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Ethnobotanical and Phytochemical Study of *Houttuynia cordata* Thunb: A Review

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Abstract

Houttuynia cordata Thunb. is a medicinal herb belonging to a family Saururaceae distributed in East Asian Country. It has long been used as edible vegetable and traditional medicine in China, Korea, Japan and Vietnam. Many studies describe *Houttuynia cordata* as predominant in bioactive compounds such as volatile oils, flavonoids, alkaloids, terpenoids, polyphenols, steroid and polysaccharides. *H. cordata* has varieties of pharmacological properties including antibacterial, anti-inflammatory, antiviral antioxidative, anticancer and antimutagenic effects. This review aimed to collect the comprehensive information on efficacy of *Houttuynia cordata* with its ethnobotanical value and also provide knowledge into disease prevention and treatment. This study summarizes detailed information about ethnomedicinal value of *H. cordata* from searching the keywords “Uses of *Houttuynia*” in Google Scholar, Pubmed, Science direct and screened out articles related to ethnobotanical value. The review concluded that *H. cordata* has significant potential for use in pharmaceuticals and functional foods, given its numerous health benefits and low toxicity. This study suggests that, it is necessary to identify actual bioactive metabolites and understand pattern of traditional use of the plant in different location of Nepal.

Keywords: Antibacterial, Bioactive, Pharmacology

1. Introduction

Houttuynia cordata Thunb is the most essential medicinal plants of the family Saururaceae. It is a small perennial herb native to mountainous region of most of the Asian countries including Japan, China, Korea, Indonesia, Thailand, Vietnam, Myanmar, Bhutan, India and Nepal ranging from 1300-2500 m (Chopra et al., 2000). This plant grows in wet land, ditch bank, forest slopes and stream sides on variety of soil ranges like sandy loam, clay loam and rocky places with pH 5.9 and 80 % moisture (Rathi et al., 2013).

Ancient peoples of China were the first identify *H. cordata* plant as medicinal properties. Most of the peoples use this plant as edible food and medicinal value (Rathi et al., 2014). It is commonly distributed in Eastern and Central part of Nepal including Dhankuta, Ilam, Dolakha, Kathmandu districts (Bhattachary & Sharma, 2010). The plant has various local names viz. Fishmint, Fishwort, Lizard tail,

Chameleon in English, Gwande, Gane in Nepali, and Ghandhey Jhar, Ganaune Jhar in Sikkim (Rai, 2003).

Many peoples of south East Asia used the young green leaves and stoloniferous rhizome of *H. cordata* Thunb. as vegetables, flavor and fragrant odor either by cooking or as uncooked salad (Haywood, 1979). Peoples used this herb as traditional medicine to relief from fever, resolving toxin, swelling reducing agent and promoting urination (Zhang et al., 1998). During the period of outbreak of SARS as respiratory syndrome in China, *H.cordata* was used as the most important drugs to prevent the effect of SARS in China (Lau et. al., 2008).

This plant is also considered as a good blood purifier and also used to care stomach ulcers, muscular pain, hypertension and constipation (Lu et al., 2006). The leaf of *H. cordata* is used to make beverage called *Dokudami cha* in Japan and also used as traditional medicine in Asia. *H. cordata* plant has antibacterial, anti-cancer, antiviral, immune stimulant, diuretic and anti-inflammatory effects (Yoshino et al., 2005). Therefore the objective of this review is to give summarize guideline on ethnomedicinal knowledge of *H. cordata* plant as well as its derivatives. This study is also accumulated the sprinkle informations of therapeutic properties of *H.* plant against human diseases.

2. Botanical Characters

Houttuynia Cordata Thunb is an aromatic perennial medicinal herbs that have 30 to 60 cm height with creeping root stock. It has broad, ovate, cordate, petiolate leaves with measuring the length 4-8 cm and width of 3-6 cm. Leaf base possess stipular sheath, leaf petioles are 1-3.5 cm in length, glabrous and ciliated (Bora, 2001). Inflorescence 1.5-2.5 cm long, 3-5 cm wide, peduncle 1.5- 2.5 cm, subglabrous involucre bracts, which are oblong or obovate, 10-14 mm long opened with dense spike, surrounded by four petaloid white bracts, involcre, elongated, yellow inflorescence which about 1-3 cm length of three stamens. Mostly flowery in the month June to July. Stamens longer than ovary seeds are small but sterile. Rhizomatous root spread deeply in to the soil up to 90 cm and sprouting after winter months (Polunin & Stainton ,1985).

3. Propagation

It is propagated by vegetative method through rhizome and root. In most of the cases, seeds are sterile. During the winter (November-January), the areal part of the plant dried out and the rhizome remain under the soil, on starting of February new leaves/ shoots develop from the underground rhizome and flowering starts from month of April to August. One and half month to two-month-old plants are ready for marketing and consumption (Rathi & Roy, 2013).

4. Biochemical Properties

Houttuynia cordata Thunb contains several types of bioactive components such as essential oil, flavonoids, alkaloids, glycosides, Pyridine, alkaloids and essential oils. (Bauer et al., 1996; Zhang et al., 2008). The flavonoids confined antineoplastic antioxidant,

antimutagenic capacity (Chen et al., 2003). Xu et al. (2006) described Rutin, Hyperoside, Quercitrin and Quercetin as four different types of flavonoids from this plant. Leaves contains 8.13 % and rhizome contain 11.5 % protein. The entire Plant has strange odor due to the presence of B-Myrcene and 2- decanone (Wang et al., 2007).

Most of the recent studies reported essential oil of *Houttuynia cordata* has anti-inflammatory, antibacterial and antiviral properties (Lu & liang, 2006). The essential oil has about 81 % fatty acid. Among the fatty acid methylated fatty acid is more dominant viz. Methyl laurate (16.15), Undeconoic acid methyl (5.62 %), Methyl oleate (1.98 %), Methyl hexadecanoate (9.27%), and methyl linoleate (1.40%) Cupric acid methyl (43.66%),. The roots contain essential fat (2.07+0.06%), Carbohydrate (23.45+3.11%), protein (12.22+0.22%) and minerals like sodium (1.30 Mg/g), potassium (49.65 mg/g) calcium (8.25 mg/g) manganese (0.08 mg/g) and iron (0.98 mg/g) (Shin et al.,2010). As well as alkaloid components possess antiplatelet of cytotoxic activities (Kim et al., 2001).

Table-1 List of isolated compounds from *H. cordata* and their bioactivity

Compounds	Bioactivity	References
Terpenoids	Antibacterial, antiviral and anti-inflammatory	Lu et al. (2006)
Hydrocarbon	Antibacterial, antiviral and anti-inflammatory	Lu et al. (2006)
Esters	Antibacterial	Lu et al. (2006)
Alcohols	Antiviral	Lu et al. (2006)
Quercetin	Antiviral	Lee et al. (2015)
Rutin	Inhibition of cholestasis	Lee et al. (2015)
Hyperin	Anti-inflammatory	Lee et al. (2015)
Quercitrin	Anti-inflammatory	Kumar et al. (1014)
Isoquercitrin	Anti-inflammatory	Fu et al. (2013)
Aristolactum A	Anti-tumor	Fu et al. (2013)
Piperolactum A	Anti-pyretic	Fu et al. (2013)
Lysicamine	Antibacterial	Fu et al. (2013)
Cepharadione B	Antioxidant	Fu et al. (2013)
Norcepharadione	Antipyretic	Fu et al. (2013)
3,4-dimethoxy -n_ methylaristolactum	Anti-inflammatory	Fu et al. (2013)
Cis -N-Benzamide	Inhibitor of platelets aggregation	Fu et al. (2013)
3,5,didecanoyl-4 nonyl-1,4 dihydropyridine	Anti -inflammatory	Fu et al. (2013)
7-chloro-6-dimethylcephardione	Antioxidant	Fu et al. (2013)
Organic acid	Antibacterial, antifungal	Jungmi et al. (1997)
Vanillin	Antioxidant	Fu et al. (2013)
Chlorogenic acid	Antihypersensitive	Fu et al. (2013)
2-undecanone	Anti-inflammatory	Lou et al. (2019)

Houttunin and sodium Houttuyfonate	Antibacterial	Shao et al. (2013)
Betullinic acid	Antiparasitic	Vijaya and Yadav (2016)
Caffiec acid	Anticancer	Jang et al. (2011)
Myrcene	Antifungal	Verma et al. (2017)
Chlorogenic acid	Antiobesity	Wang et al. (2018)

5. Traditional Uses

The use pattern of this plant is different from one country to another. Jiang Fu, Ling Dau, et al. (2019) show the documented folk uses of this plant. The whole plant (including root and leaves) has been used as vegetable in China and Vietnam, syrup and carbonated drinks in Korea, and as a deodorant and beverage in Japan (Jhiang et al., 2019)

Country	Used parts	Used	References
China	Root & leaves	vegetables	Jiang et al. (2019)
Vietnam	Root & leaves	vegetables	
Japan	whole plant	deodorant & Beverage	
Korea	whole plant	Syrup, Carbonated drinks	

In Korea, peoples used this plant for the treatment of cough, dropsy, uteritis, leucorrhoea, simplex, acne, herpes, Pneumonia, bronchitis, dysentery, chronic sinusitis and nasal polyps (Chiang & Chang, 2003; Shim et al., 2009). In Thailand, it is used as anticancer agent and immune stimulation (Nuengchamnong et al., 2009). In Japan has been used as diuretics and treatment of Stomach ulcers (Masuzawa, 1950). The shoot of plant has been used for the freshness, good sleep in India (Kala, 2005)

Besides the medicinal propose, it is also used as food and cosmetics by mixing with other herbal composition for the treatment of wrinkle (Kim & Kim, 2009) antiaging (Tehara, 2006) and improving skin condition (Arki, 2007). Its extraction also used for preventing dandruff and protection or nourishing hair (Takagi et al., 1997). As cosmetic value this plant is also used to make massage pack which is applied to treat atopy, freckle acne and many others skin infections. (You, 2006). It has antioxidant properties that's why it is used against stress related disease like coronary heart disease, cancer, diabetes and infections (Kusirisin et al., 2009).

Extraction of leaves used to treat measles dysentery and gonorrhoea (Kashyal & Chand, 1994). It has anti-bacterial character against *Trichophyton Staphylococci, Gonococci, Tubereulae bacilli* etc. Traditional Chinese medicine (TCM) used this plant to cure severe acute respiratory syndrome caused by SARS-COV. (Lu & liang, 2006).

The root juice is applied on skin to treat wounds and several skin disease (Singh, 1996) Assami peoples of India collect entire young plant and prepare "chutney" (Khumbong nayum et al., 2005). The local peoples of Manipuri eat *H. cordata* both raw and cooked stem and leaves to cure dysentery and stomach ulcers, gastritis, anemia and tuberculosis (Rai & Bhujel, 2012).

6. Therapeutic uses

6.1 Anti-viral activity

It has been explained from several studies that the *H.cordata* plant extract has inhibitory capacity against several type of viral disease. Lau et al. (2008) described the antiviral activity of *H. cordata* extracts against Coronavirus SARS-COV during 2003 in China. After this identification (Li et al., 2017) had also reported anti-viral activities of this *H. cordata* plant extract against Epstein- Barr virus, Human Immuno-Deficiency Virus (HIV), and human papilloma virus.

6.2 Anti-bacterial activity

Water extraction of *H. cordata* plant exhibit inhibitory activity against *salmonella typhimurium* (Kim et al., 2008). A constituent of *H. cordata* extract Sodium houttuynate (SH) is used as inhibitory agent against *pseudomonas aeruginosa* (Dolan, 2020). The extraction of *H. cordata* also inhibits the growth of *staphylococcus aureus* (Shao et al., 2013).

6.3 Anti-parasitic activity

Leaf extraction of *H. cordata* is used to treat helminthic diseases. Yadav and Temjenmongia (2011) reported that the *H. cordata* leaf extract has long been used as medicine to treat infection caused by *Hymenolepis diminuta* a zoonotic cestode in intestinal tract.

6.4 Anti-inflammatory activity

According to Chen et al. (2014) Sodium Houttuofunnate and 2-decanone constituents of *H. cordata* extracts has anti-inflammatory activity. Some derivatives of *H.cordata* plant extract can be induced inflammation due to *S. typhimurium* infection in intestine causing diarrhoea and other complication.

6.5 Anti-diabetic activity

H. cordata extract with metformin has high potential to reduce blood sugar level (Wang et al., 2017). This plant has also found to downgrade in normal biochemical parameters such as, blood urea, creatinine, lipid profile, protein and antioxidant enzymes in, pancreas, liver and adipose tissue (Lin et al., 2013). *H. cordata* treated human reduce body weight so it has anti-obesity properties. As a result of which lower down fatty acid synthase and sterol regulatory element-binding proteins that reduce lipid accumulation in the cells. (Kang & Koppula, 2014)

6.6 Anti-cancer activity

The derivative of *H. cordata* helps in treatment of human colon adenocarcinoma cells (Tang et al., 2009). Another report of *H. cordata* described by Kim et al. (2017) efficiency for treatment of cancer caused by hepatocellular carcinoma cells. Lou et al. (2019) studied the effect of *H. cordata* extracts on most common cancer of the world i.e., lung cancer.

7. Conclusions and recommendations

Several studies have proven that *Houttuynia cordata* is extensively used as vegetables,

salad and cure different diseases. This study realizes that it is necessary to be initiated about the importance of *Houttuynia* plant and its systematic conservation as well as utilization pattern. It contains several medicinal used water-soluble compounds. Though there are several methods applied for the investigation of this plant, there is still research gap to identify the following-

- Finding of actual bioactive metabolites.
- Understand the traditional used pattern of the plant in different location.
- Finding new patterns of use and conservation strategy.
- Establishment of effective quality control method.

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