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Pistacia lentiscus Tree and its Role in Riddance of some Environmental Polluters

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Abstract

Pistacia lentiscus grows on Libyan lands. its parts are used as a food and drug and also used as antimicrobial and phytostabilizer. This study was done to estimate some heavy metals, in *P. lentiscus* tree that grown in Msallate city, furthermore, to study its inhibition activity against some kind of microbes. The results of this study clarified that *P. lentiscus* tree has an ability to accumulate iron, lead, copper, zinc. Phytochemical analysis of *P. lentiscus* extracts revealed that the aerial parts are reach in its chemical constitute such essential oil, alkaloids, phenolic, tannins and saponins. These compounds play an important role to resist some environmental polluters such microbes and weeds.

Keywords: *Pistica lentiscus; Heavy Metals; Antimicrobial, Phytostabilization*

Introduction

Pistacia lentiscus (L), Family *Anacardiaceae*, is widely distributed and grows in many Mediterranean countries. This plant has a resin part known as Mastic resin and plant called as mastic tree.

Photochemistry

Phytochemical is a natural bioactive compound found in plants, such as vegetables, fruits, medicinal plants, flowers, leaves and roots that work with nutrients and fibers to act as an defense system against disease or more accurately, to protect against disease. Phytochemicals are divided into two groups [1]. *P. lentiscus* is extensively used in folk medicine and the pharmaceutical and antimicrobial activity of this species has been reported by several authors [2,3]. It was recognized as a terpene-storing species which produces the largest number of individual terpenes. The phytochemical analysis of shoot extracts from *P. lentiscus* revealed the presence of some bioactive components such as alkaloids, tannins, hydrolysable tannins, phlobatannins, phenol, volatile oil, saponins, glycosides, flavonoids, protein and Anthracanens. The most important component of *Pistacia lentiscus* L. are resin and Essential oil. Resin was analyzed by GC and GC-MS to obtain α-pinene, β- pinene, limonene, terpene-4-ol and terpene. Essential oil from leaves contain β- caryophylline (31.38%), germaerene (12.05%) and γ- cadinene (6.48%) [4]. Hydrodistilled oil from leaves was analyzed by GC-MS and contain α- pinene, γ-terpene and terpene-4-ol [5]. The gum oil contain 90% monoterpene hydrocarbon named as 79% of α- pinene and 3% β- myrcene.

Phytostabilization and environmental restoration

Phytostabilization plants are used to detoxify harmful environmental pollutants and reduction of heavy metals mobility. *P. lentiscus* appears to be the more suitable species for phytostabilization and revegetation, for its resistance to metals and high phytomass production.

P. lentiscus as a source of antimicrobial compounds: Microorganisms, that cause plant and human disease, are source of environmental pollutants. Thus, studies by [6] proved that *P. lentiscus* has reported as antifungal and antibacterial. *P. lentiscus* has variety of chemical compounds furthermore the chemical compounds differ depended on plant part. Thus, essential oil can be extracted from leaves, resin, Twigs and fruit. The chemical composition and the quality of such oil differ depends on its source. Essential oil from mastic gum found to be effective against Gram positive and Gram-negative bacteria while essential oil from leaves has marked inhibitory effect against *Salmonella typhi murium*.

Allopathic Phenomenon

The presences of weeds in crop fields were considered as an environmental polluter for a number of reasons. It reduces crop production competing with the desired crop plants for the resources such soil nutrients, water and space. Buriro., *et al*. [7] clarified that weeds are conceded as host plants for pests. Weeds also causes crops loss which reaches 12% and costing nearly 33 US$ to control them. *P. lentiscus* was found to be very useful source for active compounds [8] that can be work as bio-pesticides. The main objectives of the study to evaluate the allopathic potential and activity of *P. lentiscus* against herbs, an inhibitory effect of *P. lentiscus* against microorganisms, furthermore, to explain the role of *P. lentiscus* to stabilizes and removes heavy metals from the environment.

Materials and Methods

Areal Parts including leaves and fruits of P. Areal Parts including leaves and fruits of *P. lentiscus* were collected around from Msallata (northwestern part of Libya). Plant taxonomically identified by botanists Dr. M. Elgaroshii, in Botany department at Science collage- University of Misurata – Libya, also taxonomic identification done as described by Jafi and Ali [9].

Preparation of plant extracts: Leaves and parts of stem (10gm) were subjected to sohxlet extraction using 200 ml of water, ethyl-acetate and ethanol (70%), individually, as solvents. Samples kept for 6 hours at 90◦C for water and 70°C for Ethyl- acetate and ethanol.

Phytochemical tests: Plant extracts of different solvents water ethanol, ethyl acetate; and essential oil were screened for the presence of biologically active compounds [10] Alkaloids, Saponins, Flavonoids, Phenol, Tannins, Violate Oil, Anthracanens, Glycosides tests done according to Methods [11].

Essential oil extract: Fruits of *P. lentiscus* L. were grinded to the fine powder then boiled in water for 20 minutes. Essential oil was collected and stored in sterile dark glass bottles.

Mineral Compounds Analysis: The dried plant was wet oxidized and the elements were determined by Atomic Absorption Spectrophotometer (Perkin-Elmer model 403, Norwalk Ct, USA). The minerals, iron, copper, Zn, Pb, Cd and Cr in clouds were reported in ppm. Values for, Fe, was read on Atomic Absorption Spectrophotometer (180 - 30 Hitachi).

Test Microorganisms, Antibacterial and antifungal activities: The antibacterial test was carried out using referenced strain, *Staphylococcus aureus* (gram positive), *Klebsiella pneumonia* (gram negative). The fungal strain used was *Candida albicans*. The strains were obtained from the Laboratory of microbiology at the University of Misurata (Libya). The antibacterial and antifungal activities in vitro were assayed by Agar well diffusion method [12]. The effect of *P. lentiscus* extracts, water, ethanol and ethyl-acetate, obtained from leaves, resins, gum and tannins. Muller Hinton broth was used as a medium for bacteria test whereas Potato Dextrose Ager (PDA) was used as a media for fungi test.

Results and Discussion

The results as presented in Table 1 and 2; the phytochemical screening conducted on ethanol shoot and resin extract of *P. lentiscus* revealed the presence of some bioactive components. They confirm similar research conducted by [13] while the result obtained showed the presence of alkaloids, glycosides, phenols, saponins, tannins, volatile oils and anthracenes. Resin extract analysis revealed that ethyl acetate extract was reach in its phytochemical constitute when compared with water and ethanol extracts. The Chemical composition of ethyl acetate resin extract was as shown in Table (2). Result of an essential oil extract analysis illustrated that ethyl acetate was the best solvent to extract the chemical compounds from oil. Ethyl acetate oil extract contains phenol, volante oil and anthracene.

Phytochemical compounds	Color Observation	Water extract	Ethyl acetate	Ethanol extract
Alkaloids	Wagners	++	+	++
Protein	Folin test	+	++	++
Phenol	1% aqueous ferric chloride	+	+	++
Flavonoids	Pieces of magnesium chips and HCL	+	+	+
Violate oil	0.1% NaOH+ HCl	+	++	++
Tannins	10% ferric chloride, 50 ml distilled water heating 30 min.	+	++	+++
Saponins	Forth test	+	+	-
Glycosides	Fehling	+	+ =	+++
Anthracenes	Ammonia solution	+	+	+

Table 1: *Chemical constituents of ethyl acetate, ethanol and water shoot and tannins extracts of P. lentiscus.*

+: Positive; -: Negative

Phytochemical compounds	Color Observation	Water extract	Ethyl acetate	Ethanol extract
Alkaloids	Wagners	-	-	-
Protein	Folin test	-	-	-
Phenol	1% aqueous ferric chloride	-	+	-
Flavonoids	Pieces of magnesium chips and HCL	-	+	-
Violate oil	0.1% NaOH+ HCl	-	+	+
Tannins	10% ferric chloride, 50ml distilled water heating 30min.	-	-	-
Saponins	Forth test	-	+	-
Glycosides	Fehling	-	+ =	+++
Anthracenes	Ammonia solution	+	+	-

Table 2: *Chemical constituents of ethyl acetate, ethanol and water resin extracts of p. lentiscus.*

Allelopathy effects

The obtained results on the herbicidal activity of *P. lentiscus* oil, resin and shoot extracts confirm the allelopathic properties of *Anacardiaceae* family reported by [14]. The results of this study revealed that the aerial parts of *P. lentiscus*, Shoot, fruit, tannins and resin are reach in their phytochemical, essential and violate oil. Thus, our results are in agreement with [15] that has been previously reported the herbicidal effects of aerial parts, including essential oil, against weeds and their phytotoxicity.

Figure 1 shows a good Allopathic activity of *P. lentiscus*, grown in the field conditions, suggested that the presence of phenolic and terpenes compounds generally attributed to the allopathic properties.

Figure 1: *Allopathic effect of P. lentiscus grown under field conditions Msallata city during March (a) and September (b).*

Phytostabilization and environmental restoration

The result presented in Figure 2 illustrated that *P. lentiscus* shoot contains higher concentration of Iran (Fe), cupper (Cu), Zinc (Zn) and lead (Pb) while it has lower concentration of cadmium (Cd) and chrome (Cr). The presence of Cu and Pb in the shoot reveals that the plant grows in contaminated site, and according to the data reported by [15] lead is an ubiquitous environmental and industrial pollutant that has been detected in every facet of environmental and biological systems. However, *P. lentiscus* was able to absorb and accumulate heavy metals from soil to their aerial parts. This process is called (Phytovolatilization). Thus, the result showed in Figure 2 clarified that *P. lentiscus* is suitable for phytostabilization of heavy metals such as lead, Zinc and Cupper. This result in agreement with the study done by [16]. He demonstrated that *P. lentiscus* appears to be the more suitable species for phytostabilization and revegetation, both for its resistance to metals and high phytomass production.

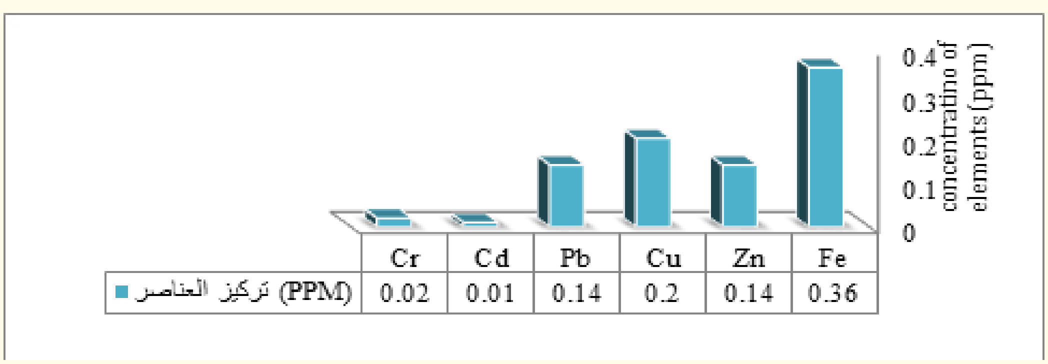

Figure 2: *Some Heavy metals detected in the shoot of P. lentiscus.*

Antimicrobial activity

The crude extract (Ethyl acetate, Ethyl alcohol and water) obtained from the shoot, tannina, resins and essential of *Pistacia lentiscus* L. has reported to inhibited the growth of *Candida albicans* fungus significantly and further study revealed that all extract obtained from all are more effective on *Candida albicans*. The result showed in Table 3 illustrated that *P. lentiscus* extracts had effect on the activity of

Staphylococcus aureus, this result are in accord agreement with [17]. Tannins extract (with different solvents) and essential oil extract with ethanol showed marked inhibitory effects, the same result demonstrated by [18-32]. Resin extract, with ethanol and ethylacetate, also essential oil water extract partly effected the growth of *Staphylococcus aureus* whereas essential oil extracted with ethylacetate; shoot extracted with water and ethylacetate showed miner effect on the activity *Staphylococcus aureus* growth. *P. lentiscus* extracts (tannins, resin and essential oil extracted with tested solvents) showed a moderately activity against *Klebsiella pneumonia* growth while shoot extract with different tested solvent had no effect suggesting that the active compounds presented may differed on their concentration.

Tested Microorganisms									
	Klebsiella pneumonia			***Staphylococcus aureus***			***Candida albicans***		
Aerial parts / Solvents	Water	Ethyl acetate	ethanol	Water	Ethyl acetate	ethanol	Water	Ethyl acetate	ethanol
Shoot extract	-	-	-	+	+	-	+++	+++	+++
Resin extract	++	++	++	-	++	++	+++	+++	+++
Tannins extract	++	++	++	+++	+++	+++	+++	+++	+++
Essential oil extract	++	++	+	++	+	+++	+++	+++	+++

Table 3: *Anti-microbes activity of Pistacia lentiscus L.*

(-) no activity, the inhibition zone was scored as + (less than 13 mm), ++ (14 – 18 mm, partly inhibition) and +++ (20 mm, complete inhibition)

Conclusion

Herbs, heavy metals and microorganisms are the most polluters to our environment. In order to protect the environment system that needs to use a natural product. Recently new trends in crop production lead to a reduction in the levels of herbicide and to the use of "naturally-derived" herbicide from plants origin. Among natural substances, fruit essential oils and extracts from resin, tannins, shoot used as flavoring agents are known to possess many biological activities. In this respect, natural herbicides may be effective, selective, biodegradable, and less toxic to environment. In this study *P. lentiscus*, under field conditions, showed allopathic effect on herbs suggesting that it could be used as alternative herbicides. *P. lentiscus* appears to be suitable for phytostabilization. It has ability to uptakes and accumulates heavy metals. The aerial parts of *P. lentiscus* are reach in their chemical constitutes. Thus, the presences of phytochemical compounds are promising sources of natural anti- microbes. *P. lentiscus* tested extracts shows strong effect on fungal activity (*Candida albicans*) also *Staphylococcus aureus* while it showed moderate effect on *Klebsiella pneumonia*. Tannins, essential oil and resins extracted with different solvent had strong effect on tested microbes while shoot extract exhibit lower effect on *Staphylococcus aureus* while no effect had been observed on the activity of *Klebsiella pneumonia*.

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