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Effect of *Bombax ceiba* Root on Some Cardiovascular Risk Parameters in Patients with Ischemic Heart Disease

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ABSTRACT

Bombax ceiba Linn. (Silk cotton tree) is a well known ethno-medicinal plant employed to treat a wide variety of disorders in man and animals. In the present study, its root powder was evaluated for its effect on serum lipids, plasma fibrinolytic activity and antioxidant potential in individuals with stable Ischemic Heart Disease (IHD). Fifty patients of IHD were selected and randomly divided in two groups of twenty five each. Group I (treated group) received 1.5 g root powder twice daily for 12 weeks, while group II (placebo group) received matched placebo for similar duration. Blood samples were collected in fasting state initially and at an interval of six weeks, till the end of the study. Administration of 3 g *B. ceiba* root powder significantly ($p<0.01$) increased plasma fibrinolytic activity by 69.44% and serum total antioxidant status ($p<0.05$) by 106% at the end of the study. Furthermore, a significant decrease was observed in total cholesterol ($p<0.01$), triglycerides ($p<0.05$), Very Low Density Lipoprotein Cholesterol (VLDL-C) ($p<0.05$), Low Density Lipoprotein Cholesterol (LDL-C) ($p<0.001$) levels and Atherogenic Index (AI) ($p<0.05$) along with a significant rise in High Density Lipoprotein Cholesterol (HDL-C)/Low density lipoprotein cholesterol ratio ($p<0.05$) after 12 weeks of *B. ceiba* administration. In the placebo group, there were no significant alterations in any of the parameters at the end of study. The drug was tolerated well without any significant side effects. This study has first time scientifically validated the effect of *B. ceiba* root on modification of multiple coronary risk parameters in man.

Key words: Fibrinolysis, hypolipidemic, atherogenesis, *B. ceiba*, coronary risk parameters

INTRODUCTION

Ischemic Heart Disease (IHD), hypertension and diabetes are rising in an epidemic proportion. The number of IHD patients is not only increasing but also presenting at an early age with a complicated disease profile. There are various risk factors for development of cardiovascular diseases and many of them can be very well controlled by utilizing the therapeutic value of various herbs and spices (Verma, 2002).

Plants have always been a common source of medicament either in the form of traditional preparations or pure active principles from centuries. Modern science has also given attention to the preventive and therapeutic value of many of the plants and it is the result of extensive research that excellent Cardiovascular drugs like digitoxin, ajmaline, quinine, reserpine etc. have been

developed from various plants (Straus, 2008; Mukherjee *et al*., 2010). In this regard, nature has been kind enough to humans by providing a wide range of plants having therapeutic potential. *Bombax ceiba* Linn. (Family: Bombacaceae) is one such plant which is quite popular among the tribal communities for the treatment of various diseases of both human and animals.

B. ceiba is commonly known as Silk Cotton Tree and Indian Red Kapok tree. It is found throughout India and tropical and sub-tropical parts of the world. Young roots of the plant, popularly known as Semal-Musli has been traditionally used as nutritive, restorative and aphrodisiac for the treatment of impotence. It is also claimed to be useful in gastrointestinal disorders, urogenital problems, diabetes and heart diseases (Jain and Verma, 2012).

Root powder of *Bombax ceiba* has been used for heart disease and diabetes by indigenous people since time immemorial (Sarkar, 1986; Oudhia, 2010). Recent scientific researches have shown its potential role in diabetes, hypertension and heart diseases (Gupta *et al*., 2004; Saleem *et al*., 1999; Verma *et al*., 2006, 2008; Jain *et al*., 2011a; De *et al*., 2012). Based on the strong ethnomedicinal recommendations, *B. ceiba* root powder has been evaluated for its effect on some of the cardiovascular risk factors in individuals with ischemic heart disease.

MATERIALS AND METHODS

Collection and preparation of plant material: Young roots of *B. ceiba* were collected from the forest area situated near Udaipur district, Rajasthan, India. Plant sample was identified and a voucher specimen (No. EA-202) was deposited in the Herbarium, Laboratory of Ethnobotany and Agrostology, Department of Botany, Mohanlal Sukhadia University, Udaipur for future reference. Roots were cut in small pieces, air-dried in shade at an ambient temperature. After complete drying they were grinded to make a fine homogenous powder and filled in gelatin capsules. Each capsule contained 750 mg of the dried powder. Similar gelatin capsules were filled with lactose powder for administration to placebo group.

Subject selection and distribution: After obtaining institutional ethical approval and informed consent, 50 male individuals, aged 50-70 years having ischemic heart disease (healed myocardial infarction more than six months) attending medical out patient department of Maharana Bhopal Government Hospital attached to RNT Medical College, Udaipur during the year 2010-11 were selected for the study. They were stable in symptoms and receiving isosorbide-5-mononitrate and aspirin. The patients with primary or secondary hypertension, diabetes, renal and endocrine diseases were not included in the study. Similarly, the patients who were smokers, alcoholics taking lipid lowering drugs or on dietary restrictions or weight reduction program were excluded from this study. The patients selected were randomly divided into two groups of 25 each:

- **Group I: Treated group (n = 25):** They were administered root powder in a dose of 1.5 g twice daily for a period of 12 weeks
- **Group II: Placebo group (n = 25):** They received matched placebo capsules in the same doses for 12 weeks

Blood chemistry: All the blood samples were collected in fasting state initially and at an interval of six weeks, till the end of the study for the analysis of fibrinolytic activity

(Buckell, 1958), lipid profile (Allain *et al*., 1974; Fossati and Prencipe, 1982; Izzo *et al*., 1981; Friedwald *et al*., 1972) and total antioxidant status (Miller *et al*., 1993).

Statistical analysis: Data were expressed as Mean±SE. Results were statistically analyzed with student's t-test for paired data and a p-value less than 0.05 was considered as significant.

RESULTS

Ten patients dropped out of the study therefore, final calculations were based on 20 patients in each group. Administration of 3 g *B. ceiba* root powder significantly decreased total cholesterol (27.51%), triglycerides (30%), VLDL-C (30%) and LDL-C (36.14%) levels and atherogenic index (32.82%) along with a significant rise in HDL-C/LDL-C ratio (54.83%) at the end of 12 weeks. However, levels of HDL cholesterol were not significantly altered (Table 1). The lipid parameters achieved significance at the end of six weeks and significance was further increased at the end of 12 weeks. However, when 12 weeks parameter was compared with six weeks, there was no statistical significance (p = ns). Interestingly, a significant ($p<0.05$) rise was observed in Total Antioxidant Status (TAS) to the extent of 107%. At six weeks, it did not achieve any significance but increased significantly at the end of 12 weeks. The fibrinolytic activity increased significantly ($p<0.01$) by 69% in the treated group at the end of the study (Table 2) and the level of significance improved from 6 weeks ($p<0.02$) to 12 weeks ($p<0.01$). There were no significant changes in any of the parameters of the placebo group.

Table 1: Effect of *B. ceiba* root powder (3 g) on lipid profile in patients with ischemic heart disease

Parameter	Groups	Initial (I)	6 Weeks (II)	12 Weeks (III)
Cholesterol (mg dL^{-1})	Treated	245.46±15.88	205.01±17.34^{a}	177.91±16.03^{b,c}
	Placebo	255.44±14.63	249.46±15.89^{d}	246.14±16.24^{e,c}
Triglycerides (mg dL^{-1})	Treated	174.70±9.56	136.64 ±13.5^{f}	122.30±16.03^{g,c}
	Placebo	169.40±10.04	166.64±12.33^{d}	170.23 ±14.58^{e,c}
HDL-C (mg dL^{-1})	Treated	48.57±3.95	51.23±2.26^{d}	50.16±3.14^{e,c}
	Placebo	46.92±3.24	45.68±3.02^{d}	46.89±3.39^{e,c}
VLDL-C (mg dL^{-1})	Treated	34.93±1.91	27.32±2.69^{f}	24.46±3.10^{g,c}
	Placebo	33.88±2.78	33.32±3.54^{d}	34.04±3.99^{e,c}
LDL-C (mg dL^{-1})	Treated	161.75±17.65	126.44±19.57^{h}	103.29±20.43^{i,c}
	Placebo	174.64±14.23	171.46±15.03^{d}	165.20 ±16.78^{e,c}
HDL-C /LDL-C	Treated	0.31±0.04	0.44± 0.08^{a}	0.48±0.07^{g,c}
	Placebo	0.26±0.12	0.26±0.09^{d}	0.28±0.08^{e,c}
AI	Treated	5.27±0.76	4.09±0.54^{a}	3.54±0.575^{g,c}
	Placebo	5.44±0.84	5.46±0.92^{d}	5.24±0.88^{e,c}

Values are Mean±SE, HDL-C: High density lipoprotein cholesterol, LDL-C: Low density lipoprotein cholesterol, VLDL-C: Very low density lipoprotein cholesterol, ns: Not significant, AI: Atherogenic index = Total cholesterol /HDL-C, p-value; a: <0.02 II vs. I, b: <0.01 III vs. I, c: ns III vs. II, d: ns II vs. I, e: ns III vs. I, f: <0.05 II vs. I, g: <0.05 III vs. I, h: <0.01 II vs. I, i: <0.001 III vs. I

Table 2: Effect of *Bombax ceiba* root powder (3 g) on fibrinolytic activity and total antioxidant status in ischemic heart disease individuals

Parameter	Groups	Initial (I)	6 Weeks (II)	12 Weeks (III)
Fibrinolytic activity (units)	Treated	68.96±4.56	105.55±10.65 ($p<0.02$)	116.85±7.89 ($p<0.01$)
	Placebo	70.26±3.56	72.50±6.46 (p = ns)	71.98±7.36 (p = ns)
Total antioxidant status (mM L^{-1})	Treated	0.60±0.07	0.80±0.07 (p = ns)	1.24±0.19 ($p<0.05$)
	Placebo	0.61±0.05	0.72± 0.06 (p = ns)	0.70±0.00 (p = ns)

Values are Mean±SE, ns: Not significant, p-value: As compared with initial

DISCUSSION

The IHD is an example of the burnt of endothelial dysfunction on coronaries resulting in atherothrombotic disease. There are several scientific reports that suggest that in the genesis of atherosclerosis, endothelial dysfunction is the initial event; which if reversed at its inception, the whole process of atherothrombosis can be checked. At this stage lies the strategic role of dietary alterations and lipid lowering in the prevention of atherosclerosis. However, additional strategies are needed to treat the cluster of risk factors in high-risk patients.

The role of lipids in genesis of coronary atherogenesis is beyond controversy. In this context, the hypolipidemic property of root of *B. ceiba* is worth noting. It has significantly decreased total cholesterol (28%), triglycerides (30%), LDL-C (36%) and VLDL-C (30%) at the end of 12 weeks. This alteration in the lipid pattern led to significant ($p<0.05$) reduction in the ratio between TC/HDL-C aptly called as atherogenic index (33%) and improvement in the ratio of HDL-C and LDL-C (55%) thereby further reducing the risk of ischemic heart disease. Placebo group did not show any significant alteration in all these parameters (Table 1).

The role of LDL-C in the process of atherogenesis is well established. However, it is not the free but oxidized low density lipoprotein cholesterol which initiates an array of cellular dysfunction in the vessel wall and responsible for the major mechanism of the process of atherogenesis (Steinberg and Witztum, 2002). Several studies have demonstrated that lowering serum total and LDL cholesterol reverses endothelial vasomotor dysfunction and therefore, improving endothelial function by lowering atherogenic blood cholesterol which is now regarded as a goal of therapy in the treatment of coronary artery disease (Kinlay and Ganz, 1997; Stone *et al*., 1996). In this regard, the effect of *B. ceiba* on blood lipids is rewarding as it has not only lowered the total and LDL cholesterol but also significantly reduced atherogenic index and therefore, this will be going to improve endothelial function and achieve the therapeutic benefits in patients of IHD.

Reduced fibrinolytic activity has been reported in Ischemic Heart Disease (IHD), hypertension and diabetes in many of the scientific studies (Gupta, 1969; Rani *et al*., 1981) and plays an important role in the catastrophic events with these conditions. The process of fibrinolysis has a great importance in wound healing and recanalization of thrombosed vessels. It disposes the fibrin after its haemostatic function has been fulfilled (Fearnley, 1963). Significant ($p<0.01$) enhancement (69.44%) in fibrinolytic activity by *B. ceiba* root is an added advantage to its hypolipidemic property and therefore, needs attention (Table 2).

The free radical scavenging property or antioxidant capacity has been well studied in the pathogenesis of many disease processes. It is now considered as a reliable marker of the pathogenesis and prognosis in atherothrombotic conditions, vascular diseases, diabetes mellitus, neurodegenerative disorders, kidney and lung diseases as well as cataract and cancer (Kusano and Ferrari, 2008). Patients with documented atherosclerosis have shown decreased levels of erythrocyte glutathione, serum vitamin C and total antioxidant capacity (Tamer *et al*., 2002). Moreover, patients with coronary artery disease have demonstrated lower serum levels of total antioxidant capacity, retinol, HDL, albumin and total protein (Nojiri *et al*., 2001). Increased DNA damage in the nucleus of coronary cells and decreased plasma total antioxidant capacity levels in patients with coronary artery disease has also been reported (Demirbag *et al*., 2005).

Besides this, the use of antioxidant supplementation has been shown to improve endothelial function. In coronary atherosclerosis, it prevents the oxidation of LDL-C, thereby making it less atherogenic (Anderson *et al*., 1995). In one study, two weeks supplementation of an antioxidant

rich plant food concentrate to hypercholesterolemic patients, significantly reduced cholesterol and LDL-C values and increased SOD activity as well as HDL-C/LDL-C ratio (Ziccarelli and Basu, 2003). The significant rise of 107% in TAS after 12 weeks of *B. ceiba* administration, merit special attention as this important biological property is conducive to endothelial health of coronary vascular system and might play an important role in prevention, genesis or regression of the process of coronary atherosclerosis especially with its significant hypolipidemic and fibrinolysis enhancing properties.

Many plants having strong antioxidant activities have been evaluated for their potential role for improving endothelial function in various pathological conditions. One such plant is *Terminalia arjuna*; an old heart tonic which possesses strong antioxidant and hypocholesterolemic potential. It has been shown to reverse impaired endothelial function significantly ($p<0.05$) in chronic smokers, thus scientifically proving its anti-ischemic property (Bharani *et al*., 2004). It can be expected that like *T. arjuna*, the *B. ceiba* root powder will also prove to be beneficial in patients with IHD because of its hypolipidemic, antioxidant and significant fibrinolysis enhancing potential. Many traditional formulations possess strong antioxidant capacity (Sharangi, 2011; Jain *et al*., 2011a, b; Kumolu-Johnson and Ndimele, 2011) which might be the basic mechanism for their various health beneficial properties. This demands the need of scientific validation of our age old herbal wealth employed for preserving human health.

Plants contain some health beneficial chemicals called as phytochemicals which help in providing protection against cancer, cardiovascular diseases, dementia, cataract, macular degeneration, ageing and various other disorders associated with increased oxidative stress (Jain *et al*., 2011b). Chemically, root of *B. ceiba* is rich in lupeol, β-sitosterol, isohemigossypol-1-methyl ether, phenolic compounds, sesquiterpenoids such as bombamaloside, bombaxquinones, bombamalones and naphthoquinones compounds (Jain and Verma, 2012). These chemical compounds are well known for their antioxidant, hypolipidemic and cardioprotective properties (Day, 1991; Cespedes *et al*., 2008; Zhao *et al*., 2010; Ganjewala and Srivastava, 2011; Ibraheim *et al*., 2011) and might be responsible for the beneficial effects observed in the present study.

CONCLUSION

Looking to total disease process from the factors initiating endothelial dysfunction to atherosclerosis and Coronary artery disease, *B. ceiba* root powder offers its advantages at multiple stages. It hits the inflicting causes of endothelial dysfunction such as hyperglycemia, hyperlipidaemia, reduced antioxidant status, thereby preventing the damaging effect on endothelium which in turn will reduce or reverse the process of atherogenesis. It is a safe, effective and economical plant derived therapeutic agent working through multiple approaches and modifies many of the coronary risk factors.

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