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Research Article

Anti-diabetic Activity of *Stereospermum Colais* (Bignoniaceae) Leaf Extracts

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ABSTRACT

Stereospermum colais (Bignoniaceae), known as Yellow snake tree in English and Pathiri in Tamil, is used in Ayurvedic system of medicine to treat various ailments includes vomiting, leprosy, fevers, mitigate kapha, itching, diabetes, and clean bad wounds. The coarsely powdered leaves of the plant material were extracted successively with n-hexane, chloroform, ethyl acetate, ethanol in increasing polarity by using Soxhlet's apparatus and aqueous extract by the maceration process. The Preliminary phytochemical analysis of various extracts and powder revealed the presence of carbohydrates, proteins, amino acids, steroids, glycosides, phenolic compounds, tannins, terpenoids, quinones, furan, gums and mucilage, fats and oil. The various extracts of *S.colais* were evaluated at a concentration of 50gram/litre using an *in vitro* method glucose diffusion inhibitory assay to assess the possible effects on glucose diffusion across the gastrointestinal tract and compared to the control conducted in the absence of extracts. The movement of glucose into the external solution was determined by using glucose oxidase peroxide diagnostic kit at a regular intervals. The ethanolic extract showed a significant Glucose Diffusion Retardation Index (GDRI = 1.38 ± 0.005 at 180min), and it proves the traditional claim at this stage. Hence, an in-depth research can be established to identify, isolate and characterize the compound having antidiabetic therapeutic potential.

Keywords: *Stereospermum colais;* Glucose diffusion inhibitory assay; glucose oxidase peroxides diagnostic kit

INTRODUCTION

Diabetes mellitus (DM) is an endocrinal disorder associated with depleted insulin secretions, damaged pancreatic β-cells with altered carbohydrate, lipid and protein metabolism and additionally increased risk of complications of various vascular diseases, etc. (Porter *et al.,* 2005). It causes the number of complications like retinopathy, neuropathy, and peripheral vascular insufficiencies (Chehade *et al.,* 2000). Obesity and physical inactivity are considered as the most modifiable risk factors for DM under an observational (Hu FB *et al.,* 2001) and intervention studies (Knowler *et al.,* 2002 & Tuomilehto *et al.,* 2001). The risk factors for DM also depend on the regional and ethnic background (Abate *et al.,* 2001). Diabetes is a growing epidemic around the world, which affects 10% of the population (Doreen *et al.,* 2006 & Iraj *et al*., 2009). In the year 2000, among the adults (≥20 years) number of DM cases was estimated to be 171 million and will rise to 366 million by 2030, worldwide (Wild *et al.,* 2004). In US, overall prevalence estimated for diabetes in children and adolescents was ~0.18% (Angela 2006). Majority of epidemiological studies shows males are more susceptible to DM (Johnson *et al.,* 1979, Harris *et al.,* 1987, Ahren *et al.,* 1984). The Kashmir valley study (Zargar *et al.,* 2000) reported a high prevalence of 8.1%, and it was also observed that the prevalence of Impaired Glucose Tolerance (IGT) was significantly higher in women. It is estimated that number of diabetic cases will be raised to 58% i.e., from 51 million people in 2010 to 87 million in 2030 in India (Snehalatha *et al.,* 2009). The countries with the largest number of diabetic people in the year 2025 will be India, China, United States (Ramachandran *et al.,* 2000)

Plants are used for human health care is as ancient as human beings themselves (Hu FB *et al.,* 2001). Herbal drugs are achieving fame in the treatment of diabetic mellitus (Pari *et al.,* 1999). The WHO recommended the search for beneficial use of medicinal plants for the treatment of diabetes mellitus (Geneva**,** 1985). Recent review states that more than 1123 plants species have been used ethno pharmacologically or experimentally to treat symptoms of diabetes (Grover *et al.,* 2002).

Stereospermum colais (Bignoniaceae), known as Yellow snake tree in English and Pathiri in Tamil, which is a large straight stemmed deciduous tree, 18-30 m high and 2.8 m in girth found throughout in moist regions of India up to an altitude of about 1200 m (Parrota,

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2001). It is used in Ayurvedic system of medicine to treat various ailments includes vomiting, leprosy, fevers, mitigate kapha, itching, diabetes, and clean bad wounds (Mishra Lakshmi Chandra, 2004) and it also shows antidiarrhoea activity (Vatsavaya S Raju *et al.,* 2005) , Analgesic activity (Pusuloori Rajesh *et al.,* 2011), Antioxidant activity, wound healing activity(Vijaya Bharathi *et al.,* 2010a), antibacterial, antifungal activity (Vijaya Bharathi *et al.,* 2010b). The leaves are useful in otalgia, odantalgia, rheumatalgia, malarial fever and wounds. The juice of the leaves, mixed with lime juice is used in maniacal cases. Decoction of the leaves is used for treating chronic dyspepsia and also has antipyretic properties. The decoction of root is used in asthma and cough (Warrier *et al.,* 2002). The present study aims at investigation of the glucose movement across the semi permeable membrane.

MATERIALS AND METHODS

Plant material

Fresh leaves of *Stereospermum colais* were collected from Javadhi hills (Tamilnadu, India) in the month of May and authenticated by Botanist Dr. P. Jayaraman, PARC, Chennai (voucher specimen no. PARC/2008/200) and then shade dried and coarsely powdered.

Successive solvent extraction

The coarsely powdered leaves of the plant material were extracted with various solvents in increasing polarity by using Soxhlet apparatus and finally macerated with water. Extract was concentrated by distillation of the solvent and then evaporated to dryness on water bath.

The Preliminary phytochemical analysis of ethanolic extracts and powder was performed according to the procedure (Harborne, 1983, Kokate, 1994, Khandelwal, 2006).

***In vitro* Glucose Diffusion study** (Gallagher *et al.,* 2003 & Edwards *et al.,* 1987)

A simple model system was used to evaluate effects of plant extracts on glucose movement *in vitro*. This model was adapted from a method described by Edwards *et al*., which involved the use of a sealed dialysis tube into which 15 ml of a solution of glucose and NaCl (0.15 M) was introduced and the appearance of glucose in the external solution was measured. The model used in the present experiments (Gallagher *et al.,* 2003) consisted of a dialysis tube (6 cm ±15 mm) into which 2 ml of 0.15 M NaCl containing 0.22 mM D-glucose was added. The dialysis tube was sealed at each end and placed in a 50 ml centrifuge tube containing 45 ml of 0.15 M NaCl. The tubes were placed on an orbital shaker and kept at room temperature (20 ± 2°C). The movement of glucose into the external solution was monitored at set time intervals. The effects of 50 g/l plant extracts on glucose diffusion were compared to control tests conducted in the absence of plant extract. At the end of the experimental period, the concentrations of glucose within the dialysis tubing were measured. All tests were carried out in triplicate. Glucose concentrations were measured using the glucose oxidase method of analysis.

Table 1: Effects of various extracts on glucose diffusion

Sample	Glucose content in the dialysate(m M)			
	30 min	60 min	120 min	180 min
Control	0.97 ± 0.003	1.26 ± 0.015	1.52 ± 0.011	1.82 ± 0.005
n-hexane	0.41 ± 0.008*	0.87 ± 0.0115*	1.41 ± 0.005*	1.66 ± 0.008*
Chloroform	0.54 ± 0.008*	0.93 ± 0.0115*	1.19 ± 0.02*	1.53 ± 0.01*
Ethyl acetate	0.43 ± 0.015*	0.80 ± 0.003*	1.14 ± 0.014*	1.41 ± 0.08*
Ethanol	0.38 ± 0.008*	0.75 ± 0.006*	1.12 ± 0.01*	1.38 ± 0.005*
Aqueous	0.39 ± 0.008*	0.77 ± 0.008*	1.13 ± 0.01 *	1.40 ± 0.005*

Values are expressed as mean ± SEM (n=3); Data were analysed using one way ANOVA followed by Dunnett t test; *p<0.001 compared to control.

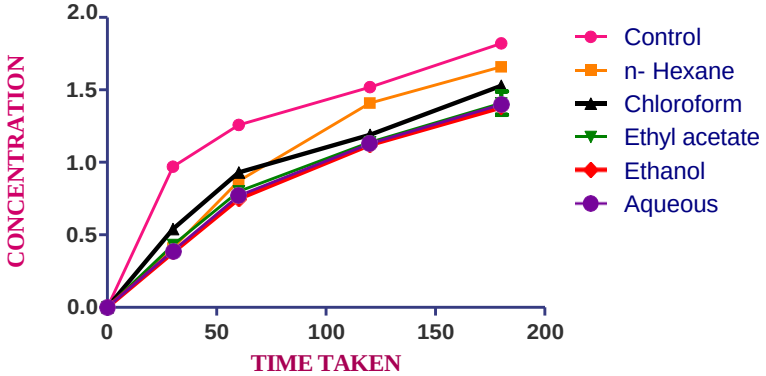

Figure 1: Effects of various extracts on glucose diffusion

Glucose Diffusion Retardation Index (GDRI)

Statistical Analysis

Data are expressed as mean ± S.E.M. Statistical comparisons between groups were done by one-way analysis of variance (ANOVA) followed by Dunnett t test to analyze the differences. $p<0.001$ were considered as significant.

RESULT AND DISCUSSION

The Preliminary phytochemical analysis of various extracts and powder revealed the presence of carbohydrates, proteins, amino acids, steroids, glycosides, phenolic compounds, tannins, terpenoids, quinones, furan, gums and mucilage, fats and oil.

The management of blood-glucose concentration is of fundamental importance in DM. This can be achieved by the number of ways namely stimulating the membrane/function of β-cells, decreasing the synthesis of glucose by altering the activities of glucose-6-phosphatase and fructose-6-phosphatase or slowing/inhibiting the absorption/transport of carbohydrates/glucose (Chhetri *et al.,* 2005). Among these, inhibiting the movement of glucose across the intestinal epithelial cells is of fundamental importance and can be controlled by dietary fibres, complex carbohydrates (Edwards *et al.,* 1988, Groop *et al.,* 1993) and increasing viscosity of the gut material (Wood *et al.,* 1994, 2000). Many natural resources have been investigated with respect to the suppression of glucose production from carbohydrates in the gut or glucose absorption from the intestine (Welsh *et al.,* 1989, Fernando *et al.,* 1991).In the present study, ethanolic extract of *Stereospermum colias* showed the maximum retarding activity against glucose movement across the dialysis membrane. It was significantly decreased from the first observation. It showed an overall significant inhibition when compared to control (Table 1 & Fig.1).

CONCLUSION

The present study was designed as a preliminary work to evaluate the antidiabetic potential of *Stereospermum colais*. We concluded two factors that might have influenced the rate of glucose diffusion through dialysis membrane are gum concentration and polysaccharide combination. Our results suggest that the ethanolic extract of *S.colais* was more effective in retardation of glucose diffusion. The significance of this study is that *S.colais* has the high potential to retard glucose diffusion. Further studies need to be conducted in order to estimate the dietary fibres and carbohydrate content and also to confirm the *invivo* action with intestinal movement of glucose.

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