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# The Study of Phenolic Compounds and Habitat Soil of *Leptadenia pyrotechnica*

**Fatemh Nejad-Alimoradi*[1], Farkhondeh Rezanejad[2]**

**[1]Department of Biology, Payame Noor University, Tehran, Iran**

**[2]Department of Biology, Shahid Bahonar University, Kerman, Iran**

***Corresponding author: Alimoradi@pnu.ac.ir**

## Introduction

*Leptadenia pyrotechnica* is a xerophytic plant from *Apocyanaceae* (*Periplocoideae*) family (Endress et al., 2014) that plays an effective role in soil stabilization and environmental protection due to its extensive root system (Abd-ElGawad et al, 2022). Natural products have a wide range of biologically active compounds. About 35 % of drugs on the market are directly isolated from natural plant sources. (Atanasov et al, 2021). Studies have shown that *L. pyrotechnica* has numerous bioactive compounds with several medicinal activities. Therefore, it can be a source for the development of new pharmaceutical compounds (El-Fitiany & Khasawneh, 2022). The plant extract has strong antioxidant potential and valuable chemical substances such as flavonoids, phenolic acids, cardiac glycosides, alkaloids, fatty acids, terpenes, amino acids, and carbohydrates (El-Fitiany & Khasawneh, 2022). Anti-tumor activity is mainly due to plant flavonoids (kaempferol and quercetin) (Youssef Moustafa et al, 2012).

Edaphic factors, including soil chemistry and texture and topography, may have strong effects on plant community composition. Soil nutrients play an effective role in species distribution, seedling growth and biomass accumulation of plants. (Estrada-Villegas et al, 2020). Nowadays, due to the increasing demand for raw materials, it is necessary to search for natural resources compatible with the sustainable environment. *L. pyrotechnica* is one of the valuable plant species in the field of natural resources and desert. Considering the low ecological needs of the plant in its growing areas and due to its medicinal importance, the characteristics of reproductive, ecological structures and phenolic-flavonoid compounds of different plant organs were studied.

## Material and Methods

Soil samples of different distribution areas of *L. pyrotechnica* were collected from a depth of 15 cm based on a completely random design with 3 replications. After passing through a 2 mm sieve, their physical and chemical characteristics, including the study of soil texture, electrical conductivity (EC), acidity (pH), soil organic carbon, and mineral elements was analyzed with an ICP-OES device (model 735 ES6, Varian, Australia) Ali-Ehyaee & Behbahanizadeh, 1994).

Shoot and flower samples of *L. pyrotechnica* were collected in March and fruits and seeds of the plant in Khordad from south of Kerman province, Kohnouj city and studied. In order to measure the types of secondary metabolites, first the vegetative and reproductive parts were separated and dried in the shade at room temperature. After grinding the dried samples, each of them was used separately to measure the secondary metabolites of the plant.

Phenolic content using Folin-Ciocalto reagent (Al-Farsi et al, 2005), measurement of total flavonoid content by aluminum chloride colorimetric method (Amira et al, 2012) and measurement of total anthocyanin content based on the method of Nogues and Baker (2000) was done.

The profile of the phenolic compounds of the methanolic extract of different parts of *L. pyrotechnica* was performed by HPLC (1200 Agilent, Germany), the injection volume was 20 µl and the washing was done at a flow rate of 1 ml/min. The mobile phase consisted of methanol as solvent A and 1% formic acid in water as solvent B. Peaks were observed at two wavelengths of 280 and 320 nm. 17 standards including sinapic acid, gallic acid, ellagic acid, rosmarinic acid, chlorogenic acid, caffeic acid, p-coumaric acid, transferulic acid, catechin, quercetin, coumarin, carvacrol, vanillin, hesperidin, eugenol, hesperetin and thymol were used (Justesen et al, 1998). Statistical analysis was performed using SAS 9.1.3 software. ANOVA and Duncan's multiple range test (p=0.05) were used to compare the means.

## Result and Discussion

The soil analysis of the distribution areas of *L. pyrotechnica* showed that sandy, non-saline to moderately saline soil with neutral to slightly alkaline acidity and containing sufficient amounts of necessary mineral elements is suitable for the growth of this plant. The plant has a limited distribution in Jiroft, but it has a wider distribution in other southern regions of Kerman province, including Kohnuj and Manojan, and often young forms of plant are seen with high density next to the mother plant. After climate, the soil factor is the second most important environmental factor affecting the distribution of plants (Santoyo et al, 2017). In a research, the important role of the plant in stabilizing the soil in the sandy desert of Saudi Arabia and Egypt is mentioned, which as a leading plant maintains the sand dunes due to its extensive root system (Abd-ElGawad et al, 2022).

Gynostegium and pollinarium is one of the characteristics of plant flowers, which helps to facilitate pollination. Continuity of flower organs is an important developmental and evolutionary features of *Apocyanaceae* (Ollerton et al, 2019; Rapini et al, 2003). And it is called organized synorganization, which in a very advanced state acts as a single complex unit consisting of flower components or as a separate organ (Endress, 2016; Nejad Alimoradi & Rezanezhad, 2018). *L. pyrotechnica*, like most *Periplocoideae* genera, it has multiple Cyme inflorescences with about 30 bisexual regular flowers, a yellow and prominent corolla, and a 5-piece perianth with many hairs, which is probably a type of adaptation to the habitat climate. anther is 5 stamens whose anthers form the pollinarium, which is a special type of organization, and the pollen grains are collected in tetrad and pollinia. The follicle fruit is often double and hanging. Abundant seeds on the middle axis of each fruit become brown and hard during maturity, which helps to preserve seed water and is considered a type of adaptation for plants in hot and dry regions. There is a dense bunch of yellow silky hairs at the end of the seeds which helps in the dispersal of the seeds by the wind (Endress & Bruyns, 2000; Ionta & Judd, 2007).

The amount of total phenolics was different in the plant organs. The highest content of total phenol, flavonoid and anthocyanin was observed in flower, seed and shoot, respectively. The results of the profile of phenolic and flavonoid compounds showed that their quantity and quality were different in the vegetative and reproductive parts of the plant. A total of 11 compounds were identified, and 9, 5, 7, and 8 compounds were identified in shoots, flowers, fruits, and seeds, respectively. Some compounds are rare, some in special organs, and some standards were not detected in any organ. The main phenolic compound in the shoot, fruit and seed was gallic acid and hesperidin in the flower. Catechins were detected only in flowers and seeds, caffeic acid in seeds, quercetin in shoots, eugenol in shoots and seeds, and hespertin only in shoots and fruits. Among the identified phenolic compounds, gallic acid and p-coumaric acid had the highest and lowest amounts. The concentration and variety of polyphenols in the plant depends on the species, organ type and plant growth stages (Bystrická et al, 2010).

An important group of secondary metabolites are phenolic and flavonoid compounds. It has been reported that *L. pyrotechnica* extract has various functions, including antioxidant, anti-cancer, anti-diabetes, treatment of cardiovascular diseases, anti-inflammatory, protective effects in neurological disorders, antimicrobial, antiviral, anti-ulcer, anti-osteoporosis, liver protector, it is vasorelaxant, anti-atherosclerotic and anti-anxiety, which is attributed to its flavonoid and alkaloid compounds (Al-Snafi, 2020; Yeshi et al, 2022; Alqasoumi et al, 2012; Javid et al, 2019).

## Conclusions

*L. pyrotechnica* has the ability to produce high biomass in the hot and dry desert sandy areas in the south of Kerman province and plays an important role in soil stabilization and environmental

protection. Gynostegium and pollinarium show the developmental and advanced features of the plant. The hard seed coat protects the seed and its fibers and plays an important role in the wide distribution of the plant. The presence of some important phenolic compounds, such as catechin, quercetin, vanillin, etc., indicates its importance in the pharmaceutical industry, as well as the plant's resistance to environmental stress conditions. Considering the numerous medicinal and environmental uses, it is suggested that more studies be done on the species.

*Keywords: Antioxidant compounds, Apocyanaceae (Periplocoideae), Soil ecological factors.*

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## Declaration of conflict of interest

*The authors declare that they have no conflicts of interest.*

## Statement on ethics

*All authors have been personally and actively involved in substantial work leading to the paper, and will take public responsibility for its content.*