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A Preliminary Study of *Santalum album* on Serum Lipids and Enzymes

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Abstract: A preliminary study was conducted on the possible hypolipidemic effect of water soluble portion of stem powder (WSPS) of *Santalum album*. Simvastatin (20mg/kg) was used as positive control in the present study. A significant reduction was found in serum total cholesterol (TC) and triglycerides (TG) levels of test rabbits treated with WSPS (30 mg/kg) for 14 days consecutively once in a day orally ($p<0.001$ *and* $p<0.0001$). A decrease was also appeared in low-density lipoprotein (LDL-C) levels of test rabbits but was not statistically significant. However, decreased levels of high-density lipoprotein (HDL-C) were observed as compared to control rabbits. Cardiac-and liver-specific enzymes *viz.,* creatine kinase (CK) and alanine aminotransferase (ALT) were found normal in test rabbits. These results indicated that WSPS has a significant hypolipidemic effect.

Key words: *Santalum* · Cholesterol · Triglycerides · LDL-C · HDL-C · ALT · CK

INTRODUCTION

Santalum album L is commonly known as white sandal tree (Family: *Santalaceae*). The sandal wood (stem) is bitter, acrid and aromatic [1]. Besides being an important element of religious world of southeast continent, this fragrant wood has also been used in perfumes and in oriental medicines [2-4]. In spite of having vast medicinal uses in history, very few pharmacological properties of dry sandal wood powder or its extract have been reported such as antibacterial, anti-ulcerogenic and antioxidant properties [5-7]. However, essential oil derived from sandal wood got much attention and is scientifically evaluated for its antimicrobial, antiviral, antioxidant, uro-genital and chemopreventive effects [8-12]. In fact, sandal wood and its essential oil hold a promising place in food and cosmetics industries as flavoring agent and in skin products respectively [13].

Studies proved that medicinal plants having anti-oxidant activity play an important role in reducing the risk of aging, diabetes, hyperlipidemia, cardiovascular diseases, cancers etc [7, 14]. Similarly, *S.album* has also been reported to be one of the plants having maximum antioxidant activity [15]. Therefore, the current experimental work was designed to investigate the effect of stem powder of *S. album* on serum lipids *viz.,* triglycerides (TG), total cholesterol (TC), high-density (HDL-C), low-density lipoproteins (LDL-C) and enzyme activities *viz.*, alanine aminotransferase (ALT) and creatine kinase (CK) in order to create a baseline study for its hypolipidemic activity.

MATERIALS AND METHODS

Animals: Rabbits weighing from 1 to 1.5 kg were purchased from local supplier of University of Karachi and used in the whole experiment. The rabbits were housed under uniform hygienic conditions with continuous airflow and maintained on a standard laboratory diet and water *ad libitum.*

Plant Material: Pieces of stems of *S.album* were purchased from Hamdard Dawakana, Sardar, Karachi and identified by expert in Botany department, University of Karachi, Karachi-75270, Pakistan. The voucher specimen has been kept in our department (KU/BCH/SAQ/03).

Hypolipidemic Activity: Experimental rabbits were divided into control, positive control and test groups. Each group contains six rabbits. The control and positive groups were

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treated respectively with distilled water (1ml) and simvastatin (Limitrol, 20 mg/kg), purchased from PharmEvo (Pvt.) Ltd. Pakistan, orally for 14 days consecutively once in a day. The grinded stem powder of *S.album* was sieved and divided into water soluble portion of stem (WSPS) and water insoluble portion of stem (WISPS). The WSPS (30 mg/kg) administrated orally once in a day to the test group for the same period. On completion of trial, rabbits were sacrificed and blood was collected from each group. Sera were separated and used to analyze biochemical parameters on Spectro UV-Visible Auto, PC Scanning Spectrophotometer, Labomed, Inc.

Biochemical Analyses: Triglycerides (TG), total cholesterol (TC), High density lipoprotein (HDL-C), alanine aminotransferase (ALT) and creatine kinase (CK) were determined by commercially available enzymatic kits (Randox, UK). LDL-C was calculated by formula given in reagent kit of same company as:

LDL-C (mg/dL) = Total cholesterol-(TG / 5)-HDL-cholesterol

Statistical Analysis: The data were analyzed by *Student's t*-test (Graphpad Software, Quick Calcs *Online calculators for Scientists*). Differences considered significant with $p< 0.0001$, $p< 0.001$, $p< 0.01$ and $p< 0.05$. Values are expressed as mean ± standard error mean (S.E.M).

RESULTS

Effect of S. Album on Lipid Profile: A significant decrease ($p<0.001$) in TG levels (40.59 mg/dL) was found in test rabbits after 14 day oral treatment with WSPS of *S.album* (30 mg/kg) as compared to control and positive control groups treated with distilled water (1ml) and simvastatin (20mg/kg) respectively for the same period (Table 1). Same doses of both *S.album* and simvastatin produced a prominent reduction ($p<0.001$) in TC levels of test (70.29 mg/dL) and positive control (40.06 mg/dL) groups as compared to control rabbits (Table 1).

A theoretical decrease in LDL-C levels (21.39 mg/dL) of test rabbits was observed as compared to control rabbits, but it was not statistically significant. However, HDL-C levels ($p<0.05$ and $p<0.001$) were also decreased in test rabbits compared with other two groups (Table 1). Observed readings of LDL-and HDL-C levels of control and positive control rabbits are mentioned in Table 1.

Table 1: Effect of *S.album* on lipid profile (mg/dL)

Parameters	Control	Positive control	Test
TG	109.04 ± 13.3	111.14 ± 14.3	40.59 ± 4.9**##
TC	103.27 ± 2.1	40.06 ± 8.04***	70.29 ± 2.4***
HDL-C	50.96 ± 3.3	96.86 ± 11.9*	40.78 ± 1.2##
LDL-C	30.50 ± 2.3	38.15 ± 8.38	21.39 ± 3.6

Each value is the mean ± S.E.M (n=6). * = $p<0.05$, ** = $p< 0.001$, *** = $P< 0.0001$ represent significant differences from respective control and ## = $p< 0.001$ from respective positive control

Table 2: Effect of *S.album* on enzyme activities (U/L)

Parameters	Control	Positive control	Test
ALT	17.14 ± 1.8	29.20 ± 0.79	15.99 ± 1.50###
CK	216.63 ± 2.5	208.44 ± 1.95*	195.45 ± 2.3***#

Each value is the mean ± S.E.M (n=6). *** = $P < 0.0001$ represent significant differences from respective control and # = $p< 0.01$, ### = $p< 0.0001$ from respective positive control

Effect of S. Album on Cardiac-and Liver-Specific Enzymes: A significant difference was found in CK levels of test rabbits compared with positive control ($p< 0.01$) and control ($p< 0.0001$) groups (Table 2). Similarly, ALT levels in all three groups including control, positive control and test rabbits were found normal and ranged from 15.59 to 29.20 U/L (Table 2).

DISCUSSION

With the high prevalence use of medicinal plants /herbs in all over the world, especially Asian countries like Pakistan, researchers are interested to investigate their benefits and harms. Continual research is necessary to evaluate new aspects of pharmacological activities of many plants / herbs which are already being used to treat different diseases. Similarly, *S. album* is also described as a medicinal plant being used for various purposes [1] but to our knowledge no report exists related to its pure hypolipidemic activity. The present study demonstrated for the first time the hypolipidemic activity of *S.album,* whereas water soluble portion of its stem (WSPS) powder was found to have pronounced effect on serum lipid contents including total cholesterol (TC), triglycerides (TG), HDL-C and LDL-C of test rabbits. Significant decrease in TG and TC levels was found in test rabbits and also accompanied with low levels of LDL-C as compared to their levels found in control rabbits. Interestingly, decreased levels of HDL-C were also found in test rabbits beside its elevated levels. Whereas simvastatin significantly elevate the levels of HDL-C ($p<0.05$) in positive control group. It has already been

reported that low levels of HDL-C and high levels of LDL-C predict the high risk of cardiovascular diseases that may be the consequences of hyperlipidemia [16]. In this study, low levels of HDL-C is actually in relation of low levels of TC found in test rabbits treated with WSPS (30 mg/kg) consecutively for 14 days. Literature showed that almost 30% blood cholesterol is carried in the form of HDL and responsible to transport cholesterol from peripheral tissues to liver for its metabolism and excretion [17]. On the other hand, decrease level of LDL-C is the beneficial aspect of present study. LDL-C transports cholesterol to peripheral tissues or arteries and as it is smaller than other lipoproteins including very low-density lipoproteins (VLDL) and chylomicrons, can easily reached into extra-cellular spaces of vessel walls where these are taken up by macrophages that gradually turn into foam cells, the predominant type of cells found in fatty streaks, an early precursor of atherosclerotic plaques or atheroma [18]. Therefore, LDL-C reducing effect of *S.album* also reduces the risk of atherosclerosis, heart attack, stroke and other cardiovascular diseases. This property has also strengthened its use as one of the ingredients of Chinese and Indian medicines for treating cardiac disorders [19]. In addition the present study has almost successfully achieved the initial theme of the paper that many medicinal plants having anti-oxidant activity significantly involved in the reduction of lipids in normal, diabetic and hyperlipidemic animals such as fenugreek, Garlic, *Mormordica diodica* roxb, Olive, *Phyllanthus emblica,* etc [20-25]. Previously antioxidant activity of sandal wood on nitric oxide production of RAW264.7 cells [15] and its oil in term of increasing glutathione-*S*-transferase (GST) activity and the acid soluble sulfhydryl (-SH) levels in liver of mice have been reported [8].

Alanine aminotransferase (ALT) is chiefly resides in liver and its elevated level represents the hepatic parenchymal injury / diseases [16]. Where as heart is one of the principal sources of creatine kinase (CK), others being are brain, skeletal and smooth muscles. Therefore the elevation in its level in serum represents myocardial infarction and muscle diseases [16]. Pharmacologically, drugs which taken into the body either orally or through any other modes of administration must not be harmful to any of the tissue of the body [26]. Tissue injury can be monitored by measuring the levels of its specific enzymes [18]. In the present study, besides being beneficial for reducing the serum lipids of rabbits, the *S.album* also involves in keeping the normal levels of ALT and CK, which indicates that WSPS powder of *S. album* did not have any harmful effects on these liver and cardiac-specific enzymes respectively.

It was concluded that, water soluble portion of stem powder of *S.album* was significant hypolipidemic agent, as it had reducing effect on serum total cholesterol, triglycerides and low-density lipoproteins in test rabbits. Work is still going on to investigate the hypolipidemic effect of its extracts (aqueous/organic solvent) on high-fat diet induced hyperlipidemia and to elucidate its probable mechanism of action on the reduction of serum lipids.

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