**Pistacia atlantica** Desf. A review of its traditional uses, phytochemicals and pharmacology

Fatemeh Mahjoub¹, Kambiz Akhavan Rezayat², Mahdi Yousefi³, Masoud Mohebbi⁴, Roshanak Salari⁵

1. MD, Ph.D candidate, Department of Persian medicine, School of Persian and complementary medicine, Mashhad University of Medical Sciences, Mashhad, Iran
2. Assistant Professor, MD, Department of Internal Medicine, School of Medicine, Mashhad University of Medical Sciences, Mashhad, Iran
3. Assistant Professor, MD, Ph.D, Department of Persian Medicine, School of Persian and Complementary Medicine, Mashhad University of Medical Sciences, Mashhad, Iran
4. Assistant Professor, MD, Endocrine research center, Mashhad University of Medical Sciences, Mashhad, Iran
5. Assistant Professor of Drug Control, Ph.D, Department of Pharmaceutical Sciences in Persian Medicine, School of Persian and complementary medicine, Mashhad University of Medical Sciences, Mashhad, Iran

**Corresponding Author:**
Prof. Roshanak Salari (Pharm.D, Ph.D)
Address: School of complementary and Persian medicine, Azadi square, Mashhad, Iran.
E-mail: salari@mums.ac.ir
Tel: +98-51-38829279, Fax: +98-51-38535980

Received: November 13th, 2017 – Accepted: March 6th, 2018

**Abstract**

*Pistacia atlantica* is the main herbal medicine that has been widely used in the Middle Eastern and Mediterranean areas since ancient time. *Pistacia atlantica* has been used for multiple purposes like stomach diseases, renal disorders, wounds and coughs. The aim of this study is to review its botanical characterization, traditional applications, photochemistry effects and pharmacological activities.

Data in this review article was gathered from credible pharmacopeias, electronic databases such as Web of Science, Science Direct, PubMed, EMBASE, Scopus, EBSCO, Google Scholar, SID and Iran Medex and textbooks of Persian medicine such as *Canon of medicine* (Ibn-e Sina, 980-1037 AD) and *Makhzan-al-Advia* (Aghili, 18th century). The keywords were searched in Persian and English books on medicinal plants and traditional medicine. The results showed that *P. atlantica* has many medicinal properties such as antioxidant, antidiabetic, antihyperlipidemic, along with others. It can also be effective in gastrointestinal diseases. Thus, different new drugs can be formulated based on *P. atlantica* for the management of various diseases.

**Keywords:** *Pistacia atlantica*; wild pistachio; traditional medicine; Persia

**Introduction**

The genus Pistacia (family of Anacardiaceae) includes over 600 species. *P. vera*, *P. atlantica*, *P. terebinthus*, *P. khinjuk*, and *P. lentiscus* are the most famous species of Pistacia that are widely distributed in the Mediterranean and Middle Eastern areas [1, 2]. More than 40% of the world production of Pistacia spp. is from Iran [3]. Iran’s Pistacia cultivation history (3000–4000 years) represents different culinary and traditional medicinal applications for this herb. The most economical species of *Pistacia* genus is *P. atlantica* (wild pistachio), found in in Iran [4]. Besides Iran, wild pistachio grows in different countries like Pakistan, Greece, Turkey, and North Africa [5]. *Cabulica*, *Kurdica*, and *Mutica* are the three subspecies of *P. atlantica* [6]. Various industrial and traditional uses are mentioned for the main parts of wild pistachio (resin and fruit) including in foods and medicine. Recent research investigates the wide pharmacological properties from various parts of *P. atlantica*, such as antimicrobial, antioxidant, anti diabetic, antitumor, and antihyperlipidemic activities. In this review, traditional uses, phytochemistry and pharmacological activities of *P. atlantica* are described.

**Methods**

This Review has been written based on Persian and modern medical textbooks. Valid Persian medical references such as *Al-Qanun Fi al-Tibb* which is called *Canon of medicine* in Latin (*Ibn-e Sina*, 980-1037 AD), *Makhzan-al-Advia* (*Aghili*, 18th century) have been chosen. Science Direct, PubMed, Scopus, EMBASE, SID, IranMedex, and Google scholar databases were also searched by keywords *Pistacia atlantica*, wild pistachio, traditional medicine, and Persia, up until 2017.

**Results**

**Botany**

*P. atlantica* is a tree with a length of 2-5 m. The branches of the tree are grayish-white and have leaves composed of 9
to 11 leaflets. Oleoresin is secreted by the trunk featuring a yellowish-green color and a mild smell. This plant is single-sex and has 5 sepals and no petals [7].

**Pistacia atlantica in traditional medicine**

In Persian, *P. atlantica* is called *Baneh*, in English *Mt. Atlas mastic tree*, in Arabic *Butm*, in the Canary Islands *Almacigo*, and in Turkish *Melengic*. The resin of wild pistachio called Saqez. Vanoshak is the name of tree fruits that has a green thin wrapper with a stiff shell and its marrow possesses nutritional value. *Baneh* have been mentioned as ripe fruits with delicious marrow [7,8]. Iran is one of the biggest producers and exporters of *P. atlantica*.

**Temperament of Pistacia atlantica in Persian medicine**

According to Persian medicinal literature, all the materials in the world exhibit four main qualities: "warmth", "coldness", "wetness", and "dryness" and Mizaj (temperament) is a predominant quality (or qualities). According to the previously-mentioned idea, herbal medicines have a specific temperament. Each particular part of the *P. atlantica* species has different degrees of temperament. Fresh fruit is warm and dry in degree 1; dried fruit is warm and dry in degree 3; resin is warm and dry in degree 2; fresh leaves and branches are warm and dry in degrees 2 and 1, respectively [9].

**Mode of application in traditional medicine**

**Gastrointestinal effects**

The fruit and resin of *P. atlantica* have beneficial effects in upper and lower gastrointestinal disorders. The resin is a stomach tonic and it is used for dyspepsia, stomach ulcer, esophagitis and gastritis. Oleoresin is an appetizer, a laxative, and it is advantageous for anal fissures. The fruit is carminative and effective in nausea and vomiting, colic, hemorrhoid, anal fissures and intestinal worms [9-12].

**Hepatic and splenic effects**

The fruit and resin of *P. atlantica* are liver tonics and have hepatoprotective properties. They are prescribed for hepatic weakness, hepatitis and ascites. The fruit is a spleen tonic and it is prescribed for splenic stagnation [9,12].

**Neurological effects**

The resin and fruit of *P. atlantica* are nerve tonics and are useful in Bell’s palsy, stroke, tetanus, seizure, tremor and headache [9,12].

**Heart and psychological uses**

This plant has beneficial effects for palpitations and syncope; its fruit also has antidepressant properties [9].

**Respiratory benefits**

*P. atlantica* (resin & fruit) are prescribed for pneumonia and productive cough due to mucolytic properties [9,12].

**Urogenital effects**

The fruit of *P. atlantica* has been known as a kidney tonic and aphrodisiac; also, it is used for nephrolithiasis. This plant (resin & fruit) has diuretic and emmenagogue properties [9,12].

**Dermatologic benefits**

This plant is effective for wound healing, scabies, lip fissures and hair loss [9,12,13].

**Miscellaneous**

The resin is a gum tissue strengthener and useful for bone fractures and musculoskeletal disorders. The fruit has been used for back pain due to its analgesic properties [9].

**Phytochemistry of Pistacia atlantica**

The chemical entities from different phytochemical groups were isolated and characterized in *P. atlantica* and mentioned in Table 1.

**Terpenoids**

An essential oil is one of the numerous metabolites extracted from the fruits, leaf-buds, twigs, flowers, leaves, resin, and galls of *P. atlantica* [8]. The main ingredients of the essential oils reported by hydrodistillation of the resin, leaves and fruits of *P. atlantica* based on GC (gas chromatography) and GC/MS (gas chromatography/mass spectrometry) is monoterpene with α-pinene (42.9%) and β-pinene (13.2%) in the resin. Terpinen-4-ol (21.7%) and elemol (20.0%) are two major ingredients in the oil of the leaves. The oil of the fruits has high amounts of oxygenated monoterpenes, with bornyl acetate (21.5%) as the predominant component [14]. Spathulenol is the main component of *P. atlantica* leaves [15]. Triterpenes like oleanolic acid, ursolic acid, masticadienonic acid, masticadienolic acid, morolic acid, and 3-O-acetyl-3-epimasticadienolic acid are detected in the resin of *P. atlantica* [5, 16].

**Phenolic Compounds**

Phenols are known for their antioxidant activities which reduce the risk of different diseases such as cancers [17]. Leaf extract contains two main chemical compounds of gallic acid and gallic acid methyl ester. Luteolin, luteolin 7-glycoside, chlorogenic acid, kampferol, naringin and naringin 7-glycoside were detected from the fruit extract [5]. Flavonoid glycosides were isolated from the aerial parts, leaves and stems of *P. atlantica*. These components
| Chemical compound | Structure | Plant parts                  | References       |
|-------------------|-----------|------------------------------|------------------|
| α-pinene          | ![Structure](image) | Leaf, fruit, gall, resin     | [1, 14, 28, 45]  |
| β-pinene          | ![Structure](image) | Resin                        | [1, 46]          |
| limonene          | ![Structure](image) | Resin, fruits                | [1, 14]          |
| Terpinolene       | ![Structure](image) | Leaf                         | [1, 47]          |
| Camphene          | ![Structure](image) | fruits                       | [1, 14]          |
| Terpinen-4-ol     | ![Structure](image) | Unripe fruits                | [1, 48]          |
| Bornyl acetate    | ![Structure](image) | Fruits                       | [1, 14]          |
| Sabinene          | ![Structure](image) | Fruits, unripe fruits        | [1, 47, 48]      |
| p-Mentha-1 (7),8 diene | ![Structure](image) | Leaf buds                    | [1, 48]          |
| Δ3-carene         | ![Structure](image) | Unripe galls                 | [1, 49]          |
| Spathulenol       | ![Structure](image) | Leaf                         | [1, 15]          |
Table 1: Chemical ingredients and their structure isolated from *Pistacia atlantica* Desf.

| Chemical compound                   | Structure          | Plant parts | References |
|-------------------------------------|--------------------|-------------|------------|
| Masticadienonic acid                | ![Masticadienonic acid](image1) | Resin       | [1, 16]    |
| Masticadienolic acid                | ![Masticadienolic acid](image2) | Resin       | [1, 16]    |
| Morolic acid                        | ![Morolic acid](image3) | Resin       | [1, 16]    |
| Oleanolic acid                      | ![Oleanolic acid](image4) | Resin       | [1, 16]    |
| Ursonic acid                        | ![Ursonic acid](image5) | Resin       | [1, 16]    |
| 3-O-acetyl-3-epiisomasticadienolic acid | ![3-O-acetyl-3-epiisomasticadienolic acid](image6) | Resin       | [1, 16]    |
| Gallic acid                         | ![Gallic acid](image7) | Gall and Leaf | [1, 5] |
| Quercetin-3-glucoside               | ![Quercetin-3-glucoside](image8) | Aerial parts | [1, 18] |
| 3-Methoxycarpachromene              | ![3-Methoxycarpachromene](image9) | Aerial parts | [1, 19] |
| β-myrcene                           | ![β-myrcene](image10) | Resin, fruits | [1, 14] |
were revealed as kaempferol-3-glucoside, quercetin-3-glucoside, quercetin-3-galactoside, quercetin-3-rutinoside, quercetin-3-glucoside-7-galactoside, apigenin 6,8-di-C-glucoside (vicenin 2) [18]. Among flavonoids, 3-methoxycarpachromene has an antiplasmodial activity which is isolated from the aerial parts of *P. atlantica* [19].

**Fatty Acids and Sterols**

The fruits of *P. atlantica* are the main sources of unsaturated fatty acids. The ingredients of the oil content are oleic (46%), linoleic (27.5%), palmitic (24%) and stearic acid [10,20]. The main sterol of the *P. atlantica* fruit oil is β-sitosterol (87%), which is similar to peanuts and *Pistacia vera* [21]. Cholesterol, campesterol, Δ5-avenasterol, Δ7-avenasterol have been revealed from the sterol composition [10]. The sterol composition has an important role in preventing coronary heart diseases [22].

**Miscellaneous**

Tocopherols and tocotrienols are the other ingredients of *P. atlantica* hull oil with antioxidant properties [22, 23].

**Pharmacological effects**

**Antimicrobial Activities**

*P. atlantica* has antibacterial properties against a large number of Gram-positive and Gram-negative bacteria. The oleoresin from *P. atlantica* var. *kurdica* with its major component -pinene has antibacterial properties against *Helicobacter pylori* [1,16]. Another research showed that acidic fractions resin of *P. atlantica* has extensively inhibitory effects against *Escherichia coli*, *Salmonella typhimurium*, *Pseudomonas aeruginosa*, *Alcaligenes faecalis*, *Enterobacter aerogenes*, *Pseudomonas fluorescens*, *Bacillus cereus*, *Streptococcus faecalis*, *Staphylococcus aureus* and *epidermidis* [24-27]. The methanolic extract from *P. atlantica* fresh fruits has been shown to affect fungi and yeast, such as *Candida albicans*, *Candida glabrata* and *Saccharomyces cerevisiae* [28,29]. The leaves and twigs of *P. atlantica* with its active substance 3-methoxycarpachromene showed antiprotozoal activity against *Plasmodium falciparum* [19]. In addition, *P. atlantica* var. *kurdica* gum could prevent cutaneous leishmaniosis from infected mice [30].

**Antioxidant Activity**

The main phenolic compounds of the fruits and leaves of *P. atlantica* are benzoic acid derivates, hydroxycinnamic acid derivates, and flavonoids that have antioxidant properties. Sinapic acid, vanillic acid and p-hydroxybenzoic acid are metabolites of hull and shell extracts with antioxidant properties [31]. A study has demonstrated the existence of new natural antioxidant ingredients isolated from the mushroom *Inonotus hispidus* growing on *P. atlantica* including methyl 5-(3,4-dihydroxyphenyl)-3-hydroxypenta-2,4-dienoate, hispolone 2 (6-(3,4-dihydroxyphenyl)-4-hydroxyhexa-3,5-dien-2-one) and hispidin 3 (6-(2-(3,4-dihydroxyphenyl)vinyl)-4-hydroxy-2H-pyran-2-one) [29, 32, 33].

**Antihyperlipidemic effects**

Research on animals revealed that *P. atlantica* fruit oil decreased LDL cholesterol, VLDL cholesterol, triglycerides and increased HDL cholesterol. In one study, the lipid profiles were reduced in female rats with experimental hypothyroidism caused by propyl thiouracil (PTU) which received wild pistachio oil [34, 35].

**Hypoglycemic effects**

Aqueous leaf extract from *P. atlantica* has hypoglycemic effects due to the inhibitory effect on α-amylase and α-glucosidase [36, 37]. An in vivo study has also shown postprandial glucose improvement equal to glipizide and metformin and higher than acarbose in rats [37].

**Anticancer activity**

The cytotoxic effects of fruit methanolic extract from *P. atlantica* sub. *kurdica* were approved against two human cancer cell lines including the human colon carcinoma (HT29), and the human breast cancer (T47D). *P. atlantica* extract can alternate tubular protein organization with inhibitory effects on microtubule polymerization and dynamics [38-40].

**Anticholinesterase Activity**

Aqueous extracts of *P. atlantica* leaves demonstrated strong acetylcholinesterase (AChE) inhibition [41], whereas both methanol and ethyl acetate extracts of *P. atlantica* leaf exhibited relatively weak AChE inhibitory activity [42].

**Wound-healing effects**

Tanideh et al. demonstrated that the resin extract is effective in burn wounds by increasing angiogenesis, concentration of basic fibroblast growth factor (bFGF) and platelet-derived growth factor (PDGF) [43]. The results of another clinical trial showed that oleoresin of *P. atlantica* has a beneficial effect on nipple fissures and pain [44].

**Gastrointestinal benefits**

*P. atlantica* has anti-inflammatory activity and an appropriate effect in the treatment of ulcerative colitis. One study on animals exhibited that fruit oil can improve colitis in rats [43].
Discussion

According to the Persian medical literature and recent studies, *P. atlantica* has various applications for dietetic and medicinal purposes. This review investigated extensive evidence on phytochemical and pharmacological features. Some of the therapeutic uses in traditional medicine are supported by recent studies, such as their beneficial effects on gastrointestinal disorders, but there are several pharmacological activities discussed in traditional medicine such as aphrodisiac activities, diuretic, emmenagogue, and medicinal purposes. This review investigated extensive studies, according to the Persian medical literature and recent network analysis method: California Polytechnic State University, network for Fresno county using geographic information systems growing along an aridity gradient in Algeria. Flora-Morphology, Distribution, Functional Ecology of Plants. 2011; https://doi.org/10.1016/j.foreco.2008.01.057

15. Benhassaini H, Bendahmane M, Benchalgo N. The chemical composition of fruits of *Pistacia atlantica desf.* subsp. *atlantica* for antiplasmodial compounds—3-Methoxycarpachromene from *Pistacia atlantica*. Phytochemistry Letters. 2009; https://doi.org/10.1016/j.phytol.2009.05.006

16. Sharifi MS, Hazell SL. Isolation, analysis and antimicrobial activity of the acidic fractions of Mastic, Kurdica, Mutica and Caboica gums from genus *Pistacia*. Global journal of health science. 2012; PMCID: PMC4777032

17. Ferreira IC, Barros L, Soares ME, Bastos ML, Pereira JA. Antioxidant activity and phenolic contents of *Olea europaea L.* leaves sprayed with different copper formulations. Food Chemistry. 2007; https://doi.org/10.1016/j.foodchem.2006.08.006

18. Kawashty S, Mosharrafa S, El-Gibali M, Saleh N. The flavonoids of *Pistacia* species in Egypt. *Biochemical Systematics and Ecology*. 2000;28(9):915–7.

19. Adams M, Plitzko I, Kaiser M, Brun R, Hamburger M. HPLC-profiling for antiplasmodial compounds—3-Methoxycarpachromene from *Pistacia atlantica*. Phytochemistry Letters. 2009; https://doi.org/10.1016/j.phytol.2009.05.006

20. Benhassaini H, Bendahmane M, Benchalgo N. The chemical composition of fruits of *Pistacia atlantica* desf. subsp. *atlantica* from Algeria. Chemistry of Natural Compounds. 2007; https://doi.org/10.1007/s10600-007-0059-4

21. Yildiz M, Gürçan ŞT, Özdemir M. Oil composition of pistachio nuts (*Pistacia vera L.*) from Turkey. Lipid- Fett. 1998;100(3):84-6.

22. Givianrad M, Saber-Tehrani M, Mohammadi SJ. Chemical composition of oils and their health effects. Nutrition Bulletin. 2009; DOI: http://dx.doi.org/10.3989/psb.6.12.18031

23. Delazar A, Nazemihem H, Modaresi M, Afshar J. Study on essential oil obtained from oleoresin of *Pistacia atlantica* var. *mutica*. 2003.
27. Ghalem B, Benali M. Bactericidal activity of Pistacia atlantica. Desf mastic gum against certain pathogens. African Journal of Plant Science. 2009;3(1):013-5.

28. Falahati M, Sepahvand A, Mahmoudvand H, Baharvand P, Jabbarnia S, Ghojogi A, Yarahmad M. Evaluation of the antifungal activities of various extracts from Pistacia atlantica Desf. Current Medical Mycoloy. 2015; DOI: 10.18869/acapub.cnnm.1.3.25

29. Benhammou N, Bekkara FA, Panovska TK. Antioxidant and antimicrobial activities of the Pistacia lenticus and Pistacia atlantica extracts. African Journal of Pharmacy and Pharmacology. 2008;2(2):022-8.

30. Taran M, Mohebali M, Esmaeli J. In vivo efficacy of gum obtained Pistacia atlantica in experimental treatment of cutaneous leishmaniasis. Iranian journal of public health. 2010; PMID: 23112988, PMCID: PMC3468973

31. Hatamnia AA, Abbaspour N, Darvishzadeh R. Antioxidant activity and phenolic profile of different parts of Bene (Pistacia atlantica subsp. kurdica) fruits. Food chemistry. 2014; PMID: 24128482, DOI: 10.1016/j.foodchem.2013.08.031

32. Rezaei M, Farhoosh R, Iranshahi M, Sharif A, Golmohamadzadeh S. Ultrasonic-assisted extraction of antioxidative compounds from Bene (Pistacia atlantica subsp. mutica) hull using various solvents of different physicochemical properties. Food chemistry. 2014; PMID: 25466062, DOI: 10.1016/j.foodchem.2014.10.081

33. Sharif A, Farhoosh R, Khodaparast MHH, Kafkani MHT. Antioxidant activity of bene hull oil compared with sesame and rice bran oils during the frying process of sunflower oil. Journal of Food Lipids. 2009; DOI: 10.1111/j.1745-4522.2009.01154.x.

34. Saeb M, Nazifi S, Mirzaei A. The effects of wild pistacio fruit oil on the serum concentration of lipids and Lipoproteins of female rabbits. Journal of Shahid Sadoughi University of Medical Sciences And Health Services. 2004; URL: http://jssu.ssu.ac.ir/article-1-1248-en.html

35. Nazifi S, Saeb M, Sepehrimanes M, Poorgonabadi S. The effects of wild pistachio oil on serum leptin, thyroid hormones, and lipid profile in female rats with experimental hypothyroidism. Comparative Clinical Pathology. 2012;21(5):851-7.

36. Hamdan I, Affif F. Studies on the in vitro and in vivo hypoglycemic activities of some medicinal plants used in treatment of diabetes in Jordanian traditional medicine. Journal of ethnopharmacology. 2004; PMID: 15182916, DOI: 10.1016/j.jep.2004.03.033

37. Kasabri V, Affif FU, Hamdan I. In vitro and in vivo acute antihyperglycemic effects of five selected indigenous plants from Jordan used in traditional medicine. Journal of ethnopharmacology. 2011; https://doi.org/10.1016/j.jep.2010.11.025

38. Rezaei PF, Fouladllo S, Hassani S, Yousefbeyk F, Ghaffari SM, Amin G, Azizi E. Induction of apoptosis and cell cycle arrest by pericarp polyphenol-rich extract of Banah in human colon carcinoma HT29 cells. Food and Chemical Toxicology. 2012; https://doi.org/10.1016/j.fct.2011.11.012

39. Shafiei B, Shasaltaneh MD, Ghaffari S, Ahmadian S, Kamarehei M, Raizi G. An in vitro study on the effect of Pistacia atlantica sub kurdica extract on microtubule proteins a potential anti-cancer compound. International Journal of Pharmaceutical Sciences and Research. 2015;6(12):5029.

40. Rezaei PF, Fouladllo S, Ghaffari SM, Amin G, Azizi E. Induction of G1 cell cycle arrest and cyclin D1 down-regulation in response to pericarp extract of Banah in human breast cancer T47D cells. DARU Journal of Pharmaceutical Sciences. 2012; https://doi.org/10.11186/2008-2231-20-101

41. Benamar H, Rached W, Derdour A, Marouf A. Screening of Algerian medicinal plants for acetylcholinesterase inhibitory activity. Journal of Biological Sciences. 2010; http://scialert.net/qredirect.php?doi.

42. Peksel A, Arisan-Atac I, Yanardag R. Evaluation of antioxidant and antiacetylcholinesterase activities of the extracts of Pistacia atlantica Desf. Leaves. Journal of food biochemistry. 2010; DOI: 10.1111/j.1745-4514.2009.00290.x

43. Taneid N, Masoumi S, Hosseinzadeh M, Safarpour AR, Erjaee H, Koohi-Hosseinabadi O, Rahimkazerooni S. Healing effect of pistacia atlantica fruit oil extract in acetic Acid-induced colitis in rats. Iranian journal of medical sciences. 2014; PMCID: PMC4242986

44. As‘adi N, Kariman N, Mobaj F, Pourhoseingholi MA. The effect of Saeqz (Pistacia atlantica) ointment on the treatment of nipple fissure and nipple pain in breastfeeding women. Electronic physician. 2017; DOI: http://dx.doi.org/10.19082/4952

45. Mecherara-Ijderi S, Hassani A, Castola V, Casanovaja J. Composition of leaf, fruit and gall essential oils of Algerian Pistacia atlantica Desf. Journal of Essential Oil Research. 2008; http://dx.doi.org/10.1080/10412950.2008.9699995

46. Delazar A, Reid R, Sarker S. GC‐MS analysis of the essential oil from the oleoresin of Pistacia atlantica var. mutica. Chemistry of Natural Compounds. 2004; https://doi.org/10.1023/B:CONC.0000025459.72590.9e

47. Roitman JN, Merrill GB, Beck JJ. Survey of ex situ fruit and leaf volatiles from several Pistacia cultivars grown in California. Journal of the Science of Food and Agriculture. 2011; PMID: 21384363, DOI: 10.1002/jsfa.4268

48. Tzakou O, Bazos I, Yannitsaros A. Volatile metabolites of Pistacia atlantica Desf, from Greece. Flavour and fragrance journal. 2007; DOI: 10.1002/jf.2008.2231-20-101

49. Gourine N, Yousfi M, Bombarda I, Nadjemi B, Stocker P, Gaydou E. Antioxidant activities of various extracts from Pistacia atlantica Desf. Current African Journal of Plant Pharmacology. 2007;2(2):022-8.

50. Roitman JN, Merrill GB, Beck JJ. Survey of ex situ fruit and leaf volatiles from several Pistacia cultivars grown in California. Journal of the Science of Food and Agriculture. 2011; PMID: 21384363, DOI: 10.1002/jsfa.4268

51. Delazar A, Reid R, Sarker S. GC‐MS analysis of the essential oil from the oleoresin of Pistacia atlantica var. mutica. Chemistry of Natural Compounds. 2004; https://doi.org/10.1023/B:CONC.0000025459.72590.9e

52. Tzakou O, Bazos I, Yannitsaros A. Volatile metabolites of Pistacia atlantica Desf, from Greece. Flavour and fragrance journal. 2007; DOI: 10.1002/jf.2008.2231-20-101

53. Gourine N, Yousfi M, Bombarda I, Nadjemi B, Stocker P, Gaydou E. Antioxidant activities of various extracts from Pistacia atlantica Desf. Current African Journal of Plant Pharmacology. 2007;2(2):022-8.

54. Roitman JN, Merrill GB, Beck JJ. Survey of ex situ fruit and leaf volatiles from several Pistacia cultivars grown in California. Journal of the Science of Food and Agriculture. 2011; PMID: 21384363, DOI: 10.1002/jsfa.4268

55. Tzakou O, Bazos I, Yannitsaros A. Volatile metabolites of Pistacia atlantica Desf, from Greece. Flavour and fragrance journal. 2007; DOI: 10.1002/jf.2008.2231-20-101

56. Gourine N, Yousfi M, Bombarda I, Nadjemi B, Stocker P, Gaydou E. Antioxidant activities of various extracts from Pistacia atlantica Desf. Current African Journal of Plant Pharmacology. 2007;2(2):022-8.