

Economic Importance and Using Purposes of *Gypsophila* L. and *Ankyropetalum* Fenzl (Caryophyllaceae) of Türkiye

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Abstract: *Gypsophila* L. is the third biggest genus of Caryophyllaceae family in Türkiye. 55 species of the genus have been growing naturally in our country. 33 of them are endemic and total number of the taxa is 55. *Ankyropetalum* Fenzl is a small genus with 3 species and 1 of them is endemic. It is agreeable that gene center of the both genera is Türkiye. In terms of growing habitats there are large areas in Türkiye. According to importance order East, Central and Southeast Anatolia regions have the biggest number of taxa growing there. *Ankyropetalum* genus distributed only in the Southeast Anatolia and Mediterranean regions and in their intersection areas of Türkiye.

Both of the genera have known as “çöven, çöğen”, halvah root and largened root parts or rhizomes are economically very important. Extracts produced from under parts of the plants known as fire extinguisher, gold polishing, silk and cloth cleaner and softener and crispness giving to halvah. These extracts have often used for making liqueur, preparing herbal cheese and making ice cream. Because of giving flavour, crispness and nice odor they generally preferred in food industry.

With different ratios all of the taxa are boron (B) hyperaccumulators. For this reason they can be used for destroyed agricultural areas. They can be planted to elevated slopes and hills to control erosion and survive biological diversity. General character of the family is their importance for horticulture. *G. paniculata* is very important for horticulture industry. In the presentation, some information about economic importance of the plants in the light of our observations and literatures were given.

Key Words: *Gypsophila*, *Ankyropetalum*, Economy, Flora of Türkiye

Introduction

Turkey is known as a gene centre of many economic groups of plants. In Turkey there are 32 genus and around 500 species of Caryophyllaceae family [1-6]. It is reported that the centres of some regions in which the species belonging to the *Gypsophila* genus are pervasive are Turkey, Caucasian, the North Iraq and the North Iran; that 75 out of 126 *Gypsophila* species in the world are found in this region and that in Turkey there have been found 55 *Gypsophila* species in 10 sections [7-8]. In the world *Ankyropetalum* genus has 4 species, and 3 of which grow in Turkey. The gene centre of both genus is Turkey.[9].

In general, soaproot is the woody roots of some perennial species of the genera *Gypsophila* L., *Saponaria* L., and *Ankyropetalum* Fenzl, belonging to the Caryophyllaceae family. However, *Saponaria* is not used as soaproot in Türkiye [10].

Turkish Çöven are commonly obtained from *Gypsophila graminifolia* Bark. *G. arrostii* Guss. var. *nebulosa* (Boiss. & Heldr.) Bark., *G. eriocalyx* Boiss., *G. bicolor* (Freyn & Sint.) Grossh., *G. perfoliata* L., *G. venusta* Fenzl subsp. *venusta* and *Ankyropetalum gypsophiloides* Fenzl. [7, 10]. But such species as *G.*

ruscifolia Boiss. and *G. bitlisensis* Bark. are less preferred. Since 1800s soaproot has been exported from Anatolia (Turkey). The leading ones are *G. bicolor*, *G. arrostii* ve *A. gypsophiloides* (Radix Gypsophilae) [11-14]. For nearly 30 years the extraction of Çöven from natural flora has been increasingly continuing in the Eastern and South-east Anatolia [10].

Ankyropetalum Fenzl is represented by 3 species in Turkey. One of these is endemic and the others are not widespread. The genus is essentially pervasive in South-west Asia including Turkey. Regarding the phytogeography the genus grows in the South east of Turkey; that is in Iran-Turan and Mediterranean regions [14, 15]. The species belonging to the *Ankyropetalum* genus which is pervasive in Turkey are *A. arsusianum* Ky, *A. reuteri* Boiss.& Hausskn. (endemic) and *A. gypsophiloides* Fenzl. The genus is found in South-east Anatolia and its neighbour countries in borders [1, 14, 15].

The taxa belonging to the *Ankyropetalum* and *Gypsophila* genus and known and used by the public are generally known by the name “Çöven Otu” . As the *Ankyropetalum* genus’ members look like perennial *Gypsophila* species and as they are distinguished hardly, they are known by the same name and used for the same purposes. In Europe *Gypsophila* species are widely known as “Baby’s Breath”. For the word *Gypsophila* “Soaproot” or “Soapworth” words are used. In Turkey these plants are called “çöven otu, çevgen, diş çöven, tarla çöveni, helva çöveni, şark çöveni” by the local public.

It is reported that the saponins are found in the different parts of the plant in different doses; that they were first obtained by boiled alcohol from the risoms of *Saponaria officinalis* and that they are called “saponin” [11]. It is reported that as the roots of Soaproot are obtained from various *Gypsophila* species, the saponin amounts in the roots which are used in the trade differs between (4-)10-20(-25) % [22]. Used as Turkish Soaproot, in the *Gypsophila bicolor* (Van Çöveni) the saponin amounts have been found to be 20-25 %, in the *G. arrostii* var. *nebulosa* (Konya, Beyşehir, Isparta Çöveni) 19-22 %, in the *G. perfoliata* (Niğde Çöveni) 15-19 % and in the *G. eriocalyx* (Çorum- Yozgat Çöveni) 10-14 % [17]. They have found out that in the *G. paniculata* the saponins synthesizes only in the roots and then moving through the other parts of the plant and that in dry material there is around 4 % saponin [20]. They report that in the Soaproot originated in Anatolia the amount of raw saponin is 10-25 %; and in their searches on the taxa of *G. bicolor*, *G. perfoliata* var. *anatolica*, *G. venusta* subsp. *venusta*, *G. eriocalyx* and *G. arrostii* var. *nebulosa* which are pervasive in different parts of Turkey the amounts of saponin are respectively 19.58 %, 14.44 %, 12.65 %, 12.39 % and 11.58 % [20]; and the amounts of protein are respectively 8.01 %, 7.80 %, 8.38 %, 8.15 % and 6.92 % [7].

It is stated that in the roots of *G. paniculata* with the affect of the enzyme of UDP-Glucuronosyltransferase the synthesis of saponin has been increased considerably and that in order to define the activity of this enzyme which has a versatile role in the plants the *G. paniculata* species would be a good model plant [17].

The Production of Soaproot Extract

The roots and risoms of Soaproot



Cut in the form of chips



The first boiling (4-5)



The second boiling



The extract of Soaproot



The extract of Soaproot whose production stages and chemical formule have been shown above is composed of sugar, resin and saponin. Saponins are highly molecular glycosides which has the characteristic of solution in water and which are widely seen in some plants especially in *Saponaria*. It keeps the plant from germs and fungus and some species of it increases the nutritional value of plant as well as simplifying the digestion [18].

Where is soaproot used?

Its usage in the food industry

It is known that *A. gypsophiloides* was formerly exported from Siirt and Batman by caravans and that it is known by such names as “Helva kökü, Çöven otu, Sabun otu, Helva otu” and that it is especially used in preparing a local food called “Siirt sweet”. *A. reuteri* is called “çöven” by the local public around Gölbaşı (Adıyaman); it is used for animal feeding by mixing with straw and it is said that it was formerly used for the purpose of animal feeding [9, 11,12].

In the Eastern Anatolia, the roots of some soaproots are used in preparing a local and original food kind “herby cheese”. [8, 13-14]. The use of extract of Soaproot is firstly an obligation in making “tahin helvası (halvah)”. Otherwise it is impossible to make the halvah crisp. Apart from halvah, it is utilized for the production of “delight” and “icecream” and also in Thracian region because of its characteristic of whitening wax and its power to make crisp soaproot is utilized in the “köpük halvah” which has a white and spummy form. Furthermore, in some parts of Turkey while making “hellim cheese” after soaproot is cooked it is added to the brine so that the cheese doesn't spoil [8, 18, 19].

It is stated that the delight obtained by mixing syrup whitened by soaproot extract with pure delight is called “sultan delight” and that the maximum saponin amount should be 0.1 % [7]. The main reasons of why soaproot is most preferred for the halvah production are those; the saponin in the soaproot whitens the sugar wax, saponin softens the sugar and makes like sponge, and it has a function like emulgator by enabling the sesame oil to mix with sugar. In halvah production the amounts used are respectively 52-65 % tahini, 35-48 % sugar, 0.5 % soaproot [17]. In the production of “köpük halvah” soaproot and sugar are boiled in water and added after it takes the wax form. Soaproot water is used in production of “köpük halvah” which is half-liquid and has a little hard stiffness. When adding soaproot water there are two elements to be taken into consideration; firstly, its amount shouldn't exceed the average level and second, when adding soaproot the pot should be covered. Otherwise the air absorbed leads to overbubbling. When making “köpük halvah” it can be used about 60- 65 % glucose syrup, 30- 35 % water and 0.01 % soaproot water [18].

Some kinds of *Gypsophila arrostii* var. *nebulosa* are economically valuable and in Konya and Beyşehir it is called “dişi çöven (female soaproot)” because of its multiplying fast. Roots of the other soaproots known as “erkek çöven (male soaproot)” are not widely used in trade. In their rhizomes there are saponin, resin and sugar. Because they are widely used in production of “tahini halvah” in Turkey and Near East they are called “helvacı çöveni (halvah soaproot)”. In some of our cities and in Cyprus in order that the “hellim cheese” which is boiled and made salted does not spoil, soaproot root is added to its water. In Thracia region a white spummy halvah known as “köpük halvah” is produced by soaproot [20].

Its Usage in The Chemistry and hygiene Industry

Soaproots are also used in the manufacturing of Saponin which is a valuable chemical substance [8, 21]. Saponins are components which have pervaded in wide districts, which are in the form of heavy molecular steroidal or triterpenoid glycsides and which have a great biological activity on plants, insects, fungus and microorganisms. Their lower doses helps the plants have roots; however higher doses decreases root growing [7].

As quoted from Çevrimli (1990); it is expressed that because of the negative impacts of alkil and aril sulfanat types of detergants on environmental pollution and human health, the usage of saponin present in *G. arrostii* as an active surface substance of detergent will be more beneficial, the saponin present in the plant will be easily used as an active surface substance in both extinguishers and soap industry, and that in the plant rhizomes there has been found around 18 % saponin [7].

Because it has a good characteristic of bubbling, soaproot is being utilized for soap, shampoo materials or fabric softener in hygiene industry. In the cool water obtained from the soaproot roots boiled, the silky and delicate fabrics and the other fabrics which are otherwise deteriorated are cleaned. Fabrics or clothes are cleaned by being dipped into the cool water obtained and are kept waiting for a few hours without spoiling their colors and brightness. Moreover, in some regions they are used in order to clean the wool obtained from the animals. [8, 18, 19]. The undersoil parts of *G. arrostii* have been used as a cleaner and a removal of stain since ancient times. [21].

Its Usage In Medicine

It is reported that in the antraks vaccine which is against Antraks disease seen among animals and which is produced in Turkey, the saponin amount has been found to be % 0.1- 0.5. It has been found out that saponins

are in the seeds, limbs, leaves, flowers and roots of plants; and that when the plants containing saponin are eaten by animals, the bitter-flavoured saponins have irritated mucosa cells in throat. Such types as *G. paniculata* and *G. arrostii* are used as a cough and respiration system diseases deterrent besides being used as a myx remover [7]. Soaproot has some features such as urine remover, exudative and myx remover [18]. As for drug, it has a function in some drugs compound when they are brewed because of its characteristics such as myx and urine remover [19].

Its Antimicrobial Effect

It is known that saponin has an antimicrobial effect and it keeps the plants against some insects in soil. Besides this, it is estimated that it has a role of increasing the plant resistance in some parts of plants. It is reported that in the soil in which the plant containing saponin grows there has been found to be saponin in certain amounts and this saponin in the soil has some impacts on some bacteria. It has been found that *Aquaspirillum dispar* and *Aquaspirillum* spp. soil bacteria have been in great numbers in the roots of *G. paniculata* [7]. In the search of *Gypsophila* species' antiviral impacts it has been expressed that *G. arrostii* var. *nebulosa*, *G. bicolor*, *G. perfoliata* and *G. eriocalyx* species have impacts on *V. stomatitis* virus, that they have no impact on *Parafainfluenza* type-1 virus and that the *G. bicolor* species has effectiveness against the other viruses (*Poliovirüs tip-1*, *Herpes simplex tip-1* ve *tip-2*, *Vesicular stomatitis* ve *Influenza A₂*) except *Parafainfluenza* type-1 virus [7, 22].

Its Usage in Horticulture

Gypsophila species are regarded as one of the most important alternatives of product diversification in the sector of flower cutting. *G. paniculata* species used as fresh and dry cut flower attract attention as being one of the most indispensable elements of arrangement and bouquet in domestic market [7, 8].

It has been reported that in Eurasia continent there have been found to be 125 species of *Gypsophila*, that the most significant of those to be used as ornamental is *G. paniculata*; that although the plant is perennial it has been grown annual and that because it cannot enable blossoming in short time and because it has no genetic evolution it is more advantageous to multiply it by cutting. It has been expressed that *G. paniculata* species has a great importance in the trade of cut flower; that although with the reparation studies the desired plants have been obtained, from these plants whose seeds are cultivated the desired plants will not be able to be obtained and that they may have genetic evolution so the plants should be grown with vegetative organs. They have found that in the *G. paniculata* species which is used in horticulture their harvest should be done when their petals have exceeded 50 % blossoming, the vase lifespan in plants has reached about 55 days with the blossoms of buds in vase and that during 82 days the flower harvest can be done on plants. In *Gypsophila paniculata* species which is used in horticulture in the flower buds, the flowers should be harvested when they blossomed 30 % and so the vase lifespan increases. They have informed that because in coastal regions of Mediterranean the floral deportation obtained in unit area for the production of *G. paniculata* will be more it can be advised to cultivate around coastal parts of The Mediterranean Region [7].

Its Usage in Mining

As a result of the studies on natural-growing 4 *Gypsophila* species in the district of boron (B) mine in Eskişehir Kırka; it has been observed that *G. sphaerocephala* Fenzl ex Tchihat. var. *sphaerocephala* and *G. perfoliata* have been the first ones which have a characteristics of a potential boron hyperaccumulator. These species grow successfully in concentrations as high total soil boron (8900 mg/kg-1) and suitable soil boron (277 mg/kg-1). As a result of the analysis conducted, it has been found out that in the upper soil parts of the *G. Sphaerocephala* it has contained B in extremely high concentrations (in seeds; 2093 ± 199 SD mg / kg-1; in leaves; 3345 ± 341 SD mg / kg-1), but in roots it has contained far less concentrations of B (51 ± 11 SD mg kg-1). In the respect of Boron amount this has been followed by *G. perfoliata*. It has been stated that by growing *G. sphaerocephala* in the soils which have some signs of high B toxid, vegetative mining can be conducted by hyperaccumulation and the soils containing boron in toxic amounts can be refined by vegetative ways [23]. In this way the agricultural fields in which fertilizers have long been used can be prevented to become barren and during reparation process it will be possible to evaluate the agricultural fields which have become dormant.

Its Other Usages

Apart from these, the cool water obtained from the boiling of soaproot roots is used in the process of whitening gold and treasures. Furthermore this solution is used as spray in the structure of film emulsion and

extinguishers. It is known that the rhizomes of perennial soaproot sold to Israel from Isparta are used in the production of extinguishers [7, 8, 21].

Picking, drying and storing the plants

Because the subsoil parts of the plants are generally utilized, from just after the precipitation season to the time of plant's fruit; that is between May- July the plants are picked. The local public utilizes its root when its leaves are on land area or when they are in the time of blossoming; they can distinguish *Gypsophila* species between others and they can extract its rhizomes by means of such tools as anchor. Because the subsoil parts of the plant are also picked, with an unconscious picking they are endangered. The roots which are picked are cleaned and after washing them, they are dried under sun. In order to dry well and in order to enable some fresh air during this process the rhizomes shouldn't be laid down thick. The subsoil organs are brought in bundles and are stored in suitable, dry and moisture free places [19].

It is reported by Anonim (2006) that in the roots of soaproot plant which can be grown in barren and hillside areas there have been found to be some dryings because of extreme damp; that it is not suitable to harvest them before four years old; that their trade situation should be considered before harvesting and if necessary the product should be waited in the field; that the roots extracted by fork or tractor plough have dried in 2-3 months and from 2.5 kg raw root about 1 kg dry root has been obtained; and that in one decare of field totally 4000-5000 kg dry roots are extracted [7].

The trade of soaproot and its standart

There is not a general accepted standart for the roots of soaproot but they can be classified in three different qualities in terms of commercial purposes according to where they grow: those growing in Van-Isparta are of the 1. quality, those obtained from Niğde are of 2. quality and those obtained from Yozgat-Çorum are of 3. quality [19].

In the usage of soaproot in industry, the hemolysis and bubble indexes of them; as for in food industry the bubble indexes are of importance. So, in the quality evaluation these rates should be taken into consideration. Both the bubble and hemolysis indexes of Van (*G. bicolor*) and Isparta-Beyşehir (*G. arrostii*) are high. Also their raw saponozite rates are more than the others.

| Species | Hemolysis index | Bubble index | % Raw saponozit |
|--|-----------------|---------------|-----------------|
| <i>G. bicolor</i> | 6.667- 6.925 | 9.000-10.000 | 20-25 |
| <i>G. arrostii</i> var. <i>nebulosa</i> | 5.295- 6.667 | 9.600-10.034 | 19-22 |
| <i>G. perfoliata</i> var. <i>anatolica</i> | 9.778-10.000 | 4.650 - 5.000 | 15-19 |
| <i>G. eriocalyx</i> | 3.385- 3.659 | 1.800- 2.000 | 10-14 |

Table 1. The Analysis of Turkish soaproot [22]

Isparta-Beyşehir *Gypsophila* (*G. arrostii*) has decreased extremely on the market. There is still Van Soaproot (*G. bicolor*) on market and is sold as being the first quality. The oldest commercial soaproot is this species, so its population has damaged greatly. But this species has been produced in fields (Atabey Plain) by some farmers. Furthermore, Isparta General Directorate of Forestry cultivated about 15-20 kg seeds 3 years ago in order to be a financial support in the future and to enable the continuation of the species generation for Sütçüler and Aksu villagers. The hemolysis index of Niğde soaproot (*G. perfoliata* var. *anatolica*) is high but its bubble index and raw saponozit percentage is low. Despite its features similar to 1. quality, it should be regarded as second quality. Çorum-Yozgat G soaproot (*G. eriocalyx*) is one type of soaproot having the lowest rates. In these respects it should be regarded as the third quality [22].

They are exported to many countries includin Germany, Egypt, Greece at the outset [19]. Between 1989-1996 the avarege annual export of soaproot root was 140 tonnes. In 1997 it decreased to 93.3 tonnes. Today, every year the avarege export of soaproot root from Turkey is about 90 tonnes. In 2004 80000 dollars have been earned from the soaproot exportation for 85 ton. According to the statistics of 2005 92 tonnes of

soaproot roots were exported from Turkey by taking 66 000 dollars in return. In 2006 despite 153 tonnes exportation the income was 61 000 dollars in an unparallel way [7, 24].

Discussion and advices

Six of species growing in Turkey has a high economic value. Besides picking plants in an uncontrollable way from nature, industrialisation and urbanisation, extension of agricultural fields and extreme grazing, tourism, the reparation of barren fields, agricultural struggle and pollution, unconscious forestation and fires are leading factors that threaten the plants in our country [7].

Because many natural plants used in medicine, exported and used traditionally are constantly being picked from nature, are exported and used in domestic market, they are increasingly disappearing [7].

Soaproot plants have been utilized in medicine, food, hygiene, as ornamentals in parks and gardens, in chemistry industry in order to produce saponin. It has the ability to extinguish the fires, whiten gold, clean silky and delicate fabrics. It also enables cleaning the contaminated soil by removing the boron which is in great amount in our country. They are cloned by cultivating *G. sphaerocephala* and *Gypsophila* species. Also it is possible to make vegetative mining by boron hyperaccumulation to the upper surface of the plant on soil.

Because they are utilized in many different areas, agriculturalists, food engineers, chemists, pharmacists, landscapists, textile workers and jewellers are all interested in them [7].

In Turkey the general name of *Gypsophila*, *Ankyropetalum* ve *Saponaria* species are “ çöven ”. But some researchers name those whose subsoil parts are economically valuable as “çöven”. Regarding this soaproot is the name of a raw material and is an extract obtained from a plant [9].

Turkish soaproot is widely obtained from 6 *Gypsophila* (*G. graminifolia*, *G. bicolor*, *G. arrostii* var. *nebulosa*, *G. eriocalyx*, *G. perfoliata* var. *anatolica* ve *G. venusta*) and 1 *Ankyropetalum* (*A. gypsophiloides* species. The gene centre of both species is Turkey [9].

Gypsophila species yielding soaproot, their locations and some properties are as below [25].

G. bicolor (Turkish names: Van çöveni, Tarla çöveni): This species is distributed around Van, Bitlis and Artvin provinces. The rhizomes are hard and difficult to break. Saponin content is 20 %-25 %. This value is higher than that in other soaproot yielding plants. This is the most preferred soaproot, also known as the soaproot of the highest quality.

G. arrostii var. *nebulosa* (Turkish name: Beyşehir çöveni, Konya çöveni): Saponin content is 19%-22%. This is also considered to be of good quality.; This species also has a narrow distribution. Halvah makers in Konya especially use this soaproot.

G. eriocalyx (Turkish name: Çorum-Yozgat çöveni): Grows around Ankara, Çankırı, Çorum, Eskişehir, Kayseri, Sivas and Yozgat provinces in steppe habitats with gypsum. This is an endemic species.

G. perfoliata (Turkish name: Niğde çöveni): Grows around Ankara, Kayseri, Sivas, Erzincan, Konya, Niğde, and Denizli provinces. It is considered to be of 3rd quality.

G. venusta subsp. *venusta* (Turkish name: Konya çöveni): Grows around Ankara, Çankırı, Konya, Gaziantep, Urfa, Sivas, Malatya, and Erzurum provinces in stepe habitats or arable fields, and yield soaproot.

G. graminifolia (Turkish name: Başkale çöveni, Dağ çöveni): This local endemic species also grows in Van province, around Başkale.

Three species of *Ankyropetalum* genus grow naturally in Turkey; all of them are endemic. However, only *A. gypsophiloides* rhizomes are known, with the name “helva (halvah) root” around Siirt province and used as soaproot. *A. gypsophilloides* (Turkish name: Siirt çöveni, Helvacı çöveni, Helva kökü): This species grows around Şanlıurfa, Mardin, Gaziantep, Batman, and Siirt provinces. Its roots are collected in Siirt and used by local halvah producers. [12].

Because the roots of these plants are generally used, the harvest time is in March-June months and thus because the plants don't produce seeds they don't enable seeds for the latter year. These plants which are constantly taken from nature both exported and used in domestic consumption and whose economic value is extremely high, are increasingly disappearing and are on the verge of extinction. This problem becomes more important especially when the plants are endemic. Except for the *G. paniculata* which is used for cut flower and cultivated, *Gypsophila* species which are used for exportation and domestic consumption and some of which are endemic are taken directly from nature. This brings the danger of extinction with itself.

Although economically important, these plants are a source of biological richness in Türkiye. Most of them are endemic species having narrow distributions. Since they are not cultivated but collected directly from nature, populations of these plants in nature deteriorate, their generations diminish or become extinct, and the balance of nature is disturbed. Since only roots and not the aerial parts are collected destruction is an even more important problem. According to some trading companies cheaper soaproot having better quality is being imported from Afghanistan, and re-exported after the extraction of their juices. This soaproot juice (extract) is

sold to halvah producers in Türkiye. So there is no need to collect soaproot in Turkey anymore. Soaproot has been collected for years due to the high unemployment rate in the region, and the demand. In order to preserve these species and also have regular exports, feasibility studies should be conducted and a determined quantity of a given quality should be cultivated. Soaproot should not only be collected from nature and its cultivation should be scheduled. Decrease in collection due to decreasing demand and soaproot imports from Afghanistan are good news. Soaproot imports may stop some day, but soaproot usage will continue and so we should take necessary precautions. Soaproot collection in Turkey should be stopped or at least alternation should be applied to collection areas. Cultivation of soaproot yielding plants, should be studied and encouraged. Standardised extract of soaproot should be prepared. Soaproot yielding other perennial species and their saponin contents should be determined and new soaproot resources should be identified, and their cultivation and marketing possibilities should be studied. Informations must be given to our public to preserve our biological richness [25].

Acknowledgement

This study is a part of the project numbered TÜBİTAK-TBAG 107 T 147, which is supported by TÜBİTAK, and themed “Revision of *Gypsophila* L. and *Ankyropetalum* Fenzl (Caryophyllaceae) Genera and Determination of Saponin Level”. We are much obliged to the support provided by this institution.

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