Journal Of Phytomedicine
And Therapeutics

JOPAT 14, 2009; 20 - 23

Hypoglycemic and Hypercholesterolemic Effects of *Alstonia scholaris* Bark Powder in Rats

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Abstract

The bark of *Alstonia scholaris* when administered to diet of rats for 30 days caused a dose-dependent and significant lowering of serum glucose in rats. There were no significant changes in concentrations of triglycerides and HDL levels. However, cholesterol and LDL levels were significantly elevated compared to control when bark powder was administered at 0.1% w/w diet. The results indicate that regular monitoring of sugar and lipid profile in serum need to be maintained when the bark is taken for considerable lengths of time.

Keywords: *Alstonia scholaris*, hypoglycemic, hypercholesterolemic, bark powder

Introduction

Alstonia scholaris (L.) R.Br. (family Apocynaceae, commonly called Blackboard tree or the Indian devil tree (synonyms *Echites scholaris* L. Mant., *Pala scholaris* L. Roberty) is an evergreen, tropical tree native to the Indian subcontinent and Southeast Asia that grows up to 40 m tall. The bark is of a grey color. The bark contains the alkaloids ditamine, echitenene, and echitamine. Other reported constituents present in the bark include akuammiginone, echitamidine-*N*-oxide 19-*O*-□-d-glucopyranoside, echitaminic acid, echitamidine *N*-oxide, *N*(b)-demethylalstogustine *N*-oxide, akuammicine *N*-oxide, and *N*(b)-demethylalstogustine (1).

Some reported pharmacological activities from various parts of the plant include *in vivo* antimalarial activity in mice (2), antiplasmodial activity (3), hepatoprotective activity (4), inhibitory activity against human lung cancer cell lines (5), and antibacterial activity (6).

Administration of bark powder directly or bark of *Alstonia scholaris* boiled in water is widely practiced in the folk medicinal system of Bangladesh for treatment of malaria. Malaria is prevalent in Bangladesh, particularly among the rural populations, who can scarcely afford modern health care or lack access to modern clinical facilities. As a result, they depend on traditional medicinal practitioners or folk healers for treatment of this disease. The traditional medicinal practitioners administer the bark of *Alstonia scholaris* for long stretches of time extending over at least a month and frequently for longer periods. Since the bark powder is consumed daily for lengthy time periods, we decided to do a preliminary study on the effect of bark powder administered in diet of rats on some serum parameters like glucose and lipid profile, which can be indicative of metabolic changes

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occurring within the body. It is noteworthy in this regard that administration of hydroalcoholic extract of bark to rats has been reported to lead to acute toxicity and damage to major organs of the body (7). The teratogenic effects of hydroalcoholic extract of the bark powder have also been reported in mice (8).

Materials and Methods

Bark powder
Bark from mature trees of *Alstonia scholaris* were collected, dried, powdered and mixed with diet at 0.01 and 0.1% (w/w) and fed to rat *ad libitum*.

Animals
Wistar rats were obtained from the International Centre for Diarrhoeal Diseases Research, Bangladesh (ICDDR,B) and were divided into three groups of five rats each. Group 1 served as Control, while Groups 2 and 3 were fed a diet containing 0.01 and 0.1% (w/w) of *Alstonia scholaris* bark powder, respectively. Rats were maintained at ambient temperature under lights for twelve hours followed by twelve hours of darkness.

Diet
Rats were fed a standard diet containing 3 kg whole wheat flour, 500g starch, 2 kg lentils, and 670 ml soybean oil with or without bark powder and carboxymethyl cellulose (CMC). The ingredients were mixed together, boiled in sufficient amounts of water for 30 minutes and then pelleted through a pelleting machine and dried (final weight of dry pelleted diet being 5 kg). Group 1 rat diet contained 5g CMC, while Groups 2 and 3 rat diets contained (4.5g CMC + 0.5g bark powder) and 5g bark powder, respectively.

Serum analysis
Following administration of diet for 30 days, rats in all Groups were sacrificed and serum collected. Concentrations of serum glucose, total cholesterol (TC), triglyceride (TG), high density lipoprotein (HDL)-cholesterol and low density lipoprotein (LDL)-cholesterol were determined through spectrophotometric procedures as per manufacturer's instructions on the assay kits. All assay kits were obtained from Chronolab Sys S.L., Avenida Diagonal 609, Planta 10, 08028 Barcelona, Spain.

Statistical analysis of results
The results are expressed in mg/dL as mean ± standard error of mean (SEM). Statistical analysis was conducted by Student's t-test (significant at 5% level denoted by an asterisk*).

Results and Discussion
Administration of bark powder in diet of rats for 30 days led to a dose-dependent and statistically significant lowering of serum glucose levels in rats (Table 1). There was also a significant elevation in serum total cholesterol level in rats fed a diet of 0.1% (w/w) of *Alstonia scholaris* bark powder. We did not observe any significant changes in serum triglyceride and HDL-cholesterol levels in rats fed a diet containing bark powder, as compared to rats in Control group. However, a significant elevation in serum LDL-cholesterol level was observed in rats fed a diet containing 0.1% bark powder (w/w).

Table : Effect of *Alstonia scholaris* bark powder administration in diet of rats on serum glucose, total cholesterol, triglyceride, HDL-cholesterol and LDL-cholesterol levels.

Serum parameters	Group 1 (n = 5)	Group 2 (n = 5)	Group 3 (n = 5)
Glucose (mg/dL)	87.4 ± 3.2	51.3 ± 6.2*	50.9 ± 6.8*
Total cholesterol (mg/dL)	70.3 ± 6.2	66.6 ± 2.3	108.6 ± 15.8*
Triglyceride (mg/dL)	100.6 ± 13.9	83.6 ± 11.4	106.7 ± 13.2
HDL-cholesterol (mg/dL)	5.0 ± 0.1	4.7 ± 0.2	4.7 ± 0.1
LDL-cholesterol (mg/dL)	45.2 ± 7.2	45.2 ± 1.9	82.6 ± 14.4*

Significance at 5% level is denoted by an asterisk*.

Alstonia scholaris bark powder is administered by folk medicinal healers to malaria patients for considerable periods of time. Quite obviously, a number of serum parameters must be monitored for the bark powder's possible toxic effects within the body system when taken for considerable time periods. The bark or bark extract is known to be hepatoprotective (4), but at the same time has been reported to possess acute toxicity, organ damaging and teratogenic effects (7, 8). We therefore measured parameters like serum glucose, TC, TG, HDL-cholesterol, and LDL-cholesterol, which although common parameters, can be indicative of serious metabolic changes in body organs or organ damages. It is disturbing to note that the bark powder when administered to rats demonstrated both a hypoglycemic effect as well as a hypercholesterolemic effect. Moreover, the increase in cholesterol levels was not only in total cholesterol but also what is considered “bad cholesterol”, namely LDL-cholesterol, whereas there were no changes in the “good cholesterol” or HDL-cholesterol (9) levels. This type of cholesterol pattern can lead to cardiac events like increased risk of ischemic heart disease (10).

The major finding from this study is that the bark powder of *Alstonia scholaris*, when administered for lengthy time periods (30 days in this instance), can lead to occurrence of adverse effects in rats like hypoglycemic and hypercholesterolemic effects. This is the first report of its kind for long-term dietary studies with *Alstonia scholaris* bark powder. Traditional medicine, although sometimes effective, can also lead to serious health consequences because of dosage, long-term administration, or inherent plant toxicity. Consequently, it is suggested that the bark powder of *Alstonia scholaris* should be administered with proper care and with at least close monitoring of serum glucose and lipid profile.

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