EAS Journal of Pharmacy and Pharmacology
Abbreviated Key Title: EAS J Pharm Pharmacol
ISSN 2663-0990 (Print) & ISSN 2663-6719 (Online)
Published By East African Scholars Publisher, Kenya

OPEN ACCESS

Volume-1 | Issue-2 | Mar-Apr-2019 |

Review Article

The Sainfoins (*Onobrychis* Mill., Fabaceae) – Forage For Grazing Animals, Honey And Medicinal Plants.

Ekaterina Kozuharova[1] and Niko Benbassat[1]

[1]Medical University of Sofia, Faculty of Parmacy, Department of Pharmacognosy, Sofia 1000, Bulgaria

*Corresponding Author
Ekaterina Kozuharova
ina_kozuharova@yahoo.co.uk

Abstract: The sainfoins (*Onobrychis* Mill, Fabaceae) are Eurasian perennial plants. Genus *Onobrychis* includes species, which are well known as forage for grazing animals and honey plants. Traditionally sainfions are used against diarrhea although they are not amongst most popular medicinal plants. The plant extracts possess anti-bacterial activity and anti-tumor effect as well as an affinity to the estrogen receptor. Sainfoins contain phenolic compounds, most often flavonoids and tannins, they have low toxicity, but are prospective in the pest control.

Keywords: *Onobrychis* Mill, ethnobotany, pharmacology.

INTRODUCTION

The sainfoins (*Onobrychis* Mill, Fabaceae) are Eurasian perennial plants. More than 150 species are presently known. The Flora Europaea lists 80 species of *Onobrychis (*ILDIS World Database of Legumes 2010, Euro+Med 2006-2019). The main centre of diversity extends from Central Asia to Iran, with 56 species – 27 of which are endemic – in the latter country alone ILDIS World Database of Legumes 2010. Many of the taxa are doubtfully distinct species and obviously still in a process of current evolution and adaptive radiation (Aktoklu 2001, Ranjbar *et al.,* 2009, 2010, Kozuharova *et al.,* 2017a &b). Genus *Onobrychis* includes species, which are well known as forage for grazing animals and honey plants (Mossadegh 1990, Sorkun & Dogan 1995, Manning 2001, Carbonero *et al.,* 2011, Čeksterytė *et al.,* 2013, Kozuharova 2018a & b). Particular emphasis is on *Onobrychis viciifolia* (Łuczaj 2012). This species is naturalized throughout many countries in Europe and North America grasslands.

Ethnobotany and Ethnopharmacology

The ethnobotanical study shows that *O. montana* in the Alps is a valuable forage for grazing animals (Pieroni & Giusti 2009).

Traditionally sainfions are used against diarrhea although they are not amongst most popular medicinal plants (Bowers *et al.,* 1995, Bonet *et al.,* 1999, Agelet & Valles, 2003).

Modern Pharmacological Tests

Few modern pharmacological tests are performed. *Onobrychis ebenoides* posses strong anti-tumor effect as well as an affinity to the estrogen receptor due to the ebenfuran content (Halabalaki *et al.,* 2000, Gutterson & Ralston 2002, Halabalaki *et al.,* 2006, 2008a & b, Katsanou *et al.,* 2006, Papoutsi *et al.,* 2007, Tchokouaha *et al.,* 2010). For *O. cornuta* is reported anti-bacterial activity (Joudi & Bibalani 2010). It was shown that O. *nitida* has anti-bacterial activity effect against *B. subtilis* and *S. aureus* and the extracts could be used in pharmacological or dietary applications due to their valuable properties (Bektaş *et al.,* 2018).

Bioactive Compounds

Most often for the members of genus Onobrychis are reported phenolic compounds, most often flavonoids and tannins. *Onobrychis biebersteinii*, *Onobrychis arenaria* and *Onobrychis tanaitica* contain flavonoids (Kazakov *et al.,* 1981, Lukyanchikov & Kasakov 1982a Lukyanchikov & Kasakov 1982b, Bektaş *et al.,* 2018). *Onobrychis bobrovii* and *Onobrychis pulchella* contain polyphenols (Kazakov *et al.,* 1981 Lukyanchikov 1982). Members of genus Onobrychis are reported to contain phenolic acids

Quick Response Code

Journal homepage:
http://www.easpublisher.com/easjpp/

Article History
Received: 28.02.2019
Accepted: 10.03.2019
Published: 22.03.2019

DOI: 10.36349/easjpp.2019.v01i02.001

(Lukyanchikov *et al.*, 1985). *Onobrychis viciifolia* contains polyphenols, condensed tannins, arbutin, kaempferol, quercetin, rutin, afzelin, the branched quercetin-3-(2 G -rhamnosylrutinoside), the amino acid l-tryptophan, the inositol (+)-pinitol, seven derivates of the cinnamic acid etc. (Lees *et al.*, 1995, Singh *et al.*, 1997, Marais *et al.*, 2000, Lu *et al.*, 2000, Regos *et al.*, 2009). Proanthocyanidins in sainfoin *Onobrychis viciifolia* are of interest to ameliorate the sustainability of livestock production. It was shown that Large variability existed in PA concentrations (23.0–47.5 mg g–1 leaf dry matter (DM)), share of prodelphinidins (79–96%), and mean degree of polymerization (11–14) among, but also within, accessions (Marais *et al.*, 2015). Also arylbenzofurans have been isolated as insect feeding deterrents from the roots of the forage legume, sainfoin. They have been identified as 2-(2'-hydroxy-4'- methoxyphenyl) -5-hydroxy-6-methoxybenzofuran (sainfuran) and 2-(2',4'-dimethoxyphenyl) -5-hydroxy-methoxybenzofuran (methylsainfuran) (Russell 1984).

Three new compouns (2-phenyl-benzofurans) are isolated from *Onobrychis ebenoides*: ebenfuran I, ebenfuran II, and ebenfuran III. Their structures were elucidated on the basis of chemical and spectral data as 2-(2,4-dihydroxyphenyl)-5-hydroxy-6-methoxy-benzofuran (1), 2-(2,4-dihydroxyphenyl)-3-formyl-4-hydroxy-6-methoxy-benzofuran (2), and 2-(2,4-dihydroxyphenyl)-3-formyl-4-hydroxy-6-methoxy-5-(3-methyl-buten-2-yl)-benzofuran (3) (Halabalaki *et al.*,2000). Phytochemical investigation of a methanol extract of *Onobrychis ebenoides* yields five new 3-formyl-2-arylbenzofurans, namely, ebenfurans IV−VIII (1−5), together with the known compounds ebenfurans I, II (6), and III (7). Only 1 and 7 exhibited growth inhibitory activity against MCF-7 and Ishikawa cells, suggesting that the prenyl moiety at position C-5 is the key determinant of the cytotoxic activity of this group of compounds (Halabalaki *et al.*, 2008).

Toxicity

In vitro is shown that *Onobrychis viciifolia* has low toxicity (Ince & Filazi 2009).

Pest Control

Prospective field for practical application of the bioactive compounds obtained from *Onobrychis viciifolia* is the pest control. It is active against mosquitoes *Aedes aegypti* and *Anopheles gambiae* (Bowers *et al.*, 1995). The arylbenzofurans possess insect feeding deterrent (Russell 1984). The condensed tannins of several legume taxa, including *Onobrychis viciifolia* have protective activity against the larvae of the economically important nematodes *Trichostrongylus colubriformis* and *Haemonchus contortus* by reducing the egg hatching and migration, development and viability of the larvae (Molan *et al.*, 2000, Barrau *et al.*, 2005, Brunet *et al.*, 2008). However the extracts of *O. viciifolia* do not have a significant inhibitory effect on the *Eimeria* oocyst (ovine coccidia) in lambs (Saratsis *et al.*, 2012).

REFERNCES

1. Agelet, A., & Valles, J. (2001). Studies on pharmaceutical ethnobotany in the region of Pallars (Pyrenees, Catalonia, Iberian Peninsula). Part I. General results and new or very rare medicinal plants. *Journal of Ethnopharmacology*, 77(1), 57-70.
2. Barrau, E., Fabre, N., Fouraste, I., & Hoste, H. (2005). Effect of bioactive compounds from Sainfoin (*Onobrychis viciifolia* Scop.) on the in vitro larval migration of *Haemonchus contortus*: role of tannins and flavonol glycosides. *Parasitology*, 131(4), 531-538.
3. Bektaş, E., Kaltalıoğlu, K., Şahin, H., Türkmen, Z., & Kandemir, A. (2018). Analysis of phenolic compounds, antioxidant and antimicrobial properties of some endemic medicinal plants.*International Journal of Secondary Metabolite*, *5*(2), 75-86.
4. Bonet, M. À., Parada, M., Selga, A., & Valles, J. 1999). Studies on pharmaceutical ethnobotany in the regions of L'Alt Emporda and Les Guilleries (Catalonia, Iberian Peninsula). *Journal of Ethnopharmacology*, 68(1), 145-168
5. Bowers, W. S., Sener, B., Evans, P. H., Bingol, F., & Erdogan, I. 1995. Activity of Turkish medicinal plants against mosquitoes Aedes aegypti and Anopheles gambiae. *International Journal of Tropical Insect Science*, 16(3-4), 339-341.
6. Brunet, S., Jackson, F., & Hoste, H. (2008). Effects of sainfoin (*Onobrychis viciifolia*) extract and monomers of condensed tannins on the association of abomasal nematode larvae with fundic explants. *International Journal for Parasitology*, *38*(7), 783-790.
7. Carbonero, C. H., Mueller-Harvey, I., Brown, T. A., & Smith, L. 2011. Sainfoin (*Onobrychis viciifolia*): a beneficial forage legume. *Plant Genetic Resources*, *9*(1), 70-85.
8. Čeksterytė, V., Kurtinaitienė, B., & Balžekas, J. (2013). Pollen diversity in honey collected from Lithuania's protected landscape areas. *Proceedings of the Estonian Academy of Sciences*, *62*(4).
9. Euro+Med. (2006-2019). Euro+Med PlantBase - the information resource for Euro-Mediterranean plant diversity. Published on the Internet http://ww2.bgbm.org/EuroPlusMed/ 02.03.2019
10. Gutterson, N., & Ralston, E. (2002). U.S. Patent No. 6,392,119. Washington, DC: U.S. Patent and Trademark Office
11. Halabalaki, M., Aligiannis, N., Papoutsi, Z., Mitakou, S., Moutsatsou, P., Sekeris, C., & Skaltsounis, A.L. (2000). Three new arylobenzofurans from onobrychis ebenoides and evaluation of their binding affinity for the estrogen receptor. *Journal of Natural Products* 63 (12), 1672-1674.

12. Halabalaki, M., Alexi, X., Aligiannis, N., Alexis, M. N., & Skaltsounis, A. L. (2008a). Ebenfurans IV− VIII from *Onobrychis ebenoides*: Evidence that C-Prenylation is the Key Determinant of the Cytotoxicity of 3-Formyl-2-arylbenzofurans. *Journal of Natural Products*, 71(11), 1934-1937.
13. Halabalaki, M., Alexi, X., Aligiannis, N., Kalpoutzakis, E., Alexis, M. N., & Skaltsounis, A. L. (2008b). *Onobrychis* species: a source of novel C-prenylated cytotoxic 3-formyl-2-arylbenzofurans. *Planta Medica*,74 (9), 1079-1079.
14. Halabalaki, M., Alexi, X., Aligiannis, N., Lambrinidis, G., Pratsinis, H., Florentin, I. *et al.*,exis, M. N. (2006). Estrogenic activity of isoflavonoids from Onobrychis ebenoides. *Planta medica*, 72(6), 488.
15. ILDIS World Database of Legumes. (2010). in: Roskov Y.R., Bisby F.A., Zarucchi J.L., Schrire B.D. & White R.J. (eds.) ILDIS World Database of Legumes: draft checklist, version 10 [published June 2006, but CD shows November 2005 date]. ILDIS, Reading, UK, 2006 [CD-Rom: ISBN 0 7049 1248 1] (also available here at https://ildis.org/LegumeWeb10.01.shtml) 02.03.2019
16. Ince, S., & Filazi, A. (2009). Determined of phytochemical properties of sainfoin (Onobrychis viciifolia) and acute orally LD50 in mice. *Ankara Üniversitesi Veteriner Fakültesi Dergisi*, 56(4), 263-267.
17. Joudi, L., & Bibalani, G. H. (2010). Exploration of medicinal species of Fabaceae, Lamiaceae and Asteraceae families in Ilkhji region, Eastern Azerbaijan Province (Northwestern Iran). *Journal of Medicinal Plants Research*,4(11), 1081-1084
18. Katsanou, E. S., Halabalaki, M., Aligiannis, N., Mitakou, S., Skaltsounis, A. L., Alexi, X., ... *et al.*, exis, M. N. (2007). Cytotoxic effects of 2-arylbenzofuran phytoestrogens on human cancer cells: modulation by adrenal and gonadal steroids. *The Journal of Steroid Biochemistry and Molecular Biology*, 104(3), 228-236
19. Kazakov, A., Kompantsev, V., & Lukyanchikov, M. (1981). Flavonoids of Onobrychis tanaitica and Onobrychis arenaria Khimiya Prirodnykh Soedinenii, (2), 244-245
20. Kožuharova, E., Nedjalkova, M., Gergov, G., & Simeonov, V. (2017a). Multivariate statistical classification of plant features – the case with *Onobrychis pindicola* subsp. *urumovii* Degen & Dren. *Comptes rendus de l'Acad´emie bulgare des Sciences. BIOLOGIE Botanique* 70 (11), 1531-1538
21. Kozuharova, E. (2018a). Flower constancy of bumblebees-the case of *Onobrychis pindicola* (Fabaceae) pollinators. *Journal of Apicultural Science*, 62(1), 135
22. Kozuharova, E. (2018b). Bumblebees and pollination of endemic Onobrychis pindicola (Fabaceae) in the subalpine habitats of Pirin Mts. *Biologica Nyssana*, 9(2), 89-101.
23. Kozuharova, E., Hale, M., Simeonov, V., Nedyalkova, M., Wolff, K., & Richards, A. J., (2017b). *Onobrychis pindicola* and *O. montana* (Fabaceae) in the Pirin and Slavyanka Mts (SW Bulgaria): can we distinguish between them?. *Phytologia Balcanica*, 23(3), 371-380
24. Lees, G., Gruber, M., & Suttill, N. (1995). Condensed tannins in sainfoin .2. Occurrence and changes during leaf development. *Canadian Journal of Botany-Revue Canadienne De Botanique*, 73 (10), 1540-1547.
25. Lu, Y.R., Sun, Y., Foo, L.Y., McNabb, W.C., & Molan, A.l. (2000). Phenolic glycosides of forage legume *Onobrychis viciifolia*. *Phytochemistry*, *55 (1), 67-75.*
26. Łuczaj, Ł. (2012). Ethnobotanical review of wild edible plants of Slovakia. *Acta Societatis Botanicorum Poloniae*, 81(4), 245-255.
27. Lukyanchikov, M., Guzhva, N., & Kazakov, A. (1985). Phenolic-acids of the genus *Onobrychis*-Adans *Khimiya Prirodnykh Soedinenii* (5), 711-711.
28. Lukyanchikov, M., & Kasakov, A. (1982). Flavonoids of *Onobrychis biebersteinii Khimiya Prirodnykh Soedinenii*, (6), 784-784.
29. Lukyanchikov, M., & Kazakov, A. (1982). Flavonoids of *Onobrychis tanaitica*. 2. *Khimiya Prirodnykh Soedinenii*, (2), 256-257.
30. Lukyanchikov, M. (1982). Polyphenols of *Onobrychis bobrovii*. *Khimiya Prirodnykh Soedinenii*, (2), 256-256.
31. Malisch, C. S., Lüscher, A., Baert, N., Engström, M. T., Studer, B., Fryganas, C., & Salminen, J. P. (2015). Large variability of proanthocyanidin content and composition in sainfoin (Onobrychis viciifolia). *Journal of agricultural and food chemistry*, *63*(47), 10234-10242.
32. Manning, R. (2001). Fatty acids in pollen: a review of their importance for honey bees. *Bee World*, *82*(2), 60-75.
33. Marais, J.P.J., Mueller-Harvey, I., Brandt, E.V., Ferreira, D. (2000). Polyphenols, condensed tannins, and other natural products in *Onobrychis viciifolia* (Sainfoin) *Journal of Agricultural and Food Chemistry*, 48 (8), 3440-3447.
34. Mossadegh, M. S. (1990). Honey and pollen sources in Lorestan, Iran. *Bee World*, *71*(1), 25-32.
35. Papoutsi, Z., Kassi, E., Halabalaki, M., Mitakou, S., & Moutsatsou, P. (2007). Evaluation of estrogenic/antiestrogenic activity of Onobrychis ebenoides extract–Interaction with estrogen receptor subtypes ERα and ERβ. *Toxicology in vitro*, 21(3), 364-370
36. Pieroni, A., & Giusti, M. E. (2009). Alpine ethnobotany in Italy: traditional knowledge of gastronomic and medicinal plants among the Occitans of the upper Varaita valley, Piedmont.

Journal of Ethnobiology and Ethnomedicine, *5*(1), 32.

37. Regos, I., Urbanella, A., & Treutter, D. (2009). Identification and quantification of phenolic compounds from the forage legume sainfoin (*Onobrychis viciifolia*). *Journal of Agricultural and Food Chemistry*, 57(13), 5843-5852
38. Richards, K. W., & Edwards, P. D. (1988). Density, diversity, and efficiency of pollinators of sainfoin, Onobrychis viciaefolia Scop. *The Canadian Entomologist*, *120*(12), 1085-1100.
39. Russell, G., Shaw, G., Christmas, P., Yates, M., Sutherland, O. (1984). 2 2-Arylbenzofurans as insect feeding deterrents from sainfoin (*Onobrychis-viciifolia*). *Phytochemistry*, 23 (7), 1417-1420.
40. Saratsis, A., Regos, I., Tzanidakis, N., Voutzourakis, N., Stefanakis, A., Treuter, D., & Sotiraki, S. (2012). In vivo and in vitro efficacy of sainfoin (*Onobrychis viciifolia*) against Eimeria spp in lambs. *Veterinary parasitology*, 188(1-2), 1-9.
41. Singh, S., McCallum, J., Gruber, M.Y., Towers, G.H.N., Muir, A.D., Bohm, B.A., Koupaiabyazani, M.R., & Glass, A.D.M. (1997). Biosynthesis of flavan-3-ols by leaf extracts of *Onobrychis viciifolia Phytochemistry*, 44 (3), 425-432.
42. Sorkun, K., & Dogan, C. (1995). Pollen analysis of Rize-Anzer (Turkish) honey. *Apiacta*, *3*, 75-81.
43. Tchokouaha, R. F., Alexi, X., Chosson, E., Besson, T., Skaltsounis, A. L., Seguin, E., & Wandji, J. (2010). Erymildbraedin A and B, two novel cytotoxic dimethylpyrano-isoflavones from the stem bark of Erythrina mildbraedii: evaluation of their activity toward endocrine cancer cells. *Journal of Enzyme Inhibition and Medicinal Chemistry*, 25(2), 228-233.
44. Aktoklu, E. (2001). Two new varieties and a new record in Onobrychis from Turkey. *Turkish Journal of Botany*, *25*(5), 359-363.
45. Ranjbar, M., Karamian, R., & Hajmoradi, F. (2009). Taxonomic notes on Onobrychis sect. Hymenobrychis (Fabaceae, Hedysareae) in Iran. *Novon: A Journal for Botanical Nomenclature*, *19*(2), 215-219.
46. Ranjbar, M., Karamian, R., & Vitek, E. (2010). Onobrychis bakuensis (Fabaceae), a new species from Azerbaijan.*Annales Botanici Fennici* Vol. 47, No. 3, pp. 233-237