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Antioxidant and Hepatoprotective activity of *Anaphyllum wightii* Schott.

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Abstract

Herbal medicines have traditionally been used worldwide for the prevention and treatmentof liver disease with fewer adverse effects. The tubersof *Anaphyllum wightii*plant were chosen andstudied for their antioxidant activity *in vitro* and hepatoprotective activity *in vivo*. The antioxidant activity of the chloroform extract was examined *in vitro* using a 1,1-diphenyl-2-picrylhydrazyl (DPPH) freeradical scavenging assay and super oxide scavenging assay. The extract had significant dose-dependent antioxidant activity in all *in vitro* experiments. The percentage of free radical scavenging by DPPH and super oxide scavenging assay values of *Anaphyllum wightii*and ascorbic acid (standard) were found to be 49.02±4.11, 60.20±3.43 and 72.78±3.97 respectively. Hepatoprotective activity of the plant extract was evaluated in a rat model of carbon tetrachloride (CCl_4)induced liver damage. CCl_4 significantly altered serum marker enzymes, total bilirubin, total protein, and liver weight. The extract caused these values to return to normal in rats with CCl_4induced liver damage. This indicated the hepatoprotective potential of*Anaphyllum wightii*and was comparable to use of the standard drug silymarin. Thus, the present study revealed that *Anaphyllum wightii* have significant antioxidant and hepatoprotective activity.

Key-Words: *Anaphyllum wightii*, antioxidant, hepatoprotective,DPPH

Introduction

Plant dugs have been a major source for treatment of diseases for a long time. They have been used in the traditional medicine on the basis of experiences and practice. With the advent of modern systems of medicine need has been felt to investigate the active constituents present in these plants. Various molecules have been isolated, characterized and tested for their related pharmacological activities.

Reactive oxygen species (ROS) and reactive nitrogenspecies (RNS) are produced by normal physiologicprocesses and fulfill important functions in the body atminute or moderate concentrations. ROS and RNS arenecessary for the maturation process of cellular structuresand can act as weapons for the host's defence system.The importance of ROS production by the immunesystem is clearly evident in patients with granulomatousdisease. These patients have a defective membrane-boundnicotinamide adenine dinucleotide phosphate (NADPH)oxidase system that precludes them from producingthe superoxide anion radical (O_2^-), thereby resultingin multiple and persistent infections[1,2].

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Oxygenradicals have crucial action such as signal transduction,gene transcription and regulation of synthesis of cyclicGuanosine monophosphate (cGMP) in cells[3,4].

Nitric oxide (NO) is a common signaling moleculeand participates in virtually every one of the body'scellular and organ functions. Optimum amountsof NO produced by endothelial cells are essential forregulating the relaxation and proliferation of vascularsmooth muscle cells, leukocyte adhesion, plateletaggregation, angiogenesis, thrombosis, vascular tone andhemodynamics[5]. In addition, NO produced by neurons serves as a neurotransmitter[6].

However, the generation of even slightly largeramounts of these essential compounds during metabolismor in response to environmental pollutants, radiation,chemicals, toxins, deep fried and spicy foods, andphysical stress can cause massive physiologic problemsby oxidation of bio-molecules (protein, amino acids,lipid, and DNA). Free radical presumably plays a majorrole in all pathologies. Free radicals are believed to beresponsible for more than one hundred conditions likecancer, diabetes, atherosclerosis, arthritis, neuropathy, nephropathy, retinopathy, aging, compromised immunity, and cardiovascular diseases[7,8,9,10].

The liver has a central role in transforming andclearing chemicals and is closely related to thegastrointestinal tract, which makes it susceptible to drugtoxicity, xenobiotic, and oxidative stress. Dysfunctionof this organ results in impairment of energy metabolismand intracellular oxidant stress with excessive formationof ROS. CYP2E1 is a cytochrome P450 isoenzymeproduced by the liver that also facilitates oxidativestress and cell injury[11, 12].Although Kupffer cellsand recruited neutrophils in the liver are part of thehost-defence system, these inflammatory cells initiateliver injury under certain circumstances,such as when excess free radicals are present [13,14,15,16].

Although the body has mechanisms to defend againstthe damaging properties of ROS[17,18],its capacity tocontrolROS can be overwhelmed, causing irreversibleoxidative damage and various conditions that threaten theliver and other parts of the body. Several synthetic andsemi-synthetic chemicals are often used to protect theliver from the detrimental effects of free radicals but they are not sufficiently effective and cause adverse reactions.Modern medicine includes many important bioactivemolecules with antioxidant and hepatoprotective properties that were derived from plant. Hence, recent research has hastened to identify notablehepatoprotective agents from plant products that willreduce the harmful effects of and problems associatedwith free radicals while causing minimal adversereactions.

As part of ongoing research, the current study examined the chloroform extract of*Anaphyllum wightii*for its use as a hepatoprotective agent to reduce thedamage caused by ROS and RNS.No reports have described the plant's hepatoprotectiveactivity. Thus, the present study sought to investigate the chloroform extract of *Anaphyllum wightii*for its hepatoprotectiveactivity using a rat model of CCl_4induced liver damageand different *in vitro* antioxidation experiments.

Material and Methods

Experimental animals

Healthy albino rats weighing 150-200g of either sex were used. The experimental protocol was approved by the Institutional Animal Ethics Committee (APSC/CPCSEA/-04/IAEC/2013) and animals were maintained under standard conditions in the animal house approved by Committee for the Purpose of Control and Supervision on Experiments on Animals (CPCSEA).

Collection and Authentication

Genus –*Anaphyllum beddomei* Engl. and *Anaphyllum wightii* Schott were reported from the high ranges of Western Ghats.The two species in this genus are similar in appearance to those in the genus Anaphyllopsis.Genus*Anaphyllum wightii* is listed as an endemic and threatened genus of South India[19]. The species of the genus Anaphyllum are found in marshes.They are characterized by pinnate leaves and twisted spathe for the spadix.Anaphyllum is a genus of flowering plants in the Araceae family. The tribal communities (Kani Tribes, Malasars,Kadars, Pulayars, Madhuvarsetc) use these plants as food and as an antidote to snake bite.Leaves of *Anaphyllum beddomei* form a part of tribal diet.Arun et al. reported the use of the corms of *Anaphyllum wightii* (Keerikizhangu), as an antidote to snake bite along with some medicinal plants[20].

Plant material

Plant tubers were collected from Wynad hills, Wynad district, Kerala, India. The taxonomical identification of the plant was done by Dr. N. Sasidharan, Scientist-F, Programme co-ordinator, FE& BC division, Kerala Forest Research Institute, Peachi, and Trissur. The voucher specimen was preserved in Academy of Pharmaceutical sciences,Pariyaram Medical College, Kannur, and Kerala.

Preparation of plant extract

The collected plant tubers was dried at room temperature, pulverized by a mechanical grinder, sieved through 40 mesh. About 200g of powdered materials were extracted with chloroform. The extracted solution was filtered using a clean cloth and the filter paper. The extract wasconcentrated first in a rotary vacuum evaporator and then in a water bath. The extracted residue was weighed and the percentyield was 9.21% w/w. The extract was then frozen prior to examination of its potentialantioxidant and hepatoprotective properties.

Chemicals

DPPH(2, 2-diphenyl-1-picrylhydrazyl), ascorbic acid, carbon tetra chloride,phosphate buffer saline (pH 6.3),EDTA, nitro blue tetrazolium (NBT), riboflavin andsilymarin were purchased from Merck Pharmaceuticals.

DPPH Free Radical Scavenging Assay[21,22,23]

1 ml of the test compound in various concentrations (50, 100,150, 200 & 250 µg/ml) was added to 1ml of 0.1 mm solution of DPPH in methanol. After 30 minutes, absorbance was measured at 517 nm, using a spectrophotometer (SHIMADZU,UV 1800).A 0.1 mM solution of DPPH in methanol was used as blank, whereas ascorbic acid was used as a reference standard. All tests were performed in triplicate. Percent inhibition was calculated using equation,

Percent inhibition = [(Control ×Test)/Control]×100

Superoxide Scavenging Assay[21,22,23]

1ml of the test compound in various concentrations (50,100,150,200& 250 µg/ml) was added to 0.2ml of EDTA, 0.1ml of NBT, 0.05 ml of riboflavin and 2.6 ml phosphate buffer. The control tubes were also set up where DMSO was added instead of the plant extracts. All the tubes were vortexed and the initial optical density was measured at 560 nm in a spectrophotometer. The tubes were illuminated using a fluorescent lamp for 30 minutes. The absorbance was measured again at 560 nm. The difference in absorbance before and after illumination was indicative of superoxide anion scavenging activity. All tests were performed in triplicate. Percent inhibition was calculated using equation,

Percent inhibition = [(Control×Test)/Control]×100

Hepatoprotective activity

The hepatoprotective activity of chloroform extract of *Anaphyllum wightii* was determined using a rat model of carbon tetrachloride induced hepatotoxicity. After seven days of acclimatization, rats were divided into four groups consisting of three rats each. Treatment lasted for 8 days. Group I served as the normal control and received only normal saline (1 ml/kg, *i.p*. for eight days). Group II served as the toxic control and was administered carbon tetrachloride in liquidparaffin (CCl4:liquid paraffin 1:2; 1 mL/kg, *i.p.*) once every 72 hours. Group III served as the positive control and was administered Silymarin (25 mg/kg/day, *p.o.*) alongwith carbon tetrachloride in liquid paraffin (CCl4:liquidparaffin 1:2; 1 mL/kg, *i.p.*) once every 72 hours. Group IV was administered chloroform extract of *Anaphyllum wightii* (300 mg/kg, *p.o.*) daily and carbontetrachloride in liquid paraffin (CCl4:liquid paraffin 1:2; 1 mL/kg, *i.p.*) once every 72hours.Twenty-four hours after the last dose, blood was taken from the retro-orbital plexus undersodium phenobarbital anesthesia and rats were dissected to remove the liver. Before blood was collected, the syringe wasringed with heparin to prevent haemolysis/clotting.The blood samples were then centrifuged at 2,500 rpm at 37°C to separate serum and were used to estimate the biochemical markers of liver damage, *i.e.* SGOT, SGPT [24, 25], ALP [26], bilirubin [27] and total protein levels[28].

Results and Discussion

Antioxidant activity

Several concentrations ranging from 50-250µg/ml of the chloroform extracts of *Anaphyllum wightii* were compared for their antioxidant activity in different *in vitro* models. It was observed that free radicals were scavenged by the extracts in a concentration dependent manner up to the given concentration in all the models. The absorbance of the extracts increased with the rise in their concentrations since the absorbance is directly proportional to the antioxidant property. As shown in Table 1 and 2 the chloroform extract of *Anaphyllum wightii* (from 22.98±2.11% to 49.02±4.11% for DPPH free radical scavenging assay and from 29.48±1.44% to 60.20±3.43% for super oxide scavenging assay) indicates better antioxidant power. The standard drug ascorbic acid showed 72.78±3.97% antioxidant power at 50µg/ml concentration. The roles of antioxidants are to neutralize the excess of free radicals, to protect the cells against their toxic effects and to help prevent disease. Results of the current study indicated that the chloroform extract of *Anaphyllum wightii* has significant DPPH and super oxide scavenging activity. These pharmacological effects of the extract may at least in part be due to phenols and flavonoids components that were found in the chloroform extract of*Anaphyllum wightii*. Phenols are ubiquitous secondary metabolites in plants and have a wide range of therapeutic uses because of their antioxidant, antimutagenic, anticarcinogenic, and free radical scavenging activity[29,30,31,32]. The antioxidant activity of phenolic compounds is mainly due to their redox properties, which can play an important role in absorbing and neutralizing free radicals, quenching single and triplet oxygen or decomposing peroxides[33]. Flavonoids are a group of polyphenolic compounds with known properties, which include free radical scavenging and inhibition of hydrolytic and oxidative enzymes[34]. Furthermore, these compounds have a strong affinity for iron ions (which are known to catalyse many processes and lead to the appearance of free radicals), so their antiperoxidative activity could also be attributed to a concomitant ability to chelate ion. Therefore, the phenol and flavonoid components in the chloroform extract of *Anaphyllum wightii* may have contributed directly to antioxidant action noted in this study.

Hepatoprotective activity

The hepatoprotective activity of the crude chloroform extract at a dose of 300 mg/kg body weight in ratswith carbon tetrachloride-induced damage is shown in Table 3. For comparison, the table also shows theuntreated group (control), carbon tetrachloride-treated group (induction control) and the group treated withthe drug (silymarin). The control group (I) had serum SGPT of 23.1 ± 0.34 U/L, SGOT of 38.8 ± 0.39 U/L,ALP of 20.28 ± 0.04 mg/dL, total bilirubin of 1.06 ±0.016 mg/dL, total protein of 12.14 ± 0.18 KA, andliver weight of 5.96 ± 0.18 g. In the group with CCl_4 induced liver damage (II), serum SGPT increased to75.6 ± 0.61 U/L, SGOT increased to 86.4 ± 0.39 U/L,

ALP increased to 68.12 ± 0.14 mg/dL, total bilirubinincreased to 6.38 ± 0.027 mg/dL, total protein increased to 7.87 ± 0.033 KA, and liver weight increased to9.87 ± 0.51 g. Administration of Chloroform extract of *Anaphyllum wightii* in rats with CCl_4induced liver damage resulted in gradual normalization of SGPT, SGOT, ALP, total bilirubin, total protein and liver weight compared to CCl_4 treated group.

In most developing countries, there is a highincidence of viral hepatitis.Identification of anefficient hepatoprotective drug derived from naturalsources is an urgent necessity. The changes associatedwith CCl_4induced liver damage are similar to thoseof acute viral hepatitis[35]. CCl_4 is therefore a usefultool for inducing hepatic damage in experimentalanimals.The hepatotoxicity of CCl_4 is the result of its reductive dehalogenation. It is catalyzed bycytochromic P450 to produce the highly reactivemetabolite trichloromethyl (CCl_3^-) free radical. Thisthen readily interacts with molecular oxygen to formthe trichloromethyl peroxy radical (CCl3OO·). Thesefree radicals bind covalently to cellular proteins orlipids or extract a hydrogen atom from an unsaturatedlipid, thereby initiating lipid peroxidation andconsequently leading to liver damage. A substantialincrease in the level of serum marker enzymes (SGOT,SGPT and ALP) and total bilirubin was noted in theCCl_4 control group. The return of elevated levelsof serum enzymes to near normal values in groupstreated with the chloroform extract of *Anaphyllum wightii* or standard silymarin is anindication of the stabilization of the plasma membraneand the repair of hepatic tissue damage caused byCCl_4. A decrease in the level of total proteins inrats with CCl_4induced liver damage is attributed todamage primarily in the endoplasmic reticulum. Thisresults in a loss of P450 and subsequent decrease inprotein synthesis. The rise in protein levels in treatedgroups suggests the stabilization of the endoplasmicreticulum and subsequent protein synthesis. Inaddition, CCl_4 led to a significant increase in liverweight because it blocks the secretion of hepatictriglycerides in plasma[36]. Silymarin and the chloroform extract of *Anaphyllum wightii*were found to prevent an increase in liver weight inrats. These results suggest that the chloroform extract of*Anaphyllum wightii* offers hepatic protection by reducing damage or bypreserving normal hepatic physiological mechanismsthat have been disturbed by a hepatotoxin such asCCl_4. This finding indicates that *Anaphyllum wightii* has protectiveaction *in vivo*.

Conclusion

The present study indicates thatchloroform extract of *Anaphyllum wightii* has potential antioxidantactivity *in vitro*and hepatoprotective activity *in vivo*.However, further studies are needed to examineunderlying mechanisms of antioxidant activity *in vitro*and hepatoprotective activity *in vivo*. Studies alsoneed to isolate the active compound(s) responsible forthis pharmacological activity.

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Table 1: Effect of chloroform extract of *Anaphyllum wightii* on in-vitro antioxidant activity by DPPH radicle scavenging assay

Concentration (µg/ml) of Chloroform extract	% Scavenging	Concentration (µg/ml) of Ascorbic acid	% Scavenging
50	22.98±2.11	10	35.63±2.32
100	31.36±2.14	20	48.69±2.43
150	35.64±3.34	30	53.67±2.52
200	42.02±3.17	40	61.91±3.57
250	49.02±4.11	50	72.78±3.97

Values are Mean ± SEM,n=3

Table 2: Effect of chloroform extract of *Anaphyllumwightii* on in-vitro antioxidant activity by superoxide scavenging assay

Concentration (µg/ml) of Chloroform extract	% Scavenging	Concentration (µg/ml) of Ascorbic acid	% Scavenging
50	29.48±1.44	10	35.63±2.32
100	31.89±1.07	20	48.69±2.43
150	46.03±2.88	30	53.67±2.52
200	56.28±2.73	40	61.91±3.57
250	60.20±3.43	50	72.78±3.97

Values are Mean ± SEM, n = 3

Table 3: Effect of chloroform extract of *Anaphyllum weightii* and Silymarin on serum bio chemical parameters in CCl_4induced liver damage in rats

Treatment Group	SGPT(µ/L)	SGOT(µ/L)	ALP(KA)	Bilirubin(mg/dL)	Total Protein(mg/dL)	Liver Weight(g)
Normal (control)	23.1±0.34	38.8±0.39	20.28±0.04	1.06±0.016	12.14±0.18	5.96±0.18
CCl_4	75.6±0.61	86.4±0.39	68.12±0.14	6.38±0.027	7.87±0.033	9.87±0.51
Chloroform Extract of AW	42.8±0.60	67.9±0.34	50.28±0.09	4.09±0.012	9.02±0.03	7.08±0.27
Silymarin	28.8±0.33	46.0±0.34	25.27±0.13	2.20±0.022	12.02±0.04	6.45±0.32

Values are mean ± STD and each group contained three rats. Drug treatment lasted for 8days.

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