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Phytochemical Constituents and Pharmacological Activities of a Traditional Medicinal Plant, *Glochidion eriocarpum* (Phyllanthaceae)

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Abstract

Glochidion eriocarpum is a shrub in the family Phyllanthaceae. The whole plant, stem bark, roots, and leaves are used for medicinal purposes by ethnic people in China to treat lacquer poison, convergence, diarrhea, dampness, and itching. As the intense research on chemical constituents, pharmacological activity and the active principles of *G. eriocarpum* have attracted the interest to the discovery of new drugs. This review summarizes the traditional uses of *G. eriocarpum* and its chemical constituents, pharmacological effects, and clinical applications with some suggestions for future research.

Keywords

Glochidion eriocarpum · Ethnomedicine · Chemical constituents · Pharmacological activity

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25.1 Introduction

Glochidion eriocarpum Champ. ex Benth. is a shrub in the family Phyllanthaceae (earlier included in Euphorbiaceae). The medicinal value of the genus *Glochidion* has attracted the interest of many scholars at home and abroad, and many patents have reported compounds from this genus for the treatment of certain diseases.

China is a rich country with abundant plant resources in the world. There are 37,500 plant species; 11,146 species of plants are used by people to treat diseases. *Glochidion eriocarpum* is a national plant in southwestern China and is widely used by many ethnic groups. The species is mainly distributed in China (Jiangsu, Fujian, Taiwan, Hunan, Guangdong, Hainan, Guangxi, Guizhou, Yunnan, etc.), Laos, Thailand, and Vietnam, growing on hillsides, valleys, or forest edges at an altitude of 130–1600 m (Luo and Sun 2013). Especially in China, the whole plant, root, and leaf of *Glochidion eriocarpum* are used for medicinal purposes. And it is commonly used to address hepatitis, intestinal diseases, diarrhea, urticaria, mastitis, toothache, menorrhagia, dysentery, skin eczema, and other diseases (Liu 2012). Thus, the medicinal value of the genus *Glochidion* has aroused the interest of many scholars at home and abroad. Some patents have reported that compounds from this genus were used to treat chronic and acute osteomyelitis, cirrhosis, chronic gastritis, hepatitis B, liver ascites, and malignant tumors. However, the scientific evidence of the abundant use value of this plant is still lacking. This paper summarizes various methods of utilizing this plant by Chinese people and chemical structure and pharmacological activities of *Glochidion eriocarpum* in the recent 10 years. We hope by systematically summarizing the research of the *Glochidion eriocarpum* we can further broaden the development and utilization prospects of the plant and provide clues and scientific theoretical basis for further research and development of the resource.

25.2 Folk Value of *Glochidion eriocarpum*

In China, *Glochidion eriocarpum* is a kind of important ethnic medicinal plant resource widely used by many people (Table 25.1). There are three ethnic medicinal formulas that record *Glochidion eriocarpum* for the treatment of gynecological inflammation, urinary stones, and detoxification. It can also be used as a dietary fiber in diet therapy. Studies have shown that *Glochidion eriocarpum* has anti-*Helicobacter pylori* (Zhang and Wang 2008), which can be scientifically validated as a mechanism for treating stomach pain and gastric ulcer in Zhuang medicine. At the same time, they are used in other countries such as Vietnam for the treatment of asthma, enteritis, cholera, indigestion, rheumatism, etc. (Nhiem et al. 2012). In Laos, they were treated to treat postpartum recovery, anemia (dizziness, headache), mild puerperal fever, and abdominal pain (Vichith et al. 2011).

Table 25.1 Traditional medicinal knowledge of *Glochidion eriocarpum* in China

Linguistic group	Use and value	Part used	References
Han	Clearing heat and dampness, detoxifying, and relieving itching. Enteritis, dysentery. Allergy to raw lacquer, dermatoses, pruritus, urticaria, eczema, exfoliative dermatitis	Root; leaf	"National Compilation of Chinese Herbal Medicine"
Yi	Lacquer poisoning, dermatitis, and eczema; radical bowel disease, dysentery, rectal prolapse	Whole plant	"The Ailao"
She	Flashback, abdominal pain, food bite	Root; leaf	"She Nationality's Medicine"
Lisu	Rheumatic bone pain, bruises, and swelling. Anal prolapse, uterine prolapse, vaginal discharge, diarrhea, hepatitis	Root; leaf	"Nujiang Medicine"
Dai	Acute gastroenteritis, dysentery, rheumatoid arthritis, bruises, traumatic bleeding, sore, eczema, dermatitis	Branch; leaf	"Yunnan Provincial Records"
Dong	Diarrhea, dysentery	Root; leaf	"Guangxi Medical Records"
Yao	Enteritis, diarrhea, dysentery, epistaxis, treatment of burns, allergic dermatitis, lacquer tree allergy, skin eczema, skin irritation, acute gastroenteritis, rheumatic arthralgia, bruises, traumatic bleeding, lacquer sores	Root, leaf, whole plant	"Guangxi Medical Records"
Zhuang	Stomachache, icteric hepatitis, maternal bleeding, menorrhagia, measles, topical allergic dermatitis, lacquer tree allergy, pruritus, skin eczema, acne ulcers	Root, branch, leaf	"Guangxi Medical Records," "Yunnan Provincial Records"
Jinuo	Enteritis, itchy skin, rash	Root; leaf	"Jinuo Nationality's Medicine"

25.2.1 Chemical Constituents of *Glochidion eriocarpum*

There are 50 compounds isolated and identified from *Glochidion eriocarpum*, mainly quinones and glycosides extracted from the roots, stems, and leaves in addition to containing aromatic compounds, steroids, and other compounds.

25.2.1.1 Terpenoids

Terpenoids are the main components of the *Glochidion eriocarpum*, and they are ubiquitous in the plant kingdom which is the generic term for all isoprene polymers and their derivatives (Shi et al. 2012). Terpenoids have many biological activities, such as anticancer, anti-allergy, and anti-HIV (Chen and Li 2016), with important medicinal and economic value (Fu et al. 2003). Twenty-eight terpenoids, the highest proportion of *Glochidion eriocarpum* chemical constituents, and each part of the plant have contained terpenoids with good biological activities (Table 25.2, Fig. 25.1).

Table 25.2 Terpenoids distributed in different parts of *Glochidion eriocarpum*

No.	Compound	Chemical formula	Part	References
1	(6*R*,9*S*)-3-oxo-α-ionol-β-D-Glucopyranoside	$C_{19}H_{30}O_7$	Root	Wang (2014)
2	(6*S*,9*S*)-Roseoside	$C_{19}H_{30}O_8$	Root	Wang (2014)
3	(*Z*)-4-[3′-(β-D-Glucopyranosyloxy) butylidene]-3,5,5-trimethyl-2-cyclohexen-l-one	$C_{19}H_{30}O_7$	Root	Wang (2014)
4	3-Epilupeol	$C_{30}H_{50}O$	Shoots	Puapairoj et al. (2005); Nhiem et al. (2012); Kiem et al. (2009)
5	Blumenol C glucoside	$C_{19}H_{32}O_7$	Root	Wang (2014)
6	Cannabiside D	$C_{19}H_{30}O_9$	Root	Wang (2014)
7	Epifriendelanol	$C_{30}H_{52}O$	Stem bark	Wei (2001)
8	Friedelin	$C_{30}H_{50}O$	Stem bark	Wei (2001)
9	Glochidiol	$C_{30}H_{50}O_2$	Entire plants	Wei (2001); Puapairoj et al. (2005); Nhiem et al. (2012); Hui and Li (1976); Kiem et al. (2009)
10	Glochidionionoside A	$C_{19}H_{30}O_9$	Root	Wang (2014)
11	Glochidionionoside C	$C_{19}H_{30}O_9$	Root	Wang (2014)
12	Glochidionionoside E	$C_{19}H_{30}O_9$	Root	Wang (2014)
13	Glochidioside N	$C_{41}H_{66}O_{12}$	Stem bark	Wei (2001)
14	Glochidol	$C_{30}H_{48}O$	Stems	(Hui and Li 1976)
15	Glochidone	$C_{30}H_46O$	Entire plants	Wei (2001); Puapairoj et al. (2005); Nhiem et al. (2012); Hui and Li (1976); Kiem et al. (2009)
16	Glochidonol	$C_{30}H_{48}O_2$	Entire plants	Wei (2001); Puapairoj et al. (2005); Nhiem et al. (2012); Hui and Li (1976); Kiem et al. (2009); Kiem et al. (2009)
17	Glochierioside A	$C_{48}H_{72}O_{14}$	Shoots	Nhiem et al. (2012)
18	Glochierioside B	$C_{48}H_{72}O_{14}$	Shoots	Nhiem et al. (2012)
19	Glochierioside C	$C_{48}H_{72}O_{14}$	Shoots	Nhiem et al. (2012)
20	Glochierioside D	$C_{48}H_{72}O_{14}$	Shoots	Nhiem et al. (2012)
21	Glochierioside E	$C_{48}H_{72}O_{14}$	Shoots	Nhiem et al. (2012)
22	Glochierioside F	$C_{48}H_{72}O_{14}$	Shoots	Kiem et al. (2009)
23	Glochierioside G	$C_{48}H_{72}O_{14}$	Shoots	Kiem et al. (2009)
24	Glochilocudiol	$C_{30}H_{50}O_2$	Entire plants	Hui and Li (1976)
25	Lup-20(29)-en-3β,23-diol	$C_{30}H_{48}O_2$	Shoots part	Kiem et al. (2009)
26	Lup-20(29)-ene-1β,3β-diol	$C_{30}H_{50}O_2$	Roots	Puapairoj et al. (2005); Kiem et al. (2009)

(continued)

Table 25.2 (continued)

No.	Compound	Chemical formula	Part	References
27	Lupenone	$C_{30}H_{48}O$	Shoots, roots	Puapairoj et al. (2005); Nhiem et al. (2012); Hui and Li (1976); Kiem et al. (2009)
28	Lupeol	$C_{30}H_{50}O$	Stem bark	Wei (2001)

25.2.1.2 Glycoside Compounds

Glycosides are widely distributed in the roots, stems, leaves, flowers, and fruits of plants. It has the efficacy of eliminating phlegm and relieving cough (Liu et al. 2013), nourishing, treating rheumatism (Su 2016), lowering cholesterol, being anti-inflammatory and antibacterial (Peng et al. 2014), improving immune regulation, being antitumor (Wang et al. 2014), and other effects. *Glochidion eriocarpum* contains 10 kinds of saponins and has good activity in improving human immunity (Table 25.3, Fig. 25.2).

25.2.1.3 Other Compounds

In addition to terpenoids and glycosides, the chemical components of *Glochidion eriocarpum* were also found: bergenin, steroids (β-sitosterol, stigmasterol), octadecanoic acid, tetradecyl ester, octanol, myristic acid, lauric acid, etc.

25.3 Pharmacological Activity

25.3.1 Antitumor Activity and Cytotoxic Activity

So far, the research on *Glochidion eriocarpum* in China and abroad has focused on its cytotoxic activity and antitumor activity, but there are few studies on new compounds and pharmacological activities. In 2009, two triterpenoid glochieriosides A and B from *Glochidion eriocarpum* were reported (Otsuka et al. 2000). The results showed that these two compounds have cytotoxic activity against four human cancer cells such as HL-60, HT-29, MCF-7, and SK-OV-3. Studies have shown that glochidonol exhibits strong cytotoxic activity on human breast cancer (MCF-7), lung cancer (NCI-H460), and prostate cancer (DU-145) (Bagalkotkar et al. 2011). Glochidone and lupeol have significant anti-malignant tumor growth effects and are very sensitive and have inhibitory effects on cancerous lung cells (Sakkrom et al. 2010). At the same time, glochidiol, lup-20(29)-ene-1α,23-diol, glochidone, and 3-epi-lupeol have cytotoxic effects on human hepatocellular carcinomas (Xiao et al. 2008). Further experiments showed that glochidonol and glochidiol have the effect of preventing the proliferation of malignant tumors, but lup-20(29)ene-3α,23-diol does not (Puapairoj et al. 2005). In vivo experiments have shown that glochidiol has a strong inhibitory effect on mouse skin tumors (Tanaka et al. 2004).

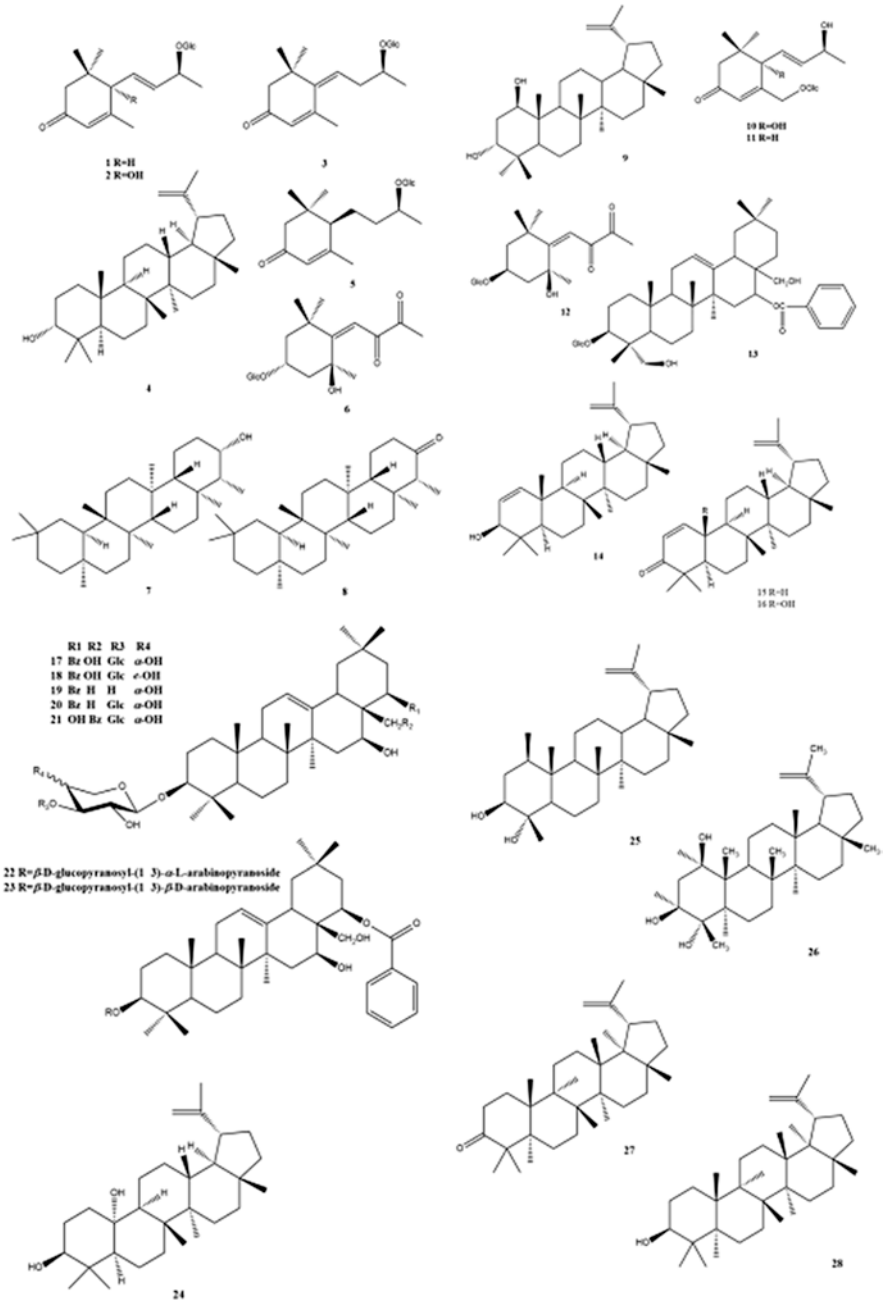

Fig. 25.1 Structures of terpenoids isolated from *Glochidion eriocarpum*

Table 25.3 The distribution of glycosides in different parts of *Glochidion eriocarpum*

No.	Compound	Chemical formula	Part	References
29	1,2-Dimethoxyphenyl-4-*O*-β-D-glucoside	$C_{36}H_{36}N_2O_8$	Root	Wang (2014)
30	1-β-D-Glucopyranosyloxy-3-methoxy-5-hydroxybenzene	$C_{13}H_{18}O_8$	Root	Wang (2014)
31	2-β-D-Glucopyranosyloxy-4-methoxy-6-hydroxy-isovalero-phenone	$C_{18}H_{26}O_9$	Root	Wang (2014)
32	3,4-Dihydroxy-1-naphthoic acid	$C_{11}H_8O_4$	Root	Wang (2014)
33	7*R*,8*S*-Dihydrodehydrodiconiferyl alcohol 4-*O*-β-D-glucopyranoside	$C_{26}H_{34}O_{11}$	Root	Wang (2014)
34	7*S*,8*R*-Dihydrodehydrodiconiferyl alcohol 4-*O*-β-D-glucopyranoside	$C_{26}H_{34}O_{11}$	Root	Wang (2014)
35	Adenosine	$C_{10}H_{13}N_5O_4$	Root	Wang (2014)
36	Koaburaside	$C_{14}H_{20}O_9$	Root	Wang (2014)
37	Koaburaside monomethyl ether	$C_{15}H_{22}O_9$	Root	Wang (2014)
38	Syringin	$C_{17}H_{24}O_9$	Root	Wang (2014)

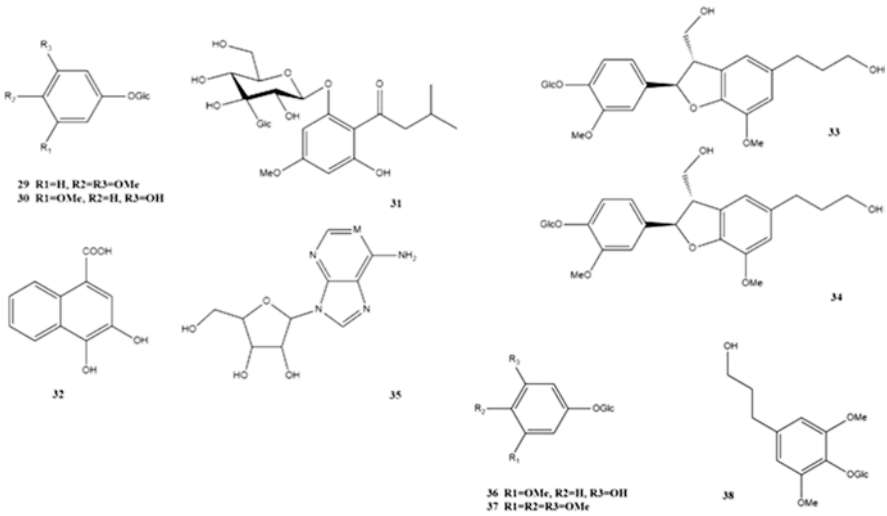

Fig. 25.2 Structures of glycosides isolated from *Glochidion eriocarpum*

25.3.2 Anti-inflammatory and Analgesic Effects

Phyllanthus urinaria was studied by Brazilians to show that its extract has analgesic effect. Chemical composition studies of *P. urinaria* extracts by chromatography and GC indicated that β-sitosterol, glochidonol, and glochidone were present in the extract (Catapan et al. 2001). Glochidone has significant antinociceptive effects on writhing and formalin tests (Krogh et al. 1999) suggesting that these compounds may have analgesic effects. *Glochidion puberum* extracts have significant anti-inflammatory and analgesic effects, and their effects may be related to the reduction of histamine content in the inflammation sites (Huang 2010). *Glochidion eriocarpum* may have the same effect.

25.3.3 Antioxidant Activity

Each extracted part of *Glochidion puberum* has a different in vitro antioxidant capacity (Hu et al. 2014). Pharmacological studies have shown that most of *Glochidion* species exhibit antibacterial, anti-inflammatory and antioxidative effects. The dominant ingredient, lupin-type triterpenoids, has potential antitumor activity and antiviral effect. There are few studies on its chemical components and active ingredients in China. It is necessary to conduct in-depth research on the substance basis of its efficacy (Ganguly et al. 1968; Puapairoj et al. 2004).

25.3.4 Others

Some patents have reported that some plants and their compounds of *Glochidion* can treat some diseases. For example, *Glochidion puberum* and its compound can treat chronic and acute osteomyelitis, chronic gastritis, hepatitis B, liver cirrhosis, liver ascites, and malignancy and assist in the treatment of hepatitis, intestinal diseases, diarrhea, and acute and chronic enteritis (Li 2007). *Glochidion eriocarpum* may contain the same chemical constituents as the *Glochidion zylanicum* root extract. The experiment shows that the water extract has inhibitory effect on *Flavobacterium tegecticola* (Sharma et al. 2010).

25.4 Conclusion

Glochidion eriocarpum is an ethnomedicinal plant in southwestern China. The study on its chemical composition and pharmacological effects can promote the standardization of *Glochidion eriocarpum* materials and provide theoretical guidance for its use, so as to further develop this ethnomedicine. So far, most of the 50 compounds extracted from *Glochidion eriocarpum* have good activity, and a small number of them are cytotoxic. They can be strengthened by structural modification and structure-activity relationship to discover new active lead compounds. However, the current research on the chemical composition of *Glochidion eriocarpum* mainly focuses on the component extraction and activity research; its activity, mechanism, and biosynthetic route and the development of ethnic medicine products need to be further explored; research on these can better develop the plant resources of *Glochidion eriocarpum*.

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