Study of Antidiabetic Activity of Dendrocalamus strictus (Shoots) Extract in High Fat Diet Induced Rats

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ABSTRACT- Objectives: - The present study has been undertaken to investigate the antidiabetic potential of methanol extract of Dendrocalamus strictus in high fat diet induced diabetic rats.
Methods:-1.Preparation of extract – Collection, authentication, cleaned and dried. Extraction- Dried shoots are subjected to solvent extraction (e.g., using methanol)

2. Animal Model- Rats are fed a high fat diet for several weeks (usually 6-8 weeks) to induce insulin resistance and hyperglycemia, mimicking type-2 diabetes.

3. Experimental design –Groups- Normal control(std diet),Diabetic control(high fat diet), diabetic + low dose of extract , diabetic + high dose of extract, positive control(Glibenclamide)

4. Treatment- The extract is administered orally for a specified duration. Doses are determined based on preliminary studies.

5. Assessment- Blood glucose levels: Measured periodically. OGTT: Performed to assess glucose handling. Insulin levels: measured using ELISA kits.

Results: - Blood glucose levels: Significant reduction in blood glucose levels in the methanolic extract compared to the diabetic control. OGTT: Improved glucose tolerance in methanolic extract. Insulin levels: Increased insulin sensitivity secretion.

Conclusion:-From the toxicity study it was observed that methanolic extract of Dendrocalamus strictus was nontoxic up to the dose of 2000 mg/kg body weight. In this study, animals received continuous oral administration for a period of 15 days at the doses of 200 mg/kg and 400 mg/kg body weight. The effect was compared with oral dose of 0.5 mg/kg Glibenclamide. The results showed that the shoots extract exhibits significant antidiabetic activity in high fat diet induced diabetic rats, suggesting its potential as a natural therapeutic agent for managing diabetes. Further studies including clinical trials would be necessary to confirm its efficacy and safety in humans.

Kew word:- OGTT, HDL, LDL, GOD-POD, Dendrocalamus strictus

INTRODUCTION

The most common and dominant bamboo species of Odisha is *Dendrocalamus strictus*(Poaceae) commonly known as *Salia* bamboo, which occurs naturally in forests, mostly on hill slopes. Culms 6-10 m high and 2.5-to 4 cm in diameter, grayish green with white powdery patches when young, dull green on maturity, arching outwards above half of its height; nodes usually swollen, basal nodes rooting. Internodes 20-30 cm long, thick walled usually with a small lumen or at times fully solid. Culm-sheaths - variable, lower ones shorter, upper ones oblong, 7.5 – 30 cm long with brown stiff hairs on the back, at times glabrous in dry localities, occasionally striate when young, top rounded or wavy, margin hairy, only slightly auricled; sheath-blades lanceolate, triangular, hairy on both sides with a very narrow and toothed ligule. [1]Freshly collected bamboo shoots have good amount of thiamine, niacin, vitamin A, vitamin B6, and vitamin E.[2] Also the bamboo shoot based diets are rich source of dietary fibres and phytosterols and less cholesterol contents.[3] It has been observed that, the plant materials selected based on their traditional claims was found to be biologically active. However, all species of bamboo shoots available worldwide are not edible. The utilization pattern of the bamboo shoots in most of the countries indicates that it is consumed in the forms of raw, dried, canned, boiled, fermented or medicinal, which is traditional, non-standardized, unorganized and region-specific with little value addition.[4] The new bamboo culms that emerge from the ground (bamboo sprouts) is the edible shoots of bamboo species particularly *Dendrocalamus strictus, B. vulgaris*. It's a vegetable that's used in a variety of western Odisha and broths. They are sold in a variety of processed shapes and come in fresh, dried, and canned varieties.The culms grow into full height and diameter during the monsoon season of 4-6 months; however, maturity period may range from 2-6 years. Bamboo shoots are the culm that usually tapers at one end and grows extraordinarily. [5]

However, the tenderness, taste and aroma are lost once attained maturity. The buds from the rhizome, which grow above ground, are called culms that are commonly referred to as bamboos. These are hollow (some times solid) cylindrical, jointed and tapering upwards. The joints are called nodes from where the branches and leaves spread. The lower nodes also produce rootless. The upper nodes have dormant buds which can grow to new shoots and roots under specific treatment. During young stage the culms are covered with sheath at each inter node, which falls off as the bamboo grows. The exposed upper part of the internode is sometimes covered with waxy powder and hairs, which disappear subsequently. Bamboo shoots are becoming one of the most favourite food items among people all over the world, but there is hardly any organized bamboo shoot processing and marketing industry. The products are, therefore, far off from standardization or globalization. [6]

It has been reported that bamboo shoots can significantly decrease the total serum and serum LDL cholesterol in rats and total liver lipids including liver cholesterol by 16.1 mg/dl. With 17 different types of amino acids, it contains over 10 kinds of mineral elements- Co, Cr, Zn, Mn, Mg, Ni, Co, Cu, etc; Lysine, of amino acids, called 'one limited amino acid' is helpful for growth and development of children; Germaclinium, reported in the shoots are known to carry anti-aging properties. [7]

The quantity of cyanides inbamboo shoots varies depending upon genetic and environmental factors, location of cultivation, season and soil type, parts of the shoot and time of and from harvest. [8,9,10] Boiled bamboo shoots are used as appetizers and the decoction of shoots are used for cleaning wounds and maggot infected sores, ulcers, etc. mixed with palm-jaggery, it is known to induce parturition and abortion[11]. The silicious substance found near the joint inside is a white camphor like crystalline in appearance, slightly sticky to the tongue and sweet in taste [12] Locally (in the Districts of undivided Ganjam, Kalahandi, Koraput, Sambalpur), the fermented bamboo (*Bambusa arundinacea* L) shoot is known as *karadi*. The tips of youngling bamboos are collected, sliced into pieces and then dipped in water for a day to be fermented. In the process of fermentation, the bitterness of bamboo shoot is washed off. This fermented bamboo is usually produced during June-September when bamboo shoots sprout. The powdered form is locally called as *handua*, which is cooked as curry throughout the year.[13] It was reported that the extract of *B. Arundinacea* showed anti-inflammatory, antiulcer, antifertility, antimicrobial and hypoglycemic activities. The hypoglycemic properties of extracts of bambusa leaves have also been established. A previous research on this plant has resulted in the isolation of flavones glycosides[14] . The root (burnt root) is applied to ringworm, bleeding gums, painful joints. Seeds are acrid, laxative, said to be beneficial in strangury and urinary discharge. Bark is used for skin eruptions. Leaf is emmenagogue, antileprotic, febrifuge used in haemoptysis [15].

Though the plant and its extracts have been used in the folklore medicine extensively, there is no scientific evidence for such activities available in established scientific journals of repute. Keeping this in view, the present study has been undertaken to investigate the anti diabatic activity of methanol extract of *Dendrocalamus strictus* in high fat diet induced diabetic rats.

Material and Methods Plant

Healthy and fresh bamboo shoots of *Dendrocalamus strictus* were collected from Naxapali, Maneswar block Sambalpur, Odisha area. The collected shoots were washed with tap water to remove the dust particles. Then shade dried for 10 to 15 days then powdered by electric grinder.

Extract preparation

The powder was passed through sieve no.30 and stored in a container. The powder *Dendrocalamus strictus* shoots were packed in a Soxhlet apparatus and extracted with methanolic solvent for 12 hours. The obtained extract was dried at 35-40°C in hot air oven till solid/semisolid mass was obtained. The yield of the alcohol extract was approximately 15% of the powder. Extracts were stored in air tight container in refrigerator below 10°C. The suspensions of extracts were prepared by using normal saline as solvent for administration to experimental animals.

Animal: Albino rats of either sex weighing 150-200 gm were used for the studies. This study was permitted by the Institutional Animal Ethics Committee with Reg No (1339 / ac / 10 / CPCSEA).

For the estimation of effect of methanolic extract of shoots of *Dendrocalamus strictus* on high fat diet induced rats, 4 groups of rats were taken having 6 rats in each group. For high fat induced insulin resistance, combination of coconut oil and vanaspati ghee mixed with daily foods was fed to rats for four weeks (except group 1).

On the day of experiment the initial blood glucose label was taken. Then glucose was administered in the dose of 2 gm/kg, p.o. after two hours of drug administration and to determine the blood glucose level by glucose oxidase - peroxidase (GOD/POD) method. The change in body weight was observed throughout the treatment period in experimental animals.

Acute toxicity studies

In acute oral toxicity study, the methanol extract of shoots of *Dendrocalamus strictus* did not produced lethality up to the dose level of 2000 mg/kg.

Group-1: Normal group, receive solvent and tween 80.

Group-2: HFD group, receive solvent.

Group-3: HFD group, treated with test drug (200 mg/kg).

Group-4: HFD group, treated with test drug (400 mg/kg).

Group-5: HFD group, treated with Glibenclamide (0.5 mg/kg).

Effect of methanolic extract of shoots of *Dendrocalamus strictus* on high fat diet (HFD) induced rats. (MEDS)

Groups	Post Induction Days		
	5th	15th	20th
Group I Non diabetic control	66.65 ± 0.95	67.12 ± 0.93	68.82 ± 1.0
Group II Diabetic control	251.04 ± 2.0***	238.11 ± 1.5***	237.23 ± 1.1***
Group III Diabetic control + MEDS (200 mg/kg)	247.02 ± 1.8	195.11 ± 1.2**	174.41 ± 0.93**
Group IV Diabetic control + MEDS (400 mg/kg)	249.14 ± 1.5	161.15 ± 0.44***	143.74 ± 0.30***
Group V Diabetic control + Glibenclamide(0.5mg/kg)	248.09 ± 2.0	111.10 ± 0.91***	106.20 ± 0.74***

All the values are expressed as mean ± SEM, n=6 in each group. Values are significantly different from control. *P < 0.05; **P < 0.01; ***P < 0.001

RESULT AND DISCUSSION

Fasting blood glucose level (FBS) was measured on 5th, 15^{th} and 20th day of post induction. The FBS level of Group III (MEDS 200 mg/kg) and Group IV (MEDS 400 mg/kg) on 15^{th} day of post induction (10 days of treatment) were 195.10 ± 1.2 mg/dL and 161.15 ± 0.44 mg/dL respectively. The FBS level of Glibenclamide (0.5 mg/kg) treated animal was 111.10 ± 0.91 mg/dL on 15th day of post induction. The FBS level of Group III (200 mg/kg) and Group IV (400 mg/kg) on 20th day of post induction (15 days of treatment) were 174.40 ± 0.93 mg/dL and 143.74 ± 0.30 mg/dL respectively. The FBS level of Glibenclamide (0.5 mg/kg) treated animal was 106.20 ± 0.74 mg/dL on 20th day of post induction. The FBS levels in high fat induced treated rats were significantly high (P < 0.001) when compared to the non diabetic control. Oral administration of MEDS at the dose of 200 mg/kg body weight showed a significant decrease in FBS level (247.02 ± 1.8 to 174.41 ± 0.93 mg/dL, $P < 0.01$), as compared with the diabetic control group. Oral administration of MEDS at the dose of 400 mg/kg body weight showed a significant decrease in FBS level (249.14 ± 1.5 to 143.74 ± 0.30 mg/dL, $P < 0.001$), as compared with the diabetic control group. Glibenclamide treated group showed a significant decrease in the FBS levels (248.09 ± 2.0 to 106.20 ± 0.74 mg/dL, $P<0.001$), as compared to the diabetic control. The continuous oral administration of MEDS for a period of 15 days at the doses of 200 mg/kg and 400 mg/kg body weight showed a significant decrease in fasting blood sugar (FBS) level, which was dose dependant and also comparable to that of the standard drug Glibenclamide.

CONCLUSION

In conclusion, the mechanism of anti-diabetic activity of the extracts of *Dendrocalamus strictus* cannot be proposed by the present study. The possibility exists that the plant may act by either a pancreatic or extra-hepatic mechanism or both mechanisms. The methanol extract of *Dendrocalamus strictus shoots* showed a significant anti-diabetic activity in high fat induced diabetic rats. The phytosterols present in methanolic extract may be possibly responsible for the anti-diabetic activity. However, we suggest that further work should be carried out at cellular and molecular levels to find out the absolute mechanism of action of the plant in experimental diabetes. The present investigation has also opened avenues for further research to the development of potent phytomedicine for diabetes mellitus from the *Dendrocalamus strictus shoots* . The traditional use of the plant to treat diabetes is supported by our research.

REFERENCES

[1] Adarsh Kumar, Gupta, B. B. and Negi, D. S. 1988. Vegitative Propagation of Dendrocalamus strictus through Macro-proliferation, Indian Forester, 114:564-567

[2] K. Visuphaka, “The role of bamboo as a potential food source in Thailand,” in Proceedings of the International BambooWorkshop, pp. 301–303, Recent Research on Bamboos, Hangzhou, China, October 1985.

[3] N. H. Xia, “Analysis of nutritive constituents of bamboo shoots inGuangdong,” Acta Botanica Austro Sinica, vol. 4, pp. 199–206, 1989

[4] Debangana Choudhury, Jatindra K Sahu & GD Sharma, Bamboo shoot: Microbiology, Biochemistry and Technology of fermentation - a review, Indian Journal of Traditional Knowledge Vol.11 (2), April 2012, pp. 242-249

[5] Sangeetha, R., Diea, Y. K. T., Chaitra, C., Malvi, P. G., & Shinomol, G. K. (2015). The amazing bamboo: a review on its medicinal and pharmacological potential. Indian J Nutr, 2(1), 1-7.

[6] Bhatt BP, Singha, LB, Sachan MS & Singh K, Commercial edible bamboo species of North Eastern Himalayan region, India. Part II. Fermented, roasted and boiled bamboo shoots, J Bamboo Rattan, 4(1) (2005) 13-31.

[7] NMBA, Bamboo shoot composition, (National Mission on Bamboo Application, India), 2009.

[8] Anonnymous, Cyanogenic glycosides in cassava and bamboo shoots, a human health risk assessment, Technical report series no. 28. Food Standards Australia New Zealand, 2004.

[9] Ermans AM, Mbulamoko NM, Delange F & Ahluwalia R, Role of cassava in the etiology of endemic goitre and cretinism, (Ottawa, Ontario, International Development Research Centre), 1980, 182-182.

[10] JECFA, Cyanogenic glycosides, In: Toxicological evaluation of certain food additives and naturally occurring toxicants, 39th Meeting of the Joint FAO/WHO Expert Committee on Food Additives, 1993, 234-237.

[11] RFRI, Bamboo as food and medicine, (Report of Rain Forest Research Institute, Jorhat, India), 2008.

[12] Vaidya B. Some Controversial Drugs in Indian Medicine, Chaukhambha Orientalia, Varanasi. 1982: 203-207.

[13] Ramesh c.Ray,Manas Ranjan Swain, Indigenous Fermented Foods and Beverages of Odisha, India: an Overview, https://www.researchgate.net/publication/261698668, on 17 April 2014

[14] Nazreen S, Alam MS, Hamid H, Kaur G, Alam MM , Haider S, Shafi S. Phytochemical investigation of BambusaarundinaceaRetz. Int J Nat Prod Sci. 2011;3:1-7.

[15] Rathod JD, Pathak NL, Patel RG, Jivani NP, Patel LD, Chauhan V. Ameliorative effect of

Bambusa arundinaceaagainst adjuvant arthritis-with special reference to bone erosion and tropical splenomegaly. J Drug Deliv Ther. 2012;2:141-145.