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Review

Plants used in traditional treatment of prostate diseases in Turkey

Yunus Emre Şahin[1], Meryem Şeyda Erbay[1], Sezin Anıl[1], Roukie Kantar[2], Şükran Kültür[2], Gülay Melikoğlu[1]

[1]Department of Pharmacognosy, Faculty of Pharmacy, Istanbul University, Istanbul, Turkey
[2]Department of Pharmaceutical Botany, Faculty of Pharmacy, Istanbul University, Istanbul, Turkey

ORCID IDs of the authors: Y.E.Ş. 0000-0002-4148-9610; M.Ş.E. 0000-0001-9889-9250; S.A. 0000-0003-2092-2419; R.K. 0000-0002-2531-1660; Ş.K. 0000-0001-9413-5210; G.M. 0000-0003-4510-1326.

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ABSTRACT

Turkey has a very rich flora and also many medicinal plants, due to its geography. The aim of this study was to provide information about the plants used for prostate diseases in Turkey. Ethnobotanical studies made in various parts of the Turkey have been researched and 107 taxa used in the treatment of prostate diseases have been recorded. These plants belong predominantly to the Rosaceae (15 taxa), Asteraceae (13 taxa), Lamiaceae (10 taxa), Poaceae (4 taxa), Anacardiaceae (3 taxa), Apiaceae (3 taxa), Brassicaceae (3 taxa) families. The plant parts used for treatment are leaves, aerial parts, flowers, roots and seeds. Flavonoids, essential oils, tannins, saponins, alkaloids, and steroids are the most common chemical compounds in these plants. Activity studies have been found which support the use of 17 taxa in prostate diseases. Similar activity studies can be carried out for other plants and so new drugs can be developed for the treatment of prostate diseases.

Keywords: Prostate diseases, medicinal plants, traditional treatment, Turkey

INTRODUCTION

The prostate gland is mainly an organ of the male reproductive system. It is located just below the bladder and surrounds the urethra. It secretes a special secretion that helps sperm transport and fertilization (Guyton 2007).

Prostate diseases can be listed under three main headings. These are prostate inflammation, benign prostatic hypertrophy and prostate cancer.

Prostate inflammation (prostatitis) is usually a disease caused by bacteria and reduces the quality of life due to symptoms. Clinical trials show that 50% of men have prostatitis at least once in their lifetime (Internet source 1).

Benign prostatic hyperplasia (BPH), known as benign prostate enlargement, can be described as compression of the urinary tract caused by the prostate gland is enlarged. Prostate growth is a common, non life threatening disease that reduces the quality of life of the patient (Internet source 2).

Prostate cancer is one of the most common types of cancer among men. It can be described as an uncontrolled proliferation of the prostate gland cells. Prostate cancer symptoms may not be felt for a long time or symptoms may be confused with other diseases. Prostate cancer may spread to other organs at later stages and treatment may become difficult. For this reason, men over the age of 40 must have prostate examinations at certain intervals (Internet source 3).

Address for Correspondence :
Meryem Şeyda ERBAY, e-mail: mseydaerbay@gmail.com

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Turkey has a very rich flora due to its geography. Approximately eleven thousand plant species are growing in our country, and three thousand of them are endemic (Güner et al. 2000; Özhatay et al. 2013, 2015, 2017). Traditional treatments using these plants in each region of our country can treat many diseases and protect against diseases. In the research carried out, many herbal remedies used against prostate diseases in Turkey were encountered.

MATERIALS AND METHODS

This study was prepared screening the National Thesis Center of the Council of Higher Education and electronic sources (ScienceDirect, PubMed, Google Scholar). The plants used for treating prostate diseases were searched in the ethnobotanical articles, MSc and PhD theses. Then, for each of these plants, activity studies to support the use of prostate diseases were investigated.

RESULTS

In the Table 1, information concerning the botanical and local names, used parts, usage, and chemical compositions of plants used for prostate diseases in traditional treatment in Turkey are given.

Table 1. The list of plants used in traditional treatment for prostate diseases in Turkey

Botanical name	Family	Local name	Chemical composition	Plant part used	Usage	References
Achillea biebersteinii Afan.	Asteraceae	Sarı civanperçemi	Essential oil (Mirahmadi et al. 2017), germacranolid derrivs, coumarin, monoterpene and flavonoid (Mohamed et al.2015)	Whole plant	Dec. Int.	Karakurt 2014
A. millefolium L.	Asteraceae	Sarı civanperçemi	Terpenoid, flavonoid (Shari Moghadem et al. 2017)	Whole plant	Dec. Int.	Karakurt 2014
A. wilhelmsii C. Koch	Asteraceae	Sarı civanperçemi	Essential oil (Baytop 1984, Güner et al. 2000), alkaloid, flavonoid, sesquiterpene (Güner et al. 2000)	Whole plant	Dec. Int.	Karakurt 2014
Acorus calamus L.	Acoraceae	Eğir kökü, Hazanbel	Carbohydrates, calcium and potassium salt (Baytop 1984)	Root	Inf. Int.	Akan and Bakır Sade 2015; Korkmaz and Karakurt 2014; Fakir et al. 2009
Agrimonia eupatoria L.	Rosaceae	Tırtıklı aslan pençesi	Catechical tannins (PDR 2007)	Whole plant	Inf. Int.	Tetik 2011
Agropyron repens L.	Poaceae	Ayrık otu	Mucilage, carbohydrates, calcium and potassium salt (Baytop 1984)	Whole plant	Inf. Int.	Karakurt 2014, Akan et al. 2015
Allium cepa L.	Liliaceae	Soğan	Alliin, essential oil, peptide, flavonoids (Çubukçu et al. 2002)	Leaf	Dec. Int.	Sağıroğlu et al. 2013
Alnus glutinosa (L.) *Gaertner subsp. glutinosa*	Betulaceae	Kızılağaç	Shikimic acid, epigallocatechin gallate (Altınyay et al. 2016)	Male flower	Dec. Int.	Ecevit Genç and Özhatay 2006
Alyssum sibiricum Willd.	Brassicaceae	Prostat çiçeği	-	Aerial part	Inf. Int.	Özdemir and Alpınar 2015
Anchusa undulata L.	Boraginaceae	Sığır dili, Ballıbaba	Triterpene glycosides, flavone glycosides (Koz et al. 2009)	Root	Dec./ Inf. Int.	Oral 2007
Anthemis cotula L.	Asteraceae	Beyaz papatya, Papatya	Essential oil, organic acids, glycosides and alkaloid (Baytop 1999)	Capitulum	Inf. Int.	Tuzlacı 2006
A. kotschyana Boiss. var. *kotschyana*	Asteraceae	Papatya	-	Aerial part	Inf. Int.	Özdemir and Alpınar 2015
Apium graveolens L.	Apiaceae	Kereviz	Essential oil, coumarins, flavonoids (Çubukçu et al. 2002)	Seed Whole plant	Dec. Int. +Honey, Int. Dec. Int.	Polat 2010 Akan and Bakır Sade 2015 Polat and Satıl 2012
Arbutus unedo L.	Ericaceae	Andrana, Kocayemiş, Dağyemişi	Sugars, tannins, vitamin (Baytop 1963; 1999), phenolic acids, aucubin glycosides, diterpenoid, triterpenoid (Baytop 1999, Evans 2002)	Fruit	Eaten	Kızılarslan and Özhatay 2012

Table 1. The list of plants used in traditional treatment for prostate diseases in Turkey (continued)

Botanical name	Family	Local name	Chemical composition	Plant part used	Usage	References
A. andrachne L.	Ericaceae	Dağ çileği, Sandal ağacı	Organic acids, sugars, phenolic components (Serçe et al. 2010)	Fruit	Eaten, Inf.	Polat et al. 2015, Güzel et al. 2015
Arum sp.	Araceae	Yılan burçağı	Alkaloids, essential oil (Azab 2017)	Fruit	Eaten	Şenkardeş and Tuzlacı 2014
Asparagus acutifolius L.	Liliaceae	Kediyen, Tilki kuyruğu	Steroid saponins (Gürdal 2010)	Whole plant Aerial part Flowering branches, leaf	Inf. Int. Dec. Int. Oinment, Inf.	Sargın et al. 2013 Güzel et al. 2015 Sargın et al. 2015
Brassica oleracea L. var *italica*	Brassicaceae	Brokoli	Sulforaphane, phenolic compounds, carotenoids, vitamin C and K (RX Media Pharma 2017)	Fruit	Raw, Eaten Dec. Int.	Eşen 2008 Metin 2009
Cannabis sativa L.	Cannabinaceae	Kenevir otu, Aptal otu	Resin, essential oil, oil (2008a)	Seed	Cooked, Int.	Birinci 2008
Carduus nutans L.	Asteraceae	Eşek çalısı, Eşek dikeni	Sterols, triterpenes, flavonoids (Abdallah et al. 1989)	Flowering branch	Dec. Int.	Tuzlacı et al. 2010
C. pycnocephalus L. subsp. *albidus* (Bieb.) Kazmi	Asteraceae	Eşek dikeni, Kangal	-	Flowering branch	Dec. Int.	Doğan 2014
Carthamus tinctorius L.	Asteraceae	Aspir	Pigments (Baytop 1984)	Flower	Not specified	Akan and Bakır Sade 2015
Cedrus libani A.Rich.	Pinaceae	Katran	Terpenic acids (Avcıbaşı et al. 1988)	Flower, Laef, Sprout	Not specified	Özçelik and Balabanlı 2005
Centaurea glastifolia L.	Asteraceae	Tahlişk	Guaianolides (Oksuz and Tupcu 1994)	Aerial part	Dried, Dec. Int.	Kaval et al. 2014
Cerasus mahalep (L.) Miller var. *mahalep*	Rosaceae	Mahlep	Oil, coumarin (Tetik 2011)	Seed	Inf. Int. Powder	Altundağ and Öztürk 2011 Akbulut and Bayramoğlu 2013
C. microcarpa (C. A. Meyer) Boiss. subsp. *tortuosa*	Rosaceae	Zerdali	-	Fruit	Eaten	Doğan 2014, Kaval et al. 2014
Ceratonia siliqua L.	Fabaceae	Harnup, Keçiboynuzu	Sugars, oil, pectin, tannin, vitamin, mineral, protein (Çubukçu et al. 2002, Baytop 1999)	Fruit	Molasses, Eaten	Gürdal and Kültür 2013
Ceterach officinarum DC.	Aspleniaceae	Altınotu	Essential oil, tannin, mucilage (Baytop 1999)	Aerial part	Inf./ Dec. Int.	Oral 2007
Cichorium intybus L.	Asteraceae	Kaniş	Coumarin glicoside, sesquiterpenes, caffeic acid, polysaccharides, tannin (PDR 2007, Çubukçu et al. 2002, Baytop 1999, Tyler et al. 1988, Tanker and Tanker 2003, Trease and Evans 2009)	Aerial part	Dec. Int.	Kaval et al. 2014
Cistus laurifolius L.	Cistaceae	-	Diterpene, glucosides (Sadhu et al. 2006, Joaquin et al. 1986), inositol (Joaquin et al. 1986)	Leafy branch	Dec. Int.	Tuzlacı 2006
Convolvulus arvensis L.	Convolvulaceae	Tarla sarmaşığı	Alkaloids, phenolic compounds, sugars, mucilage, sterols, resin, tannins, unsaturated sterols/ triterpenes, lactones, proteins (Al-Snafi 2016)	Leaf and flower	Inf. Int.	Fakir et al. 2009
Corylus avellana L.	Corylaceae	Fındık, Yabani fındık	Tannin, resin, protein, starch, oil, salt, vitamin, flavonoid (2008a)	Pericarp	Dec. Int.	Kültür 2007
C. maxima Miller	Corylaceae	Fındık	Oil, protein, sugars, phosphor, calcium (Baytop 1999)	Sprout	Dec. Int.	Tuzlacı 2006

Table 1. The list of plants used in traditional treatment for prostate diseases in Turkey (continued)

Botanical name	Family	Local name	Chemical composition	Plant part used	Usage	References
Cotinus coggyria Scop.	Anacardiaceae	Tetre, Tetere	Tannin, flavonoid (Baytop 1999)	Leaf	Inf. Int.	Tuzlacı and Alparslan 2007
Crataegus monogyna Jacq. subsp. *monogyna*	Rosaceae	Kırmızı alıç	Sugars, organic acids, phenolic compounds (Edwards et al. 2012)	Leaf anf flower	Inf. Int.	Fakir et al. 2009
Crataegus orientalis Pallas ex Bieb. var. *orientalis*	Rosaceae	Sarı alıç	Phenolic compounds Çalışkan 2015; Melikoğlu (et al. 1999)	Leaf anf flower	Inf. Int.	Fakir et al. 2009
Cucurbita maxima Duchesne	Cucurbitaceae	Kabak	Proteins, minerals, sugars, tocopherols, β-sitosterol, phenolic acids (Rezig et al. 2012)	Seed	Eaten	Güzel et al. 2015
C. pepo L.	Cucurbitaceae	Kabak	Steroids, Δ-7 stigmasterol, tocopherol, oil (Çubukçu et al. 2002)	Seed	Dec. Int.	Kahraman and Tatlı 2004
Cupressus sempervirens L.	Cupressaceae	Andız	Tannin, essential oil (Baytop 1999)	Leaf	Int.	Gürdal and Kültür 2013
Cynara scolymus L.	Asteraceae	Enginar	Caffeic acid derivatives, sesquiterpene lactone, flavonoid (Çubukçu et al. 2002)	Leaf	Dried, Dec. Int.	Sargın et al. 2013
Cynodon dactylon (L.) Pers.	Poaceae	Ayrık otu	Calcium and potassium salts, polysaccharides, saponin, essential oil (Baytop aerial 1963; 1999)	Root Root and part	Dec./ Inf. Int. Dec. Int.	Oral 2007, Bulut et al. 2017, Kartal and Güneş 2017 Güneş 2017
C. dactylon (L.) Pers. var. *villosus* Regel	Poaceae	Ayrıkotu	-	Rhizome	+Fruits of *Hordeum vulgare* and root of *Eryngium campestre* var. *virens* Dec., Int.	Şenkardeş 2014
Dracunculus vulgaris Schott	Araceae	Yılanbıçagı, Yılanburçagı	Fatty acids (Saglik et al. 2002)	Fruit	Eaten	Bulut et al. 2017
Elaeagnus angustifolia L.	Elaeagnaceae	İğde	Flavonoids, terpenoid compounds, saponins, sugars, phenolic acid, tannins, amino acids, carotenoids, vitamins (Hassanzadeh and Hassanpour 2018)	Fruit	Eaten	Güzel et al. 2015
Epilobium angustifolium L.	Onagraceae	Yakı otu, Çayır gülü	Provitamin A, karotenoid, steroids, barbituric acid derivatives, flavonoids (Sayık 2007)	Flower, leaf	+Water Int.	Akan and Bakır Sade 2015
Equisetum arvense L.	Equisetaceae	Ekli ot	Minerals, flavonoids, dicarboxylic acid (Çubukçu et al. 2002)	Whole plant	Dried, Dec. Int.	Kayabaşı 2011
E. giganteum L.	Equisetaceae	Kırkkilit otu, kavakotu	Phenolic compounds (Francescato et al. 2013)	Aerial part	Dec. Int.	Güneş 2017
E. telmateia Ehrh.	Equisetaceae	Çam otu, Kırkboğum	Alkaloids, silicic acid, saponin, tannin (Baytop 1999), flavone, sugars, mineral (Baytop and Gürkan 1972)	Aerial part	Dec. Int.	Ezer and Arısan 2006
Eryngium campestre var. *virens* (Link) Weins	Apiaceae	Boğa dikeni, Eşek dikeni, Kenger, Kuşkonmaz	Triterpene saponins, coumarins, monoterpene glycosides, caffeic acid esters, oligosaccharide, tannin (PDR 2007, Baytop 1999)	Root	Dec. Int. +Fruits of *Hordeum vulgare* and rhizome of *Cynodon dactylon* var. *villosus* Dec., Int.	Saglik et al. 2002

Table 1. The list of plants used in traditional treatment for prostate diseases in Turkey (continued)

Botanical name	Family	Local name	Chemical composition	Plant part used	Usage	References
Fraxinus angustifolia Vahl. subsp. *oxycarpa*	Oleaceae	Dışbudak	Secoiridoids (Çalış et al. 1996)	Flowering branch	Inf. Int.	Bulut 2008
Galium verum L.	Rubiaceae	Yoğurt otu	Hydroxycinnamic acid derivatives and glycosides, flavonoid, phenolic acid and glycosides (Jaiswal et al. 2014)	Leaf	Dec./ Inf. Int.	Oral 2007
Helichrysum armenium DC.	Asteraceae	Yayla çiçeği, Altınotu, Ölmez çiçek	Flavonoids (Çubukçu and Yüksel 1982)	Whole plant	Inf. Int.	Korkmaz and Karakurt 2014
Helichrysum plicatum subsp. *plicatum* DC.	Asteraceae	Yayla çiçeği, Altınotu, Ölmez çiçek	Flavonoids, saponin, catechical tannin (Keklik 1990), essential oil (Sezik and Aslan 1997)	Flower	Inf. Int.	Karakurt 2014
Hypericum perforatum L.	Hypericaceae	Kantaron, Seker otu	Flavonoids, phloroglucinol, catechic tannin, naftodiantron deriv (hypericin) (Bisset 1994), essential oil (Erken et al. 2001)	Aerial part Flowering branch	Dec. Int. Oleat, . Int	Tuzlacı and Alparslan 2007 Bulut et al. 2017
Juniperus oxycedrus L. subsp. *oxycedrus*	Cupressaceae	Ardıç	Essential oil, resin, bicyclic sesquiterpene, phenol deriv. (Baytop 1999, Tyler et al. 1988, Tanker and Tanker 2003, Trease and Evans 2009)	Cone	Inf. Int.	Tuzlacı and Alparslan 2007
Lallemantia iberica (M.Bieb.) Fisch et C.A.Mey.	Lamiaceae	-	Carbonhydrates, essential oil (Badawy et al. 2013), phenoilic glycoside (Dehaghi et al. 2012)	Whole plant	Inf. Int.	Doğan 2014
Lamium purpureum L.	Lamiaceae	Ballıbaba	Iridoid glycosides, essential oil (Flamini et al. 2005)	Aerial part	Inf. Int.	Uzun et al. 2004
Laurus nobilis L.	Lauraceae	Defne, Lüks	Starch, oil, tannin, essential oil (Baytop 1999), alkaloid, flavonoid (Topaloğlu 1987), sesquiterpenes (Glasby 1991)	Seed	Crushed, Inf. Int.	Sarıkan 2007
Lavandula stoechas L. subsp. *stoechas*	Lamiaceae	Karabaş otu, Karahan	Glycoside, saponin, essential oil (Baytop 1999)	Aerial part	Inf. Int.	Gürdal and Kültür 2013
Linum mucronatum Bertol. subsp. *mucronatum*	Linaceae	Sarı çiçek	Aryl-tetralin lignans (Koulman et al. 2005)	Aerial part	Inf. Int.	Doğan 2014
Malva neglecta Wallr.	Malvaceae	Ebegümeci	Mucilage, tannin, flavonoid (Bisset 1994)	Leafy branch	Dec. Int.	Koyuncu 2005
M. slyvestris L.	Malvaceae	Ebegümeci, Devetabanı, Katırtırnağı	Alkaloid (Topaloğlu 1987), anthocyanidins, flavonoids, tannin (Çubukçu et al. 2002), sugars, polysaccharides (Baytop 1999)	Leafy branch	Dec. Int.	Koyuncu 2005
Marrubium vulgare L.	Lamiaceae	Köpeksiyan otu	Diterpenes, essential oil, tannin (Çubukçu et al. 2002)	Aerial part	Dec. Int.	Tuzlacı 2006
Mentha spicata L. subsp. *spicata*	Lamiaceae	Yarpuz, Nane	Essential oil (Baytop 1999), flavonoids, caffeic acid (Brendler et al. 2003)	Leaf	Cooked or raw, Eaten	Koçak 1999
Micromeria cristata subsp. *orientalis* P.H. Davis	Lamiaceae	Kekik	-	Leaf, Flower	Inf. Int.	Karakurt 2014
Myrtus communis L.	Myrtaceae	Murt, mersin, yaban mersini	Essential oil, phenolic compounds, fatty acids (Mahboubi 2017)	Leaf, Fruit	Eaten, Fruit juice, Dec. Int.	Sargın 2015; Bulut and Tuzlaci 2013

Table 1. The list of plants used in traditional treatment for prostate diseases in Turkey (continued)

Botanical name	Family	Local name	Chemical composition	Plant part used	Usage	References
Nasturtium officinale R. Br.	Brassicaceae	Sukumbi	Sulfuric glycosides, vit A, C, D, essential oil (Baytop 1999)	Aerial part	Not specified	Saraç et al. 2013
Ononis spinosa subsp. *leiosperma* (Boiss.) Sirj.	Fabaceae	Sabankıran	Sugars, tannin, essential oil, flavonoids, minerals, organic acids, saponin (PDR 2007, Dermirezer 2011, Gürkan 2007)	Root	Dec. Int.	Doğan 2014
Ornithogalum umbellatum L.	Hyacinthaceae	Sakarca	Rhodexin A, rhodexoside (Smith and Paterson 1967), cardenolide glycosides, steroids (Tang et al. 2013, Şabudak and Oyman 2002), glcosides, saponin (Baytop 1999)	Whole plant	Inf.	Polat et al. 2015
Paliurus spina-christi Mill.	Rhamnaceae	Çaltı, muska otu	Flavonoids, tannins, amino acids, alkaloids, sterols (Brantner et al. 1996, Baytop 1999)	Seed	Dec. Frankincense	Sargın 2015
Peganum harmala L.	Zygophyllaceae	Üzerlik	Harmala alkaloids (Küçükbezirci 1967), musilage (Akalın and Alpınar 1994)	Sprout	Dec. Int. Not specified	Özgökçe and Özçelik 2004 Öztürk et al. 2013
Petroselinum crispum L.	Apiaceae	Maydanoz	Essential oil, flavonoid heteroside, furanocoumarins, phtalide, steroids, vit C, oil (Çubukçu et al. 2002, Baytop 1999, Tyler et al. 1988, Tanker and Tanker 2003)	Whole plant	Dec. Int., Eaten	Karakurt 2014
Phlomis russeliana Poiret	Lamiaceae	Laden	Essential oil, sesquiterpene (Demirci et al. 2008)	Leaf	Inf. Int.	Demirci and Özhatay 2012
Pinus nigra J.F.Arnold	Pinaceae	Selvi, Çam kozalağı	Essential oil (Sezik et al. 2010)	Cone	Dec. Int.	Akan and Bakır Sade 2015
Pistacia atlantica Desf.	Anacardiaceae	Çitlenbik ağacı, Menengeç	Essential oil (Trabelsi et al. 2012)	Leafy sprout	Inf. Int.	Tuzlacı 2006
P. terebinthus subsp. *paleaestina* (Boiss.) Engler	Anacardiaceae	Çitlenbik ağacı, Menengeç	Resin, tannin, essential oil, oil (Baytop 1999), flavonoids (Topaloğlu 1987)	Leafy sprout	Dec. Int.	Tuzlacı 2006
Plantago lanceolata L.	Plantaginaceae	Damar otu	Iridoid glycosides, flavonoids, coumarin, saponin, alkaloids, silicic acid, sugar, organic acids, mucilage, tannin (Çubukçu et al. 2002)	Leaf	Dec. Int.	Arslan 2005
P. *major* L. subsp. *major*	Plantaginaceae	Sinirli ot, Sinirotu, Yara otu	Polysaccharides, lipids, caffeic acid derivatives, flavonoids, iridoid glycosides, terpenoids, vitamins, organic acids (Samuelsen 2000)	Leaf	Inf. Int.	Güneş 2017
Platanus orientalis L.	Platanaceae	Çınar	Tannin, triterpenes, flavonoids (Bulut 2008)	Stem bark Leaf	Dec. Int. Inf. Int. Mash, Ext..	Koyuncu 2005 Güneş et al. 2017
Polygonum aviculare L.	Polygonaceae	Keçi memesi	Tannins, triterpenoids, anthraquinones, coumarins, phenylpropanoides, lignans, flavonoids (Granica et al. 2013)	Aerial part	Dec. Int.	Güzel et al. 2015
Polypodium vulgare L. subsp. *vulgare*	Polypodiaceae	Tatlı papra	Saponin, essential oil, tannin (Baytop 1999)	Aerial part	Inf. Int.	Kültür 2007
Prunus armeniaca L.	Rosaceae	Kayısı	Oil, amygdalin (Baytop 1999)	Leaf	Inf. Int.	Uzun et al. 2004

Table 1. The list of plants used in traditional treatment for prostate diseases in Turkey (continued)

Botanical name	Family	Local name	Chemical composition	Plant part used	Usage	References
Quercus cerris var. *austriaca* (Willd.) Loudon	Fagaceae	Palamut meşesi, meşe	Triterpenes (Sen et al. 2015)	Leaf	Dec. Int.	Kültür 2007
Rosa canina L.	Rosaceae	Köpek gülü, Kuşburnu	Phenolic compounds, minerals, vitamins, sugar, pectin, organic acid, essential oil, tannin (Demir and Özcan 2001)	Fruit	Dec., Inf. Int.	Güneş 2017
Rubus canescens DC.	Rosaceae	Böğürtlen	-	Root, Fruit Root	Dec. Int., Pickles, jam, molasses +*Urtica urens* roots + *Juglans regia* leaves	Sargın 2015 Polat and Satıl 2012
R. canescens var. *glabratus* (Godr.) Davis et Meikle	Rosaceae	Böğürtlen, Garantı	-	Root	+*Urtica* sp., leaf of *Juglans regia, Secale cereale,* Int.	Polat 2010
R. discolor Weihe and Nees	Rosaceae	Karamuk, Böğürtlen	Anthocyanins, ascorbic acid (Dujmović Purgar et al. 2012)	Root	Dec. Int.	Kültür 2007
R. hirtus Waldst. and Kit.	Rosaceae	Böğürtlen	Flavonoids, triterpenes, gallic tannin (Mercan 2006)	Root	Dec. Int.	Tuzlacı 2006, Kültür 2007
R. sanctus Schreber	Rosaceae	Böğürtlen, Garantı	Tannin, organic acid, sugar (Baytop 1999)	Root Leaf and Flower Root, Fruit	Inf. Int. +*Urtica* sp., *Juglans regia*, *Secale cereale*, Int. +*Urtica urens* roots+ *Juglans regia* leaves Dec. Int. Dec. Int., Pickles, jam, molasses	Tetik 2011, Tetik et al. 2013 Polat 2010 Polat and Satıl 2012 Güzel et al. 2015 Sargın 2015
R. saxatilis L.	Rosaceae	Böğürtlen	Sugars, pectins, anthocyanins, catechins, vitamin C, phenolic acids, flavonoids, tannins, fatty acids (Tomczyk and Gudej 2005)	Root, Fruit	Dec. Int., Pickles, jam, molasses	Sargın 2015
Sambucus nigra L.	Caprifoilaceae	Mürver, Milver, Patlanguç, Özübüyük	Caffeic acid, mucilage, potassium salts, glycosides, steroids, tannin, triterpenes, essential oil (Çubukçu et al. 2002)	Fruit	Eaten Dec. Int. Mac. Int.	Kültür 2007 Fujita et al. 1995 Sargın et al. 2013
Satureja cuneifolia Ten.	Lamiaceae	Kekik, Keklik otu, Dağ kekiği	Essential oil, terpenes (Oke et al. 2009)	Aerial part	Dec. Int.	Kartal and Güneş 2017; Güneş 2017
Sorbus aucuparia L.	Rosaceae	Üvez	Anthocyanins (Isakina et al. 2015)	Leaf	Dec. Int.	Kültür 2007

Table 1. The list of plants used in traditional treatment for prostate diseases in Turkey (continued)

Botanical name	Family	Local name	Chemical composition	Plant part used	Usage	References
S. domestica L.	Rosaceae	Üvez, Börtlücan	Tannin, essential oil, sorbitol, organic acids, pigments (Baytop 1999)	Leaf	Dec. Int.	Kültür 2007
Telephium imperati subsp. *lorientale* (Boiss.) Nyman	Caryophyllaceae	Sidik zoru otu, Siğil otu	-	Aerial part	Inf. Int.	Tuzlacı and Erol 1999
Thymus sibthorpii Bentham	Lamiaceae	Kekik	Phenolic acids, flavone glycosides (Raudone et al. 2017)	Aerial part	Inf. Int.	Ecevit Genç and Özhatay 2006
T. sipyleus subsp. *sipyleus* Boiss.	Lamiaceae	Kekik	Essential oil, sesquiterpenes, monoterpenes (Tanker and Tanker 2003, Tepe et al. 2005)	Leaf and flower	Inf. Int.	Karakurt 2014
Tribulus terrestris L.	Zygophyllaceae	Demir dikeni	Saponin, amid, alkaloid (Koçyiğit 2005)	Aerial part	Dec. Int.	Doğan 2014; Güzel et al. 2015
Urtica dioica L.	Urticaceae	Isırgan	Ca, K, silicic acid salts, organic acids, biogen amids, sitosterols, lectin, terpenes, triterpenes, flavonoids, lignans, essential oil, coumarins, Vit C (PDR 2007, Çubukçu et al. 2002, Baytop 1999, Trease and Evans 2009, Demirezer 2011, Gürkan 2007)	Aerial part Leaf	Inf. Int. +*Petroselinum crispum* Dec. Int. +Olive oil, impasted, eaten Dec. Int.	Bulut et al. 2017 Karakurt 2014 Yeşilyurt et al. 2017; Korkmaz and Alpaslan 2014
U. urens L.	Urticaceae	Dırık, Isırgan ve Pırıke	Phenolic compounds (Carvalho et al. 2017), vitamins, essential oil (Mzid et al. 2018)	Leaf	Dec. Int.	Korkmaz and Alpaslan 2014
Verbascum cheiranthifolium var. *cheiranthifolium* Boiss.	Scrophulariaceae	Sığır kuyruğu	Saponin, mucilage, resin, bitter compound (Baytop 1999, Keskin 2011)	Leaf	Inf. Int.	Keskin 2011
V. pycnostachyum Boiss. and Heldr	Scrophulariaceae	Sığır kuyruğu	Iridoid glycosides, phenylethanoid glycosides (Tatlı et al. 2007)	Leaf and flower	Dec. Int.	Oral 2007
Viburnum lantana L.	Adoxaceae	Girebolu	Glycosides (Calis et al. 1995)	Fruit	Juice, Int.	Karakurt 2014
V. opulus L.	Adoxaceae	Gilaburu, Girebolu	Organic acids, phenolic compounds, vitamins, terpenoids (Sarıözkan et al. 2017)	Meyve	Juice, Int.	Korkmaz and Karakurt 2014
Viola odorata L.	Violaceae	Tırtılsız aslan pençesi, Kokulu menekşe	Alkaloid, glycoside, saponin, methyl silicate, gum (Demiray 2013), β-ionone (Ansari and Emami 2016)	Flower and leaf	Inf. Int.	Tetik 2011
Viscum album L subsp. *austriacum* (Wiesb.) Vollman	Loranthaceae	Burç, Ahlat purçu, Çam burcu, Ökse otu	Alkaloids, glycosides, lectines, polypeptides, triterpenes, phenolic acids, organic acids, biogen amin, mucilage, lignans, resin, tannin (PDR 2007, Çubukçu et al. 2002, Baytop 1999, Tyler et al. 1988, Tanker andTanker 2003, Demirezer 2011, Gürkan 2007, Ergün and Deliorman 1995)	Leaf Aerial part, branches, leaf	Dec. Int. Dec., Mac., Int.	Sargın et al. 2013 Sargın et al. 2015
Zea mays L.	Poaceae	Mısır	Bitter compounds, amins, phytosterol, starch, pigments, resin, saponin, vitamin C,K (Barnes et al. 2002), potassium salt, oil, flavonoids, mucilage, sugar, tannin, essential oil (Çubukçu et al. 2002), maysin (Lee et al. 2014)	Corncob	Dried, Dec. Int. Dec., Inf. Int.	Tuzlacı 2006; Güneş and Özhatay 2011 Tetik 2011

Dec: Decoction; Inf: Infusion; Mac: Maceration; Int: Internal

CONCLUSION

In this study, 107 taxa which have traditionally been used in the treatment of prostate diseases in Turkey have been recorded. These plants are predominantly from the Rosaceae (15 taxa), Asteraceae (13 taxa), Lamiaceae (10 taxa), Poaceae (4 taxa), Anacardiaceae (3 taxa), Apiaceae (3 taxa), Brassicaceae (3 taxa) families.

Commonly used taxa in different regions of Turkey are *Apium graveolens, Asparagus acutifolius, Cynodon dactylon*, *Rubus sanctus*, *Sambucus nigra* and *Urtica dioica*. The parts of the plants that are used for treatment are the leaves, aerial parts, flowers, roots and seeds. Flavonoids, essential oils, tannins, saponins, alkaloids, steroids, sugars, and minerals are the most common chemical compounds in plants.

Activity studies have been found which support the use of 17 taxa in prostate diseases. These plants are; *Achillea wilhelmsii, Acorus calamus*, *Allium cepa.*, *Brassica oleraceae* var. *italica*, *Cannabis sativa*, *Carthamus tinctorius*, *Cucurbita pepo*, *Epilobium angustifolium*, *Hypericum perforatum*, *Mentha spicata* subsp. *spicata, Nasturtium officinale*, *Prunus armeniaca*, *Tribulus terrestris*, *Urtica dioica, Viburnum opulus*, *Viola odorata* and *Zea mays*. The scientific studies on these plants are as follows:

Volatile oil of *Achillea wilhelmsii* has a cytotoxic effect against prostate cancer cells. No cytotoxic effect for normal cells (Guatam et al. 2014).

The ethanolic extract of the *Acorus calamus* root was found to suppress cell proliferation and angiogenesis and stimules early apoptosis in LNCaP (prostate left supraclavicular lymph node carcinoma) prostate cancer cell lines, depending on dose and time (Koca et al. 2018).

Consumption of onion (*Allium cepa*) and garlic slows down the formation of BPH (Galeone et al. 2007).

It has been stated that Sulforaphane (one compound of *Brassica oleracea* L. var *italica*) reduces prostate cancer formation by induces Phase 2 Enzymes in human prostate cells (Brooks et al. 2001).

It has been identified that cannabinoid (one compound of *Cannabis sativa*) receptors are more abundant in cells with prostate cancer than normal prostate cells, especially in men with bone metastatic prostate cancer, it is thought that cannabinoids are effective in improving analgesia of bone pain and improving the quality of life of the patient (Ramos and Bianco 2012).

It has been determined that the ethanolic extract of *Carthamus tinctorius* is an effective 5α-reductase inhibitor and hair growth promoter (Kumar et al. 2012). 5α-reductase is an important enzyme in the conversion of testosterone (T) to the more potent androgen dihydrotestosterone (DHT) in androgens metabolism. Dihydrotestosterone is effective in the growth of the prostate gland. It is thought that *Carthamus tinctorius* may be used as a 5α-reductase inhibitor to stop the growth of the prostate gland.

β-Sitosterol in *Cucurbita pepo* oil has been shown to be a potent inhibitor of prostaglandin biosynthesis in prostate tissue of patients with BPH (Nakic et al. 2006). It is thought that *Cucurbita pepo* may be used in the treatment of inflammation and complaints depending on prostaglandin as a consequence of inhibites prostaglandin biosynthesis. A multicenter clinical trial was conducted with 2245 BPH patients. Urinary symptoms were recorded using the International Prostate Symptom Score (I-PSS) according to the American Urological Association and the effect on quality of life was also recorded using the Life Quality questionnaire (LQ Index). The patient was treated with capsules containing 500 mg pumpkin seed extract. I-PSS decreased by 41.4% during treatment and the quality of life score increased by 46.1% at the end of treatment. More than 96% of the patients reported no side effects in this treatment (Younis et al. 2000).

Oenothein A and oenothein B, which are macrocyclic elagitannins of *Epilobium angustifolium*, inhibit the activity of 5-alpha-reductase and aromatase enzymes, which play a key role in the formation of benign prostate growth (BPH), and so prevent benign prostate growth (Şığva 2012).

In another study, it was reported that photodynamic therapy with hypericin (one compound of *Hypericum perforatum*) is an alternative approach to the treatment of prostate tumors and may be useful in tumors that do not respond to androgen therapy (Colasanti et al. 2000).

In the experiment on male rats, the anti-androgenic effect of *Mentha spicata* on testis was determined (Kumar et al. 2008). It is thought that *Mentha spicata* subsp. *spicata* can be used in the treatment of prostate diseases due to its anti-androgen effect.

Nasturtium officinale contains significant amounts of β-Phenethyl isothiocyanate (PEITC). It has been shown that at the progression phase of carcinogenesis in cell lines of prostate, leukemia, colon, lung and liver cancer, PEITC can inhibit proliferation and induces apoptosis (Pappa et al. 2006).

It was observed that the *Prunus* shell in different species was significantly inhibitory for testosterone-induced BPH. The most effective species were identified as *P. domestica*, *P. persica*, *P. amygdalus*, P. *cerasoides* and *P. armeniaca* (Jena et al. 2016).

The in vivo study of *Tribulus terrestris* extract and *Cornus officinalis* extract showed a marked enhancement of ICP and cAMP. Accordingly, it has been determined that a mixture of *T. terrestris* extract and *C. officinalis* extract may enhance erectile function (Kam et al. 2012). Reduction of erectile dysfunction, one of the symptoms of BHP in the treatment of prostate diseases, is thought to improve patient quality of life.

Urtica dioica extract (UR102) inhibits 5 α-reductase enzyme activity depending on concentration. UR102 can affect enzyme activity only at high concentrations (≥ 12 mg/mL) and it was calculated to ED50 of 14.7 mg/mL (Hartmann et al. 1996). *Urtica dioica* is thought to be potentially useful in the treatment of prostate diseases by inhibiting 5-α-reductase enzyme.

Gilaburu (*Viburnum opulus*, Glb) fruit extract is effective on testis and sperm damage induced by docetaxel (DTX) and paclitaxel (PTX) chemotherapeutics in rats. According to the study, DTX and PTX caused significant decreases in absolute and relative weights of all reproductive organs, testosterone level, sperm motility, concentration, Bcl-2 anti-apoptotic immunopositive cell scores of testes and spermatozoa as well as catalase activity in epididy-

mal tissue, superoxide dismutase and glutathione peroxidase activities of testicular and epididymal tissues when compared with the control group. However, Glb consumption mitigated the PTX-induced decreases in the absolute weights of the epididimis, seminal vesicles, ventral prostate and both taxanes-induced disturbances in sperm characteristics, imbalances in oxidant/antioxidant system, increments in germ cell apoptosis and testicular histo-and cyto-pathological damage. It was concluded that long-term Glb consumption alleviates the taxanes induced damage in the reproductive system of male rats (Sarıözkan et al. 2017).

Viola odorata is known to contain β-ionone (Ansari and Emami 2016). In studies on the cytotoxic activity of β-ionone, it has been shown to inhibit the proliferation of cancer cells in a concentration-dependent manner on β-ionone on DU145, LNCaP (human prostate carcinoma cells), and PC-3 (prostate adenocarcinoma cells) (Jones et al. 2013).

It was identified that maysin, an important flavonoid in the maize tassel (*Zea mays*), inhibits the growth of PC-3 (androgen-independent human prostate cancer cell) by induction of mitochondrial-dependent apoptotic cell death and it has a strong therapeutic potential in the treatment of chemotherapy-resistant or androgen-independent human prostate cancer (Lee et al. 2014). Purple corn is a pigmented variety of *Zea mays* grown for hundreds of years in the Andean region of South America (Paucar-Menacho et al. 2017). It has been determined that purple corn is effective in the inhibition of prostate carcinogenesis in animal studies. Three main anthocyanins (cyanidin-3-glucoside, pelargonidin-3-glucoside and peonidin-3-glucoside) of purple corn, have been tested with LNCaP (Prostate left supraclavicular lymph node carcinoma) cells. The results showed that cyanidin-3-glucoside and pelargonidin-3-glucoside were the active compounds (Long et al. 2013).

Similar activity studies can be conducted for other plants and so new drugs can be developed for the treatment of prostate diseases.

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