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Phytochemistry and Biological Properties of Burnet Weed (*Sanguisorba* spp.): A Review

Anestis KARKANIS[1], Evangelos VELLIOS[1], Thomas THOMAIDIS[2], Dimitrios BILALIS[3]*, Aspasia EFTHIMIADOU[4], Ilias TRAVLOS[3]

[1]*University of Thessaly, Department of Agriculture Crop Production and Rural Environment, Nea Ionia, Magnesia, Greece; anekark80@yahoo.gr; evellios@agr.uth.gr*

[2]*University of Thessaly, Liaison Office, Greece; thomaidistv@gmail.com*

[3]*Agricultural University of Athens, Department of Crop Science, Laboratory of Crop Production, Athens, Greece; bilalisdimitrios@yahoo.gr (*corresponding author); htravlos@yahoo.gr*

[4]*New York College, Dean of Postgraduates, Athens, Greece; sissyefthimiadou@yahoo.gr*

Abstract

Great burnet (*Sanguisorba officinalis* L.) and small burnet (*Sansguisorba minor* Scop.) are edible, perennial weeds widely distributed in the world. These are the most widespread *Sanguisorba* species. The bioactive components of *Sanguisorba* plants include phenolics (phenolic acids, flavonoids and neolignans) and terpenoids. Large potential exists to use burnets as medicinal plants. *Sanguisorba* species are known to show anticancer properties, antioxidative, antimicrobial and antiviral activities. Also, *Sanguisorba* extracts show anti-Alzheimer and anti-inflammatory properties. Small burnet extracts could also be a useful alternative to synthetic fungicides for crop production. This review focuses on biological activities of *Sanguisorba* extracts and emphasizing their potential applications in pharmaceutical areas.

Keywords: burnet, human health,phenolics, plant extracts, terpenoids

Introduction

Natural products are important for human health and drug discovery (Ji *et al*., 2009; Mondal *et al*., 2012). Many species of medicinal-aromatic plants are cultivated for industrial uses (i.e. colorants, dyes, biocides, pharmaceuticals), but most are still wild collected (Lubbe and Verpoorte, 2011). Burnets (*Sanguisorba officinalis* L. and *Sanguisorba minor* Scop.), as well as several other herbs (Efthimiadou *et al*., 2012; Karkanis *et al*., 2011; Xia *et al*., 2011), have been used extensively in traditional medicine (Cuccioloni *et al*., 2012; Retta *et al*., 2012; Yu *et al*., 2011).

Large potential exists to cultivate burnet as medicinal plant. Moreover, small burnet has good forage quality (Elgersma *et al*., 2013a). Burnet plants are very good cold tolerant. A limiting factor in burnet production is weed competition. There is a report that small burnet can tolerate bromoxynil, clethodim, clopyralid, dimethenamid-P, metribuzin, pendimethalin andquincloracherbicides (Nelson *et al*., 2014).The aim of this paper is to review the existing literature and explore the potential of burnet plants for medicinal properties.

Botanical-morphological description

Burnet (*Sanguisorba* spp.) is a member of the Rosaceaee family. Great burnet (*Sanguisorba officinalis* L.) and small burnet (*Sansguisorba minor* Scop. (synonym *Poterium sanguisorba* L.)) are the most widespread *Sanguisorba* species. Burnets are perennial herbs widely distributed throughout Europe, Asia and other parts of the world.

Burnets plants have pinnate leaves (Fig. 1). Leaflets are in pairs placed opposite or alternative. Inflorescences appear at the end of stems. The flowers have four sepals and no petals (Sutton, 2007; Andrabi *et al*., 2012). The seeds are achenes. The weight of 1000 burnet seeds is 10 g.

S. minor is a drought tolerant species (Koukoura *et al*., 2007). Douglas *et al*. (1994) reported that *S. minor* plants in the dry regime had soluble sugar levels of 1.4 -1.7 times higher than those watered adequately, which suggested that plants adjusted to water depletion.

Sanguisorba plants can be propagated from seeds. Seeds of *Sanguisorba* spp. germinated most rapidly at 24 to 25 °C constant temperatures, following 6 months of dry storage at 4 °C. Presence or absence of light does not affect germination percentages (Holloway and Matheke, 2003).

Burnets active constituents

Burnets contains several active compounds. The active constituents of *Sanguisorba* plants include phenolics: phenolic acids, flavonoids (i.e. quercetin; Fig. 2), neolignans and terpenoids. Ranfa *et al*. (2014) reported that small burnet exhibited the highest total polyphenols (258 mg/100g) content. Vanzani *et al*. (2011) also found that the amount of

Fig. 1. Plant and leaves of small burnet (*Sanguisorba minor* Scop.)

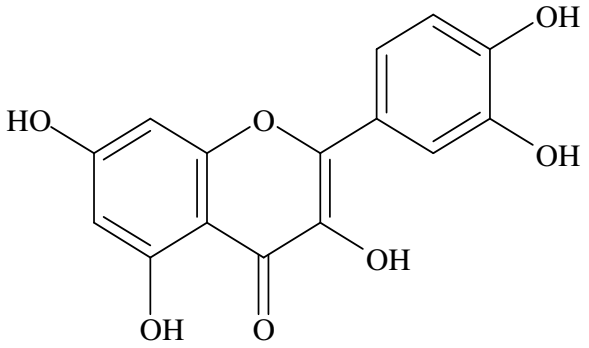

Fig. 2. Structure of quercetin

polyphenols present in small burnet was particularly high (98.2 mmol total phenols/kg). Moreover, small burnet contains high levels of α-tocopherol (85 mg/kg dry matter) and β-carotene (30 mg/kg dry matter; Elgersma *et al*., 2013b). Bioactive compounds isolated from *Sanguisorba* leaves and roots are listed in Tab. 1.

Burnets and human health

S. officinalis leaves can be used in salads or for various extracts or specialized preparations. Several studies have recently confirmed the anticancer properties of burnet plants (Goun *et al*., 2002). According to Wang *et al*. (2012) and Shin *et al*. (2012) *S. officinalis* inhibited the growth of breast and oral cancer. Choi *et al*. (2012a) also observed that extracts of *S. officinalis* could be used for treatment of prostate cancer.

Furthermore, *Sanguisorba* species are known to show antioxidative activities. Menkovic *et al*. (2007) reported that *S. minor* and *S. officinalis* extracts showed strong antioxidant activity. There was a correlation between the phenolic content and antioxidant activity. Moreover, Choi *et al*. (2012b) reported that ZYM-201 sodium succinate (salt form) can be used for the treatment of atherosclerosis and vascular diseases. ZYM-201 (methyl ester of a triterpenoid glycoside) is isolated from *S. officinalis* (Choi *et al*., 2006).

Burnet plants also show antiviral and antimicrobial activities. According to Bedoya *et al*. (2001) and Abad *et al*. (2000) the aqueous extracts of *S. minor* showed inhibitory effects against human immunodeficiency virus type 1 (HIV-1), herpes simplex virus type I (HSV-1) and vesicular stomatitis virus (VSV). Furthermore, Moreira *et al*. (2011) reported that the *S. hybrida* extracts showed high antibacterial activity against *Staphylococcus aureus*.

Moreover, *Sanguisorba* extracts show anti-Alzheimer activities. *Sanguisorba* spp. extracts inhibited the glycogen synthase kinase 3β (Kaufmann *et al*., 2009). Glycogen synthase kinase 3 has been shown to play an important role in Alzheimer's disease (Anand and Singh, 2013; Kaufmann *et al*., 2009). Moreover, it has been reported that acetylcholinesterase enzyme inhibitors are approved for Alzheimer management (Tabet, 2006). Ferreira *et al*. (2006) found that *S. minor* showed the best inhibition of acetylcholinesterase enzyme. These findings indicate that *Sanguisorba* extracts could be used against Alzheimer's disease.

Tab. 1. Bioactive compounds isolated from burnet plants

Compound	Reference	Compound	Reference
sanguidioside A	Liu *et al*. (2004)	gallic acid	Ayoub (2003)
sanguidioside B	Liu *et al*. (2004)	ellagic acid	Ayoub (2003)
sanguidioside C	Liu *et al*. (2004)	quercetin-3-O-(600-galloylglucose)	Ayoub (2003)
sanguidioside D	Liu *et al*. (2004)	b-glucogallin	Ayoub (2003)
quercetin	Ayoub (2003)	quercetin-3-glucuronide	Cuccioloni *et al*. (2012)
2,3-hexahydroxydiphenol-(a/b)-glucose	Ayoub (2003)	1-gallory-2,3-hexahydroxydroxyediphenol-a-glucose	Ayoub (2003)
2-(4-carboxy-3-methoxystyryl)-2 methoxysuccinic acid	Ayoub (2003)	4,8-dimethoxy-7-hydroxy-2-oxo-2H-1-benzopyran-5,6-dicarboxylic acid	Ayoub (2003)
(7S,8R)-4,9,5',9'-tetrahydroxy-3,3'-dimethoxy-8-O-4'-neolignan-7-O-α-l-rhamnopyranoside	Hu *et al*. (2012)	(7S,8R)-4,9,9'-trihydroxy-3,3',5'-trimethoxy-8-O-4'-neolignan-7-O-α-l-rhamnopyranoside	Hu *et al*. (2012)
(7S,8R)-4,7,9,9'-tetrahydroxy-3,3'-dimethoxy-8-O-4'-neolignan	Hu *et al*. (2012)	3b-[(a-L-arabinopyranosyl)oxy]-19b-hydroxyurs-12,20(30)-dien-28-oic acid	Liu *et al*. (2005)

Anti-inflammatory properties of *S. officinalis* have been the subject of several studies. Lee *et al*. (2010) observed that *S. officinalis* ethanol extract has therapeutic potential against bronchial asthma associated with allergic diseases. Yu *et al*. (2011) also found that burnet extracts can be effectively applied as a therapeutic agents and anti-inflammatory herbal medicines.

Furthermore, Chapman (2013) reported that the *S. officinalis* treatment significantly reduced hair loss and significantly reduced the telogen/anagen ratio. *S. minor* is also used to treat bites of the most venomous snakes in southern Europe (i.e. Bosnia and Herzegovina), such as *Vipera berus* and *Vipera ammodytes* (Redzic, 2010).

Small burnet and other uses

Small burnet extracts could be a useful alternative to synthetic fungicides in the management of postharvest fungal pathogens (Gatto *et al*., 2011). The authors reported that the extracts from small burnet completely inhibited *in vitro* spore germination of *Monilnialaxa, Penicilliumdigitatum, Pencilliumitalicum* and *Aspergilusniger,* while it significantly reduced those of *Botrytis cinerea* and *Pencilliumexpansum*. Askarne *et al*. (2012) also observed that the powder of *Sanguisorba minor* was effective against *P. italicum*. Kokubun *et al*. (1994) found that the root tissue of *S. minor* produced the phenolic compound 2′6′-dihydroxy-4′-methoxyacetophenone as a phytoalexin after fungal inoculation with *Botrytis cinerea*.

Moreover, the dry powder of small burnet leaves could be used to enrich vegetable oils with low content of natural antioxidant, such as sunflower and corn oil (Romojaro *et al*., 2013). Finally, the addition of *S. minor* (leaves and stems) increased the content of phenolic compounds and antioxidant capacity in orange and kiwifruit juices in more than 30% (Sanchez-Bel *et al*. 2014).

Conclusions

Burnets are perennial herbs widely distributed throughout Europe, Asia and other parts of the world. Burnets are rich in bioactive compounds. Great burnet (*Sanguisorba officinalis* L.) and small burnet (*Sansguisorba minor* Scop.) plants show anticancer, antioxidative, antiviral and antimicrobial activities. Furthermore, *Sanguisorba* extracts could be used against Alzheimer's disease. Their pharmacological properties are due to the presence of phenolics and terpenoids as active constituents.

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