



A Review on Pteridophyte Antioxidants and their Potential Role in Discovery of New Drugs.

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Abstract

In recent years much attention has been devoted to natural antioxidant and their associations with health benefits. Plants are potential sources of natural antioxidants. They produce various antioxidant compounds to counteract reactive oxygen species (ROS) in order to survive. Reactive oxygen species are highly reactive due to the presence of unpaired valence shell electrons. Some of the antioxidant compounds namely flavan-4-ol glycosides, abacopterins, huperzine A, isoquercetin, di-E-caffeoyl-mesotartaric acid, flavaspidic acid PB, flavaspidic acid AB, flavan-3-ol, kaempferol, A-type proanthocyanidins, afzelechin were isolated from few pteridophytes like Abacopteris penangiana, Huperzia selago, Equisetum arvense, Dryopteris crassirhizoma etc. From the previous research it has been given that only 36 numbers of pteridophyte plants species were examined for antioxidant activity study which is highlighted in this paper. Thus, knowledge of antioxidant potentiality of pteridophytes and their remedial activity against different diseases is remain incomplete. Hence, an exclusive study is essential for better understanding and exploration of potentiality of antioxidant from pteridophytes.

Keywords: Antioxidant, ROS, Pteridophytes

Introduction

For thousands of years, plants have provided humanity with many of the basic and important material required for day to day living including oxygen, food, clothing as well as being a source of compounds such as oils, resins, rubbers, gums, dyes, pesticides and drugs. India is one among the twelve mega diversity countries. Pteridophytes are vascular cryptogams and form a neglected group of plants in biodiversity as far as their economic value is concerned. In the world flora of pteridophytes 12,000 species has been identified among which 1,000 species into 70 families and 191 genera are occur in India (Dixit, 1975). The ferns had an important role in folklore medicine. Pteridophytes have been successfully used in the different systems of medicines like Ayurvedic, Unani, Homeopathic and other systems of medicines. The pteridophytes are mostly

distributed in the Himalayas. More than 300 species of ferns and fern allies are reported from the Western Ghats, South India (Manickam and Irudhayaraj 1992). As folk medicine, the pteridophytes which constitute fern and fern allies, have been known to man for more than 2000 years, and also been mentioned in ancient literature (Kirtikar and Basu, 1935; Nayar, 1957; Chopra et al., 1958; Kumar and Roy, 1972; Watt, 1972; Sharma and Vyas, 1985). Kaushik (1998) emphasized on the ethno-botanical importance of ferns of Rajasthan, India. The ethno-botanical uses of this unique group are of immense importance. The most important studies on food and medicinal values of pteridophytes were conducted by Nayar (1957), Hodge (1973), and Dixit (1974, 1975). Recently, Ghosh et al., (2004) reported some edible pteridophytes as vegetables and medicines.

Antioxidant compounds are exogenous or endogenous in nature which either prevents the generation of toxic oxidants, intercept any that are generated and inactivate them and thereby block the chain propagation reaction produced by these oxidants.

Choudhary et al., in 2008 reported in their paper entitled 'Phenolic and other constituents of fresh water fern *Salvinia molesta*' that two glycosides, 6-*O*-(3,4-dihydroxy benzoyl)- α -D-glucopyranosyl ester(1), and 4-*O*- α -D-glucopyranoside-3-hydroxy methyl benzoate (2) along with five known compounds methyl benzoate, hypogallic acid, caffeic acid, paeoniflorin and pikuroside were isolated for the first time from a fresh water fern *Salvinia molesta* D.S. Mitch. These compounds showed a potent antioxidant radical scavenging activity in a non-physiological assay.

Zhongxiang et al., in 2007 in their paper entitled 'Antioxidant Flavonoid Glycosides from aerial parts of the Fern *Abacopteris penangiana*' reported about the presence of five new flavan-4-ol glycosides, abacopterins E-I (5-9), and seven known flavonoid glycosides were isolated from the aerial parts of the fern *Abacopteris penangiana*. The structures of these compounds were elucidated on the basis of extensive spectroscopic analysis, including HSQC, HMBC, ^1H - ^1H COSY, and ROESY, and chemical evidence. The isolated glycosides were evaluated for their antioxidant activity using the TEAC assay, and compounds showed TEAC values of 1.03-1.91 mM.

Daonian et al., in 2010 studied on *Arachniodes exilis* for the antioxidant and hepatoprotective activity by different assays, including reducing power, lipid peroxidation, 2, 2'-diphenyl-1-picrylhydrazyl (DPPH), 2, 2'-azinobis-3-ethylbenzothiazoline-6-sulphonic acid (ABTS), superoxide anion, hydroxyl radicals and hydrogen peroxide. *Davallia solida* rhizome has long been used as an herb tonic to treat osteoporosis, arthralgia, and arthritis. The aqueous extract of *D. solida* rhizome contains a high content of phenolic compound and shows a strong 1,1-diphenyl-2-picrylhydrazyl (DPPH) scavenging activity (Yung-Husan Chen et al., 2008). Shweta

Sood et al., on 2003, studied on the fern *Onychium contiguum* which shows the increase in lipid peroxidation along with altered antioxidant status in the urinary bladder of fern exposed animals. Dragana et al., 2010, investigated the antioxidative and antiproliferative activity of different horsetail (*Equisetum arvense* L.) extracts. The antioxidative activity was measured by the electron spin resonance (ESR) spectroscopy-spin trapping method. The hydroalcoholic extract of stems from *Equisetum arvense* (HAE) reverses the cognitive impairment in aged rats, as well as, evaluates its in vitro antioxidant properties (Jair et al., 2005). Free radical-scavenging activity of aqueous extract of *Pteris multifida* was done by the assay of DPPH, hydroxyl radicals and reducing power (Wang et al., 2006). The study of antioxidant activity and phenolic composition of three different extracts (EtOAc, n-BuOH and H₂O) of field horsetail (*Equisetum arvense* L.) has been evaluated by measuring the total reducing power, inhibition of lipid peroxidation, and free radical scavenging capacity (RSC) towards 2, 2'-diphenyl-1-picrylhydrazyl (DPPH radical) and nitric oxide (NO) and the total flavonoid content (TFC) and phenolic constituents of each extract also determined (Mimica et al., 2008).

The antioxidant activity of an aqueous extract (infusion) and ethyl acetate fraction of *Equisetum telmateia* Ehrh. (Equisetaceae), a plant used in traditional medicine for its anti-inflammatory and diuretic properties, has been evaluated by DPPH, TEAC and TBARS assays. A high and significant antioxidant activity was detected in the ethyl acetate fraction. Analysis of the aqueous extract and the ethyl acetate fraction by HPLC-PAD-ESI/MS allowed the identification of the major phenolic compounds as flavan-3-ol, kaempferol and phenolic acid derivatives (Helena et al., 2005).

Lycopodium Linn. syn. *Huperzia* (Family: *Lycopodiaceae*), commonly known as "club moss, ground pine, devil's claw, devil ash" is a pteridophyte abundantly found in tropical and subtropical forests in the world. Many lycopods are used by tribals as memory enhancing effect (Bai D, 1993) also as an analgesic to relieve

rheumatic pain in joints and back (Huang T et al., 1987). Huperzine A was reported to have an in vivo antioxidant activity in several studies (Zhang et al., 2002).

Antioxidant activity of two phloroglucinol derivatives from *Dryopteris crassirhizoma* exhibited significant antioxidant activity as assessed by DPPH radical scavenging assay in vitro (Sang-Myung Lee et al., 2003).

Table 1: List of Pteridophytes having Antioxidant Activity.

Sl.no	Species	Family	Sl.no	Species	Family
1	<i>Dryopteris crassirhizoma</i>	Aspidiaceae	19	<i>Dicksonia sellowiana</i>	Cyatheaceae
2	<i>Lycopodium clavatum</i>	Lycopodiaceae	20	<i>Equisetum sylvaticum</i>	Equisetaceae
3	<i>Equisetum telmateia</i>	Equisetaceae	21	<i>Equisetum fluviatile</i>	Equisetaceae
4	<i>Equisetum arvense</i>	Equisetaceae	22	<i>Equisetum palustre</i>	Equisetaceae
5	<i>Polypodium leucotomos</i>	Polypodiaceae	23	<i>Helminthostachys zeylanica</i>	Botrychiaceae
6	<i>Cyathea phalerata</i>	Cyatheaceae	24	<i>Onychium contiguum</i>	Pteridaceae
7	<i>Drynara fortune</i>	Polypodiaceae	25	<i>Pteris multifida</i>	Pteridaceae
8	<i>Pseudodrynaria coronans</i>	Polypodiaceae	26	<i>Adiantum capillus</i>	Adiantaceae
9	<i>Davallia divaricata</i>	Davalliaceae	27	<i>Angiopteris evecta</i>	Marattiaceae
10	<i>Davallia mariesii</i>	Davalliaceae	28	<i>Marsilea quadrifolia</i>	Marsileaceae
11	<i>Humata griffithiana</i>	Davalliaceae	29	<i>Pteridium aquilinum</i>	Dennstaedtiaceae
12	<i>Abacopteris penangiana</i>	Thelypteridaceae	30	<i>Blechnum orientale</i>	Blechnaceae
13	<i>Selaginella labordei</i>	Selaginellaceae	31	<i>Acrostichum aureum</i>	Pteridaceae
14	<i>Selaginella involvens</i>	Selaginellaceae	32	<i>Asplenium nidus</i>	Aspleniaceae
15	<i>Selaginella deluicatulata</i>	Selaginellaceae	33	<i>Cibotium barometz</i>	Cyatheaceae
16	<i>Selaginella wightii</i>	Selaginellaceae	34	<i>Dicranopteris linearis</i>	Gleichiniaceae
17	<i>Arachniodes exilis</i>	Dryopteridaceae	35	<i>A. bulbiferum.</i>	Aspleniaceae
18	<i>Davallia solida</i>	Davalliaceae	36	<i>Equisetum maximum</i>	Equisetaceae

Table 2: List of Pteridophytes having antioxidant compound

Sl. no.	Pteridophyte	Antioxidant compound	Reference
1	<i>Salvinia molesta</i>	6 ^l -O-(3,4-dihydroxy benzoyl)-â-d-glucopyranosyl ester and 4-O- â-d-glucopyranoside-3-hydroxy methyl benzoate, hypogallic acid, caffeic acid, paeniflorin and pikuroside	Choudhury M.Iqbal et al., 2008
2	<i>Asplenium bulbiferum</i>	Antioxidant flavonoids:Kaempferol glucosides	Cambie and Ferguson, 2003
3	<i>Abacopteris penangiana</i>	Flavan-4-ol, glycosides, abacopterins	Zhao et al., 2007
4	<i>Huperzia selago</i>	Huperzine A	Staerk et al., 2004
5	<i>Equisetum arvense</i>	Isoquercetin, di-E-caffeoyl-mesotartaric acid	Neda M. Dukic et al., 2008
6	<i>Dryopteris crassirhizoma</i>	flaspidic acid PB, flavaspidic acid AB	Lee Sang Myung et al.,2003
7	<i>Equisetum telmateia</i>	flavan-3-ol, kaempferol, A-type proanthocyanidins, afzelechin	Helena Correia et al., 2005
8	<i>Helminthostachys zeylanica</i>	flavonoids, ugonins	Yu-Ling Huang et al., 2003

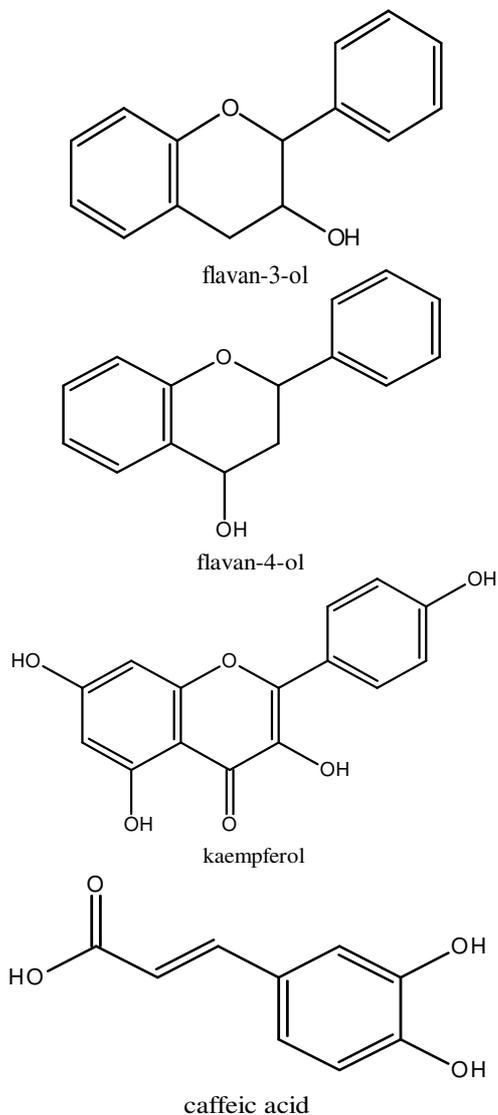


Fig: Some important antioxidant compound derived from pteridophytes.

Discussion

Pteridophytes are vascular cryptogams and form a neglected group of plants in biodiversity as far as their economic value is concerned. It is found that, there were different works has been done on antioxidant activity as well as isolation of antioxidant compound from pteridophytes. From the study it is noted that, there are total 36 numbers of sp. in which antioxidant activity and only 8 species of pteridophytes in which isolation of antioxidant compounds has been done. From the extensive survey of literature it has been revealed that, different crude extracts are used for antioxidant activity study which contain several antioxidant compound such as 6¹-O-(3,4-dihydroxy benzoyl)- β -d-glucopyranosyl ester and 4-O- β -d-glucopyranoside-3-hydroxy methyl benzoate, hypogallic acid, caffeic acid, paeniflorin and pikuroside, Kaempferol glucosides, Flavan-4-ol glycosides, abacopterins, Huperzine A, Isoquercetin, di-E-caffeoyl-mesotartaric acid, flavan-3-ol, kaempferol, A-type proanthocyanidins, afzelechin etc. Among these secondary metabolite compounds they are also responsible for the anti-inflammatory, antidiuretic, anti arthritic and antimicrobial activity which are the main qualitative character for the development of a new drug candidate.

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