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A REVIEW ON PHYTOCHEMICAL AND PHARMACOLOGICAL ACTIVITIES OF *MACROTHELYPTERIS TORRESIANA* (GAUD) CHING

Shamim Molla[1], Muhammad Torequl Islam[2,3]*

[1]Department of Pharmacy, Bangabandhu Sheikh MujiburRahman Science and Technology University, Gopalgang-8100, Bangladesh

[2]Department for Management of Science and Technology Development, Ton Duc Thang University, Ho Chi Minh City-700000, Vietnam

[3]Faculty of Pharmacy, Ton Duc Thang University, Ho Chi Minh City-700000, Vietnam

E-mail address: muhammad.torequl.islam@tdtu.edu.vn

Abstract

The medicinal plant, *Macrothelypteris torresiana* is widely distributed in China, India and Bangladesh. Ethnopharmacologically the parts of this plant are used to treat various illnesses. To date a number of scientific evidences have been seen in the phyto-pharmacological investigations of this medicinal herb. This paper offers an up-to-date comprehensive review of the phytochemical reports and pharmacological effects of *M. torresiana*. A search was made in the electronic databases: PubMed, Medline, Science Direct and Google Scholar for the published articles till December, 2018. The accumulated reports suggest that the plant contains important phytoconstituents, including flavonoids, glycosides and terpenoids, and has promising biological activities like- antitumor, hepatoprotective, reonoprotective, anticancer, antiinflammatory, antimicrobial, antidiarrheal, antidiabetic, antihyperlipidemic, and neuropharmacological effects. *M. torresiana* may be one of the potential sources of plant-based drugs.

Keywords: *Macrothelypteris torresiana; phytochemicals; biological effects*

Introduction

Macrothelypteris torresiana (Gaud.) Ching (Family: Thelypteridaceae) is generally conveyed in the south of China and has been utilized as people prescription basically for the treatment of ailments, for example, hydropsy and awful dying (Institute of Botany, 1976; Ding, 1982). *M. torresiana* is greenery and widely distributed to the tropical and subtropical areas in the world. It is a strong greenery with a short crawling rhizome (Bostock, 1998; Short, 2003). In conventional medication *M. torresiana* leaves and roots have an extensive variety of presumed therapeutic applications. The airborne parts are utilized for the treatment of fever, torment, granulation, recuperating and lessening scent in constant skin ulcer and aggravation by the clans of Pakistan, India, China, and Bangladesh (Chen et al., 2012). The Chinese people use this plant for the treatment of edema for renal injured patients (Chen et al., 2012).

To date a scientific evidences have been seen regarding to its phytochemicals and pharmacological properties. An epic flavonoid, 5, 7-dihydroxy-2-(1, 2-isopropyldioxy-4-oxocyclohex-5-enyl) - chromen-4-one was isolated from the root along with four known flavonoids such as protoapigenin, apigenin, kaempferol and quercetin (Ying et al., 2009; Wei et al., 2011). Some other epic polyphones and flavonoids isolated from this plant are: (2S) - 5, 7, 2, 5-tetrahydroxyflavanone-2-O-d-6-O-acetylglucopyranoside and (2S)- 5, 7, 2, 5-tetrahydroxyflavanone-2-O-dglucopyranoside (Fang et al., 2009; Tang et al. 2009), 5, 7-dihydroxy-2-(1, 2-isopropyldioxy-4-oxocyclohex-5-enyl)- chromen-4-one 5 (Fang et al., 2011).

The plant has renoprotective (Chen et al., 2012), antitumor (Huang et al., 2010), pain relieving, calming, and antipyretic effects (Huang et al., 2012). Lin et al. (2005) suggested that the flavonoid of this plant, protoapigenone has strong antitumor effect against a number of human cancer cells, such as HepG2, Hep3B (liver), MCF-7 (breast), A549 (lung) and MDA-MB-231. This review aims at sketching a current scenario on the phytochemical and pharmacological evidence found in databases.

Methods

A search was made in the PubMed, Science Direct and Google Scholar databases with the keyword *'Macrothelypteris torresiana'*, which was then combined with 'morphology', 'ethno-pharmacological usages', 'phytochemicals' and 'pharmacological activities'. The obtained data were incorporated and discarded by following the below criteria:

Data incorporated

(a) *In vitro*, *ex vivo* and *in vivo* studies on *M. torresiana*;
(b) Phytochemical or pharmacological reports on *M. torresiana*, its crude extracts, fractions or derived components;
(c) Reports on with or without mentioning activity mechanisms;
(d) Reports on phytochemical and/or pharmacological screenings, plant morphology, and ethnopharmacological usages.

Data excluded

(a) Studies not covering the current topic;
(b) Reports on different species of Macrothelypteris genus;
(c) Data duplication.

Findings

A total 30 articles were found in which PubMed, Google scholar and Science Direct belonged to 8, 12 and 10 respectively. After exclusion, 10 were included in this study, which discussed below.

Plant morphology

Rhizomes of the plant are short-creeping. Leaves are green in color. Stipes are tramineous up to 70 cm long. The lamina is up to 72 cm long, tripinnatifid, pinnules are adnate, basal pinnae is not reduced, not or only very slightly narrowed at the base. Pinnae are up to 26 cm long, pinnues to 5.3 cm and segments are up to 1 cm. Rachis is costae and primary costules above with dense beneath with long, slender hairs and has no scales. Indusium is very small, pale and often hidden by mature sporangia (Barcelona et al., 1994). Habit: Terrestrial, in damp woods and along stream banks. Also occurs in sheltered, moist sandstone gorges where

associated with springs and cliff line seepages. The plant taxonomy has been shown in Box 1.

Traditional usages

M. torresiana has been utilized as a medicinal plant in India, China and Bangladesh (Gao et al. 2015). The leaf and roots are used to treat various purposes, including intestinal sickness, gonorrhea, leucorrhea, hematemesis, carbuncle, injury, dying, cool, fever, torment, deadness wounds, toothache, and irritation. The plant has antibacterial and amoebicidal effects and it is used in bronchitis, loose bowels, and looseness of the bowels, edema, gastritis, hack, nephouritis, pneumonia, gum disease, menorhagia, and em-menagogue. In addition, it has emollient and diuretic properties (Sajem and Gosai, 2006; Jia et al., 2010). The aerial parts are utilized for the treatment of fever, torment, granulation, recuperating and decreasing scent in ceaseless skin ulcer and aggravation by the clans of Pakistan, India and China (Mondal et al., 2015). The Chinese people use the herb for the treatment of edema (Chen et al., 2012).

Chemical composition

A number of novel polyphones and flavonoids such as (2S) - 5, 7, 2, 5- tetrahydroxyflavanone-2-O-d-6-O-acetylglucopyranoside and (2S)-5, 7, 2, 5-tetrahydroxyflavanone-2-O-dglucopyranoside were isolated from this polyphones-rich plant (Fu et al., 2009; Tang et al., 2009). 5, 7-dihydroxy-2-(1, 2-isopropyldioxy-4-oxocyclohex-5 enyl)-chromen-4-one, a novel flavonoid was isolated from the root of the plant (Tang et al., 2009), along with four known flavonoids such as protoapigenin (Compound 1), apigenin (Compound 2), kaempferol (Compound 3), quercetin (Compound 4), apigenone (Compound 5), and protoapigenone (Compound 6) were reported from the aerial parts (Figure 1) (Fang et al., 2011).

Pharmacological activities

Antioxidant activity

Methanol extract of *M. torresiana* is evident to show DPPH (2, 2-diphenyl-1-picrylhydrazyl) scavenging capacity (Sundararajan et al., 2015).

Anti-inflammatory effect

Ethanol extract of the aerial parts of *M. torresiana* showed anti-inflammatory effect in carrageenan-induced paw edematous animals (Mondal et al., 2009). In another study the plant also found to show an anti-inflammatory effect at 200, and 400 mg/kg (p.o.) (Mondal et al., 2016).

Anticancer activity

The protoapigenone isolated from the plant is evident to show the cytotoxic effect against Hep G2, Tca-8113, MCF-7, M5 and K562 with IC_{50} 2.3, 0.6, 0.8, 0.3 and 0.9µg/mL, respectively (Xiong et al., 2009). 20-hydroxy-20,30-dihydroprotoapigenone is evident to dysregulate phosphoinositide 3-kinase (PI3K)/Akt in several human cancers, including breast, colon, ovarian, pancreas, and prostate cancer (Testa et al., 2001; Nicholson et al., 2002). Some important anticancer compounds of this plant-derived are protoapigenin 40-O-b-D-glucoside; protoapigenone; 20-methoxy 20, 30 dihydroprotoapigenone (Lin et al., 2005), flavotorresin (Lin et al., 2007a), 20-hydroxy-20, 30-dihydroprotoapigenone acetonide (Tang et al., 2009), 20,60-dimethoxy-tetrahydroprotoapigenone (Tang et al., 2010), tetrahydroprotoapigenine, and 20-hydroxy-20, 30-dihydroprotoapigenone (Fang et al., 2011).

Hepatoprotective activity

The herb extract at 300 and 600 mg/kg (p.o.) in Wistar rats showed hepatoprotective effects, where it was evident to reestablish carbon tetrachloride (CCl_4)-induced changes of serum glutamic oxaloacetic transaminase (SGOT), serum glutamate-pyruvate transaminase (SGPT), and soluble phosphatase (ALP) levels (Mondal et al., 2016).

Renoprotective effect

In a study, Chen et al. (2012) suggested that the herb has renoprotective capacity. In this study, it has been demonstrated that the extract may modulate the level of renal oxidative stress and vascular endothelial growth factor–nitric oxide (VEGF–NO) expression.

Antipyretic activity

The plant extract showed an antipyretic effect in Wistar albino rats (Sawadogo et al., 2016). In rodents, the antipyretics effect of the plant was also seen by Owoyele et al. (2007).

Analgesic activity

The herb extract at 200 and 400 mg/kg (p.o.) demonstrated analgesic effects in experimental animals (Mondal et al., 2016)

Healing effect

The ethanol extract of the herb exerted wound healing effect in thermal injury rats (Mondal et al., 2015).

Discussion

The human body generates free radicals frequently. Free radicals have many important biological activities. However, excessive production of free radicals is known to exert harmful effects in our body. It is due to the production of free radicals and generation of reactive oxygen/nitrogen species (ROS/RNS) is a chain reaction (Halliwell et al., 1984). Therefore, ROS/RNS are capable to attain many pathological conditions (Rose et al., 1982).

Among the natural products, plant-derived extracts or compounds are evident to use to treat oxidative stress (Aruoma et al., 1997). Thus, edible plants, plant extracts or their derivatives can be used to treat oxidative stress and oxidative stress related diseases (Rice-Evans et al., 1995). Scientific evidences suggest that oxidative stress can lead to inflammation, atherosclerosis, cellular aging and even cancer (Rosenfeld, 1998; Liu et al., 1999; van Kempen et al., 2006). *M. torresiana* extracts and its derivatives have been found show antioxidant, anti-inflammatory and anticancer effects in a number of studies.

Plant derived compounds, such as flavonoids are evident to exert various important pharmacological activities (Szostak-We˛gierek et al., 2014), including organ-protective capacity. *M. torresiana* is also rick in flavonoids and this herb is also found to show hepatoprotective, renoprotective, neuroprotective, wound healing activity in animal models.

In summary, this review recommends that, the *M. torresiana* contains various important phytochemicals. *M. torresiana* and its derived components possess a number of important biological effects, including antioxidant, anti-inflammatory, anticancer, analgesic, organprotective and wound healing effects. *M. torresiana* may be one of the best sources of therapeutic compounds.

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Conflict of Interest

None declared.

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Box 1. Taxonomy and morphology of *M. torresiana*

Kingdom: Plantae
Class: Polypodiopsida
Order: Polypodiales
Family: Thelypteridaceae
Genus: *Macrothelypteris*
Species: *M. torresiana*

Leaves

Roots

Figure 1. Structures of some important phytochemicals of *M. torresiana*