



REVIEW: Astrodaucus persicus (Boiss.) Drude: A Mini-Review on Phytochemistry and Pharmacological Effects

Faezeh Bodaghabadi Mohammad Ali Ebrahimzadeh Mohammad Hossein Hosseinzadeh Student Research Committee, School of Pharmacy, Mazandaran University of Medical Sciences, Sari, Iran. Pharmaceutical Sciences Research Center, School of Pharmacy, Mazandaran University of Medical Science, Sari, Iran.

Student Research Committee, School of Pharmacy, Mazandaran University of Medical Sciences, Sari, Iran.

ARTICLE INFO

 Submitted:
 03 Jun 2021

 Accepted:
 15 Jul 2021

 Published:
 01 Sep 2021

Keywords:

Astrodaucus persicus; Benzodioxole; Malaria; Neoplasms; Terpenes

Correspondence:

Mohammad Hossein Hosseinzadeh, Student Research Committee, School of Pharmacy, Mazandaran University of Medical Sciences, Sari, Iran.

Email: iranmhhz@gmail.com **ORCID:** 0000-0002-7652-9563

Citation:

Bodaghabadi F, Ebrahimzadeh MA, Hosseinzadeh MH. Astrodaucus persicus (Boiss.) Drude: A Mini-Review on Phytochemistry and Pharmacological Effects. Tabari Biomed Stu Res J. 2021;3(3):45-50.

doi 10.18502/tbsrj.v3i3.6929

ABSTRACT

Astrodaucus persicus (Boiss) Drude is an annual flowering plant of the Apiaceae family. A. persicus is mainly native to Asia and grows mostly in Iran, Turkey, Syria, and Iraq. In Iran, it grows mainly in Mazandaran, Golestan, Semnan, Tehran, Qazvin, and Kurdistan provinces. In Iran and Turkey, the plant's aerial parts and young roots are traditionally used as food additives. Various studies have been performed on essential oils and plant extracts. Essential oil compounds and some plant compounds have been identified. pharmacological effects of plant extracts and essential oils have also been reported. Monoterpenes are the main constituents in the essential oils of various parts of A. persicus. Plant extract (especially plant roots extract) effectively treats breast and colorectal cancers, which seems to be due to the presence of benzodioxole compounds or the antioxidant effects in the roots. The ripe fruits of the plant have potent larvicidal effects. Also, the fruits and roots of the plant significantly inhibit Plasmodium berghei, which can be effective in treating malaria.

Introduction

strodaucus persicus (Boiss) Drude is an annual flowering plant of the Apiaceae family. The stems of the plant are straight and branched, and the flowers are white and egg-shaped. The plant's height can reach 40-120 cm depending on the region (1, 2). A. persicus is mainly native to Asia and grows mostly in Iran, Turkey, Syria, and Iraq. In Iran (3), it grows mainly in Mazandaran, Golestan, Semnan, Tehran, Qazvin, and Kurdistan provinces (4). In Iran and Turkey, the plant's aerial parts and young

roots are traditionally used as food additives (3). In this study, phytochemical and pharmacological effects of *A. persicus* were reviewed.

Phytochemistry

According to studies, the essential oil of *A. persicus* is mainly composed of monoterpenes and sesquiterpenes. Major essential oil compounds are presented in *Figure 1*. Also, five main compounds have

been isolated and identified from the methanolic extract of the plant, which is shown in *Figure 2*.

A. persicus aerial parts was collected in the flowering stage in July 2000 from the northeastern areas of Tehran by M. Bigdeli et al. 180 g of aerial parts were hydrodistillated for 3 hours in Clevenger to prepare essential oil (yellow). 41 compounds of yellow essential oil of the plant were identified. Decanal (34.8%), dodecanal (15.5%), dodecanol (14.3%), decanol (9.3%) and carvacrol (8.6%) were the main compounds in the essential oil (5).

A. persicus seeds were collected in October 2001 from the northern regions of Iran. To prepare the essential oil (pale yellow), 90 g of dried and finely ground seeds were exposed to hydrodistillation for 4 hours in Clevenger. 99.7% of essential oil compounds were identified in the form of 18 compounds. Geranyl acetate (39.0%), alpha-pinene (13.2%), sabinene (12.9%), (E) -methyl isoeugenol (7.9%) and myrcene (7.2%) were the main compounds in the plant (2).

In July 2004, Y. T. Bazargani et al. collected the roots and aerial parts of A. persicus from Taleghan (Qazvin Province, Iran). 400 g of roots, 1700 g of stems and leaves and 350 g of flowers and fruits of the plant were exposed to hydrodistillation for 4 hours in Clevenger. 94.4% of the yellow essential oil of the roots (22 compounds), 99.7% of the green essential oil of the stems and leaves (20 compounds) and 99.9% of the bluish-green essential oil of the flowers and fruits (14 compounds) were identified. Bornyl acetate (26.5%), beta-sesquiphellandrene (25.9%) and exo-fenchyl acetate (25.1%) were the main root compounds, alpha-pinene (56.4%) and exo-fenchyl acetate (37.7%) were the main stem and leave compounds and Betapinene (46.1%), alpha-pinene (26.1%) and alpha-thujene (14.4%) were the main compounds of flowers and fruits. The essential oils of roots, stems and leaves, flowers and fruits contained 63.7%, 98.8% and 99.7% of monoterpenes and 30.7%, 0.9% and 0.2% of sesquiterpenes, respectively (6).

Goodarzi al.(2016)collected etflowers/fruits, leaves/stems in June 2010 and ripe fruits and roots of A. persicus in September 2010 from Irankhah village (Kurdistan Province, Iran). For preparation of the essential oil, plant components subjected were hydrodistillation in Clevenger for 4 hours. 98.5% compounds), 98.6% (21 (15)compounds), 98.9% (24 compounds), and 100% (21 compounds) of the compounds present in flowers/fruits, leaves/stems, ripe fruits, and plant roots essential oils were identified. respectively. Alpha-thujene (43.8%), alpha-pinene (20.9%), and betapinene (21.3%) were the main compounds of flowers/fruits. Alpha-thujene (48.0%), alphapinene (27.7%), and alpha-fenchene (9.2%) were the main compounds of the stem/leaves. Alpha-thujene (17.6%),alpha-pinene (14.3%), and beta-pinene (56.9%) were the main compounds of ripe fruits, and trans-Caryophyllene (33.5%), Bicyclogermacrene (27.3%), Germacrene-D (11.6%), And betafarnesene (7.2%) were the main compounds of roots. The essential oils of flowers/fruits, stems/leaves, ripe fruits and roots contained 96.5%, 95.9% 97.3%, and 5.2% monoterpenes and 1.4%, 2.1%, 1.1% and 90.7% of sesquiterpenes, respectively (7). A. persicus roots that collected in September 2012 from Irankhah village (Kurdistan Province, Iran) were evaluated by S. Goodarzi et al. Methanolic extract of the roots was fractionated by hexane, chloroform, ethyl acetate, and methanol. Finally, the following compounds were isolated and

• 5 - ((propanoyl methyl) amino) -4,7-dimethoxybenzo [d] [1,3] dioxole

identified (3):

- 5- (3-ethyloxiran-2-yloxy) -4,7-dimethoxybenzo [d] [1,3] dioxole
- 4,7-dimethoxy-5- (propanonyl) benzo
 [d] [1,3] dioxole
- 4-ethoxybenzo [d] [1,3] dioxol-6carbaldehyde
- 4- (O-β-D-glucopyranosyl) -6- (3-propanyloxiran-2-yloxy) benzo [d]
 [1,3] dioxole (8)

Figure 1. Major essential oil compounds. A: alpha-Thujene, B: alpha-Pinene, C: beta-Pinene, D: beta-Sesquiphellandrene, E: Exo-Fenchyl acetate, F: Bornyl acetate, G: Sabinene, H: Decanal, I: trans-Caryophyllene, J: Dodecanal, K: Bicyclogermacrene, L: Dodecanol, M: Geranyl acetate, N: Germacrene D.

Pharmacological activities

Antioxidant

Aerial parts and roots of *A. persicus* were extracted by the Soxhlet method with methanol. The extracts showed potent antiproliferative effects on T47D cell lines compared to RPMI control and doxorubicin. The extract of the root had stronger anticancer

effects than the extract of aerial parts. IC₅₀ of the extract of the aerial part and the extract of roots were reported to be 1 mg/mL and 0.5 mg/mL, respectively. Both extracts were treated on G1 phases of the cell cycle of T47D cells, but doxorubicin was treated on G2/M phases of the cell cycle of T47D cells. The pattern of cell cycle phase distribution of both extracts was similar to RPMI control, but it differs from doxorubicin (9).

Figure 2. Major compounds isolated from methanolic extract. A: 5-((propanoyl methyl)amino)-4,7-dimethoxybenzo[d][1,3]dioxole, B: 5-(3-ethyloxiran-2-yloxy)-4,7-dimethoxybenzo[d][1,3]dioxole, C: 4,7-dimethoxy-5-(propanonyl) benzo[d][1,3]dioxole, D: 4-ethoxybenzo[d][1,3]dioxol-6-carbaldehyde, E: 4-(O- β -D-glucopyranosyl)-6-(3-propanyloxiran-2-yloxy)benzo[d][1,3]dioxole.

Hexane fraction of root of *A. persicus* extract showed potent anticancer activity against MCF-7 breast adenocarcinoma (IC₅₀ of 0.01 ± 0.01 µg/mL), SW480 colorectal carcinoma (IC₅₀ of 0.36 ± 0.1 µg/mL) and L929 normal cell lines (IC₅₀ of 0.70 ± 0.12 µg/mL) in comparison to doxorubicin with IC₅₀ of 0.35 ± 0.07 , 2.50 ± 0.80 and 0.55 ± 0.06

 $\mu g/mL$ respectively. Also, the chloroform fraction of fruit extract showed strong cytotoxicity on SW480 colorectal carcinoma cell lines (IC₅₀ of 5.42±1.24 $\mu g/mL$). This statement is remarkable that IC₅₀ less than 20 $\mu g/mL$ for crude extracts and less than 4 $\mu g/mL$ for pure compounds indicated activity against cancer cell lines (10).

Aerial parts and roots of A. persicus extracted with methanol by the soxhlet method. In the IC50 concentration, methanolic extracts of aerial parts and roots increased expression, methanolic extract of aerial parts increased Bcl-2 expression, and methanolic extract of roots decreased Bcl-2 expression in T47D cells in comparison to RPMI significantly (p<0.05). The aerial parts and root extracts decreased the nuclear staining of p53 and cytoplasmic staining of Bcl-2 proteins in T47D cells' treatment compared to RPMI control. Anti-proliferative activity of A. persicus on T47D breast carcinoma cells may be related to the presence of coumarin compounds in this plant (4).

Antimalaria

Fruits and roots of A. persicus were extracted with 80% methanol with the maceration method. At 160 g/L, chloroform and ethyl acetate fractions of fruits extract had the best larvicidal effect after 24h treatment with the rate of 98% (LC50 of 45.11g/L and LC90 of 139.36 g/L) and 97% (LC₅₀ of 34.49 g/L and LC₉₀ of 108.61 g/L), respectively. The larvicidal effect of ethyl acetate fraction of fruits was better than chloroform fraction at lower concentrations. Also, petroleum ether fraction of roots and fruits showed 80% (LC₅₀ of 101.21 g/L and LC90 of 478.94 g/L) and 74% (LC₅₀ of 82.53 g/L and LC₉₀ of 513.60 g/L) mortality rates at 160g/L, respectively. Generally, different fractions of fruit extract had stronger insecticidal effects (11).

Goodarzi *et al.* (2017) were extracted the ripe fruits and roots of *A. persicus* with 80% methanol. Fruits and roots extract fractionated with chloroform, ethyl acetate, hexane, and methanol. At 500 mg/kg/day, hexane fraction of roots (73% suppression, P=0.023) and ethyl acetate fraction of fruits (72.3% suppression, P=0.045) was the most effective fractions in inhibiting *Plasmodium berghei* on the fourth day. The other fractions did not show a significant effect (10).

Conclusion

Monoterpenes are the main constituents in the

essential oils of various parts of *A. persicus*. Plant extract (especially plant roots extract) effectively treats breast and colorectal cancers, which seems to be due to the presence of benzodioxole compounds or the antioxidant effects in the roots. The ripe fruits of the plant have potent larvicidal effects. Also, the fruits and roots of the plant significantly inhibit *Plasmodium berghei*, which can be effective in treating malaria. Based on this fact that *A. persicus* has potential effects in the treatment of various diseases. It seems that more research is needed on this plant.

Acknowledgments

This research was supported by a grant from the Research Council and Student Research Committee of Mazandaran University of Medical Sciences.

Conflicts of interest

The authors declare no conflict of interest in this study.

Authors' contributions

All authors have intellectually contributed to the study design and process. In detail, M.H.H searched databases and evaluated relevant articles for inclusion in the study; F.B and M.H.H wrote and revised the first draft of the manuscript; M.A.E supervised the team and evaluated the scientific accuracy of the content. The final manuscript was revised and approved by all authors.

Funding

Mazandaran University of Medical Sciences (Grant No. 10410, Student Research Committee).

References

- 1. Mozaffarian V. Identification of medicinal and aromatic plants of Iran: éditeur non identifié; 2013.
- 2. Omidbaigi R, Bastan M, Omidbaigi M.

Essential oil content and chemical composition of Astrodaucus persicus Boiss cultivated in Iran. Journal of Essential Oil Bearing Plants. 2005;8(3):334-6.

- 3. Goodarzi S, Hadjiakhoondi A, Yassa N, Khanavi M, Tofighi Z. New benzodioxole compounds from the root extract of Astrodaucus persicus. Iranian Journal of Pharmaceutical Research. 2016;15(4):901-6.
- 4. Azizi E, Abdolmohammadi M, Fouladdel S, Shafiee A, Amin G, Ghaffari S. Evaluation of p53 and Bcl-2 genes and proteins expression in human breast cancer T47D cells treated with extracts of Astrodaucus persicus (Boiss.) Drude in comparison to Tamoxifen. DARU Journal of Pharmaceutical Sciences. 2015;17(3):181-6.
- 5. Bigdeli M, Rustaiyan A, Ameri N, Masoudi S. Essential Oil of Astrodaucus persicus (Boiss.) Drude. from Iran. Journal of essential oil research. 2004;16(5):420-1.
- 6. Bazargani Y, Almasirad A, Amin G, Shafiee A. Chemical composition of the essential oils of Astrodaucus persicus (Boiss.) Drude root, stem/leaves and flowers/fruits. Flavour and fragrance journal. 2006;21(2):294-6.
- 7. Goodarzi S, Hadjiakhoondi A, Yassa N, Khanavi M, Tofighi Z. Essential oils chemical composition, antioxidant activities and total phenols of Astrodaucus persicus. Iranian Journal of Basic Medical Sciences. 2016;19(2):159-65.
- 8. Ghorbani Hesari N, Tofighi Z, Shirmardi SF, Hashemi SM, Hadjiakhoondi A, Goodarzi S. Possible potential of Astrodaucus genus in development of anticancer drugs. Avicenna Journal of Phytomedicine. 2021;11(1):11-21.
- 9. Abdolmohammadi M, Sh F, Shafiee A, Gh A, Ghaffari S, Azizi E. Anticancer effects and cell cycle analysis on human breast cancer T47D cells treated with extracts of Astrodaucus persicus (Boiss.) Drude in comparison to doxorubicin. DARU Journal of Pharmaceutical Sciences. 2008;16(2):112-8.
- 10. Goodarzi S, Nateghpour M, Asgharian P, Hadjiakhoondi A, Yassa N, Tavakoli S, et al. Antimalarial and cytotoxic activities of roots and fruits fractions of Astrodaucus persicus extract. Iranian Journal of Basic Medical Sciences. 2017;20(12):1318-23.
- 11. Goodarzi S, Vatandoost H, Abai MR, Tavakoli S, Hatamian A, Ajani Y, et al. Astrodaucus persicus as a new source of bioinsectisides against malaria vector, Anopheles stephensi. Asian Pacific journal of tropical medicine. 2017;10(9):896-9.