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REVIEW

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Traditional uses, phytochemistry, and toxic potential of *Teucrium polium* L.: A comprehensive review

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ABSTRACT

The aim of this study was to present information about the traditional use and phytochemistry of *T. polium*, to discuss contradictory views about chemotaxonomy and its toxic effect on liver and kidneys, and to make suggestions about controversial areas and gaps in the literature. Literature data showed that *T. polium* has toxic effect on kidney tissue. Moreover, in some of the studies on the liver and in all clinical reports, *T. polium* has also been proven to have toxic effect on the liver. The components responsible for toxicity are thought to be *neo*-clerodane diterpenoids. However, it has been reported that flavonoids and some polyphenols in the plant also show antioxidant and anti-inflammatory effects. It has been concluded that more attention should be paid to the use of this plant. More clinical studies are needed to better understand the effects of *T. polium* on the liver. The effects of the plant on blood serum parameters and histological changes on the liver tissue should be documented in more detail. It was also concluded that that regular consumption of *T. polium* should be avoided for long periods of time.

1. Introduction

Many sources suggest that the use of plants as medicines is as old as the written history of humanity. However, the use of plants for the treatment of various diseases probably dates back to written history (Gunes et al., 2017). The history of many active medicines today goes back to the Hellenic civilization. In Egyptian Ebers Papyrus, which is thought to date back to 1500 BC, it is known that many medicinal plants are classified according to their therapeutic properties. On the other hand, it is claimed that the Balinese and Assyrians mentioned many herbal remedies such as licorice, cinnamon and coriander. It is also known that in a work written by Chinese doctor Chou Kung in 1100 BC, the use of certain herbal medicines are described. Additionally, Sustruta, published in the early period of Christianity, contains information about 700 herbal medicines. Galen's contribution to herbal medicine is also very valuable. The herbal extract preparation methods developed by Galen are still practiced today with the term 'Galenic' (Al-Asmari et al., 2014).

Traditional medicine is a system of therapeutic methods established by local people within their own belief, socio-cultural values and varies greatly from country to country, even from region to region (Alachkar et al., 2011). Information on herbal products used for medicinal purposes has been transmitted from generation to generation for centuries and highly reliable application systems have been created with increasing experience and constantly changing information in each generation (Hayta et al., 2014). It can be argued that what percentage of the world's population actually uses local and traditional medicines. However, research on the determination of this ratio shows that a significant number of people have great interest in herbal treatment methods. Studies conducted in Australia and the United States show that 34-48.5% of the

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participants benefit from traditional treatment methods at least once in their lifetime (Hasani-Ranjbar et al., 2008). The WHO is working hard to integrate traditional medical methods into official health systems (Alachkar et al., 2011). According to the data published by WHO, approximately 70-80% of the population living in developing countries meets their treatment needs primarily by using medicinal plants (Milosevic-Djordjevic et al., 2018). The main reason for this is thought to be the economic difficulties people face. Because, in developing countries, people who have difficulty in meeting the high pharmaceutical costs are turning to herbal alternatives for health needs (Khader et al., 2010). It is estimated that approximately 50.000-70.000 plant species are used for this purpose in all over the world. Today, the international herbal product market with an annual trade volume of 62 billion dollars is estimated to reach 5 trillion dollars by 2050 (Hayta et al., 2014).

Teucrium (Lamiaceae) is a perennial, polymorphic and cosmopolitan genus, wildly distributed in temperate regions of Europe, especially the Mediterranean, and North Africa (Milosevic-Djordjevic et al., 2018). There are reports that *Teucrium* species are also distributed in Asia, America and Australia (Khaled-Khodja et al., 2014). According to some sources, this genus contains 300 plant species (El Atki et al., 2019b; Khani and Heydarian, 2014; Sadeghi et al., 2014a), while other sources state that there are 340 or more species (Boghrati et al., 2016; De Martino et al., 2010; Sabzeghabaie and Asgarpanah, 2016). *Teucrium* species have evolved considerably in both growth characteristics and aromas through natural hybridization and selection mechanisms (Asgharipour and Shabankare, 2017). They usually grow in dry and stony areas (Khani and Heydarian, 2014). *Teucrium* species have been used as medicinal plants for more than 2000 years because of their therapeutic properties (Hachicha et al., 2009; Hasani-Ranjbar et al., 2010). According to ethnopharmacological records, members of this genus have long been used in the treatment of gastrointestinal problems, absorption disorders, cough, asthma, cognitive disorders, colds, pulmonary diseases, fungal infections and parasitic diseases (Boghrati et al., 2016; Elmasri et al., 2014; Khaled-Khodja et al., 2014; Kovacevic et al., 2001; Menichini et al., 2009; Sabzeghabaie and Asgarpanah, 2016; Sadeghi et al., 2014a; Sayyad and Farahmandfar, 2017). *Teucrium* species are also known as stimulant, hypoglycemic, hypolipidemic, analgesic, carminative, diuretic, perspiring, amoebicidal, antispasmodic, anti-rheumatic, antiseptic, antihelminic, anti-hypertensive, anti-inflammatory, antipyretic, anti-feedant, anticonvulsant and flavouring agents as well as their use as tonics (De Martino et al., 2010; Elmasri et al., 2014; Grubesic et al., 2012; Hachicha et al., 2009; Hasani-Ranjbar et al., 2010; Khaled-Khodja et al., 2014; Kovacevic et al., 2001; Menichini et al., 2009; Sabzeghabaie and Asgarpanah, 2016; Sadeghi et al., 2014a; Stefkov et al., 2011). These species are also preferred in the preparation of flavored wines, herbal teas and liqueurs (Menichini et al., 2009).

T. polium is a plant species belonging to Ajugoideae subfamily of Lamiaceae family. The name of this plant is known to originate from the union of the Greek terms “teúcrion”, in honor of an ancient Trojan king. According to Pliny, the Roman historian and writer, the Trojan king was the first to use this plant for medical purposes. Polium, the species name of the plant, comes from the old Greek word "poliòn". This word is used to indicate that the flower colour of the plant is whitish grey (Venditti et al., 2017). It is known that *T. polium* has some subspecies or varieties such as aurasiacum, pilosum, aragonense, capitatum, gnaphalodes, cylindricum, vincentinum, expansum, polium, yalentinum *(Bahramikia and Yazdanparast, 2012)*.

T. polium is a perennial and aromatic herbaceous plant, of which base has a woody structure (Abadian et al., 2016; Venditti et al., 2017). The plant has round and pubescent stalks. The stem of the plant is erected and can extend up to 10-35 cm (Amraei et al., 2018a; Venditti et al., 2017). The plant can grow up to 30-50 cm (Abadian et al., 2016). The upper parts of the body have a fully branched anatomical appearance. The leaves of the plant are 2 cm long and 4 mm wide (Venditti et al., 2017). Some sources indicate that the leaves may be 1-3 cm long (Afifi et al., 2005; Al-Qudah et al., 2011; Asgharipour and Shabankare, 2017). The lower parts have intact and folded margins; on the contrary, the margins in the upper parts are crenate and outstretched. It blooms in different colours ranging from pink to yellow between April and August (Venditti et al., 2017). Some sources indicate that the colour of the flower may be of varying tones of white or pale cream (Abadian et al., 2016; Alizadeh et al., 2011; Asgharipour and Shabankare, 2017). It is known that bruised foliage releases a pleasant aromatic odour (Bahramikia and Yazdanparast, 2012; Mahmoudabady et al., 2018; Menichini et al., 2009). The flowering branches and leaves of the plant are known to contain essential oil (Ravan et al., 2019). The fruits are light brown to dark brown nutlets with a latticed surface (Sabzeghabaie and Asgarpanah, 2016).
T. polium is known to spread in almost all Mediterranean countries from Southeast Asia to Europe (Venditti et al., 2017). Plant shows more intensive distribution in Iran, Iraq, Saudi Arabia, Egypt, Jordan, Palestine and Turkey (Aburjai et al., 2006; Afifi et al., 2005). The plant has also been reported to distribute overseas, such as Australia and America (Chioibas et al., 2019). Dry and stony hills, calcareous soils and deserts up to 3000 m are typical habitats of the plant (Sayyad and Farahmandfar, 2017; Venditti et al., 2017). Some researchers report that the plant grows also on gravel and sandy beaches (Amraei et al., 2018a). The plant has seasonal metamorphosis to adapt to the stressful climatic conditions seen in winter and summer seasons (Lianopoulou et al., 2014).

In this review, all published studies on the ethnopharmacological properties, phytochemistry and toxic potentials of *T. polium* from 1981 to November 2019 were screened. It is known that *T. polium* is frequently used by local people in the treatment of various diseases. The aim of this study was to gather information about the traditional use and phytochemistry of *T. polium*, to discuss contradictory views about chemotaxonomy and its toxic effect on liver and kidneys, and to make suggestions about controversial areas and gaps in the literature. Although *T. polium* is one of the most important plants used by local people, scientific data show that this plant can cause serious toxicity to organs such as liver and kidney. Not only people, but also scientists have opposing views on the reliability of the use of the plant. Some scientific studies have reported that the plant has a hepatoprotective effect, while some others (especially some case reports) suggest that the plant has toxic effects due to the various phytochemical ingredients. This leads to speculative situations regarding the use of the plant. Here, the information put forward by different social groups (both local people and the scientific community) is given and an assessment of the therapeutic potential of the plant is made considering the balance of profit and loss. In addition, the gaps in this field were discussed and some suggestions were made regarding the actions to be taken to eliminate these gaps.

2. Methodology

In order to get literature data on the ethnopharmacological properties, phytochemistry and toxic potential of *T. polium*, a search was performed using the keyword ‘Teucrium polium’ in Web of Science, Scopus and PubMed databases. As a result of the

screening, an EndNote library consisting of 379 studies containing the aforementioned keyword was created from 1981 to November 2019. Two authors screened these studies in detail at the text level and as a result of this first stage the number of records has been reduced to 276 by eliminating some of them, which does not contain *T. polium* actually as the keyword. The remaining records were then grouped according to the characteristics of Teucrium genus, geographic distribution, botanical properties and historical background of *T. polium*, ethnopharmacological uses, phytochemical composition and toxicity on kidney and liver. In addition, one of the authors identified the local names of the plant in different languages and converted them into a table (Table 1). Data obtained from ethnopharmacological studies, phytochemistry and toxicity findings were given in Tables 1, 2, 3, 4, 5, and 6, respectively. As a result of the ethnopharmacological research, controversial data regarding toxic and/or protective properties of this plant, especially on the liver, were obtained. Therefore, ethnopharmacological data and the results of scientific studies were compared and a consistent and holistic judgment was tried to be reached. Finally, the gaps created by the conflicting data about *T. polium* were pointed out, and opinions were given about what needs to be done to eliminate these gaps.

Table 1. Commonly used local names of *T. polium* in different languages.

Common name (In alphabetical order)	Language	Reference
Acı Ot	Turkish	(Erbay and Sari, 2018)
Acı Yavşan	Turkish	(Arasan and Kaya, 2015; Erbay and Sari, 2018)
Adi Yavşanotu	Turkish	(Selimoglu et al., 2015)
Ak Sedef Otu	Turkish	(Erbay and Sari, 2018)
Al-Ajrah	Arabic	(Boulila et al., 2008)
Al-Ja'adeh	Arabic	(Ben Othman et al., 2017)
Basur Otu	Turkish	(Erbay and Sari, 2018)
Bozot	Turkish	(Erbay and Sari, 2018)
Calpoureh	Persian	(Hasani-Ranjbar et al., 2010; Mahjoub et al., 2012; Mousavi et al., 2012; Nor et al., 2019)
Cat Thyme	English	(Ali-Shtayeh et al., 2000; BaniHani and Al Manasra, 2009; Khalil et al., 2009)
Cığde	Arabic, Syriac	(Akgul et al., 2018)
Coda	Turkish	(Orhan and Aslan, 2009)
Espand	Persian	(Mashreghi and Niknia, 2012)
Felty Germander	English	(Al-Tikriti et al., 2017; Alamdar et al., 2007; Bakari et al., 2015; Dag et al., 2014b; Huseini et al., 2019; Menichini et al., 2009; Milosevic-Djordjevic et al., 2018; Nor et al., 2019; Orhan and Aslan, 2009; Pellow and Nienhuis, 2018; Rad et al., 2014; Salbi et al., 2016; Stankovic et al., 2011; Stankovic et al., 2012; Venditti et al., 2017; Yaldiz et al., 2017)
Gattaba	Arabic	(Ben Othman et al., 2017)
Gattabet	Arabic	(Boulila et al., 2008)
Germander	English	(Aburjai et al., 2006; Al-Qudah et al., 2011; Bendif et al., 2018; Chioibas et al., 2019; El Atki et al., 2019a; El Atki et al., 2019b; Hasani-Ranjbar et al., 2010; Starakis et al., 2006; Suboh et al., 2004; Tadjrobehkar and Abdollahi, 2014)
Golden Germander	English	(Chitturi and Farrell, 2008; Fiorentino et al., 2011; Pacifico et al., 2012; Polymeros et al., 2002; Rahmouni et al., 2019; Stefkov et al., 2011; Vasileiadou et al., 2003)
Gurisa	Arabic	(Alachkar et al., 2011)
Ja'adah	Arabic	(Abdulrazzaq, 2017)
Ja'da	Arabic	(Jaradat et al., 2016)
Jaa'deh	Arabic	(Aburjai et al., 2006; Al-Qudah et al., 2011; Al-Tikriti et al., 2017)
Jaad	Arabic	(Al-Asmari et al., 2014)
Jaada	Arabic	(Boulila et al., 2008; El Atki et al., 2019a; El Atki et al., 2019b)
Jaadah	Arabic	(Bendif et al., 2018; Rahmouni et al., 2018)
Jaadeh	Arabic	(Alachkar et al., 2011)
Jae'dah	Arabic	(Kerbouche et al., 2015)
Jeada	Arabic	(Abu-rish et al., 2016; Alzweiri et al., 2011; Suboh et al., 2004)
Joode	Arabic	(Hosseinkhani et al., 2017)
Kalbpoureh	Persian	(Mashreghi and Niknia, 2012)
Kalpooreh	Persian	(Asgharipour and Shabankare, 2017; Dag et al., 2014b; Darabpour et al., 2010; Khani and Heydarian, 2014; Khoshnood-Mansoorkhani et al., 2010; Mahjoub et al., 2012; Mahmoudabady et al., 2018; Mahmoudi et al., 2014; Mahmoudi et al., 2015; Nikpour et al., 2018; Raei et al., 2014; Ravan et al., 2019; Rezvannejad et al., 2019; Sadrizadeh et al., 2018; Seyyednejad and Motamedi, 2010; Shabankare et al., 2015)
Kalporeh	Persian	(Abadian et al., 2016)
Kalpoureh	Persian	(Boghrati et al., 2016; Sabzeghabaie
Kalpurak	Persian	(Sadeghi et al., 2014b)
Kalpureh	Persian	(Ghasemi et al., 2019a)
Kayatta	Arabic	(Bendif et al., 2018)
Khayata	Arabic	(Ben Othman et al., 2017; Kerbouche et al., 2015)
Kısa Mahmut	Turkish	(Polat and Satil, 2012)
Kısa Mahmut Otu	Turkish	(Uysal et al., 2012)
Koyun Otu	Turkish	(Erbay and Sari, 2018)
Koyun Yavşanı	Turkish	(Orhan and Aslan, 2009)
Mayasıl Otu	Turkish	(Erbay and Sari, 2018; Hayta et al., 2014; Tuncturk et al., 2019)
Meryem Otu	Turkish	(Erbay and Sari, 2018)
Meryem Saçı	Turkish	(Orhan and Aslan, 2009)
Mountain Germander	English	(Dababneh, 2008; Dag et al., 2014a)
Oğlan Otu	Turkish	(Erbay and Sari, 2018)
Oğul Otu	Turkish	(Erbay and Sari, 2018)
Peryavşan	Turkish	(Erbay and Sari, 2018)
Poleigamander	German	(Amraei et al., 2017b; Yousefi et al., 2018)
Poly-Germander	English	(Khoshnood-Mansoorkhani et al., 2010; Sezer and Bozaykut, 2012)
Sancı Otu	Turkish	Erbay and Sari, 2018)
Takmazzut	by Touaregs	(Baali et al., 2016)
Tiksinik Otu	Turkish	(Erbay and Sari, 2018)
Tüylü Kısamahmut	Turkish	(Coban et al., 2003; Tuncturk et al., 2019)
Ürper yavşağı	Turkish	(Cakilcioglu and Turkoglu, 2010)
Wall Germander	English	(Amraei et al., 2017a)
Yavşan	Turkish	(Erbay and Sari, 2018)

3. Traditional and medicinal use

T. polium is known by different local names in different languages and cultures. Table 1 shows the local names of *T. polium* in different geographical regions of the world. Since the plant has a Eastern Mediterranean and Middle Eastern origin, it is seen that the native languages of these countries play an important role in determining the local names and the different names used in the same country are similar to each other phonetically. *T. polium* is known in Turkish, Arabic and Persian with a large number of local names that are thought to have differentiated over time from the same source. While the names 'Calpoureh' or 'Kalpoureh' are common in Persian, 'Ja'adeh' and its derivatives are used frequently in Arabic. In Tunisia, whose official language is Arabic, *T. polium* is called as 'Al-Ja'adeh', 'Khayata' or 'Gattaba'. It is stated that these terms mean 'cicatrisant' in Arabic (Ben Othman et al., 2017). In some countries, the local names of the plant may also vary regionally. For example, in the eastern regions of Algeria, *T. polium* is called as 'Kayatta', while in the western regions it is known as 'Jaadah' (Bendif et al., 2018). Because of its pharmacological and/or toxic effects on certain tissues and organs, *T. polium* attracted the attention of scientists from Western countries as well as researchers from Eastern Mediterranean and Middle East. Therefore, in Western languages, *T.*

polium is commonly known as 'Germander', 'Golden Germander' and 'Felty Germander'.

T. polium is one of the most popular herbal remedies in the world and has been used by local people for the treatment of various ailments for over 2000 years (Hasanein and Shahidi, 2012). Its use as a medicinal herb dates back to Hippocrates, Dioscorides, Palin and Galen (Ghasemi et al., 2019a). This plant has been used medicinally since ancient Greek times (Menichini et al., 2009; Sheikhbahaei et al., 2018) and medical of reputation of this plant was also noticed in traditional medicine by Socrates and Jalinous (Mahmoudi et al., 2015; Seyyednejad and Motamedi, 2010).

Table 2 gives information about the diseases which *T. polium* is used for treatment among the local people. The table also specifies which parts of the plant are used, how they are prepared and how they are used. Based on the data in the table, it is possible to make a judgment about the usage habits and frequency of use of this plant. As it is known, ethnopharmacological knowledge is transferred from past to present through generations and enriched with increasing experience in each generation. In the table, information on the use of the plant in the treatment of certain diseases is expressed by many authors, while the number of authors who comment on the use of the plant in the treatment of some other diseases is less. This shows that the effectiveness of *T. polium* in the treatment of some diseases has been verified through generations. Therefore, it can be concluded that the reliability of the information will increase as the accumulation of knowledge confirming each other about the therapeutic properties of the plant on any disease increases.

Table 2. Ethnopharmacological uses of *T. polium*.

Used as/in the treatment of (In alphabetical order)	Plant part(s)	Preparation	Suggested utilization method(s)	Reference
Amenorrhea	Aerial parts	Infusion, decoction	Not specified	(Ben Othman et al., 2017; De Marino et al., 2012)
Anorexia	Aerial parts	Infusion	Not specified	(Alzweiri et al., 2011; Bahramikia and Yazdanparast, 2012; Ben Othman et al., 2017; De Martino et al., 2010; Khaled-Khodja et al., 2014; Mashreghi and Niknia, 2012; Menichini et al., 2009; Rad et al., 2014)
Anorexia	Aerial parts	Infusion	Not specified	(Alzweiri et al., 2011; Bahramikia and Yazdanparast, 2012; Ben Othman et al., 2017; De Martino et al., 2010; Khaled-Khodja et al., 2014; Mashreghi and Niknia, 2012; Menichini et al., 2009; Rad et al., 2014)
Anti-cancer	Aerial parts	Infusion	Aerial parts are crushed and prepared as herbal tea.	(Alachkar et al., 2011; Farahmandfar et al., 2019)
Anti-convulsant	Not specified	Not specified	Not specified	(Abadian et al., 2016; Amraei et al., 2018b; Ghasemi et al., 2019a; Ghasemi et al., 2019b; Hasani-Ranjbar et al., 2010; Khoshnood-Mansoorkhani et al., 2010; Pesaraklu et al., 2011; Rad et al., 2014; Rezvannejad et al., 2019)
Anti-diabetic, insulinotropic	Aerial parts, stems	Infusion, decoction	- Aerial parts are crushed and prepared as tea. - Aerial parts are eaten as raw material or infused in hot water to consume as tea. - Aerial parts are consumed in powder form. - Infusion taken orally three times a week. - One cup of herbal tea is consumed on an empty stomach in the morning. - One teacup herbal tea is drunk two times a day for a 1-2 weeks.	(Aburjai et al., 2006; Afifi et al., 2005; Akgul et al., 2018; Al-Qudah et al., 2011; Al-Tikriti et al., 2017; Alachkar et al., 2011; Alamdar et al., 2007; Alzweiri et al., 2011; Amini et al., 2009; Amraei et al., 2018b; Arasan and Kaya, 2015; Ardestani and Yazdanparast, 2007; Bahramikia et al., 2009; Bahramikia and Yazdanparast, 2011, 2012; Baradaran et al., 2013; Bedir et al., 1999; Ben Othman et al., 2017; Bendif et al., 2018; Boghrati et al., 2016; Boulila et al., 2008; Bozov and Penchev, 2019; Cakilcioglu et al., 2010; Cakilcioglu and Turkoglu, 2010; Chitturi and Farrell, 2008; Coban et al., 2003; Dababneh, 2008; Dag et al., 2014a; Dag et al., 2014b; Darwish and Aburjai, 2010; De Martino et al., 2010; El Atki et al., 2019a; El Atki et al., 2019b; Elmasri et al., 2014; Esmaeili and Yazdanparast, 2004; Farahmandfar et al., 2019; Ghasemi et al., 2019a; Ghasemi et al., 2019b; Grubesic et al., 2012; Hachicha et al., 2009; Hasani-Ranjbar et al., 2010; Hayta et al., 2014; Huseini et al., 2019; Kandouz et al., 2010; Khader et al., 2010; Khaled-Khodja et al., 2014; Khalil et al., 2009; Khodadadi et al., 2018; Khoshnood-Mansoorkhani et al., 2010; Kiyani et al., 2011; Lianopoulou et al., 2014; Ljubuncic et al., 2005; Mahjoub et al., 2012; Mashreghi and Niknia, 2012; Menichini et al., 2009; Milosevic-Djordjevic et al., 2018; Mitreski et al., 2014; Monfared and Pournourmohammadi, 2010; Mousavi et al., 2012; Movahedi et al., 2014; Niazmand et al., 2011; Niazmand et al., 2017; Nikpour et al., 2018; Oroojalian et al., 2017; Panovska and Kulevanova, 2005; Pesaraklu et al., 2011; Polat and Satil, 2012; Rad et al., 2014; Raei et al., 2014; Rahmouni et al., 2019; Rezvannejad et al., 2019; Sadeghi et al., 2014b; Scognamiglio et al., 2012; Shabankare et al., 2015; Stefkov et al., 2011; Tuncturk et al., 2019; Vasileiadou et al., 2003; Yaldiz et al., 2017; Zabihi et al., 2018)
Anti-diarrheal	Aerial parts	Infusion, decoction	- About 15 g of leaves are kept in 100 ml water for two hours; this infusion is drunk after each meal. - Infusion of the leaves and flowers is consumed as herbal tea.	(Akgul et al., 2018; Amraei et al., 2018b; Baali et al., 2016; Ghasemi et al., 2019a; Ghasemi et al., 2019b; Jaradat et al., 2016; Krishnaiah et al., 2011; Pesaraklu et al., 2011; Rezvannejad et al., 2019; Tuncturk et al., 2019)
Anti-hemorroidal	Aerial parts	Infusion, decoction	- Dried and crushed aerial parts are used internally or externally. In the case internal use, the powdered material can be mixed to honey.	(Bedir et al., 1999; Dag et al., 2014b; Erbay and Sari, 2018; Hayta et al., 2014; Khalil et al., 2009; Stefkov et al., 2011)

Used as/in the treatment of (In alphabetical order)	Plant part(s)	Preparation	Suggested utilization method(s)	Reference
			- One cup of herbal tea is also consumed on an empty stomach in the morning.	
Anti-hyperlipidemic	Aerial parts	Infusion	One cup of herbal tea prepared from the aerial parts or powdered material is consumed on an empty stomach in the morning.	(Ardestani and Yazdanparast, 2007; Bahramikia et al., 2009; Boghrati et al., 2016; Chitturi and Farrell, 2008; Dababneh, 2008; De Martino et al., 2010; Farahmandfar et al., 2019; Forouzandeh et al., 2013; Hachicha et al., 2009; Hayta et al., 2014; Mitreski et al., 2014; Mousavi et al., 2012; Sadeghi et al., 2014b; Shabankare et al., 2015; Stefkov et al., 2011; Vasileiadou et al., 2003; Yaldiz et al., 2017)
Anti-hypertensive	Aerial parts	Infusion	Infusion prepared from the aerial parts or powdered material is consumed as herbal tea	(Al-Tikriti et al., 2017; Amraei et al., 2018b; Ardestani and Yazdanparast, 2007; Bahramikia et al., 2009; Bahramikia and Yazdanparast, 2012; Ben Othman et al., 2017; Boghrati et al., 2016; De Martino et al., 2010; El Atki et al., 2019a; El Atki et al., 2019b; Farahmandfar et al., 2019; Forouzandeh et al., 2013; Khaled-Khodja et al., 2014; Khoshnood-Mansoorkhani et al., 2010; Lianopoulou et al., 2014; Mashreghi and Niknia, 2012; Menichini et al., 2009; Mitreski et al., 2014; Mousavi et al., 2012; Movahedi et al., 2014; Nikpour et al., 2018; Rad et al., 2014; Rezvannejad et al., 2019; Sadeghi et al., 2014b; Scognamiglio et al., 2012; Tuncturk et al., 2019; Yaldiz et al., 2017)
Anti-inflammatory	Aerial parts, stems	Infusion	Not specified	(Al-Asmari et al., 2014; Alzweiri et al., 2011; Amraei et al., 2018b; Ardestani and Yazdanparast, 2007; Bahramikia et al., 2009; Bahramikia and Yazdanparast, 2011, 2012; Baradaran et al., 2013; Ben Othman et al., 2017; Boghrati et al., 2016; Cakilcioglu et al., 2010; Chitturi and Farrell, 2008; Dababneh, 2008; De Martino et al., 2010; Derakhshan et al., 2011; El Atki et al., 2019b; Elmasri et al., 2014; Farahmandfar et al., 2019; Forouzandeh et al., 2013; Ghasemi et al., 2019a; Ghasemi et al., 2019b; Grubesic et al., 2012; Hachicha et al., 2009; Huseini et al., 2019; Khader et al., 2010; Khader et al., 2007; Khaled-Khodja et al., 2014; Khalil et al., 2009; Khodadadi et al., 2018; Khoshnood-Mansoorkhani et al., 2010; Lianopoulou et al., 2014; Ljubuncic et al., 2005; Mashreghi and Niknia, 2012; Menichini et al., 2009; Milosevic-Djordjevic et al., 2018; Mitreski et al., 2014; Mousavi et al., 2012; Movahedi et al., 2014; Niazmand et al., 2011; Niazmand et al., 2017; Panovska and Kulevanova, 2005; Pesaraklu et al., 2011; Rad et al., 2014; Raei et al., 2014; Rezvannejad et al., 2019; Scognamiglio et al., 2012; Shabankare et al., 2015; Stefkov et al., 2011; Yaldiz et al., 2017; Zabihi et al., 2018)
Anti-mutagenic	Not specified	Not specified	Not specified	(Farahmandfar et al., 2019)
Anti-nociceptive, analgesic, anti-spasmodic on abdominal colic/pains, headache, body and joint pains, dysmenorrhea, toothache and visceral pains	Aerial parts	Infusion, decoction	- Aerial parts are consumed in powder form or as herbal tea. - Fresh leaves can be chewed. - Aerial parts are crushed and prepared as tea. - Infusion taken orally three times a week. - One cup of herbal tea is consumed three times a day or aerial parts can be cooked. - Infusion prepared from the aerial parts or powdered material is consumed as herbal tea.	(Abadian et al., 2016; Abdollahi et al., 2003; Aburjai et al., 2006; Afifi et al., 2005; Akgul et al., 2018; Al-Qudah et al., 2011; Al-Tikriti et al., 2017; Alachkar et al., 2011; Alamdar et al., 2007; Alzweiri et al., 2011; Ardestani and Yazdanparast, 2007; Baali et al., 2016; Bahramikia et al., 2009; Bahramikia and Yazdanparast, 2011, 2012; Bakari et al., 2015; Baradaran et al., 2013; Ben Othman et al., 2017; Bendif et al., 2018; Boghrati et al., 2016; Bozov and Penchev, 2019; Dababneh, 2008; Dag et al., 2014a; Dag et al., 2014b; Darwish and Aburjai, 2010; Elmasri et al., 2014; Farahmandfar et al., 2019; Forouzandeh et al., 2013; Ghasemi et al., 2019a; Ghasemi et al., 2019b; Grubesic et al., 2012; Gunes et al., 2017; Hachicha et al., 2009; Hasani-Ranjbar et al., 2010; Huseini et al., 2019; Kandouz et al., 2010; Kerbouche et al., 2015; Khaled-Khodja et al., 2014; Khazaei et al., 2018; Khodadadi et al., 2018; Khoshnood-Mansoorkhani et al., 2010; Kiyani et al., 2011; Ljubuncic et al., 2006; Mahmoudabady et al., 2018; Mashreghi and Niknia, 2012; Masoudi, 2018; Menichini et al., 2009; Milosevic-Djordjevic et al., 2018; Mitreski et al., 2014; Mosaddegh et al., 2012; Movahedi et al., 2014; Niazmand et al., 2011; Niazmand et al., 2017; Nikpour et al., 2018; Oroojalian et al., 2017; Pacifico et al., 2012; Pesaraklu et al., 2011; Rad et al., 2014; Raei et al., 2014; Rahmouni et al., 2019; Rezvannejad et al., 2019; Sabzeghabaie and Asgarpanah, 2016; Sadeghi et al., 2014a; Sadeghi et al., 2014b; Scognamiglio et al., 2012; Sevindik et al., 2016; Shabankare et al., 2015; Tuncturk et al., 2019; Venditti et al., 2017; Yaldiz et al., 2017; Zendehdel et al., 2011)
Anti-parasitic (amoebicidal, anti-helmintic, vermifuge)	Not specified	Infusion	Not specified	(Aburjai et al., 2006; Al-Qudah et al., 2011; Alamdar et al., 2007; Bendif et al., 2018; El Atki et al., 2019a; El Atki et al., 2019b; Elmasri et al., 2014; Grubesic et al., 2012; Sadeghi et al., 2014a)
Anti-pyretic, febrifuge	Aerial parts	Infusion, decoction	- Infusion of the leaves and flowers or their powdered forms is consumed as herbal tea.	(Abdollahi et al., 2003; Bahramikia and Yazdanparast, 2012; Bakari et al., 2015; Ben Othman et al., 2017; Boghrati et al., 2016; Cakilcioglu and Turkoglu, 2010; Chitturi and Farrell, 2008; Dababneh, 2008; El Atki et al., 2019a; El Atki et al.,

Used as/in the treatment of (In alphabetical order)	Plant part(s)	Preparation	Suggested utilization method(s)	Reference
			- One teacup of herbal tea is drunk two times a day before meal until recovery.	2019b; Elmasri et al., 2014; Forouzandeh et al., 2013; Grubesic et al., 2012; Hasani-Ranjbar et al., 2010; Khaled-Khodja et al., 2014; Khazaei et al., 2018; Khoshnood-Mansoorkhani et al., 2010; Krishnaiah et al., 2011; Ljubuncic et al., 2006; Mahmoudabady et al., 2018; Mashreghi and Niknia, 2012; Menichini et al., 2009; Mitreski et al., 2014; Movahedi et al., 2014; Niazmand et al., 2011; Niazmand et al., 2017; Pacifico et al., 2012; Rad et al., 2014; Sabzeghabaie and Asgarpanah, 2016; Sadeghi et al., 2014b; Sevindik et al., 2016; Tuncturk et al., 2019; Uysal et al., 2012; Yaldiz et al., 2017; Zabihi et al., 2018)
Anti-rheumatic	Aerial parts	Infusion, decoction	Not specified	(Akgul et al., 2018; Al-Asmari et al., 2014; Bahramikia and Yazdanparast, 2011, 2012; Bendif et al., 2018; Dababneh, 2008; El Atki et al., 2019a; El Atki et al., 2019b; Farahmandfar et al., 2019; Grubesic et al., 2012; Huseini et al., 2019; Khaled-Khodja et al., 2014; Khazaei et al., 2018; Lianopoulou et al., 2014; Menichini et al., 2009; Milosevic-Djordjevic et al., 2018; Raei et al., 2014; Tuncturk et al., 2019; Yaldiz et al., 2017)
Antibacterial, antifungal	Aerial parts	Not specified	Not specified	(Amraei et al., 2018b; Ardestani and Yazdanparast, 2007; Bahramikia et al., 2009; Bahramikia and Yazdanparast, 2012; Dababneh, 2008; De Martino et al., 2010; Farahmandfar et al., 2019; Forouzandeh et al., 2013; Ghasemi et al., 2019a; Ghasemi et al., 2019b; Huseini et al., 2019; Khaled-Khodja et al., 2014; Khazaei et al., 2018; Khoshnood-Mansoorkhani et al., 2010; Menichini et al., 2009; Mousavi et al., 2012; Movahedi et al., 2014; Nikpour et al., 2018; Pesaraklu et al., 2011; Rad et al., 2014; Rezvannejad et al., 2019; Shabankare et al., 2015; Tuncturk et al., 2019; Yaldiz et al., 2017)
Antioxidant	Aerial parts	Not specified	Not specified	(Dababneh, 2008; De Martino et al., 2010; Farahmandfar et al., 2019; Shabankare et al., 2015; Tuncturk et al., 2019)
Antiseptic	Not specified	Not specified	Not specified	(Grubesic et al., 2012; Sevindik et al., 2016)
Appetizer	Aerial parts	Infusion	It is consumed as herbal tea	(Amraei et al., 2017a; Bendif et al., 2018; Elmasri et al., 2014; Goulas et al., 2012; Sharififar et al., 2009; Stankovic et al., 2011; Stankovic et al., 2012; Tepe et al., 2011; Tepe et al., 2012)
Arthritis, gout	Aerial parts	Infusion, decoction	Not specified	(Ben Othman et al., 2017; De Marino et al., 2012; Khader et al., 2010)
Astringent	Not specified	Not specified	Not specified	(Bendif et al., 2018; Sadeghi et al., 2014a)
Body weight loss agent	Not specified	Not specified	Not specified	(Farahmandfar et al., 2019; Tuncturk et al., 2019)
Cholagogic, bile stimulator	Aerial parts	Not specified	Not specified	(Abdollahi et al., 2003; Bakari et al., 2015; Dababneh, 2008; Ghasemi et al., 2019a; Grubesic et al., 2012; Hasani-Ranjbar et al., 2010; Ljubuncic et al., 2006; Mahmoudabady et al., 2018; Mitreski et al., 2014; Pacifico et al., 2012; Sabzeghabaie and Asgarpanah, 2016; Yaldiz et al., 2017)
Chronic bronchitis, asthma, cough, expectorant, common cold, flu, grippe	Aerial parts	Infusion, decoction	- One cup of herbal tea is consumed three times a day. - One teacup of herbal tea is drunk two times a day before meal until recovery. - For the treatment of flu, one cup of herbal tea is consumed on an empty stomach in the morning. - Infusion of the leaves and flowers is consumed as herbal tea.	(Akgul et al., 2018; Bahramikia and Yazdanparast, 2011, 2012; Ben Othman et al., 2017; Bendif et al., 2018; Boghrati et al., 2016; De Marino et al., 2012; Elmasri et al., 2014; Farahmandfar et al., 2019; Gunes et al., 2017; Hayta et al., 2014; Krishnaiah et al., 2011; Masoudi, 2018; Oroojalian et al., 2017; Raei et al., 2014; Sadeghi et al., 2014a; Sheikhbahaei et al., 2018; Tuncturk et al., 2019; Uysal et al., 2012; Venditti et al., 2017)
Condiment, spice	Aerial parts	Not specified	Not specified	(Amraei et al., 2017a; Baali et al., 2016; Bendif et al., 2018; Goulas et al., 2012; Mahjoub et al., 2012; Pacifico et al., 2012; Sharififar et al., 2009; Stankovic et al., 2012)
Dementia, mental performance	Not specified	Not specified	Not specified	(Ghasemi et al., 2019a; Ghasemi et al., 2019b; Hasanein and Shahidi, 2012; Milosevic-Djordjevic et al., 2018; Orhan and Aslan, 2009; Simonyan and Chavushyan, 2015)
Depurative	Aerial parts	Infusion	Not specified	(Aburjai et al., 2006; Al-Qudah et al., 2011; Alamdar et al., 2007; Ben Othman et al., 2017; Bendif et al., 2018; Sadeghi et al., 2014a)
Diaphoretic, sweat gland activator	Aerial parts	Infusion, decoction	Not specified	(Abdollahi et al., 2003; Bakari et al., 2015; Ben Othman et al., 2017; Dababneh, 2008; De Marino et al., 2012; Ghasemi et al., 2019a; Hasani-Ranjbar et al., 2010; Kerbouche et al., 2015; Ljubuncic et al., 2006; Mahmoudabady et al., 2018; Mashreghi and Niknia, 2012; Mitreski et al., 2014; Movahedi et al., 2014; Pacifico et al., 2012; Rad et al., 2014; Sabzeghabaie and Asgarpanah, 2016; Yaldiz et al., 2017)
Diuretic	Aerial parts	Infusion, decoction	Not specified	(Abdollahi et al., 2003; Amraei et al., 2018b; Bakari et al., 2015; Ben Othman et al., 2017; Boghrati et al., 2016; Chitturi and Farrell, 2008; Dababneh, 2008; De Marino et al., 2012; Ghasemi et al., 2019a; Grubesic et al., 2012; Hasani-Ranjbar et al., 2010; Huseini et al., 2019; Kerbouche et al., 2015; Khazaei et al., 2018; Khoshnood-Mansoorkhani et al., 2010; Ljubuncic et al., 2006; Mahmoudabady et al., 2018; Mashreghi and Niknia, 2012; Mitreski et al., 2014; Movahedi

Used as/in the treatment of (In alphabetical order)	Plant part(s)	Preparation	Suggested utilization method(s)	Reference
				et al., 2014; Pacifico et al., 2012; Rad et al., 2014; Sabzeghabaie and Asgarpanah, 2016; Tuncturk et al., 2019; Yaldiz et al., 2017)
Eczema	Not specified	Not specified	Not specified	(Khader et al., 2010; Milosevic-Djordjevic et al., 2018; Tuncturk et al., 2019)
Emesis	Aerial parts	Infusion	Infusion prepared from the aerial parts or powdered material is consumed as herbal tea	(Sadeghi et al., 2014b)
Fertility, feminine sterility	Not specified	Not specified	Not specified	(Al-Tikriti et al., 2017; Bendif et al., 2018; Sadeghi et al., 2014a)
Flavouring	Not specified	Not specified	Not specified	(Bendif et al., 2018; Grubesic et al., 2012)
Gastrointestinal disorders (indigestion, dyspepsia, stomachache, gastralgia, gastric inflammation, enteritis) and effect on intestinal motility and abdominal tension as carminative and purgative agents	Aerial parts, stems	Infusion, decoction	- Infusion of the leaves and flowers is consumed as herbal tea. - Aerial parts or stems are consumed as powdered material. - Infusion of the aerial parts or powdered material is taken orally three times a week. - Aerial parts are crushed and prepared as tea.	(Akgul et al., 2018; Al-Asmari et al., 2014; Al-Tikriti et al., 2017; Alachkar et al., 2011; Ali-Shtayeh et al., 2000; Alzweiri et al., 2011; Amraei et al., 2018b; Baali et al., 2016; Bahramikia and Yazdanparast, 2011, 2012; Bedir et al., 1999; Ben Othman et al., 2017; Bendif et al., 2018; Boghrati et al., 2016; Boulila et al., 2008; Bozov and Penchev, 2019; Cakilcioglu et al., 2010; Cakilcioglu and Turkoglu, 2010; Chizzola, 2006; Coban et al., 2003; Dag et al., 2014a; Dag et al., 2014b; Darwish and Aburjai, 2010; De Marino et al., 2012; De Martino et al., 2010; Derakhshan et al., 2011; El Atki et al., 2019a; El Atki et al., 2019b; Farahmandfar et al., 2019; Ghasemi et al., 2019a; Ghasemi et al., 2019b; Grubesic et al., 2012; Hasani-Ranjbar et al., 2010; Jaradat et al., 2016; Kandouz et al., 2010; Khader et al., 2010; Khaled-Khodja et al., 2014; Khalil et al., 2009; Khazaei et al., 2018; Khodadadi et al., 2018; Krishnaiah et al., 2011; Ljubuncic et al., 2005; Masoudi, 2018; Menichini et al., 2009; Milosevic-Djordjevic et al., 2018; Mosaddegh et al., 2012; Nikpour et al., 2018; Oroojalian et al., 2017; Panovska and Kulevanova, 2005; Rad et al., 2014; Raei et al., 2014; Rahmouni et al., 2019; Rezvannejad et al., 2019; Sadeghi et al., 2014a; Sadeghi et al., 2014b; Stankovic et al., 2011; Stankovic et al., 2012; Tuncturk et al., 2019; Venditti et al., 2017)
Gynaecological infections, leucorrhoea, urogenital diseases, urinary tract inflammations	Aerial parts	Infusion, decoction	Aerial parts are consumed as herbal tea or they can be cooked.	(Al-Tikriti et al., 2017; Bahramikia and Yazdanparast, 2011, 2012; Ben Othman et al., 2017; De Marino et al., 2012; Khader et al., 2010; Masoudi, 2018; Milosevic-Djordjevic et al., 2018; Mosaddegh et al., 2012; Raei et al., 2014; Venditti et al., 2017)
Heart failure, alleviating heart pain	Not specified	Not specified	Not specified	(Khodadadi et al., 2018; Niazmand et al., 2011; Niazmand et al., 2017)
Insect repellent, anti-feedant	Aerial parts	Infusion	Infusion prepared from the aerial parts or the powdered material is applied topically.	(Sadeghi et al., 2014b)
Kidney stones, pains and other kidney disorders	Aerial parts, stems	Infusion, decoction	- Infusion taken orally three times a week. - One teacup herbal tea is drunk two times a day for a 1-2 weeks.	(Aburjai et al., 2006; Akgul et al., 2018; Al-Qudah et al., 2011; Al-Tikriti et al., 2017; Alamdar et al., 2007; Alzweiri et al., 2011; Bendif et al., 2018; Darwish and Aburjai, 2010; Elmasri et al., 2014; Khader et al., 2010; Khader et al., 2007; Khalil et al., 2009; Ljubuncic et al., 2005; Milosevic-Djordjevic et al., 2018; Polat and Satil, 2012; Stefkov et al., 2011)
Liver disorders, anti-hepatitis	Aerial parts, stems	Infusion, decoction	Infusion of the leaves and flowers is consumed as herbal tea.	(Akgul et al., 2018; Al-Asmari et al., 2014; Bedir et al., 1999; Cakilcioglu et al., 2010; El Atki et al., 2019a; El Atki et al., 2019b; Khader et al., 2010; Khader et al., 2007; Khalil et al., 2009; Krishnaiah et al., 2011; Ljubuncic et al., 2005; Milosevic-Djordjevic et al., 2018)
Neurotonic disorders	Aerial parts	Not specified	Not specified	(Chizzola, 2006)
Obesity	Not specified	Not specified	Not specified	(Al-Tikriti et al., 2017; Chitturi and Farrell, 2008)
Refreshing beverage	Aerial parts	Infusion	Infusion of the leaves and flowers is consumed as herbal tea.	(Goulas et al., 2012; Krishnaiah et al., 2011; Movahedi et al., 2014; Sharififar et al., 2009; Tepe et al., 2011; Tepe et al., 2012)
Sedative	Aerial parts	Infusion	Infusion prepared from the aerial parts or powdered material is consumed as herbal tea	(Sadeghi et al., 2014b)
Skin erythema	Not specified	Not specified	Not specified	(Stefkov et al., 2011)
Snake/scorpion bite	Aerial parts	Infusion	Infusion prepared from the aerial parts or the powdered material is applied topically.	(Sadeghi et al., 2014b)
Stimulant	Aerial parts	Infusion, decoction	Not specified	(Ben Othman et al., 2017; Bendif et al., 2018; De Marino et al., 2012; Grubesic et al., 2012; Sadeghi et al., 2014a; Tuncturk et al., 2019)
Tea	Not specified	Not specified	Not specified	(Baali et al., 2016; Goulas et al., 2012; Mahjoub et al., 2012; Pacifico et al., 2012; Sharififar et al., 2009; Stankovic et al., 2012; Tepe et al., 2011; Tepe et al., 2012)
Tonic	Aerial parts	Infusion, decoction	One teacup of herbal tea two times a day before meal until recovery is drunk.	(Abdollahi et al., 2003; Baali et al., 2016; Bakari et al., 2015; Ben Othman et al., 2017; Bendif et al., 2018; Coban et al., 2003; Dababneh, 2008; De Marino et al., 2012; Ghasemi et al., 2019a; Hasani-Ranjbar et al., 2010; Kerbouche et al., 2015; Khazaei et al., 2018; Ljubuncic et al., 2006; Mahmoudabady et al., 2018; Mashreghi and Niknia, 2012;

Used as/in the treatment of (In alphabetical order)	Plant part(s)	Preparation	Suggested utilization method(s)	Reference
				Movahedi et al., 2014; Pacifico et al., 2012; Rad et al., 2014; Sabzeghabaie and Asgarpanah, 2016; Sadeghi et al., 2014a; Sevindik et al., 2016; Stankovic et al., 2012; Uysal et al., 2012; Yaldiz et al., 2017)
Vulnerary, wound healing agent	Aerial parts	Infusion	Aerial parts are consumed as herbal tea or in powder form.	(Bendif et al., 2018; Dag et al., 2014a; Elmasri et al., 2014; Sadeghi et al., 2014a; Sadeghi et al., 2014b; Tuncturk et al., 2019)

As far as our literature survey could ascertain, since 1981, 120 studies have been reported providing information on the use of *T. polium* in traditional medicine. Among these studies, those who stated that the plant has anti-diabetic and/or insulinotropic effect are in the first place (79 reports, 65.8% of the total). This is followed by the plant's anti-nociceptive effect (71 reports, 59.2% of the total), therapeutic potential on gastrointestinal diseases (59 reports, 49.2% of the total), and anti-inflammatory activity (50 reports, 41.7% of the total). The plant is also often used for its anti-pyretic, anti-hypertensive, diuretic, antimicrobial (i.e. anti-bacterial and anti-fungal) activities and its effectiveness on upper respiratory tract infections (chronic bronchitis, asthma, cough, expectorant, common cold, and flu). There is a detailed discussion of the toxic effects of the plant under the heading 'Toxicity on kidney and liver'. However, it is worth mentioning that the plant has some therapeutic properties on liver and kidney disorders. Although there is some scientific evidence that the plant has toxic effects on the liver and kidney, it is known that the plant is frequently used by the local people in the treatment of liver diseases, hepatitis, kidney stones, kidney pain and other kidney diseases. Therefore, a profit-loss balance regarding the use of the plant should be considered. It is believed that both health authorities and scientists should provide a satisfactory explanation of the therapeutic properties of the plant without ignoring toxic effects.

As can be seen from Table 1, there are very few reports on the therapeutic properties of the plant on certain diseases. For example, one or two reports claims that *T. polium* is effective in the treatment of amenorrhea, obesity, emesis, neurotonic disorders, skin erythema and snake/scorpion bite or can be used as anti-cancer, antiseptic, astringent, flavouring, anti-mutagenic, insect repellent, anti-feedant, sedative and body weight loss agent agents. Therefore, the therapeutic potential of the plant on these disorders should be considered with suspicion. It would be a more realistic approach to have doubts before obtaining satisfactory information about the therapeutic potential of the plant on these ailments.

It was previously stated that the plant is a species of Eastern and Central Mediterranean origin. Therefore, this plant is mostly used by people living in the Middle East for therapeutic purposes. It is seen that especially the Iranians frequently use this plant in the treatment of type 2 diabetes (Alamdar et al., 2007; Amini et al., 2009; Bahramikia and Yazdanparast, 2011, 2012; Esmaeili and Yazdanparast, 2004; Farahmandfar et al., 2019; Ghasemi et al., 2019a; Khodadadi et al., 2018; Movahedi et al., 2014), gastrointestinal disorders (Bahramikia and Yazdanparast, 2011, 2012; Boghrati et al., 2016; Farahmandfar et al., 2019; Khodadadi et al., 2018; Raei et al., 2014), inflammation (Ardestani and Yazdanparast, 2007; Bahramikia and Yazdanparast, 2011; Forouzandeh et al., 2013; Ghasemi et al., 2019a; Movahedi et al., 2014), abdominal colic, pain and tension (Alamdar et al., 2007; Bahramikia and Yazdanparast, 2012; Farahmandfar et al., 2019; Ghasemi et al., 2019a; Raei et al., 2014), common cold, grippe (Bahramikia and Yazdanparast, 2012; Boghrati et al., 2016; Farahmandfar et al., 2019; Raei et al., 2014), bacterial infections (Ardestani and Yazdanparast, 2007; Forouzandeh et al., 2013; Ghasemi et al., 2019a; Movahedi et al., 2014), hypertension (Ardestani and Yazdanparast, 2007; Forouzandeh et al., 2013; Movahedi et al., 2014), urogenital diseases (Bahramikia and Yazdanparast, 2012; Raei et al., 2014), rheumatism (Bahramikia and Yazdanparast, 2011; Farahmandfar et al., 2019), hyperlipidaemia (Ardestani and Yazdanparast, 2007; Forouzandeh et al., 2013), heart failure (Khodadadi et al., 2018; Niazmand et al., 2017), headache (Abadian et al., 2016; Alamdar et al., 2007), convulsion (Abadian et al., 2016; Ghasemi et al., 2019a), kidney stones (Alamdar et al., 2007), dysmenorrhea (Abadian et al., 2016), diarrhoea (Ghasemi et al., 2019a), dementia (Ghasemi et al., 2019a) and as anti-spasmodic (Alamdar et al., 2007; Forouzandeh et al., 2013; Movahedi et al., 2014), anti-pyretic (Forouzandeh et al., 2013; Movahedi et al., 2014), anti-nociceptive (Ardestani and Yazdanparast, 2007; Movahedi et al., 2014), visceral pain killer (Zendehdel et al., 2011), vermifuge (Alamdar et al., 2007), diuretic (Movahedi et al., 2014), diaphoretic (Movahedi et al., 2014) and depurative agents (Alamdar et al., 2007). It is also known that this plant is one of the first remedies for the treatment of type 2 diabetes, especially in the southern parts of Iran (Bahramikia and Yazdanparast, 2011, 2012).

As a result of ethnopharmacological researches, it was understood that *T. polium* is not only used for the treatment of various diseases, but is also consumed for certain purposes in kitchens. The plant is especially valuable in the Middle Eastern cuisine as appetizer, condiment and spice, flavouring agent, tonic and tea. Especially in Iran, it is widely used as appetizer and spice (Sharififar et al., 2009). Although the issue of safety is one of the most debated issues, it is reported that the plant does not have any critical side effects although it is consumed so often in the Middle East (Derakhshan et al., 2011). The plant is also used as a refreshing beverage in personal care (Goulas et al., 2012; Krishnaiah et al., 2011; Movahedi et al., 2014; Sharififar et al., 2009; Tepe et al., 2011; Tepe et al., 2012).

In addition to the purposes for which the plant is used, it is necessary to mention which parts are consumed and in what way. Almost all of the sources evaluated indicate that the aerial parts of the plant are used. While some studies do not specify the form of preparation, the majority of the studies state that an infusion or a decoction is prepared from the plant. It is seen that the aerial parts of the plant or the powder obtained from these parts are often consumed as tea or raw material. Sometimes the aerial parts of the plant are consumed by cooking. There are also cases where the aerial parts of the plant are chewed in the mouth or mixed with honey to relieve stomach ailments. When the usage behaviour of the local people is evaluated, it is seen that there is no standardized use of the plant. There are those who use one tea cup tea or infusion on an empty stomach in the morning, after each meal, one or two times a day before meals until recovery and three times a week, as well as those who consume the same amount of tea or infusion twice a day for 1-2 weeks. It has been reported that the plant can be administered topically for snake/scorpion bites or as insect repellent/anti-feedant agent as well as the above-mentioned oral uses.

4. Phytochemistry

Data on the chemical composition of essential oils isolated from *T. polium*, subspecies or varieties were given in Table 3. The main components of essential oils and other phytochemicals were also given in Tables 4 and 5 respectively.

Table 3. A comprehensive list of the chemical constituents isolated from the essential oils *T. polium* together with its subspecies and varieties[1].

No	Chemical compound	ssp.[2]/var.[3]	Locality	Part/Extract	Reference
1	(+)-3-Carene	-	Jordan	TCM[4]	(Al-Qudah et al., 2011)
2	*(+)*-Aromadendrene	-	Jordan	TCM	(Al-Qudah et al., 2011)
3	*(+)*-Spathulenol	-	Jordan	TCM	(Al-Qudah et al., 2011)
4	*(+)*-Cycloisosativene	-	Iran	Aerial parts	(Nikpour et al., 2018)
5	*(-)*-Myrtenol	-	Jordan	TCM	(Al-Qudah et al., 2011)
6	*(-)*-Globulol	-	Iran	Aerial parts	(Nikpour et al., 2018)
7	*(-)-trans*-Pinocarvyl acetate	-	Iran	Aerial parts	(Nikpour et al., 2018)
8	*(-)*-α-Panasinsen	-	Iran	Aerial parts	(Nikpour et al., 2018)
9	*(1R)-(-)*-Myrtenal	-	Iran	Aerial parts	(Nikpour et al., 2018)
10	*(1R)-endo-(+)*-Fenchyl alcohol	-	Iran	Aerial parts	(Nikpour et al., 2018)
11	*(1S)-(-)*-Verbenone	-	Iran	Aerial parts	(Nikpour et al., 2018)
12	(3*E*,5*E*)-2,6-Dimethyl-1,3,5,7-octatetraene	-	Iran	Aerial parts	(Nikpour et al., 2018)
13	*(E,E)*-1,3,5-Undecatriene	-	Iran	Aerial parts	(Boroomand et al., 2018)
14	*(E,E)*-2,4-Decadienal	ssp. *polium*	Algeria	Aerial parts	(Djabou et al., 2012)
15	*(E)*-2-Hexenal	-	Iran	Fruits	(Oroojalian et al., 2017)
		-	Iran	Leaves	(Masoudi, 2018)
16	*(E)*-3-Caren-2-ol	-	Saudi Arabia	Aerial parts	(Ibrahim et al., 2017)
17	*(E)*-9-Octadecanoic acid	-	Iran	Flowers	(Masoudi, 2018)
18	*(E)*-Anethole	-	Iran	Aerial parts	(Heydarzade and Moravvej, 2012)
19	*(E)*-Caryophyllene	-	Iran	Aerial parts	(Keykavousi et al., 2016; Sadeghi et al., 2014a)
		-	Algeria	Flowers	(Bendif et al., 2018)
		ssp. *capitatum*	Greece	Leaves and inflorescences	(Fanouriou et al., 2018)
		-	Algeria	Vegetative parts	(Bendif et al., 2018)
20	*(E)*-Decaline	-	Iran	Aerial parts	(Heydarzade and Moravvej, 2012)
21	*(E)*-Hex-2-en-1-ol	ssp. *polium*	Algeria	Aerial parts	(Djabou et al., 2012)
22	*(E)*-Isoelemicin	ssp. *capitatum*	Crete	Aerial parts	(De Martino et al., 2010)
23	*(E)*-Linalool oxide	-	Algeria	Vegetative parts	(Bendif et al., 2018)
24	*(E)*-Nerolidol	ssp. *polium*	Algeria	Aerial parts	(Djabou et al., 2012)
		-	Iran	Flowers	(Masoudi, 2018)
		-	Iran	Leaves	(Masoudi, 2018)
		-	Iran	Stems	(Masoudi, 2018)
25	*(E)*-Phytol	ssp. *polium*	Algeria	Aerial parts	(Djabou et al., 2012)
26	*(E)*-Piperitenone oxide	-	Iran	Aerial parts	(Heydarzade and Moravvej, 2012)
27	*(E)*-α-Bergamotene	ssp. *capitatum*	Corsica	Aerial parts	(Djabou et al., 2012)
		ssp. *polium*	Algeria	Aerial parts	(Djabou et al., 2012)
28	*(E)*-β-Damascenone	ssp. *capitatum*	Crete	Aerial parts	(De Martino et al., 2010)
29	*(E)*-β-Farnesene	ssp. *capitatum*	Crete	Aerial parts	(De Martino et al., 2010)
		ssp. *capitatum*	Greece	Leaves and inflorescences	(Fanouriou et al., 2018)
30	*(E)*-β-Ionone	-	Algeria	Vegetative parts	(Bendif et al., 2018)
31	*(E)*-β-Ocimene	-	Serbia and Montenegro, Tunisia, Iran	Aerial parts	(Bakari et al., 2015; Gholivand et al., 2013; Kovacevic et al., 2001)
		ssp. *capitatum*	Corsica, Serbia and Montenegro, Bulgaria	Aerial parts	(Cozzani et al., 2005; Djabou et al., 2012; Mitic et al., 2012)
		ssp. *polium*	Algeria	Aerial parts	(Djabou et al., 2012)
		-	Algeria	Flowers	(Bendif et al., 2018)
		-	Iran	Fruits	(Oroojalian et al., 2017)
		-	France	Inflorescence	(Chizzola, 2006)
		-	Iran, France	Leaves	(Chizzola, 2006; Masoudi, 2018)
		-	Iran	Stems	(Masoudi, 2018)
		-	Algeria	Vegetative parts	(Bendif et al., 2018)
32	*(E)*-γ-Bisabolene	-	Iran	Aerial parts	(Gholivand et al., 2013; Sadeghi et al., 2014a)
33	*(Z,E)*-Farnesol	ssp. *capitatum*	Crete	Aerial parts	(De Martino et al., 2010)
34	*(Z,Z)*-9,12-Octadecadienoic acid	ssp. *capitatum*	Crete	Aerial parts	(De Martino et al., 2010)
		-	Iran	Flowers	(Masoudi, 2018)
		-	Iran	Stems	(Masoudi, 2018)
35	*(Z,Z)*-Farnesol	-	Iran	Flowers	(Masoudi, 2018)
		-	Iran	Leaves	(Masoudi, 2018)
		-	Iran	Stems	(Masoudi, 2018)
36	*(Z)*-9-Octadecenamide	-	Algeria	Flowers	(Bendif et al., 2018)
		-	Algeria	Vegetative parts	(Bendif et al., 2018)
37	*(Z)*-9,17-Octadecadienal	-	Iran	Flowers	(Masoudi, 2018)
38	*(Z)*-Hex-3-en-1-ol	ssp. *polium*	Algeria	Aerial parts	(Djabou et al., 2012)
39	*(Z)*-Nerolidol	-	Iran	Fruits	(Oroojalian et al., 2017)
		-	Iran	Leaves	(Masoudi, 2018)
40	*(Z)*-α-Bisabolene	-	Amman	Aerial parts	(Aburjai et al., 2006)
41	*(Z)*-α-Caryophyllene	-	Iran	Aerial parts	(Gholivand et al., 2013)
42	*(Z)*-α-Santalol	-	Amman	Aerial parts	(Aburjai et al., 2006)
43	*(Z)*-β-Caryophyllene	-	Iran	Aerial parts	(Gholivand et al., 2013)

No	Chemical compound	ssp.[2]/var.[3]	Locality	Part/Extract	Reference
44	*(Z)*-β-Farnesene		Croatia, Turkey, Iran	Aerial parts	(Bezic et al., 2011; Heydarzade and Moravvej, 2012; Sevindik et al., 2016)
		ssp. *capitatum*	Serbia and Montenegro	Aerial parts	(Mitic et al., 2012)
		-	Algeria	Flowers	(Bendif et al., 2018)
45	*(Z)*-β-Ocimene	-	Tunisia, Iran	Aerial parts	(Bakari et al., 2015; Heydarzade and Moravvej, 2012)
		ssp. *capitatum*	Serbia and Montenegro	Aerial parts	(Mitic et al., 2012)
		ssp. *polium*	Algeria	Aerial parts	(Djabou et al., 2012)
46	*(Z)*-γ-Bisabolene	-	Amman	Aerial parts	(Aburjai et al., 2006)
47	1-Methoxynaphthalene	-	Iran	Aerial parts	(Gholivand et al., 2013)
48	1-*nor*-Bourbonanone	ssp. *capitatum*	Bulgaria	Aerial parts	(Mitic et al., 2012)
		-	Algeria	Flowers	(Bendif et al., 2018)
		-	Greece	Leaves	(Lianopoulou et al., 2014)
		-	Algeria	Vegetative parts	(Bendif et al., 2018)
49	1-Octen-3-ol	-	Tunisia, Iran	Aerial parts	(Bakari et al., 2015; Gholivand et al., 2013; Nikpour et al., 2018)
		ssp. *capitatum*	Crete	Aerial parts	(De Martino et al., 2010)
		ssp. *polium*	Algeria	Aerial parts	(Djabou et al., 2012)
		-	Algeria	Flowers	(Bendif et al., 2018)
		-	Iran	Fruits	(Oroojalian et al., 2017)
		-	Greece	Leaves	(Lianopoulou et al., 2014)
		-	Jordan	TCM	(Al-Qudah et al., 2011)
50	1-Octen-3-yl-acetate	-	Iran	Aerial parts	(Nikpour et al., 2018)
		-	Iran	Leaves	(Masoudi, 2018)
51	1,2,3-Trimethyl-cyclopentene	-	Iran	Aerial parts	(Nikpour et al., 2018)
52	1,2,3,6,7,7a-hexahydro-5-h-inden-5-one	-	Iran	Aerial parts	(Boroomand et al., 2018)
53	1,2,4,4-Tetramethylcyclopentene	-	Iran	Aerial parts	(Nikpour et al., 2018)
54	1,3,8-*p*-Menthatriene	-	Iran	Aerial parts	(Gholivand et al., 2013; Nikpour et al., 2018)
55	1,5-Epoxysalvial-4(14)-ene	-	Algeria	Aerial parts	(Bendjabeur et al., 2018)
56	1,6,10-Dodecatriene,7,11-dimethyl-3-methylene	-	Iran	Aerial parts	(Mahmoudi et al., 2014)
57	1,8-Cineole	-	Iran, Tunisia, Greece	Aerial parts	(Asgharipour and Shabankare, 2017; Boulila et al., 2008; Essid et al., 2015; Shabankare et al., 2015; Vokou and Bessiere, 1985)
		ssp. *capitatum*	Corsica, Serbia and Montenegro	Aerial parts	(Djabou et al., 2012; Mitic et al., 2012)
		-	Iran	Fruits	(Oroojalian et al., 2017)
		-	Greece	Leaves	(Lianopoulou et al., 2014)
58	1,8-Dehydro-cineole	ssp. *capitatum*	Corsica	Aerial parts	(Cozzani et al., 2005; Djabou et al., 2012)
59	11-Acetoxyeudesman-4-α-ol	-	Iran	Aerial parts	(Sadeghi et al., 2014a; Sayyad and Farahmandfar, 2017)
60	14-Hydroxy-9-*epi*-*trans*-caryophyllene	-	Amman	Aerial parts	(Aburjai et al., 2006)
61	14-Hydroxy-α-muurolene	-	Algeria	Flowers	(Bendif et al., 2018)
62	1H-3a,7-Methanoazulene	-	Iran	Aerial parts	(Mahmoudi et al., 2014)
63	1H-Cycloprop-[e]-azulene	-	Iran	Aerial parts	(Sadrizadeh et al., 2018)
64	2-Methyl naphthalene	-	Iran	Stems	(Masoudi, 2018)
65	2-Methylbutyl butyrate	ssp. *polium*	Algeria	Aerial parts	(Djabou et al., 2012)
66	2-Naphthalene methanol	-	Iran	Aerial parts	(Sadrizadeh et al., 2018)
67	2-Pentyl furan	-	Algeria	Vegetative parts	(Bendif et al., 2018)
68	2-Undecanone	-	Algeria	Aerial parts	(Bendjabeur et al., 2018)
69	2-(4-Methyl-3-cyclohexen-1-yl)-2-propanamine	-	Iran	Aerial parts	(Nikpour et al., 2018)
70	2-Benzyl-1,3-dimethyl-guanidine	-	Iran	Aerial parts	(Nikpour et al., 2018)
71	2-Bromo-1-phenyl-1-propanone	-	Iran	Aerial parts	(Nikpour et al., 2018)
72	2-Menthene	-	Iran	Aerial parts	(Nikpour et al., 2018)
73	2-Methyl-3-hexyne	-	Iran	Aerial parts	(Nikpour et al., 2018)
74	2-Methyl-5-(1-methylethyl), *(S)*-2-cyclohexen-1-one	-	Iran	Aerial parts	(Nikpour et al., 2018)
75	2-Methylene bornane	-	Iran	Aerial parts	(Nikpour et al., 2018)
76	2-Pentanone	-	Iran	Aerial parts	(Nikpour et al., 2018)
77	2,3,3-Trimethyl-3-cyclopentene acetaldehyde	-	Iran	Aerial parts	(Mahmoudi et al., 2014)
78	2,4-Diisopropenyl-1-methyl-1-vinylcyclohexane	-	Iran	Aerial parts	(Nikpour et al., 2018)
79	2,4-Hexadiene	-	Iran	Aerial parts	(Nikpour et al., 2018)
80	2*E*-Hexenol	-	Algeria	Vegetative parts	(Bendif et al., 2018)
81	2H-Cycloprop-[e]-azulene	-	Iran	Aerial parts	(Sadrizadeh et al., 2018)
82	3-Cyclohexene-1-methanol,α,4-dimethyl	-	Iran	Aerial parts	(Mahmoudi et al., 2014)
83	3-Dodecarone	-	Iran	Aerial parts	(Gholivand et al., 2013)
84	3-Octanol	-	Iran	Aerial parts	(Asgharipour and Shabankare, 2017; Shabankare et al., 2015)
		-	Iran	Fruits	(Oroojalian et al., 2017)
85	3-Methyl butanal	-	Iran	Aerial parts	(Nikpour et al., 2018)
86	3-Methyl cyclohexene	-	Iran	Aerial parts	(Nikpour et al., 2018)
87	3,7-Dimethyl-2,6-octadien-1-ol	-	Iran	Aerial parts	(Nikpour et al., 2018)
88	3β-Hydroxy-α-muurolene	ssp. *aurasiacum*	Algeria	Aerial parts	(Kabouche et al., 2007)
89	4-Epicubebol	ssp. *polium*	Algeria	Aerial parts	(Djabou et al., 2012)
90	4-Methylacetophenone	-	Tunisia	Aerial parts	(Ben Othman et al., 2017)
		ssp. *capitatum*	Corsica	Aerial parts	(Cozzani et al., 2005; Djabou et al., 2012)
91	4-Vinyl guaiacol	ssp. *capitatum*	Crete	Aerial parts	(De Martino et al., 2010)
92	4-Amino furazan-3-carboximide acid	-	Iran	Aerial parts	(Nikpour et al., 2018)

No	Chemical compound	ssp.[2]/var.[3]	Locality	Part/Extract	Reference
	hydrazide				
93	4-Isopropyl-1-methyl-2-cyclohexen-1-ol	-	Iran	Aerial parts	(Nikpour et al., 2018)
94	4-Methyl-1-(1-methylethyl)-3-cyclohexen-1-ol	-	Iran	Aerial parts	(Nikpour et al., 2018)
95	4,6-Dimethylhept-5-en-2-one	ssp. *capitatum*	Corsica	Aerial parts	(Cozzani et al., 2005; Djabou et al., 2012)
96	4α-Hydroxy dihydro agarofuran	ssp. *capitatum*	Corsica	Aerial parts	(Djabou et al., 2012)
97	5-*iso*-Cedranol	-	Amman	Aerial parts	(Aburjai et al., 2006)
98	5-Isopropyl-2-methyl bicyclo[3.1.0]hexan-2-ol	-	Iran	Aerial parts	(Nikpour et al., 2018)
99	5,6-Dimethyl-1,3-cyclohexadiene	-	Iran	Aerial parts	(Nikpour et al., 2018)
100	5*E*,9*E*-Farnesyl acetone	-	Algeria	Vegetative parts	(Bendif et al., 2018)
101	6-Methyl-5-heptene-2-one	-	Iran	Aerial parts	(Sadeghi et al., 2014a)
		ssp. *capitatum*	Corsica	Aerial parts	(Cozzani et al., 2005; Djabou et al., 2012)
102	6-Camphenol	-	Iran	Aerial parts	(Nikpour et al., 2018)
103	6,10,14-Trimethyl-2 pentadecanone	-	Iran	Flowers	(Masoudi, 2018)
		-	Iran	Fruits	(Sabzeghabaie and Asgarpanah, 2016)
		-	Iran	Leaves	(Masoudi, 2018)
		-	Iran	Stems	(Masoudi, 2018)
104	6,6-Dimethyl-2-methylene bicyclo[3.1.1]heptan-3-one	-	Iran	Aerial parts	(Nikpour et al., 2018)
105	6,7-Bisepoxy-sec-calamenene	ssp. *capitatum*	Corsica	Aerial parts	(Cozzani et al., 2005; Djabou et al., 2012)
106	7-*epi*-α-Eudesmol	ssp. *capitatum*	Corsica	Aerial parts	(Cozzani et al., 2005; Djabou et al., 2012)
107	7-*epi*-α-Selinene	-	Iran	Aerial parts	(Sadrizadeh et al., 2018)
		-	Algeria	Flowers	(Bendif et al., 2018)
		-	Algeria	Vegetative parts	(Bendif et al., 2018)
108	7-*epi*-γ-Eudesmol	ssp. *capitatum*	Corsica	Aerial parts	(Cozzani et al., 2005; Djabou et al., 2012)
109	7-Methyl-1-octene	-	Iran	Aerial parts	(Nikpour et al., 2018)
110	8-Cedren-13-ol	-	Amman	Aerial parts	(Aburjai et al., 2006)
111	8-(1-Methylethylidene)bicyclo[5.1.0]octane	-	Iran	Aerial parts	(Nikpour et al., 2018)
112	Acetic acid	-	Iran	Aerial parts	(Sadrizadeh et al., 2018)
113	Agarospirol	-	Iran	Aerial parts	(Nikpour et al., 2018)
114	*allo*-Aromadendrene	-	Amman, Tunisia, Greece, Algeria	Aerial parts	(Aburjai et al., 2006; Bendjabeur et al., 2018; Boulila et al., 2008; Vokou and Bessiere, 1985)
		ssp. *aurasiacum*	Algeria	Aerial parts	(Kabouche et al., 2007)
		ssp. *capitatum*	Crete, Greece, Serbia and Montenegro, Bulgaria	Aerial parts	(De Martino et al., 2010; Menichini et al., 2009; Mitic et al., 2012)
		ssp. *polium*	Algeria	Aerial parts	(Djabou et al., 2012)
		-	Algeria	Flowers	(Bendif et al., 2018)
		-	Iran	Fruits	(Sabzeghabaie and Asgarpanah, 2016)
		-	Iran	Stems	(Masoudi, 2018)
		-	Algeria	Vegetative parts	(Bendif et al., 2018)
115	*ar*-Curcumene	ssp. *capitatum*	Crete, Greece	Aerial parts	(De Martino et al., 2010; Menichini et al., 2009)
116	Aristolene	ssp. *polium*	Algeria	Aerial parts	(Djabou et al., 2012)
117	Aromadendrene	-	Algeria, Serbia and Montenegro, Iran	Aerial parts	(Bendjabeur et al., 2018; Kovacevic et al., 2001; Nikpour et al., 2018; Sadrizadeh et al., 2018)
		ssp. *capitatum*	Crete	Aerial parts	(De Martino et al., 2010)
		ssp. *polium*	Algeria	Aerial parts	(Djabou et al., 2012)
		-	Algeria	Flowers	(Bendif et al., 2018)
		-	Algeria	Vegetative parts	(Bendif et al., 2018)
118	Aromadendrene oxide	-	Iran	Aerial parts	(Nikpour et al., 2018)
119	Benzene	-	Iran	Aerial parts	(Mahmoudi et al., 2014)
120	Benzene, 1-methyl	-	Iran	Aerial parts	(Mahmoudi et al., 2014)
121	Benzenemethanol, 4-(1-methylethyl)	-	Iran	Aerial parts	(Mahmoudi et al., 2014)
122	Benzyl benzoate	-	Iran	Aerial parts	(Gholivand et al., 2013)
123	Bicyclo[3.1.1]Hept-2-ene-2-methanol	-	Iran	Aerial parts	(Sadrizadeh et al., 2018)
124	Bicyclo[3.1.1]Hept-3-en-2-one	-	Iran	Aerial parts	(Sadrizadeh et al., 2018)
125	Bicyclo[3.1.1]hept-3-en-2-one, 4,6,6-trimethyl	-	Iran	Aerial parts	(Mahmoudi et al., 2014)
126	Bicyclogermacrene	-	Iran, Algeria, Serbia and Montenegro	Aerial parts	(Asgharipour and Shabankare, 2017; Bendjabeur et al., 2018; Gholivand et al., 2013; Heydarzade and Moravvej, 2012; Keykavousi et al., 2016; Kovacevic et al., 2001; Mahmoudi et al., 2014; Mahmoudi et al., 2015; Nikpour et al., 2018; Purnavab et al., 2015; Raei et al., 2014; Sadeghi et al., 2014a; Sadrizadeh et al., 2018; Shabankare et al., 2015)
		ssp. *capitatum*	Crete, Greece, Serbia and Montenegro, Bulgaria	Aerial parts	(De Martino et al., 2010; Menichini et al., 2009; Mitic et al., 2012)
		ssp. *polium*	Algeria	Aerial parts	(Djabou et al., 2012)
		-	Algeria	Flowers	(Bendif et al., 2018)
		-	Iran	Fruits	(Oroojalian et al., 2017; Sabzeghabaie and Asgarpanah, 2016)
		-	France	Inflorescence	(Chizzola, 2006)
		-	France, Greece, Iran	Leaves	(Chizzola, 2006; Lianopoulou et al., 2014; Masoudi, 2018)
		ssp. *capitatum*	Greece	Leaves and inflorescences	(Fanouriou et al., 2018)
		-	Iran	Stems	(Masoudi, 2018)
		-	Algeria	Vegetative parts	(Bendif et al., 2018)
127	Bicyclosesquiphellandrene	ssp. *capitatum*	Crete	Aerial parts	(De Martino et al., 2010)
128	Borneol	-	Tunisia, Croatia,	Aerial parts	(Bakari et al., 2015; Ben Othman et al., 2017; Bezic

No	Chemical compound	ssp.[2]/var.[3]	Locality	Part/Extract	Reference
			Iran, Serbia and Montenegro, Greece		et al., 2011; Gholivand et al., 2013; Kovacevic et al., 2001; Raei et al., 2014; Vokou and Bessiere, 1985)
		ssp. *capitatum*	Crete, Corsica, Greece, Serbia and Montenegro, Bulgaria	Aerial parts	(De Martino et al., 2010; Djabou et al., 2012; Menichini et al., 2009; Mitic et al., 2012)
		ssp. *polium*	Algeria	Aerial parts	(Djabou et al., 2012)
		-	Algeria	Flowers	(Bendif et al., 2018)
		-	Iran	Fruits	(Sabzeghabaie and Asgarpanah, 2016)
		-	Iran	Leaves	(Masoudi, 2018)
		-	Iran	Stems	(Masoudi, 2018)
		-	Algeria	Vegetative parts	(Bendif et al., 2018)
129	Bornyl acetate	-	Iran, Algeria, Croatia	Aerial parts	(Asgharipour and Shabankare, 2017; Bendjabeur et al., 2018; Bezic et al., 2011; Djabou et al., 2012; Keykavousi et al., 2016; Nikpour et al., 2018; Raei et al., 2014; Shabankare et al., 2015)
		ssp. *capitatum*	Corsica	Aerial parts	(Cozzani et al., 2005; Djabou et al., 2012)
		-	Algeria	Flowers	(Bendif et al., 2018)
		-	Iran	Fruits	(Oroojalian et al., 2017)
		-	Iran	Leaves	(Masoudi, 2018)
		-	Iran	Stems	(Masoudi, 2018)
		-	Algeria	Vegetative parts	(Bendif et al., 2018)
130	Bornyl propionate	-	Iran	Aerial parts	(Gholivand et al., 2013)
131	Bourbonanone	ssp. *polium*	Algeria	Aerial parts	(Djabou et al., 2012)
132	Bulnesol	ssp. *capitatum*	Corsica	Aerial parts	(Cozzani et al., 2005; Djabou et al., 2012)
133	Bulnesyl acetate	ssp. *capitatum*	Corsica	Aerial parts	(Cozzani et al., 2005; Djabou et al., 2012)
134	Butanoic acid ethyl ester	-	Iran	Aerial parts	(Nikpour et al., 2018)
135	Butyl hydroxy toluene	-	Iran	Aerial parts	(Sadrizadeh et al., 2018)
136	Cadalene	-	Amman, Algeria, Iran	Aerial parts	(Aburjai et al., 2006; Bendjabeur et al., 2018; Nikpour et al., 2018)
		ssp. *capitatum*	Corsica, Crete, Iran, Greece	Aerial parts	(Cozzani et al., 2005; De Martino et al., 2010; Djabou et al., 2012; Khani and Heydarian, 2014; Menichini et al., 2009)
		-	Algeria	Flowers	(Bendif et al., 2018)
137	Cadina-1,4-diene	-	Algeria	Aerial parts	(Bendjabeur et al., 2018)
		ssp. *capitatum*	Crete, Greece	Aerial parts	(De Martino et al., 2010; Menichini et al., 2009)
		ssp. *polium*	Algeria	Aerial parts	(Djabou et al., 2012)
		-	Algeria	Flowers	(Bendif et al., 2018)
		-	Algeria	Vegetative parts	(Bendif et al., 2018)
138	Cadina-4,10(15)-dien-3-one	-	Iran	Leaves	(Masoudi, 2018)
		-	Iran	Stems	(Masoudi, 2018)
139	Cadinol	-	Serbia and Montenegro	Aerial parts	(Kovacevic et al., 2001)
140	Camphene	-	Iran, Tunisia, Algeria, Serbia and Montenegro	Aerial parts	(Asgharipour and Shabankare, 2017; Bakari et al., 2015; Ben Othman et al., 2017; Bendjabeur et al., 2018; Boulila et al., 2008; Gholivand et al., 2013; Kovacevic et al., 2001; Nikpour et al., 2018; Shabankare et al., 2015)
		ssp. *capitatum*	Corsica, Serbia and Montenegro, Bulgaria	Aerial parts	(Cozzani et al., 2005; Djabou et al., 2012; Mitic et al., 2012)
		ssp. *polium*	Algeria	Aerial parts	(Djabou et al., 2012)
		-	Algeria	Flowers	(Bendif et al., 2018)
		-	Iran	Fruits	(Oroojalian et al., 2017; Sabzeghabaie and Asgarpanah, 2016)
		-	Greece, Iran	Leaves	(Lianopoulou et al., 2014; Masoudi, 2018)
		-	Jordan	TCM	(Al-Qudah et al., 2011)
141	Camphenilone	ssp. *capitatum*	Corsica	Aerial parts	(Cozzani et al., 2005; Djabou et al., 2012)
		ssp. *polium*	Algeria	Aerial parts	(Djabou et al., 2012)
142	Camphor	-	Tunisia, Croatia, Iran, Serbia and Montenegro	Aerial parts	(Ben Othman et al., 2017; Bezic et al., 2011; Boulila et al., 2008; Essid et al., 2015; Keykavousi et al., 2016; Kovacevic et al., 2001)
		ssp. *capitatum*	Corsica	Aerial parts	(Djabou et al., 2012)
		ssp. *polium*	Algeria	Aerial parts	(Djabou et al., 2012)
		-	Algeria	Flowers	(Bendif et al., 2018)
		-	Iran	Fruits	(Oroojalian et al., 2017)
		-	Algeria	Vegetative parts	(Bendif et al., 2018)
143	Car-3-ene	-	Tunisia	Aerial parts	(Boulila et al., 2008)
144	Carotol	ssp. *capitatum*	Iran	Aerial parts	(Khani and Heydarian, 2014)
145	Carvacrol	-	Iran, Tunisia, Greece	Aerial parts	(Asgharipour and Shabankare, 2017; Essid et al., 2015; Keykavousi et al., 2016; Menichini et al., 2009; Shabankare et al., 2015; Vokou and Bessiere, 1985)
		ssp. *capitatum*	Corsica, Crete, Greece	Aerial parts	(Cozzani et al., 2005; De Martino et al., 2010; Djabou et al., 2012)
		ssp. *polium*	Algeria	Aerial parts	(Djabou et al., 2012)
		-	Iran	Fruits	(Oroojalian et al., 2017)
		-	France	Leaves	(Chizzola, 2006)
		-	Algeria	Vegetative parts	(Bendif et al., 2018)
146	Carvone	-	Algeria, Iran, Greece	Aerial parts	(Bendjabeur et al., 2018; Heydarzade and Moravvej, 2012; Nikpour et al., 2018; Vokou and

No	Chemical compound	ssp.[2]/var.[3]	Locality	Part/Extract	Reference
					Bessiere, 1985)
		ssp. *capitatum*	Corsica, Crete, Greece	Aerial parts	(Cozzani et al., 2005; De Martino et al., 2010; Djabou et al., 2012; Menichini et al., 2009)
		ssp. *polium*	Algeria	Aerial parts	(Djabou et al., 2012)
		-	Algeria	Flowers	(Bendif et al., 2018)
		-	Algeria	Vegetative parts	(Bendif et al., 2018)
147	Caryophylladienol I	ssp. *capitatum*	Greece	Aerial parts	(Menichini et al., 2009)
148	Caryophyllene	-	Iran	Aerial parts	(Nikpour et al., 2018; Sadrizadeh et al., 2018)
		ssp. *capitatum*	Crete, Greece	Aerial parts	(De Martino et al., 2010; Menichini et al., 2009)
149	Caryophyllene alcohol	-	Iran	Aerial parts	(Gholivand et al., 2013)
150	Caryophyllene oxide	-	Tunisia, Iran, Amman, Serbia and Montenegro, Greece	Aerial parts	(Aburjai et al., 2006; Asgharipour and Shabankare, 2017; Boulila et al., 2008; Essid et al., 2015; Gholivand et al., 2013; Heydarzade and Moravvej, 2012; Keykavousi et al., 2016; Kovacevic et al., 2001; Nikpour et al., 2018; Raei et al., 2014; Sadeghi et al., 2014a; Sadrizadeh et al., 2018; Sayyad and Farahmandfar, 2017; Shabankare et al., 2015; Vokou and Bessiere, 1985)
		ssp. *aurasiacum*	Algeria	Aerial parts	(Kabouche et al., 2007)
		ssp. *capitatum*	Crete, Corsica, Iran, Serbia and Montenegro	Aerial parts	(De Martino et al., 2010; Djabou et al., 2012; Khani and Heydarian, 2014; Mitic et al., 2012)
		ssp. *polium*	Algeria	Aerial parts	(Djabou et al., 2012)
		-	Algeria, Iran	Flowers	(Bendif et al., 2018; Masoudi, 2018)
		-	Iran	Fruits	(Oroojalian et al., 2017; Sabzeghabaie and Asgarpanah, 2016)
		-	France	Inflorescence	(Chizzola, 2006)
		-	Greece, Iran	Leaves	(Lianopoulou et al., 2014; Masoudi, 2018)
		-	Iran	Stems	(Masoudi, 2018)
		-	Algeria	Vegetative parts	(Bendif et al., 2018)
151	Caryophyllenol II	-	Iran	Aerial parts	(Sadrizadeh et al., 2018)
		ssp. *capitatum*	Crete	Aerial parts	(De Martino et al., 2010)
152	Cedrenol	ssp. *capitatum*	Crete, Greece	Aerial parts	(De Martino et al., 2010; Menichini et al., 2009)
153	Cedrol	-	Iran, Serbia and Montenegro	Aerial parts	(Gholivand et al., 2013; Kovacevic et al., 2001)
154	Chrysanthenone	-	Tunisia	Aerial parts	(Ben Othman et al., 2017)
		ssp. *capitatum*	Corsica	Aerial parts	(Cozzani et al., 2005; Djabou et al., 2012)
155	Cinerolon	-	Iran	Aerial parts	(Heydarzade and Moravvej, 2012)
156	Cinerone	-	Iran	Aerial parts	(Nikpour et al., 2018)
157	*cis-(Z)*-α-Bisabolene epoxide	ssp. *capitatum*	Crete, Greece	Aerial parts	(De Martino et al., 2010; Menichini et al., 2009)
158	*cis*-Carveol	-	Iran	Aerial parts	(Nikpour et al., 2018)
		ssp. *capitatum*	Crete, Greece	Aerial parts	(De Martino et al., 2010; Menichini et al., 2009)
		-	Algeria	Flowers	(Bendif et al., 2018)
		-	Algeria	Vegetative parts	(Bendif et al., 2018)
159	*cis*-Carvone oxide	-	Iran	Aerial parts	(Nikpour et al., 2018)
160	*cis*-Chrysanthenyl acetate	-	Iran	Leaves	(Masoudi, 2018)
		-	Iran	Stems	(Masoudi, 2018)
161	*cis*-Decaline	-	Iran	Aerial parts	(Heydarzade and Moravvej, 2012)
162	*cis*-Geraniol	-	Iran	Aerial parts	(Nikpour et al., 2018)
163	*cis*-Jasmone	-	Iran	Aerial parts	(Heydarzade and Moravvej, 2012)
164	*cis*-Linalool oxide, furanoid	ssp. *capitatum*	Crete, Greece	Aerial parts	(De Martino et al., 2010; Menichini et al., 2009)
165	*cis*-Muurola-4(14),5-diene	ssp. *capitatum*	Serbia and Montenegro, Bulgaria	Aerial parts	(Mitic et al., 2012)
166	*cis*-Pinocamphone	ssp. *capitatum*	Corsica	Aerial parts	(Djabou et al., 2012)
167	*cis*-Pinocarveol	ssp. *capitatum*	Bulgaria	Aerial parts	(Mitic et al., 2012)
168	*cis*-Piperitone epoxide	ssp. *capitatum*	Serbia and Montenegro	Aerial parts	(Mitic et al., 2012)
169	*cis*-Sabinene hydrate	ssp. *capitatum*	Crete, Corsica, Greece	Aerial parts	(De Martino et al., 2010; Djabou et al., 2012; Menichini et al., 2009)
		-	Algeria	Flowers	(Bendif et al., 2018)
		-	Algeria	Vegetative parts	(Bendif et al., 2018)
170	*cis*-Sabinol	ssp. *capitatum*	Crete, Greece	Aerial parts	(De Martino et al., 2010; Menichini et al., 2009)
171	*cis*-Thujopsenal	-	Algeria	Flowers	(Bendif et al., 2018)
		-	Algeria	Vegetative parts	(Bendif et al., 2018)
172	*cis*-Verbenol	-	Tunisia, Iran	Aerial parts	(Bakari et al., 2015; Ben Othman et al., 2017; Gholivand et al., 2013; Heydarzade and Moravvej, 2012; Nikpour et al., 2018)
		ssp. *capitatum*	Crete, Corsica, Greece	Aerial parts	(De Martino et al., 2010; Djabou et al., 2012; Menichini et al., 2009)
		ssp. *polium*	Algeria	Aerial parts	(Djabou et al., 2012)
		-	Algeria	Flowers	(Bendif et al., 2018)
		-	Iran	Fruits	(Sabzeghabaie and Asgarpanah, 2016)
		-	Iran	Leaves	(Masoudi, 2018)
		-	Algeria	Vegetative parts	(Bendif et al., 2018)
173	*cis*-Verbenone	ssp. *capitatum*	Crete, Greece	Aerial parts	(De Martino et al., 2010; Menichini et al., 2009)
174	*cis*-α-Bisabolene	-	Tunisia	Aerial parts	(Boulila et al., 2008)
175	*cis*-β-Farnesene	-	Iran	Aerial parts	(Asgharipour and Shabankare, 2017; Shabankare et al., 2015)
176	*cis*-β-Guaiene	-	Amman	Aerial parts	(Aburjai et al., 2006)
		ssp. *capitatum*	Crete, Greece	Aerial parts	(De Martino et al., 2010; Menichini et al., 2009)
		-	Algeria	Vegetative parts	(Bendif et al., 2018)

No	Chemical compound	ssp.[2]/var.[3]	Locality	Part/Extract	Reference
177	*cis*-β-Ocimene	-	Algeria	Aerial parts	(Bendjabeur et al., 2018)
		-	Iran	Fruits	(Sabzeghabaie and Asgarpanah, 2016)
178	Citral	-	Iran	Aerial parts	(Nikpour et al., 2018)
179	Citronellol	-	Iran	Aerial parts	(Gholivand et al., 2013)
180	Cryptomerione	-	Iran	Aerial parts	(Keykavousi et al., 2016)
181	Cryptone	ssp. *polium*	Algeria	Aerial parts	(Djabou et al., 2012)
182	Cubenol	-	Iran, Serbia and Montenegro	Aerial parts	(Kovacevic et al., 2001; Nikpour et al., 2018)
		-	Iran	Fruits	(Sabzeghabaie and Asgarpanah, 2016)
183	Cumin aldehyde	ssp. *capitatum*	Crete, Greece, Corsica	Aerial parts	(Cozzani et al., 2005; De Martino et al., 2010; Djabou et al., 2012; Menichini et al., 2009)
		-	Algeria	Flowers	(Bendif et al., 2018)
		-	Algeria	Vegetative parts	(Bendif et al., 2018)
184	Cuminol	ssp. *capitatum*	Corsica	Aerial parts	(Cozzani et al., 2005; Djabou et al., 2012)
185	Cuparene	-	Iran	Aerial parts	(Nikpour et al., 2018)
186	Cyclohexene, 1-methyl-4-(1-methylethenyl)	-	Iran	Aerial parts	(Mahmoudi et al., 2014)
187	Cyclolongifolene oxide, dehydro	-	Iran	Aerial parts	(Mahmoudi et al., 2014)
188	Cyclosativene	-	France	Inflorescence	(Chizzola, 2006)
189	Cyperene	-	Iran	Aerial parts	(Asgharipour and Shabankare, 2017; Shabankare et al., 2015)
190	Decanal	ssp. *polium*	Algeria	Aerial parts	(Djabou et al., 2012)
191	Dehydro sabina ketone	ssp. *capitatum*	Bulgaria	Aerial parts	(Mitic et al., 2012)
192	Dehydro sesquicineol	-	Iran	Aerial parts	(Sadeghi et al., 2014a; Sayyad and Farahmandfar, 2017)
193	*diepi*-α-Cedrene epoxide	-	Iran	Aerial parts	(Nikpour et al., 2018)
194	Diethyl phthalate	ssp. *capitatum*	Iran	Aerial parts	(Khani and Heydarian, 2014)
195	Diisobutyl phthalate	ssp. *polium*	Algeria	Aerial parts	(Djabou et al., 2012)
196	Dillapiol	-	Iran	Fruits	(Sabzeghabaie and Asgarpanah, 2016)
197	Dodecanoic acid	ssp. *polium*	Algeria	Aerial parts	(Djabou et al., 2012)
		-	Iran	Stems	(Masoudi, 2018)
198	Dotriacontane (C32)	-	Algeria	Flowers	(Bendif et al., 2018)
199	Eicosane (C20)	-	Iran, Algeria	Flowers	(Bendif et al., 2018; Masoudi, 2018)
200	Elemol	-	Serbia and Montenegro	Aerial parts	(Kovacevic et al., 2001)
		-	Algeria, Iran	Flowers	(Bendif et al., 2018; Masoudi, 2018)
		-	Iran	Fruits	(Oroojalian et al., 2017; Sabzeghabaie and Asgarpanah, 2016)
		-	France	Inflorescence	(Chizzola, 2006)
		-	France, Iran	Leaves	(Chizzola, 2006; Masoudi, 2018)
		-	Iran	Stems	(Masoudi, 2018)
		-	Jordan	TCM	(Al-Qudah et al., 2011)
		-	Algeria	Vegetative parts	(Bendif et al., 2018)
201	Elemol acetate	-	Algeria	Flowers	(Bendif et al., 2018)
		-	Algeria	Vegetative parts	(Bendif et al., 2018)
202	Endobornyl acetate	-	Jordan	TCM	(Al-Qudah et al., 2011)
203	*epi*-Bicyclosequiphellandrene	-	Algeria	Aerial parts	(Bendjabeur et al., 2018)
		ssp. *capitatum*	Crete, Greece	Aerial parts	(De Martino et al., 2010; Menichini et al., 2009)
204	*epi*-α-Cadinol	-	Iran	Aerial parts	(Gholivand et al., 2013)
		-	France	Leaves	(Chizzola, 2006)
205	*epi*-α-Muurolol	ssp. *capitatum*	Iran	Aerial parts	(Khani and Heydarian, 2014)
206	Epicubenol	ssp. *polium*	Algeria	Aerial parts	(Djabou et al., 2012)
207	Epiglobulol	ssp. *capitatum*	Iran	Aerial parts	(Khani and Heydarian, 2014)
		ssp. *polium*	Algeria	Aerial parts	(Djabou et al., 2012)
208	Epizonaren	-	Iran	Aerial parts	(Sadrizadeh et al., 2018)
209	Eucarvone	-	Greece	Aerial parts	(Vokou and Bessiere, 1985)
210	Eudesma-4(15)-ene-6-ol	ssp. *polium*	Algeria	Aerial parts	(Djabou et al., 2012)
211	Eudesma-3,7(11)-diene	-	Iran	Aerial parts	(Nikpour et al., 2018)
212	Eugenol	-	Croatia, Iran	Aerial parts	(Bezic et al., 2011; Heydarzade and Moravvej, 2012; Nikpour et al., 2018)
		ssp. *capitatum*	Crete, Greece	Aerial parts	(De Martino et al., 2010; Menichini et al., 2009)
		-	Jordan	TCM	(Al-Qudah et al., 2011)
213	Farnesene	-	Iran	Aerial parts	(Raei et al., 2014)
214	Fenchol	-	Tunisia	Aerial parts	(Ben Othman et al., 2017; Essid et al., 2015)
		ssp. *capitatum*	Corsica	Aerial parts	(Djabou et al., 2012)
215	Fencholenic aldehyde	-	Tunisia	Aerial parts	(Bakari et al., 2015)
216	Fenchone	ssp. *capitatum*	Corsica	Aerial parts	(Djabou et al., 2012)
		ssp. *polium*	Algeria	Aerial parts	(Djabou et al., 2012)
217	Fenchyl acetate	-	Iran, Tunisia	Aerial parts	(Ben Othman et al., 2017; Heydarzade and Moravvej, 2012)
		-	Iran	Fruits	(Djabou et al., 2012)
218	Folifolone	ssp. *capitatum*	Corsica	Aerial parts	(Sabzeghabaie and Asgarpanah, 2016)
219	Gaulyl acetate	-	Jordan	TCM	(Djabou et al., 2012)
220	Geranial	ssp. *polium*	Algeria	Aerial parts	(Al-Qudah et al., 2011)
221	Geraniol	-	Iran	Aerial parts	(Djabou et al., 2012)
		ssp. *capitatum*	Corsica	Aerial parts	(Gholivand et al., 2013)
		ssp. *polium*	Algeria	Aerial parts	(Cozzani et al., 2005; Djabou et al., 2012)
		-	Algeria	Flowers	(Djabou et al., 2012)
222	Geranyl acetate	-	Iran	Aerial parts	(Bendif et al., 2018)
		ssp. *capitatum*	Corsica	Aerial parts	(Nikpour et al., 2018)
		-	Iran	Fruits	(Cozzani et al., 2005; Djabou et al., 2012)
		ssp. *polium*	Algeria	Aerial parts	(Djabou et al., 2012)
223	Geranyl acetone	-	Iran	Stems	(Masoudi, 2018)

No	Chemical compound	ssp.[2]/var.[3]	Locality	Part/Extract	Reference
224	Geranyl-*n*-butyrate	-	Iran	Stems	(Masoudi, 2018)
225	Germacra-4(15),5,10(14)-trien-1-α-ol	-	Algeria	Flowers	(Bendif et al., 2018)
		-	Algeria	Vegetative parts	(Bendif et al., 2018)
226	Germacrene	-	Iran, Tunisia	Aerial parts	(Alamdar et al., 2007; Essid et al., 2015)
227	Germacrene A	-	Iran	Aerial parts	(Gholivand et al., 2013)
		ssp. *capitatum*	Serbia and Montenegro, Bulgaria	Aerial parts	(Mitic et al., 2012)
228	Germacrene B	-	Iran, Amman, Turkey, Tunisia, Serbia and Montenegro	Aerial parts	(Aburjai et al., 2006; Boulila et al., 2008; Gholivand et al., 2013; Kovacevic et al., 2001; Mahmoudi et al., 2014; Mahmoudi et al., 2015; Sadeghi et al., 2014a; Saltan et al., 2019; Sayyad and Farahmandfar, 2017)
		ssp. *capitatum*	Crete, Greece, Serbia and Montenegro, Bulgaria	Aerial parts	(De Martino et al., 2010; Menichini et al., 2009; Mitic et al., 2012)
		-	Algeria	Flowers	(Bendif et al., 2018)
		-	Iran	Fruits	(Sabzeghabaie and Asgarpanah, 2016)
		-	Algeria	Vegetative parts	(Bendif et al., 2018)
229	Germacrene D	-	Amman, Iran, Algeria, Croatia, Tunisia, Serbia and Montenegro, Turkey	Aerial parts	(Aburjai et al., 2006; Asgharipour and Shabankare, 2017; Bendjabeur et al., 2018; Bezic et al., 2011; Boulila et al., 2008; Gholivand et al., 2013; Heydarzade and Moravvej, 2012; Keykavousi et al., 2016; Kovacevic et al., 2001; Mahmoudi et al., 2014; Mahmoudi et al., 2015; Nikpour et al., 2018; Purnavab et al., 2015; Raei et al., 2014; Sadrizadeh et al., 2018; Sevindik et al., 2016; Shabankare et al., 2015)
		ssp. *capitatum*	Crete, Greece, Serbia and Montenegro, Bulgaria	Aerial parts	(De Martino et al., 2010; Menichini et al., 2009; Mitic et al., 2012)
		ssp. *polium*	Algeria	Aerial parts	(Djabou et al., 2012)
		-	Algeria, Iran	Flowers	(Bendif et al., 2018; Masoudi, 2018)
		-	Iran	Fruits	(Oroojalian et al., 2017; Sabzeghabaie and Asgarpanah, 2016)
		-	France	Inflorescence	(Chizzola, 2006)
		-	France, Greece, Iran	Leaves	(Chizzola, 2006; Lianopoulou et al., 2014; Masoudi, 2018)
		ssp. *capitatum*	Greece	Leaves and inflorescences	(Fanouriou et al., 2018)
		-	Iran	Stems	(Masoudi, 2018)
		-	Algeria	Vegetative parts	(Bendif et al., 2018)
230	Germacrene D 4-ol	-	Amman	Aerial parts	(Aburjai et al., 2006)
		ssp. *capitatum*	Crete, Greece	Aerial parts	(De Martino et al., 2010; Menichini et al., 2009)
		ssp. *polium*	Algeria	Aerial parts	(Djabou et al., 2012)
		-	Algeria	Flowers	(Bendif et al., 2018)
		-	France	Inflorescence	(Chizzola, 2006)
		-	Algeria	Vegetative parts	(Bendif et al., 2018)
231	Globulol	ssp. *capitatum*	Crete, Iran, Greece	Aerial parts	(De Martino et al., 2010; Khani and Heydarian, 2014; Menichini et al., 2009)
		ssp. *polium*	Algeria	Aerial parts	(Djabou et al., 2012)
232	Glycerol-2-palmitate	-	Algeria	Flowers	(Bendif et al., 2018)
233	Gossonerol	-	Iran	Aerial parts	(Sadeghi et al., 2014a; Sayyad and Farahmandfar, 2017)
234	Guaiol	-	Amman	Aerial parts	(Aburjai et al., 2006)
		ssp. *capitatum*	Corsica	Aerial parts	(Cozzani et al., 2005; Djabou et al., 2012)
		-	Iran	Stems	(Masoudi, 2018)
		-	Jordan	TCM	(Al-Qudah et al., 2011)
235	Heneicosane (C21)	-	Algeria	Flowers	(Bendif et al., 2018)
236	Hentriacontane	ssp. *capitatum*	Crete, Greece	Aerial parts	(De Martino et al., 2010; Menichini et al., 2009)
237	Heptacosane (C27)	-	Croatia	Aerial parts	(Bezic et al., 2011)
		ssp. *capitatum*	Crete, Greece, Serbia and Montenegro	Aerial parts	(De Martino et al., 2010; Menichini et al., 2009; Mitic et al., 2012)
		-	Algeria	Flowers	(Bendif et al., 2018)
		-	Algeria	Vegetative parts	(Bendif et al., 2018)
238	Heptadecane	ssp. *capitatum*	Crete	Aerial parts	(De Martino et al., 2010)
239	Hexadecanoic acid	ssp. *capitatum*	Crete	Aerial parts	(De Martino et al., 2010)
		-	Iran	Flowers	(Masoudi, 2018)
		-	Iran	Fruits	(Oroojalian et al., 2017)
		-	Iran	Leaves	(Masoudi, 2018)
		-	Iran	Stems	(Masoudi, 2018)
240	Hexahydrofarnesyl acetone	-	Algeria	Aerial parts	(Bendjabeur et al., 2018)
		ssp. *capitatum*	Crete, Greece	Aerial parts	(De Martino et al., 2010; Menichini et al., 2009)
241	Hexanal	-	Iran	Aerial parts	(Nikpour et al., 2018)
242	Hinesol	ssp. *capitatum*	Corsica	Aerial parts	(Djabou et al., 2012)
243	Humulene epoxide II	ssp. *capitatum*	Crete, Greece	Aerial parts	(De Martino et al., 2010; Menichini et al., 2009)
		ssp. *polium*	Algeria	Aerial parts	(Djabou et al., 2012)
		-	Algeria	Flowers	(Bendif et al., 2018)
		-	Algeria	Vegetative parts	(Bendif et al., 2018)

No	Chemical compound	ssp.[2]/var.[3]	Locality	Part/Extract	Reference
244	*Iso*-3-thujanol	-	Iran	Aerial parts	(Gholivand et al., 2013)
245	*Iso*-Menthone	ssp. *capitatum*	Serbia and Montenegro	Aerial parts	(Mitic et al., 2012)
246	Isoaromadendrene epoxide	-	Iran	Aerial parts	(Nikpour et al., 2018)
247	Isobornylacetate	ssp. *capitatum*	Serbia and Montenegro, Bulgaria	Aerial parts	(Mitic et al., 2012)
248	Isochrysanthenone	ssp. *capitatum*	Corsica	Aerial parts	(Cozzani et al., 2005; Djabou et al., 2012)
249	Isophorone	-	Tunisia	Aerial parts	(Ben Othman et al., 2017)
		ssp. *capitatum*	Corsica	Aerial parts	(Cozzani et al., 2005; Djabou et al., 2012)
250	Isopiperitenone	-	Iran	Aerial parts	(Nikpour et al., 2018)
251	Isopropylsulfonyl chloride	-	Iran	Aerial parts	(Nikpour et al., 2018)
252	Isospathulenol	ssp. *polium*	Algeria	Aerial parts	(Djabou et al., 2012)
253	Junipene	-	Iran	Aerial parts	(Sadrizadeh et al., 2018)
254	Kaurene	ssp. *capitatum*	Crete, Greece	Aerial parts	(De Martino et al., 2010; Menichini et al., 2009)
255	Khusinol	-	Iran	Leaves	(Masoudi, 2018)
256	Ledene	-	Turkey	Aerial parts	(Sevindik et al., 2016)
257	Ledol	ssp. *polium*	Algeria	Aerial parts	(Djabou et al., 2012)
		-	Algeria	Flowers	(Bendif et al., 2018)
		-	Greece	Leaves	(Lianopoulou et al., 2014)
		-	Algeria	Vegetative parts	(Bendif et al., 2018)
258	Limonene	-	Amman, Iran, Tunisia, Algeria, Croatia, Serbia and Montenegro, Turkey, Greece	Aerial parts	(Aburjai et al., 2006; Alamdar et al., 2007; Asgharipour and Shabankare, 2017; Bakari et al., 2015; Ben Othman et al., 2017; Bendjabeur et al., 2018; Bezic et al., 2011; Boulila et al., 2008; Essid et al., 2015; Gholivand et al., 2013; Heydarzade and Moravvej, 2012; Keykavousi et al., 2016; Kovacevic et al., 2001; Nikpour et al., 2018; Purnavab et al., 2015; Raei et al., 2014; Sadeghi et al., 2014a; Sayyad and Farahmandfar, 2017; Sevindik et al., 2016; Shabankare et al., 2015; Vokou and Bessiere, 1985)
		ssp. *aurasiacum*	Algeria	Aerial parts	(Kabouche et al., 2007)
		ssp. *capitatum*	Corsica, Serbia and Montenegro, Bulgaria	Aerial parts	(Cozzani et al., 2005; Djabou et al., 2012; Mitic et al., 2012)
		ssp. *polium*	Algeria	Aerial parts	(Djabou et al., 2012)
		-	Algeria	Flowers	(Bendif et al., 2018)
		-	Iran	Fruits	(Oroojalian et al., 2017; Sabzeghabaie and Asgarpanah, 2016)
		-	France	Inflorescence	(Chizzola, 2006)
		-	France, Greece, Iran	Leaves	(Chizzola, 2006; Lianopoulou et al., 2014; Masoudi, 2018)
		ssp. *capitatum*	Greece	Leaves and inflorescences	(Fanouriou et al., 2018)
		-	Iran	Stems	(Masoudi, 2018)
		-	Algeria	Vegetative parts	(Bendif et al., 2018)
259	Linalool	-	Iran, Tunisia, Croatia, Greece, Tunisia	Aerial parts	(Asgharipour and Shabankare, 2017; Bakari et al., 2015; Ben Othman et al., 2017; Bezic et al., 2011; Gholivand et al., 2013; Mahmoudi et al., 2014; Mahmoudi et al., 2015; Nikpour et al., 2018; Shabankare et al., 2015; Vokou and Bessiere, 1985)
		ssp. *aurasiacum*	Algeria	Aerial parts	(Kabouche et al., 2007)
		ssp. *capitatum*	Corsica, Crete, Greece, Serbia and Montenegro, Bulgaria	Aerial parts	(Cozzani et al., 2005; De Martino et al., 2010; Djabou et al., 2012; Menichini et al., 2009; Mitic et al., 2012)
		ssp. *polium*	Algeria	Aerial parts	(Djabou et al., 2012)
		-	Algeria	Flowers	(Bendif et al., 2018)
		-	Iran	Fruits	(Oroojalian et al., 2017; Sabzeghabaie and Asgarpanah, 2016)
		-	Greece, Iran	Leaves	(Lianopoulou et al., 2014; Masoudi, 2018)
		-	Iran	Stems	(Masoudi, 2018)
		-	Jordan	TCM	(Al-Qudah et al., 2011)
		-	Algeria	Vegetative parts	(Bendif et al., 2018)
260	Linalool oxide	-	Tunisia	Aerial parts	(Bakari et al., 2015)
261	Linalyl acetate	-	Croatia, Tunisia	Aerial parts	(Bezic et al., 2011; Boulila et al., 2008)
		ssp. *capitatum*	Corsica	Aerial parts	(Cozzani et al., 2005; Djabou et al., 2012)
262	Longipinanol	-	Algeria	Vegetative parts	(Bendif et al., 2018)
263	Longiverbenone	ssp. *capitatum*	Iran	Aerial parts	(Khani and Heydarian, 2014)
264	Manoyl oxide	ssp. *capitatum*	Crete	Aerial parts	(De Martino et al., 2010)
265	Menthone	-	Iran	Aerial parts	(Keykavousi et al., 2016)
266	Menthyl acetate	-	Iran	Aerial parts	(Gholivand et al., 2013)
267	Methyl cyclopentane	-	Iran	Aerial parts	(Nikpour et al., 2018)
268	Mint sulfide	-	Algeria	Vegetative parts	(Bendif et al., 2018)
269	Mustakone	-	Algeria	Flowers	(Bendif et al., 2018)
		-	Algeria	Vegetative parts	(Bendif et al., 2018)
270	Myrcene	-	Amman, Iran, Tunisia, Croatia, Serbia and Montenegro,	Aerial parts	(Aburjai et al., 2006; Asgharipour and Shabankare, 2017; Ben Othman et al., 2017; Bezic et al., 2011; Boulila et al., 2008; Essid et al., 2015; Heydarzade and Moravvej, 2012; Keykavousi et al., 2016;

No	Chemical compound	ssp.[2]/var.[3]	Locality	Part/Extract	Reference
			Turkey, Greece		Kovacevic et al., 2001; Purnavab et al., 2015; Raei et al., 2014; Sayyad and Farahmandfar, 2017; Sevindik et al., 2016; Shabankare et al., 2015; Vokou and Bessiere, 1985)
		ssp. *aurasiacum*	Algeria	Aerial parts	(Kabouche et al., 2007)
		ssp. *capitatum*	Corsica	Aerial parts	(Cozzani et al., 2005; Djabou et al., 2012)
		ssp. *polium*	Algeria	Aerial parts	(Djabou et al., 2012)
		-	Algeria	Flowers	(Bendif et al., 2018)
		-	Iran	Fruits	(Oroojalian et al., 2017; Sabzeghabaie and Asgarpanah, 2016)
		-	France	Inflorescence	(Chizzola, 2006)
		-	France, Iran	Leaves	(Chizzola, 2006; Masoudi, 2018)
		ssp. *capitatum*	Greece	Leaves and inflorescences	(Fanouriou et al., 2018)
		-	Iran	Stems	(Masoudi, 2018)
		-	Algeria	Vegetative parts	(Bendif et al., 2018)
271	Myrtenal	-	Tunisia, Algeria, Iran, Serbia and Montenegro, Greece	Aerial parts	(Bakari et al., 2015; Ben Othman et al., 2017; Bendjabeur et al., 2018; Heydarzade and Moravvej, 2012; Keykavousi et al., 2016; Kovacevic et al., 2001; Mitic et al., 2012; Vokou and Bessiere, 1985)
		ssp. *aurasiacum*	Algeria	Aerial parts	(Kabouche et al., 2007)
		ssp. *capitatum*	Corsica, Serbia and Montenegro, Bulgaria	Aerial parts	(Cozzani et al., 2005; Djabou et al., 2012; Mitic et al., 2012)
		ssp. *polium*	Algeria	Aerial parts	(Djabou et al., 2012)
		-	Iran	Fruits	(Sabzeghabaie and Asgarpanah, 2016)
		-	Greece, Iran	Leaves	(Lianopoulou et al., 2014; Masoudi, 2018)
		-	Jordan	TCM	(Al-Qudah et al., 2011)
272	Myrtenol	-	Iran, Greece	Aerial parts	(Gholivand et al., 2013; Nikpour et al., 2018; Vokou and Bessiere, 1985)
		ssp. *capitatum*	Corsica, Crete, Bulgaria	Aerial parts	(Cozzani et al., 2005; De Martino et al., 2010; Djabou et al., 2012; Menichini et al., 2009; Mitic et al., 2012)
		ssp. *polium*	Algeria	Aerial parts	(Djabou et al., 2012)
273	Myrtenyl acetate	-	Iran	Aerial parts	(Nikpour et al., 2018)
		ssp. *polium*	Algeria	Aerial parts	(Djabou et al., 2012)
		-	Algeria	Flowers	(Bendif et al., 2018)
		-	Algeria	Vegetative parts	(Bendif et al., 2018)
274	Naphthalene	-	Iran	Aerial parts	(Mahmoudi et al., 2014; Sadrizadeh et al., 2018)
275	*neo*-Intermedeol	-	Algeria	Flowers	(Bendif et al., 2018)
		-	Algeria	Vegetative parts	(Bendif et al., 2018)
276	*neo-iso*-3-Thujanol acetate	-	Algeria	Flowers	(Bendif et al., 2018)
		-	Algeria	Vegetative parts	(Bendif et al., 2018)
277	Nerol	-	Tunisia	Aerial parts	(Ben Othman et al., 2017)
		ssp. *capitatum*	Corsica	Aerial parts	(Djabou et al., 2012)
		ssp. *polium*	Algeria	Aerial parts	(Djabou et al., 2012)
		-	Algeria	Flowers	(Bendif et al., 2018)
		-	Iran	Fruits	(Sabzeghabaie and Asgarpanah, 2016)
		-	Algeria	Vegetative parts	(Bendif et al., 2018)
278	Neryl acetate	ssp. *capitatum*	Corsica	Aerial parts	(Cozzani et al., 2005; Djabou et al., 2012)
		ssp. *polium*	Algeria	Aerial parts	(Djabou et al., 2012)
279	Nonacosane (C29)	ssp. *capitatum*	Crete, Greece	Aerial parts	(De Martino et al., 2010; Menichini et al., 2009)
		-	Algeria	Flowers	(Bendif et al., 2018)
		-	Algeria	Vegetative parts	(Bendif et al., 2018)
280	Nonanal	-	Tunisia, Iran	Aerial parts	(Ben Othman et al., 2017; Gholivand et al., 2013; Nikpour et al., 2018)
		ssp. *capitatum*	Corsica, Crete, Greece, Bulgaria	Aerial parts	(Cozzani et al., 2005; De Martino et al., 2010; Djabou et al., 2012; Menichini et al., 2009; Mitic et al., 2012)
		ssp. *polium*	Algeria	Aerial parts	(Djabou et al., 2012)
		-	Greece	Leaves	(Lianopoulou et al., 2014)
281	*o*-Cymene	-	Tunisia	Aerial parts	(Essid et al., 2015)
		ssp. *capitatum*	Greece	Leaves and inflorescences	(Fanouriou et al., 2018)
282	*o*-Cymol	-	Iran	Aerial parts	(Nikpour et al., 2018)
283	*o*-Menth-8-ene	-	Iran	Aerial parts	(Mahmoudi et al., 2014)
284	Ocimene	-	Iran	Aerial parts	(Nikpour et al., 2018)
285	Octacosane (C28)	-	Croatia	Aerial parts	(Bezic et al., 2011)
		-	Algeria	Flowers	(Bendif et al., 2018)
286	Octane	ssp. *polium*	Algeria	Aerial parts	(Djabou et al., 2012)
287	Oplopanone	-	Algeria	Flowers	(Bendif et al., 2018)
		-	Algeria	Vegetative parts	(Bendif et al., 2018)
288	*p*-Acetyltoluene	-	Iran	Aerial parts	(Nikpour et al., 2018)
289	*p*-Cymen-7-ol	-	Greece	Aerial parts	(Vokou and Bessiere, 1985)
		ssp. *capitatum*	Crete, Greece	Aerial parts	(De Martino et al., 2010; Menichini et al., 2009)
		-	Algeria	Flowers	(Bendif et al., 2018)
290	*p*-Cymen-8-ol	-	Tunisia, Iran	Aerial parts	(Bakari et al., 2015; Ben Othman et al., 2017; Nikpour et al., 2018)
		ssp. *capitatum*	Corsica	Aerial parts	(Cozzani et al., 2005; Djabou et al., 2012)
		-	Algeria	Flowers	(Bendif et al., 2018)
		-	Algeria	Vegetative parts	(Bendif et al., 2018)

No	Chemical compound	ssp.[2]/var.[3]	Locality	Part/Extract	Reference
291	*p*-Cymene	-	Amman, Iran, Tunisia, Algeria, Greece	Aerial parts	(Aburjai et al., 2006; Asgharipour and Shabankare, 2017; Bakari et al., 2015; Ben Othman et al., 2017; Bendjabeur et al., 2018; Boulila et al., 2008; Gholivand et al., 2013; Heydarzade and Moravvej, 2012; Nikpour et al., 2018; Raei et al., 2014; Shabankare et al., 2015; Vokou and Bessiere, 1985)
		ssp. *capitatum*	Corsica, Crete, Greece	Aerial parts	(Cozzani et al., 2005; De Martino et al., 2010; Djabou et al., 2012; Menichini et al., 2009)
		ssp. *polium*	Algeria	Aerial parts	(Djabou et al., 2012)
		-	Algeria	Flowers	(Bendif et al., 2018)
		-	Iran	Fruits	(Oroojalian et al., 2017; Sabzeghabaie and Asgarpanah, 2016)
		-	Greece	Leaves	(Lianopoulou et al., 2014)
		-	Iran	Stems	(Masoudi, 2018)
		-	Algeria	Vegetative parts	(Bendif et al., 2018)
292	*p*-Cymenene	ssp. *capitatum*	Corsica	Aerial parts	(Cozzani et al., 2005; Djabou et al., 2012)
		-	Algeria	Vegetative parts	(Bendif et al., 2018)
293	*p*-Mentha-1-en-7-al	ssp. *capitatum*	Corsica	Aerial parts	(Cozzani et al., 2005; Djabou et al., 2012)
294	*p*-Mentha-1,3-dien-7-al	ssp. *capitatum*	Corsica	Aerial parts	(Djabou et al., 2012)
295	*p*-Mentha-1,4-dien-7-ol	-	Iran	Aerial parts	(Nikpour et al., 2018)
		-	Algeria	Flowers	(Bendif et al., 2018)
		-	Algeria	Vegetative parts	(Bendif et al., 2018)
296	*p*-Mentha-1,5-dien-8-ol	-	Iran, Tunisia	Aerial parts	(Bakari et al., 2015; Ben Othman et al., 2017; Gholivand et al., 2013; Keykavousi et al., 2016; Sadrizadeh et al., 2018)
		ssp. *capitatum*	Corsica	Aerial parts	(Cozzani et al., 2005; Djabou et al., 2012)
		ssp. *polium*	Algeria	Aerial parts	(Djabou et al., 2012)
		-	Greece	Leaves	(Lianopoulou et al., 2014)
297	*p*-Mentha-3-en-8-ol	-	Iran	Aerial parts	(Gholivand et al., 2013)
298	*p*-Menthane-1,2,3-triol	-	Iran	Aerial parts	(Heydarzade and Moravvej, 2012)
299	*p*-Mentha-1-en-9-al	-	Iran	Aerial parts	(Nikpour et al., 2018)
300	*p*-Methoxyacetophenone	-	Iran	Aerial parts	(Nikpour et al., 2018)
		ssp. *capitatum*	Crete, Greece	Aerial parts	(De Martino et al., 2010; Menichini et al., 2009)
301	Palmitic acid	-	Iran	Fruits	(Sabzeghabaie and Asgarpanah, 2016)
302	Pentacosane (C25)	-	Croatia	Aerial parts	(Bezic et al., 2011)
		ssp. *capitatum*	Serbia and Montenegro, Crete, Greece	Aerial parts	(De Martino et al., 2010; Menichini et al., 2009; Mitic et al., 2012)
		ssp. *polium*	Algeria	Aerial parts	(Djabou et al., 2012)
		-	Algeria	Flowers	(Bendif et al., 2018)
		-	Algeria	Vegetative parts	(Bendif et al., 2018)
303	Perillaldehyde	ssp. *capitatum*	Corsica	Aerial parts	(Djabou et al., 2012)
304	Phellandral	-	Iran	Aerial parts	(Nikpour et al., 2018)
305	Phenylacetaldehyde	-	Iran	Aerial parts	(Nikpour et al., 2018)
		ssp. *capitatum*	Crete	Aerial parts	(De Martino et al., 2010)
306	Phytol	-	Algeria	Flowers	(Bendif et al., 2018)
		-	Algeria	Vegetative parts	(Bendif et al., 2018)
307	Phytone	ssp. *polium*	Algeria	Aerial parts	(Djabou et al., 2012)
308	Pinocarveol	-	Algeria	Aerial parts	(Bendjabeur et al., 2018)
309	Pinocarvone	-	Tunisia, Algeria, Iran, Serbia and Montenegro	Aerial parts	(Bakari et al., 2015; Ben Othman et al., 2017; Bendjabeur et al., 2018; Gholivand et al., 2013; Kovacevic et al., 2001)
		ssp. *capitatum*	Corsica, Crete, Serbia and Montenegro, Bulgaria	Aerial parts	(Cozzani et al., 2005; De Martino et al., 2010; Djabou et al., 2012; Mitic et al., 2012)
		ssp. *polium*	Algeria	Aerial parts	(Djabou et al., 2012)
		-	Algeria	Flowers	(Bendif et al., 2018)
		-	Greece, Iran	Leaves	(Lianopoulou et al., 2014; Masoudi, 2018)
		-	Algeria	Vegetative parts	(Bendif et al., 2018)
310	Piperitenone	-	Iran	Aerial parts	(Heydarzade and Moravvej, 2012)
311	Piperitenone oxide	-	Iran	Aerial parts	(Heydarzade and Moravvej, 2012)
312	Pulegone	-	Iran	Aerial parts	(Keykavousi et al., 2016)
313	Rosifoliol	ssp. *polium*	Algeria	Aerial parts	(Djabou et al., 2012)
314	Sabina ketone	-	Greece	Aerial parts	(Vokou and Bessiere, 1985)
		ssp. *capitatum*	Corsica, Crete, Greece	Aerial parts	(Cozzani et al., 2005; De Martino et al., 2010; Djabou et al., 2012; Menichini et al., 2009)
		-	Algeria	Flowers	(Bendif et al., 2018)
		-	Algeria	Vegetative parts	(Bendif et al., 2018)
315	Sabinene	-	Iran, Amman, Algeria, Tunisia, Serbia and Montenegro	Aerial parts	(Aburjai et al., 2006; Asgharipour and Shabankare, 2017; Bendjabeur et al., 2018; Boulila et al., 2008; Gholivand et al., 2013; Kovacevic et al., 2001; Nikpour et al., 2018; Raei et al., 2014; Sayyad and Farahmandfar, 2017; Shabankare et al., 2015)
		ssp. *capitatum*	Corsica, Crete, Iran, Greece, Serbia and Montenegro, Bulgaria	Aerial parts	(Cozzani et al., 2005; De Martino et al., 2010; Djabou et al., 2012; Khani and Heydarian, 2014; Menichini et al., 2009; Mitic et al., 2012)
		ssp. *polium*	Algeria	Aerial parts	(Djabou et al., 2012)
		-	Algeria	Flowers	(Bendif et al., 2018)

No	Chemical compound	ssp.[2]/var.[3]	Locality	Part/Extract	Reference
		-	Iran	Fruits	(Oroojalian et al., 2017; Sabzeghabaie and Asgarpanah, 2016)
		-	France	Inflorescence	(Chizzola, 2006)
		-	France, Greece	Leaves	(Chizzola, 2006; Lianopoulou et al., 2014)
		-	Algeria	Vegetative parts	(Bendif et al., 2018)
316	Salicylic acid butyl ester	-	Iran	Aerial parts	(Gholivand et al., 2013)
317	Salvial-4(14)-en-1-one	-	Algeria, Iran	Aerial parts	(Bendjabeur et al., 2018; Sadrizadeh et al., 2018)
		ssp. *capitatum*	Bulgaria	Aerial parts	(Mitic et al., 2012)
318	Sesquisabinene hydrate	-	Iran	Aerial parts	(Mahmoudi et al., 2014; Mahmoudi et al., 2015)
		ssp. *capitatum*	Iran	Aerial parts	(Khani and Heydarian, 2014)
319	Shyobunol	ssp. *capitatum*	Serbia and Montenegro, Bulgaria	Aerial parts	(Mitic et al., 2012)
		-	Algeria	Flowers	(Bendif et al., 2018)
		-	Algeria	Vegetative parts	(Bendif et al., 2018)
320	Sorbaldehyde	-	Iran	Aerial parts	(Nikpour et al., 2018)
321	Spathulenol	-	Amman, Iran, Tunisia, Algeria, Serbia and Montenegro	Aerial parts	(Aburjai et al., 2006; Alamdar et al., 2007; Asgharipour and Shabankare, 2017; Ben Othman et al., 2017; Bendjabeur et al., 2018; Boulila et al., 2008; Heydarzade and Moravvej, 2012; Keykavousi et al., 2016; Kovacevic et al., 2001; Mahmoudi et al., 2014; Mahmoudi et al., 2015; Raei et al., 2014; Sadeghi et al., 2014a; Sayyad and Farahmandfar, 2017; Shabankare et al., 2015)
		ssp. *capitatum*	Crete, Serbia and Montenegro, Bulgaria	Aerial parts	(De Martino et al., 2010; Mitic et al., 2012)
		ssp. *polium*	Algeria	Aerial parts	(Djabou et al., 2012)
		-	Algeria	Flowers	(Bendif et al., 2018)
		-	Iran	Fruits	(Oroojalian et al., 2017; Sabzeghabaie and Asgarpanah, 2016)
		-	France, Greece, Iran	Leaves	(Chizzola, 2006; Lianopoulou et al., 2014; Masoudi, 2018)
		ssp. *capitatum*	Greece	Leaves and inflorescences	(Fanouriou et al., 2018)
		-	Algeria	Vegetative parts	(Bendif et al., 2018)
322	Spathulenol, 1h-Cycloprop	-	Iran	Aerial parts	(Sadrizadeh et al., 2018)
323	Squalene	-	Algeria	Flowers	(Bendif et al., 2018)
324	*t*-Cadinol	-	Turkey, Tunisia, Algeria, Greece	Aerial parts	(Ben Othman et al., 2017; Bendjabeur et al., 2018; Boulila et al., 2008; Saltan et al., 2019; Vokou and Bessiere, 1985)
325	*t*-Muurolol	-	Algeria	Flowers	(Bendif et al., 2018)
		-	Algeria	Vegetative parts	(Bendif et al., 2018)
326	*tau*-Cadinol	-	Algeria	Flowers	(Bendif et al., 2018)
		-	Algeria	Vegetative parts	(Bendif et al., 2018)
327	Terpinen-4-ol	-	Tunisia, Croatia, Iran, Greece	Aerial parts	(Bakari et al., 2015; Ben Othman et al., 2017; Bezic et al., 2011; Boulila et al., 2008; Gholivand et al., 2013; Vokou and Bessiere, 1985)
		ssp. *capitatum*	Corsica, Crete, Greece	Aerial parts	(Cozzani et al., 2005; De Martino et al., 2010; Djabou et al., 2012; Menichini et al., 2009)
		ssp. *polium*	Algeria	Aerial parts	(Djabou et al., 2012)
		-	Algeria	Flowers	(Bendif et al., 2018)
		-	Iran	Fruits	(Oroojalian et al., 2017; Sabzeghabaie and Asgarpanah, 2016)
		-	Iran, Greece	Leaves	(Lianopoulou et al., 2014; Masoudi, 2018)
		-	Algeria	Vegetative parts	(Bendif et al., 2018)
328	Terpinolene	-	Tunisia	Aerial parts	(Ben Othman et al., 2017)
		ssp. *capitatum*	Corsica	Aerial parts	(Cozzani et al., 2005; Djabou et al., 2012)
		ssp. *polium*	Algeria	Aerial parts	(Djabou et al., 2012)
		-	Algeria	Flowers	(Bendif et al., 2018)
		-	Iran	Leaves	(Masoudi, 2018)
		-	Algeria	Vegetative parts	(Bendif et al., 2018)
329	Tetradecanal	-	Iran	Stems	(Masoudi, 2018)
330	Tetradecanoic acid	-	Iran	Stems	(Masoudi, 2018)
331	Thuja-2,4(10)-diene	ssp. *capitatum*	Bulgaria	Aerial parts	(Mitic et al., 2012)
		ssp. *polium*	Algeria	Aerial parts	(Djabou et al., 2012)
		-	Algeria	Vegetative parts	(Bendif et al., 2018)
332	Thymol	-	Iran	Aerial parts	(Gholivand et al., 2013)
		ssp. *capitatum*	Crete, Corsica, Greece	Aerial parts	(De Martino et al., 2010; Djabou et al., 2012; Menichini et al., 2009)
		ssp. *polium*	Algeria	Aerial parts	(Djabou et al., 2012)
		-	Iran	Fruits	(Sabzeghabaie and Asgarpanah, 2016)
		-	France	Inflorescence	(Chizzola, 2006)
		-	France	Leaves	(Chizzola, 2006)
		-	Algeria	Vegetative parts	(Bendif et al., 2018)
333	Toluene	-	Iran	Aerial parts	(Nikpour et al., 2018)
334	Torreyol	-	Iran	Aerial parts	(Nikpour et al., 2018)
		ssp. *capitatum*	Crete, Greece	Aerial parts	(De Martino et al., 2010; Menichini et al., 2009)
335	*trans-(+)*-Carveol	-	Iran	Aerial parts	(Sadrizadeh et al., 2018)
336	*trans*-2-Hexenal	-	Iran	Aerial parts	(Nikpour et al., 2018)
		ssp. *polium*	Algeria	Aerial parts	(Djabou et al., 2012)
337	*trans*-Calamenene	-	Serbia and	Aerial parts	(Kovacevic et al., 2001)

No	Chemical compound	ssp.[2]/var.[3]	Locality	Part/Extract	Reference
			Montenegro		
		ssp. *polium*	Algeria	Aerial parts	(Djabou et al., 2012)
		-	Algeria	Flowers	(Bendif et al., 2018)
		-	Algeria	Vegetative parts	(Bendif et al., 2018)
338	*trans*-Carveol	-	Tunisia, Iran, Greece	Aerial parts	(Ben Othman et al., 2017; Gholivand et al., 2013; Vokou and Bessiere, 1985)
		ssp. *capitatum*	Corsica	Aerial parts	(Cozzani et al., 2005; Djabou et al., 2012)
		ssp. *polium*	Algeria	Aerial parts	(Djabou et al., 2012)
		-	Algeria	Flowers	(Bendif et al., 2018)
		-	Algeria	Vegetative parts	(Bendif et al., 2018)
339	*trans*-Carvyl acetate	-	Greece	Aerial parts	(Vokou and Bessiere, 1985)
340	*trans*-Caryophyllene	-	Iran	Aerial parts	(Sadrizadeh et al., 2018)
		ssp. *capitatum*	Serbia and Montenegro, Bulgaria	Aerial parts	(Mitic et al., 2012)
		-	Iran	Fruits	(Sabzeghabaie and Asgarpanah, 2016)
341	*trans*-Chrysanthenyl acetate	-	Iran	Aerial parts	(Nikpour et al., 2018)
342	*trans*-Linalool oxide, furanoid	ssp. *capitatum*	Crete, Greece	Aerial parts	(De Martino et al., 2010; Menichini et al., 2009)
343	*trans*-*p*-Mentha-2,8-dien-1-ol	-	Algeria	Flowers	(Bendif et al., 2018)
344	*trans*-Pinocamphone	ssp. *capitatum*	Corsica	Aerial parts	(Cozzani et al., 2005; Djabou et al., 2012)
345	*trans*-Pinocarveol	-	Tunisia, Serbia and Montenegro, Greece	Aerial parts	(Bakari et al., 2015; Ben Othman et al., 2017; Kovacevic et al., 2001; Vokou and Bessiere, 1985)
		ssp. *aurasiacum*	Algeria	Aerial parts	(Kabouche et al., 2007)
		ssp. *capitatum*	Corsica, Serbia and Montenegro, Bulgaria	Aerial parts	(Cozzani et al., 2005; Djabou et al., 2012; Mitic et al., 2012)
		ssp. *polium*	Algeria	Aerial parts	(Djabou et al., 2012)
		-	Algeria	Flowers	(Bendif et al., 2018)
		-	Iran	Fruits	(Sabzeghabaie and Asgarpanah, 2016)
		-	Greece, Iran	Leaves	(Lianopoulou et al., 2014; Masoudi, 2018)
		-	Algeria	Vegetative parts	(Bendif et al., 2018)
346	*trans*-Sabinene hydrate	-	Tunisia	Aerial parts	(Boulila et al., 2008)
		ssp. *capitatum*	Crete, Greece	Aerial parts	(De Martino et al., 2010; Menichini et al., 2009)
		ssp. *polium*	Algeria	Aerial parts	(Djabou et al., 2012)
		-	Algeria	Vegetative parts	(Bendif et al., 2018)
347	*trans*-Sabinol	-	Algeria	Flowers	(Bendif et al., 2018)
		-	Algeria	Vegetative parts	(Bendif et al., 2018)
348	*trans*-Sabinyl acetate	-	Algeria	Flowers	(Bendif et al., 2018)
		-	Algeria	Vegetative parts	(Bendif et al., 2018)
349	*trans*-Sesquisabinene hydrate	-	Iran	Stems	(Masoudi, 2018)
350	*trans*-Thujone	-	Algeria	Vegetative parts	(Bendif et al., 2018)
351	*trans*-Verbenol	-	Greece, Iran	Aerial parts	(Keykavousi et al., 2016; Vokou and Bessiere, 1985)
		ssp. *capitatum*	Bulgaria, Corsica, Serbia and Montenegro	Aerial parts	(Cozzani et al., 2005; Djabou et al., 2012; Mitic et al., 2012)
		ssp. *polium*	Algeria	Aerial parts	(Djabou et al., 2012)
		-	Greece	Leaves	(Lianopoulou et al., 2014)
352	*trans*-α-Bergamotene	-	Croatia, Serbia and Montenegro	Aerial parts	(Bezic et al., 2011; Kovacevic et al., 2001)
		ssp. *capitatum*	Corsica	Aerial parts	(Cozzani et al., 2005)
		-	France, Iran	Leaves	(Chizzola, 2006; Masoudi, 2018)
		-	Iran	Stems	(Masoudi, 2018)
353	*trans*-β-Caryophyllene	-	Tunisia	Aerial parts	(Boulila et al., 2008)
354	*trans*-β-Farnesene	-	Iran	Aerial parts	(Gholivand et al., 2013; Sadrizadeh et al., 2018)
		-	Iran	Fruits	(Sabzeghabaie and Asgarpanah, 2016)
		-	Greece	Leaves	(Lianopoulou et al., 2014)
355	*trans*-β-Guaiene	-	Algeria, Iran	Aerial parts	(Bendjabeur et al., 2018; Gholivand et al., 2013)
356	*trans*-β-Ocimene	-	Algeria	Aerial parts	(Bendjabeur et al., 2018)
357	Triacontane	ssp. *capitatum*	Crete	Aerial parts	(De Martino et al., 2010)
358	Umbellulone	-	Tunisia	Aerial parts	(Ben Othman et al., 2017)
		ssp. *capitatum*	Corsica, Crete, Greece	Aerial parts	(Cozzani et al., 2005; De Martino et al., 2010; Djabou et al., 2012; Menichini et al., 2009)
359	Undecanal	ssp. *polium*	Algeria	Aerial parts	(Djabou et al., 2012)
360	Untriacontane (C31)	-	Algeria	Flowers	(Bendif et al., 2018)
361	Valencene	-	Amman, Serbia and Montenegro, Iran	Aerial parts	(Aburjai et al., 2006; Asgharipour and Shabankare, 2017; Kovacevic et al., 2001; Shabankare et al., 2015)
		ssp. *capitatum*	Crete, Greece	Aerial parts	(De Martino et al., 2010; Menichini et al., 2009)
362	Valerianol	-	Iran	Aerial parts	(Keykavousi et al., 2016)
		ssp. *capitatum*	Corsica	Aerial parts	(Djabou et al., 2012)
		-	Iran	Stems	(Masoudi, 2018)
363	Verbenene	-	Tunisia, Iran	Aerial parts	(Bakari et al., 2015; Gholivand et al., 2013; Mahmoudi et al., 2014)
		-	Iran	Fruits	(Sabzeghabaie and Asgarpanah, 2016)
364	Verbenol	-	Tunisia, Iran	Aerial parts	(Bakari et al., 2015; Nikpour et al., 2018)
		-	Jordan	TCM	(Al-Qudah et al., 2011)
365	Verbenone	-	Iran, Tunisia, Greece	Aerial parts	(Ben Othman et al., 2017; Gholivand et al., 2013; Heydarzade and Moravvej, 2012; Keykavousi et al., 2016; Vokou and Bessiere, 1985)
		ssp. *capitatum*	Corsica, Bulgaria	Aerial parts	(Cozzani et al., 2005; Djabou et al., 2012; Mitic et

No	Chemical compound	ssp.[2]/var.[3]	Locality	Part/Extract	Reference
					al., 2012)
		ssp. *polium*	Algeria	Aerial parts	(Djabou et al., 2012)
		-	Algeria	Flowers	(Bendif et al., 2018)
		-	Iran	Fruits	(Sabzeghabaie and Asgarpanah, 2016)
		-	Jordan	TCM	(Al-Qudah et al., 2011)
		-	Algeria	Vegetative parts	(Bendif et al., 2018)
366	Viridiflorol	-	Serbia and Montenegro, Iran	Aerial parts	(Kovacevic et al., 2001; Sadrizadeh et al., 2018)
		ssp. *capitatum*	Iran	Aerial parts	(Khani and Heydarian, 2014)
		-	Algeria	Flowers	(Bendif et al., 2018)
		-	Algeria	Vegetative parts	(Bendif et al., 2018)
367	Widdrol	ssp. *capitatum*	Crete	Aerial parts	(De Martino et al., 2010)
368	α-Agarofuran	ssp. *capitatum*	Corsica	Aerial parts	(Cozzani et al., 2005; Djabou et al., 2012)
369	α-Amorphene	-	Serbia and Montenegro	Aerial parts	(Kovacevic et al., 2001)
		ssp. *capitatum*	Crete, Greece	Aerial parts	(De Martino et al., 2010; Menichini et al., 2009)
		-	Iran	Fruits	(Sabzeghabaie and Asgarpanah, 2016)
370	α-Bisabolene	-	Greece	Aerial parts	(Vokou and Bessiere, 1985)
371	α-Bisabolol	-	Iran	Aerial parts	(Sadeghi et al., 2014a; Sayyad and Farahmandfar, 2017)
		ssp. *capitatum*	Crete	Aerial parts	(De Martino et al., 2010)
		-	Jordan	TCM	(Al-Qudah et al., 2011)
372	α-Bisabolol oxide	-	Jordan	TCM	(Al-Qudah et al., 2011)
373	α-Bisabolol oxide B	-	Iran	Aerial parts	(Sadeghi et al., 2014a)
374	α-Bourbonene	-	Iran	Aerial parts	(Nikpour et al., 2018)
		ssp. *polium*	Algeria	Aerial parts	(Djabou et al., 2012)
375	α-Bulnesene	-	Iran	Aerial parts	(Nikpour et al., 2018)
376	α-Cadinene	-	Algeria	Aerial parts	(Bendjabeur et al., 2018)
		ssp. *polium*	Algeria	Aerial parts	(Djabou et al., 2012)
		-	Algeria	Flowers	(Bendif et al., 2018)
		-	Algeria	Vegetative parts	(Bendif et al., 2018)
377	α-Cadinol	-	Greece, Serbia and Montenegro, Turkey, Amman, Tunisia	Aerial parts	(Aburjai et al., 2006; Ben Othman et al., 2017; Bendjabeur et al., 2018; Boulila et al., 2008; Kovacevic et al., 2001; Saltan et al., 2019; Vokou and Bessiere, 1985)
		ssp. *aurasiacum*	Algeria	Aerial parts	(Kabouche et al., 2007)
		ssp. *capitatum*	Iran, Crete, Greece, Bulgaria	Aerial parts	(De Martino et al., 2010; Khani and Heydarian, 2014; Menichini et al., 2009; Mitic et al., 2012)
		ssp. *polium*	Algeria	Aerial parts	(Djabou et al., 2012)
		-	Algeria, Iran	Flowers	(Bendif et al., 2018; Masoudi, 2018)
		-	Iran	Fruits	(Oroojalian et al., 2017)
		-	France	Inflorescence	(Chizzola, 2006)
		-	Greece, France, Iran	Leaves	(Chizzola, 2006; Lianopoulou et al., 2014; Masoudi, 2018)
		-	Iran	Stems	(Masoudi, 2018)
		-	Jordan	TCM	(Al-Qudah et al., 2011)
		-	Algeria	Vegetative parts	(Bendif et al., 2018)
378	α-Calacorene	-	Algeria	Aerial parts	(Bendjabeur et al., 2018)
		ssp. *capitatum*	Corsica, Crete, Greece	Aerial parts	(Cozzani et al., 2005; De Martino et al., 2010; Djabou et al., 2012; Menichini et al., 2009)
		ssp. *polium*	Algeria	Aerial parts	(Djabou et al., 2012)
		-	Algeria	Flowers	(Bendif et al., 2018)
		-	Iran	Stems	(Masoudi, 2018)
		-	Algeria	Vegetative parts	(Bendif et al., 2018)
379	α-Camphene	-	Iran	Aerial parts	(Asgharipour and Shabankare, 2017; Shabankare et al., 2015)
		-	Iran	Fruits	(Oroojalian et al., 2017)
380	α-Campholenal	-	Tunisia, Iran	Aerial parts	(Ben Othman et al., 2017; Gholivand et al., 2013; Heydarzade and Moravvej, 2012; Keykavousi et al., 2016; Nikpour et al., 2018)
		ssp. *capitatum*	Corsica, Bulgaria	Aerial parts	(Cozzani et al., 2005; Djabou et al., 2012; Mitic et al., 2012)
		ssp. *polium*	Algeria	Aerial parts	(Djabou et al., 2012)
		-	Algeria	Flowers	(Bendif et al., 2018)
		-	Iran	Fruits	(Sabzeghabaie and Asgarpanah, 2016)
		-	Greece	Leaves	(Lianopoulou et al., 2014)
		-	Algeria	Vegetative parts	(Bendif et al., 2018)
381	α-Campholenaldehyde	-	Algeria, Tunisia	Aerial parts	(Bakari et al., 2015; Bendjabeur et al., 2018)
382	α-Caryophyllene	-	Iran	Aerial parts	(Sadrizadeh et al., 2018)
383	α-Copaene	-	Iran, Greece, Serbia and Montenegro, Algeria, Croatia, Tunisia	Aerial parts	(Bendjabeur et al., 2018; Bezic et al., 2011; Boulila et al., 2008; Kovacevic et al., 2001; Nikpour et al., 2018; Raei et al., 2014; Sayyad and Farahmandfar, 2017; Vokou and Bessiere, 1985)
		ssp. *aurasiacum*	Algeria	Aerial parts	(Kabouche et al., 2007)
		ssp. *capitatum*	Crete, Greece, Serbia and Montenegro, Bulgaria	Aerial parts	(De Martino et al., 2010; Menichini et al., 2009; Mitic et al., 2012)
		ssp. *polium*	Algeria	Aerial parts	(Djabou et al., 2012)
		-	Algeria, Iran	Flowers	(Bendif et al., 2018; Masoudi, 2018)

No	Chemical compound	ssp.[2]/var.[3]	Locality	Part/Extract	Reference
		-	France	Inflorescence	(Chizzola, 2006)
		-	Iran	Leaves	(Masoudi, 2018)
		ssp. *capitatum*	Greece	Leaves and inflorescences	(Fanouriou et al., 2018)
		-	Iran	Stems	(Masoudi, 2018)
		-	Algeria	Vegetative parts	(Bendif et al., 2018)
384	α-Cubebene	-	Algeria, Tunisia	Aerial parts	(Bendjabeur et al., 2018; Boulila et al., 2008)
		-	Iran	Fruits	(Sabzeghabaie and Asgarpanah, 2016)
		-	Algeria	Vegetative parts	(Bendif et al., 2018)
385	α-Cubenol	-	Tunisia	Aerial parts	(Ben Othman et al., 2017)
386	α-Curcumene	-	Greece	Aerial parts	(Vokou and Bessiere, 1985)
387	α-Cyperone	-	Iran	Fruits	(Sabzeghabaie and Asgarpanah, 2016)
388	α-Elemene	-	Serbia and Montenegro	Aerial parts	(Kovacevic et al., 2001)
389	α-Farnesene	-	Turkey	Aerial parts	(Sevindik et al., 2016)
390	α-Fenchyl acetate	-	Iran	Stems	(Masoudi, 2018)
391	α-Funebrene	ssp. *capitatum*	Crete, Greece	Aerial parts	(De Martino et al., 2010; Menichini et al., 2009)
392	α-Guaiene	-	Iran	Aerial parts	(Gholivand et al., 2013)
		ssp. *polium*	Algeria	Aerial parts	(Djabou et al., 2012)
393	α-Gurjunene	-	Amman, Tunisia	Aerial parts	(Aburjai et al., 2006; Boulila et al., 2008)
		ssp. *capitatum*	Crete, Greece	Aerial parts	(De Martino et al., 2010; Menichini et al., 2009)
		-	Algeria	Flowers	(Bendif et al., 2018)
		-	Algeria	Vegetative parts	(Bendif et al., 2018)
394	α-Humulene	-	Iran, Greece, Serbia and Montenegro, Algeria, Croatia, Tunisia, Amman	Aerial parts	(Aburjai et al., 2006; Asgharipour and Shabankare, 2017; Bendjabeur et al., 2018; Bezic et al., 2011; Boulila et al., 2008; Gholivand et al., 2013; Kovacevic et al., 2001; Nikpour et al., 2018; Raei et al., 2014; Sadeghi et al., 2014a; Sayyad and Farahmandfar, 2017; Shabankare et al., 2015; Vokou and Bessiere, 1985)
		ssp. *aurasiacum*	Algeria	Aerial parts	(Kabouche et al., 2007)
		ssp. *capitatum*	Crete, Greece, Serbia and Montenegro, Bulgaria	Aerial parts	(De Martino et al., 2010; Menichini et al., 2009; Mitic et al., 2012)
		ssp. *polium*	Algeria	Aerial parts	(Djabou et al., 2012)
		-	Algeria, Iran	Flowers	(Bendif et al., 2018; Masoudi, 2018)
		-	Iran	Fruits	(Oroojalian et al., 2017; Sabzeghabaie and Asgarpanah, 2016)
		-	France	Inflorescence	(Chizzola, 2006)
		-	France, Iran	Leaves	(Chizzola, 2006; Masoudi, 2018)
		-	Iran	Stems	(Masoudi, 2018)
		-	Algeria	Vegetative parts	(Bendif et al., 2018)
395	α-Longipinene	ssp. *capitatum*	Crete, Greece	Aerial parts	(De Martino et al., 2010; Menichini et al., 2009)
396	α-Muurolene	-	Greece, Serbia and Montenegro, Algeria, Iran	Aerial parts	(Bendjabeur et al., 2018; Kovacevic et al., 2001; Nikpour et al., 2018; Vokou and Bessiere, 1985)
		ssp. *capitatum*	Crete	Aerial parts	(De Martino et al., 2010)
		ssp. *polium*	Algeria	Aerial parts	(Djabou et al., 2012)
		-	Iran	Stems	(Masoudi, 2018)
397	α-Muurolol	-	Algeria, Iran	Flowers	(Bendif et al., 2018; Masoudi, 2018)
		-	France, Iran	Leaves	(Chizzola, 2006; Masoudi, 2018)
		-	Iran	Stems	(Masoudi, 2018)
		-	Algeria	Vegetative parts	(Bendif et al., 2018)
398	α-Phellandrene	-	Tunisia, Iran	Aerial parts	(Boulila et al., 2008; Gholivand et al., 2013; Nikpour et al., 2018)
		ssp. *capitatum*	Corsica	Aerial parts	(Djabou et al., 2012)
		ssp. *polium*	Algeria	Aerial parts	(Djabou et al., 2012)
399	α-Pinene	-	Iran, Turkey, Greece, Serbia and Montenegro, Amman, Tunisia, Algeria	Aerial parts	(Aburjai et al., 2006; Alamdar et al., 2007; Asgharipour and Shabankare, 2017; Bakari et al., 2015; Ben Othman et al., 2017; Bendjabeur et al., 2018; Boulila et al., 2008; Essid et al., 2015; Gholivand et al., 2013; Heydarzade and Moravvej, 2012; Keykavousi et al., 2016; Kovacevic et al., 2001; Nikpour et al., 2018; Purnavab et al., 2015; Raei et al., 2014; Sadeghi et al., 2014a; Saltan et al., 2019; Sayyad and Farahmandfar, 2017; Sevindik et al., 2016; Shabankare et al., 2015; Vokou and Bessiere, 1985)
		ssp. *aurasiacum*	Algeria	Aerial parts	(Kabouche et al., 2007)
		ssp. *capitatum*	Corsica, Crete, Greece, Serbia and Montenegro, Bulgaria	Aerial parts	(Cozzani et al., 2005; De Martino et al., 2010; Djabou et al., 2012; Menichini et al., 2009; Mitic et al., 2012)
		ssp. *polium*	Algeria	Aerial parts	(Djabou et al., 2012)
		-	Algeria	Flowers	(Bendif et al., 2018)
		-	Iran	Fruits	(Oroojalian et al., 2017; Sabzeghabaie and Asgarpanah, 2016)
		-	France	Inflorescence	(Chizzola, 2006)
		-	Greece, France, Iran	Leaves	(Chizzola, 2006; Lianopoulou et al., 2014; Masoudi, 2018)

No	Chemical compound	ssp.[2]/var.[3]	Locality	Part/Extract	Reference
		-	Iran	Stems	(Masoudi, 2018)
		-	Algeria	Vegetative parts	(Bendif et al., 2018)
400	α-Selinene	-	Algeria	Flowers	(Bendif et al., 2018)
401	α-Terpinene	-	Amman, Tunisia, Algeria, Iran	Aerial parts	(Aburjai et al., 2006; Bakari et al., 2015; Bendjabeur et al., 2018; Boulila et al., 2008; Gholivand et al., 2013)
		ssp. *capitatum*	Corsica, Serbia and Montenegro	Aerial parts	(Cozzani et al., 2005; Djabou et al., 2012; Mitic et al., 2012)
		ssp. *polium*	Algeria	Aerial parts	(Djabou et al., 2012)
		-	Algeria	Flowers	(Bendif et al., 2018)
		-	Algeria	Vegetative parts	(Bendif et al., 2018)
402	α-Terpineol	-	Serbia and Montenegro, Tunisia, Iran	Aerial parts	(Bakari et al., 2015; Ben Othman et al., 2017; Gholivand et al., 2013; Kovacevic et al., 2001; Nikpour et al., 2018)
		ssp. *capitatum*	Corsica, Greece	Aerial parts	(Cozzani et al., 2005; Djabou et al., 2012; Menichini et al., 2009)
		ssp. *polium*	Algeria	Aerial parts	(Djabou et al., 2012)
		-	Algeria	Flowers	(Bendif et al., 2018)
		-	Iran	Fruits	(Oroojalian et al., 2017)
		-	Greece	Leaves	(Lianopoulou et al., 2014)
		-	Jordan	TCM	(Al-Qudah et al., 2011)
		-	Algeria	Vegetative parts	(Bendif et al., 2018)
403	α-Terpinolene	-	Tunisia, Algeria, Iran	Aerial parts	(Bakari et al., 2015; Bendjabeur et al., 2018; Gholivand et al., 2013)
		-	France	Leaves	(Chizzola, 2006)
404	α-Terpinyl acetate	-	Serbia and Montenegro, Iran	Aerial parts	(Boroomand et al., 2018; Gholivand et al., 2013; Kovacevic et al., 2001)
		ssp. *capitatum*	Corsica	Aerial parts	(Cozzani et al., 2005; Djabou et al., 2012)
		ssp. *polium*	Algeria	Aerial parts	(Djabou et al., 2012)
		-	Algeria	Flowers	(Bendif et al., 2018)
		-	Algeria	Vegetative parts	(Bendif et al., 2018)
405	α-Thujene	-	Iran, Turkey, Amman, Tunisia, Algeria	Aerial parts	(Aburjai et al., 2006; Asgharipour and Shabankare, 2017; Bakari et al., 2015; Ben Othman et al., 2017; Bendjabeur et al., 2018; Gholivand et al., 2013; Nikpour et al., 2018; Raei et al., 2014; Sayyad and Farahmandfar, 2017; Sevindik et al., 2016; Shabankare et al., 2015)
		ssp. *capitatum*	Corsica, Crete, Serbia and Montenegro	Aerial parts	(Cozzani et al., 2005; De Martino et al., 2010; Djabou et al., 2012; Mitic et al., 2012)
		ssp. *polium*	Algeria	Aerial parts	(Djabou et al., 2012)
		-	Iran	Fruits	(Sabzeghabaie and Asgarpanah, 2016)
		-	France	Inflorescence	(Chizzola, 2006)
		-	France	Leaves	(Chizzola, 2006)
		ssp. *capitatum*	Greece	Leaves and inflorescences	(Fanouriou et al., 2018)
		-	Algeria	Vegetative parts	(Bendif et al., 2018)
406	α-Thujenol	-	Jordan	TCM	(Al-Qudah et al., 2011)
407	α-Thujone	-	Tunisia	Aerial parts	(Ben Othman et al., 2017)
		ssp. *capitatum*	Corsica	Aerial parts	(Djabou et al., 2012)
		ssp. *polium*	Algeria	Aerial parts	(Djabou et al., 2012)
408	α-Ylangene	-	Serbia and Montenegro, Iran	Aerial parts	(Gholivand et al., 2013; Kovacevic et al., 2001)
		ssp. *polium*	Algeria	Aerial parts	(Djabou et al., 2012)
		-	Algeria	Flowers	(Bendif et al., 2018)
		-	Greece	Leaves	(Lianopoulou et al., 2014)
		-	Algeria	Vegetative parts	(Bendif et al., 2018)
409	α-Zingiberene	-	Tunisia	Aerial parts	(Boulila et al., 2008)
410	β-Bisabolene	-	Iran, Turkey, Tunisia	Aerial parts	(Asgharipour and Shabankare, 2017; Boulila et al., 2008; Nikpour et al., 2018; Raei et al., 2014; Sadeghi et al., 2014a; Sayyad and Farahmandfar, 2017; Sevindik et al., 2016; Shabankare et al., 2015)
411	β-Bisabolenol	-	Algeria	Flowers	(Bendif et al., 2018)
412	β-Bisabolol	-	Iran	Aerial parts	(Sadeghi et al., 2014a; Sayyad and Farahmandfar, 2017)
413	β-Bourbonene	-	Iran, Greece, Serbia and Montenegro, Amman, Algeria, Croatia, Tunisia	Aerial parts	(Aburjai et al., 2006; Alamdar et al., 2007; Bendjabeur et al., 2018; Bezic et al., 2011; Boulila et al., 2008; Gholivand et al., 2013; Kovacevic et al., 2001; Sadrizadeh et al., 2018; Vokou and Bessiere, 1985)
		ssp. *capitatum*	Crete, Greece, Serbia and Montenegro, Bulgaria	Aerial parts	(De Martino et al., 2010; Menichini et al., 2009; Mitic et al., 2012)
		ssp. *polium*	Algeria	Aerial parts	(Djabou et al., 2012)
		-	Algeria	Flowers	(Bendif et al., 2018)
		-	Iran	Fruits	(Sabzeghabaie and Asgarpanah, 2016)
		-	France	Inflorescence	(Chizzola, 2006)
		-	Greece, France	Leaves	(Chizzola, 2006; Lianopoulou et al., 2014)
		ssp. *capitatum*	Greece	Leaves and inflorescences	(Fanouriou et al., 2018)

No	Chemical compound	ssp.[2]/var.[3]	Locality	Part/Extract	Reference
		-	Algeria	Vegetative parts	(Bendif et al., 2018)
414	β-Cadinene	-	Iran	Aerial parts	(Sadrizadeh et al., 2018)
415	β-Calacorene	-	Serbia and Montenegro, Greece	Aerial parts	(Kovacevic et al., 2001; Vokou and Bessiere, 1985)
		ssp. *capitatum*	Corsica	Aerial parts	(Djabou et al., 2012)
		ssp. *polium*	Algeria	Aerial parts	(Djabou et al., 2012)
		-	Algeria	Flowers	(Bendif et al., 2018)
		-	Algeria	Vegetative parts	(Bendif et al., 2018)
416	β-Caryophyllene	-	Iran, Greece, Serbia and Montenegro, Amman, Algeria, Croatia, Tunisia	Aerial parts	(Aburjai et al., 2006; Alamdar et al., 2007; Asgharipour and Shabankare, 2017; Bendjabeur et al., 2018; Bezic et al., 2011; Essid et al., 2015; Heydarzade and Moravvej, 2012; Kovacevic et al., 2001; Raei et al., 2014; Sayyad and Farahmandfar, 2017; Shabankare et al., 2015; Vokou and Bessiere, 1985)
		ssp. *aurasiacum*	Algeria	Aerial parts	(Kabouche et al., 2007)
		-	Iran	Flowers	(Masoudi, 2018)
		-	Iran	Fruits	(Oroojalian et al., 2017)
		-	France	Inflorescence	(Chizzola, 2006)
		-	Greece, France, Iran	Leaves	(Chizzola, 2006; Lianopoulou et al., 2014; Masoudi, 2018)
		-	Iran	Stems	(Masoudi, 2018)
417	β-Copaene	-	Croatia	Aerial parts	(Bezic et al., 2011)
		ssp. *capitatum*	Serbia and Montenegro, Bulgaria	Aerial parts	(Mitic et al., 2012)
		ssp. *polium*	Algeria	Aerial parts	(Djabou et al., 2012)
		-	Algeria	Flowers	(Bendif et al., 2018)
		-	Algeria	Vegetative parts	(Bendif et al., 2018)
418	β-Cubebene	-	Serbia and Montenegro, Amman, Tunisia	Aerial parts	(Aburjai et al., 2006; Boulila et al., 2008; Kovacevic et al., 2001)
		ssp. *capitatum*	Crete, Greece, Serbia and Montenegro	Aerial parts	(De Martino et al., 2010; Menichini et al., 2009; Mitic et al., 2012)
		-	France	Inflorescence	(Chizzola, 2006)
419	β-Cyclocitral	ssp. *capitatum*	Crete	Aerial parts	(De Martino et al., 2010)
420	β-Dihydroagarofuran	ssp. *capitatum*	Corsica	Aerial parts	(Djabou et al., 2012)
421	β-Elemene	-	Iran	Aerial parts	(Gholivand et al., 2013)
		ssp. *capitatum*	Crete, Greece	Aerial parts	(De Martino et al., 2010; Menichini et al., 2009)
		ssp. *polium*	Algeria	Aerial parts	(Djabou et al., 2012)
		-	Algeria	Flowers	(Bendif et al., 2018)
		-	Iran	Fruits	(Sabzeghabaie and Asgarpanah, 2016)
		-	Algeria	Vegetative parts	(Bendif et al., 2018)
422	β-Eudesmol	-	Iran, Amman	Aerial parts	(Aburjai et al., 2006; Alamdar et al., 2007; Heydarzade and Moravvej, 2012; Keykavousi et al., 2016)
		ssp. *capitatum*	Corsica, Serbia and Montenegro	Aerial parts	(Cozzani et al., 2005; Djabou et al., 2012; Mitic et al., 2012)
		-	Algeria, Iran	Flowers	(Bendif et al., 2018; Masoudi, 2018)
		-	Algeria	Vegetative parts	(Bendif et al., 2018)
423	β-Eudesmol acetate	-	Algeria	Flowers	(Bendif et al., 2018)
		-	Algeria	Vegetative parts	(Bendif et al., 2018)
424	β-Farnesene	-	Iran, Tunisia	Aerial parts	(Essid et al., 2015; Nikpour et al., 2018)
425	β-Guaiene	-	Iran	Fruits	(Sabzeghabaie and Asgarpanah, 2016)
426	β-Gurjunene (Calarene)	-	Turkey, Algeria	Aerial parts	(Bendjabeur et al., 2018; Sevindik et al., 2016)
		ssp. *capitatum*	Crete, Greece	Aerial parts	(De Martino et al., 2010; Menichini et al., 2009)
		-	France	Leaves	(Chizzola, 2006)
427	β-Humulene	ssp. *capitatum*	Crete, Greece	Aerial parts	(De Martino et al., 2010; Menichini et al., 2009)
428	β-Myrcene	-	Iran, Tunisia, Algeria	Aerial parts	(Bakari et al., 2015; Bendjabeur et al., 2018; Gholivand et al., 2013; Mahmoudi et al., 2014; Mahmoudi et al., 2015; Nikpour et al., 2018)
		ssp. *capitatum*	Serbia and Montenegro, Bulgaria	Aerial parts	(Mitic et al., 2012)
		-	Iran	Fruits	(Oroojalian et al., 2017)
		-	Greece	Leaves	(Lianopoulou et al., 2014)
429	β-Oplopenone	-	Amman	Aerial parts	(Aburjai et al., 2006)
		-	Greece	Leaves	(Lianopoulou et al., 2014)
430	β-Patchoulene	-	Iran	Aerial parts	(Nikpour et al., 2018)
431	β-Phellandrene	-	Amman, Iran, Turkey	Aerial parts	(Aburjai et al., 2006; Boroomand et al., 2018; Sevindik et al., 2016)
		ssp. *capitatum*	Corsica	Aerial parts	(Cozzani et al., 2005; Djabou et al., 2012)
432	β-Pinene	-	Iran, Turkey, Greece, Serbia and Montenegro, Amman, Tunisia, Algeria, Croatia	Aerial parts	(Aburjai et al., 2006; Alamdar et al., 2007; Asgharipour and Shabankare, 2017; Bakari et al., 2015; Ben Othman et al., 2017; Bendjabeur et al., 2018; Bezic et al., 2011; Boulila et al., 2008; Essid et al., 2015; Gholivand et al., 2013; Heydarzade and Moravvej, 2012; Keykavousi et al., 2016; Kovacevic et al., 2001; Mahmoudi et al., 2014;

No	Chemical compound	ssp.[2]/var.[3]	Locality	Part/Extract	Reference
					Mahmoudi et al., 2015; Nikpour et al., 2018; Purnavab et al., 2015; Raei et al., 2014; Sadeghi et al., 2014a; Sayyad and Farahmandfar, 2017; Sevindik et al., 2016; Shabankare et al., 2015; Vokou and Bessiere, 1985)
		ssp. *aurasiacum*	Algeria	Aerial parts	(Kabouche et al., 2007)
		ssp. *capitatum*	Corsica, Greece, Serbia and Montenegro, Bulgaria	Aerial parts	(Cozzani et al., 2005; Djabou et al., 2012; Menichini et al., 2009; Mitic et al., 2012)
		ssp. *polium*	Algeria	Aerial parts	(Djabou et al., 2012)
		-	Algeria	Flowers	(Bendif et al., 2018)
		-	Iran	Fruits	(Oroojalian et al., 2017; Sabzeghabaie and Asgarpanah, 2016)
		-	France	Inflorescence	(Chizzola, 2006)
		-	Greece, France, Iran	Leaves	(Chizzola, 2006; Lianopoulou et al., 2014; Masoudi, 2018)
		ssp. *capitatum*	Greece	Leaves and inflorescences	(Fanouriou et al., 2018)
		-	Iran	Stems	(Masoudi, 2018)
		-	Algeria	Vegetative parts	(Bendif et al., 2018)
433	β-Selinene	-	Algeria, Iran, Turkey	Aerial parts	(Bendjabeur et al., 2018; Gholivand et al., 2013; Sevindik et al., 2016)
		ssp. *aurasiacum*	Algeria	Aerial parts	(Kabouche et al., 2007)
		ssp. *polium*	Algeria	Aerial parts	(Djabou et al., 2012)
		-	Algeria	Flowers	(Bendif et al., 2018)
		-	Iran	Fruits	(Sabzeghabaie and Asgarpanah, 2016)
		-	France	Leaves	(Chizzola, 2006)
		-	Algeria	Vegetative parts	(Bendif et al., 2018)
434	β-Thujone	-	Tunisia, Croatia	Aerial parts	(Bakari et al., 2015; Ben Othman et al., 2017; Bezic et al., 2011)
		ssp. *capitatum*	Corsica	Aerial parts	(Cozzani et al., 2005; Djabou et al., 2012)
		ssp. *polium*	Algeria	Aerial parts	(Djabou et al., 2012)
435	β-Ylangene	ssp. *polium*	Algeria	Aerial parts	(Djabou et al., 2012)
		-	Algeria	Flowers	(Bendif et al., 2018)
		-	Algeria	Vegetative parts	(Bendif et al., 2018)
436	γ-Cadinene	-	Iran, Greece, Serbia and Montenegro, Amman, Algeria, Tunisia	Aerial parts	(Aburjai et al., 2006; Asgharipour and Shabankare, 2017; Bendjabeur et al., 2018; Boulila et al., 2008; Kovacevic et al., 2001; Raei et al., 2014; Sayyad and Farahmandfar, 2017; Shabankare et al., 2015; Vokou and Bessiere, 1985)
		ssp. *capitatum*	Crete, Serbia and Montenegro, Bulgaria	Aerial parts	(De Martino et al., 2010; Mitic et al., 2012)
		ssp. *polium*	Algeria	Aerial parts	(Djabou et al., 2012)
		-	Algeria, Iran	Flowers	(Bendif et al., 2018; Masoudi, 2018)
		-	Iran	Fruits	(Oroojalian et al., 2017)
		-	Iran	Leaves	(Masoudi, 2018)
		-	Iran	Stems	(Masoudi, 2018)
		-	Algeria	Vegetative parts	(Bendif et al., 2018)
437	γ-Elemene	-	Iran	Aerial parts	(Alamdar et al., 2007; Gholivand et al., 2013; Nikpour et al., 2018)
		ssp. *capitatum*	Crete, Greece	Aerial parts	(De Martino et al., 2010; Menichini et al., 2009)
		ssp. *polium*	Algeria	Aerial parts	(Djabou et al., 2012)
		-	Iran	Fruits	(Sabzeghabaie and Asgarpanah, 2016)
438	γ-Muurolene	-	Iran, Algeria	Aerial parts	(Alamdar et al., 2007; Bendjabeur et al., 2018)
		ssp. *capitatum*	Serbia and Montenegro, Bulgaria	Aerial parts	(Mitic et al., 2012)
		ssp. *polium*	Algeria	Aerial parts	(Djabou et al., 2012)
		-	Algeria	Flowers	(Bendif et al., 2018)
		-	Algeria	Vegetative parts	(Bendif et al., 2018)
439	γ-Terpinene	-	Amman, Tunisia, Algeria, Iran	Aerial parts	(Aburjai et al., 2006; Bakari et al., 2015; Bendjabeur et al., 2018; Boulila et al., 2008; Essid et al., 2015; Gholivand et al., 2013)
		ssp. *capitatum*	Corsica, Serbia and Montenegro	Aerial parts	(Cozzani et al., 2005; Djabou et al., 2012; Mitic et al., 2012)
		ssp. *polium*	Algeria	Aerial parts	(Djabou et al., 2012)
		-	Algeria	Flowers	(Bendif et al., 2018)
		-	Greece, Iran	Leaves	(Lianopoulou et al., 2014; Masoudi, 2018)
		-	Algeria	Vegetative parts	(Bendif et al., 2018)
440	δ-Amorphene	ssp. *capitatum*	Greece	Leaves and inflorescences	(Fanouriou et al., 2018)
441	δ-Cadinene	-	Iran, Turkey, Greece, Amman, Algeria, Tunisia	Aerial parts	(Aburjai et al., 2006; Bendjabeur et al., 2018; Boulila et al., 2008; Essid et al., 2015; Gholivand et al., 2013; Nikpour et al., 2018; Sadeghi et al., 2014a; Sadrizadeh et al., 2018; Sevindik et al., 2016; Vokou and Bessiere, 1985)
		ssp. *capitatum*	Corsica, Crete, Greece, Serbia and Montenegro, Bulgaria	Aerial parts	(Cozzani et al., 2005; De Martino et al., 2010; Djabou et al., 2012; Menichini et al., 2009; Mitic et al., 2012)

No	Chemical compound	ssp.[2]/var.[3]	Locality	Part/Extract	Reference
		ssp. *polium*	Algeria	Aerial parts	(Djabou et al., 2012)
		-	Algeria, Iran	Flowers	(Bendif et al., 2018; Masoudi, 2018)
		-	Iran	Fruits	(Sabzeghabaie and Asgarpanah, 2016)
		-	France	Inflorescence	(Chizzola, 2006)
		-	Greece, France, Iran	Leaves	(Chizzola, 2006; Lianopoulou et al., 2014; Masoudi, 2018)
		ssp. *capitatum*	Greece	Leaves and inflorescences	(Fanouriou et al., 2018)
		-	Iran	Stems	(Masoudi, 2018)
		-	Algeria	Vegetative parts	(Bendif et al., 2018)
442	δ-Cadinol	-	Tunisia	Aerial parts	(Boulila et al., 2008)
		ssp. *capitatum*	Iran	Aerial parts	(Khani and Heydarian, 2014)
443	δ-Calacorene	-	Greece	Aerial parts	(Vokou and Bessiere, 1985)
444	δ-Elemene	-	Iran	Flowers	(Masoudi, 2018)
		-	Iran	Leaves	(Masoudi, 2018)
445	δ-Guaiene	ssp. *polium*	Algeria	Aerial parts	(Djabou et al., 2012)
446	τ-Cadinol	-	Amman	Aerial parts	(Aburjai et al., 2006)
		ssp. *polium*	Algeria	Aerial parts	(Djabou et al., 2012)
		-	Jordan	TCM	(Al-Qudah et al., 2011)
447	τ-Muurolol	-	Iran	Aerial parts	(Nikpour et al., 2018)
		ssp. *capitatum*	Serbia and Montenegro, Bulgaria	Aerial parts	(Mitic et al., 2012)
		ssp. *polium*	Algeria	Aerial parts	(Djabou et al., 2012)

[1] Essential oil components found in the trace amounts in essential oils have been ignored. The components are listed in alphabetical order.
[2] ssp : subspecies,
[3] var: variety,
[4] TCM: Tissue culture material

As can be seen from Table 3, the chemical composition of the essential oil of *T. polium* has been studied by many researchers. In addition to *T. polium* itself, the subspecies aurasicum, capitatum, and polium have also been studied many times. As stated in section 3, *T. polium* is a plant species of Middle East origin. For this reason, most of the studies on this plant have been carried out in Middle Eastern countries such as Iran, Amman, Jordan, and Saudi Arabia. In addition, researchers from North African countries, such as Algeria and Tunisia, have been shown to be intensely interested in this plant species. Chemical composition of the essential oil of *T. polium* was also analysed by several research teams in Turkey. Due to the nature of a bridge between Europe and the Middle East, Turkey has a great importance in the comparison of data between east and west. In addition, essential oil compositions of samples collected from European countries such as Greece, Croatia, Bulgaria, France, Serbia and Montenegro, and islands in the Mediterranean such as Corsica and Crete were studied. In essential oil analysis, it was understood that the most ideal sample is aerial parts. In addition, flowers, fruits, inflorescence, leaves, stems, and vegetative parts have also been used in essential oil isolation. Interestingly, even tissue culture material was used to obtain the essential oil (Al-Qudah et al., 2011).

Since 1982, a total of 447 essential oil components have been identified from *T. polium* and its subspecies. It is understood that monoterpenes such as limonene, myrcene, β-Pinene, linalool, α-pinene, *(E)*-β-ocimene, borneol, *p*-cymene, sabinene, α-terpineol, α-thujene and sesquiterpenoids such as bicyclogermacrene, caryophyllene oxide, germacrene D, α-copaene, α-humulene, δ-cadinene, β-bourbonene, elemol, spathulenol, γ-cadinene are frequently identified in essential oil samples in the majority of these studies.

The main components of essential oils isolated from *T. polium* and its subspecies were given in Table 4. Compounds with a rate of more than 5 % in the oil samples were given in the table. According to literature data, as in Table 3, the main components of the essential oil of both *T. polium* and its subspecies (ssp. *capitatum*, ssp. *aurasicum*, and ssp. *polium*) were monoterpenes or sesquiterpenes. In samples collected from Iran, Tunisia, Amman, Croatia, Algeria and Greece, almost half of the essential oils were found to be composed of carvacrol (monoterpene), β-caryophyllene and β-bisabolol (sesquiterpenes). In addition, β-pinene, 11-acetoxyeudesman-4-a-ol, α-bisabolol, 1,2,3,6,7,7α-hexahydro-5-h-inden-5-one, α-pinene, germacrene D, 8-cedren-13-ol, γ-muurolene, 3β-hydroxy-α-muurolene, piperitenone oxide, t-cadinol and *(Z)*-α-caryophyllene were also higher than 20% in oil samples. It was found that the major compounds mentioned above were generally determined in the oils isolated from aerial parts of the samples. The main components were also found in the leaves, inflorescences, stems, fruits, flowers, and tissue culture materials.

Other components isolated from *T. polium* and its subspecies were given in Table 5. In addition to the subspecies given Tables 3 and 4, *expansum*, *gnaphalodes*, *pilosum*, *aureum*, and *vincentinum* were also among the subspecies where the compounds in Table 5 was isolated.

According to the data in the table, a total of 172 compounds belonging to flavonoids, *neo*-clerodane diterpenoids, phenolic compounds, phenylpropanoid glycosides, iridoid glycosides, abietane diterpenoids, sterols, triterpenic alcohols, abeo-abietanes, phenylethanol glycosides, and saponin glycosides were identified. In addition to aerial parts of the plant, roots, leaves, stems, and seeds were also used for the isolation of these compounds. Solvents used in the isolation of these compounds were EtOAc, acetone, petroleum ether, chloroform, MeOH, water, *n*-hexane, and CH_2Cl_2. The most frequently isolated components in the studies presented in Table 5 were flavonoids (apigenin, luteolin, cirsimaritin, routine). In addition, poliumoside, verbascoside (phenylpropanoid glycosides), teucardoside (iridoid glycoside), caffeic acid (phenolic compound) and teulamifin B (*neo*-clerodane diterpenoid) were also frequently identified. Aerial parts of the samples were mostly used for the isolation of these components. It was understood that the variety components in both Tables 3, 4, and 5 were not affected by the localities where the plants were collected and similar components were detected in the samples collected from both the Middle Eastern and European countries.

In addition to the classification performed according to morphological and/or anatomical features, plants can also be subjected to chemical classification, taking into account chemical

variations. In this classification, called chemotaxonomy, the distribution of chemical compounds or biosynthetically related compound groups in plants is examined. Although traditionalist researchers insist that they do not accept chemical taxonomy against morphological classification, since ancient times, chemotaxonomic data are believed to be important, since some of the main components of essential oils have been used in the cosmetic, food and pharmaceutical industries (Bhargava et al., 2013). Kamel and Sandra (1994) suggested that sesquiterpenoids, particularly sesquiterpene alcohols, can be used as chemotaxonomic markers for the essential oils of *T. polium*. The data in Table 4 show that the suggestion that sesquiterpenes can be used as chemotaxonomic markers is correct. However, monoterpenes can also be evaluated as important chemotaxonomic markers for *T. polium* and its subspecies.

Table 4. Major compounds of the essential oils of *T. polium* together with its subspecies and varieties[1]

Chemical compound	Percentage (%)	ssp.[2]/var.[3]	Locality	Part/Extract	Reference
(-)-Myrtenol	5.20	-	Jordan	TCM[2]	(Al-Qudah et al., 2011)
(+)-3-Carene	6.80	-	Jordan	TCM	(Al-Qudah et al., 2011)
(+)-Aromadendrene	8.70	-	Jordan	TCM	(Al-Qudah et al., 2011)
(+)-Spathulenol	8.60	-	Jordan	TCM	(Al-Qudah et al., 2011)
(E,E)-1,3,5-Undecatriene	8.97	-	Iran	Aerial parts	(Boroomand et al., 2018)
(E)-3-Caren-2-ol	12.10	-	Saudi Arabia	Aerial parts	(Ibrahim et al., 2017)
(E)-Caryophyllene	8.0-12.90	-	Iran	Aerial parts	(Sadeghi et al., 2014a)
(E)-β-Farnesene	10.05	ssp. *capitatum*	Greece	Leaves and inflorescences	(Fanouriou et al., 2018)
(Z)-Nerolidol	7.13	-	Iran	Leaves	(Masoudi, 2018)
	6.23	-	Iran	Fruits	(Oroojalian et al., 2017)
(Z)-α-Caryophyllene	18.91-20.10	-	Iran	Aerial parts	(Gholivand et al., 2013)
(Z)-β-Farnesene	15.49	-	Turkey	Aerial parts	(Sevindik et al., 2016)
1,2,3,6,7,7a-Hexahydro-5-h-inden-5-one	25.80	-	Iran	Aerial parts	(Boroomand et al., 2018)
1,8-Cineole	6.26	-	Tunisia	Aerial parts	(Essid et al., 2015)
11-Acetoxyeudesman-4-α-ol	30.20	-	Iran	Aerial parts	(Sadeghi et al., 2014a)
	26.30	-	Iran	Aerial parts	(Sayyad and Farahmandfar, 2017)
3β-Hydroxy-α-muurolene	22.50	ssp. *aurasiacum*	Algeria	Aerial parts	(Kabouche et al., 2007)
8-Cedren-13-ol	24.75	-	Amman	Aerial parts	(Aburjai et al., 2006)
Bicyclo[3.1.1]Hept-3-en-2-one	6.76	-	Iran	Aerial parts	(Sadrizadeh et al., 2018)
Bicyclogermacrene	5.00-12.00	-	Iran, Algeria	Aerial parts	(Asgharipour and Shabankare, 2017; Bendjabeur et al., 2018; Mahmoudi et al., 2014; Mahmoudi et al., 2015; Purnavab et al., 2015; Raei et al., 2014; Shabankare et al., 2015)
	6.2	ssp. *capitatum*	Serbia	Aerial parts	(Mitic et al., 2012)
	5.5	ssp. *polium*	Algeria	Aerial parts	(Djabou et al., 2012)
	5.80	-	France	Inflorescence	(Chizzola, 2006)
	6.20	-	France	Leaves	(Chizzola, 2006)
	9.11	ssp. *capitatum*	Greece	Leaves and inflorescences	(Fanouriou et al., 2018)
Camphene	6.40	-	Jordan	TCM	(Al-Qudah et al., 2011)
Camphor	6.21	-	Iran	Fruits	(Oroojalian et al., 2017)
Carvacrol	8.00-56.06	-	Iran, Tunisia	Aerial parts	(Asgharipour and Shabankare, 2017; Essid et al., 2015; Keykavousi et al., 2016; Shabankare et al., 2015)
	9.60-10.10	ssp. *capitatum*	Crete, Greece	Aerial parts	(De Martino et al., 2010; Menichini et al., 2009)
Carvone	11.29	-	Iran	Aerial parts	(Heydarzade and Moravvej, 2012)
Caryophyllene	9.80-10.10	ssp. *capitatum*	Crete, Greece	Aerial parts	(De Martino et al., 2010; Menichini et al., 2009)
Caryophyllene oxide	5.70-6.70	-	Iran, Greece	Aerial parts	(Keykavousi et al., 2016; Sadeghi et al., 2014a; Sayyad and Farahmandfar, 2017; Vokou and Bessiere, 1985)
	5.00-25.90	ssp. *capitatum*	Crete, Iran	Aerial parts	(De Martino et al., 2010; Khani and Heydarian, 2014)
	6.49	-	Iran	Stems	(Masoudi, 2018)
Cedrol	14.52-15.26	-	Iran	Aerial parts	(Gholivand et al., 2013)
cis-Verbenol	6.25	-	Iran	Aerial parts	(Nikpour et al., 2018)
cis-β-Farnesene	5.60-18.40	-	Iran	Aerial parts	(Asgharipour and Shabankare, 2017; Shabankare et al., 2015)
Cubenol	10.00	-	Iran	Fruits	(Sabzeghabaie and Asgarpanah, 2016)
Elemol	14.50	-	Iran	Fruits	(Sabzeghabaie and Asgarpanah, 2016)
	5.53	-	Iran	Stems	(Masoudi, 2018)
	8.20	-	Jordan	TCM	(Al-Qudah et al., 2011)
Endobornyl acetate	5.90	-	Jordan	TCM	(Al-Qudah et al., 2011)
epi-α-Muurolol	8.10	ssp. *capitatum*	Iran	Aerial parts	(Khani and Heydarian, 2014)
Epizonaren	9.62	-	Iran	Aerial parts	(Sadrizadeh et al., 2018)
Eugenol	6.50	-	Jordan	TCM	(Al-Qudah et al., 2011)
Farnesene	13.00	-	Iran	Aerial parts	(Raei et al., 2014)
Gauilyl acetate	9.50	-	Jordan	TCM	(Al-Qudah et al., 2011)
Germacrene B	8.70-10.11	-	Turkey, Iran	Aerial parts	(Mahmoudi et al., 2014; Mahmoudi et al., 2015; Saltan et al., 2019)
Germacrene D	6.33-25.00	-	Amman, Iran, Algeria, Croatia, Tunisia ,Serbia and Montenegro, Turkey	Aerial parts	(Aburjai et al., 2006; Asgharipour and Shabankare, 2017; Bendjabeur et al., 2018; Bezic et al., 2011; Boulila et al., 2008; Gholivand et al., 2013; Kovacevic et al., 2001; Mahmoudi et al., 2014; Mahmoudi et al., 2015; Purnavab et al., 2015; Raei et al., 2014; Sadrizadeh et al., 2018; Sevindik et al., 2016;

Chemical compound	Percentage (%)	ssp.[2]/var.[3]	Locality	Part/Extract	Reference
					Shabankare et al., 2015)
	17.70-31.80	ssp. *capitatum*	Serbia, Bulgaria	Aerial parts	(Mitic et al., 2012)
	14.80	ssp. *polium*	Algeria	Aerial parts	(Djabou et al., 2012)
	7.80-12.50	-	Algeria	Flowers	(Bendif et al., 2018)
	7.36	-	Iran	Fruits	(Oroojalian et al., 2017)
	12.70-34.40	-	France	Inflorescence	(Chizzola, 2006)
	8.70-35.00	-	France, Greece	Leaves	(Chizzola, 2006; Lianopoulou et al., 2014)
	53.68	ssp. *capitatum*	Greece	Leaves and inflorescences	(Fanouriou et al., 2018)
	13.80	-	Algeria	Vegetative parts	(Bendif et al., 2018)
Guaiol	8.70	-	Jordan	TCM	(Al-Qudah et al., 2011)
Hexadecanoic acid	16.37	-	Iran	Flowers	(Masoudi, 2018)
	5.17	-	Iran	Stems	(Masoudi, 2018)
Ledene	6.33	-	Turkey	Aerial parts	(Sevindik et al., 2016)
Limonene	5.03-9.20	-	Iran, Tunisia, Croatia, Turkey	Aerial parts	(Alamdar et al., 2007; Bakari et al., 2015; Bezic et al., 2011; Heydarzade and Moravvej, 2012; Keykavousi et al., 2016; Purnavab et al., 2015; Sevindik et al., 2016)
	5.20-6.40	ssp. *capitatum*	Corsica, Bulgaria	Aerial parts	(Djabou et al., 2012; Mitic et al., 2012)
	5.60	ssp. *polium*	Algeria	Aerial parts	(Djabou et al., 2012)
	5.00	-	Iran	Fruits	(Sabzeghabaie and Asgarpanah, 2016)
Linalool	15.65-15.65	-	Iran	Aerial parts	(Asgharipour and Shabankare, 2017; Shabankare et al., 2015)
	14.00	ssp. *capitatum*	Serbia	Aerial parts	(Mitic et al., 2012)
	7.80	-	Greece	Leaves	(Lianopoulou et al., 2014)
Myrcene	12.50-15.50	-	Tunisia, Iran	Aerial parts	(Boulila et al., 2008; Purnavab et al., 2015)
	6.20-9.90	-	France	Inflorescence	(Chizzola, 2006)
	5.00-11.50	-	France	Leaves	(Chizzola, 2006)
Nonacosane (C29)	6.30	-	Algeria	Vegetative parts	(Bendif et al., 2018)
o-Cymene	6.13	-	Tunisia	Aerial parts	(Essid et al., 2015)
p-Cymene	5.25	-	Tunisia	Aerial parts	(Ben Othman et al., 2017)
	7.00	ssp. *capitatum*	Corsica	Aerial parts	(Cozzani et al., 2005)
Phytol	9.50	-	Algeria	Vegetative parts	(Bendif et al., 2018)
Piperitenone oxide	21.72	-	Iran	Aerial parts	(Heydarzade and Moravvej, 2012)
Sabinene	5.24	-	Amman	Aerial parts	(Aburjai et al., 2006)
	21.80	-	France	Inflorescence	(Chizzola, 2006)
	25.50	-	France	Leaves	(Chizzola, 2006)
Sesquisabinene hydrate	5.26	-	Iran	Aerial parts	(Mahmoudi et al., 2014; Mahmoudi et al., 2015)
Shyobunol	5.60-8.40	-	Algeria	Flowers	(Bendif et al., 2018)
Spathulenol	5.80-15.06	-	Iran, Algeria	Aerial parts	(Alamdar et al., 2007; Bendjabeur et al., 2018; Heydarzade and Moravvej, 2012; Keykavousi et al., 2016; Mahmoudi et al., 2014; Mahmoudi et al., 2015)
	6.40	ssp. *polium*	Algeria	Aerial parts	(Djabou et al., 2012)
	6.70	-	Greece	Leaves	(Lianopoulou et al., 2014)
Spathulenol, 1h-Cycloprop	18.39	-	Iran	Aerial parts	(Sadrizadeh et al., 2018)
t-Cadinol	9.30-21.00	-	Turkey, Greece	Aerial parts	(Saltan et al., 2019; Vokou and Bessiere, 1985)
Terpinen-4-ol	6.20	ssp. *capitatum*	Corsica	Aerial parts	(Djabou et al., 2012)
	5.30-6.10	-	Greece	Leaves	(Lianopoulou et al., 2014)
Terpineol	5.00	-	Jordan	TCM	(Al-Qudah et al., 2011)
Terpinyl acetate	19.60	-	Iran	Aerial parts	(Boroomand et al., 2018)
Thymol	7.90	-	France	Leaves	(Chizzola, 2006)
Torreyol	6.50-7.60	ssp. *capitatum*	Crete Greece	Aerial parts	(De Martino et al., 2010; Menichini et al., 2009)
trans-Caryophyllene	6.17	-	Iran	Aerial parts	(Sadrizadeh et al., 2018)
trans-Caryophyllene	8.80	ssp. *capitatum*	Serbia	Aerial parts	(Mitic et al., 2012)
trans-Verbenol	6.30	-	Iran	Aerial parts	(Keykavousi et al., 2016)
Valenene	5.40	-	Iran	Aerial parts	(Asgharipour and Shabankare, 2017; Shabankare et al., 2015)
Verbenone	5.03	-	Tunisia	Aerial parts	(Ben Othman et al., 2017)
	5.30	-	Jordan	TCM	(Al-Qudah et al., 2011)
α-Bisabolol	24.60-27.10	-	Iran	Aerial parts	(Sadeghi et al., 2014a; Sayyad and Farahmandfar, 2017)
	9.60	-	Jordan	TCM	(Al-Qudah et al., 2011)
α-Bisabolol oxide	9.70	-	Jordan	TCM	(Al-Qudah et al., 2011)
α-Bisabolol oxide B	7.40	-	Iran	Aerial parts	(Sadeghi et al., 2014a)
α-Cadinol	5.10-8.80	-	Greece, Turkey, Tunisia	Aerial parts	(Boulila et al., 2008; Saltan et al., 2019; Vokou and Bessiere, 1985)
	46.80	ssp. *aurasiacum*	Algeria	Aerial parts	(Kabouche et al., 2007)
	46.20	ssp. *capitatum*	Iran	Aerial parts	(Khani and Heydarian, 2014)
	13.01	-	Iran	Flowers	(Masoudi, 2018)
	8.11	-	Iran	Leaves	(Masoudi, 2018)
	15.72	-	Iran	Stems	(Masoudi, 2018)
	9.40	-	Jordan	TCM	(Al-Qudah et al., 2011)
α-Camphene	6.10	-	Iran	Aerial parts	(Asgharipour and Shabankare, 2017; Shabankare et al., 2015)
	5.73	-	Iran	Fruits	(Oroojalian et al., 2017)
α-*epi*-Cadinol	5.27-5.44	-	Iran	Aerial parts	(Gholivand et al., 2013)
α-Farnesene	10.71	-	Turkey	Aerial parts	(Sevindik et al., 2016)
α-Humulene	7.90	-	France	Inflorescence	(Chizzola, 2006)

Chemical compound	Percentage (%)	ssp.[2]/var.[3]	Locality	Part/Extract	Reference
	5.80	-	France	Leaves	(Chizzola, 2006)
α-Muurolol	19.53	-	Iran	Flowers	(Masoudi, 2018)
	20.03	-	Iran	Leaves	(Masoudi, 2018)
	25.02	-	Iran	Stems	(Masoudi, 2018)
α-Pinene	5.02-25.76	-	Iran, Serbia and Montenegro, Turkey, Tunisia	Aerial parts	(Alamdar et al., 2007; Asgharipour and Shabankare, 2017; Bakari et al., 2015; Ben Othman et al., 2017; Boulila et al., 2008; Essid et al., 2015; Heydarzade and Moravvej, 2012; Keykavousi et al., 2016; Kovacevic et al., 2001; Nikpour et al., 2018; Purnavab et al., 2015; Raei et al., 2014; Saltan et al., 2019; Shabankare et al., 2015)
	9.50	ssp. *aurasiacum*	Algeria	Aerial parts	(Kabouche et al., 2007)
	9.30-28.80	ssp. *capitatum*	Corsica, Bulgaria	Aerial parts	(Cozzani et al., 2005; Djabou et al., 2012; Mitic et al., 2012)
	7.20	ssp. *polium*	Algeria	Aerial parts	(Djabou et al., 2012)
	18.20	-	Iran	Fruits	(Sabzeghabaie and Asgarpanah, 2016)
	9.70-14.80	-	France	Inflorescence	(Chizzola, 2006)
	6.30-20.00	-	France	Leaves	(Chizzola, 2006)
α-Terpineol	5.20	-	Iran	Aerial parts	(Nikpour et al., 2018)
	5.10	-	Jordan	TCM	(Al-Qudah et al., 2011)
α-Thujene	8.46	-	Tunisia	Aerial parts	(Ben Othman et al., 2017)
	5.00-8.10	ssp. *capitatum*	Corsica	Aerial parts	(Cozzani et al., 2005; Djabou et al., 2012)
α-Thujenol	5.20	-	Jordan	TCM	(Al-Qudah et al., 2011)
α-Ylangene	5.00	-	Greece	Leaves	(Lianopoulou et al., 2014)
β-Bisabolol	45.60	-	Iran	Aerial parts	(Sadeghi et al., 2014a)
β-Caryophyllene	7.70-52.00	-	Iran, Amman, Croatia, Tunisia, Greece	Aerial parts	(Aburjai et al., 2006; Alamdar et al., 2007; Asgharipour and Shabankare, 2017; Bezic et al., 2011; Essid et al., 2015; Raei et al., 2014; Sayyad and Farahmandfar, 2017; Shabankare et al., 2015; Vokou and Bessiere, 1985)
	10.64	-	Iran	Flowers	(Masoudi, 2018)
	7.94	-	Iran	Fruits	(Oroojalian et al., 2017)
	5.40-14.70	-	France	Inflorescence	(Chizzola, 2006)
	10.11-16.70	-	France, Iran	Leaves	(Chizzola, 2006; Masoudi, 2018)
	10.86	-	Iran	Stems	(Masoudi, 2018)
β-Eudesmol	5.70-7.51	-	Iran	Aerial parts	(Alamdar et al., 2007; Keykavousi et al., 2016)
	8.70	-	Algeria	Vegetative parts	(Bendif et al., 2018)
β-Gurjunene	7.50	-	Turkey	Aerial parts	(Sevindik et al., 2016)
β-Myrcene	6.07-10.05	-	Iran, Tunisia	Aerial parts	(Bakari et al., 2015; Mahmoudi et al., 2014; Mahmoudi et al., 2015)
β-Phellandrene	6.62-10.77	-	Turkey, Iran	Aerial parts	(Boroomand et al., 2018; Sevindik et al., 2016)
β-Pinene	5.77-35.97	-	Iran, Serbia and Montenegro, Tunisia, Algeria	Aerial parts	(Alamdar et al., 2007; Asgharipour and Shabankare, 2017; Bakari et al., 2015; Ben Othman et al., 2017; Bendjabeur et al., 2018; Boulila et al., 2008; Heydarzade and Moravvej, 2012; Keykavousi et al., 2016; Kovacevic et al., 2001; Mahmoudi et al., 2014; Mahmoudi et al., 2015; Purnavab et al., 2015; Raei et al., 2014; Shabankare et al., 2015)
	8.30	ssp. *aurasiacum*	Algeria	Aerial parts	(Kabouche et al., 2007)
	7.20-26.80	ssp. *capitatum*	Corsica, Serbia, Bulgaria	Aerial parts	(Cozzani et al., 2005; Djabou et al., 2012; Mitic et al., 2012)
	16.60	ssp. *polium*	Algeria	Aerial parts	(Djabou et al., 2012)
	6.09-10.10	-	Iran	Fruits	(Oroojalian et al., 2017; Sabzeghabaie and Asgarpanah, 2016)
	12.20-22.70	-	France	Inflorescence	(Chizzola, 2006)
	6.65-19.30	-	Greece, France, Iran	Leaves	(Chizzola, 2006; Lianopoulou et al., 2014; Masoudi, 2018)
β-Thujone	5.70	-	Croatia	Aerial parts	(Bezic et al., 2011)
γ-Cadinene	6.26	-	Iran	Fruits	(Oroojalian et al., 2017)
γ-Elemene	16.80	-	Iran	Aerial parts	(Alamdar et al., 2007)
γ-Muurolene	23.15	-	Iran	Aerial parts	(Alamdar et al., 2007)
δ-Cadinene	7.70	-	Algeria	Flowers	(Bendif et al., 2018)
τ-Cadinol	9.20	-	Jordan	TCM	(Al-Qudah et al., 2011)

[1] Compounds of greater than 5.0% in oil samples were considered. [2] ssp : subspecies, [3] var: variety, [4] TCM: Tissue culture material

In providing information on chemotaxonomic markers, it is considered that in addition to the general names of the chemical compound groups, the authors should clearly document the compounds included in these groups (eg carvacrol, β-caryophyllene, β-bisabolol, β-pinene, α-bisabolol, α-pinene, germacrene D etc.). It has also been suggested in the literature that phenylethanoid and iridoid glycosides can be used as chemotaxonomic markers (Mitreski et al., 2014; Venditti et al., 2017). However, in addition to these groups, flavonoids, neo-clerodane diterpenoids, phenolic compounds, and phenylpropanoid glycoside were thought to be chemotaxonomic markers for T. polium.

5. Toxicity on kidney and liver

As discussed in detail in section 3, the use of *T. polium* among the people is very common. However, as with all herbal products consumed for various purposes, *T. polium* should be questioned in terms of possible toxic effects. In the literature, there are some data

on the beneficial properties of this plant, as well as researchers who argue that it has various levels of toxic effects. Unfortunately, the researchers are not yet in consensus on whether *T. polium* has a toxic effect. Literature data on the effects of various extracts from *T. polium* on kidney and liver are given in Table 6 and 7.

Table 5. Other phytochemicals isolated from *T. polium* together with its subspecies and varieties[1].

Chemical class	No	Compound	ssp.[2]/var.[3]	Plant part	Extract	Reference
abeo-Abietanes	448	12,16-epoxy-6,11,14-trihydroxy-17(15→16)-abeo-3a,18cyclo-5,8,11,13,15-abietapentaen-7-one	-	Roots	EtOAc	(Fiorentino et al., 2010)
	449	12,16-epoxy-6,11,14-trihydroxy-17(15→16)-abeo-5,8,11,13,15-abietapentaen-7-one	-	Roots	EtOAc	(Fiorentino et al., 2010)
	450	12,16-epoxy-6,11,14,17-tetrahydroxy-17(15→16)-abeo5,8,11,13,15-abietapentaen-7-one	-	Roots	EtOAc	(Fiorentino et al., 2010)
	451	12,16-epoxy-6,11,14,17-tetrahydroxy-17(15→16)abeo-3a,18-cyclo-5,8,11,13,15-abietapentaen-7-one	-	Roots	EtOAc	(Fiorentino et al., 2010)
Abietane diterpenoids	452	Ferruginol	ssp. *expansum*	Roots	Acetone	(Cuadrado et al., 1992)
	453	Teuvincenone A	ssp. *expansum*	Roots	Acetone	(Cuadrado et al., 1992)
			-	Roots	EtOAc	(Fiorentino et al., 2010)
	454	Teuvincenone B	ssp. *expansum*	Roots	Acetone	(Cuadrado et al., 1992)
			-	Roots	EtOAc	(Fiorentino et al., 2010)
	455	Teuvincenone C	-	Roots	EtOAc	(Fiorentino et al., 2010)
	456	Teuvincenone D	-	Roots	EtOAc	(Fiorentino et al., 2010)
	457	Teuvincenone H	ssp. *expansum*	Roots	Acetone	(Cuadrado et al., 1992)
	458	Teuvincenone I	ssp. *expansum*	Roots	Acetone	(Cuadrado et al., 1992)
Flavonoids	459	3',6-Dimethoxyapigenin	-	Aerial parts	Petroleum ether, chloroform, MeOH, water	(Sharififar et al., 2009)
	460	3',4',5trihydroxy-6,7-dimethoxy-flavone	-	Aerial parts	CH_2Cl_2–MeOH	(Elmasri et al., 2015b)
	461	4',7-Dimethoxyapigenin	-	Aerial parts	Petroleum ether, chloroform, MeOH, water	(Sharififar et al., 2009)
	462	5,3',4'-trihydroxy-3,7-dimethoxyflavone	-	Aerial parts	MeOH, hexane, EtOAc	(Goulas et al., 2012)
	463	5,4'-dihydroxy-3,7-dimethoxyflavone	-	Aerial parts	MeOH, hexane, EtOAc	(Goulas et al., 2012)
	464	7,4'-*O*-dimethylscutellar-ein(5,6-dihydroxy-7,4'-dimethoxyflavone)	-	Aerial parts	*n*-Hexane, CH_2Cl_2, and MeOH	(Elmasri et al., 2014)
	465	7-*O*-β-D-(5-*O*-syringyl)apiofuranosyl-(1→2)-β-D-glucopyranoside	-	Leaves	MeOH	(D'Abrosca et al., 2013)
	466	Acacetin	-	Stems and leaves	EtOH	(Venditti et al., 2017)
	467	Apigenin	spp. *capitatum*	Aerial parts	EtOH	(Stefkov et al., 2011)
			-	Leaves	MeOH	(D'Abrosca et al., 2013)
			-	Aerial parts	MeOH	(Esmaeili et al., 2009b)
			-	Aerial parts	MeOH, hexane, EtOAc	(Goulas et al., 2012)
			-	Aerial parts	MeOH	(Milosevic-Djordjevic et al., 2018)
			-	Aerial parts	MeOH	(Mitreski et al., 2014)
			-	Aerial parts	MeOH	(Mitreski et al., 2014)
			-	Leaves	MeOH	(Pacifico et al., 2012)
			-	Leaves	MeOH	(Proestos et al., 2006)
			-	Aerial parts	Petroleum ether, chloroform, MeOH, water	(Sharififar et al., 2009)
			-	Stems and leaves	EtOH	(Venditti et al., 2017)
	468	Apigenin 5-galloylglucoside	-	Leaves and stems	EtOH	(Kawashty et al., 1999)
	469	Apigenin 7-glucoside	-	Leaves and stems	EtOH	(Kawashty et al., 1999)
	470	Apigenin 7-*O*-glucoside	-	Aerial parts	MeOH	(Mitreski et al., 2014)
			-	Aerial parts	MeOH, hexane, EtOAc	(Goulas et al., 2012)
	471	Apigenin 7-*O*-glucuronide	-	Not specified	H_20	(Tepe et al., 2011)
	472	Apigenin-7-*O*-rutinoside	-	Aerial parts	MeOH, hexane, EtOAc	(Goulas et al., 2012)
			-	Aerial parts	MeOH	(Mitreski et al., 2014)

Chemical class	No	Compound	ssp.[2]/var.[3]	Plant part	Extract	Reference
	473	Apigenin 7-*O*-β-glucoside	-	Stems and leaves	EtOH	(Venditti et al., 2017)
	474	Apigenin glucoside	-	Aerial parts	MeOH	(Mitreski et al., 2014)
	475	Apigenin-4',7-dimethylether	-	Not specified	Not specified	(Verykokidouvitsaropoulou and Vajias, 1986)
	476	Apigenin-4'-*O*-glucoside	-	Aerial parts	MeOH, hexane, EtOAc	(Goulas et al., 2012)
	477	Cirsilineol	spp. *capitatum*	Aerial parts	EtOH	(Stefkov et al., 2011)
	478	Cirsiliol	spp. *capitatum*	Aerial parts	EtOH	(Stefkov et al., 2011)
			-	Aerial parts	MeOH	(Mitreski et al., 2014)
			-	Not specified	Not specified	(Stefova et al., 2007)
			-	Not specified	Not specified	(Verykokidouvitsaropoulou and Vajias, 1986)
	479	Cirsimaritin	spp. *capitatum*	Aerial parts	EtOH	(Stefkov et al., 2011)
			-	Aerial parts	CH_2Cl_2–MeOH	(Elmasri et al., 2015b)
			-	Aerial parts	MeOH	(Mitreski et al., 2014)
			-	Stems and leaves	EtOH	(Venditti et al., 2017)
			-	Not specified	Not specified	(Verykokidouvitsaropoulou and Vajias, 1986)
	480	Dihydroxymethoxyflavone glycoside	-	Not specified	H_20	(Tepe et al., 2011)
	481	Diosmetin	spp. *capitatum*	Aerial parts	EtOH	(Stefkov et al., 2011)
			-	Not specified	H_20	(Tepe et al., 2011)
			-	Aerial parts	MeOH	(Mitreski et al., 2014)
			-	Aerial parts	MeOH	(Mitreski et al., 2014)
	482	Diosmetin 7-*O*-glycoside	-	Not specified	H_20	(Tepe et al., 2011)
	483	Diosmetin 7-*O*-rutinoside	-	Aerial parts	MeOH	(Mitreski et al., 2014)
	484	Eriodictyol	-	Leaves	MeOH	(Proestos et al., 2006)
	485	Eupatorin	-	Not specified	Not specified	(Verykokidouvitsaropoulou and Vajias, 1986)
	486	Isorhoifolin	ssp. *gnaphalodes*	Aerial parts	MeOH	(Boghrati et al., 2016)
	487	Jaranol	ssp. *gnaphalodes*	Aerial parts	MeOH	(Boghrati et al., 2016)
	488	Kaempferol	-	Leaves	EtOH	(Chioibas et al., 2019)
	489	Kaempferol 7-*O*-diglucoside	-	Aerial parts	MeOH	(Mitreski et al., 2014)
	490	Luteolin	spp. *capitatum*	Aerial parts	EtOH	(Stefkov et al., 2011)
			-	Leaves	MeOH	(D'Abrosca et al., 2013)
			-	Aerial parts	CH_2Cl_2–MeOH	(Elmasri et al., 2015b)
			-	Aerial parts	MeOH	(Milosevic-Djordjevic et al., 2018)
			-	Aerial parts	MeOH	(Mitreski et al., 2014)
			-	Leaves	MeOH	(Pacifico et al., 2012)
			-	Leaves	MeOH	(Proestos et al., 2006)
			-	Not specified	H_20	(Tepe et al., 2011)
			-	Stems and leaves	EtOH	(Venditti et al., 2017)
	491	Luteolin 7-glucoside	-	Leaves and stems	EtOH	(Kawashty et al., 1999)
	492	Luteolin-7-*O*-glucoside	-	Aerial parts	MeOH	(De Marino et al., 2012)
			-	Aerial parts	MeOH	(Mitreski et al., 2014)
			-	Not specified	H_20	(Tepe et al., 2011)
	493	Luteolin-7-*O*-rutinoside	-	Aerial parts	MeOH	(De Marino et al., 2012)
			-	Aerial parts	MeOH	(Mitreski et al., 2014)
			-	Not specified	H_20	(Tepe et al., 2011)
	494	Luteolin-4'-*O*-glucoside	-	Aerial parts	MeOH	(De Marino et al., 2012)
	495	Luteolin-7-*O*-neohesperidoside	-	Aerial parts	MeOH	(De Marino et al., 2012)
	496	Luteolin-rutinoside	-	Aerial parts	MeOH	(Mitreski et al., 2014)
	497	Myricetin	-	Aerial parts	MeOH	(Milosevic-Djordjevic et al., 2018)
	498	Naringenin	-	Leaves	MeOH	(Proestos et al., 2006)
	499	*p*-Coumaroylglucoside	-	Aerial parts	MeOH	(Mitreski et al., 2014)
			-	Aerial parts	MeOH	(Mitreski et al., 2014)
	500	Quercetin	-	Leaves	EtOH	(Chioibas et al., 2019)
			-	Aerial parts	MeOH	(Milosevic-Djordjevic et al., 2018)
			-	Leaves	MeOH	(Proestos et al., 2006)
	501	Quercetin 3-*O*-rutinoside	-	Aerial parts	MeOH	(Mitreski et al., 2014)
	502	Quercetin-3-rutinoside	-	Not specified	Not specified	(Esmaeili et al., 2009a)
	503	Rutin	-	Leaves	EtOH	(Chioibas et al., 2019)
			-	Aerial parts	MeOH	(Esmaeili et al., 2009b)
			-	Aerial parts	MeOH	(Milosevic-Djordjevic et al., 2018)
			-	Leaves	MeOH	(Proestos et al., 2006)
			-	Aerial parts	Petroleum ether, chloroform, MeOH, water	(Sharififar et al., 2009)
	504	Salvigenin	-	Aerial parts	*n*-Hexane, CH_2Cl_2, and MeOH	(Elmasri et al., 2014)
	505	Tetrahydroxyflavone 7-*O*-glycoside	-	Not specified	H_20	(Tepe et al., 2011)
	506	Vicenin-2	-	Leaves and stems	EtOH	(Kawashty et al., 1999)
Iridoid glycosides	507	(1*R*,4*S*,10*R*) 10,11-dimethyl-dicyclohex-5(6)-en-1,4-diol-7-one	-	Aerial parts	CH_2Cl_2–MeOH	(Elmasri et al., 2016a)
	508	(7*S*,8*R*)-4-(*O*-*β*-D-	-	Aerial parts	CH_2Cl_2–	(Elmasri et al., 2015b)

Chemical class	No	Compound	ssp.[2]/var.[3]	Plant part	Extract	Reference
		glucopyranosyl)dehydrodiconiferyl alcohol			MeOH	
	509	(7*S*,8*R*)-5-methoxy-4-(*O*-*β*-D-glucopyranosyl)dehydrodiconiferyl alcohol	-	Aerial parts	CH_2Cl_2–MeOH	(Elmasri et al., 2015b)
	510	1α-(β-D-glucopyranoxy)-6α,7α-epoxy-4aβ,5α-dihydroxy-7methyl-1,4a,5,6,7,7aβ-hexahydrocyclopenta[c]pyran	-	Aerial parts	CH_2Cl_2–MeOH	(Elmasri et al., 2015b)
	511	1α-(β-D-glucopyranoxy)-7α,8α-epoxy-5β,6α-dihydroxy-8-methyl-1,5,6,7,8,9β-hexahydrocyclopenta[c]pyran	-	Aerial parts	CH_2Cl_2–MeOH	(Elmasri et al., 2016b)
			-	Aerial parts	CH_2Cl_2–MeOH	(Elmasri et al., 2016b)
	512	4-[(β-D-glucopyranosyloxy)methylene]-5α-(2-hydroxyethyl)-5-(α-L-rhamnopyranosyloxy)-3-methylcyclopent-2en-1-one	-	Aerial parts	CH_2Cl_2–MeOH	(Elmasri et al., 2015b)
				Aerial parts	CH_2Cl_2–MeOH	(Elmasri et al., 2016b)
	513	4α-[(β-Dglucopyranosyloxy)methyl]-5α-(2-hydroxyethyl)-3-methylcyclopent-2-en-1-one	-	Aerial parts	CH_2Cl_2–MeOH	(Elmasri et al., 2015b)
	514	5,6,7,3′,4′-pentahydroxyflavone	-	Aerial parts	CH_2Cl_2–MeOH	(Elmasri et al., 2015b)
	515	5α-(2hydroxyethyl)-4α-hydroxymethyl-3-methylcyclopent-2-en-1one	-	Aerial parts	CH_2Cl_2–MeOH	(Elmasri et al., 2015b)
	516	5α-[2(β-D-glucopyranosyloxy)ethyl]-4α-hydroxymethyl-3-methylcyclopent-2-en-1-one	-	Aerial parts	CH_2Cl_2–MeOH	(Elmasri et al., 2016b)
			-	Aerial parts	CH_2Cl_2–MeOH	(Elmasri et al., 2015b)
	517	Teucardoside	-	Aerial parts	MeOH	(De Marino et al., 2012)
			-	Aerial parts	*n*-Hexane, CH_2Cl_2, and MeOH	(Elmasri et al., 2014)
			-	Aerial parts	CH_2Cl_2–MeOH	(Elmasri et al., 2016b)
			-	Not specified	EtOH	(Rizk et al., 1986)
			-	Aerial parts	CH_2Cl_2–MeOH	(Elmasri et al., 2016b)
			-	Aerial parts	CH_2Cl_2–MeOH	(Elmasri et al., 2015b)
			-	Not specified	EtOH	(Rizk et al., 1986)
neo-clerodane diterpenoids	518	19-Acetyl gnaphalin	ssp. *aureum*	Aerial parts	Acetone	(Eguren et al., 1981)
	519	19-Acetylteupolin-Iv	ssp. *pilosum*	Not specified	Not specified	(Delatorre et al., 1986)
	520	19-Deacetylteuscorodol	-	Leaves	EtOAc, MeOH	(Fiorentino et al., 2011)
	521	20-*epi*-Auropolin	ssp. *polium*	Aerial parts	Acetone	(Bruno et al., 2003)
	522	20-*O*-Acetyl-teucrasiatin	-	Stems and leaves	EtOH	(Venditti et al., 2017)
	523	3,20-bis-deacetylteupyreinidine	ssp. *aurasianum*	Aerial parts	CH_2Cl_2–H_20	(Ladjel et al., 1994)
	524	3,6,20-tri-Deacetylteupyreinidine	ssp. *aurasianum*	Aerial parts	CH_2Cl_2–H_20	(Ladjel et al., 1994)
	525	3-Deacetylteumicropodine	ssp. *aurasianum*	Aerial parts	CH_2Cl_2–H_20	(Ladjel et al., 1994)
	526	6,20-bis-Deacetylteupyreinidine	ssp. *aurasianum*	Aerial parts	CH_2Cl_2–H_20	(Ladjel et al., 1994)
	527	7-Epicapitatin	-	Not specified	Not specified	(Alhazimi and Miana, 1993)
	528	Acetyl auropolin	ssp. *polium*	Aerial parts	Acetone	(Bruno et al., 2003)
	529	Auropolin	ssp. *aureum*	Aerial parts	Acetone	(Eguren et al., 1981)
			ssp. *polium*	Aerial parts	Acetone	(Bruno et al., 2003)
	530	Capitatin	ssp. *polium*	Aerial parts	Acetone	(Bruno et al., 2003)
	531	Gnaphalidin	ssp. *aureum*	Aerial parts	Acetone	(Eguren et al., 1981)
	532	Montanin B	-	Leaves	EtOAc, MeOH	(Fiorentino et al., 2011)
	533	Montanin D	ssp. *vincentinum*	Aerial parts	Acetone	(Bozov and Penchev, 2019)
			-	Leaves	EtOAc, MeOH	(Fiorentino et al., 2011)
			-	Leaves	MeOH	(Pacifico et al., 2012)
	534	Montanin E	-	Leaves	EtOAc, MeOH	(Fiorentino et al., 2011)
			-	Leaves	MeOH	(Pacifico et al., 2012)
	535	Montanin F	-	Leaves	EtOAc, MeOH	(Fiorentino et al., 2011)
	536	Polivincin A	ssp. *vincentinum*	Aerial parts	Acetone	(Bozov and Penchev, 2019)
	537	Polivincin B	ssp. *vincentinum*	Aerial parts	Acetone	(Bozov and Penchev, 2019)
	538	Polivincin C	ssp. *vincentinum*	Aerial parts	Acetone	(Bozov and Penchev, 2019)

Chemical class	No	Compound	ssp.[2]/var.[3]	Plant part	Extract	Reference
	539	Teubutilin A	-	Leaves	EtOAc, MeOH	(Fiorentino et al., 2011)
			-	Leaves	MeOH	(Pacifico et al., 2012)
	540	Teuchamaecrin C	-	Leaves	EtOAc, MeOH	(Fiorentino et al., 2011)
			-	Leaves	MeOH	(Pacifico et al., 2012)
	541	Teucrasiatin	-	Stems and leaves	EtOH	(Venditti et al., 2017)
	542	Teucrin P_1	ssp. *aureum*	Aerial parts	Acetone	(Eguren et al., 1981)
	543	Teucroxylepin	-	Leaves	EtOAc, MeOH	(Fiorentino et al., 2011)
	544	Teukotschyn	-	Leaves	EtOAc, MeOH	(Fiorentino et al., 2011)
	545	Teulamifin B	ssp. *vincentinum*	Aerial parts	Acetone	(Bozov and Penchev, 2019)
			-	Not specified	Not specified	(Malakov et al., 1988)
			-	Aerial parts	MeOH	(De Marino et al., 2012)
			-	Leaves	EtOAc, MeOH	(Fiorentino et al., 2011)
			-	Leaves	MeOH	(Pacifico et al., 2012)
	546	Teulolin A	-	Aerial parts	MeOH	(Bedir et al., 1999)
	547	Teulolin B	-	Aerial parts	MeOH	(Bedir et al., 1999)
	548	Teumicropodine	ssp. *aurasianum*	Aerial parts	CH_2Cl_2–H_20	(Ladjel et al., 1994)
	549	Teupolin I	-	Not specified	Not specified	(Alhazimi and Miana, 1993)
	550	Teupolin III	-	Not specified	Not specified	(Malakov et al., 1982)
	551	Teupolin IX	-	Leaves	EtOAc, MeOH	(Fiorentino et al., 2011)
			-	Leaves	MeOH	(Pacifico et al., 2012)
	552	Teupolin VI	-	Leaves	EtOAc, MeOH	(Fiorentino et al., 2011)
			-	Leaves	MeOH	(Pacifico et al., 2012)
	553	Teupolin VII	-	Leaves	EtOAc, MeOH	(Fiorentino et al., 2011)
			-	Leaves	MeOH	(Pacifico et al., 2012)
	554	Teupolin VIII	-	Leaves	EtOAc, MeOH	(Fiorentino et al., 2011)
			-	Leaves	MeOH	(Pacifico et al., 2012)
	555	Teupolin X	-	Leaves	EtOAc, MeOH	(Fiorentino et al., 2011)
			-	Leaves	MeOH	(Pacifico et al., 2012)
	556	Teupolin XI	-	Leaves	EtOAc, MeOH	(Fiorentino et al., 2011)
			-	Leaves	MeOH	(Pacifico et al., 2012)
	557	Teupolin XII	ssp. *vincentinum*	Aerial parts	Acetone	(Bozov and Penchev, 2019)
			-	Leaves	EtOAc, MeOH	(Fiorentino et al., 2011)
			-	Leaves	MeOH	(Pacifico et al., 2012)
	558	Teusalvin C	-	Aerial parts	MeOH	(De Marino et al., 2012)
			-	Leaves	EtOAc, MeOH	(Fiorentino et al., 2011)
	559	Teuvincentin A	ssp. *vincentinum*	Not specified	Not specified	(Alhazimi and Miana, 1993)
	560	Teuvincentin B	ssp. *vincentinum*	Not specified	Not specified	(Alhazimi and Miana, 1993)
	561	Teuvincentin C	ssp. *vincentinum*	Not specified	Not specified	(Alhazimi and Miana, 1993)
Phenolic compounds	562	*(+)*-Catechin	-	Leaves	MeOH	(Proestos et al., 2006)
	563	3,4-Dihydroxybenzoic acid	-	Leaves	MeOH	(Proestos et al., 2006)
	564	3-Nitro-phthalic acid	-	Leaves	MeOH	(Proestos et al., 2006)
	565	5-Caffeoylquinic acid	-	Aerial parts	MeOH	(Mitreski et al., 2014)
	566	8-*O*-Acetylharpagide	-	Aerial parts	MeOH	(De Marino et al., 2012)
	567	Arteincultone	-	Aerial parts	*n*-Hexane, CH_2Cl_2, and MeOH	(Elmasri et al., 2014)
	568	Caffeic acid	-	Leaves	EtOH	(Chioibas et al., 2019)
			-	Aerial parts	MeOH	(Milosevic-Djordjevic et al., 2018)
			-	Aerial parts	MeOH	(Mitreski et al., 2014)
			-	Leaves	MeOH	(Proestos et al., 2006)
			-	Not specified	H_20	(Tepe et al., 2011)
			-	Not specified	Not specified	(Vladimir-Knezevic et al., 2014)
	569	Catechin	-	Aerial parts	MeOH	(Milosevic-Djordjevic et al., 2018)
	570	Chlorogenic acid	-	Aerial parts	MeOH	(Milosevic-Djordjevic et al., 2018)
			-	Not specified	Not specified	(Vladimir-Knezevic et al., 2014)
	571	Coumaric acid	-	Leaves	EtOH	(Chioibas et al., 2019)
	572	Coumarin	-	Leaves	MeOH	(Proestos et al., 2006)
	573	Epicatechin	-	Leaves	EtOH	(Chioibas et al., 2019)
	574	Ferulic acid	-	Leaves	EtOH	(Chioibas et al., 2019)
			-	Leaves	MeOH	(Proestos et al., 2006)
			-	Not specified	Not specified	(Vladimir-Knezevic et al., 2014)
	575	Gallic acid	-	Leaves	EtOH	(Chioibas et al., 2019)
			-	Aerial parts	MeOH	(Milosevic-Djordjevic et al., 2018)

Chemical class	No	Compound	ssp.[2]/var.[3]	Plant part	Extract	Reference
			-	Leaves	MeOH	(Proestos et al., 2006)
	576	Gentisic acid	-	Leaves	MeOH	(Proestos et al., 2006)
	577	Hydroxycaffeic acid	-	Leaves	MeOH	(Proestos et al., 2006)
	578	Hydroxytyrosol	-	Leaves	MeOH	(Proestos et al., 2006)
	579	*o*-Coumaric acid	-	Leaves	MeOH	(Proestos et al., 2006)
	580	*o*-Hydroxybenzoic acid	-	Leaves	MeOH	(Proestos et al., 2006)
	581	*p*-Coumaric acid	-	Aerial parts	MeOH	(Milosevic-Djordjevic et al., 2018)
			-	Leaves	MeOH	(Proestos et al., 2006)
	582	Pheophorbide A	-	Stems and leaves	EtOH	(Venditti et al., 2017)
	583	*p*-Hydroxybenzoic acid	-	Leaves	MeOH	(Proestos et al., 2006)
	584	*p*-Hydroxyphenylpropionic acid	-	Leaves	MeOH	(Proestos et al., 2006)
	585	Protocatechuic acid	-	Leaves	EtOH	(Chioibas et al., 2019)
	586	Resveratrol	-	Leaves	EtOH	(Chioibas et al., 2019)
	587	Rosmarinic acid	-	Leaves	EtOH	(Chioibas et al., 2019)
	588	Sinapinic acid	-	Aerial parts	MeOH	(Milosevic-Djordjevic et al., 2018)
	589	Tyrosol	-	Leaves	MeOH	(Proestos et al., 2006)
	590	Vanillic acid	-	Aerial parts	MeOH	(Milosevic-Djordjevic et al., 2018)
			-	Leaves	MeOH	(Proestos et al., 2006)
Phenylethanol glycosides	591	2-(3,4dihydroxyphenyl)ethanol	-	Aerial parts	CH_2Cl_2–MeOH	(Elmasri et al., 2015b)
	592	3-(O-β-D-glucopyranosyl)α-(O-β-D-glucopyranosyl)-4-hydroxyphenylethanol	-	Aerial parts	CH_2Cl_2–MeOH	(Elmasri et al., 2015b)
	593	3,4-dihydroxy-3(O-β-D-glucopyranosyl)phenethanol	-	Aerial parts	CH_2Cl_2–MeOH	(Elmasri et al., 2015b)
Phenylpropanoid glycosides	594	Allysonoside	-	Aerial parts	MeOH	(Mitreski et al., 2014)
	595	Caerulescenoside	-	Aerial parts	MeOH	(Mitreski et al., 2014)
	596	Castanoside A	-	Aerial parts	MeOH	(Mitreski et al., 2014)
	597	Echinacoside	-	Aerial parts	MeOH	(Mitreski et al., 2014)
	598	Forsythoside A	-	Aerial parts	MeOH	(Mitreski et al., 2014)
	599	Forsythoside B	-	Aerial parts	MeOH	(Mitreski et al., 2014)
	600	Leucoseptoside A	-	Aerial parts	MeOH	(Mitreski et al., 2014)
	601	Poliumoside	ssp. *gnaphalodes*	Aerial parts	MeOH	(Boghrati et al., 2016)
			-	Aerial parts	MeOH	(De Marino et al., 2012)
			-	Aerial parts	*n*-Hexane, CH_2Cl_2, and MeOH	(Elmasri et al., 2014)
			-	Aerial parts	MeOH, hexane, EtOAc	(Goulas et al., 2012)
			-	Aerial parts	MeOH	(Mitreski et al., 2014)
			-	Not specified	MeOH	(Oganesyan et al., 1991)
			-	Leaves	MeOH	(Pacifico et al., 2012)
	602	Poliumoside B	-	Aerial parts	MeOH	(De Marino et al., 2012)
			-	Aerial parts	MeOH	(Mitreski et al., 2014)
	603	Samioside	-	Aerial parts	MeOH	(Mitreski et al., 2014)
	604	Teucreoside	-	Aerial parts	MeOH	(Mitreski et al., 2014)
			-	Not specified	H_20	(Tepe et al., 2011)
	605	Teupolioside	-	Not specified	MeOH	(Oganesyan et al., 1991)
	606	Verbascoside	ssp. *gnaphalodes*	Aerial parts	MeOH	(Boghrati et al., 2016)
			-	Aerial parts	MeOH, hexane, EtOAc	(Goulas et al., 2012)
			-	Aerial parts	MeOH	(Mitreski et al., 2014)
			-	Not specified	MeOH	(Oganesyan et al., 1991)
			-	Not specified	H_20	(Tepe et al., 2011)
			-	Stems and leaves	EtOH	(Venditti et al., 2017)
Saponin glycosides	607	Poliusaposide A	-	Aerial parts	CH_2Cl_2–MeOH	(Elmasri et al., 2015a)
	608	Poliusaposide B	-	Aerial parts	CH_2Cl_2–MeOH	(Elmasri et al., 2015a)
	609	Poliusaposide C	-	Aerial parts	CH_2Cl_2–MeOH	(Elmasri et al., 2015a)
Sterols	610	Campesterol	-	Seeds	Hexane	(Hachicha et al., 2009)
	611	Clerosterol	-	Seeds	Hexane	(Hachicha et al., 2009)
	612	Obtusifoliol (methylsterol)	-	Seeds	Hexane	(Hachicha et al., 2009)
	613	Sitosterol	-	Seeds	Hexane	(Hachicha et al., 2009)
	614	Stigmasterol	-	Seeds	Hexane	(Hachicha et al., 2009)
Triterpenic alcohols	615	24-Methylenecycloartanol	-	Seeds	Hexane	(Hachicha et al., 2009)
	616	A',Neogammacer-22(29)-en-3-ol	-	Seeds	Hexane	(Hachicha et al., 2009)
	617	Fern-7-en-3β-ol	-	Seeds	Hexane	(Hachicha et al., 2009)
	618	Lanosterol	-	Seeds	Hexane	(Hachicha et al., 2009)
	619	β-Amyrine	-	Seeds	Hexane	(Hachicha et al., 2009)

[1] The components are listed in alphabetical order.
[2] ssp : subspecies
[3] var: variety

According to Scognamiglio et al. (2012), *T. polium* is a plant that can be safely consumed as it has a negligible side effect. There are other additional studies in the literature that support this claim. Al-Asmari et al. (2014) argued that *T. polium* has a protective effect on cultured hepatocytes due to its potent antioxidant and anti-inflammatory compounds and may only cause mild toxicity at high doses. According to Kiyani et al. (2011), the hydroalcoholic extract (1:1) obtained from this plant did not show any toxicity and induce hepatotoxicity. Kulevanova et al. (2006) also claims that *T. polium* is hepatoprotective. According to these researchers, the EtOAc extract from *T. polium* significantly eliminated CCl_4-induced liver damage in rats.

Table 6. Toxic effect of *T. polium* on kidney and liver on experimental animals.

Plant part	Extract	Test subject	Dose	Duration	Method of application	Result	Reference
Reports on kidney							
Not specified	Water extract	Spragu-Dawly rats	1.0, 2.0, 3.0, and 4.0 g/kg	14 days	Not specified	The extract has been reported to cause some changes in the renal extracellular matrix. For this reason, it has been suggested that more studies are needed to be used carefully and to determine complications.	(Talaei Khozani et al., 2005)
Aerial parts	Hydroalcoholic extract	Wistar rats	50, 100, 150, 200 mg/kg	28 days	Intraperitoneally	Due to the increase in *T. polium* dose, various kidney injuries such as degeneration, destruction and vacuolization have been reported in the kidney.	(Baradaran et al., 2013; Rafieian-Kopaei et al., 2014)
Aerial parts	Hydroalcoholic extract	Wistar rats	3, 10, 30, 100, and 200 mg/kg	7 days	Intraperitoneally	Hydroalcoholic extract at 200 mg/kg caused damage to kidney tissue.	(Ghasemi et al., 2019a)
Aerial parts	Decoction	Wistar rats	5g/L	7 days	By gavage	Treatment with *T. polium* resulted in the reversal of oxidative damage and biochemical changes induced by CCl_4.	(Rahmouni et al., 2019)
Not specified	Not specified	Sprague-Dawley rats	100, 300, 600 mg/kg	45 days	By gavage	It has been reported that ALT and AST levels increased significantly in female rats receiving *T. polium* at a dose of 300 mg/kg.	(Rasekh et al., 2004)
Reports on liver							
Aerial parts	EtOAc extract	N-Mary rats	0.5 g/kg	8 weeks	By gavage	Extract treatment provided improvement in liver steatosis, ballooning degeneration and inflammation in rats with NASH.	(Aghazadeh and Yazdanparast, 2010)
Leaves	EtOAc extract	N-Mary rats	0.5 g leaves powder/kg	8 weeks	Intragastric administration	Lipoprotein profiles of NASH animals treated with the extract were significantly improved. Serine ALP, AST and ALT activities decreased, while SOD, GPx, and GSH activities were increased.	(Amini et al., 2009)
Not specified	Crude extract	N-Mary rats	0.5 g/kg	8 weeks	Orally	Grade 1 hepatosteatosis, lobular inflammation and ballooning degeneration were reduced in NASH animals receiving crude extract.	(Amini and Yazdanparast, 2011)
Aerial parts	EtOAc extract	N-Mary rats	0.5 g leaves powder/kg	3 weeks	Orally	Treatment with *T. polium* extract reduced the severity of NASH symptoms. It also reduced the hepatic TNF-α and TGF-β gene expression, caspase-3 level, phosphorylated form of JNK, and high MDA level. On the other hand, the extract increased the SOD and GPx activities, phosphorylated level of ERK1/2 and hepatic GSH level.	(Amini et al., 2011)
Not specified	Not specified	Not specified	Not specified	Not	Not specified	The extract has been	(Mimidis et al., 2009)

Plant part	Extract	Test subject	Dose	Duration	Method of application	Result	Reference
				specified		reported to cause severe acute cholestasis.	
Not specified	Not specified	Not specified	Not specified	Not specified	Not specified	The extract has been reported to cause severe acute cholestasis.	(Polymeros et al., 2002)
Aerial parts	Polyphenolic extract (butanolic fraction)	Wistar rats	300 mg/kg	10 days	Orally	It has been reported that the application of polyphenolic extract obtained from *T. polium* has a hepatoprotective effect. The extract has also been suggested to increase mitochondrial bioenergetics and suppress liver CYP2E1, GSTpi and TNF-α mRNA levels. These mechanisms are thought to contribute to the hepatoprotective effect.	(Baali et al., 2016)
Whole plant	80% aqueous-ethanol extract	ICR mice	125, 250 and 500 mg/kg	5 days	Orally	Doses of 250 and 500 mg/kg of *T. polium* extract have been reported to have a significant hepatoprotective effect.	(Forouzandeh et al., 2013)
Aerial parts	Hydroalcoholic extract	Wistar rats	3, 10, 30, 100, and 200 mg/kg	7 days	Intraperitoneally	200 mg/kg of *T. polium* extract has been reported to increase ALT, AST and bilirubin levels and cause tissue damage to the liver.	(Ghasemi et al., 2019a)
Not specified	Hydroalcoholic extract	Mice (not specified)	125, 250, 500mg/kg	5 days	Not specified	The extract showed hepatoprotective effect at all doses administered. However, the most effective dose values have been reported to be 250 and 500 mg/kg.	(Kalantari et al., 2012)
Aerial parts	EtOH extract	Hepatocyte culture	8.16 µg/mL of *T. polium* extract	3 hours	Not specified	EtOH extract from *T. polium* has been reported to have an inhibitory effect on the mutagenicity induced by MNNG. It has been stated that the extract does not show any toxic effects such as necrosis or apoptosis.	(Khader et al., 2010)
Not specified	Aqueous extract	Hepatocytes from Fischer rats	62.7 µg/mL of *T. polium* extract	3 hours	Not specified	The extract has been reported to significantly reduce apoptosis and necrotic cell number in combination with MNNG.	(Khader et al., 2007)
Leaves	Decoction	Sprague-Dawley rats	200mg/kg	28 weeks	Intraperitoneal	In this study, where the effectiveness of *T. polium* extract against hepatocellular carcinoma was examined, serum biochemical markers including ALT, AST, AFP, GGT, ALP, HCY, TNF-γ, α2MG and CbG returned to normal after 28 weeks of treatment. Total antioxidant capacity was significantly increased, liver lesion score decreased, and glucocorticoid activity was significantly intensified.	(Movahedi et al., 2014)
Aerial parts	Decoction	Wistar rats	200 mg/kg	7 days	By gavage	Treatment with a 200 mg/kg dose of *T. polium* extract provided protection against oxidative damage and biochemical changes induced by CCl_4.	(Rahmouni et al., 2019)
Not specified	Total extract	Sprague-Dawley rats	100, 300, or 600 mg/kg	45 days	By gavage	Significant increases in ALT and AST levels were detected in female rats	(Rasekh et al., 2004)

Plant part	Extract	Test subject	Dose	Duration	Method of application	Result	Reference
						administered 300 mg/kg of *T. polium* extract. In addition, it has been reported that weights of the livers of female rats administered 600 mg/kg extract increased significantly.	

In addition to the literature data presented above, there are those who claim that *T. polium* has toxic effect on both kidney and liver. Although nearly half of the researchers suggest that this plant has a toxic effect on the liver, it is clear that in the vast majority of studies, *T. polium* has a toxic effect on the kidneys. According to Alzweiri et al. (2011), the infusion prepared from *T. polium* leads to jaundice. The same research group argued that *T. polium* had a negative impact on human health due to its anorexic effect. It has also been claimed that consuming tea prepared from the aerial parts of this plant causes low birth in pregnant women (Mosaddegh et al., 2012). In addition to the results of *in vivo* studies, case reports were also presented in Table 7. Although consensus has not been reached in the in vivo studies regarding the toxic effect of *T. polium* on the liver, all clinical findings prove that this plant has a negative effect on liver function. It is stated in all case reports that *T. polium* toxicity is observed in everyone who consumes the tea of this herb regularly, regardless of age restriction. In the majority of cases, in addition to jaundice, serum ALT, AST, total bilirubin and direct bilirubin levels increased and a significant decrease in prothrombin level was observed. In patients undergoing liver biopsy, as a result of histological examination, hepatitis findings with moderate or severe necroinflammatory activity were observed (Savvidou et al., 2007). In almost all case reports, it was found that liver enzyme levels returned to normal after stopping *T. polium* intake. Vasileiadou et al. (2003) further suggested that after continuous or intermittent use of the plant, liver damage may occur and acute or chronic hepatitis with or without cholestasis may develop. The researchers also stated that people should not consider the use of plants without being officially informed about their possible negative effects.

Table 7. Toxic effect of *T. polium* on kidney and liver as the case reports.

Case reports	
Report	**Reference**
Three patients, 31, 33 and 37 years of age, admitted to the clinic due to the two years of persistent jaundice and elevated liver enzymes. It was determined that the patients used *T. polium* from forty days to three months. Two of the patients continued using *T. polium* during their previous pregnancy periods and admitted to another clinic due to similar complaints. Liver enzyme levels returned to normal in approximately three months after the stopping of *T. polium* use.	(Dag et al., 2014a)
T. polium was found to be the main cause of liver damage in seven of ten hepatotoxic patients admitted to the clinic.	(Dag et al., 2014b)
It was determined that a patient who admitted to the clinic used *T. polium* tea for ten days in August 1992 and additional ten days in December 1992 for the treatment of hypercholesterolemia. Jaundice appeared five days after the end of the second treatment period. In biochemical tests, a significant increase in ALT and AST levels and a decrease in prothrombin level were detected.	(Mattei et al., 1995)
An increase in ALT, AST, total bilirubin and direct bilirubin levels of a patient who consumed *T. polium* tea for six months for the treatment of hyperlipidemia was reported.	(Mazokopakis et al., 2004)
Five cases have been reported regarding the consumption of *T. polium* in the form of tea causing intrahepatic cholestasis.	(Mazokopakis et al., 2007)
Two Greek patients who used *T. polium* extract for two-three months to treat high cholesterol levels admitted to the clinic with high aminotransferase levels. Jaundice developed in one of the patients. As a result of histological examination of liver biopsies, moderate or severe necroinflammatory findings were detected. Discontinuation of herbal medicine treatment led to the normalization of liver enzymes in both patients.	(Savvidou et al., 2007)
Twin sisters of two months admitted to the emergency with vomiting complaints. It was understood that *T. polium* was given in the form of tea for the treatment of infantile colic by their families. The consumption of the tea in question was recommended by the neighbors. The babies were hospitalized due to possible side effects of *T. polium* consumption. ALT and AST levels were found to be high.	(Sezer and Bozaykut, 2012)
A 70-year-old farmer applied to the clinic for liver disease. The patient stated that he consumed approximately one-two liters of *T. polium* tea a day. As a result of biochemical analysis, the patient's ALT, AST and bilirubin levels were found to be high.	(Starakis et al., 2006)
Between 2000-2002, five patients were hospitalized. It was learned that three of these patients used *T. polium* for the treatment of diabetes and two of them for hyperlipidemia. Three of the patients used the plant occasionally and two of them used regularly every day for one month. Liver biopsy revealed acute hepatitis in two patients and chronic hepatitis with low grade cholestasis in the other two patients.	(Vasileiadou et al., 2003)

According to Rafieian-Kopaei et al. (2014), it has been reported that the pro-oxidant activity of some antioxidants may cause toxicity through oxidative stress. According to Chitturi and Farrell (2008), which claims that *T. polium* is the first plant to be proven to cause acute liver failure, some diterpenoid-derived reactive metabolites are the main components responsible for hepatotoxicity. Today, *T. polium* toxicity is thought to be caused mainly by neo-clerodane diterpenoids (Venditti et al., 2017).

6. Conclusions

In this review, the traditional use, phytochemistry and toxic effects of *T. polium* on kidney and liver were documented. It was understood that the plant has been used frequently by many people in many parts of the world since ancient times in the treatment of certain diseases. However, literature data showed that *T. polium* has toxic effect on kidney tissue. Moreover, in some of the studies on the liver and in all clinical reports, *T. polium* has also been proven to have toxic effect on the liver. Although it is difficult to change the traditional consumption habits of the people, it has been concluded that more attention should be paid to the use of the plant. As evaluated in detail in the sections above, the plant species in question has been frequently used by humans in the treatment of various diseases (especially gastrointestinal system disorders) since ancient times. It is thought that awareness of the possible harms of this plant should be created in people by providing sufficient information. As clearly stated by Rafieian-Kopaei et al. (2014), more clinical studies are required to better understand the effects *of T. polium* on the liver. In particular, the effects of the plant on ALT, AST, bilirubin, and prothrombin levels should be documented in more detail, and the histological changes on the liver tissue should be followed as a result of the use of the plant. It was also concluded that that regular consumption of *T. polium* should be avoided for long periods of time.

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None.

Conflict of Interest

The authors confirm that there are no known conflicts of interest.

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Arzuhan Sihoglu Tepe: Conceptualization, Investigation, Methodolygy, Writing, Review & Editing.
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