PHARMACOLOGICAL AND CHEMOTAXONOMIC ASPECT OF TERPENES IN SECURINEGA VIROSA

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ABSTRACT

Securinega virosa is synonymous to Flueggea virosa, it could be used interchangeably. Many studies have shown that Securinega virosa is a natural source for alkaloids, these alkaloids are term Securinega alkaloids. Though, many other compounds have been isolated from this medicinal plant i.e. flavonoids, phenolics and terpenes. Alkaloids have been established as a chemotaxonomic marker for this species since this medicinal plant is a component in most herbal products. This review seeks to establish the friendly connection between this plant and terpenoids by explicitly stating the pharmacological importance of this class of compounds in this species, which suggest the nature and property of terpenoids and also giving an update on the isolated terpenoids (about forty-one (41) isolated so far). Also to clarify that beside alkaloids compounds, terpenoids could be used also as a chemotaxonomic marker for this plant.

Keywords: Securinega virosa; Flueggea virosa; alkaloids; terpenoids; polyphenols

INTRODUCTION

From species Flueggea, Phyllanthus and Securinega, many alkaloids have been isolated termed Securinega alkaloids. This class of secondary metabolites is fascinating group of compounds mostly from Euphorbiaceae family (Beutler and Brubaker, 1987; Snieckus, 1973). Some authors first isolated securinine, an example of these compounds for over sixty years ago, from Securinega suffruticccosa in 1956 (Murev’eva and Ban’kovskii, 1956). Alkaloids of these type includes pyrrolizidine (norsecurinine-type) heterocycle/ an (securinine-type) indolizidine and α, β, γ, δ-conjugated lactone fragment to form a highly rigid tetracyclic skeleton (Zhang et al., 2013). Securinega alkaloids have received wide and interesting attention from scientists in the field of drug discovery because of their intriguing features and significant pharmacological properties. Many authors have established that these compounds possess activities such as anti-HIV, antitumour and anticancer, antiarrhythmic and anti-hepatitis C virus (Zhang et al., 2015; Zhang et al., 2013; Wehlauch et al., 2016; Tatematsu et al, 2006; Monkodkaew et al., 2009; Iketuboisin and Mathieson, 1963). These alkaloids have been known to this genus for a very long time hence they also serve as a chemotaxonomic marker for the species in the genus. Siddiqui et al. (2017) reported two compounds that could serve as biomarker/taxonomic marker for Securinega virosa because this plant species is in use by in many herbal products around the world. These compounds are ent-phylanthidine (40) and rutin (41), these were isolated from the methanol extract of aerial parts of Flueggea virosa (Siddiqui et al., 2017). One of the compound is an alkaloid while the other is a flavonoid hence the need to establish the connection between S. virosa and terpenoids. Literatures are obvious with the isolation of terpenoids but none seek to emphasize its connection with S. virosa hence this study seeks to prove the importance of terpenoids to this genus and exact its uniqueness since about forty-one of this-type of compounds were isolated from them.

REVIEW METHODOLOGY

Relevant literature was collected by searching the major scientific databases including EBSCO, google and google-scholar, Pubmed, PROTA, Medline, SciFinder, Science-direct and SCOPUS, also other Botanical/play plants databases. Many Publications’ sites were queried like Springer, Elsevier, and dissertations search engines like Open-thesis, OATD, ProQuest and EthOs were put to use. Various keywords were used: Securinega virosa, uses of Securinega virosa, biological activity of Securinega virosa, terpenoids of Securinega virosa.

Ethnobotany and Ethnomedicinal Uses

Securinega virosa (Roxb. ex Willd.) Baillon belongs to Euphorbiaceae family and plant order Geraniales. S. virosa is the name to the same plant as Fluggea microcarpa Blume and Fluggea virosa (Roxb. ex Willd.) Baillon. These names could be used interchangeably, many plant search engines confirm this (The Plant List (2013); plants.jstor.org, 2015) Securinega virosa (Roxb. ex.Willd.) Baillon (Euphorbiaceae) is a flowering shrub that flourishes in the sub-Sahara Africa, it grows up to about 6 m in this region. Many authors have reported its traditional uses in many developing countries. It is employed in Tanzania against chest pain, diarrhoea, dysmenorrhea, edema, epilepsy, gonorrhrea, gastrointestinal conditions, renal complaint and rheumatism (Haerdi, 1964; Khan et al., 1978; Sawhney et al., 1978; Hedberg et al., 1983a). Malaria, sexual prowess liver disease, inflammation and pain, removal of worms in the human
body, against bilharziasis, are some of the diseases reportedly manage by *S. virosa* by the locals. It is also used for the treatment of malaria (Hedberg *et al.*, 1983a; Vasileva, 1969; Holdsworth, 1975; Yang *et al.*, 1987; Hedberg *et al.*, 1983b; Berhault, 1971; Hedberg *et al.*, 1983b; Samuelsson *et al.*, 1992). In developing countries i.e. Ghana, Senegal, Tanzania and Zimbabwe, many authors give a report of various part of this medicinal plant traditionally use. Decoction from its roots are employed as aphrodisiac, it leaves and roots are used to against pain in children, help to sleep, the fruits and the stems is used against snake-bite (Dalzel, 1936; Moshi *et al.*, 2000; Neuwinger, 1996; Watt and Breyer-Brandwijk, 1962). Traditional healers in some parts of Nigeria, use its leaves decoction against cancer, roots and twigs concoction is employed against epilepsy and mental illness (Magaji *et al.*, 2008; Soladoye *et al.*, 2010; Yerima *et al.*, 2009).

**Securinega virosa and Vernacular names**

This medicinal plant has a string of names by which it is called around the world as illustrated in Table 1. *S. virosa* is commonly referred to as Snowberry tree, white berry bush, Chinese water-berry, simple-leaf bush-weed, common bush-weed in English language.

<table>
<thead>
<tr>
<th>Table 1: Other names of <em>Rumexacetosa</em></th>
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<td><strong>Country</strong></td>
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**Phytochemistry**

Chao *et al.*, 2016 isolated these terpenoids: 3α,10α-Dihydroxy-12-methoxy-13-methyl-9(10 / 20)-abeoent-podocarpa-8,11,13-triene (1), 3β,10α,12-Trihydroxy-13-methyl-9(10 / 20)-abeoentpodocarpa-6,8,11,13-tetraene (2), 3β,10α-Dihydroxy-12-methoxy-13-methyl-9(10 / 20)-abeo-ent-podocarpa-8,11,13-triene (3), 10α-Hydroxy-12-methoxy-13-methyl-9(10 / 20)-abeo-ent-podocarpa-6,8,11,13-tetraen-3-one (4), 10α-Hydroxy-12-methoxy-13-methyl-9(10 / 20)-abeo-ent-podocarpa-8,11,13-trien-3-one (5), 10α,12-Dihydroxy-13-methyl-9(10 / 20)-abeo-
entpodocarp-6,8,11,13-tetraen-3-one (6), 3α,20-Dihydroxy-12-methoxy-13-methyl-ent-podocarp-6,8,11,13-tetraene (7), 3β-Hydroxy-12-methoxy-13-methyl-ent-podocarp-8,11,13-triene (8), 3β-Hydroxy-12-methoxy-13-methyl-ent-podocarp-6,8,11,13-tetraene (9), 3α,12-Dimethoxy-13-methyl-ent-podocarp-6,8,11,13,17-methyl-ent-podocarp-6,8,11,13,17-tetraene (10), 3α,20-Epoxy-3β,12-dihydroxy-13-methyl-ent-podocarp-8,11,13-triene (11), 3α,20-Epoxy-3β,12-dihydroxy-13-methyl-ent-cleistantha-8,11,13,15-tetraene (12), 12-Methoxy-13-methyl-ent-podocarp-6,8,11,13-tetraeno-20,3α-lactone (13), 12-Hydroxy-13-methyl-ent-podocarp-6,8,11,13-tetraeno-20,3α-lactone (14), 12-Hydroxy-13-methyl-ent-podocarp-8,11,13-triene-20,3α-lactone (15), 6β-Hydroxy-12-methoxy-13-methyl-ent-podocarp-8,11,13-trien-3,7-dione (16), 6,12-Dihydroxy-13-methyl-7-oxo-ent-podocarp-5,8,11,13-tetraeno-20, 3α-lactone (17), (2R,4S) 2,4-epoxy-4,23,29-trihydroxy- 3, 4-seco-30-norfriedel-19-en-3-ol acid methyl ester (18), 3-p-bromobenzoate esters (2R,4S) 2, 4-epoxy-4,23,29-trihydroxy-3,4-seco-30-norfriedel-19-en-3-ol acid methyl ester (19), 3-p-bromobenzoate ester-6,12-Dihydroxy-13-methyl-7-oxo-ent-podocarp-5, 8, 11, 13-tetraeno-20,3α-lactone (20) (Chao et al., 2016). Chao et al., 2014 isolated these terpenoids from the roots of flavugia virosa, 3β,12-Dihydroxy-13-methylpodocarp-6,8,11,13-tetraene (21), 3β,12-Dihydroxy-13-methylpodocarp-8,11,13-triene (22), Spruceanol (23), ent-3β,12α-Dihydroxyxipimara-8 (14),15-diene (24), 3α-Hydroxy-12-methoxy-13-methyl-ent-podocarp-6,8,11,13-tetraene (25), 3α-Hydroxy-13-hydroxyxymethyl-12-methoxy-ent-podocarp-6,8,11,13-tetraene (26), 3β-Hydroxy-13-hydroxyxymethyl-12-methoxy-ent-podocarp-6,8,11,13-tetraene (27), 12-Hydroxy-13-methyl-ent-podocarp-6,8,11,13-tetraen-3-one (28), 12-Methoxy-13-methyl-ent-podocarp-6,8,11,13-tetraen-3-one (29), 6β,12-Dihydroxy-13-methyl-ent-podocarp-8,11,13-trien-3-one (30), 7α, 20-Epoxy-3α-hydroxy-12-methoxy-13-methyl-ent-podocarp- 8,11,13-triene (31), 3α,20-Epoxy-3β-hydroxy-12-methoxy-13-methyl-ent-podocarp- 8,11,13-triene (32) (Chao et al., 2014). Monkodkaew et al., 2009 isolated five triterpenes from F. virosa namely Friedelin (33), epifriedelanol (34), heptanolide (35), betulonic acid (36) and stigmasterol (37). Magaji et al., 2015 and Pu et al., 2001 isolated a terpenoid from the twigs and leaves of S. virosa called Bergenin (38) (Fig. 1).**

Pharmacological Importance of Terpenoids Isolated from S. virosa

**Anti-hepatitis C Virus Activity**

Chao et al. (2016) reported the anti-hepatitis C virus (HCV) infection to human hepatoma Huh7.5 cells activity of some of the isolated terpenoids. Compounds 8 and 9 displayed a very significant activity toward the virus (Chao et al., 2016).

**Antiarrhythmic and Sleep Promoting Effect**

Magaji et al. (2015) isolated bergenin (38) from the root bark of S. virosa and evaluated it for its sleeping potential. The authors concluded that this compound (38) may be responsible for the sedative effect of this medicinal plant. Pu et al., 2001 isolated bergenin (38) from the aerial part of flavugia virosa, the compound was evaluated against animal dosed cardiac arrhythmic. Bergenin (38) proved to be effective as an antiarrhythmic agent (Magaji et al., 2015; Pu et al., 2001).

**Antiproliferative Activity**

Monkodkaew et al., 2009 reported the antiproliferative activity of the five triterpenes that were isolated from S. virosa. Their result showed that betulonic acid (36) displayed good cytotoxicity activity against the human cancer cell lines used.

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Chemotaxonomic significance
*Flueggea virosa* also known as *Securinega virosa* contain terpenoids metabolites, especially different types of diterpenoids. Many authors have isolated these compounds-type from this species, compounds 1 – 20 (Chao et al., 2016), compounds 21 - 32 (Chao et al., 2014), compounds 33 -37 (Monkodkaew et al., 2009), compound 38 (Siddiqui et al., 2015). One or more of these compounds could serve as chemotaxonomy marker for this plant species, bergenin (38) or any of the diterpenoids can serve this purpose. Siddiqui et al. (2015) proposed that bergenin (38) and menisdaurin (39), the latter be a phenolic, Siddiqui et al., 2017 as reported earlier in this study proposed that ent-phyllanthidine (40) and rutin (41). Hence, terpenoids also could serve as a chemotaxonomic marker for *S. virosa*.

CONCLUSION
This review gives the overview of isolated terpenoids from *S. virosa*. About thirty-eight of these compounds have been isolated so far from this medicinal plant. Its use in many and major herbal product calls easy identification based on chemotaxonomy hence this study. Terpenes might aid with growth and impact the plant’s reproduction via multifaceted sets of interactions but they may not be significant in determining plants’ survival. The result is in relation with the proposed
theory that alkaloids and terpenoids could be of taxonomy importance in this species.

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CONFLICTS OF INTEREST STATEMENT

No potential conflict of interest was reported by the authors.

REFERENCES


