Assessing the Therapeutic Potential of *Cinnamon zeylanicum* (Cinnamon) and

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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

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

phosphatase (ALP), and serum urea and serum creatinine) levels to near normal.

Assessing the Therapeutic Potential of Cinnamon zeylanicum (Cinnamon
Syzygium cumini

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 in volve 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 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 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 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 assays

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

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

Flavonoid content: 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 findings 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.

Cinnamon	
Jamun seeds	

DPPH	
Cinnamon	
Jamun seeds	

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

	[illegible]
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	[illegible]
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	[illegible]

Effect of treatments on serum insulin level in diabetic rats.

			TAG
Normal control	[illegible]	56.00	[illegible]
Diabetic control	35.00	[illegible]	[illegible]
Cinnamon treatment	[illegible]	[illegible]	[illegible]
Jamun seeds treatment	[illegible]	65.00	[illegible]
[illegible]	[illegible]	[illegible]	[illegible]

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 [illegible]: 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)

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