Original Article

Analyzing The Therapeutic Effects Of Sandalwood Powder (Santalum Album) In Management Of Hypercholesterolemic Patients: An Experimental Trail

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Abstract

Cardiovascular diseases (CVDs), which significantly increase mortality, disabilities, and medical costs globally, are at risk to health due to dyslipidemia. Components of Chinese medicine that can be used to cure illness and provide healthcare include medicinal and culinary plants because of the similarity between their roles as food and medicine.

Primary prevention is critical in lowering the incidence of CVDs, breakthroughs in reducing dyslipidemia can significantly reduce morbidity and mortality associated with CVDs. Sandalwood oil and its extract are traditionally used to treat different conditions which include diabetes, cancer, dyslipidemia, and cardiovascular diseases. The current research was examined to evaluate the cardio-protective effects of sandalwood powder as primary prevention in treatment of hyperlipidemia. For this purpose, sandalwood powder was initially analyzed for chemical phytochemical analysis. Furthermore, to check its hypolipidemic effects Hyperlipidemic females were selected from age 30 -50 years and divided into three equal groups in which Control group were not given any doses, While the experimental group G1 and G2 were given 2g and 4g doses respectively along their regular medication. Biochemical test of patients along with physical parameters like weight and height were also observed before the initiation and after the end of trial. The results showed that wood powder contains 0.44% moisture content,15.94% ash content, 0.00% crude fat, 04.05% crude fiber, 3.625% crude protein and NFE 75.90%. Sandalwood powders also contain a certain amount of antioxidant Total phenolic content (TPC) 315.33±11.51. Total flavonoids contents (TFC) 25.39±2.87. The patient's biochemical data revealed that the experimental groups G1 and G2 had considerably (P 0.001) lower serum lipid profiles before the study ended, whereas HDL levels had increased. Besides helping people lose weight and drink more water, sandalwood powder also has anti-hyperlipidemic properties.

Keywords: hyperlipidemia, sandalwood (Santalum album), Nutritional Facts, Antioxidant activity, Herbal Medicine

Introduction

Hyperlipidemia is a condition that includes several inherited and developed abnormalities that narrate high levels of lipids in the human body. A great range of experiments has been done which gives the clear association of elevated lipid profile with coronary heart diseases. Hyperlipidemia is very common throughout the world but especially in the western countries. At present, over three million persons in the United States and Europe have been confirmed to have Hyperlipidemia, and that figure is progressively increasing (AlshamiriM et al., 2018). Lipid profile typically includes

HDL, LDL, and VLDL. High levels of LDL are associated with the development of coronary artery diseases. While HDL (high density lipoproteins) is identified to have cholesterol lowering effects. As a result, they inhibit the process of vascular diseases by balancing the cholesterol in the body (Ballantyne CM et al., 2000). Indian sandalwood, also known as Chandana in Sanskrit, is one of the world's most valued gifts from ancient India. In the perspective of contemporary medicine, the scientific and therapeutic merits of Indian sandalwood are being rediscovered. Numerous pharmacological benefits of sandalwood have been discovered, including anti-inflammatory, antioxidant, anti-microbial, and anti-proliferative activities. The main component of SWO, alpha-santalol, has been shown to have chemo preventive properties and may not be hazardous to normal cells (Dwivedi et al., 2003). Sandalwood trees are sized in the middle. Its native land is the Malayan Peninsula. The Malayan Peninsula serves as its primary trading hub. Before it was commercialized, it supplies most of the sandalwood in East Asia, the Arab world, and India. The best-selling types of sandalwood (Santalum spicatum) are advertised as being Indian and Austrian. It is held by Pakistan, Bangladesh, Sri Lanka, Australia, Indonesia, Nepal, and Hawaii. Santalum album (Sandalwood) contains Sesquiterpenols: α-santalol, β-santalol, and sesquiterpenenes as an active component (Raghavendra, 2009). Sandalwood oil reveals a secondary antioxidant action by enhancing the glutathione-S-transferase (GST) activity and. The petroleum ether fraction of Santalum album has anti-diabetic and anti-hyperlipidemic qualities that could be used to treat cardio vascular diseases and insulin resistance (Scartezzini and SperoniE, 2000).

Materials and methods

Research Area

Research was accompanied in the department nutrition and dietetics of The University of Faisalabad.

Collection and Preparation of Raw Material

The sandal wood powder was bought from the local pansar shop in Faisalabad. The powder was kept in a polythene bag to avoid any contamination. The powder was subjected to numerous analyses defined as follows.

Chemical Characterization of Sandal Wood powder

Proximate analysis

The sandalwood powder was analyzed for moisture ash, crude fiber, crude protein and NFE according to the particular methods as defined in AOAC 1990 (AOAC,1990).

Mineral analysis

The sandalwood powder was analyzed for the mineral determination. Calcium and iron was analyzed by using an atomic absorption spectrophotometer (MillerRO,1998).

Phytochemical analysis of Sandal wood Powder (Santalum Album)

The total phenolic contents in sandalwood powder were determined by Folin-Ciocalteu (Nazetal., 2016).

Bio evaluation of sandal wood powder (Santalum Album) against hyperlipidemia in human female subjects:

Inclusion criteria

All Hyperlipidemic females of age of 30 to 45 with no other disease were included in the study.

Exclusion criteria

No lactating women, pregnant women, Women with other disease then hyperlipidemia, no male patients were included

in the study.

Treatments group and treatment plan

The study was conducted for the period of 60 days.30 females were randomly selected from 40 years to 45 years of age were divided into 3 equal groups each contained 10 patients describe in table.

Table1: Treatments plan

Groups	Title	Treatment
G0	Control group	Placebo
G1	Treatment group	Sandal wood capsule of 2g/kg/body weight
G2	Treatment group	Sandal wood capsule of 4g/kg/body weight

Collection of blood samples

Before the trial began and after it ended, blood samples from the participants were taken to examine their lipid profiles and hematological markers using the technique described by (Means et al., 2023).

RESULTS

Proximate composition of sandal wood powder (Santalum album)

A crucial factor in the quality of the raw materials used in an effective technique is the outcome determination of the proximate composition.

In this analysis six attributes being observed were moisture content, ash content, crude fat, crude fiber, crude protein, and nitrogen free extract. Sandal wood powder contained 0.46% moisture content, 15.94% ash content, 0% crudefat,4.05%crudefiber,3.625%crudeproteinand75.92%nitrogenfree extract (NFE).

Table2: Mean±S.D of proximate analyses of sandal wood powder (Santalum album)

Proximate features	Values(%)±S.D
Crude fat	00.00
Moisture content	00.46±0.02
Crude protein	3.625±0.98
Crude fiber	04.05±0.61
Crude ash	15.94±1.78
Nitrogen free extract	75.90±4.72

Mineral analysis

Minerals analysis of sandalwood powder was conducted by using the Atomic Absorption Spectrophotometer (HitachiPolarizedZeemanAAS, Z8200, Japan) ensuing the conditions described in AOAC (1990).Calcium and iron was analyzed in the powder. Calcium was present insufficient amount in the powder.

Table3: Mineral analysis of sandal wood powder

Minerals	Amount(mg/kg)	Amount(µg/g)
Calcium (Ca)	726±16.28	5.0±0.31
Iron (Fe)	175±7.56	0.0±0.0

Phytochemical Screening of Sandalwood Powder (Santalum Album)

Phenolic and flavonoids is the major photochemical that are responsible for the antioxidant activities of medicinal plants and plants products. These are nonnutritive compounds that provide health benefits. The total phenolic contents in sandalwood powder were determined by Folin-Ciocalteumethod.

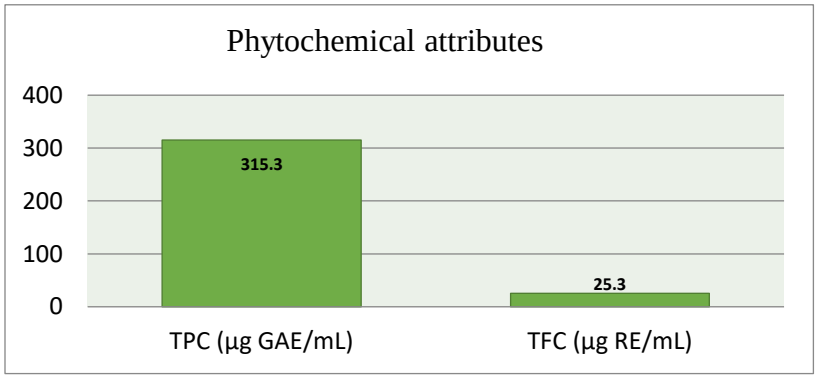

Figure No.1: Phytochemical analysis of sandal wood powder

Investigation of Anti-hyperlipidemic Potential of Sandal wood (Santalum Album) Effects on Cholesterol Levels

The investigation showed significant changes in the cholesterol levels of patients after one and two months as compared to G0 (control group). In G0 the means values for cholesterol remain same while in G1 and G2 the values decrease from 207.00b±16.95 to 203.40b±25.50 and 243.40a ±16.95 to 232.00a ±24.48 after one month respectively. And again, after two months the mean values decrease from203.40b±25.50 to198.90ab±49.04in G2 group and 232.00a±24.48 to224.60ab±37.70 in G1 group.

Table4: **The change in serum Cholesterol of control and treatment groups**

Groups	0-day	1month	2month
G0	221.50^{ab}±17.4	220.50^{ab}±20	220.50^{ab}±17.47
G1	207.00^{b}±16.95	203.40^{b}±15.0	198.90^{ab}±19.04
G2	243.40^{a}±16.95	239.00^{a}±14.8	224.60^{ab}±17.70

Effects on Triglycerides

Means for the triglycerides showed significant changes in the triglyceride's levels of patients after one and two months as compared to G0 (control group). In G0 the means values for triglycerides remains same while inG1 and G2 the values decrease from270.50a ±90.22 to 265.90a±86.71 and 265.40a±90.22 to 254.60a±88.36. After one month respectively. And again after two months the mean values decrease from 265.90a ±86.71 to 260.50a ±49.45 in G1 group and 25460a ±88.36 to 244.20a±48.59 in G2 group.

Table5: The change in serum Triglycerides of control and treatment groups

Groups	0-day	1month	2month
G0	258.20a±23.13	277.50a±17.31	277.50a±28.58

G1	272.50a±20.22	268.90a±16.71	260.50a±29.45
G2	323.40a±20.22	315.60a±18.36	305.20a±28.59

Effects on Low Density Lipoproteins (LDL)

Low density lipoproteins levels are reduced significantly in both treatments' groups. The mean values of LDL levels decrease from 218.20abc±42.72to210.20bc±67.07after one month and from 210.20bc±67.07 to 200.60bc±27.16 in G1. In G2 group the mean values of LDL decrease from 221.50a±45.80 to 210.00ab±67.16 after one month and values further decreased from 210.00ab±67.16 to 190.50ab±27.86after two months. While in the control group the values of LDL increased after one and two months respectively.

Table6: The change in serum LDL-c of control and treatment groups

Groups	0-day	1month	2month
G0	153.70^{c}±20.59	159.70^{c}±25.09	162.10^{c}±17.47
G1	190.20^{abc}±22.2	177.20^{bc}±27.07	173.60^{bc}±17.16
G2	221.50^{a}±25.80	214.00^{ab}±27.16	206.50^{ab}±17.86

In comparative studies between the three groups the high-density lipoproteins levels are seen significantly high in G2 group as compared to G1 and G0. The mean values of HDL in G1group increase from 63.50ab±20.24 to 71.00b ±10.38 after one month and from 71.00b ±10.38 to 85.20b ±15.43 after two months. While in G2 group the mean values increase from 0 day60.70b ±20.24 to 75.80b ±10.30 after one month and after two months HDL values further increase from75.80b±10.30 to 89.00ab±15.81. While in G0 group the HDL values were seem decreased from 0 day to one month and further decreased after two months.

Table No. 7: The change in serum HDL-c of control and treatment groups

Groups	0-day	1month	2month
G0	93.00^{a}±17.14	54.00^{b}±16.02	54.00^{b}±14.91
G1	63.50^{ab}±20.24	65.00^{b}±10.38	69.20^{b}±15.43
G2	50.70^{b}±20.24	53.80^{b}±10.30	57.00^{ab}±15.81

Effects on the Physical Parameters (Weight Change &Water Intake):

Physical parameters of the patients of all three groups were measured before initiation of trail after month and again after termination of trail after two months.

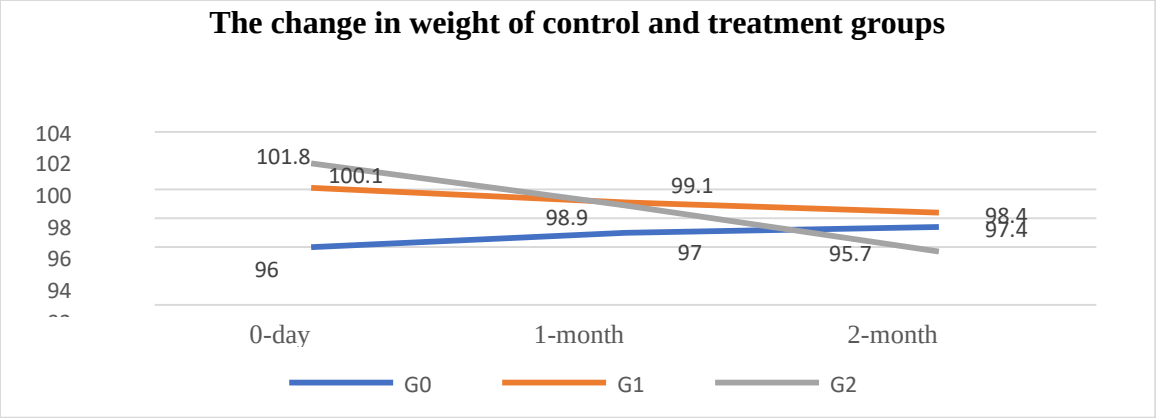

Figure No.2: The change in weight of control and treatment groups

In comparative study among all three groups the patient in G2 group showed more weight loss and increased water intake as compared to G1 and G0. In following graphs of weight changes the mean values of G0 group increased from 96 to 97.4, the mean values of G1decreased from 100.1 to 98.4, while in G2 group the mean value decreased from 101.8to95.7 which is high as compared to both G1and G0 group.

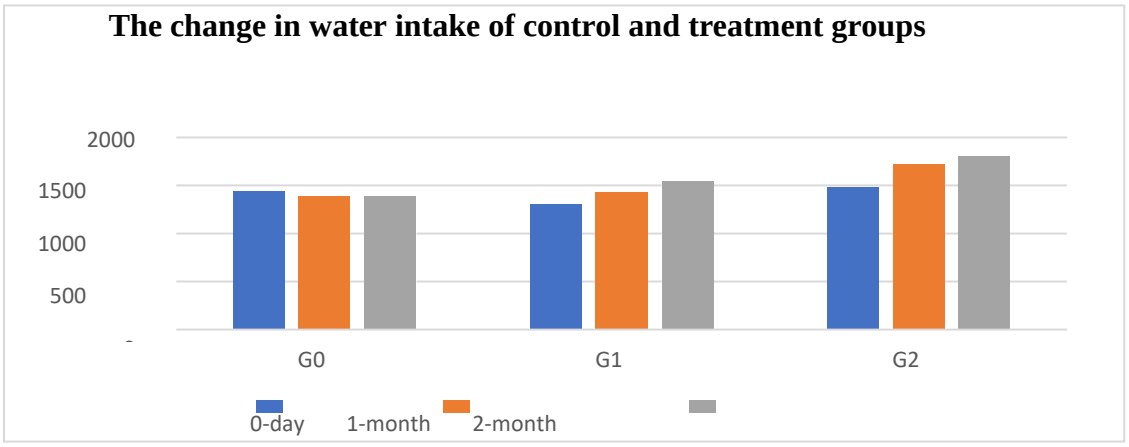

Figure No.3: The change in water intake of control and treatment groups

DISSUUSSION:

For the determination of the nutritional profile the proximate analysis is a significant method. Proximate analysis includes different parameters which are moisture content, ash content, crude fiber, crude protein, and crude fat. It also includes nitrogen free extract of the sample. in the recent study the sandal wood powder was used while in the literature sandalwood oil was used to determine it pharmaceutical properties (Bombarded et al., 2019). Any substance or object's water content will show how much moisture it contains, which varies for different substances depending on how well they can retain or consume moisture. Amount of Ash content that was15.94±1.78%. The body uses fats as a source of energy and as building blocks for the absorption of vitamins A, D, E, and K. Long-standing health advantages include a substantial decrease in cardiovascular diseases when the saturated fat is replaced with mono-and polyunsaturated fats. The crude fat of my sample was about 0.002 ± 0.0 %while the while an investigation was directed by certain analysts, they presumed that sandal wood powder contains 04.05±0.61 % substance of crude fat (Kumar et al., 2019). The rough protein was dissected in every one of the medicines, the sandal wood powder leaves contains undo protein that was about 3.625±0.98% (Thulasiram et al., 2022). The mineral requirements of the human body are substantial.

However, their absence can lead to a variety of health issues in the body, including osteoporosis, arthritis, and issues with the teeth. According to the recent research the amount of Calcium (Ca) in sandal wood was726±16.28mg/kg, ppm and Iron (Fe) was175±7.56mg/ kg, µg/g (Umdale et al., 2020). Flavonoids and phenolic contents are very helpful because they work as antioxidants and protect from different heart problems, cancers, and degeneration of cells. According to recent research sandalwood powder was 56 contained the amount total phenoliccontent315.33±11.51mgGAE/ml. in past research the sandalwood oil and berries were used. A berry of sandalwood tree has a higher concentration of moisture content and total phenolic content. The moisture level (82.390.32%) and ash content (30.60.17%) of the ripened berries were also quite high. It also has a good amount of crude protein (8.66 g/100 g), total carbs (8.08 g/100 g), crude fat (1.79 g/100 g), and energy (67.87 g/100 g). Although the aqueous extract of berries had more flavonoids (10.98 0.14 mg RE/100 g), the methanolic extract of berries included higher concentrations of phenolic (4.97 0.07 mg GAE/100 g) and alkaloids (7.16 0.09mgCoE/100 g) (UmdaleS et al.,2020).the aim of the study was to explore the Therapeutic potential of sandalwood (Santalum album) against hyperlipidemia. 30 human female subjects were selected randomly. They were divided into 3 groups G0, G1 and G2. GO was the control group receiving 0g/day of sandalwood powder. While G1 and G2 were treatment groups receiving 2g/day and 4g/day sandal wood powder in the form of capsules. The study was conducted for 60 days. A biochemical investigation was done to check the efficacy of sandal wood powder against Hyperlipidemia. Lipid profile of patients was done before initiation of trial, in the middle of trial (after 30 days) and again after the end of trial. The physical parameters of the patients of all three groups were measured before the trial, after one month and again at the termination of the trial. in comparative study among all three groups the patient in G2 group showed more weight loss and increased water intake as compared to G1 and G0. Abroad inspection to determine the nutritional value of food is part of the cycle of guarantee of debris content. It is the underlying advances for basic investigation in example readiness my sample's overall analysis reveals significant effect.

CONCLUSION

Hyperlipidemia is a leading cause of cardiovascular diseases all over the world. The prevalence of hyperlipidemia has been raised due to inactive lifestyle, food patterns and eating habits. In today’s modern era herbal medicines has gain much popularity as compared to the drugs. Herbal medication probably has fewer side effects as compared to the chemical drugs. Our research was conducted to explore the anti-hyperlipidemic potential of sandalwood powder (Santalum album) on patients with elevated lipid profile. Two doses 2g and 4g doses of sandal wood powder were selected for experimental groups G1 and G2 respectively and given orally in the form of gelatin capsules for the period of 60 days. It was seen that Sandal wood capsules cause can significantly decrease in serum cholesterol, triglycerides, and LDL.

In the beginning of trial, HDL levels start rising significantly. The use of sandalwood powder can prevent hyperlipidemia. However, it is important that the physiological and nutritional effects are properly established through carefully monitored clinical trials.

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