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Ruscus Species Distributed in Türkiye

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ABSTRACT: *Ruscus species are represented by seven species in the world and four of these species* ***(R. aculeatus L., R. hypoglossum L., R. hypophyllum L.*** *and* ***R. colchicus Yeo****) grow naturally in the flora of Turkiye. Other Ruscus species* ***(R. hyrcanus Woronow., R. x microglossus Bertol.*** *and* ***R. streptophyllus Yeo****) are naturally distributed in different parts of the world. Ruscus species grow between 80 and 100 cm tall. These species have numerous evergreen leaf-like flattened structures, which have photosynthetic capability, on branched stems known as cladodes. The small violet flowers are situated on the center of cladodes. Their orange-red fruits are 5-10 mm in diameter. Ruscus species are perennial plants. In addition to their use as outdoor plants in landscape architecture, these species are mostly used as cut greens for flower arrangements and medicinal purposes, as well as for cosmetic products. Ruscus species are also known as geophytes due to the structure of their storage organs (rhizomes), which are located under the soil surface. In this compilation study, our main aims were to provide information about these species, which grow naturally in Türkiye's flora and are uncontrollably collected from nature and put on the market, to reveal their potential for evaluation as ornamental plants and to increase awareness about these valuable native species to protect our genetic resources. The distribution regions in nature, various morphological properties and different usage areas of four Ruscus species naturally grown in Türkiye are given in detail.*

Keywords: *Ruscus species, geophyte, native plants, cut green, medicinal plant, genetic resources.*

Türkiye'de Yayılış Gösteren Ruscus Türleri

ÖZ: *Ruscus türleri dünyada yedi türle temsil edilmekte ve bu türlerden dördü (****R. aculeatus L., R. hypoglossum L., R. hypophyllum L. ve R. colchicus Yeo****) Türkiye florasında doğal olarak yetişmektedir. Diğer Ruscus türleri (****R. hyrcanus Woronow., R. x microglossus Bertol. ve R. streptophyllus Yeo****) dünyanın farklı yerlerinde doğal olarak dağılmıştır. Ruscus türlerinin boyları 80 ile 100 cm arasında değişmektedir Bu türler kladod olarak adlandırılan, fotosentez yeteneğine sahip, herdem yeşil çok sayıda yaprak benzeri yassı yapıya sahiptir. Küçük mor çiçekler, örtülerin merkezinde yer alır. Turuncu-kırmızı meyveleri 5-10 mm çapındadır. Ruscus türleri çok yıllık bitkilerdir. Peyzaj mimarlığında dış mekan bitkisi olarak kullanımının yanı sıra, bu türler çoğunlukla kesme yeşillik olarak çiçek aranjmanlarında, tıbbi amaçlarla ve kozmetik ürünlerde kullanılmaktadır. Ruscus türleri toprak yüzeyinin altında bulunan depolama organlarının (rizomlarının) yapısından dolayı geofit olarak da bilinmektedir. Bu derleme çalışmamızda temel amacımız, Türkiye florasında doğal olarak yetişen ve kontrolsüz bir şekilde doğadan toplanıp piyasaya sürülen bu türler hakkında bilgi vermek, süs bitkisi olarak değerlendirilme potansiyellerini ortaya koymak ve bu değerli bitkiler hakkında farkındalığı artırmaktır. Genetik kaynaklarımızı korumak için yerli türler. Türkiye'de doğal olarak yetişen dört Ruscus türünün doğadaki yayılış bölgeleri, çeşitli morfolojik özellikleri ve farklı kullanım alanları ayrıntılı olarak verilmektedir.*

Anahtar kelimeler: *Ruscus türleri, geofit, doğal bitkiler, kesme yeşillik, tıbbi bitki, genetik kaynaklar.*

INTRODUCTION

Türkiye is located at the intersection of two important gene centers (Mediterranean and Near East) and three important biogeographic regions (Europe-Siberia, Mediterranean, Iran-Turan). The existence of three different bioclimate types in Türkiye, different topographic and geographical conditions, as well as different soil types and wetlands (sea, lake, fresh-salty and soda waters) have enabled the formation of different ecosystem types. These natural conditions bring a rich biodiversity that does not exist in many countries (Anonymous, 2007), so Türkiye has as much plant biodiversity as the entire European continent with 12,000 plant species. In terms of endemic

species, it is richer than the European continent with more than 4,000 species (Kaya, 2014).

Very few commercially ornamental plant species are produced in Türkiye, instead of this they are grown and sold after being imported from abroad as saplings, seedlings and cuttings (Karakurt and Gümüş, 1998; Çelikel, 2014; Erken, 2016). The fact that the genetic resources in Türkiye are not sufficiently defined and their characteristics are not sufficiently revealed, not evaluated for breeding purposes and not being registered makes it difficult to protect these species (Erken, 2016). It is very important to cultivate the species that can grow in different regions in the natural vegetation, to produce them as ornamental plants and to investigate the possibilities of their use in landscaping, not only in terms of protecting the natural environment but also for economic benefits (Kostak, 1992). Moreover, the development and dynamism of the ornamental plants sector at the national level is closely related to the inclusion of new products in the market and the establishment of production and marketing policies (Karagüzel *et al*., 2010). Ornamental plants generally include cut flowers and cut greens, potted plants and other plants used for landscaping. The ornamental plants sector is divided into four different activity areas: cut flowers, indoor ornamental plants, outdoor ornamental plants and natural flower bulbs (geophytes) (Alp, 2022).

In Türkiye, almost all cut greens are collected from nature. *Ruscus* species are one of these cut greens. Species within the *Ruscus* genus are among the plant groups called geophytes. These group of plants with specialized underground storage organs such as bulbs, tubers and rhizomes are an important source of the biodiversity in the flora of Türkiye. In addition to their cosmetic and medicinal uses due to their herbal content, these plant groups have an important value as ornamental plants since their flowers bloom in winter, fall and spring (Özzambak *et al*., 2007; Ergun *et al*., 1997; Karaoğlu, 2010; Haspolat, 2011; Çelikel, 2014; Kebeli, 2021). In addition, there is a limited number of plants that can be used in landscape areas where sea wind is effective or in shade and semi shade areas which increases the importance of this species (Baktır and Yılmaz, 2010).

The genus *Ruscus* has been included in different families, such as *Convallariaceae* and *Liliaceae*, including different *Ruscaceae* families before being included in *Asparagaceae* by the APG III (Angiosperm Phylogeny Group) classification system (Kim *et al*., 2010; Thomas and Mukassabi, 2014; Masullo *et al*., 2016). Plants within the genus *Ruscus* are generally distributed in Southern and Western Europe and the Mediterranean (Thomas and Mukassabi, 2014; Masullo *et al*., 2016). *Ruscus* species are represented by seven species, distributed from Europe to Iran (Yeo, 1968). These species are *Ruscus aculeatus* L., *Ruscus colchicus* Yeo., *Ruscus hypoglossum* L., *Ruscus hypophyllum* L., *Ruscus hyrcanus* Woronow, *Ruscus x microglossus* Bertol and *Ruscus streptophyllus* Yeo. The most widespread species among the *Ruscus* species is *Ruscus aculetus*. *R. hypoglossum*, *R. hypophyllum* and *R x microglossum* species are seen in the Mediterranean region. *R. streptophyllus* is an endemic species and is native to the Madeira islands. *R. colchicus* is endemic to the Caucasus and *R. hyrcanus* to Azerbaijan (Veronese, 2015).

Four *Ruscus* species are naturally distributed in the flora of Türkiye, especially in forested areas of broad-leaved trees, meadows and rocky bluffs. These plants have characteristics that are important for the ornamental plants sector such as their form, the position of their fruits on the cladodes, drought resistance, high competitive power with other plant species and long vase life. Indeed, *R. aculeatus, R. hypoglossum and R. hypophyllum* species are the most traded herbaceous cut green species in the world (Ergür *et al*., 2016). In addition, some phytochemicals derived from these species, such as ruscogenin and neuroruscogenin, allow these plants to be used in the pharmaceutical and cosmetic industries.

R. aculeatus is generally called butcher's broom. The species is named this because in ancient times butchers cleaned the boards on which they cut meat with the shoots of these plants. The cladodes of *R. aculetus*, which are hard and spiny at the ends, were placed around stored crops in Germany to protect them from pests. This species is therefore called 'mouse stinger' in Germany (Masullo *et al*., 2016). *R. hypophyllum* species is sold on the market as 'Israeli Ruscus'.

Ruscus species are perennial, evergreen shrub-like plants with rhizomes and produce multiple shoots on their rhizomes. The shoots are green in color and grow upright up to 1 m. In *Ruscus* species, the tissues that

appear as leaves on the stem are actually flattened stems called cladodes (Masullo *et al*., 2016). Cladodes are highly developed in terms of photosynthetic activity, and in this respect, they have taken the place of true leaves. The true leaves are absent on the plant or reduced to small scale-like structures (Veronese, 2015). Cladode structures can reach between 2-18 cm in length and 1-8 cm in width. Flowers and subsequent fruits are formed on the cladodes. Fruits are spherical, bright red with a diameter of 8-14 mm and form 1-4 mm large seeds inside (Masullo *et al*., 2016). *Ruscus* species form strong but flexible shoots from the soil surface every year. These plants reproduce with fleshy and robust rhizome structures under the soil. The flowers are actinomorphic and have a horizontal or drooping stance (Veronese, 2015). Some *Ruscus* species are monoecious and some ruscus species are dioecious. Male and female plants are generally quite similar in appearance (Masullo *et al*., 2016). However, male and female plants differ from each other in some characteristics. Male individuals produce numerous shoots that grow upright. Female plants form larger but fewer shoots that grow horizontally (Halada and Erdelska, 2005).

Vegetative and generative methods can be used in the production of *Ruscus* species (Stamps, 2001; Ergür *et al*., 2016). Seeds of *Ruscus* species are dormant and this dormancy period can last up to one year. Vegetative production of *Ruscus* species is carried out by dividing the rhizomes, which are the underground organs (Stamps, 2001; Halada and Erdelska, 2005).

The aim of this review is to introduce the four *Ruscus* species naturally distributed in Türkiye (*R. aculeatus*, *R. hypoglossum*, *R. hypophyllum* and *R. colchicus*), to emphasize their importance and to give an idea for future studies on the species. Also the botanical characteristics and different uses of other *Ruscus* species distributed in the world are summarized in the review.

RUSCUS SPECIES IN TÜRKİYE

Ruscus aculeatus L.

This species is found in Europe, Africa, and the Near East in oak, pine and beech forests and scrub areas. This species is indicative of a Mediterranean habitat. It is quite common in the south of England (Veronese, 2015). In Türkiye, *R. aculeatus* species are distributed throughout the Black Sea Region, Mediterranean Region, Main Aegean Region, South Marmara and Kocaeli-Çatalca regions (Anonymous, 2023a) *R. aculeatus* is an evergreen perennial herb. It is adapted to shade and semi-shade areas.

Plant height can reach up to 80 cm. It produces green-white flowers and red-orange round-shaped fruits (Tamer and Baktır, 2013; Ergür *et al*., 2016.) There are storage organs called rhizomes under the soil. New shoots are formed every year in the shoot eyes formed between the nodes and internodes on the rhizomes. Young shoots become mature within one year. Branching is seen on the shoots. On these branches, there are flattened stem structures called cladodes. These structures are capable of assimilation. The tips of the cladodes are spiny. It is a dioecious species. It is resistant to -15 to -20 °C temperatures. Branching is seen on the shoots (Veronese, 2015). Flowers and fruits of the species are formed on these structures. Dormancy is observed in the seeds (Kebeli, 2021). The greenish flowers appear in spring and the plant bears red berries in fall (Figures 1 and 2).

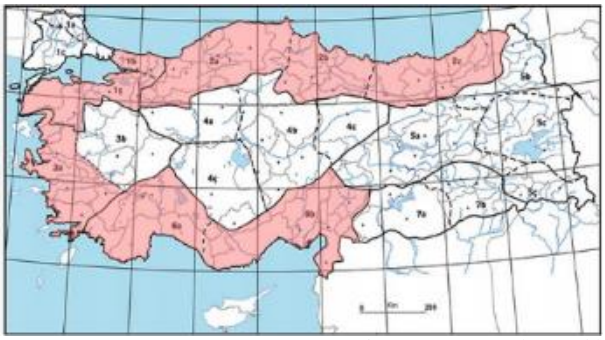

Figure 1. Natural distiribution zone of *R. aculeatus* in Türkiye (Anonymous, 2023a).

Figure 2. *R. aculeatus* (F. KEBELİ, Beykoz).

Ruscus hypoglossum L.

This species is distributed in the Danube region of Italy and Anatolia in broad-leaved forests (usually beech forests and up to 1.400 m altitude) (Veronese, 2015). In Türkiye (Figure 3), *R. hypoglossum* is distributed in the Central and Western Black Sea, Catalca-Kocaeli, Southern Marmara and Istranca regions (Anonymous, 2023a). *R. hypoglossum* is an evergreen perennial plant with rhizomatous subsoil organs. New shoots are formed on the rhizomes every year, and the new shoots reach maturity within one year. Shoots maintain their vitality for an average of four to five years. Shoot lengths can reach up to 45-50 cm. Unlike *R. aculeatus*, there is no branching on the shoot. The cladode structures are longer and wider, and there are no spines on the cladode tips. This species has broad leafy bracts. For this reason, in Italy it is called "bislingua" (double tongue). One of the 'tongue' structures is the bract leaves and the other is the cladodes (Figure 4). Cladodes have a dark green color. It is a dioecious species and is resistant to -15 to -20 ˚C in winter (Veronese, 2015). Round, orange-red fruits are formed on the cladodes. Dormancy is observed in the seeds (Kebeli, 2021).

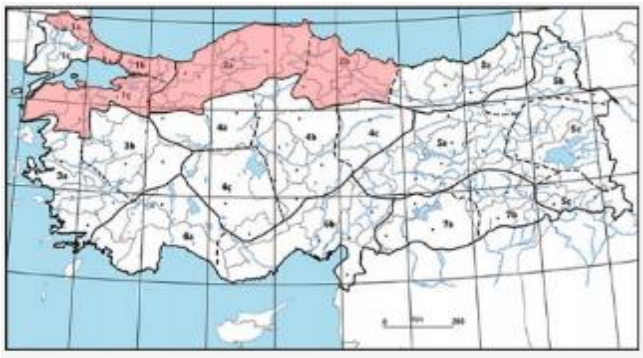

Figure 3. Natural distiribution zone of *R. hypoglossum* in Türkiye (Anonymous, 2023a).

Figure 4. *R. hypoglossum* (F. KEBELİ, Beykoz).

Ruscus hypophyllum L.

R. hypophyllum is distributed throughout the western Mediterranean region, especially from North Africa to Tunisia. It is found in the natural flora of the Aegean Region and Catalca-Kocaeli Regions (Figure 5) in Türkiye (Anonymous, 2023a). *R. hypophyllum* is an evergreen, perennial, shrub-like plant. New shoots form on the rhizomes every year. Cladodes are spineless, dark green in color and approximately 8 cm long (Figure 6). The fruits are round, approximately 1.3 cm long and bright red in color. It is adapted to shade and semi-shade areas. It is a drought-resistant species (Stamps, 2001). Bract leaves are quite small. The flowers of this species can occur in different positions on the cladodes. Flowers can occur on the lower, upper, both lower and upper parts of the cladodes on the same plant, or rarely on both the upper and lower surface of the same cladode. It is resistant to low temperatures of -5 to -10 ˚C in winter. Shoots can grow up to 70-100 cm in length (Veronese, 2015).

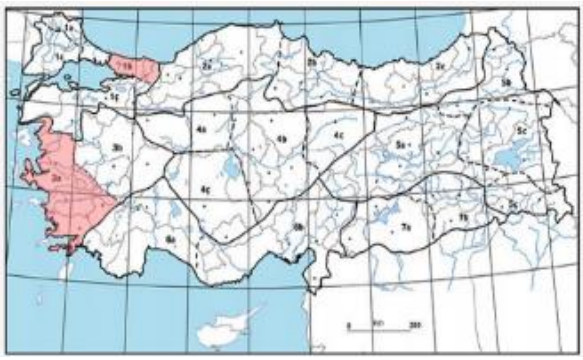

Figure 5. Natural distiribution zone of *R. hypophyllum* in Türkiye (Anonymous, 2023a)

Figure 6. *R. hypophyllum* (Anonymous, 2023b).

***Ruscus colchicus* Yeo.**

This species is naturally distributed in the eastern parts of the Black Sea Region of Türkiye (Figure 7), from the northeastern coast to the deciduous forests of the South Caucasus at an altitude of 500 m. (Veronese, 2015; Anonymous, 2023a) *R. colchicus* is an evergreen shrub-like species. The shoots can grow up to 60 cm in length and do not branch. The cladodes are 13 cm long, 8 cm wide and have thornless tips (Figure 8). Fruits are formed on the lower surface of the cladodes. The cladodes are distinctly pale green in color, giving the species a delicate appearance. Flowers are abaxial on the cladodes. It can survive at temperatures as low as -10 ˚C in winter, and flowering occurs between February and April (Veronese, 2015).

Figure 7. Natural distiribution zone of *R. colchicus* in Türkiye (Anonymous, 2023a).

Figure 8. *R. colchicus (*Anonymous, 2023c).

OTHER *RUSCUS* SPECIES AROUND THE WORLD

***Ruscus hyrcanus* Woronow.**

R. hyrcanus is one of the rare endemic species of the Talish mountains in the territory of Azerbaijan. Branching is observed on the shoots formed on the plant. The shoots grow between 30-50 cm in length. Cladodes are dark green and spiny at the ends. It is a dioecious species. It can withstand temperatures as low as -10 °C in cold periods (Veronese, 2015).

***Ruscus x microglossus* Bertol.**

R. x microglossus is very attractive with its curved, thornless cladodes of metallic green color, sometimes branching shoots and its prostrate appearance. The species can grow up to 60 cm in height. Flowering can be observed all year round. This species is thought to be a hybrid of *R. hypoglossum* and *R. hypophyllum* due to the similarity of the leaf structures, the small bracts and the structure and position of the abaxial flowers. The species is resistant to low temperatures down to -5 ˚C (Veronese, 2015). It is native to Italy (Anonymous, 2024a).

***Ruscus streptophyllus* Yeo.**

R. streptophyllus is the rarest species in the genus and occurs in the shade and rocky areas of Laurissilva forests on the Madeira Islands. The species can grow shoots up to 60 cm in length. The cladode structures are dark green and horizontal. The species is distinguished within the genus by having resupinate cladodes with small bract leaves and adaxial flowers. This species blooms in winter and early summer. It is the only species among *Ruscus* species with monoecious flower structure (Veronese, 2015).

USAGES OF *RUSCUS* SPECIES

Ruscus species are one of the important plant species in the ornamental plants market as cut foliage in the world. This species is used as an outdoor plant as well as a background filler in arrangements. However, there are also presentations in the form of different plant arrangements created by using its shoots at Christmas time in Türkiye (Ergür *et al*., 2016).

Young shoots of *R. aculeatus* are used as food like asparagus shoots in Mediterranean countries and the seeds have also been used as a coffee substitute

(Masullo *et al*., 2016). In some parts of Italy, young shoots of *R. aculeatus* are consumed as food to restore food traditions and increase product diversity (D'Antuano and Lovato, 2003). Fresh leaves of *R. hypoglossum* species are used against mastitis in livestock (Hadzifejzovic *et al*., 2013). *R. colchicus* species are used by local people in animal feed to increase milk yield and fat content (Perrone *et al*., 2009).

Although the aerial parts of *Ruscus* species are edible, their underground organs, rhizomes and root structures, are used as phytotherapeutic products in traditional medicine. Since the Middle Ages, young shoots from *R. aculetus* species have been consumed as food as well as used in the treatment of urinary disorders and abdominal pain (Balica *et al*., 2013). Extracts from the species *R. aculeatus* are used as a vascular inhibitor and tonic for disorders involving the venous system, including varicose veins (Bouskela, 1993a; Bouskela, 1993b).

The most pharmacologically studied *Ruscus* species is *R. aculeatus*. Phytochemicals obtained from *Ruscus* species are among the natural preparations included in venoactive drug groups (Eriş, 2010). The steroidal saponins ruscogenin and neuroruscogenin were identified in *Ruscus* species in the mid-20th century. *R. aculeatus* preparations have been used in Europe for more than 40 years for the treatment of chronic venous insufficiency and vasculitis (Bouskela *et al*., 1994; Huang *et al*., 2008). Since the discovery of the vasoconstrictive and venotonic properties of ruscogenin and neoruscogenin, *R. aculeatus* has been widely used, especially in Germany and France. It has been used to treat chronic venous insufficiency, varicose veins, hemorrhoids and orthostatic hypotension (Balica *et al*., 2013). Beside these that primary steroidal saponins (ruscogenin and neuroruscogenin) obtained from *R. aculeatus* species increase vascular strength in line with clinical studies and also prevent blood from leaking out of the vein by increasing the elasticity of the vessel walls (Anonymous, 2021). In addition, in the "Materia Medica" written by the physician Diocorides in the first century, the laxative and diuretic properties of the underground parts of the *R. aculeatus* plant were mentioned (Başer, 2013). Balica *et al*. (2013), the underground parts of *R. aculeatus* are used as diuretic (diuretic) as well as for the treatment of hemorrhoids and atherosclerosis due to their anti-inflammatory (pain relieving, edema relieving, antipyretic) properties. In addition, the drug 'Proctolog', which is used in the treatment of hemorrhoids produced using ruscus extracts by a private pharmaceutical company contains 0.5 g ruscogenin in cream formulation and 10 mg ruscogenin in suppository formulation (Anonymous, 2021). *Ruscus* extracts have been traditionally used in Europe for many years in the treatment of circulatory system diseases. In traditional medicine in Türkiye, the roots of *R. aculeatus* are boiled and used as diuretic and also against nephritis, eczema and kidney stones (Güvenç *et al*., 2007). In Palestine, extracts from the rhizomes of this species are used as folk medicine in the treatment of skin diseases (Ali-Shtayeh *et al*., 1998), and in Italy for the treatment of warts and chilblains (Guarrera, 2005).

R. hyrcanus is traditionally used in Iran as a diuretic, antilaxative, appetizer, vasoconstrictor, anti-varicose veins and laxative (Dehghan *et al*., 2016).

Aerial plant parts of *Ruscus* species are used in traditional medicine, too. In Türkiye, the fruits of *R. hypoglossum* species are boiled and used in the treatment of skin disorders such as chilblains and warts (Hadzifejzovic *et al*., 2013)

Ruscogenin extracted from *R. aculeatus* rhyzome is recently used as cosmetic and body shaping products (Ivanova *et al*., 2019; Walasek-Janusz *et al*., 2022). Herbal extracts obtained from the species, especially *R. aculeatus*, are used by private companies in different formulations in the cosmetic industry, such as astringent, refreshing, skin conditioning, soothing, stabilizing and tonic (Anonymous, 2024b). Also, the roots of the species are used as a vegetable dye to produce yellow color when boiled with fabrics (Nath and Kültür, 2016).

DISCUSSION AND CONCLUSION

Ruscus species are commonly known as “silcan, tavşanmemesi, tavşan kirazı, diken kökü, yandak dikeni, kandak or sıçan dikeni” (Güvenç *et al*., 2011). In terms of their phytochemical content, especially the components ruscogenin and neuroruscogenin are used in different formulations in the treatment of circulatory system disorders, in the treatment of skin diseases and in the cosmetic industry as human health products. Also these species, which are naturally distributed in the flora of Türkiye, have the opportunity to be used in landscape areas as outdoor

plants for different purposes in terms of the botanical properties they have, and as cut greens in floral arrangements such as bouquets, wreaths and other arrangements. Especially *R. hypophyllum* species gain value as cut foliage in terms of the length of their shoots and cladode structures. Similarly, the shoot structures of *R. hypoglossum* species and the number and arrangement of cladodes are very suitable for use as cut greens. The cladodes of *R. colchicus* have a thornless structure like *R. hypophyllum* and *R. hypoglossum* but with much larger cladodes. Since *Ruscu*s species generally have a long vase life, they have possibility of use indoors in vases for decorative purposes. In addition, after the shoots are dried, the cladodes are painted in different colors and can be used for decorative purposes indoors. The shoots of the *R. aculeatus* species are collected from nature, especially at Christmas time, and the seeds of the Smilax plant are tied to the top of the shoots and sold in bunches named "kokina". These species can also be used as border plants in landscaping due to their tolerance to shade and their competitive power.

R. aculeatus species are collected from nature for different uses, especially to meet the demand of the pharmaceutical industry. For this reason, it has been reported that the populations of *R. aculeatus* have disappeared in some collecting areas located in the Central and Western Black Sea. In Türkiye, most of the roots of *R. aculeatus* species are harvested from Samsun, Adapazarı, Balıkesir, Bursa, Çanakkale, Adana, K. Maraş, Osmaniye provinces. Although it varies from year to year, around 900 tons of plant material (Anonymous, 2021) (dry and cleaned roots) are exported mainly to France (Ozer *et al*., 2018).

The cultivation and conservation of these species, which are naturally found in the flora of Türkiye and have the opportunity to be used in different fields from medicine to food, from animal feed to cosmetics sector in terms of their herbal ingredients and botanical properties, is of great importance in terms of conservation. In addition, it is of great importance to give due significance to these *Ruscus* species in order to produce value-added products from these species, which are the source of herbal chemicals such as ruscogenin and neuroruscogenin used in medicine and cosmetics, to contribute to the national economy and to take place in large markets such as the medical and cosmetics sector with locally produced products.

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