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Chichak Akbarova

Baku State University

PhD in Biology

<https://orcid.org/0000-0003-1475-7517>

cicekekberova59@gmail.com

The Research of Ornamentally-Medicinally Useful Members of *Crassulaceae* D .C Family Spread in Caucasus Minor

Abstract

Irreplaceable ornamental plants in urbanization are used for aesthetic purposes in modern time. In connection with this, it is preferred to use ornamental plants in habitats and parks, gardens, streets, shopping centers, indoor and outdoor places. However, it is an important issue to choose and use the right ornamental plants in landscaping. Recently the succulents have become popular as the pot plants among the decoration plants. The tendency in the areas requiring less water and low maintenance increases the interest to succulents because of irrigation water limits and high costs. Succulents are the best choice for arid environments because they can tolerate drought for a long time. Moreover, these plants have interesting ornamental features. From this point of view the species of *Crassulaceae* family have more significance in decoration. In the framework of conducting research, the qualities of the *Crassulaceae* family species which naturally spread in Caucasus Minor are investigated as the medicinal and ornamental plants.

Keywords: *Caucasus Minor*, *Rosularia*, *Sedum*, *Sempervivum*, *Succulent*

Introduction

The succulents hold water in their stems and leaves, so they adapt extremal ecological environment with their way of living. However, viability in the minimal light makes them suitable (Bell, 2001). As the succulents globally spread and produced in all living areas, they are cultivated for the environmental benefit and aesthetic purposes (Oldfield, 1997). It has been investigated many species of *Sedum* which is suitable for “green roof” covering (Van Woert, Rowe, Andresen, Rugh, & Xiao, 2005; Kim, Huh, & Huh, 2010). On the other hand, the succulents draw attention in the field of medicine as they are a potential raw material in medicine (Cabahug, Nam, Lim, Jeon, Hwang, 2018). That’s why it is desired fast spread of the succulents because of their impact on health and environment. 690 kinds and 12500 succulent species relating to *Crassulaceae* family have been described by Nyfeller and Eggly (2010). The members of the *Crassulaceae* family spread all over the world but they are widespread in the northern hemisphere (picture1). The species live typically in arid and cold places. The *Crassulaceae* family includes various kinds of plants from small sized annual plants to perennial grass, bush and trees. Many types have attractive flowers. The whole family consists of approximately 1410 members from 35 kinds. *Sedum* has most species typified by 428 sorts, *Crassula* (195 species), *Kolonchae* (144species), (*Sempervivum* 63 species) (Lopez-Angulo, Montes-Avila, Díaz-Camacho, Vega-Aviña, Baez-Flores, & Delgado-Vargass, 2016). These are widely used as ornamental plants (Eid, Ezzat, Gonaïd, & Choucry, 2018).

Research

The members of the family are commonly seen in the areas where monsoon rain and high humidity exist, some species (for example *sempervivum*) are mainly found in arid mountainous living areas and higher altitude. Fleshy leaves and “*Crassulaceae* Acid Metabolism” make them adapt to the changeable water environment, but they are not seen in the real desert areas. CAM is a type of photosynthesis observed in the plants such as pineapples and cacti living in the arid climate.

One of the useful features of *Crassulaceae* family is that some species are edible and important in treatment. *Sedum acre* and *Sedum telephium* are pharmaceutically significant (Akbarova, Mammadova, 2024).

Different pharmaceutical investigations show that some members of the family have antioxidants, antimicrobial, anti-serogen, cytotoxic, anti-inflammatory and antiseptic activity, anti-malaria,



antimutagen, myometrial, biological activity.

Picture 1. Distribution map of *Crassulaceae* D.C family in the world

Material and methods

The monitorings in the research, expeditions to Caucasus Minor, the literature data related to the Crassulaceae family are considered the main materials. Moreover, some bibliographical materials such as Flora of China, Flora of Iraq, Flora of Tropical East Africa as well as flora of Azerbaijan and former SSR have been investigated. It has been used geographical, ecological, morphological-systematic methods during the investigation. The expeditions covering the various botanical-geographical regions of Azerbaijan have been carried out by route methods. Various diagnostically important bio-morphological indications of succulent plants have been encoded taking into account the available digital polytomous specification key while using the literal-digital polytomous specification key of studied species (Balkovsky, 1964; Qurbanov, 2011). Phenological observations have been conducted by Kuznetsov and Ruquzov's methods (Kuznetsov, 1976), evaluation of viability of the plants has been carried out by V. Alexeyeva's method (1990). R and JMP programs have been used in statistical analysis of data. The classification of species is based on herbarium fonds, SSR, Caucasus, Azerbaijani fundamental floras while naming of taxons have been carried out on the basis of Cherepanov (1998), "Caucasian Flora Conspectus" (2003-2006) and conspectus of A. Asgarov and the areological research have been conducted according to N.N Porteniyer's classifications (2006).

The result and its discussion

The members of Crassulaceae spread in Caucasus Minor are annual, biennial or perennial grass, but mostly succulent plants. Generally, these types have rosette-shaped, thick and fleshy leaves and cluster shaped, white, yellow and red flowers. Some of the species used as ornamental plants for their visual values are Sedum and Sempervivum.

Some taxons from the Crassulaceae family naturally spread in Caucasus Minor are investigated according to their pharmaceutical and ornamental features. Four evergreen species from the kind of Rosularia, Sedum and Sempervivum which have leaf and flower aesthetics and their features have been shown in this framework.

Rosularia (STAPF, 2009)

Rosularia spread in semi-arid regions is a small kind consisting of 28 species (Mabberley 2008). Rosularia is rosette-shaped, perennial grass, while some sorts are a monocarp. The leaves of this

kind are striped, spoon-shaped or rectangular spoon-shaped. The leaves are stalkless. The flowering is mono or multiflowered, cluster or cymose-shaped or cluster-shaped consisting of cymose. The flowers of species spread in Azerbaijan are yellow, white, pink or red. Some members of *Rosularia* are used for pharmaceutical purposes (Sarwar, Qaiser, 2012).

Some species are cultivated due to their flower and leaf structure. (*R. alba*, *R. sempervivum*, *R. pallida*, *R. plathyphylla*). These species are used in landscaping in the gardens and cities like pot plants as well.

***Rosularia sempervivum* (M. Bieb.) A. Berger. (Syn.: *Rosularia sempervivum* subsp. *sempervivum*).** *Sempervivum* is widespread in the areas up to the 900-3000 meters of altitude. Some subspecies are endemic. Its evergreen leaves have a stacked view (picture 2).



Picture 2. *Rosularia sempervivum*

Rosularia has a floral structure that produces tall stalks (6-25 cm) bearing a compound cluster of flowers. It has small rosette-shaped flowers that typically are dark pink. Its ornamental aesthetics makes the succulents be cultivated in a large scaled places, roof and terrace gardens as well as rock gardens.

Sedum L

The species belonging to this kind are annual, biennial and perennial plants mostly branchy and succulent. The species of *Sedum* have a geographical widespread, mainly found in dry climate, shallow soils, stony or gravelly rocks, especially mild and subtropical regions. *Sedum* grows well in sunny or partially sunny places. Thanks to special photosynthesis, they are durable to humidity and high temperature. It has been revealed that some species (*Sedum album*, *sedum acre*, *sedum spurium*) of *Sedum* can survive for 88 days without water (Getter, Rowe, 2008). Some species are tolerant to windy conditions. The succulents are easily cultivated plants. The flowering period of *Sedum* lasts from the end of spring to autumn, they have star-shaped, yellow, white, red, pink, and golden shaded flowers. These plants have nectar-rich flowers. They are very attractive for the insects. At this point of view, *Sedum L* attaches importance for bees, butterflies, and the other pollinators. Their height reaches a few centimeters. The leaves have a soft structure and are easily

crushed. *Sedum L* is not a water-loving plant. They can survive for a long time and gradually growing in waterless conditions while they grow fast where water exists (Carter, Butler, 2008, Nectarios, 2015). Demand and interest to this kind are linked to air pollution and urban heat island. They are used in steady and economical design – “green roof” in order to diminish the increasing economical problems in the cities. Nevertheless, the various *Sedum* taxons can differently adapt to the green roofs (Damas, Cite, Donvez, 2010; Nagase, Dunnett, 2010). They can be used as the technology of urban agriculture according to the decorative values and metabolic features. Majority of these taxons are ornamental plants and can be used in landscaping.

Sedum acre

It spreads in Europe, Caucasus, Georgia, Western Asia, Northern Africa. Known as *Sedum acre* the succulent has 5-10 cm of height in Azerbaijan. Being the perennial and evergreen grass, the plants are seen at the 800-2000 meters of altitude. They grow in rocky, stony areas, southern slopes and open spaces (Tubives, 2021). Its leaves are stalkless and opposite. The flowers of this succulent are yellow (picture 3).



Picture 3. *Sedum acre* L.

Inflorescence of the succulents covers the months of May and July. They may grow in arid and shady places which can create a good ground cover. The succulents tolerate drought and need rare watering. Raw or baked leaves can be used as food, but they have a bitter taste. The plants are used for medical purposes. The succulents propagate in a vegetative method. They are cultivated as ornamental plants at the moment. The aesthetics of leaves and flowers make a contribution to the visual qualities of environment. They are used in the gardens, parks, cities, as well as a large scale of areas. It is also made a use of succulents as ground cover.

Sedum album L.

These are mainly specific to Europe, North-west of Iran, Caucasus, Lebanon, Near East, Anadolu. It is a taxon growing in sunny, sandy and rocky soils at the height of 2400 meters above the sea level. They are evergreen succulents growing at a medium speed (picture 4).



Picture 4. *Sedum album* L.

The height of white flower receptacles flowering between June and September may reach 5-20 cm. This succulent is not a shade-loving plant which grow in undernourished soils and tolerate drought. Moreover, there are many investigations showing that this succulent can live without rain or watering for 100 days. These characteristic features make them a better alternative in the usage of “green roof” in the urban environment. It may improve the environment by insulating the building in this way and providing a good condition for living beings.

These may be used in the gardens, rocks, dry walls, pots, slopes, herbal compositions as ground cover.

Sempervivum L

It spreads to large areas through Europe to Asia. Approximately 40 main species of Sempervivum are found in the nature, generally mountainous areas as well as Iran, Armenia and Caucasus. They are evergreen perennial plants growing to 10-20 cm and have rosette-shaped, thick rhizoids. These plants develop in sandy soils and rocky surface. They grow better in sunny places than shady areas. The rosettes die after the inflorescence period during some years, but the generations developing around them make the succulents vivid. In summer star-shaped flowers make a cluster and are white, yellow, red and purple. The flowers of species spreading to Azerbaijan consist of 8-15 parts. Sempervivum has enough viability in severe conditions. The leaves and young buds of these succulents are edible. They grow well in hot climate, as well as the plants can tolerate cold weather. Sempervivum are the succulents which have aesthetic leaves growing in the shape of rosette through the center to tips. During the growth of receptacle, the plant vertically grows and create a generation. For that reason, it makes an aesthetic tissue with these generations in various sizes and leaf colors. Many species exist naturally, while some are cultivated and used as ornamental plants indoor and outdoor places.

Sempervivum transcaucasicum muirhead

These species grow at the 550-2700 meters of altitude in volcanic rocks. They have stalks growing to 20-30 cm flowering in august and have yellow flowers. (picture 5).



Picture 5. *Sempervivum transcaucasicum*

This kind can grow in acid, neutral soils and mainland (slightly alkaline) especially in sunny areas. This succulent is suitable for drought not the shady places. While creating a receptacle only in summer, its invariable leaves, shape, texture, and color aesthetics draw attention. Many species of this kind are cultivated. In Alpine and rock gardens, dry walls, marginalia and containers can be cultivated as ornamental plants. The work on applying them in landscape is important due to increasing durability of these special kinds.

Conclusion

The frequency and intensity of drought period have significantly increased for last ten years in the Mediterranean basin including Azerbaijan (Giannakopoulos, Le Sager, Bindi, Moriondo, Kostopoulou, Goodess, 2009; Lopez-Nicolas, Pulido-Velazquez, Rouge, Harou, & Escrive-Bou, 2018; Ortega-Gomez, Perez-Martin, Estrela, 2018). According to the activity plan on climate change, Azerbaijan will be warmer, drier, and rainy, so it will cause indefinite climate change and loss of water as well. It is forecasted a significant decrease in terms of funds).

Drought is one of the most difficult stress factors that global ecosystems face and it affects the physiological and biochemical structure of the plants (Bartlett, Scoffoni, & Sack, 2012). So, it may have a negative impact on physiological processes (Osakabe, Osakabe, Shinozaki, & Tran, 2014; Mammadova, 2022). A cell as well as a small disbalance is linked to plant growth and productivity. It will affect the physiological processes as well (Mathur, Agrawal, & Jajoo, 2014; Nxele, Klein, & Ndimba, 2017). It has been revealed an effective adaptation for durability to drought, minimum-maximum temperature and precipitation change (Sari, Karashah, 2020). That's why this adaptation will empiere agriculture as well as cultivation of ornamental plants in the cities, gardens, and parks.

Protection of water reserve and its efficient use in all fields assume importance because of increasing effects of global warming. Some approaches have been accepted that support lasting use of natural reserves in planting of greenery. Regulatory conceptions such as "Effective use of water in Landscaping", "Use of water" (Wat-wise, Water Smart), and "Natural Landscape" under the general name of "A water-efficient landscape design". It includes planning principles providing the

most rational use of these resources. Easiness and durability of adaptation in selecting the plant species which easily adapt to the ecological condition and have viability with natural rain water and limited watering.

The succulent plants are the best choice specially in landscape. The areas of use include not only open and green fields of the city but also roads, slopes and walking places. It can be used in the field demanding minimum technical service condition, airports, problematic places and rurals. Using of the succulents indoor places widely spread in order to contribute aesthetic, functional, and ecological value to the venues in green fields as being in outdoor areas. In the investigation conducted for outdoor places, it is preferred to cultivate 72,3 percent of succulents and cacti, 49,1 percent of ornamental species. Generally it is demanded decorational, aesthetics, leaf and flower and succulent-cacti kinds in the design of interiors. Durability of cacti and succulents to drought, easy care, prevention of radiation indoor places and easy carriage of the plants for its size are the main reasons to select these species.

Crassulaceae family, covering the majority of succulent species using in landscaping widely spreads to Caucasus Minor. Despite the great diversity of natural species in Caucasus Minor, cultivating of these species as ornamental plants is limited. That's why using of decoration plants draws more attention. It is recommended to pay attention to the use of natural species and drought tolerant grass including succulent plants in order to lessen grass fields whether it is preferred to external species in designing of cities, parks and gardens.

It is a great demand to demonstrate people an increase of information, natural species, providing the permanence of their aesthetic features, and the succulents having the eatable, medicinal, and functional properties. In the framework of this investigation the aforesaid species are the succulents having a potential of being used indoor and outdoor places with aesthetical, ecological and functional features. It is considered that the investigation of landscaping properties of natural species will contribute to science in the point of view finding the most used field of ecosystem.

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