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Use of Toxic and Allergen Plants in Landscape Arrangements of Urban Historical Areas: The Case of Çeşme Castle (İzmir)

Kentsel Tarihi Alanların Peyzaj Düzenlemelerinde Zehirli ve Alerjen Bitki Kullanımları: Çeşme Kalesi (İzmir) Örneği

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Abstract

Urban historical areas and buildings are structures that provide important information, culture and tradition transfer from the past to the present. These places are both an effective tourism area and a part of urban life. In addition to the aesthetic, ecological and functional benefits of the plants to be used in urban historical areas, attention should be paid to their allergenic and toxic effects. Exposure to plants with toxic effects may cause mild or serious negative effects on human health. The study was carried out to determine the toxic and allergenic plants found in the historical area of Çeşme Castle and to make evaluations about the area. The plants were examined on site and photographed in the study area. According to the literature, the allergenic effect, toxic status, toxic parts and toxic substances of the plant species were determined. The data obtained were analysed and as a result of the analyses; 30 plant species, 29 genera and 22 families were identified in the area. The ratio of toxic plant species in the area was 53.33 % and the ratio of allergenic plant species was 36.66 %. According to their forms, the proportion of toxic plant species was 37.5 % and the proportion of allergenic plant species was 81.81 %, with the highest proportion found in tree form plant species. Among the identified plants, 5 species have both toxic and allergenic effects. Suggestions were made such as measures that can be taken to stop the contact of plants with toxic effects with the users in the area, and the portable ones can be replaced with non-toxic plants. In addition, suggestions were also made for measures that can be taken during the landscape design phase regarding allergenic plants.

Keywords: Allergen plants, plant design, Çeşme Castle, historical areas, toxic plants

Özet

Kentsel tarihi alanlar ve yapılar geçmişten günümüze önemli bilgi, kültür ve gelenek aktarımı sağlayan yapılardır. Bu yerler hem etkili birer turizm alanı hem de kent yaşamının bir parçasıdır. Kentsel tarihi alanlarda kullanılacak bitkilerin estetik, ekolojik ve fonksiyonel faydalarının yanında sahip oldukları alerjen ve zehirli etkilerine de dikkat edilmelidir. Zehirli etkiye sahip bitkilere maruz kalmak insan sağlığında hafif ya da ciddi olumsuz etkilere neden olabilir. Çalışma Çeşme Kalesi tarihi alanında bulunan zehirli ve alerjen bitkileri belirlemek ve alanla ilgili değerlendirmeler yapmak için gerçekleştirilmiştir.

Bitkiler çalışma alanında yerinde incelenmiş ve fotoğrafları çekilmiş. Literatüre göre bitki türlerinin alerjen etkisi, zehir durumları, zehirli kısımları ve zehirli maddeleri belirlenmiştir. Elde edilen veriler analiz edilmiş ve analizler sonucunda; alanda 30 bitki türü, 29 cins ve 22 familya tespit edilmiştir. Alandaki zehirli bitki tür oranı % 53.33, alerjenik bitki tür oranı % 36.66 belirlenmiştir. Formlarına göre zehirli bitki tür oranı % 37.5, alerjenik bitki tür oranı % 81.81 ile en çok ağaç formlu bitki türlerinde saptanmıştır. Tespit edilen bitkilerden 5 tür hem zehirli hem de alerjenik etkiye sahiptir. Alanda zehirli etkiye sahip bitkilerin kullanıcılar ile temasının kesilebilmesi için alınabilecek önlemler, taşınabilir olanların zehirsiz bitkiler ile değiştirilebileceği gibi önerilerde bulunulmuştur. Ayrıca alerjen bitkiler ile ilgili peyzaj tasarım aşamasında alınabilecek önlemler için de önerilerde bulunulmuştur.

Anahtar Kelimeler: Alerjen bitkiler, bitkisel tasarım, Çeşme Kalesi, tarihi alanlar, zehirli bitkiler

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1. Introduction

Historical and cultural sites, buildings and all similar important artefacts transmit the essence of many concepts such as knowledge, culture, and tradition from the past to the present. Therefore, such areas, structures and similar artefacts can be considered as the common heritage of humanity in the world. In addition, it would not be wrong to say that historical areas, which are located within the urban structure and are a part of urban life, are the memory and identity of the regions where they are located (Altan Erol, 2021). Also, historical sites bearing traces of the past are both important tourism areas for future generations and important tourism areas that contribute to the economy of their location (Gür and Erduran Nemutlu, 2021). It can be said that all other land uses in the city and historical areas are closely related to the landscape. From this point of view, the quality of the landscaping of urban historical areas, which are a part of urban life, stands out in terms of the comfort of visiting tourists and the sustainability of tourism (Gür and Kahraman, 2022). Attention and care should be paid to the correct selection of plant species, which is one of the most basic elements in ensuring the quality of landscape arrangements and constitutes most of the materials used (Bogenç and Bekçi, 2020; Öksüz and Koçan, 2021). In addition to the aesthetic, ecological and functional benefits of plants, it should not be ignored that they may be harmful due to their allergenic and toxic effects (Kušen et al., 2022). Humans or animals may show different symptoms when exposed to plants with toxic effects. Exposure to these plants may cause minor discomfort or heart rhythm disturbances, vomiting, paralysis and even death (Fančovičová and Prokop, 2011). In some flowering plants, especially in dioecious plants, pollen produced by male reproductive cells can cause allergenic effects called pollinosis at certain times of the year (Tutuş, 2022). Considering all these risks, it is obvious how important is the selection of plants used in plant design. When the literature on the subject is examined, it is seen that there are different studies on the use of plants with toxic effects in urban landscape design. Gümüşcü and Gümüşçü (2012), in their study, gave detailed information about some plants that grow naturally in Turkey and are used as commercial, medicinal, food or ornamental plants. They gave information about the toxic parts of the plants, toxic active ingredients and possible symptoms that may occur if these plants are consumed. Muca et al. (2012) identified toxic plant species used in public areas in Isparta. They gave information about the situations that may occur in case of exposure to the plants they identified in such areas. Gür and Kahraman (2023), in their study, determined the species with toxic effects among the plant species used in the landscaping of

recreation areas in public open spaces in Simav district of Kütahya province in Turkey. They also evaluated whether there is a measure against these plants in their study. At the end of the study, they made suggestions on the use of these plants in the design phase and the measures that can be taken.

This study was carried out to reveal and evaluate the toxic and allergenic plant status in the historical area of Çeşme Castle. The study also aimed to develop recommendations to prevent plant-induced negativities in similar urban historical areas and to take necessary precautions.

2. Material and Method

The study was conducted between March and April 2023 at Çeşme Castle located in Musalla Neighbourhood of Çeşme district of İzmir province (Figure 1). Çeşme Castle was built in 1508 during the reign of Bayezid II to protect the region and the trade in the region by the Governor of Aydın, Mir Haydar, to the architect Ahmet son Mehmet (Öztürker, 2011; Turkey Culture Portal, 2023). The castle was built in a cascade shape depending on the topography of its location and the height of the structure from the sea is 6 metres (Sağlam, 2021). The castle area is between 38°19'25.17" north parallel and 26°18'10.63" east meridian. Çeşme Castle, which is approximately 85x130 m in area, faces the sea in the east-west direction. In front of the entrance of the castle, there are a car road, a recreation area, and the Aegean Sea, respectively (Figure 2).

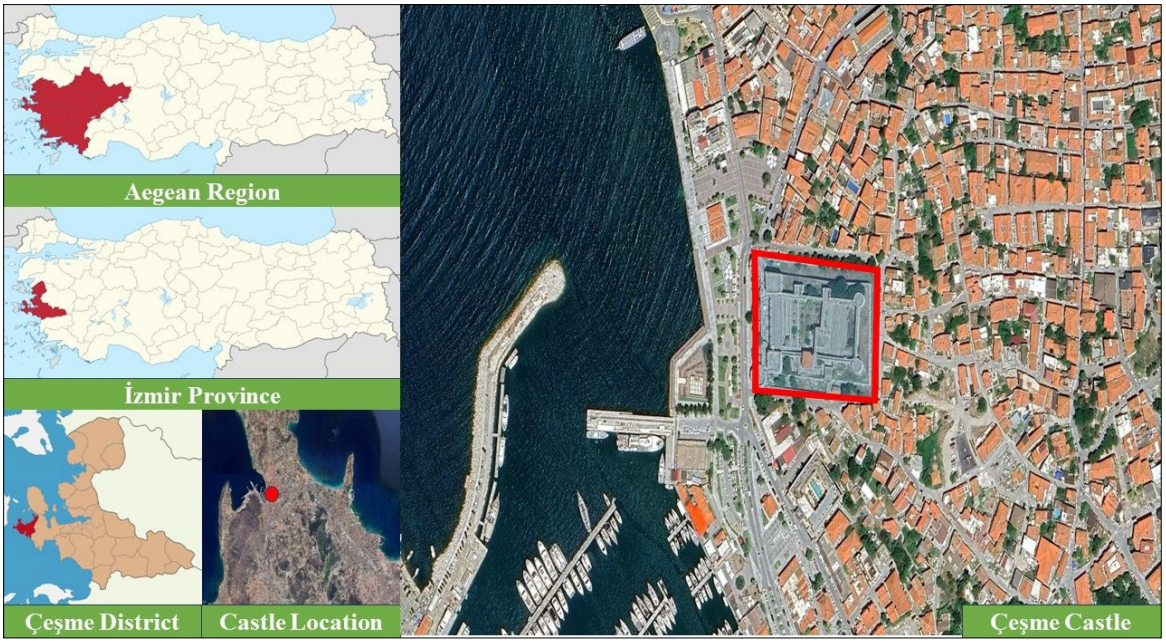


Figure 1. Location of the Study Area and Çeşme Castle (Modified from Google Earth Pro, 2023; Wikipedia, 2023a; Wikipedia, 2023b).

Figure 2. View of Çeşme Castle from different angles (Çeşme District Governorate, 2023).

The study was carried out in five different steps. Firstly, the plant species used in the landscape design of Çeşme Castle were examined on site and the plants were photographed. Then, in the light of the literature, the species, families, and forms of the plants identified in the study area were determined and listed. In the third stage, the allergenic effect of the plant species, toxic plant species, plant organs with toxic effect and toxic active substances were determined by reviewing the literature. The literatures used in the research are given in Table1.

Table 1. Literature used to determine the toxic and allergenic effects of the plants identified in the study area.

Toxic and Allergenic Effects of Plants	Literatures Used
Plants with Toxic Effect	• Aplin (1976) • Seçmen and Leblebici (1987) • Baytop (1989) • Johnson and Johnson (2006) • Nelson et al. (2007) • Zencirkıran et al. (2018) • Çelik and Zencirkıran (2021) • Çorbacı and Ekren (2021) • Hatipoğlu and Ekren (2022) • Mahonski et al. (2022)
Plants with Allergenic Effect	• D'amato and Spieksma (1991) • D'amato (1998) • Lorenzoni-Chiesura et al. (2000) • Jianan et al. (2007) • Irian et al. (2013) • Hong (2015) • Green et al. (2018) • Kušen et al. (2022)

In the fourth step, the data obtained on plant species were analysed. As a result of the analysis, plant species in the area, toxic plant species, plant species with allergenic effect, plant species numbers, toxic and allergenic plant species ratios, plant group ratios, toxic plant and allergenic plant species ratios by plant group were determined. Finally, suggestions were made about the measures to be taken on toxic plants and plants with allergenic effects in the current area and in the landscaping of urban historical areas.

3. Results and Discussion

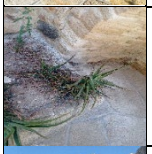
As a result of the on-site investigations, 30 plant species, 29 genera and 22 families were identified in the study area. The plant species identified are shown in Table 2 according to their general forms.

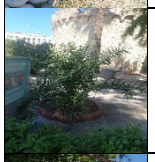
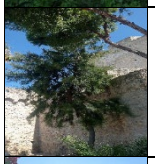
Table 2. Plant species, families and general forms identified in the study area.

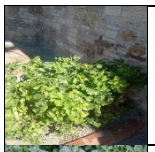
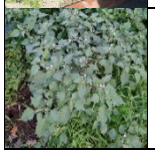
Plant Species	Family	General Form
Acacia saligna (Labill.) Wendl	*Mimosaceae*	Tree
Cupressus arizonica Greene	*Cupressaceae*	Tree
Eriobotrya japonica (Thunb.) Lindl.	*Rosaceae*	Tree
Ficus carica L.	*Moraceae*	Tree
Juglans regia L.	*Juglandaceae*	Tree
Morus nigra L.	*Moraceae*	Tree
Olea europaea L.	*Oleaceae*	Tree
Phoenix canariensis Chabaud	*Arecaceae*	Tree
Pinus brutia Ten.	*Pinaceae*	Tree
Prunus persica (L.) Batsch	*Rosaceae*	Tree
Schinus molle L.	*Anacardiaceae*	Tree
Washingtonia robusta H.Wendl.	*Arecaceae*	Tree
Ficus benjamina L.	*Moraceae*	Small Tree
Nerium oleander L	*Apocynaceae*	Small Tree
Aeonium arboreum Webb & Berthel.	*Crassulaceae*	Shrub
Aloe speciosa Baker	*Asphodelaceae*	Shrub
Euonymus japonicus Thunb.	*Celastraceae*	Shrub
Lantana camara L.	*Verbenaceae*	Shrub
Lavandula officinalis Chaix.	*Lamiaceae*	Shrub
Pelargonium zonale (L.) L'Hér. ex Aiton	*Geraniaceae*	Shrub
Pittosporum tobira (Thunb.) W.T.Aiton	*Pittosporaceae*	Shrub
Rosa semperflorens W.M.Curtis	*Rosaceae*	Shrub
Rosmarinus officinalis L.	*Lamiaceae*	Shrub
Allium giganteum Regel	*Amaryllidaceae*	Herbaceous
Solanum nigrum L.	*Solanaceae*	Herbaceous
Tulbaghia violacea Harv.	*Amaryllidaceae*	Herbaceous
Bougainvillea glabra Choisy	*Nyctaginaceae*	Climber
Lonicera japonica Thunb	*Caprifoliaceae*	Climber
Senecio angulatus L.f.	*Asteraceae*	Climber
Vitis vinifera L.	*Vitaceae*	Climber

In the study area, the ratio of plants according to their forms was determined as 40 % trees, 30 % shrubs, 10 % herbaceous, 13.33 % climbers, 6.66 % small trees. The pictures, family, toxic parts, toxic substances and allergenicity of plant species with toxic effect and allergenic effect through pollen are given in Table 3.

Table 3. Plant species with toxic effects and allergenic effects through pollen in the study area.

Plant Species		Turkish Name	Toxic Part	Active Ingredient	Allergenic Effect
	*Acacia saligna*	Kıbrıs Akasyası	All Plant	Hydrogen cyanide	Effective
	*Allium giganteum*	Başlı Soğan	All Plant	Cyanides	-
	*Aloe speciosa*	Sarı Sabır	Leaf inner juice	Barbaloin, Anthraquinone glycoside	-
	*Cupressus arizonica*	Arizona Servisi	-	-	Effective
	*Eriobotrya japonica*	Malta Eriği	Pit core	Amygdalin, Cyanogenic glycoside	-
	*Euonymus japonicus*	Taflan	All Plant	Saponin, Cardiotonic glycoside and alkaloid	-
	*Ficus benjamina*	Benjamin	Plant latex	Furocoumarin, Psoralens, Ficin, Sesquiterpenoid glycosides, Triterpenes	Effective
	*Ficus carica*	İncir	Plant latex	Furocoumarins, Psoralens, Ficin, Sesquiterpenoid glycosides, Triterpenes	-

	*Juglans regia*	Ceviz	Leaves	Tannins	Effective
	*Lantana camara*	Ağaç Minesi	Fruits	Triterpene acids, Lantaden A, Lantaden B	-
	*Lonicera japonica*	Japon Hanımeli	Fruits and Leaves	Saponic and Cyanogenic Glycosides	-
	*Morus nigra*	Kara Dut	-	-	Effective
	*Nerium oleander*	Zakkum	All Plant	Digitoxigenin, Oleandrin, Neriin	-
	*Olea europaea*	Zeytin	-	-	Effective
	*Pelargonium zonale*	Sardunya	Leaves	Geraniol, Linalool	-
	*Phoenix canariensis*	Yalancı Hurma	-	-	Effective
	*Pinus brutia*	Kızıl Çap	-	-	Effective
	*Prunus persica*	Şeftali	Leaves, Flowers, Seeds	Cyanogenetic glycoside	Effective
	*Rosa semperflorens*	Gül	-	-	Effective
	*Schinus molle*	Yalancı Karabiber	Fruits	Triterpene	Effective

	*Senecio angulatus*	Cape Sarmaşığı	All Plant	Pyrrolizidine alkaloids	-
	*Solanum nigrum*	İtüzümü	Leaf and Fruits	Solanine and Solasonine	-

If we look at the ratio of toxic plant species detected in the study area in the general total, it is seen that 53.33% of the plant species in the total have toxic effects. If we explain this analysis by reducing it to plant forms, the highest rate of toxic plant species in tree-form plant species was determined as 37.5%. Shrub plant species are in the second place with a rate of 25%. The rate of toxic plant species in herbaceous, small tree and climbing forms was determined as 12.5%. The percentage distribution of the parts of toxic plants with toxic effects is shown in Figure 3.

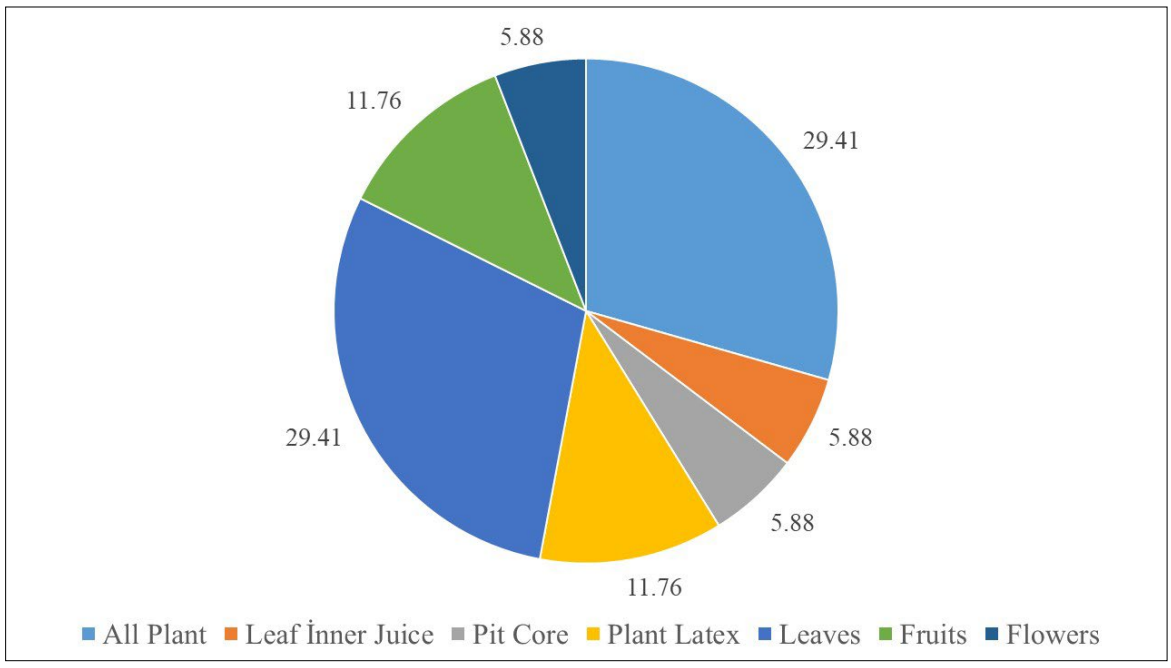


Figure 3. The percentage distribution of the parts of toxic plants with toxic effects.

When the proportion of plants identified to have allergenic effects through pollen in the region is analysed over the general total, it constitutes 36.66% of all plant species in the study area (Figure 4). As in the distribution of the proportion of toxic plant species by form, the highest proportion of allergenic plant species was found in the tree form plant species (81.81%). The proportion of allergenic plant species in shrub and woody plant species was the same with 9.09%. No allergenic plant species were detected in climbing and herbaceous

plant groups. Figure 4 shows the percentage distribution of toxic, allergenic and non-effective plant species for all plants.

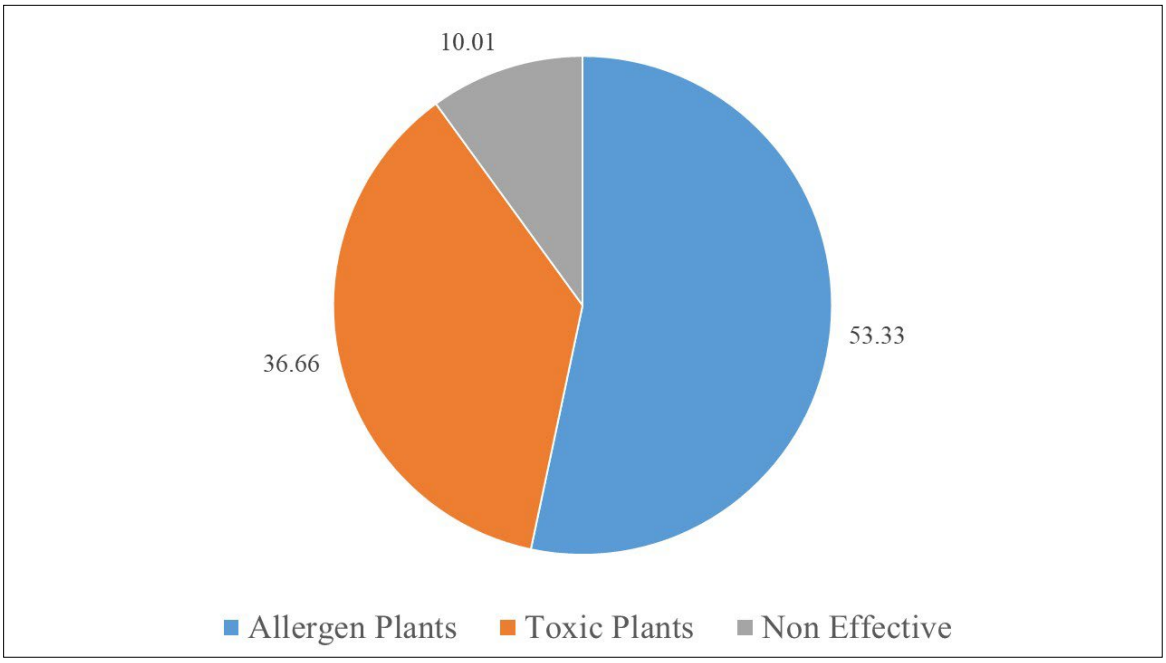


Figure 4. Percentage distribution of toxic, allergen and non-effective of all plants.

The symptoms that visitors will show in case of possible exposure to the species found to be toxic in the area may vary depending on the type of plant they are exposed to, the age, gender, immune system resistance and the amount of plant consumption. In addition, the toxic effect, or the degree of toxicity of plants found to be toxic may also vary. Some of the plants in Table 2 may have a negligible degree of toxicity or effect, but this does not mean that the plant does not have a toxic that causes negative effects and discomfort. For example, in case of exposure to the toxic parts of *Juglans regia*, *Euonymus japonicus* and *Ficus benjamina* plants in Table 2, mild complaints such as vomiting, headache, dizziness, diarrhoea, weakness and trembling may be observed (Baytop, 1989; Atasoy, 2012). However, when the toxic parts of *Nerium oleander* plant, which is also listed in Table 2, are consumed, it may cause serious problems that may result in loss of consciousness, bloody diarrhoea, weakening of the pulse, paralysis of the lungs and death (Aydın, 2010). Plant species that have allergenic effects through pollen show effects on humans mostly through wind. Depending on the climate and wind conditions of a region, the rate of pollen density in the air affecting people varies (Gür, 1997). Considering the climate and high wind speed of Çeşme district, it can be said that allergen pollen density can be significantly effective in the area (Koçaslan, 2010). This situation shows that the plant species determined to have allergenic effects in the area will be highly effective on visitors with the effect of wind. It is

seen that *Acacia saligna, Ficus benjamina, Juglans regia, Prunus persica* and *Schinus molle* plants in the study area have both toxic and allergenic effects. Attention should be paid to the use of plant species with both allergenic and toxic effects in plant design, and necessary precautions should be taken in the field. Like this study, Mrđan et al. (2017) examined the toxic and allergenic effects of plants used in the landscape design of kindergartens and primary schools in Novi Sad, Serbia and listed toxic and allergenic plants. They made suggestions about the measures that can be taken regarding the use of toxic and allergenic plants to prevent plant-related damage to young children in their educational life. Although there is a similarity with Mrđan et al. (2017)'s study in terms of the harmful effects of the plants investigated, this study differs in terms of field quality and field use.

4. Discussion and Conclusions

Areas of great historical importance, structures, archaeological finds and ruins provide important information to understand human history and cultural heritage, as well as the opportunity to connect with the past. In the landscaping of historical areas such as Çeşme Castle, which has an important place in tourism activities and urban life in Çeşme district of İzmir province, importance should be given to the aesthetic, functional and ecological features of plant species as well as other features of these plants. Contact with allergens or toxic substances in plants may pose a risk to human health. For this reason, attention should be paid to the harmful effects of plants for visitor satisfaction, comfort and prevention of possible negative effects in historical areas with intensive visitor circulation throughout the year. Within the scope of the study, Çeşme Castle was selected as a sample study area in order to identify, evaluate and prevent toxic and allergenic plants that may have negative effects on visitors in historical areas. The study area was visited and examined on-site and plant species with toxic and allergenic effects were identified among all plant species in the area. In this context, it was determined that the ratio of plant species with toxic effect among all plant species in the study area was 53.33% and the ratio of allergenic plant species was 36.66%. Considering the high rate of plant species with toxic effects in the area, necessary information should be provided about these plant species and measures should be taken to make access to these plants difficult. When the area was analysed, it was seen that most of the toxic plants were in the circulation network and the distance to reach these plants was quite close. In the study area, trees took the first place in the ratio of toxic plant species and shrubs took the second place. Precautions and design studies related to the use of poisonous and allergenic plants in urban historical areas can be listed as follows;

- In case of intensive use of trees and shrubs in the landscape of urban historical areas, it is very important to consider the toxic substances that these plants may have and the organs they carry toxic substances during the plant design phase and to obtain expert opinion on the subject during the design phase.
- In landscape restoration, landscape design or landscape maintenance and repair works to be carried out in historical areas, obtaining information about the user potential of the area and the socio-economic and socio-cultural structures of the users will be useful in making predictions about user and plant relations.
- Since most of the historical sites are under high protection, it is necessary to make appropriate determinations and orientations in case the poisonous plants growing naturally in the area cannot be removed or transported. Taking precautions such as the use of fences to reduce or completely prevent contact with these plants and the use of warning signs in both Turkish and English using warm colours will be effective for the health of visitors to the site.
- Poisonous plant species with eye-catching organs such as leaves flowers and fruits suitable for fresh consumption should not be used in such areas, even if they are aesthetically effective.
- To reduce the allergenic effect, attention should be paid to climatic data and care should be taken to use species that produce less pollen. Species with intense foreign pollination and intensive use of male individuals of dioecious plant species should be avoided.
- In addition, as stated in the measures to be taken for poisonous plants, if plants with allergenic effects cannot be transported, visitors should be informed about this issue at the entrance to the area and protection measures should be instilled by using information signs.

Designing the plant design in landscaping arrangements in historical sites in a way that does not harm visitor health will increase tourist satisfaction and tourism quality. Therefore, this situation will lead to the development of the socio-economic situation in that region as well as providing other alternative tourism opportunities in the regions where historical sites are located. On the other hand, in this situation, which will affect the economy of the country, the necessity of assigning qualified staff in the discipline of landscape architecture by the necessary management units in historical areas, related ministries and directorates has thus

been revealed. In addition, landscape-tourism relationship should be emphasised in both landscape architecture and tourism education in our country.

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