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Ethnobotanical and Bioactive Characteristics of some *Sideritis* L. Taxa and Major Essential Oil Compounds

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Abstract

Turkey with a huge and rich variety of flora reserves lots of medical, aromatic and bioactive properties plants within its structure. In Turkey public medical science applications are encountered extensively and Turkey is one of the leading countries in the trade of medicinal and aromatic plants because of its geographical location, difference climate conditions, plant diversity and agricultural potential. As in whole world and in Turkey, use of plants existing in the natural flora for different purposes in traditional medicine; as spice, tea, insecticide, resin, veterinary cure, glue, essential oil, beverage, beekeeping, landscape and cosmetic industry. On the other hand, this important ethnobotanical knowledges are facing a danger of being lost by contemporary urbanisation and other negative factors.

The local population has long utilized the taxa of the genus *Sideritis* L., as herbal tea and in traditional medicine. Most of *Sideritis* taxa have significant biological activity, the biological activities and traditional usage of the *Sideritis* taxa are far better understood in recent years but still needs attention. The majority of *Sideritis* taxa exhibit a variety of biological functions and are highly interesting for future research on their pharmacological characteristics and potential for pharmacy and medicine.

In this study, it is aimed to review major essential oil compound, usage of traditional knowledge and biological activities of some *Sideritis* taxa in Turkey.

Keywords: *Sideritis*, Ethnobotany, Medicinal plant, Aromatic plant, Traditional use, Biological activity, Essential oil.

1. Introduction

Sideritis L. genus is in the Lamiaceae family. Lamiaceae is a family include economically important grasses, shrubs and rarely in tree form. *Sideritis*, *Salvia*, *Thymus*, *Mentha*, *Origanum*, *Phlomis*, *Nepeta*, *Teucrium*, *Rosmarinus*, *Lavandula*, *Thymbra*, *Satureja*, *Ballota*, *Stachys*, *Ajuga*, *Prunella*, *Melissa*, *Lamium*, *Marrubium* are most known genuses of Lamiaceae; which have many aromatic and medicinal importance taxa. While Lamiaceae members naturally grow in many parts of the world, especially in the gene center of Mediterranean region, Labiatae is represented by very few species in cold regions.

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The Lamiaceae family is one of the rich and important cosmopolitan families of Angiosperms, represented by 224 genera and approximately 5600 species in the world. According to the Flora of Turkey, there are approximately 45 genera and more than 850 taxa of which more than 235 are endemic. In addition, Lamiaceae members are in the first place among the plants traded in Turkey (Kılıç, 2014).

Members of Lamiaceae have a unique aromatic odor and are aromatic plants, and these fragrances they carry are due to essential oils. Due to have abundant essential oils, they have been used in medicine, cuisine, landscaping, pharmacy and perfumery for a long time. In addition, it is known that aromatic compounds, which are abundant in Lamiaceae members, affect the mood and health of individuals intensely and are used extensively in phytotherapy and aromatherapy. The Lamiaceae family is the family of plants most known and studied for their essential oils all over the world (Lee et al., 2011).

The genus *Sideritis* is one of the genus with the highest endemism rate in Turkey, and approximately 1/3 of the *Sideritis* taxa are endemic for Turkey. Due to its high endemism rate (79.5 %), Turkey is one of the gene centers of this genus. In Turkey, the species belonging to the genus *Sideritis* are known by different names among the people (Kılıç, 2002).

In this review study, major essential oil compound, usage of traditional knowledge and biological activities of some *Sideritis* taxa in Turkey are compiled.

2. Results and discussion

Usage properties of some *sideritis* taxa

Medicinal aromatic plants are generally used as a source of tea, spice, folk medicine and source of essential oil, and *Sideritis* members are ethnobotanically important and economically valuable plants used for these purposes. The first information about the use of *Sideritis* taxa as medicinal plants dates back to the first century. In many country *Sideritis* taxa are used as herbal tea. In addition, *Sideritis* taxa are usage as herbal tea, many taxa are used in the traditional medicine for treatment of different diseases and health problems (Başer, 2000).

Sideritis taxa are widely used as folk medicine and herbal tea in Turkey ethnobotany. Commonly used because of its nervous system stimulant, anti-inflammatory, antispasmodic, carminative, analgesic, sedative, antitussive, stomachic and anticonvulsant effects. Members of the *Sideritis* genus are also widely used in the treatment of colds and gastrointestinal diseases (Table 1).

Sideritis taxa are also widely used in the aromatherapy and in phytotherapy, because they contain high rates of fragrant oils and commonly used aromatic substances. For this reason, some members of the *Sideritis* genus, which have high economic value. *Sideritis* species are often used in the treatment of inflammation and gastrointestinal disorders. These activities are based on the antioxidant properties of terpenoids and flavonoids in its composition (Koleva et al., 2002).

Sideritis albiflora, *Sideritis congesta*, *Sideritis libanotica*, *Sideritis perfoliata* and *Sideritis sipylea* have also been reported to be used as analgesics in stomach pain (Özaydın et al., 2005). *S. vulcanica* is consumed as an antipyretic and as an antipyretic among the people, and it is also ground and inhaled as a powder against headache (Arslan, 1999). *Sideritis libanotica* as a sedative, in colds, in the treatment of skin wounds, as an astringent. It has been reported that *S. montana* is used as a cough suppressant (Altundağ, Öztürk, 2011).

According to another study, *Sideritis perfoliata* is used in folk medicine for colds, bronchitis, stomach disorders. It has been noted that *Sideritis trojana* is also used in stomach disorders, abdominal pain, laxative, kidney diseases and sore throat (Bulut, Tuzlacı, 2015). *Sideritis trojana* was used as a folk remedy for digestive problems and colds (Polat, Satıl, 2012).

In another study, *Sideritis leptoclada* was used as a sedative in the treatment of colds and shortness of breath. It has been noted that *Sideritis montana* is used as a folk remedy in the treatment of stomach ailments (Kılıç et al., 2021). It has been reported that *Sideritis albiflora* is used as a diuretic, diabetic, relieving stomach and respiratory ailments (Sarı et al., 2010). *S. scardica* for calming down after work and *Sideritis condensata* is used traditionally for stress relief (Bruno et al., 2002).

Many *Sideritis* taxa are used for treatment of flu and colds, respiratory diseases, diseases of the digestive system, diseases of the urinary system, diseases of the cardiovascular system and anemia. In addition pharmacological activity of *Sideritis* members can be listed as; antimicrobial

and antivirus activity, antioxidant activity, anti-inflammatory activity, gastroprotective activity, pharmacologic activities on the central nervous system diseases, cytotoxic activity and other activities (Aneva et al., 2019).

Table 1. Used part, ethnobotanical uses, bioactivity and major essential compound of some *Sideritis* taxa.

| Botanical name | Location of the Plant | Used Part | Preparation method | Ethnobotanical uses | Reported bioactivities | Major essential oil compound |
|---|---|-----------------------------|---|--|---|---|
| <i>S. athea</i> | Bingöl, Kazdağı/Balıkesir, Edremit/Balıkesir | Aerial parts, flowers | Infusion | Common cold, flu, stomach ailments (Polat et al., 2011; Kalankan et al., 2015) (Polat, Satıl, 2012; Şahin, Kılıç, 2022) | Antimicrobial, Antidepressant, Ability to memorize (Kılıç et al., 2003; Öztürk et al., 1996) | Carvacrol (Küçük et al., 2021) |
| <i>S. bilgeriana</i> | Aladaglar/Nigde | Aerial part | Infusion | Heartburn, cold, hemorrhoids (Özdemir, Alpınar, 2015; Şahin, Kılıç, 2022) | Antimicrobial, Antioxidant (Dulger et al., 2006; Iscan et al., 2005; Aydin et al., 1996) | β-pinene (Iscan et al., 2005) |
| <i>S. brevidens</i> | Eğirdir/Isparta, Erdemli/Mersin, Gölhisar/Burdur, Fethiye/Muğla | Unspecified | Unspecified | Common cold (Başer et al., 2006) | Antioxidant, Antimicrobial, Antifungal (Tunalier et al., 2004; Dülger et al., 2005) | β-pinene (Kirimer et al., 1999) |
| <i>S. caesarea</i> | Pinarbasi/Kayseri | Aerial parts | Fresh herb is ingested. boiled in water, after filtering drunk as tea | Stomach ailments, ulcer (Gürbüz et al., 2005; Şahin, Kılıç, 2022) | Antifungal, Antimicrobial, Antioxidant, Antiulcerogenic, Antioxidative (Gürbüz et al., 2005; Dulger et al., 2006; Sağdıç et al., 2008; Aşkun et al., 2008; Çelik, Kaya, 2011) | β-caryophyllene (Günbatan et al., 2017) |
| <i>S. condensata</i> | The Middle Aegean Region | Aerial parts | Decoction | Food (Kargioğlu et al., 2010) | Antimicrobial, Antioxidant (Dülger et al., 2005; Özkan et al., 2001; Özkan et al., 2005; Güvenc et al., 2010; Özcan et al., 2005) | β-caryophyllene (Kirimer et al., 1996) |
| <i>S. erythrantha</i> var. <i>cedretorum</i> | Bozyazı/Mersin | Aerial parts | Infusion, gargle, mixture, spice | Cold, flu, pharyngitis, blurred vision, pleasure, as tea (Sargin, 2015) | Antimicrobial, Antioxidant (Köse et al., 2010) | α-pinene (Tabanca, 2001) |
| <i>S. erythrantha</i> var. <i>erythrantha</i> | Bozyazı/Mersin, Sütçüler/Isparta | Aerial parts, leaf, flowers | Infusion, gargle, mixture (Pickles, jam i.e.), spice | Cold, flu, pharyngitis, blurred vision, pleasure, as tea, antiseptic, germicidal, nausea, cold, asthma, desiccant, night sweats, spinal cord discomfort, blood purifier, gas reliever, breast milk booster (Sargin, 2015; Demirel, 2021) | Antimicrobial, Antioxidant, Antiviral (Köse et al., 2010; Altundağ et al., 2011; Altundağ, Aslım, 2011; Özkan et al., 2005; Yesilada, 2023) | α-pinene (Başer, Kirimer, 2018) |
| <i>S. germanicopolitana</i> | Kisecik/Karaman | Flowers | Infusion | For tea purpose (Yücel et al., 2016) | No studies found | Myrcene (Kirimer et al., 1992) |
| <i>S. lanata</i> | Bozyazı/Mersin | Aerial parts | Infusion | Kidney renewing, pleasure, as tea (Sargin, 2015) | Antidepressant, Antimicrobial (Uğur et al., 2005) | Spathulenol (Kirimer, 2000) |
| <i>S. leptoclada</i> | Acıpayam/Denizli | Aerial parts | Infusion | Sedative (Bulut et al., 2017) | Antimicrobial, Antioxidant (Saraç, Uğur, 2007; Askun et al., 2009; Güvenc et al., 2005) | Germacrene D (Deveci, 2019) |

| | | | | | | |
|---|---|-----------------------------|--|--|--|---|
| <i>S. libanotica</i> Subsp. <i>microchlamys</i> | Gölbashi/Adiyaman, Tut/Adiyaman, Birecik/Şanlıurfa, Adiyaman (centre), Yashıca/Şanlıurfa | Aerial part | Infusion | Stomach relaxing, fatigue relieving, pleasant, cold, flu, shortness of breath, cough (Güldaş, 2009; Furkan, 2016; Balos, Hakan, 2007; Abak, 2018) | Antioxidant, Antimicrobial, Cytotoxicity, Anticholinesterase (Atas et al., 2019) | β -caryophyllene (Kirimer et al., 2004) |
| <i>S. libanotica</i> subsp. <i>linearis</i> | Kürecik/Malatya, Midyat/Mardin, Andırın/Kahramanmaraş | Aerial parts, leaf | Infusion, decoction | Food, cold, for tea purpose (Kargioğlu et al., 2010; Akgül et al., 2018; Demirci, Özhatay, 2012; Tevent, 2020) | Antioxidant, Insektisit, Anti-inflammatory, Antimicrobial, Antiproliferative (Ayhan, 2008; Demirtaş et al., 2009; Yeşilada, Ezer, 1989; Ezer et al., 1994; Ezer et al., 1995) | α -bisabolol (Erbaş, Fakir, 2012) |
| <i>S. libanotica</i> subsp. <i>libanotica</i> | Sariveliler/Karman, Hatay (centre), Yeşildere/Karman | Flowers, aerial part | Infusion, decoction | For tea purpose, appetizer, carminative, sedative (Bağcı et al., 2016; Güzel et al., 2015; Akdag, Dogu, 2016) | Antioxidant (Güvenc et al., 2005) | Sideridiol (Formisano et al., 2015) |
| <i>S. libanotica</i> subsp. <i>violascens</i> | Sariveliler/Karman, Yeşildere/Karman | Flowers | Infusion | As tea (Bağcı et al., 2016; Akdag, Dogu, 2016) | Antimicrobial (Yılmaz, 2013) | β -caryophyllene (Kirimer et al., 2004) |
| <i>S. libanotica</i> subsp. <i>kurdica</i> | East Anatolia, Artuklu/Mardin, Bozova/Şanlıurfa, Şanlıurfa (centre), Gölpınar/Şanlıurfa | Leaf, flowers, aerial parts | Infusion, decoction, diabetes, a pinch is consumed as raw. | Sedative, colds, skin wounds, astringent, for tea purpose, gargle, diabetes (Abak, 2018; Altundag, Ozturk, 2011; Akan, Ayaz, 2015; Fidan, 2018; Kılıç, 2019; Oymak, 2018; Şahin-Fidan, 2018) | Antidepressant (Öztürk, 1996) | α -pinene (Kirimer et al., 2004) |
| <i>S. montana</i> subsp. <i>montana</i> | Kırklareli (centre) | Aerial parts | Decoction | Cold, flu, cough (Kültür, 2011) | Anticancer, Antioxidant (Venditti et al., 2016) | Germacrene D (Kirimer et al., 2000) |
| <i>S. perfoliata</i> | Kazdağı/Bahkesir, Bayramiç/Çanakale, Acıpayam/Denizli, Andırın/Kahramanmaraş, Sütçüler/Isparta, Bigadiç/Bahkesir, Bergama/Izmir | Aerial parts, leaf, flowers | Infusion | As tea, cold, bronchitis, stomach ailments, diuretic (Saçlı, Akahın, 2001) | Antimicrobial, Antidepressant, Anticancer, Ability to memorize, Antioxidant, Anti-inflammatory, Reducing blood pressure, Hypoglycaemic, Antioxidant, Antimicrobial, Cytotoxic, Anticholinesterase (Ezer et al., 1994; Kirimer et al., 2008; Atalay, 2014; Carıkcı, 2020) | Limonene (Kirimer et al., 2008) |
| <i>S. phrygia</i> | Yahyalı-Pınarbaşı/Kayseri, Develi/Kayseri | Flowers | Infusion | As tea (Çelikel, 2002) | Antioxidant (Öztürk et al., 1996; Güvenc et al., 2005) | Limonene (Özer-Sağır, 2016) |
| <i>S. pisidica</i> | Yörenler-Elmalı/Antalya, Dumanlı- | Leaf | Infusion, externally as porridge | Tonic, as a tea, for stomachaches (Yeşilada et al., | Antimicrobial, Anti-inflammatory, Antioxidant, | Caryophyllene (Özer-Sağır, 2016) |

| | | | | | | |
|--|---|---------------------|------------------|--|---|--|
| | Beyşehir/Konya | | | 1993) (Yeşilada et al., 1995) | Anticholinesterase, Antitumorase (Dülger et al., 2005; Yeşilada, Ezer et al., 1994; Özer-Sağır, 2016; Devceci et al., 2017) | |
| <i>S. rubriflora</i> | Bozyazı/Mersin | Aerial parts | Infusion, gargle | Cold, flu, pharyngitis, pleasure, as tea (Demirel, 2021; Bulut et al., 2017; Demirci, Özhatay, 2012; Bulut, Tuzlacı, 2015; Kocabaş, Gedik, 2016; Tanaydın, 2021; Arasan, 2022) | Antimicrobial, Antifeedant, Antifungal, (Dulger et al., 2006; Bondi et al., 2000) | β -pinene (Kirimer et al., 1999) |
| <i>S. scardica</i> subsp. <i>scardica</i> | Kırklareli (centre), | Aerial parts | Decoction | Bronchitis, cough, cold, flu (Sargin, 2015; Şahin, Kılıç, 2022) | Antioxidant (Tunalier et al., 2004) | b-pinene (Solomou et al., 2019) |
| <i>S. sipylea</i> | Sarıgöl/Manisa | Aerial parts | Infusion | Foot odor, haircare, pleasure, cold, flu, as tea (Kültür, 2007) | Antimicrobial, Antioxidant (Dulger et al., 2006; Güvenc et al., 2005; Loğoğlu et al., 2006; Aligiannis et al., 2001; Gergis et al., 1991) | β -myrcene (Maškovic et al., 2023) |
| <i>S. stricta</i> | Aladağlar/Niğde | Aerial parts | Infusion | Cold, flu (Akgül et al., 2016; Sarı et al., 2010) | Antimicrobial, Alzheimer's disease, Parkinson's disease, Anti-inflammatory, Analgesic (Küpeli et al., 2007; Kılıç, 2006; Turkmenoglu et al., 2015; Küpeli et al., 2007) | β -pinene (Sattar, 1995) |
| <i>S. syriaca</i> subsp. <i>nusairiensis</i> | Kahramanmaraş (centre) | Aerial parts | Unspecified | Cold (Güzel et al., 2015; Kocabaş, Gedik, 2016; Altay et al., 2015; Varlıbaş-Odunkıran, 2020; Özer, Türkmen, 2019) | Antiviral, Antimicrobial, Antioxidant, Analgesic, Antiinflammatory (Sattar, 1995; Koutsaviti et al., 2013; Goulas et al., 2014; Karapandzova et al., 2013; Menghini et al., 2005) | α -pinene (Kirimer et al., 2004) |
| <i>S. trojana</i> | Kazdağı/Balıkesir, Bayramiç/Çanak kale, Edremit/Balıkesir | Herbs, aerial parts | İnfusion | As tea, stomach ailments, Abdominal pain, laxative, kidney ailments, sore throat, cold (Şahin, Kılıç, 2022; Bulut, Tuzlacı, 2009) | Cytotoxic, Antimicrobial, Anti-helicobacter, Insecticidal, Antioxidant, Antifungal, (Kılıç et al., 2003; Dulger et al., 2006; Kirimer et al., 2008; Kılıç et al., 2003; Kırmızıbekmez et al., 2017; Aslan et al., 2006; Kırmızıbekmez et al., 2012) | β -pinene (Kirimer et al., 2008) |
| <i>S. vulcanica</i> | Arıcak/Elazığ | Aerial parts | Infusion | Appetizer, germicidal, anti-inflammatory, carminative, urinary tract infections, Cold (Polat, Satıl, 2012; Saçlı, Akalın, 2001; Bulut, Tuzlacı, 2015) | Antioxidant (Tunalier et al., 2004) | α -pinene (Başer, Kirimer, 2018) |

3. Conclusion

In Turkey ethnobotany the domestic people used *Sideritis taxa* for preparing beverages like herbal tea, and also for the treatment of various diseases and health problems, as wound healing and for some blood disorders.

Most information available is about the use of *Sideritis taxa* in the case of respiratory diseases, especially cold and flu. Many *Sideritis taxa* also have high antibacterial and antiviral activities. These activities are supposed to be due mostly to the terpenes, iridoids, some flavonoids, sterols and essential oils. The traditional use of many species of *Sideritis* genus for treatment of digestive system diseases could be linked to the inflammatory activity, due to the flavonoids.

Studies of the biological activities of *Sideritis taxa* (Figure 1) are dominated by these focused on the antioxidant and antibacterial activity of the plant extracts. Still, the predominant studies are of screening type, with emphasis on the selecting of appropriate species, extraction method and testing material, while the studies on the mechanism of action of the active substances are scarce.

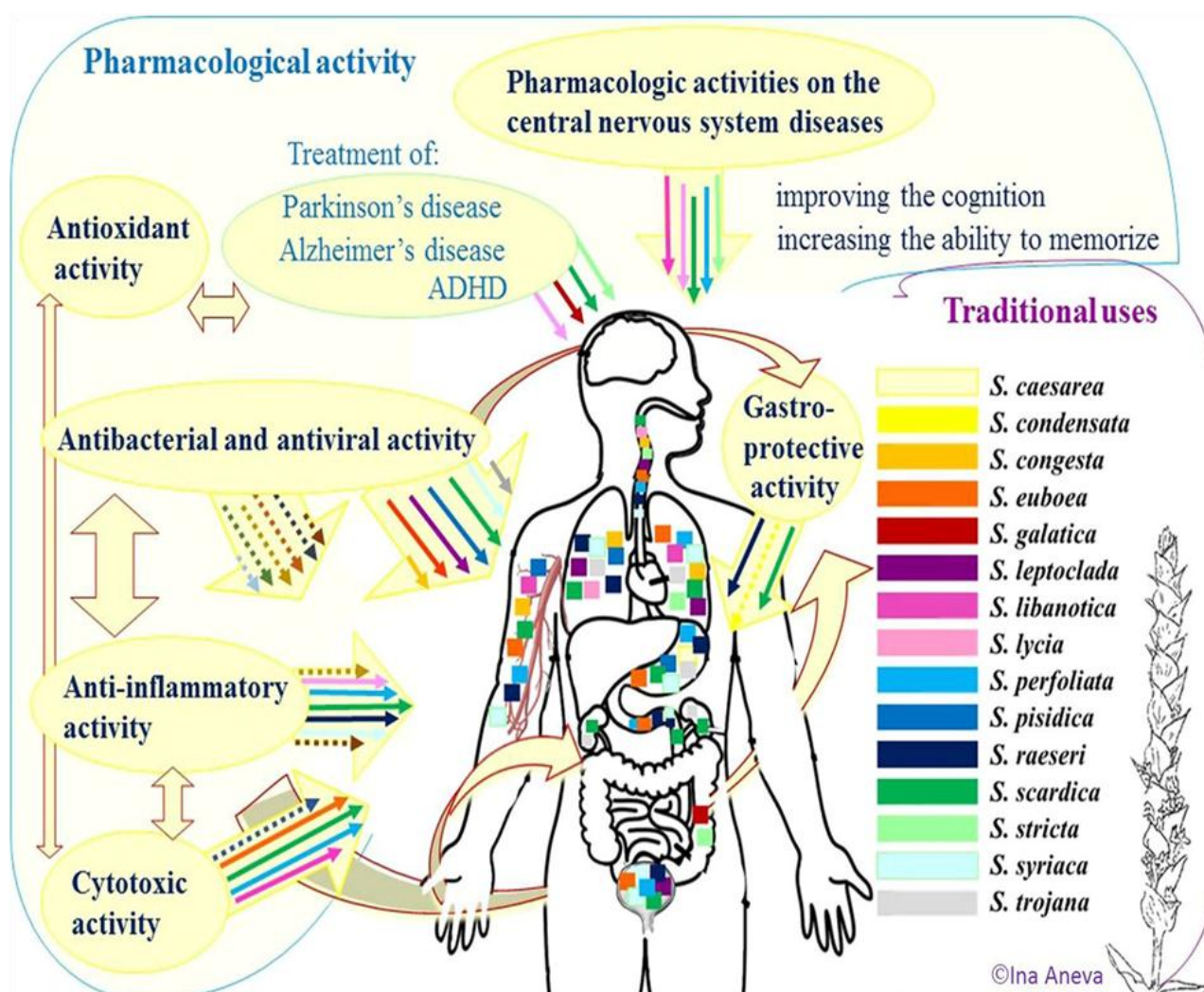


Fig. 1. Biological activities of some *Sideritis taxa* in human body (Aneva et al., 2019).

In conclusion, *Sideritis taxa* offers a wide source in different research fields and these taxa are provides a wide range of possibilities that can be found in further scientific studies like; phytochemistry, phytoteraphy, pharmacology, pharmacognosy, aromateraphy, toxicology etc.

4. Conflict of interest

The authors declare that there are no conflicts of interest.

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