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TRADITIONAL USES AND ANTIDIABETIC PROPERTY OF EUGENIA JAMBOLANA

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ABSTRACT

The aim of present review article is to briefly discuss the Traditional and pharmacological studies of Eugenia jambolana in the context of its anti-diabetic properties. The data was collected from libraries of various institute, journals and different available online sources on the above topic and thoroughly studied. Results of these traditional and pharmacological studies were observed and compared by keeping in view the various parameters used in it and also tried to explore the pharmacological activity of Eugenia jambolana as antidiabetic agent. The comparative review shows that Eugenia jambolana has significant impact on controlling blood sugar. And it has good potential for the management of diabetes mellitus as described in traditional systems of medicine, that too without any major side effect.

Keywords- Diabetes, Eugenia jambolana, pharmacology, traditional uses

1. INTRODUCTION

Jamun (Eugenia jambolana) is an important but under - exploited indigenous fruit tree of India. It is a very common, large, evergreen beautiful tree of the Indian subcontinent. It belongs to the Myrtaceae family. The other common names of jamun are java plum; black plum, jambul and Indian blackberry. Jamun has promising therapeutic value due to its various phyto-constituents such as tannins, alkaloids, steroids, flavonoids, terpenoids, fatty acids, phenols, minerals, carbohydrates and vitamins. Its pharmacological properties like hypoglycemic, diuretics, analgesic, anti-inflammatory, antiplaque, antimicrobial, antidiarrheal, antioxidant, gastro-protective and astringency have been proven on animal systems.

Diabetes management through use of Eugenia jambolana has been demonstrated. Majority of the studies of Eugenia jambolana as anti-diabetic agent with its possible mechanism of action and delaying complications of diabetes such as cataract and neuropathy have been conducted but detailed studies on isolation of bioactive compounds and clinical trials followed by standardization are seriously required to know the full potential of plant and fruits.

The pharmacological trials were mainly carried out using seeds of Eugenia jambolana but the potential of other parts of the tree need to be explored. Jamun fruit has considerable nutritive value. It is a good source of iron apart from being the source of minerals, sugars and other phytochemicals (Singh et al., 1967).

The fruits have sub-acid spicy flavour and commonly used as dessert. Apart from eating as fresh, it can also be used for the preparation of delicious beverages, jelly, jam, squash, wine, vinegar and pickles (Ochse et al., 1961).

2. BOTANICAL CLASSIFICATION

Kingdom - plantae
Sub-Kingdom- Viridiplantae
Infra Kingdom - Streptophyta (Land Plants)
Super Division – Embryophyta
Division- Tracheophyta (Tracheophytes or Vascular Plants)
Sub Division - Spermatophyta (Spermatophytes or Seed Plants)
Class- Magnoliopsida
Super order – Rosanae
Order – Myrtales
Family - Myrtaceae
Genus- Syzygium
Species - Syzygium cumini

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Figure.1 - Eugenia jambolana Plant

PHYTOCONSTITUENT OF VARIOUS PARTS OF EUGENIA JAMBOLANA

Fruit-

Fruit of Jamun contains Malic acid is the major acid (0.59 of the wt of fruit), a small quantity of oxalic acid is also reported to be present. Gallic acid and tannins account for astringency of the fruit. The purple colour of the fruit is due to presence of cyanidin diglycosides. Fruit contain sugar (8.09%), nonreducing sugar (9.26%) and sulfuric acid (1.21%)2,10. It also contains glucose, fructose, mannose, and galactose as the principal sugar moieties. The mineral constituents are also reported to present which includes Ca, Mg, Na, K, Cu and vitamins such as thiamine, riboflavin, nicotinic acid etc31,32. Studies have shown that the pulp of Jamun contains anthocyanins, delphinidin, petunidin, malvidin-diglucosides, and are responsible for the bright purple color23 . Fruit pulp contains Anthocyanins, diglucosides of delphinidin, petunidin, malvidin, peonidin, and cyanidin. Volatile oils such as α-pinene, ß-pinene, ß-myrcene, cisocimene, trans-ocimene, terpinolene, linalool, 4-terpineol, α-terpineol, cis-dihydrocarvone, caryophyllene, α-humelene, cis-ß-farnesene, cis-α-farnesene, trans-α-farnesene, cisnerolidol, geranyl butyrate, globulol, widdrol, torreyol, neocedranol, ß-bisabolol6 .

Seeds

Seed contains a glucoside jamboline, a new phenolic substance, a trace of pale yellow essential oil, chlorophyll, fat, resin, albumen, tannins (19%), Phenolic such as ellagic acid, gallic acid (1-2%), caffeic and ferulic acids and derivaties, guaicol, resorcinol dimethyl ether and corilaginin9 . Farrukh et al6 ., investigated that Jamun seeds contains Ellagitannins, Jambosine, gallic acid, ellagic acid, corilagin, 3, 6-hexahydroxy diphenoylglucose, 1-galloylglucose, 3-galloylglucose, quercetin, β-sitoterol, and 4,6- hexahydroxydiphenoylglucose. Brij and Subramanian4 , reported that seeds of jamun to contains antimellin, alkaloid, glycoside jambolin and jambosine, which halts the diastatic conversion of starch into sugar.

Flower

Ramya et al23 ., investigated that the flowers of eugenia jambolana contains erategolic acid (maslinic acid), flavonoids - isoquercitrin, quercetin, kaempferol, myricetin-3-L-arabinoside, quercetin-3-D-galactoside, dihydromyricetin, oleanolic acid, acetyl oleanolic acid, eugenoltriterpenoid A and eugenoltriterpenoid B.

Stem bark -

The stem bark of eugenia jambolana has been testified to possess friedelin, friedelan- 3-a-ol, betulinic acid, ß-sitosterol, kaempferol, ß-sitosterol-Dglucoside, gallic acid, ellagic acid, gallotannin, ellagitannin and myricetin, betulinic acid, eugenin and fatty acid ester of epi-friedelanol, quercetin, bergenins, flavonoids and tannins, lignan derivatives cuminiresinol, syzygiresinol A, syzygiresinol B, di-demethyl-5- hydroxypinoresinol, dimethylpinoresinol, didemethoxy- pinoresinol, pinoresinol and 4'- methyl- 5'-hydroxypinoresinol17,25,27 .

Leaves

The leaves are used as food for livestocks. The leaves and bark are used for controlling blood pressure. Vinegar and wine are also made from the fruit. The S. cumini leaves reported to contain ß-sitosterol, betulinic acid, mycaminose, crategolic acid, n-hepatcosane, n-nonacosane, n-hentriacontane, noctacosanol, n-triacontanol, n-dotricontanol, quercetin, myricetin, myricitrin and flavonol glycosides, myricetin myricetin 3-O-(4"-acetyl)-aLrhamnopyranosides, acylated flavonol glycosides, triterpenoids and tannin, eicosane, octacosane, octadecane. Essential oils from leaves are rich in pinocarveol, a-terpeneol, myrtenol, eucarvone, muurolol, a- myrtenal, cineole, geranyl acetone, a-cadinol and pinocarvone.

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TRADITIONAL USES

1. Traditionally the jambul fruits, leaves, seeds, and bark are all used in ayurvedic medicine. The bark contains tannins and carbohydrates, accounting for its long-term use as an astringent to combat ailments like dysentery. A glycoside in the seed, jamboline, is considered to have antidiabetic properties. Older French research shows that the seeds have a significant hypoglycemic effect in diabetic rabbits.
2. The seeds have also shown anti-inflammatory effects in rats and antioxidant proper ties in diabetic rat. Older reports from Indian medical journals suggest jambul seed and bark can be beneficial in humans with diabetes.
3. Jamun fruit seeds and pulp have been reported to serve various purposes in diabetic patients, such as lowering blood glucose levels and delaying diabetic complications including neuropathy and cataracts .
4. Jamun is most often recognized as an adjuvant therapy in type-2 diabetes. This has been traced not only to its anthocyanin-rich, dark-purple fleshy pulp, but also to its seeds, which have been most studied for their antidiabetic principles. Jamun seeds are reported to be a rich source of ellagitannins (ETs), including corilagin, 3,6-hexa hydroxyl diphenoyl glucose and its isomer 4,6-hexahydroxy diphenoyl glucose, 1- galloylglucose, 3-galloylglucose, gallic acid, and ellagic acid (EA) .
5. This marker compound has anti-diabetic activity. When alloxan induced diabetic rats were fed with Jamun seed extract, the blood glucose, blood urea, serum cholesterol and serum triglyceride levels were found to decrease significantly . Jamun fruit reduces the sugar in the blood and is very good in the control of diabetes.
6. Its seeds contain Glucoside, Jamboline and Elolagic acid, which are reported to have the ability to check the conversion of starch into sugar in case of excess production of glucose . All parts of the jambolana can be used medicinally and it has a long tradition in alternative medicine.
7. The plant has been viewed as an antidiabetic plant since it became commercially available several decades ago. From all over the word, the fruits have been used for a wide variety of ailments, including cough, diabetes, dysentery, inflammation and ringworm.
8. It is also an ancient medicinal plant with an illustrious medical history and has been the subject of classical reviews for over 100 years. It is widely distributed throughout India and Ayurvedic medicine (Indian folk medicine) mentions its use for the treatment of diabetic mellitus.
9. Various traditional practitioners in India use the different parts of the plant in the treatment of diabetes, blisters in mouth, cancer, colic, and diarrhea, digestive complaints, dysentery, piles, pimples and stomach ache. During last four decades, numerous folk medicinal reports on the antidiabetic effects of this plant have been cited in the literature.
10. In Union medicine various parts of Jambolan acts as liver tonic, enrich blood, strengthen teeth and gums and form Good lotion for removing ringworm infection of the head . E. jambolana leaf extract showed hypoglycemic action in diabetic rats The seed powder of E. jambolana is reported to have hypoglycemic action in streptozotocin diabetic rats . Its effect may be persistent, as in one study, homeostasis was maintained in the rats for two weeks after the cessation of treatment.
11. In all oxan-diabetic rabbits the water extract of E. jambolana fruit pulp was more effective than the ethanol extract at reducing fasting blood glucose and improving blood glucose levels in the glucose tolerance test. E. jambolana also increased blood insulin levels in both diabetic and severely diabetic rabbits.
12. The inhibition of insulinase activity from liver and kidney by extract of Eugenia jambolana also has been reported, which points out to its extra-pancreatic mechanism . Another study also found that E. jambolana seed extract reduced blood glucose, glycosylated hemoglobin, and increased plasma insulin . E. jambolana fruit combined with bitter melon decreased insulin levels that were raised in diabetic rats fed a fructose diet.
13. Jamun is most often recognized as an adjuvant therapy in type-2 diabetes. This has been traced not only to its anthocyanin-rich, dark-purple fleshy pulp, but also to its seeds, which have been most studied for their antidiabetic principles. Other reports from Indian medical journals suggest jambul seed and bark can be beneficial in humans with diabetes

MEDICINAL USES

1. In Ayurvedic medicine, 1–3 g of dried seed powder is usually given orally to humans to treat diabetic conditions.
2. Jamun is known in Unani medicine to strengthen teeth and gums, enrich blood, and deworm against ringworm infection of the head.
3. The fruit juice is useful for treating enlarged spleen and resolving urinary problems
4. The leaf juice and poultice of the leaves are effective in the treatment of dysentery and skin disorders

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5. The leaves have long been used to treat diabetes, constipation, and leucorrhoea, as well as to prevent blood from leaking into the faces.
6. The bark contains tannins and carbohydrates, accounting for its long-term use as an astringent to combat ailments like dysentery (Namasivayam et al. 2008).
7. The seeds have also shown anti-inflammatory effects in rats and antioxidant properties in diabetes (Chaudhuri et al. 1990).
8. Jamun fruit reduces the sugar in the blood and is very good in the control of diabetes.

PHARMACOLOGICAL PROPERTIES

Eugenia jambolana has been reported to have hypoglycaemic effects both in pre-clinical and clinical studies. Some of pharmacological studies that have been conducted for anti-diabetic effect of Eugenia jambolana are as follows- Study conducted by

Kumar et al isolated a compound mycaminose from SC seed extract. The isolated compound mycaminose (50 mg/kg) and ethyl acetate [EA] and methanol [ME] extracted compounds of Eugenia jambolana seed (200 and 400 mg/kg) was undertaken to evaluate the anti-diabetic activity against streptozotocin (STZ) - induced diabetic rats. The compound 'Mycaminose' and ethyl acetate and methanol extracted produced significant reduction in blood glucose level.

Ratsimamanga et al reported that the ethanolic extract of bark of jamun decrease blood sugar level by 21% after one hour in hyperglycaemic rabbits in a dose corresponding to 10 gm/kg.

Ravi et al evaluated hypoglycaemic activity of different parts of E. jambolana seeds such as whole seed, kernel and seed coat on streptozotocin induced diabetic rats. Administration of ethanolic extract of kernel at a concentration 100mg/kg of body weight significantly decreased the levels of blood glucose, blood urea and cholesterol, increased glucose tolerance and levels of total proteins and liver glycogen and decreased the activities of glutamate oxaloacetate transaminase and glutamate pyruvate transaminase in experimental diabetes rats.

Chattu et al conducted a study to evaluate the anti-diabetic potency of Eugenia jambolana leaf on the blood glucose level in alloxan induced diabetic rats. Diabetic Wistar strain rats were treated with standard drug Glibenclamide and test drug Eugenia jambolana at 100mg, 200mg and the hypoglycemic effect was determined in the rats and the efficacy of the test drug was compared to the standard drug Glibenclamide. Eugenia jambolana leaf was orally administered for 14 days in alloxan induced diabetic rats.

Jana K et al in their study aimed to investigate the antidiabetic effect of the ethyl acetate fraction of the seed of Eugenia jambolana in streptozotocin-induced diabetic male albino rats. The diabetic rats were treated with this fraction at a dose of 200 mg/kg/d for 35 days and the potential antidiabetic mechanisms were investigated with blood glucose (short-term and long-term model). The result suggests a significant antihyperglycemic action in both short-term and long-term treatment schedules

Chatterjee K et al conducted a study to evaluate the anti-diabetic potency of ethyl acetate fraction of hydromethanolic (40:60) extract of seed of Eugenia jambolana was investigated following in-vivo models in experimental diabetic rat. Oral administration of 20 mg ethyl acetate fraction or 0.6 mg Glibenclamide in 0.5 ml water/100 g body weight/rat for twice a day at fasting state to diabetic rats for 28 days significantly ($p< 0.05$) resulting in carbohydrate metabolic towards the control levels. Two separate spots of ethyl acetate fraction were recorded after scanning of HPTLC fingerprinting. RPHPLC study also shows two completely resolved peaks. Its biosafety profle was established following guidelines . Prabakaran K reveals in their study that the extract exhibits the dose-dependent increase in the inhibitory effect on alpha amylase enzyme upto 95.4%. The result suggested that significant amount of flavonoid in Syzygium cumini seed is responsible for antidiabetic properties and it is further confirmed by higher intensity of alpha amylase inhibitory effect.

Achrekar S et al concluded in their study that the extract of jamun pulp from fruit of Eugenia jambolana showed hypoglycemic activity. This report is the first evidence of such activity in relation to pulp. The effect of pulp was seen in 30 min, while the seeds of the same fruit required 24 hr. Villas nor suggested that the dried bark of Eugenia jambolana (Linn.) Skeels (Myrtaceae) exhibited anti-hyperglycemic activities when fed simultaneously with glucose. At the same dosages of 5 mg/20 g mouse, Eugenia jambolana -treated mice showed a significant decrease in blood glucose levels (BGLs) at 30 min (alpha=0.10) and from 45 min onwards at alpha=0.05

Schossler et al in their study verified the effect of Eugenia jambolana upon the regeneration of insulin producing cells in the pancreatic duct wall. For this purpose the animals were divided into four groups, control (C), treated control (TC), diabetic control (DC) and treated diabetic (TD). An aqueous extract from Eugenia jambolana bark was given by gavage in a daily dose of 1g/kg of body weight. After a thirty day period the animals were euthanized and the pancreas

taken to Immunohistochemical analysis. it was observed the positive staining for insulin on cells of the pancreatic duct and connective tissue in the pancreas of TD and TC animals.

These results indicate that Eugenia jambolana bark extract stimulates development of insulin positive cells from the pancreatic duct epithelial cells.

Bhavana Srivastava et al on hypoglycaemic and hypolipidemic activity of Eugenia jambolana (EJ) pulp and seed extract in Streptozotocin induced diabetic albino rats that EJ pulp extract 200mg/kg/day (Group III) reduced the hyperglycaemia significantly as compared to the diabetic group II , it failed to restore the level to that of the control group and same finding was seen with E. Jambolana pulp extract (group IV).[13]

S.B Sridhar et al concludes that the anti-diabetic effect of E. jambolana seed powder was better with 500 mg/kg body weight in Streptozotocin diabetic female albino wistar rats weighing 150-200 g. Blood glucose levels decreased only by 11-15% vs the normal controls after the GTT, this shows that E. jambolana possibly acts as a hypoglycemic agent by rising insulin levels rather than just as an anti-hyperglycemic agent.[14]

Chaturvedi et al a study on anti-diabetic and antiulcer effects of extract of Eugenia jambolana seed in mild diabetic rats: study on gastric mucosal offensive acid-pepsin secretion by showed seed kernel of Eugenia. Jambolana (EJE) dose-dependent decrease in blood glucose level in mild diabetes rats.

Blood glucose level remained stable in mild diabetic rats from 3rd day onwards after streptozotocin administration (taken as 1st day for treatment) and EJE (200 mg/kg) showed anti-hyperglycemic effect on 10th day of its administration. Glycosylated haemoglobin level in mild diabetic rats was decreased significantly after treatment with EJE for 30 days.

EJ has been reported to show significant antihyperglycemic activity in mild diabetes rats which have functioning pancreatic beta cells. This indicates that it may alter insulin release which was observed with an increase in insulin level with EJ treatment.

Pandey and Khan et al conducted a study in alloxan diabetic rats which demonstrates that feeding for 21 days of the diets containing 15% powdered unextracted seeds containing water soluble gummy fibre, 15% powdered defatted seeds from which lipid and saponins were removed only and 6% water soluble gummy fibre isolated from S. cumini seeds significantly lowered blood glucose levels and improved oral glucose tolerance.

Saravanan et al showed that oral administration of aqueous extract of the bark of Syzygium cumini in the dose of 300 mg/kg body weight led to significantly decreased levels of blood glucose and urine sugar in diabetic rats. Also, during oral glucose tolerance test, long term administration of Syzygium cumini aqueous extract was able to significantly decreased blood sugar concentration in streptozotocin diabetic rats.

Singh and Gupta et al shows that the alcoholic extract of S. cumini produced a fall in blood glucose level of 13, 23 and 28% after 30 days with 25, 50 and 75mg doses respectively in alloxan diabetic albino rats. The blood sugar once dropped to normal level after extract feeding, did not increase again after discontinuation of extract feeding up to 15 days.

The possible mechanism of action for hypoglycaemic effect is due to regeneration of beta cells in alloxan induced diabetic albino rats and probably due to presence of alkaloid in alcohol extract of S. cumini which causes improvement in beta cells.

Vasim Khan et al stated that the increased serum insulin levels and inhibition of insulinase activity from the kidneys was observed on oral administration of the extract of Eugenia jambolana in diabetic rats.

Ravi and Sivagnanam et al Ethanolic extract of Eugenia seed kernel also established its antioxidant potential along with hypoglycaemic effect in streptozotocindiabetic rats in a study conducted by Combination treatment of lower dose of glimepride together with ethanolic Eugenia seed extract showed potent hypoglycaemic as well as antihyperglycemic activities without stern hypoglycaemia in normal rats. It concludes that it may be possible to use for considerable dose reduction of standard drugs. Potentiation of the insulin effect of plasma by increasing either the pancreatic secretion of insulin from beta cells of the islets of Langerhans or its sensitivity by Eugenia seed kernel. As administration of Eugenia jambolana leads to decrease in blood glucose as discussed in the present study.

Deepika Yadav et al better positive response was found after administration of 50% methanolic extract of Syzygium cumini in alloaxan induced diabetic rats.

Results in test group treated by Syzygium cumini exhibits better response than control group. Study indicates that methanolic extracts of Syzygium cumini exhibited significant anti-hyperglycemic activities in alloxan-induced hyperglycemic rats through the regeneration of cells of pancreas.

G Shivaprakash et al. conducted open labeled, randomized trial in DM patients: fifteen in group1 received Eugenia jambolana seed powder 10 gm orally per day along with diet and exercise shows the antihyperglycemic and antioxidant action with use of Eugenia jambolana seed powder. Significant reduction observed only in FBS, maintenance of PPBS values at the baseline level throughout the study period and no increase in serum insulin levels at any visits suggest that EJ seed powder also exhibits an extra pancreatic action, besides the pancreatic action as suggested by previous studies. This extra pancreatic action could be due to its action on the liver to decrease blood glucose levels by enhancing glycogenesis or by restoring carbohydrate enzyme activity.

3. CONCLUSION

The results of various studies confirm the use of Eugenia jambolana in traditional system of medicine to manage Diabetes mellitus. And important role in prevention and treatment of diabetes and also for the further research especially with reference to development of potent Phytomedicine for the treatment of Diabetes mellitus from Eugenia jambolana. Advance comprehensive studies are needed to make clear the antihyperglycaemic action of Eugenia jambolana.

4. REFERENCE

[1] World Health Organization, World Health Organization. Definition and diagnosis of diabetes mellitus and intermediate hyperglycemia: report of a WHO/IDF consultation. Geneva: World Health Organization, 2010; 1-50.

[2] Ravi K, Sivagnanam K, Subramanian S. Anti-diabetic activity of Eugenia jambolana seed kernels on streptozotocin-induced diabetic rats. J Med Food. 2004;7(2):187-9.

[3] Jana K, Bera TK, Ghosh D. Antidiabetic effects of Eugenia jambolana in the streptozotocin-induced diabetic male albino rat. Biomarkers and Genomic Medicine. 2015; 7(3):116-2.

[4] Chatterjee K, Ali KM, De D, Panda DK, Ghosh D. Antidiabetic and antioxidative activity of ethyl acetate fraction of hydromethanolic extract of seed of Eugenia jambolana Linn through in-vivo and in-vitro study and its~ 11 ~chromatographic purification. Free Radicals and Antioxidants. 2012; 2(1):21-30.

[5] Khan, A.H. and Burney, A., A preliminary study of the hypoglycaemic properties of indigenous plants. Pakistan Journal Medical Research, 2: 100-116 (1962).

[6] 26. Ravi, K., Sivagnanam, K. and Subramanjan, S., Antidiabetic activity Eugenia jambolana seed kernels on streptozotocin induced diabetic rats.

[7] Journal of Medicinal Food, 7 (2): 187-191 (2004) Kumar, A., Ilavarasan, R., Jayachandran, T., Deecaraman, M., Aravindan, P.,Padmanabhan, N. and Krishan, M.R.V.,Anti-diabetic activity of Syzygium cumini and its isolated compound against streptozotocin-induced diabetic rats.Journal of Medicinal Plants Research, 2(9): 246-249 (2008)

[8] Benherlal PS, Arumughan C. Chemical composition and in vitro antioxidant studies on Syzygium cumini fruit, Journal of the Science of Food and Agriculture.2007;87(14):256.

[9] Bhargava KK, Dayal R, Seshadri TR. Chemical components of Eugenia Jambolena stem and bark. Current Science. 1974;43(20):645-46.

[10] Bhatia IS, Bajaj KL. Chemical constituents of the seeds and bark of Syzygium cumini. Planta Medica. 1975;28(08):346-35.

[11] Chaturvedi A, Kumar MM, Bhawani G, Chaturvedi G, Kumar M, Goel RK. Effect of ethanolic extract of Eugenia jambolena seeds on gastric ulceration and secretion in rats, Indian J Physiol. Pharmacol. 2007;51(2):131-4

[12] Schossler DRC, Mazzanti CM, Almeida da Luz SC, Filappi A, Prestes D, Ferreria da Silveira A. Syzygium cumini and the regeneration of insulin positive cells from the pancreatic duct,. Brazilian Journal of Veterinary Research and Animal Science. 2004; 41:236-239.

[13] Achrekar S, Kaklij GS, Pote MS, Kelkar SM. Hypoglycemic activity of Eugenia jambolana and Ficus bengalensis: mechanism of action. in vivo. 1991; 5:133 148.

[14] Prof. P.V.Sharma Dravya guna Vigyan Vol. 2 Chaukhambha Bharati Academy, Varanasi P. 659- 661.

[15] Prof. P.V.Sharma, Dhanwantri Nighantu commentry, Chaukhambha Orientalia, Varanasi.P.P. 120-121.

[16] Uma Makheswari M, Sudarsanam D. Phytomedicine for Diabetes mellitus. An Overview Research in Pharmacy 2011; 1(4):28-37.

[17] Chattu M. Evaluation of antidiabetic activity for ethanolic extract of Syzygium cumini leaf in dexamethasone induced diabetic rats. Res Pharm Hlth Sci 2016; 2(2):85–90.

[18] Jagetia GC. A review on the role of jamun, syzygium cumini skeels in the treatment of diabetes. Int J Complement Alt Med. 2018; 11 (2):91-95. DOI: 10.15406/ijcam.2018.11.00374

[19] Dagadkhair, A.C., Pakhare, K.N., Todmal, A.D. and Andhale, R.R., Jamun (Syzygiumcumini) Skeels: A Traditional Therapeutic Tree and its Processed Food Products, Int. J. Pure App. Biosci. 5(5): 1202-1209 (2017).

[20] Khan V, et al, A pharmacological appraisal of medicinal plants with antidiabetic potential, Journa of Pharmacy and Bioallied Sciences, 2015; 4(1): 27-42.

[21] Srivastava B, et al, Study of hypoglycaemic and hypolipidemic activity of Eugenia jambolana pulp and seed extract in Streptozotocin induced diabetic albino rats, Asian Journal of Pharmacy and Life Science, 2012; 2(1): 10-19.

[22] Sridhar S.B, et al, Preclinical evaluation of the antidiabetic effect of Eugenia jambolana seed powder in streptozotocin-diabetic rats, ABnratizdiliiaabne Jtoicu renffaelc ot f oMf eEduigceanl iaan jda mBiboololagniac asle Reedsearch., 2005; 38: 463-468.

[23] Chaturvedi A, et al, antidiabetic and antiulcer effects of extract of Eugenia jambolana seed in mild diabetic rats :Study on gastric mucosal offensive Acid-pepsin secretion, Indian J Physiol Pharmacol, 2009; 53(2): 137–146.

[24] Tripathi AK, Bhoyar PK, Baheti JR, Biyani DM, Mayuresh MK, Yogesh K, et al. Bhanarkar herbal antidiabetics: a review. Int J Res Pharm Sci., 2011; 2(1): 30-7.

[25] Pandey M, Khan A, Hypoglycaemic effect of defatted seeds and water soluble fibres from the seeds of Syzgium cumini (Linn) skeels in alloxan diabetic rats, Indian Journal of Experimental Biology, 2002; 40: 1178-1182.

[26] Gupta R, Saxena A.M., Hypoglycemic and Anti-hyperglycemic Activities of Syzygium cumini (Linn.) Skeels Whole Fruit, in Normal and Streptozotocin-Induced Diabetic Rats, 2011, Asian Journal of Pharmaceutical and Biological Research, 2011; 1(3): 267-272.

[27] Saravanan G, Pari L, Hypoglycaemic and antihyperglycaemic effect of Syzgium cumini bark in streptozotocin-Induced diabetic rats, Journal of pharmacology and toxicology., 2008; 3(1): 1-10.

[28] Singh N, Gupta M, Effect of ethanolic extract of Syzgium cumini (Linn.) seed powder on pancreatic islets of alloxan diabetic rats, Indian journal of experimental biology, 2007; 45: 861-867.

[29] Yadav D, Lalit A, Singh S, Galgut J M, Beg M A. Evalution of antidiabetic and phytochemical activity of 50% methanolic extract of jamun seed (syzygium cumini)., 2013; 3: 13-16.

[30] Shivaprakash G, Pai M. R. S. M, Nandini M, Reshma K, Sahana D.A, Rajendran K etal, Antioxidant potential of Eugenia jambolana seed; a randomizedclinical trial in type-2diabetes mellitus.International Journal of Pharma and Bio-sciences., 2011; Apr-Jun; 2(2): 220-228.

[31] Grover JK, Vats V, Rathi SS. Antihyperglycemic effect of Eugenia jambolana and Tinospora cordifolia in experimental diabetes and their effects on key metabolic enzymes involved in carbohydrate metabolism. J Ethnopharmacol., 2000; 73(3): 461-70.

[32] S. E. Godwin, Manonmani A.J. Effect of Eugenia jambolana on Streptozotocin-Nicotinamide induced type-2 Diabetic Nephropathy in Rats, Int. J. Drug Dev. & Res., 2014; 6(1): 175-187.