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REVIEW ARTICLE **Open Access**

Overview of ethnobotanical, phytochemical and biological activity relations of *Verbascum* species in worldwide

Dünya çapında *Verbascum* türlerinin etnobotanik, fitokimyasal ve biyolojik aktivite ilişkilerine genel bakış

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ABSTRACT

Verbascum species are important medicinal plants frequently used worldwide. This study aimed to compile the medical, veterinary, and other uses of these species by reviewing ethnobotanical studies conducted in countries where *Verbascum* species are naturally distributed. Ethnobotanical studies conducted in Türkiye, Italy, Pakistan, Spain, Iraq, Iran, Bosnia and Herzegovina, India, Pakistan, Serbia, Afghanistan, Uzbekistan, and the USA were identified using standard keywords through databases such as PubMed, Sciencedirect, Scopus, Google Scholar, and the Turkish National Thesis Center. Articles published in peer-reviewed journals, congress proceedings, and theses (gray literature) were included. Scientific and local names, parts used, preparation and application methods were obtained from 110 ethnobotanical studies. The most cited plant species, countries, purposes, and plant parts were identified. A total of 46 *Verbascum* species were found to be medicinal plants used in folk medicine. The most cited species are *V. thapsus*, *V. cheiranthifolium*, *Verbascum* sp., *V. speciosum*, *V. sinuatum*, *V. phlomoides*, and *V. lasianthum*. The most frequently cited countries are Türkiye, Italy, Pakistan, Spain, Iraq, Bosnia and Herzegovina, and India. The most commonly used parts of these plants were found to be flowers (38%) and leaves (36%). The preparation and application method is generally internal use in the form of infusion and decoction in respiratory diseases, and there are external methods such as poultice, powder, and direct application for hemorrhoids and wounds. Additionally, bioactivity studies of the most cited plants were reviewed to evaluate their use in ethnobotany. This review identified *Verbascum* species that may have potential therapeutic effects for conditions such as respiratory disorders, hemorrhoids, wounds, and burns, but further preclinical and clinical studies are needed to confirm their activities.

ÖZ

Verbascum türleri dünya çapında sıklıkla kullanılan önemli tıbbi bitkilerdir. Bu çalışmada, *Verbascum* türlerinin doğal olarak yayılış gösterdiği ülkelerde yapılan etnobotanik çalışmaları inceleyerek bu türlerin tıbbi, veterinerlik ve diğer kullanımlarını derlemek amaçlanmıştır. Türkiye, İtalya, Pakistan, İspanya, Irak, İran, Bosna-Hersek, Hindistan, Pakistan, Sırbistan, Afganistan, Özbekistan ve ABD'de yapılan etnobotanik çalışmalar PubMed, Sciencedirect, Scopus, Google Akademik ve Türkiye Ulusal Tez Merkezi gibi veri tabanları üzerinden standart anahtar kelimeler kullanılarak belirlenmiştir. Hakemli dergilerde yayınlanan makaleler, kongre bildirileri ve tezler (gri literatür) çalışmaya dahil edilmiştir. 110 etnobotanik çalışmadan bilimsel ve yerel adları, kullanılan kısımları, hazırlama ve uygulama yöntemleri elde edilmiştir. En çok atıf yapılan bitki türleri, ülkeler, amaçları ve bitki kısımları belirlenmiştir. Toplam 46 *Verbascum* türünün halk hekimliğinde kullanılan tıbbi bitki olduğu bulunmuştur. En çok atıfa sahip türler *V. thapsus*, *V. cheiranthifolium*, *V. speciosum*, *V. sinuatum*, *V. phlomoides* ve *V. lasianthum*'dur. En sık atıfta bulunulan ülkeler ise Türkiye, İtalya, Pakistan, İspanya, Irak, Bosna-Hersek ve Hindistan'dır. Tıbbi bitkilerin en sık kullanılan kısımlarının %38 oranında çiçekler ve %36 oranında yapraklar olduğu belirlenmiştir. Hazırlama ve uygulama yöntemi genellikle solunum yolu hastalıklarında demleme ve kaynatma şeklinde dahili kullanım olup, hemoroid ve yaralar için lapa, toz olarak serpme, doğrudan uygulama gibi harici yöntemler de kullanılmıştır. Ayrıca, etnobotanikte kullanımlarını değerlendirmek için en çok atıfta bulunulan bitkilerin biyoaktivite çalışmaları incelenmiştir. Bu derlemede solunum yolu bozuklukları, hemoroid, yara ve yanıklar gibi durumlar için potansiyel terapötik etkileri olabilecek *Verbascum* türleri belirlenmiştir, ancak aktivitelerini doğrulamak için daha fazla klinik öncesi ve klinik çalışmaya ihtiyaç vardır.

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1. INTRODUCTION

The Scrophulariaceae family, which includes the genus *Verbascum* L., is an important plant family consisting of 62 genera and approximately 1830 recognized species (Christenhusz & Byng, 2016). They occur mostly in temperate and subtropical regions, and many produce beautiful flowers either in a garden setting or as roadside plants. *Verbascum* is the largest genus of this family. It spans from Europe and Asia (the center of diversity is in Türkiye and Iran) to Northeast Africa and contains about 360 species (Figure 1) (Fischer, 2004). This genus, which is widely distributed all over the world, includes 99 species (Ferguson, 1972) in Flora Europea, 51 species in the USSR (Fedchenko, 1955), 48 species in Flora Iranica (Huber-Morath, 1981; Sotoodeh et al., 2015), 20 species in Flora Palaestina (Feinbrun-Dothan, 1978), 6 species in Flora Cyprus (Meikle, 1985) and finally 4 species (Boulos, 2009) in Flora Egypt. In Türkiye, it is represented by 248 species and 129 hybrids (Güner, 2012; Karavelioğulları, 2012).

Figure 1. Countries with the ethnobotanical use of *Verbascum* species

V. thapsus L. is the most important of the species formerly used in medicine and is known by various names, including mullein, great mullein, woolly mullein, candlewick plant, velvet plant, blanket leaf, white man's footsteps, Aaron's rod, Jacob's staff, hedge taper, high taper, old man's flannel, lady's foxglove, and mullein. sığır kuyruğu (in Turkish) (Ucar Turker and Gurel, 2005).

The traditional use of *Verbascum* (Mullein) around the world dates back to ancient times. There are used worldwide for asthma, bronchitis, expectorant, healing wounds and burns, hemorrhoid, rheumatism, eczema, mycodermatitis (Pieroni, 2000; Pieroni et al., 2002; Hamayun et al., 2006; Altundağ & Öztürk; 2011; Di Novella et al., 2013; Amin et al., 2016; Erbay & Sarı, 2018; Erarslan et al., 2020).

The biological activities of plants are mostly attributed to their phytochemical components. A wide variety of compounds have been identified when it comes to *Verbascum* species. These compounds are classified into eight main categories, including saponins, iridoids, phenylethanoid glycosides, monoterpene glycosides, neolignan glycosides, steroids, flavonoids, and spermine alkaloids (Ziyaev et al., 1971; Świątek, 1982; Świątek et al., 1984a,1984b; Seifert et al., 1985; Eribekyan et al.,

1987; Khuroo et al., 1988; Souleles & Geronikaki, 1989; Paszkiewicz-Gadek et al., 1990; Warashina et al., 1991; Warashina et al., 1992; Klimek, 1996a,1996b; Ucar Turker and Gurel, 2005, Angeloni et al., 2021).

Antioxidant, anti-inflammatory, antibacterial, antimicrobial, antiviral, anthelmintic, antimutagenic, antinociceptive, wound healing, antidiabetic, antihyperlipidemic activities of various species with in vitro and in vivo studies of *Verbascum* species were reported (McCutcheon et al., 1992; McCutcheon et al., 1995; Aboutabl et al., 1999; Lin et al., 2002; Küpeli et al., 2007; Senatore et al., 2007; Tatli et al., 2007; Tatli et al., 2008; Sener & Dulger, 2009; Rajbhandari et al., 2009; Süntar et al., 2010; Akdemir et al., 2011; Georgiev et al., 2011; Kahraman et al., 2011; Ali et al., 2012; Kahraman et al., 2014; Prakash et al., 2016; Hacıoğlu Doğru et al., 2019; Selseleh et al., 2020; Çavuş Alan & Özen, 2021). For these reasons, the importance of understanding the bioactive components of plants that play a vital role in human health has become increasingly recognized. Scientific verification of their traditional uses is very important in supporting herbal treatments and traditional medicine. This article discusses the ethnobotanical uses of *Verbascum* species, while also examining their phytochemical compositions, ethnopharmacological uses, biological activities and relevant clinical studies in more detail.

In conclusion, this review compiles findings from previous research on *Verbascum* species and highlights knowledge gaps that need to be addressed to fully understand the mechanisms of action of *Verbascum* extracts used in traditional medicine. In addition, it emphasizes the need to investigate in detail the connection between pharmacological effects and the bioactive compounds responsible for these effects. The review brings together ethnobotanical, phytochemical and bioactivity studies, providing researchers with valuable information to conduct further research, improve the existing knowledge base and potentially discover new applications for this intriguing species.

1.1 Botany of *Verbascum*

Annual, biennial or perennial herbs; rarely small shrubs. Stems erect, rounded. Leaves cauline and in a basal rosette, alternate, linear-lanceolate to ovoid or orbicular, acuminate or obtuse, entire or pinnatifid to pinnatisect and with dentate to serrate or crenate margin. Plants glabrous or with indumentum of eglandular or glandular, simple or branched hairs. Inflorescence with axillary cymes and accessory flowers or racemose. Flowers in terminal racemes, spikes or panicles. Calyx equally or very rarely unequally divided deeply 5-lobed, lobes equal. Corolla yellow, rarely violet or purple, brown or yellowish or bluish green, rotate, ± actinomorphic or somewhat zygomorphic. Stamens 4 or 5, sometimes 4 fertile and 1 staminode; filaments villous, with yellowish or purple-violet hairs, or rarely glabrous, all equal or 2 anterior (lower) longer and thicker; anthers of 2 or 3 posterior stamens always reniform and transversely medifixed, those of 2 anterior stamens similar or ± elongate, longitudinally inserted and decurrent or rarely obliquely inserted. Style single, filiform or scarcely club-shaped; stigma hemispherical, obovate or spathulate; ovary ovoid to globose. Capsule septicidal, globose or oblong-ovoid or cylindrical; seeds numerous, small; endosperm alveolated (bothrospermous). 2n = 18, 26, 30, 32, 34, 36, 44, 45, 48, 64, 66 (Huber-Morath, 1978).

Verbascum thapsus L. is the most common species of this genus worldwide and is found wild in stony ground, wasteland, woodland, clearings and roadsides (Speranza et al., 2010). The use of *V. thapsus* is increasing not only globally but also in developed and developing countries (Turker & Camper, 2002).

1.2 Traditional and ethnomedicinal importance of *Verbascum* sp.

Mullein has an ancient relationship with humans. Mullein is traditionally revered for its mystical and medicinal powers. According to ancient beliefs, if someone keeps part of the plant, that plant has the ability to keep away evil spirits and horror (Muenscher, 1935; Debray, 1978). Among the Greeks, Ulysses was known to have taken this plant to protect against Circe's tricks (Debray, 1978). In the Western United States, the Greeks and Romans knew it as a candle/torch and used it at funerals and other sacred ceremonies (Muenscher, 1935). The Romans and Irish called it 'lungwort' for its beneficial effects on lung diseases in both humans and animals (Muenscher, 1935; Debray, 1978). In Russia, *V. nigrum* L. is commonly known colloquially as "Tsarsky skipetr" (Tsar's scepter) (Kalinina et al., 2014).

Verbascum's generic name is believed to be "Barbascum", which derives from the Latin word 'barba'

meaning beard, due to the species hairy appearance. *Verbascum* species are important for their healing properties and are widely used both at home and in ordinary medicine. The word “Mullein” is originally from the Latin mollis; it comes from Middle English moleyne and Old French moleine, meaning 'soft' and referring to leaves (Strange, 1977; Ucar Türker & Gürel, 2005).

Although mullein has been used in medicinal applications since ancient times, its popularity has experienced a resurgence in recent years. In modern herbal medicine, products derived from *Verbascum* species are increasingly sought after for their therapeutic benefit. Today, various forms of mullein, including mullein leaves and flowers, mullein extracts, oral capsules, and flower oils can be found in health and wellness stores throughout the United States. This increase in availability reflects growing interest in natural ingredients and the potential health benefits of this versatile starter (Ucar Türker & Gürel 2005).

In Türkiye, the number of *Verbascum* species is quite high. For this reason, it is seen that many types are used in traditional treatments. It is frequently used in colds, asthma, bronchitis, hemorrhoids, wounds and burns and mycodermatitis, uterine inflammations, pregnancy nausea, abdominal pain, prostate, arthralgia, migraine, gastric ulcer, fissures in the hands, rheumatism and various skin disorders (Leporatti & Ivancheva, 2003; Gençler Özkan & Koyuncu, 2005; Gürbüz et al., 2005; Şığva & Seçmen, 2009; Altundağ & Öztürk, 2011; Özüdoğru et al., 2011; Sağiroğlu et al., 2013; Mükemre et al., 2015; Günbatan et al., 2016; Bağcı & Keskin, 2022; Yücel & Yücel, 2022). In addition to being used as expectorant, antiulcerogenic, antituberculosis and emenogogue, it is also used as a fish poison while fishing. It has also been reported to be used in skin disorders in Cyprus (Gonza´lez-Tejero et al., 2008)

In Italian medicine, the use of *Verbascum* species has been reported in diseases such as psoriasis, gastrointestinal system disorders, respiratory disorders (antitussive, expectorant, decongestant, cold, cough, bronchitis). It is also used externally for skin problems and wounds (in lambs, dogs, cattle, pigs, mules and horses), as a sedative in gangrene, for disinfection of wounds, for hemorrhoids and snake bites (Pieroni, 2000; Uncini Manganelli et al., 2001; Pieroni et al., 2002; Leporatti ve Ivancheva, 2003; Viegi et al., 2003; Gonza´lez-Tejero et al., 2008; Idolo et al., 2010; Di Novella et al., 2013; Leto et al., 2013; Laura et al., 2014; Tuttolomondo et al., 2014; Dei Cas et al., 2015) (Table 1).

It has been recorded that the species were included in the mixtures used in the treatment of dental diseases in Medieval England (Anderson, 2004)

Their use in tuberculosis and various lung diseases has been recorded among the public in Ireland (DeBray, 1978; Allen & Hatfield, 2004)

In Spanish folk medicine, they have uses as an emollient, pain reliever, anti-hemorrhoid, chest infections, colds, cough and asthma, earache, respiratory ailments, cardiovascular ailments (Gonza´lez-Tejero et al., 2008; Alarcón et al., 2015; Rigat et al., 2015; Gras et al., 2017)

In traditional folk medicine of Bulgaria, the infusion obtained from the leaves of the plant is used internally as antitussive, expectorant, anti-inflammatory, analgesic, spasmolytic and blood pressure lowering. It is used externally on wounds (Ivancheva & Stantcheva, 2000; Leporatti & Ivancheva, 2003).

In Greek traditional medicine*, Verbascum ikaricum* Murb. is kept in olive oil together with *Hypericum perforatum* L.and applied to wounds (Axiotis et al., 2018). On the other hand, all the aerial parts of another species are consumed in the form of tea to relieve cough, as an antiprostate and in the treatment of stomachaches. It has also been reported that they consume the tea obtained by the infusion of aerial parts for their problems as hemorrhoids, constipation, asthma, common cold, arthritis, rheumatism, diuretic (Vokou et al., 1993; Hanlidou et al., 2004; Tsioutsiou et al., 2019).

In the Balkans (Bosnia and Herzegovina, Serbia, Albania, Estonia, Romania), it has been reported to be used in the treatment of tuberculosis, skin diseases, digestive disorders, alopecia, inflammations, ulcers, wounds and as expectorant (Redzic et al., 2007; Gonza´lez-Tejero et al., 2008; Šarić-Kundalic et al., 2010; Sõukand & Kalle, 2012; Jarić et al., 2015; Gilca et al., 2018).

In Iraqi folk medicine, the leaves of *Verbascum* species are used in the treatment of ailments such as mycodermatitis, burns and wound inflammations, snake bites and diarrhea. It has also been noted to be used as

an antiparasitic and antiseptic (Ghorbani, 2005; Amin et al., 2016).

In Uzbekistan, it has been reported that the flowers of the *V. songaricum* Schrenk are used in the tea obtained by decoction in the treatment of cough and externally in wounds (Khojimatov et al., 2020).

When looking at Pakistani traditional medicine, various parts of the species are used for skin disorders (such as eczema, swelling, wounds and cuts), diarrhea, dysentery in cattle, lung ailments (such as cough), wound healing and as pain reliever, antiseptic, narcotic, antipyretic, astringent, antihypertensive and bleeding stopper. In addition, it is also added to the feed of cows as a milk enhancer (Shinwari & Gilani, 2003; Wazir et al., 2004; Hamayun et al., 2006; Sher, 2011; Kifayatullah et al., 2017; Ullah et al., 2021; Haq et al., 2022) (Tables 1, 2).

In Indian traditional medicine, the root and flowers of *V. thapsus* L. are used as cigarettes in asthma (Lewis & Elvin-Lewis, 1977). At the same time, the leaves are applied as a poultice on the chest to relieve pain caused by the common cold (Mehra et al., 2014). It is also included in the porridge mixture prepared for use in snake bites (Jain & Puri, 1984).

When we look at the place of *Verbascum* in traditional medicine in North America, it has been seen that the leaves and flowers of the *V. densiflorum* Bertol are used in respiratory system disorders (asthma, bronchitis, tonsillitis, cough, cold, tuberculosis, pneumonia) in Mexico (Rodriguez-Fragoso et al., 2008).

In Canada, it has been recorded that the flowers of the *V. thapsus* species are mixed with garlic and dripped into the ear used for ear infections of pets (Lans et al., 2008) (Table 2). The same species is also used as an ointment for burns and earache in the Eastern United States (Riaz et al., 2013) (Tables 1, 2).

Finally, the use of *V. thapsus* in sensory disorders is recorded in Moroccan folk medicine in Africa (Gonzá lez-Tejero et al., 2008). Medicinal uses of all *Verbascum* species on humans are given in Table 1.

As a result of the review, all these ethnobotanical uses and phytochemical and bioactivity studies conducted with *Verbascum* will be brought together and will provide valuable information for researchers to conduct further research will improve the current knowledge base and potentially discover new applications for this interesting species.

This review compiles the ethnobotanical uses, phytochemical and bioactivity studies of Verbascum, providing valuable insights for researchers to expand current knowledge, conduct further research and potentially uncover new applications for this impressive species.

2. MATERIALS AND METHODS

Scientific databases and repositories, such as Google Scholar, PubMed/Medline, ScienceDirect, Mendeley, Scopus and Web of Science were used to search for information. The research was carried out using the following key words *Verbascum*/ethnobotany, *Verbascum*/folk medicine, *Verbascum*/traditional uses, *Verbascum*/chemistry, *Verbascum*/bioactivity, *Verbascum*/flavonoids. We obtained about 1071 references according to these terms from 110 ethnobotanical studies. References relating to *Verbascum* consist of English and Turkish sources.

Inclusion criteria: Publications which have focused on botanical description, geographical repartition, traditional uses, chemistry and pharmacological activities of *Verbascum* species. These data have been arranged in tables and presented in this study according to each field.

Exclusion criteria: Articles written in other languages than English and Turkish, case studies or works that included pharmacological experiments associated with homoeopath products.

The most important data were summarized in tables and figures. The taxonomy of plants has been confirmed using the PlantList. The preparation method specified as tea is given as infusion.

Abbreviations used in the tables and figures are as follows:

Plant parts: Aer: aerial parts, fb: flowering branches, f: flowers, fr: fruits, l: leaves, r: roots, s: seeds, st: stem, wp: whole plant (Tables 1-4).

Methods of use: asc: as a cigaratte, boi: boiled, pom: pomade, com: compress, cr: crushed, dec: decoction, du: directly use, ext: externally, inh: inhalation, int:

internally, mac: maceration, oin: oinment, pat: patch, pou: poultice, pow: powder (Table 1-4).

Grouping of diseases: All diseases are grouped according to systems. Respiratory system disorders include cold, expectorant, cough, asthma, bronchitis, shortness of breath, spasmolytic, lung disorders, antitussive. Skin and sensory organ disorders include eczema, wounds, burns, stretch marks, hair loss, skin disorders, itching, snake bites, ear infections, earache, motor system disorders, sensory disorders, dental disorders. Circulatory system disorders include hemorrhoids, hypertension, diuretics, gangrene, astringent, diabetes. Infectious diseases include tuberculosis, mycodermatitis, dysentery, aches, fever, malaria, chest infections. Gastrointestinal system disorders include digestive, gastric, ulcer, diarrhea, constipation, abdominal pain. Musculoskeletal disorders include swelling, rheumatism, joint pain, arthritis. Reproductive diseases include prostate, uterine infection, emenogogue, infertility, female sterility. Other uses include fishing and toy making (Table 1-4, Figure 4).

3. RESULTS

The use of *Verbascum* species in folk medicine is common in Asian countries, especially Türkiye, followed by Pakistan and India. Following this, the most intensive use in the European continent is seen in Italy, Spain and Bosnia and Herzegovina (Figure 2). Common uses include very different purposes such as medicinal, veterinary, fishing and tool making (Table 1-4).

The most commonly used *Verbascum* species for medicinal purposes is *V. thapsus*, which is widely distributed throughout the World (Figure 1). This is followed by *V. cheiranthifolum* Boiss. and *V. speciosum* Schrad. The most common uses of these types are respiratory diseases and hemorrhoids (Table 1).

Table 1. A list of male canid samples (Haplotypes/Sequences) sequenced and used in this study (nr = number)

***Verbascum* taxa**	**Vernacular Name**	**Part used**	**Preparation, administration**	**Medicinal uses (For Human)**	**Country**	**References**
V. agrimoniifolium* (C. Koch) Hub.-Mor. subsp. *agrimoniifolium	Sığır guyruğu	L	Du/Ext	Mycodermatitis	Türkiye	Altundağ & Öztürk, 2011
***V. alceoides* Boiss. & Hausskn**	-	L	Cr	Mycodermatitis	Iraq	Amin et al., 2016
***V. assurense* Bornm. & Hand.-**	-	L	Inf	Antiparasitic	Iraq	Amin et al., 2016
***V. asperuloides* Hub.-Mor.**	Maçyanık	L	Inf	Antiparasitic	Türkiye	Altundağ & Öztürk, 2011
	Maçyanık		Ext	Asthma	Türkiye	Altundağ & Öztürk, 2011
	Somuruk otu	F	Pom/Ext	Wounds	Türkiye	Şığva & Seçmen, 2009
	Maçyanık, Yalankı		Inf	Asthma	Türkiye	Melikoğlu et al., 2015
***V. bombyciferum* Boiss.**	-	-	-	Bronchitis, anti-tuberculosis	Türkiye	Yücel & Yücel, 2022
***V. calvum* Boiss.& Kotsch**	-	L	Dec	Wounds	Iraq	Amin et al., 2016
***V. cheiranthifolium* Boiss.**	Sığırkuyruğu	R	Dec	Hemorrhoid	Türkiye	Günbatan et al., 2016
	Masicerk	L	Com/Ext	Rheumatism	Türkiye	Mükemre et al, 2015
	-		Boi/Ext (the patient sitting over steaming water)	Hemorrhoid	Türkiye	Çelik & Yeşil, 2019
	-		Inf/Int	Prostate	Türkiye	Şahin et al., 2019; Keskin 2011
	Sığırkuyruğu		Pow/Ext	Wounds	Türkiye	Özgen et al., 2012;
	Sığırkuyruğu		Pou/(together with *Malva neglecta)*/Ext	Hemorrhoid	Türkiye	Özgen et al., 2012;

	Calba, Yalangı		Dec/Int	Coughs, shortness of breath	Türkiye	Gençler Özkan & Koyuncu, 2005
	Calba, Yalangı		Pou/Ext	Joint pain	Türkiye	Gençler Özkan & Koyuncu, 2005
	Yalağı, Korek, Sığır kuyruğu	F	Dec/Int	Uterine inflammations, shortness of breath, asthma,	Türkiye	Özüdoğru et al, 2011
	Yalağı, Korek, Sığır kuyruğu		Dec/Ext	Pruritus	Türkiye	Özüdoğru et al, 2011
	Yalağı, Korek, Sığır kuyruğu		Ext/(Dried flowers mixed with garlic cloves and applied on bald area after moistened with water)	Hairloss	Türkiye	Özüdoğru et al, 2011
	Sığırkuyruğu		Dec/Int	Hemorrhoid	Türkiye	Kurnaz & Karagöz, 2013
	Gırç		Dec/Int	Stomachache,	Türkiye	Özgen et al., 2012
	Calba, yalangı			Abdominal pain	Türkiye	Gençler Özkan & Koyuncu, 2005
	Calba, yalangı			Gastric ulcers	Türkiye	Gürbüz et al., 2005
	Ayıkulağı, Sığırkulağı		Inf	Shortness of breath	Türkiye	Bulut et al., 2017b
	Calba, yalangı		Dec/Ext	Fissures on hand	Türkiye	Gençler Özkan & Koyuncu, 2005
	Ayıkulağı, Sığırkulağı	Fb	Dec	Hemorrhoids	Türkiye	Bulut et al., 2017b
	Sığırkuyruğu	Aer	Inf/Int	Women sterility	Türkiye	Altundağ & Öztürk, 2011
	Masicerk		Inf/Ext	Hemorrhoids	Türkiye	Mükemre et al., 2015
	Sığırkuyruğu		Pou/Ext	Arthralgia	Türkiye	Altundağ & Öztürk, 2011
	Calba, yalangı		Dec/Ext	Urinary inflammation	Türkiye	Gençler Özkan & Koyuncu, 2005
		Wp	Dec	Hemorrhoids, prostate, dyspnea and renal disorders as diuretic.	Türkiye	Bağcı & Keskin, 2022
***V. densiflorum* Bertol.**	Visok lopen, Verbasco, Tasso barbasso, Gordolobo	L	Inf	Expectorant, antitussive, antiinflammatuar, spasmolitic	Bulgaria	Leporatti & Ivancheva, 2003, Ivancheva & Stantcheva, 2000
		L, F	-	Respiratory disorders	Mexico	Rodriguez-Fragoso et al., 2008
		F	Dec/Int	Sedative for colds, coughs	Italy	Leporatti & Ivancheva, 2003
			Pat (as an ointment in olive oil)/Ext	Gangrene	Italy	Leporatti & Ivancheva, 2003
***V. diversifolium* Hochst.**	Sığırkuyruğu	F	Inh	Antitussive	Türkiye	Çakılcıoğlu et al., 2010
***V. dudleyanum* (Hub.-Mor.) Hub.-Mor.**	Sığırkuyruğu	L	Dec	Expectorant, abscess goiter	Türkiye	Güneş & Özhatay, 2011
		F	Dec	Hemorrhoid	Türkiye	Erbay & Sarı, 2018
***V. elegantulum* Hub-Mor.**	Sığırkuyruğu	F, L	Inf	Expectorant	Türkiye	Fakir et al., 2009
***V. froedinii* Murb.**	-	L	Dec	Mycodermatitis, burns	Iraq	Amin et al., 2016
***V. glomeratum* Boiss.**	Sığırkuyruğu	L	Inf and Dec/Int	Hemorrhoid	Türkiye	Erbay & Sarı, 2018
	Sığırkuyruğu		Dec/Ext	Rheumatism	Türkiye	Han & Bulut, 2015
	Sığırkuyruğu	F & Fb	Inf/Int	Stomach ailments	Türkiye	Han & Bulut, 2015

	Sığırkuyruğu	F	Mixed with honey / Int	Cough		Han & Bulut, 2015
***V. gossypinum* M. Bieb.**	Segher-ghureq	L, F	-	Snake bites, diarrhea, antiseptic	Iran	Ghorbani, 2005
***V. hadschinense* Freynin.**	Sığırkuyruğu	Aer	Dec (with *Thyme* sp.)	Expectorant, antitussive	Türkiye	Sağiroğlu et al., 2013
	Sığırkuyruğu	F	Dec	Migraine	Türkiye	Sağiroğlu et al., 2013
***V. ikaricum* Murb.**	-	-	It is kept in olive oil together with *Hypericum perforatum* L. and applied to the wounds.	Wounds, sunburns	Greek Islands (Samos Lesbos and Chios)	Axiotis et al., 2018
***V. infidelium* Boiss.. & Hausskn. ex Bentham**	Sığırkuyruğu	F	-	Respiratory regulator	Türkiye	Karaman & Kocabaş, 2001
***V. lasianthum* Boiss. ex Bentham**	Sığırkuyruğu	F	Inf (with *Viola* sp.)/Int	Apnea, asthma, bronchitis	Türkiye	Kalankan et al., 2015
	Sığırkuyruğu, Yalangı, Yılangı		Inf/Int	Hemorrhoid	Türkiye	Erbay & Sarı, 2018; Bulut et al., 2017c
	Sığırkuyruğu, Yalangı, Yılangı	R	Roots are ground and eaten with *Vitis vinifera* L.	Hemorrhoid	Türkiye	Akgül et al.,2018; Erbay & Sarı, 2018
***V. longifolium* Ten.**	Verbasco	L	Dec	Abdominal pain	Greece	Tsioutsiou et al., 2019
	Verbasco, Lupusiou	Aer	Dec	Cough	Greece	Tsioutsiou et al., 2019
	Verbasco, Lupusiou		Dec	Prevent and treat prostatitis	Greece	Tsioutsiou et al., 2019
***V. macrurum* Ten.**	Sığırkuyruğu	F	Inf/Int	Stomacache	Türkiye	Tuzlacı et al., 2010; Erbay et al., 2017
V. nigrum	Tsarsky skipetr	-	Inf	Diuretic	Russia	Kalinina et al., 2014; Sokolov, 1990
		-	Ethanol and aqueous extracts	Neurosis, epilepsy, acute respiratory diseases, asthma, diarrhea, gastralgia, dysentery	Russia	Kalinina et al., 2014; Budantsev & Lesovskii, 2001
***V. nudatum* Murb.**	Sığırkuyruğu	F & L	Inf	Expectorant	Türkiye	Fakir et al., 2009
***V. olympicum* Boiss.**	Sığırkuyruğu	F & L	Inf	Expectorant	Türkiye	Fakir et al., 2009
				Asthma and cough prevention	Türkiye	Yücel & Yücel, 2022
***V. oocarpum* Murb.**	Sığırkuyruğu	F, L	Inf	Expectorant	Türkiye	Fakir et al., 2009
***V. oreophilum* C. Koch**	Sığırkuyruğu	L	Du/Ext	Mycodermatitis, woman sterility	Türkiye	Altundağ & Öztürk, 2011
	Masicerk		Dec/Ext	Rheumatism	Türkiye	Mükemre et al., 2015
	Sığır kuyruğu, gırç		Boi/Inh	Hemorrhoids	Türkiye	Karakaya et al., 2020
	Masicerk	Aer	Dec	Hemorrhoid	Türkiye	Mükemre et al., 2015
	Masicerk		Inf	Hemorrhoid	Türkiye	Erbay & Sarı, 2018
	Sinem		Dec	Diabetes	Türkiye	Demir, 2020
***V. orgyale* Boiss. & Heldr.**	Sığırkuyruğu, Gırç	F, L	Inf	Expectorant	Türkiye	Fakir et al., 2009
***V. ovalifolium* Donn ex Sims**	Sığırkuyruğu	F	Inf	Gastric ulcer	Türkiye	Tuzlacı et al., 2010; Erbay et al., 2017
***V. phlomoides* L.**	Lopen	L	-	Anti-hypertensive, spasmolytic	Bulgaria	Leporatti & Ivancheva, 2003
	Verbasco, Tasso barbasso	F	Int	Emollient against catarrh and coughs.	Italy	Leporatti & Ivancheva, 2003
			Ext	Cataplasm applied to soothe gangrenous sores	Italy	Leporatti & Ivancheva, 2003

	Divizma	F	Inf	Tuberculosis	Bosnia and Herzegovina	Red'zi'c et al., 2007
	Mullein	R	Ext	Alopecia, inflammations, ulcers, wounds and burns	Romania	Gilca et al., 2018
	-	-	-	Expectorant and emollient, diuretic, fever and malaria, rheumatism, arthritis, astringent	Greece	Vokou et al., 1993
	Sığırkuyruğu	-	-	Pain, rheumatic pain	Türkiye	Öz Aydın et al., 2006
***V. phoeniceum* L..**	Sığırkuyruğu	F	Ext	Hemorrhoid	Türkiye	Kadıoğlu et al., 2021
***V. pinetorum* (Boiss.) O. Kuntze**	Gavurdedengili	L	Cr/Ext	Wounds	Türkiye	Demirci & Özhatay, 2012
***V. ponticum* Stef.**	-	L	Du	Mycodermatitis	Iraq	Amin et al., 2016
***V. pulverulentum* Vill.**	Gordolobo, Gordillogo, Patilobo, Blenera, Borrassa, Cua de Guilla, Flor de Torpa, Herba Ploranera	L	Ext	Hemorrhoids, abdominal pain, wounds	Spain	Gonzáleza et al., 2010
	Blenera, borrassa, cua de guilla, flor de torpa, herba ploranera	R, L	Ext	Antieczematous, for fistula	Spain	Rigat et al., 2015
***V. pycnostachyum* Boiss. & Heldr.**	Ayıkulağı, sığırkulağı	L	Ext	Rheumatism	Türkiye	Bulut et al., 2017b
	Sığırkuyruğu	F	Ext	Hemorrhoids	Türkiye	Güneş et al., 2017
	Sığırkuyruğu	F and L	Dec/Int	Prostate	Türkiye	Şahin et al., 2019
***V. pyramidatum* M. Bieb.**	Masicerk	L	Dec	Rheumatism	Türkiye	Mükemre et al., 2015
	Masicerk	Aer	Dec/İnf	Hemorrhoid	Türkiye	Erbay et al., 2017; Mükemre et al., 2015
***V. saccatum* K. Koch.**	Masîjerk	F, L	Dec/Com	Rheumatism	Türkiye	Dalar et al., 2018b
***V. sinuatum* L.**	Sığırkuyruğu	L	Dec/Int	Hemorrhoids	Türkiye	Erbay & Sarı,2018; Doğan, 2014
	Tassubarbassu		Dec	Hemorrhoids	Italy	Leto et al., 2013
	Tassubarbassu		Pou/Ext	Wounds	Italy	Leto et al., 2013
	Erba de morroidi		Pou/Ext	Hemorrhoids, wounds	Italy	Tuttolomondo et al., 2014
	Çıldır	Aer	-	Stomach ache on babies	Türkiye	Uysal et al, 2010
	Smennune		Dec/Int	Pregnancy nausea relief	Türkiye	Güzel et al., 2015
	-	-	Dec/Ext	Psoriasis, hemorrhoids, wounds	Italy	Leporatti & Ivancheva, 2003
	-	-	-	Skin diseases	Cyprus	Gonza´lez-Tejero et al., 2008
	-	-	-	Respiratory ailments, cardiovascular ailments	Spain	Gonza´lez-Tejero et al., 2008
***V. songaricum* Schrenk**	Masîjerk	L	Dec/Com	Hemorrhoid	Türkiye	Dalar et al., 2018b
	Sigir kuyruk	F	Dec/Ext	Cough, wounds	Uzbekistan	Khojimatov et al., 2020
	Mazijanık	F	Dec/Int	Emenogogue, infertility	Türkiye	Nadiroğlu et al., 2019

***V. speciosum* Schrad.**	Kabalak, Ayılahanası	R	Int	Hemorrhoid	Türkiye	Erbay & Sarı, 2018; Kızılarslan, 2008
	Yalağı	Aer	Dec/Ext	Pruritus	Türkiye	Özüdoğru et al, 2011
	Masicark		Inf/Vm	Rheumatism	Türkiye	Kaval et al., 2014
	Mascerik		Dec/Int	Cough, anti- inflammatory	Türkiye	Görhan & Ozturk, 2021
	Yalağı, korek, sığır kuyruğu	F	Dec	Uterine inflammations and shortness of breath	Türkiye	Özüdoğru et al, 2011
	Yalağı, korek, sığır kuyruğu		Ext/Com (with *Allium sativum* L.)	Hairloss	Türkiye	Özüdoğru et al, 2011
	Kabalak, Ayılahanası		Inf/Int	Hemorrhoid	Türkiye	Erbay & Sarı, 2018; Kızılarslan, 2008
***V. splendidum* Boiss.**	Calba	F, L	Ext	Hemorrhoid	Türkiye	Şığva & Seçmen 2009
***V. stenostachyum* Hub. Mor.**	Sığırkuyruğu	L	Dec/Ext	Hemorrhoid	Türkiye	Kargıoğlu et al., 2008
		F	Inf/Int	Expectorant, diabetes	Türkiye	Kargıoğlu et al., 2008
***V. thapsus* L.**	-	R	Herbal mixture/Ext	Dental disorders.	England (Medieval)	Anderson, 2004; Riaz et al., 2013
	Burunca		-	Diuretic	Türkiye	Mumcu & Korkmaz, 2018
	-		-	Treatment of diabetes and its complications	Canada	McCune and Johns, 2002
	Tasso bardasso	L	Leaves are rolled up in cigarettes and inhaled	As a tonic, antitussive	Italy	Pieroni, 2000; Pieroni et al., 2002
	Lengua ri void		Ext	Hemorrhoids	Italy	Di Novella et al., 2013;
	Khardag		Pou	For acne and rashes	Pakistan	Ullah et al., 2021
	-		Ext	To relieve pain caused by cold, fever	India	Mehra et al., 2014
	-		-	Expectorant, spasm-sedating	-	Mumcu & Korkmaz, 2018
	Caskanacawa (Sheep's ear)		D/Ext	The heated leaves are applied to the swellings.	North America	Brownstein et al., 2017; Kindscher & Hurlburt 1998
	-		Oin/Ext	Burns and earache	Eastern United States	Riaz et al., 2013
	Tasso Barbasso	L, F	-	In preparations against cold, cough, bronchitis	Italy	Idolo et al., 2010
	-		-	Lung disease, fever, and bleeding	Pakistan	Shinwari & Gilani, 2003
	Kherkanr		Pou	Cough and pulmonary diseases	Pakistan	Hamayun et al., 2006
	Khar Ghwag	L, S	Pow/Int	Hypertension	Pakistan and Afghanistan	Haq et al., 2022
	Khar Ghwag		Pou/Ext	Wounds	Pakistan and Afghanistan	Haq et al., 2022
	-	L, F, R	-	Fever, astringent, narcotic	Pakistan	Wazir et al., 2004
	Khardag	L, Fr	-	Skin diseases, itching, scabies, eczema, swellings, wounds and cuts	Pakistan	Sher, 2011
	Sığırkuyruğu, burunca	L and F	Dec	Sore throat, expectorant, abdominal pain, bronchitis, sedative	Türkiye	Ugulu et al., 2009
	Sığırkuyruğu	Fb	Inf/Int	Hemorrhoid	Türkiye	Erbay & Sarı, 2018; Korkmaz & Karakurt, 2015

	Sığırkuyruğu		Dec	Anti-inflammatory, asthma-bronchitis, expectorant, cough, hemorrhoids, migraine, headache, toothache	Türkiye	Korkmaz & Karakurt, 2015
	Verbasco, Tasso barbasso	F	Dec/Int	It is used Int as a sedative for colds and coughs	Italy	Leporatti & Ivancheva, 2003
	Verbasco, Tasso barbasso		Dec/Ext	As a sedative for gangrene	Italy	Leporatti & Ivancheva, 2003
	Burunca		-	Eczema, inflammation, wound	Türkiye	Mumcu and Korkmaz., 2018
	Gordolobo, gordolobo chico		Inf	Antitussive	Spain	Gonzáleza et al., 2010
	Gordolobo		Inf	Colds, cough and asthma	Spain	Alarcón et al., 2015
	Gordolobo		As syrup	Chest infections	Spain	Alarcón et al., 2015
	Gordolobo		Flowers are soaked in olive oil, dripped into the ear/Ext	Earache	Spain	Alarcón et al., 2015
	Divizma		Inf	Tuberculosis	Bosnia and Herzegovina	Red'zi'c et al., 2007
	-	F, R	Asc	Asthma	India	Lewis & Elvin-Lewis, 1977
	-	S	-	Narcotic and fish poison	Pakistan	Wazir et al., 2004
	-	Aer	Inf, Dec	Expectorant, decongestant, anti-inflammatory against itching and irritation.	Italy	Dei Cas et al., 2015
	Yugisingh		-	Wounds, urinary system disorders, edema	Nepal	Riaz et al., 2013; Rajbhandari et al., 2009
	Burunca		-	Antituberculosis;	Türkiye	Mumcu & Korkmaz, 2018
	-	Wp	-	Tuberculosis	Ireland	Riaz et al., 2013; Allen & Hatfield, 2004
	-		Ext	Snake bites	India	Jain & Puri, 1984; Riaz et al., 2013
	Kherkanr		-	Analgesic, antiseptic, wounds	Pakistan	Hamayun et al., 2006
	-	-	Int	Lung diseases	Ancient Rome and Modern Ireland	Riaz et al., 2013; DeBray, 1978
	-	-	-	Antitussive	Bulgaria	Leporatti & Ivancheva, 2003
	-	-	-	Sensory disturbances	Morocco	Gonza´lez-Tejero et al., 2008
	-	-	-	Respiratory disorders	Italy	Gonza´lez-Tejero et al., 2008
	Santjoan. Gordolobo oficinali, Bouillon blanc male	-	-	Emollient, pain reliever, antihemorrhoidal	Spain	Gras et al., 2017
***V. tripolitanum* Boiss.**	Smennune, sığırkuyruğu	Aer	Dec/Int	Pregnancy nausea reliever	Türkiye	Güzel et al., 2015
***V. virgatum* Stokes.**	-	-	-	Respiratory diseases cardiovascular disorders	Spain	Gonza´lez-Tejero et al., 2008
V. vulcanicum* Boiss. & Heldr. var. *vulcanicum	Yalağı, korek, sığır kuyruğu	F	Dec (as tea)/Int	Uterine inflammations, shortness of breath	Türkiye	Özüdoğru et al., 2011
	Yalağı, korek, sığır kuyruğu		Dried flowers mixed with garlic cloves and applied on bald area	Hairloss	Türkiye	Özüdoğru et al., 2011

			after moistened with water /Ext			
	Yalağı	Aer	Dec/Ext	Antipruritic	Türkiye	Özüdoğru et al., 2011
	Gırdek	S	Dec/Int	Jaundice	Türkiye	Özgen et al., 2012
***Verbascum* sp.**	Divizma	F	Ext	Skin disorders	Bosnia and Herzegovina	Šarić-Kundalić et al., 2010
	Sığırkuyruğu		Ext	Wounds	Türkiye	Tetik et al., 2013
	Sığırkuyruğu		Inf	Antitussive	Türkiye	Tetik et al., 2013
	Sığırkuyruğu		Inf/Int	Asthma	Türkiye	Korkma & Karakuş, 2015; Sargın, 2019
	Öküz kuyruğu, Sığırkuyruğu		Int	Respiratory, asthma, shortness of breath	Türkiye	Arı et al., 2015
	Sığırkuyruğu		Dec/Int	Kidney stone	Türkiye	Kültür et al., 2021; Bağcı et al. 2016; Baser, 2015
	Zarmasi	F and L	Ext	Wound	Türkiye	Bulut et al., 2017a
	Zarmasi		Inf/Int	Cough, sore throat	Türkiye	Bulut et al., 2017a
	Sığırkuyruğu, Öküzkuyruğu	L	Ext	Skin diseases, warts, eczema	Türkiye	Arı et al., 2015
	Verbasko	Aer	Inf	Hemorrhoids, constipation, asthma, common cold, arthritis, rheumatism, diuretic, sanative)	Greece	Hanlidou et al., 2004
	Divizma		Inf/Int	Expectorant	Serbia	Jarić et al., 2015
	Sığırkuyruğu, Tozkulak, Tozluk, Calba, Kancık		Inf	Urinary tract infection,	Türkiye	Sargın et al, 2013
	Sığırkuyruğu, Tozkulak, Tozluk, Calba, Kancık		Inf/ with *Heracleum platytaenium* Boiss.	Hemorrhoid	Türkiye	Erbay & Sarı, 2018; Sargın et al, 2013
	-	-	-	Skin disorders, digestive problems	Albania	Gonzaʹlez-Tejero et al., 2008.

Note: A map of sampling localities for male canid samples in this study (see Table 1 for letters and numbers on the map)

4. DISCUSSION

As a result of the scanning of ethnobotanical publications made around the world, a total of forty-six *Verbascum* species were found to be used among the public. In some studies, the exact diagnosis of the species was not made and *Verbascum* sp. included as. When the findings of all ethnobotanical studies are evaluated, the most frequently used species is *V. thapsus* with fifty-six citations, followed by *V. cheiranthifolium* with twenty nine citations and *Verbascum* sp. with twenty citations. The most cited species are presented graphically according to frequency of use (Figure 2).

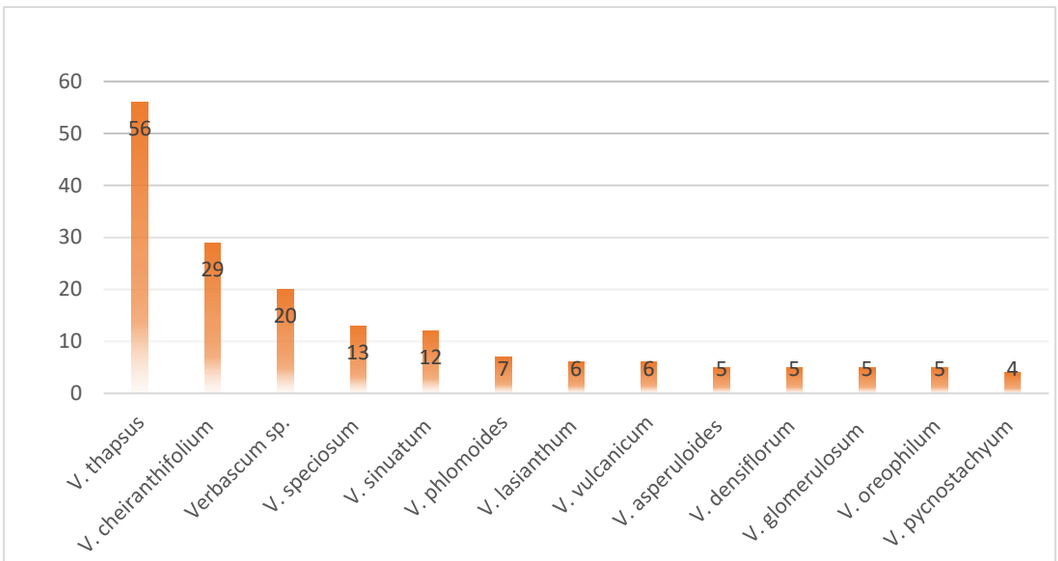

Figure 2. *Verbascum* species according to frequency of use

The distribution of the genus worldwide is seen in Europe, West and Central Asia and North Africa continents. It has been naturalized in the American continent. The countries where *Verbascum* species are most frequently used are as follows respectively; Türkiye, Italy, Pakistan, Spain, Iraq, Bosnia and Herzegovina and India (Figure 3).

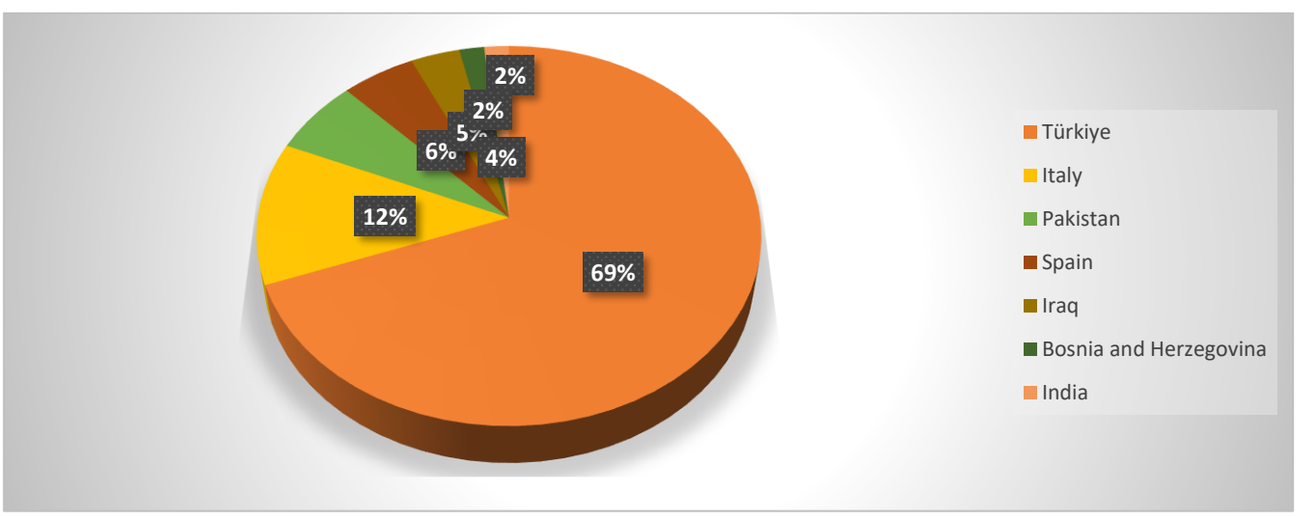

Figure 3. Countries where *Verbascum* species are most commonly used in folk medicine

Verbascum species are used in folk medicine around the world, and their use has been reported for respiratory system disorders, skin and sensory organ disorders, circulatory system disorders, infectious diseases, other uses, gastrointestinal disorders, musculoskeletal system disorders and reproductive system disorders (Figure 4).

Among circulatory system applications, the anti-hemorrhoidal use of Verbascum is the best known, appearing thirty-five times in the literature (Table 1). Topical application is reported to be the most common posology. It can be applied by taking a sit bath with the liquid obtained from the plant decoction (Yeşil & Çelik 2019) or by applying the fresh leaves or boiled plant to

the affected area (Karakaya et al., 2020) or poultice together with Malva neglecta Wallr. (Özgen et al., 2012).

The second most common use is for wounds and burns. The most common posology is topical applications. It is applied by drying the plant leaves, turning them into powder (Özüdoğru et al., 2011), boiling them and making a poultice (Erarslan et al., 2021), or by macerating them in olive oil with Hypericum perforatum (Axiotis et al., 2018). While Verbascum species are mostly used for wounds in humans in Asian countries, they are mostly used in the wounds of animals in European countries. It has been observed that mostly the leaves and flowers of the plant are used externally on wounds. Apart from this generality, two different applications attract attention. One is the treatment of V. cheiranthifolium leaves by powdering it and sprinkling it on cattle wounds in Türkiye (Özgen et al., 2012) and the other is the treatment of V. ikaricum species with H. perforatum in olive oil and applied to the wounds (Axiotis et al., 2018) (Table 1 and Table 2).

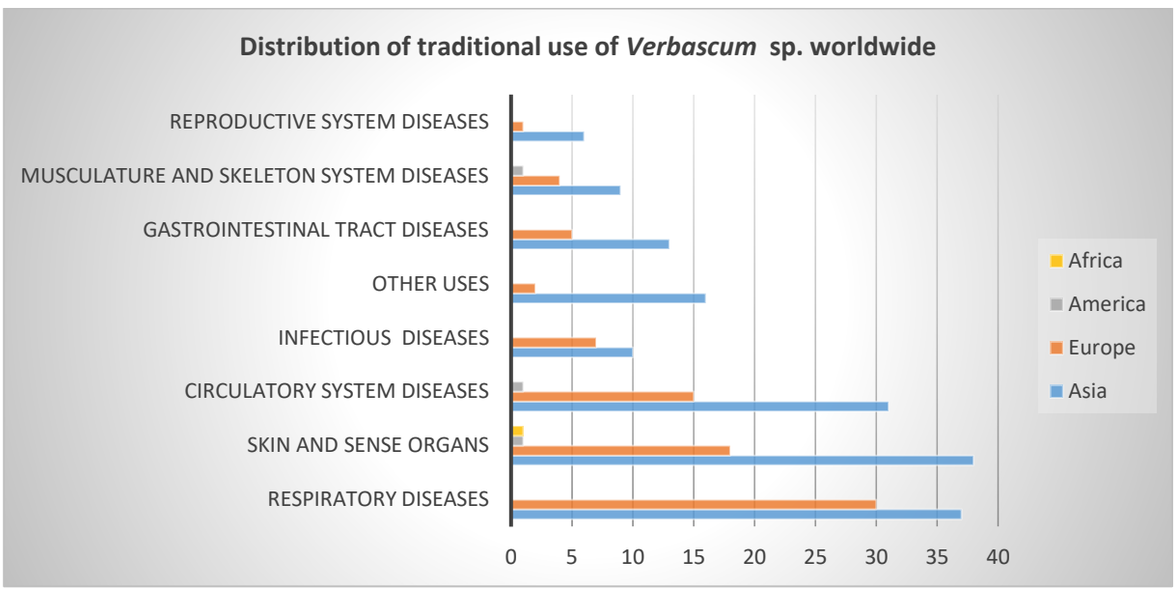

Figure 4. Distribution rates of ethnobotanical use of *Verbascum* species across continents

The second most common use is for wounds and burns. The most common posology is topical applications. It is applied by drying the plant leaves, turning them into powder (Özüdoğru et al., 2011), boiling them and making a poultice (Erarslan et al., 2021), or by macerating them in olive oil with Hypericum perforatum (Axiotis et al., 2018). While Verbascum species are mostly used for wounds in humans in Asian countries, they are mostly used in the wounds of animals in European countries. It has been observed that mostly the leaves and flowers of the plant are used externally on wounds. Apart from this generality, two different applications attract attention. One is the treatment of V. cheiranthifolium leaves by powdering it and sprinkling it on cattle wounds in Türkiye (Özgen et al., 2012) and the other is the treatment of V. ikaricum species with H. perforatum in olive oil and applied to the wounds (Axiotis et al., 2018) (Table 1 and Table 2). The third most common use is for coughs that occur for various reasons (such as asthma, bronchitis, cold). It is common to use the flowers and leaves of the plant as an antitussive through infusion or decoction (Leporatti & Ivancheva, 2003; Rodriguez-Fragoso et al., 2008; Fakir et al., 2009; Bulut et al., 2017c; Khojimatov et al., 2020; Görhan & Ozturk, 2021; Yücel & Yücel, 2022). In addition, decoction with Thyme; Its use as paste or syrup has also been recorded (Sağiroğlu et al., 2013; Hamayun et al., 2006; Alarcón et al., 2015) (Table 1).

The purposes and methods of use of the plant differ from country to country. For example, in respiratory system disorders, flowers and stem leaves are generally consumed in the form of infusion or decoction in Asian and European countries, while flowers and roots are used in the form of cigarettes in India. In hemorrhoids, the aerial parts of the plant are used internally in the form of infusion or decoction, as well as external use in

the form of boiling the leaves and sitting in the steam or directly to the related area as poultice. In a study conducted in Türkiye, it was observed that the infusion of Heracleum platytaenium plant, a species defined as Verbascum ssp., was used as an enema in the treatment of hemorrhoids (Sargın et al., 2013) Another way of use is recorded in Türkiye where the roots are boiled for hemorrhoids, and in another region, the roots are ground and eaten with raisins, and even the roots are chewed like pills. In Italy, fresh leaves are applied for external wound cleaning in hemorrhoids, and in another region of Italy, the leaves are applied as a patch to the hemorrhoidal area.

Species of the plant are widely used as fish poison for fishing in Türkiye. For this reason, the plant is also called fish grass among the people (Table 3).

In all these uses, the most frequently used parts of the plants are flowers (38%). Following these are leaves (36%), aerial part (11%), root (7%), seed (3%), flowering branches (3%) and fruits (2%) (Figure 5).

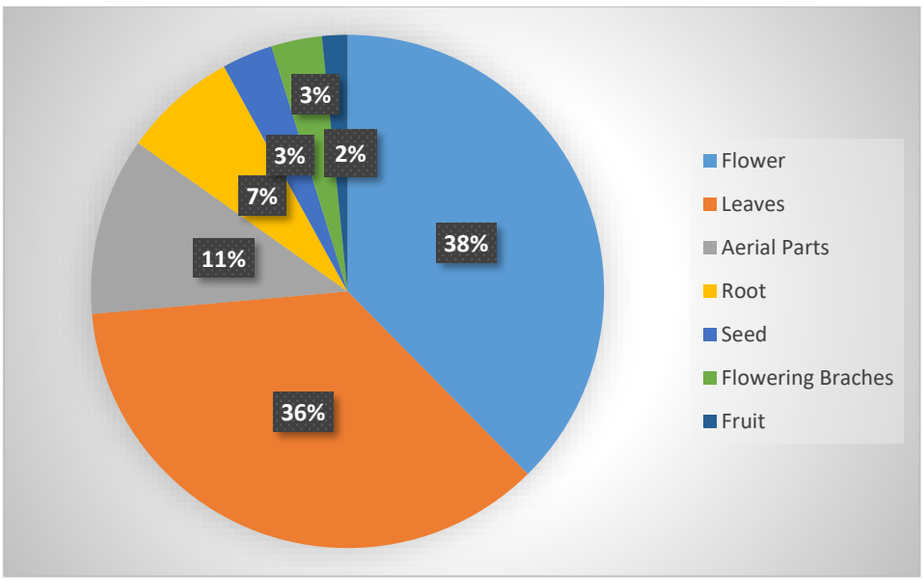

Figure 5. Plant parts used to ranked by frequency of use

A comprehensive analysis of the literature as mentioned above confirmed that the ethnomedical uses of *Verbascum* ssp. had a history of thousands of years in Western Asia and Europe countries. Several main compounds have been identified from *Verbascum* including saponins, flavonoids, phenylethanoid glycosides, iridoid glycosides, flavanone glycosides, cardiac glycosides, alkaloids, steroids, organic acids, phenolic acids, flavonols, polyphenols, polysaccharides, sesquiterpenes, coumarins, anthocyanins and other ingredients (Ulubelen et al., 1975; Tschesche et al., 1979; Papay et al., 1980; Tschesche et al., 1980; Mehrotra et al., 1989; Warashina et al., 1991; Warashina et al., 1992; Akdemir et al., 2004a; Akdemir et al., 2004b; Tatli & Akdemir, 2004; Klimek et al., 2010; Armatu et al., 2011; Riaz et al., 2013; Dalar et al., 2018; Sinha, 2019; Angeloni et al., 2021).

It can easily be said that this rich content of *Verbascum* species members is responsible for the activities attributed to the species. The chemical content of the compounds showing antioxidant activity is due to the presence of various components, including phenolic compounds (Kumar et al., 2010; Armatu et al., 2011; Jamshidi-Kia et al., 2018). These components serve as hydrogen donors and are considered strong antioxidants in this respect. Flavonoids are known to have the highest antioxidant activity, among other phenolic compounds (Turker & Gurel 2005). As a result of the phytochemical analysis of *V. bugulifolium* Lam., iridoid glycosides, phenylethanoid glycosides, flavonoids and 13 secondary metabolites belonging to the phytosterol group were detected. Luteolin and verbascoside showed high antioxidant activity. Additionally, luteolin exhibited the highest anti-inflammatory activity (Gökmen et al., 2020). In a study by Recio et al. (1994), they explained the

relationship between iridoid components and anti-inflammatory effects. This supports the anti-inflammatory effect of *Verbascum* species. A study concluded that the aqueous extract of *V. insulare* Boiss. & Heldr. showed antioxidant, antifungal and DNA damage prevention effects due to the high phenolic components it contains (Alan & Yılmaz, 2019). Flavonoid content gives the plant diuretic, anti-spasm, anti-tumor, anti-bacterial or antifungal effects (Saboora & Dadmehr, 2013; Jamshidi-Kia et al., 2018). Anti-inflammatory and antimicrobial activities are thought to result from the presence of phenolic compounds, flavonoids and phenylethanoids (Froutan, 2011, Setorki et al., 2009; Dalar et al., 2014; Asgary et al., 2016; Jamshidi-Kia et al., 2018).

Mucilages are high molecular weight carbohydrates that dissolve in water and become swollen and bulky after absorbing water. (Sharifnia, 2007; Jamshidi-Kia et al., 2018). Due to these effects, mucilages are used in skin disorders, respiratory system, sore throat, intestinal problems, and bronchitis treatment (Turker & Gurel 2005).

The emollient, expectorant and laxative effects of mullein are attributed to the presence of saponin and mucilage (Ghasemi et al., 2015). Saponins are glycosides with high molecular weight, and their most important physical property is that they produce foam when dissolved in water. It can be said that these components have diuretic, laxative, expectorant and antitussive effects (Francis et al., 2002). These compounds have been reported to have anti-inflammatory and antifungal effects (Gestetner et al., 1970; Bowyer et al., 1995; Wang et al., 1998). It appears that most of these expectorant, antifungal, and antimicrobial effects are found in *Verbascum* spp. and are related to the presence of mucilage and saponins.

The antimicrobial activity of *Verbascum* spp. is due to the presence of many glycosides and alkaloids (Amirnia et al., 2011). Alkaloids have physiological properties such as anti-inflammatory, analgesic and antimicrobial effects. In addition, some alkaloids are effective on the respiratory system and bronchitis (Turker & Gurel 2005). It is concluded that many of the healing effects reported for plants belonging to this genus are probably related to the presence of alkaloids.

In a study conducted to investigate the teratogenic effect of *V. cheiranthifolium*, it appears that the use of this medicinal plant in pregnant women should be avoided, based on the clear teratogenic effects of the aqueous extract of the plant in terms of causing growth retardation and skeletal anomalies in mouse embryos (Vatanchian et al., 2014).

Verbascum plants are known to have a wide range of biological activities and have therefore been used in folk medicine for centuries. However, information on the metabolites formed in different mullein species is still limited. In recent years, interest in studies on the breed has increased.

5. CONCLUSION

Verbascum species are widely used in traditional medicine as medicinal plants for various diseases, many of which are related to inflammatory processes. These uses can be scientifically justified, considering the chemical composition of these plants and the studies on their biological activities tested in vitro or in vivo.

The popular use of *Verbascum* spp. in folk medicine is for ailments related to its anti-inflammatory properties. Many studies have well confirmed this effect. Such studies have an important role in elucidating potential plantspecies and their phytochemical components that can be used as drug candidates in the treatment of a wide variety of diseases and finding the effective compound. In the case of the studied species, the activity of molecules such as flavonoids (apigenin, apigetrin, luteolin, quercetin, kaempferol, routine, acacetin), iridoids (catalposide), phenylpropanoids (verbascoside), sesquiterpenes and saponins (ursolic acid) may inspire the design of drugs developed to treat a wide range of diseases, including respiratory disorders, which have been of particular interest recently.

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