoprotein (HDL), total cholesterol (TC) and triacylglycerol (TAG) were measured using commercial kits [19].

Biological safety tests

Liver and kidney functioning tests: The aspartate transaminase (AST) and alanine transaminase (ALT) were assessed following the protocol of Nakyinsige et al. [20]. However, serum alkaline phosphatase (ALP) was measured according to the method of Park et al. [21]. Likewise, serum urea and creatinine levels were also be measured as markers of kidney function [22].

Statistical analysis: Data obtained for each parameter was analyzed using statistical model [23].

Results and Discussions

Chemical analysis

Cinnamon and jamun seeds were analyzed for proximate compositions that play a crucial role in assessing quality characteristics of raw material. Proximate composition of cinnamon and jamun seeds shown in Table 1. Proximate analysis composition that designated cinnamon contain moisture content 5.82%, crude protein content 3.56%, crude fat content 4.35%, and crude fiber content 31.24%, total ash content 2.67% and NFE as 52.36%. The finding of result is in line with the result of Ereifej et al. [24] that showed cinnamon contains crude protein 4.2%, crude fat 1.7%, and crude fiber 52% and ash 4.5%.

The values of moisture content 5.82% obtain in this manuscript are in line with Khan and Chaudhry [25] who found that cinnamon contain 4.9% of the moisture content. Further these results are in line with Gul and Safdar [26] that were in accordance with the result of ash 2.4%, crude protein 3.5%, crude fat 4%, crude fiber 33% and Nitrogen Free Extract 52%. The current results of jamun seed obtained are accordance with Prasad et al. [27] represented that jamun seed consists moisture 9.34%, crude protein 2.42%, crude fat 0.92%, crude fiber 6.08% and ash content 2.93%. Recently, Raza et al. [28] observed that jamun seeds contain moisture 16.34 ± 0.49, crude protein 1.97 ± 0.59, crude fat 0.65 ± 0.01, crude fiber 4.19 ± 0.12, ash 2.18 ± 0.06 and NFE 74.67 ± 2.24.

Proximate composition	Cinnamon (%)	Jamun seeds (%)
Moisture	5.82	15.48
Crude protein	3.56	1.98
Crude fat	4.35	0.76
Crude fiber	31.24	4.27
Ash	2.67	2.46
NFE	52.36	75.05

Table 1: Proximate composition of cinnamon and jamun seeds (%).

Mineral content

The powder of cinnamon and jamun seeds were analyzes for minerals. Minerals determination experiment was to study the nutritional value of cinnamon and jamun seeds. Different minerals had been inspected, which were the iron, magnesium, calcium, sodium, zinc and manganese. These minerals are regarded as the most significant minerals in a valuable food. Minerals composition of cinnamon and jamun seeds shown in Table 2 that indicated that cinnamon contain iron 7.9 mg/100 g, magnesium 136.3 mg/100 g, calcium 283.5 mg/100 g, sodium 10.5 mg/100 g, zinc 1.2 mg/100 g and manganese 9.3 mg/100 g. These finding are in line with Ereifej et al. [24] that suggested cinnamon consist of iron 8.1 mg/100g, magnesium 140.3 mg/100 g , calcium 299.1 mg/100g, sodium 12 mg/100g, zinc 1.3 mg/100 g and manganese 8.7 mg/100g. Current results of jmaun seeds contain iron 0.94 mg/100 g, magnesium 9.85 mg/100g, calcium 19.49 mg/100 g, sodium 220 mg/100g, zinc 0.69 mg/100g and manganese 1.38 mg/100 g that are accordance with Nawaz et al. [29] that showed jamun seeds consists of iron 0.85 mg/100g, magnesium 10.33 mg/100 g, calcium 21.04 mg/100g, sodium 239.72 mg/100 g, zinc 0.56 mg/100 g and manganese 1.33 mg/100 g.

Phytochemical screening tests

Total phenolic content (TPC): The TPC of cinnamon and jamun seeds was examined by using Folin-Ciocalteu method shown in Table 3. Cinnamon contains 245.69 mg GAE/g of total phenolic content. This result in line with Abeysekera et al. [30] indicated that the TPC of cinnamon are 309.23 ± 0.05 and 200 ± 0.05 mg Gallic acid equivalents/g of extract. Further these results are comparable with Prasad et al. [31] that suggested TPC of cinnamon extract are 289 ± 2.2 and 200 ± 0.01 mg Gallic acid equivalents/g.

It is obtain from the result that jamun seeds contain total phenolic content 1856.67 mg Gallic acid equivalent (GAE)/ 100g. The current result of jamun seed are in agreement with Benherlal and Arumughan [32] who stated total phenolic content in jamun seeds were 370 ± 7.8 g/Kg. Furthermore, Sartaj Ali et al. [33] determined the oxidation inhibitor content of jamun seeds extract and detected total phenolic content in biochemically extracted seeds was 4812.03 mg Gallic acid equivalents/100 g. The finding are also in line with Tipu et al. [34], who

Minerals	Cinnamon	Jamun seeds
Iron	7.9	0.94
Magnesium	136.3	9.85
Calcium	283.5	19.49
Sodium	10.5	220
Zinc	1.2	0.69
Manganese	9.3	1.38

Table 2: Minerals content in cinnamon and jamun seeds (mg/100 g).

Total phenolic content	Quantity
Cinnamon	245.69 mg GAE/g
Jamun seeds	1856.67 mg GAE/100 g

Table 3: Total phenolic content in cinnamon and jamun seeds.

stated that total polyphenol 90.45 mg Gallic acid equivalent (GAE)/g of jamun seeds sample.

Flavonoids: Total flavonoid content of ethanolic extract of cinnamon and jamun seeds were measured showed in Table 4. Cinnamon showed the total flavonoid content 15.44 mg/g of extract, these finding are in line with Abeysekera et al. [30] that find the flavonoid in cinnamon extract 16.1 ± 1.22 to 17.26 ± 1.24 mg/g of extract. Furthermore Adisakwattana et al. [35] measured the flavonoid in cinnamon bark 5.76 ± 1.46 mg/g of extract.

Jamun seeds also showed flavonoid content which was 934.64 mg/100g. The data of research in jamun seed accordance with Benherlal and Arumughan [32] that showed the flavonoid in jamun seed sample that was 32.00 ± 0.52 g/Kg. Moreover the finding of present research is accordance with the result of Sonewane and Arya [36] that showed the flavonoid to be 6.00 mg certainty equivalent /g in jamun seed sample. Furthermore Ali et al. [33] that determined the oxidation inhibitor content of jamun seed extracts that were attained by altered extraction methods. The flavonoid in biochemically extracted jamun seed was 2380 mg *Quercetin equivalent* /100 g.

Antioxidant assays (DPPH assay): Cinnamon and jamun seeds powder were analyzed for antioxidant assays by using DPPH assay showed in Table 5. In present research cinnamon showed antioxidant assay (DPPH assay) of ethanolic extract was 96.24%. These finding are accordance with Abeysekera et al. [30] they resulted ethanolic extract of cinnamon bark showed 107.69 ± 2.01% free radical scavenging activity (mg Trolox equivalents/g of cinnamon) while the methanol extract showed 60.49 ± 0.48% free radical scavenging activity (mg Trolox equivalents/g of cinnamon).

Jamun seeds in present research showed the free radical scavenging activity using DPPH assay 76.54%. Present finding for jamun seed are accordance with the results of Benherlal and Arumughan [32] that determined the value of DPPH that was in range of 60% to 80% and these valued are measured for different doses of jamun seed. Moreover Sonewane and Arya [36] determined the DPPH antioxidant assay of jamun seed resulted in 360.03 μM TE/g through extract of ethanol. Furthermore Ali et al. [33], showed the 82.54% antioxidant activity of jamun seeds by using DPPH assay.

Total flavonoid	Quantity
Cinnamon	15.44 mg/g
Jamun seeds	934.64 mg/100 g

Table 4: Total flavonoid in cinnamon and jamun seeds.

DPPH	Quantity (%)
Cinnamon	96.24
Jamun seeds	76.54

Table 5: Antioxidant assay in cinnamon and jamun seeds.

In vivo study

Effect of cinnamon and jamun seeds on blood glucose level: In present experimental study, cinnamon and jamun seeds were selected to control the blood glucose level in hyperglycemic diabetic rats. It is evident from the result that from fourth week study the lowest blood glucose level in treated rats was observed in cinnamon+jamun seeds treated group on 8th week (99 mg/dL) followed by same treatment on 7th week (106 mg/dL) along with jamun seeds treated group on 8th week (106 mg/dL). Whereas highest blood glucose level was observed in cinnamon and jamun seeds treated group on 4th week (125 and 124 mg/dL) respectively, followed by cinnamon+jmaun seeds treated group on same week (123 mg/dL) shown in Table 6. Similarly, decreasing trend in blood glucose level of rats was also observed by Rekha et al. [11], in their study thirty female wistar rats were obtained. There was a significant ($p<0.001$) increase in blood glucose levels in STZ induced diabetic rats when compared with normal rats. Administration of aqueous extract of pulp of jamun and bark of cinnamon in separate manner decreased the blood glucose level to near normal but treatment with composite extract showed better decrease in blood glucose level.

Similarly, decreasing trend in glucose level was also observed by Mahmood et al. [12], in that study the effect of cinnamon on blood glucose level was checked. The experimental study showed that the different levels of cinnamon dosage reduced the fasting serum glucose (18-29%) in models. Further Sharma et al. [37] evaluated the hypoglycemic potential of jamun seeds using ethanolic extract on the alloxan-induced diabetic rabbits. On the provision of ethanolic extract of jamun seed to the diabetic rabbits, decline of 42.85% was observed in blood sugar concentration.

Effect of cinnamon and jamun seeds on serum insulin level: The highest insulin mean values in treated rats was observed in cinnamon+jamun seeds treated group (1.32 IU/mL) followed by jamun seeds treated group (1.27 IU/mL). Whereas, lowest insulin means values was observed in cinnamon treated group (0.97 IU/mL) shown in Table 7. Similarly the effect on cinnamon and jamun seeds on insulin level was investigated by Sharafeldin and Rizvi [15], they showed that STZ-induced rats of diabetes had decreased level of serum insulin significantly ($p<0.001$) in comparison with normal control rats, while the treatment of cinnamon and jamun seeds significantly ($p<0.05$ and $p<0.001$) increased serum insulin levels, toward normal levels more than diabetic control rats. Furthermore Babu et al. [38] investigate the effect of Cinnamaldehyde (chemical constituent of cinnamon) on

Treatments	Weeks								
	1	2	3	4	5	6	7	8	Means
T_1	96	98	97	99	98	99	98	97	97.75
T_2	95	114	127	133	136	140	143	148	129.50
T_3	96	117	129	125	121	117	114	110	116.13
T_4	99	116	128	124	119	114	110	106	114.50
T_5	98	114	129	123	117	111	106	99	112.13
Means	96.80	111.80	122.00	120.80	118.20	116.20	114.20	112.00	

T_1-Normal control

T_2-Diabetic control

T_3-Cinnamon treated group

T_4-Jamun seeds treated group

T_5-Cinnamon+jamun seeds treated group

Table 6: Hypoglycemic activity of cinnamon and jamun seeds in diabetic rats.

Normal control	2.86
Diabetic control	0.78
Cinnamon treatment	0.97
Jamun seeds treatment	1.27
Cinnmaon+jamun seeds treatments	1.32

Table 7: Effect of treatments on serum insulin level in diabetic rats.

Serum lipid profile (mg/dL)			
Treatments	**HDL**	**TC**	**TAG**
Normal control	58.00	56.00	104.00
Diabetic control	35.00	95.00	152.00
Cinnamon treatment	49.00	75.00	124.00
Jamun seeds treatment	46.00	65.00	111.00
Cinnmaon+jamun seeds treatment	52.00	61.00	108.00

Table 8: Effect of treatments on serum lipid profile in diabetic rats.

Liver and kidney function test					
Treatments	**AST (IU/L)**	**ALT (IU/L)**	**ALP (IU/L)**	**Serum urea (g/dL)**	**Serum creatinine (mg/dL)**
Normal control	101.00	84.00	51.00	37.00	0.55
Diabetic control	167.00	136.00	91.00	112.0	1.33
Cinnamon treatment	139.00	104.00	62.00	64.00	0.72
Jamun seeds treatment	133.00	94.00	60.00	80.00	0.62
Cinnmaon+jamun seeds treatment	130.00	91.00	58.00	63.00	0.58

Table 9: Effect of treatments on liver and kidney function in diabetic rats.

insulin level in diabetic rats. Results showed that there was a significant increased ($p<0.05$) in plasma insulin level when compare to the untreated diabetic group. Previously, Sharma et al. [37] documented the anti-hyperglycemic effect of jamun seed and described momentous effect on the insulin release.

Effect of cinnamon and jamun seeds on lipid profile: In present study cinnamon and jamun seeds were selected for the improvement of high density lipoprotein (HDL), total cholesterol (TC) and triacylglycerol (TAG) level in the hyperglycemic diabetic rats. The highest HDL mean values in treated rats was observed in cinnamon+jamun seeds treated group (52 mg/dL) followed by cinnamon treated group (49 mg/dL). Whereas, lowest mean values was observed in jamun seeds treated group (46 mg/dL). The highest HDL mean values in treated rats was observed in cinnamon+jamun seeds treated group (52 mg/dL) followed by cinnamon treated group (49 mg/dL). Whereas, lowest mean values was observed in jamun seeds treated group (46 mg/dL). The lowest TC and TAG mean values in treated rats was observed in cinnamon+jamun seeds treated group (61 and 108 mg/dL) respectively, followed by jamun seeds treated group (65 and 111 mg/dL) respectively. Whereas, highest TC and TAG mean values was observed in cinnamon treated group (75 and 124 mg/dL) respectively shown in Table 8. Earlier Sharafeldin and Rizvi [15] probed the effect of cinnamon and jamun seeds on high density lipoprotein cholesterol (HDL), total cholesterol (TC) and triacylglycerol (TAG). 200 mg cinnamon and jamun seeds/kg body weight separately administered to diabetic rats. There was a significantly ($p<0.05$) increase in level of HDL was observed in diabetic rats after treatment with cinnamon and jamun seeds compared to diabetic control rats. Further cinnamon and jamun seeds showed significant ($p<0.001$) reduction in elevated total cholesterol when compared to diabetic control rats. Also there was a significantly ($p<0.05$) decrease in level triacylglycerol was observed in diabetic rats after treatment with cinnamon and jamun seeds compared to diabetic control rats.

Accordance with the results of Haghighian et al. [39] there was significant effect of cinnamon on HDL level. The HDL level was increase after consumption of cinnamon powder, significantly ($p<0.05$). Raza et al. [28] showed the Anti-hypercholesterolemia effect of ethanolic extract of jamun fruit and seed in hypercholesterolemia rats. The diet containing 3% extract was fed to the rats. Serum analysis showed that increase in high density lipoproteins (HDL) was 2.62%, due to nutraceutical seed extract diet. The HDL level in control group declined from 38.16 ± 1.56 to 37.50 ± 1.55 mg/dL. However, it increased for jamun fruit and jamun seeds extract groups from 38.69 ± 1.54 to 39.56 ± 1.58 mg/dL and 40.27 ± 1.61 to 41.32 ± 1.65 mg/dL, respectively.

Furthermore Sharma et al. [40] studied the relationship of lipid indicates with the glycemic parameters on rabbits. Total lipids were reduced up to 10.7% in mild and 11.4% in severe diabetic rabbits. Ravi et al. [41] conducted a comparative assessment regarding the antihyperlipidemic properties of jamun seed. The results revealed that jamun seed encompasses better ability to reduce cholesterol up to 57%. Earlier Al Jamal [42] investigate the effects of supplementation of cinnamon on levels of blood glucose and lipids among type 2 diabetics. From the results obtained, the mean value the mean values for lipids were triglyceride (205.5 mg/dl), when diabetic subjects consumed the dose of cinnamon for 4 weeks, their mean triglycerides (160.2 mg/dl). The reductions in the mean lipids levels were significant at $p<0.05$.

Effect of cinnamon and jamun seeds on liver and kidney: The results regarding aspartate transaminase (AST), alanine transaminase (ALT), alkaline phosphatase (ALP) serum urea (g/dL) and serum creatinine (mg/dL) level in diabetic rats influenced by the treatments shown in Table 9. The lowest AST, ALT and ALP mean values in treated rats was observed in cinnamon+jamun seeds treated group (130, 91 and 58 IU/L) respectively, followed by jamun seeds treated group (133, 94 and 60 IU/L) respectively. Whereas, highest mean values of AST, ALT and ALP was observed in cinnamon treated group (139, 104 and 62 IU/L) respectively. The lowest serum urea mean values in treated rats was observed in cinnamon+jamun seeds treated group (63 g/dL)

followed by cinnamon treated group (64 g/dL). Whereas, highest serum urea mean values was observed in jamun seeds treated group (80 g/dL).

The lowest serum creatinine mean values in treated rats was observed in cinnamon+jamun seeds treated group (0.58 mg/dL), followed by jamun seeds treated group (0.62 mg/dL). Whereas, highest serum creatinine mean values was observed in cinnamon treated group (0.72 mg/dL). Earlier Sharafeldin and Rizvi [15] administered the cinnamon and jamun seeds to the diabetic rats essentially reduced the AST. Bilal et al. [43] showed the ethanolic extract of cinnamon and jamun seeds causes a reduction in serum ALT and ALP level in male albino rats. Also, other study reveals the utilization of cinnamon as a medicinal plant for liver diseases. Earlier Furthermore Mhammad et al. [1] checked the histological examination of liver, kidney and spleen, no structural changes were found in the tissue of the examined organs in normal rats treated with cinnamon. While there was a significant ($P<0.001$) effect on ALT level and there was a significant ($p<0.001$) effect on ALP level.

Earlier Sharafeldin and Rizvi [15] showed that diabetes mediated renal malfunction in rats as evidenced by reduced serum urea and creatinine. There was a significant $p<0.05$ decrease in serum urea and creatinine level. Moreover Bilal et al. [43] observed the ALP in STZ-induced diabetic rats, ethanolic extract of jamun seeds causes a reduction in serum ALP in male albino rats.

Conclusion

The present study was carried out with the aim to find out the biochemical estimation of cinnamon and a jamun seed contains chemical analysis, different minerals contents and phytochemical screening tests. Cinnamon and jamun seeds may have anti-hyperglycemic anti-lipidemic properties and have potential to improve the liver and kidney functioning. It is also necessary to look for side effects of herb if any.

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