



A Review on Pharmacological Activities of Tetrapleura Tetraptera

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ABSTRACT

Tetrapleura tetraptera Taub, in the family of Mimosaceae, commonly known as Aridan (fruit). A single stemmed, robust, perennial tree of about 30m. It has a grey/brown, four winged pods 12-25x3.5-6.5cm. It is generally found in lowland forest of tropical Africa. It is used in Africa as a spice and in folk medicine. It is one of the molluscicidal medicinal plants of Nigeria, also useful in the management of convulsions, leprosy, inflammation and/or rheumatoid pains. The biological or pharmacological activities are found to be molluscicidal, cardio-vascular, neuromuscular, hypotensive, anti-convulsant, molluscicidal, trypanocidal, schistosomiasis control, anti-ulcerative, anti-inflammatory, hypoglycaemic, anti-microbial, emulsifying property, birth control, and of intestinal parasites. All the compounds isolated either from the fruits or other parts were found to exhibit strong molluscicidal properties against the schistosomiasis.

Keywords: Tetrapleura tetraptera, molluscicidal, schistosomiasis

INTRODUCTION

Tetrapleura tetraptera (Mimosaceae) has numerous ethnopharmacological relevance, the plant has played significant roles in the management of numerous health conditions including ulcer, inflammations, arthritis, malaria and even as molluscicidal agent. Tetrapleura tetraptera Taub (Fabaceae-Mimosoideae) is a well-known tree growing widely in forest zones all over West Africa. It is used in wound-healing, diabetes mellitus, asthma, hypertension, epilepsy, convulsions, leprosy, mental illness, inflammation, arthritis and rheumatoid pain, schistosomiasis control, as a general tonic and as a flavourer/spice. The main aim of this review is to give an update on the chemistry, nutritional and medicinal values of its fruit, extracts and isolated compounds. It gives the opportunity to highlight the various ethnopharmacological uses as well as the pharmacological findings on T. tetraptera. T. tetraptera was reported to contain various biologically-active compounds such as 7-Hydroxy-6-methoxy coumarin- an anticonvulsant and hypotensive, hentriacontane-an anti-inflammatory agent, N-acetylglycosides of oleanolic acid, echinocystic acid and 27-hydroxyolean-12(13)-en-28-oic acid-as molluscicidal saponins, echinocystic acid-3-O sodium sulphate, chalcones-butein and isoliquiritigenin and the flavanone-naringenin-strong antioxidants, fatty acids with a high level of omega-3 and omega-6 acids, propanoids, amino acids-as bioactive and antioxidant constituents and structurally-related compounds. ⁽¹⁾The extracts and some of the isolated compounds showed sedative, hypotensive, molluscicidal, CNS depressant, anti-inflammatory, antimicrobial, wound-healing, contraceptive, analgesic, hypoglycaemic, antioxidant, hypolipidaemic, antimalarial, muscle-relaxant, anticonvulsant, hypothermic and anxiolytic effects in experimental animals⁽²⁾

TETRAPLEURA TETRAPTERA

Plant Identity: Tetrapleura tetraptera (mimosaceae)

Synonyms: Tetrapleura thonningii Benth, Adenantha tetraptera Schum et Thonn

Common names; Aidan tree (English)

Vernacular names; Aridan/Aidan (Yoruba), Uyayak (Ibibio), Oshosho (Igbo), Ora ora (Awka), Ighimiakia

(Bini), Imiminje (Etsako), Prekese (Twi, Ghana), Dawo (Hausa) etc

Tetrapleura tetraptera, Mimosaceae, commonly known as Aridan (fruit), A stemmed, robust, perennial tree of about 30m.ft has a grey/brown, smooth/rough bark with glabrous young branchlets. The flower is yellow/pink and racemes white the fruit has dark brown, four winged pods 12-25 x 3.5-6.5cm. It is generally found in the lowland forest of tropical Africa. The fruit consists of a fleshy pulp with small, brownish-black seeds. The phytochemical composition in the fruits of Tetrapleura tetraptera includes polyphenols (tannins, flavonoids), saponins, phytate, triterpenoid, coumarinic (scopoletin) and phenolic (caffeic acid, cinnamic acids) compounds, a triterpene glycoside (aridanin) which have been found as the active ingredients. The fruit possesses

a fragrant, characteristically pungent aromatic odour, which is attributed to its insect repellent property. It is used as spices and aroma (exotic tropical scents) and for fish poisoning. ⁽³⁾It is one of the molluscicidal medicinal plants of Nigeria, also useful in the management of convulsions, leprosy, inflammation and/or rheumatoid pains. The biological and/or pharmacological activities are found to be molluscicidal, cardio-vascular, neuromuscular, hypotensive, anti-convulsant, molluscicidal, trypanocidal, schistosomiasis control, anti-ulcerative, ectotoxicity, anti-inflammatory, hypoglycaemic, anti-microbial, emulsifying property, birth control and the intestinal parasites infections. Active-guided fractionation of the methanol extract of the fruits of *Tetrapleura tetraptera* the isolation of a saponin glycoside with an oleanolic acid aglycone, a mono desinosidic diglycoside of the rare sapogenin 27-hydroxyolean-12 (13)-en-28-oic acid; echinocystic acid-3-0-sodium sulfate from the stem bark, umbellifurone and ferulic acid from the leaves and branches respectively. ⁽⁴⁾ Also isolated from the fruits were aridanin and three of its olean-12-en-28-oic acid derivatives. All the compounds isolated either from the fruits or other parts were found to exhibit strong molluscicidal properties against the schistosomiasis.

ETHNOPHARMACOLOGY

Aqueous extracts of *Tetrapleura tetraptera* contains tannins, reducing sugars and coumarins. It also contains alkaloids, flavonoids, terpenoids, sterols and saponins but in a variable amount with significant radical scavenging activities. Copper (Cu), iron (Fe), lead (Pb) and zinc (Zn) were detected though they were all within the permissible range for medicinal plants. Variable antimicrobial activities were observed with the methanolic extracts being more potent. The various parts of *Tetrapleura tetraptera* were rich in phytochemical, possessed antioxidant and antimicrobial activities, supporting ethnomedicinal uses. The stem bark, root, leaves or fruit are usually added to palm wine in neighbouring countries to make for "more potent wine." The fruits are usually charred and the ash resulting from burnt fruits is collected and used in the making of black soaps traditionally formulated, in admixture with certain plant materials such as charred *Threobroma cacao* fruits and *Cola nitida* fruits, to wash off feverish conditions, skin rashes, treat ulcers or even drunk in very low doses for internal cleansing in herbal medicine. The nutritive quality of the dry fruit of *T. Tetraptera* used as spice as assessed showed the fruit shell, pulp and seed contained varying amounts of nutrients such as protein, lipids and minerals, which were comparable and some higher than popular spices such as pepper, onion, curry and ginger a reason why it is used in the preparation of pepper soup in southern parts of Nigeria. The fruits also found to contain cinnamic acids, caffeic acid and carbohydrates. Tannins were reported to be abundant in the fruit and stem along with saponins ^(5,6).

PHARMACOLOGICAL USES

Molluscicidal activity

Molluscicides are one of the best means for the control of schistosomiasis and trematode infections in the world's endemic countries. Aridan, *Tetrapleura tetraptera* is likely to cause less ecological damage and its potency of 1.33-5.22 ppm for different snails appears a promising one for a vegetable molluscicide as the most promising Nigerian plant molluscicide to date with the molluscicidal activity of the methanolic extract of the leaf, leaf-stalk, stem-bark, bark and fruit varies between 1.51 and 3.16 mg/L indicating that all the parts are active. The aqueous and methanolic extracts of a series of typical tannin-containing plants exhibited strong molluscicidal properties against the fresh water snail *B. glabrata*, which is the intermediate host of schistosomiasis. The molluscicidal activities of this plant have been linked to the presence of saponins alone. There is the need to identify the contributions of tannins to the molluscicidal properties of this plant to present a true picture of the molluscicidal effects of the plant. The presence of saponins which exhibited very strong molluscicidal effects against known schistosomiasis-transmitting snails.

Anti-Diabetic activity

In Streptozotocin induced diabetic rats with aqueous root bark extracts of *T. tetraptera* causes reduction in the elevated FBS levels of these rats, implying that *T. tetraptera* possess antidiabetic effects. The fruits of *T. tetraptera* have been reported to contain triterpenoidal saponins and flavonoids. One of the most obvious features of the aqueous root bark of *T. tetraptera* is the very high degree of frothing, which is a classic indicator of the presence of saponins. Polyphenols including saponins and flavonoids, apart from their antioxidant properties, are reported to exert hypoglycaemic effects. Plant flavonoids have been reported to produce hypoglycaemia by reducing glucose absorption, acting as insulin secretagogues or insulin mimetics and/or stimulating glucose uptake in peripheral tissues. In addition, triterpenoidal saponins have been reported to increase glucose uptake by tissue and cause pancreatic α -cell regeneration. Though the exact mechanism by which *T. tetraptera* exerts its antidiabetic effect remains unknown; the presence of these phytochemicals in *T. tetraptera* may be responsible for its anti-diabetic effect. The antidiabetic effect observed for *T. tetraptera* aqueous root bark extract in this study substantiates the folkloric use of this part of the plant as an antidiabetic remedy.

Anti- hypolipidaemic Activity

The polyphenol content, present in *T. tetraptera* have in vitro anti-oxidant, anti- amylase and anti- lipase activities. The aqueous extracts of the fruit had the highest content of phenolic compounds, the fruit was not potent in anti-amylase activity and also had low potency in anti-lipase activity. The hypolipidaemic effects of the fruit were investigated in hypercholesterolaemic rats, increase in lipid peroxidation and a concomitant decrease in the enzymatic antioxidant activity was observed. The varying levels of protection against CCl₄-induced liver damage, as revealed in the reduction in the activities of serum marker enzymes for liver damage- Alanine transaminase, Aspartate transaminase and Alkaline phosphatase; and bilirubin levels when compared with CCl₄- intoxicated control rats. Such defenses were made possible by the presence of flavonoids. The extracts decrease the elevation in the activities of liver enzymes and protected against CCl₄-induced liver damage and that the protection was mediated through its antioxidative defenses. ⁽⁷⁾ The antioxidant activity of the ethanolic extracts of the stem bark and fruit could be attributed to their cysteine, histidine, flavonoids-butein, naringenin

and isoliquiritigenin and phenyl propanoidscopoletin, ferulic acid, caffeic acid and p-coumaric acid in the plant extracts. The isolated flavonoids have also been shown to have different medicinal values; isoliquiritigenin, showed vasorelaxant effect, exhibited aldose reductase inhibiting property, is potent anti-tumour and an anti-inflammatory agent, butein is a potent antioxidant and an anti-inflammatory agent and naringenin, an antioxidant, showed blood glucose lowering property and lower plasma cholesterol. Oxidative stress has been linked to disease conditions like inflammation, cancer, diabetes, cataracts and aging. The presence of these metabolites in *T. tetraptera* may provide the rationale for the traditional use of the plant in these many disease conditions.

Anti-convulsant activity

T. tetraptera fruit have anti-convulsant activity due to the presence of Scopoletin. Scopoletin produced quiescence and reduction of spontaneous locomotor activity in mice, it delayed the onset of seizures induced by leptazol. The properties associated with scopoletin are similar to its derivative, scoparone, which was isolated from *Artemisia scoparia* and which also showed strong anticonvulsant activities. Many health benefits of scopoletin are now known; Scopoletin may have some benefits on people at risk of some types of cancer. It was reported that scopoletin inhibited proliferation of certain cancer cells by inducing apoptosis. Scopoletin was found to inhibit hepatic lipid peroxidation and increased the activity of oxidants, superoxide.⁽⁸⁾

Dismutase and catalase. Other studies suggested that scopoletin might benefit those at risk of high triglyceride, cholesterol and glucose levels. The fruit volatile oil was screened for anticonvulsant activity. It was reported that the fresh fruit oil provides some protection against leptazol-induced convulsions animals. It was reported on the study that the aqueous extract of the fruit was antagonizes pentylentetrazole - induced seizures. The aqueous extract of the fruit also profoundly antagonized picrotoxin - induced seizures, but only partially and weakly antagonized bicuculine-induced seizures.

CNS-Depressant Properties

The central nervous system depressant effect and neural mechanisms of Aridanin were performed by Novelty-induced rearing, head dips, locomotor activity and effect on learning and memory. It indicate the constituent, Aridanin responsible for antidepressant activity.⁽⁹⁾

Analgesic Activity

The crude aqueous extracts of the fruit possess analgesic and and hypothermic effects. Analgesic and hypothermic actions were mediated through opioids and cholinergic, 5-HT receptors. It is reported that decreased rectal temperature and acetic acid-induced writhes. The effect on acetic acid-induced writhing was completely blocked by naltrexone alone. It is reported that it did not show any analgesic activity using the hot plate test but significantly reduced acetic acid-induced writhing in mice, concluded that the compound showed both analgesic and hypothermic activities.

Anxiolytic Activity

The anxiolytic properties of aridanin isolated from *Tetrapleura tetraptera* in mice. Elevated plus-maze was used to investigate the effect. The possible involvement of the GABA- benzodiazepine receptor complex was also investigated using flumazenil. Aridanin at doses of 5 and 10 mg/kg, i.p. administered 30 min prior induced anxiolytic effect expressed by increase number of entries in and time spent in the open arms and percentage of open arm entries and decrease number of entries and time spent in the closed arms. The treatment of mice with flumazenil 15 min before the administration of aridanin (10 mg/kg, i.p.) blocked the aridanin induced anxiolytic effect. It was found out that aridanin induced an anxiolytic effect in mice which may be mediated through interaction with GABA-benzodiazepine receptor complex

Anti-inflammatory Activity & Anti-Oxidant Activity

The anti-inflammatory activity of the aqueous extract of *T. tetraptera* fruit in egg albumin-induced paw edema as well as in vitro anti-inflammatory and antioxidant activity had been documented. The acute toxicity of the methanol plant extract was determined using Lorke's method. In vivo carrageenan/kaolin induced arthritis assay was performed on *Tetrapleura tetraptera* (TtME) extract (100, 200 and 400 mg/kg) using albino rats. Indomethacin (10 mg/kg) and normal saline were employed as positive and negative controls, respectively. Histological study was performed on the knee joint of the animals after collection of blood for antioxidants analysis. Acute toxicity study showed that it is safe by oral administration up to 5000 mg/kg body weight. Oral administration of indomethacin (10 mg/kg) produced a significant and dose-dependent decrease in joint diameter. There was a decrease in malondialdehyde and increase in glutathione and superoxide dismutase. The histological assessment revealed no major adverse effects on the animals. *Tetrapleura tetraptera* fruit extract possesses anti-arthritis activity, which may be attributed to its anti-inflammatory and antioxidant activity.^(9,10)

Antibacterial Activity

The antibacterial activity and the mechanism of *Tetrapleura tetraptera* root extract against *Escherichia coli* and *Staphylococcus aureus* were investigated. The mechanism of action of *T. tetraptera* on tested bacterial species was predominantly characterized by the study of transmission electron microscopy, which revealed severe damage on the primary target which affected the cell integrity and cell membrane permeability. The loss of soluble proteins studied by bacterial protein sodium dodecyl sulfate-polyacrylamide gel electrophoresis analysis and the decreased adenosine triphosphate and DNA contents confirmed the leakage of cell wall. In addition, it is revealed that the root extract of *T. tetraptera* could also disrupt the respiratory metabolism by inhibiting the bacteria through the hexose monophosphate pathways. *T. tetraptera* extract possessed a high level of antimicrobial activity in pork, which significantly reduced total viable bacterial population. It clearly indicates that the *T. tetraptera* could be a potential source of new antimicrobial agent which has proven effective activity against antibiotic-resistant strains of pathogens.

CONCLUSION

Tetrapleura tetraptera Solvent extracts of plant parts of Tetrapleura tetraptera contain tannins, reducing sugars and coumarins. It also contains alkaloids, flavonoids, terpenoids, sterols and saponins but in a variable amount with significant radical scavenging activities. Copper (Cu), iron (Fe), lead (Pb) and zinc (Zn) were detected though they were all within the permissible range for medicinal plants. Variable antimicrobial activities were observed with the methanolic extracts being more potent. The study indicated that the various parts of Tetrapleura tetraptera were rich in phytochemical, possessed antioxidant and antimicrobial activities, supporting ethnomedicinal uses and could be evaluated further for other pharmacological activities. It is a widely used food/drug plant and recent biological/pharmacological studies have generally confirmed ethno-medicinal and folk-lore uses of the plant in various disease conditions; convulsions, pain, microbial infection, inflammation, diabetes mellitus, hypertension, malaria and feverish conditions, impaired immune system etc.; in food as tonic, flavourer, spice and as an economic plant, in soap making and the formulation of Prekese bitters, syrup and spices. The nutritive quality of the dry fruit of T. Tetrapleura used as spice as assessed showed the fruit shell, pulp and seed contained varying amounts of nutrients such as protein, lipids and minerals, which were comparable and some higher than popular spices such as pepper, onion, curry and ginger a reason why it is used in the preparation of pepper soup in southern parts of Nigeria. The fruits also found to contain cinnamic acids, caffeic acid and carbohydrates.

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