1. Medicinal plants in the Mediterranean area: Synthesis of the results of the project Rubia

Gonzalez-Tejero, MR (Gonzalez-Tejero, M. R.)[1]; Casares-Porcel, M (Casares-Porcel, M.)[1]; Sanchez-Rojas, CP (Sanchez-Rojas, C. P.)[1]; Ramiro-Gutierrez, JM (Ramiro-Gutierrez, J. M.)[1]; Molero-Mesa, J (Molero-Mesa, J.)[1]; Pieroni, A (Pieroni, A.)[2]; Giusti, ME (Giusti, M. E.)[3]; Censorii, E (Censorii, E.)[3]; de Pasquale, C (de Pasquale, C.)[3]; Della, A (Della, A.)[4]; Paraskeva-Hadijchambi, D (Paraskeva-Hadijchambi, D.)[4]; Hadjichambis, A (Hadjichambis, A.)[4]; Houmani, Z (Houmani, Z.)[5]; El-Demerdash, M (El-Demerdash, M.)[6]; El-Zayat, M (El-Zayat, M.)[6]; Hmamouchi, M (Hmamouchi, M.)[7]; ElJohrig, S (ElJohrig, S.)[7]

1] Univ Granada, Dept Bot, E-18071 Granada, Spain
[2] Univ Bradford, Med Biosci Res Focus Grp, Bradford BD7 1DP, W Yorkshire, England
[3] Univ Florence, Dept Art Mus & Performance, I-50121 Florence, Italy
[4] Inst Agr Res, CY-1516 Nicosia, Cyprus
[5] Blida Univ, Dept Agron Agrovet & Biol, Blida 09100, Algeria
[6] Mansoura Univ, Dept Bot, Mansoura, Egypt
[7] Rabat Inst, Inst Natl Plantes Med & Aromat, Rabat, Morocco

mreyes@ugr.es; mcasares@ugr.es; artemisa@ugr.es; jmolero@ugr.es; a.pieroni@bradford.ac.uk; elenagiusti@tin.it; ecensorii@libero.it; ciddippi@yahoo.it; Athena.Della@arinet.ari.gov.cy; d.chadjihambi@cytanet.com.cy; chadjiha@cytanet.com.cy; zhoumani@yahoo.fr; mdash@mans.edu.eg; mzayat2002@yahoo.com; hmamouchim@wanadoo.net.ma

Abstract

Aim of study: Within the scope of the European project RUBIA (ICA3-2002-10023), research has been performed on the traditional use and handling of plant species in several Mediterranean countries, Albania, Algeria, Cyprus, Egypt, Italy, Morocco, and Spain. This paper synthesises the chief results related to the medicinal utilization of those plants. Material and methods: The information has been gathered by means of semi-structured interviews (1256) and techniques of participant observation with 803 informants. In each of the participating countries the study areas were selected by means of uniform criteria defined at the beginning of the study. Results and conclusions: A total of 985 species have been catalogued, of which 406 have medicinal use. This work constitutes the first comparative study performed with ethnobotanical data gathered by a coordinated methodology in the Mediterranean area. An exhaustive list is provided for the species catalogued, indicating the regions where each plant was mentioned. Ethnopharmacological relevance: This information underlines the ethnobotanical richness of the region and the need to broaden this study to other areas of the Mediterranean. Furthermore, this constitutes a base for future phytochemical and pharmacological studies which could lead to new therapeutic

products.

Keywords: ethnobotany; Mediterranean; medicinal plants

Published In: JOURNAL OF ETHNOPHARMACOLOGY **Volume:** 116 **Issue:** 2 **Pages:** 341-357 **DOI:** 10.1016/j.jep.2007.11.045 **Published:** MAR 5 2008

References

1. Agelet, J. Valles(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 (2001), pp. 57–70.
2. Agelet, J. Valles (2003a): Studies on pharmaceutical ethnobotany in the region of Pallars (Pyrenees, Catalonia, Iberian Peninsula). Part II. New or very rare uses of previously known medicinal plants. Journal of Ethnopharmacology, 84 (2003), pp. 211–227
3. Agelet, J. Vallesn (2003b): Studies on pharmaceutical ethnobotany in the region of Pallars (Pyrenees, Catalonia, Iberian Peninsula). Part III. Medicinal uses of non-vascular plants. Journal of Ethnopharmacology, 84 (2003), pp. 229–234
4. N.M. Alexiades, J.E. Sheldon (Eds.), (1996): Selected Guidelines for Ethnobotanical Research: A Field Manual, New York Botanical Garden, New York, USA .
5. Alkofahi, A.H. Atta (1999): Pharmacological screening of the anti-ulcerogenic effects of some Jordanian medicinal plants in rats. Journal of Ethnopharmacology, 67 (1999), pp. 341–345
6. M.A. Bonet, C. Blanché, J. Vallés (1992): Ethnobotanical study in River Tenes valley (Catalonia, Iberian Peninsula). Journal of Ethnopharmacology, 37 (1992), pp. 205–212
7. J. Camejo-Rodrigues, L. Ascensao, M.A. Bonet, J. Valles (2003): An ethnobotanical study of medicinal and aromatic plants in the Natural Park of “Serra de Sao Mamede” (Portugal). Journal of Ethnopharmacology, 89 (2003), pp. 199–209
8. Castroviejo, J. (Ed.), 1986–2005. Flora Iberica. Real Jardín Botánico de Madrid, CSIC, vol. 1–8, 10, 14, 21.
9. Cotton (1996): Ethnobotany. Principles and Applications. Wiley & Sons, Chichester (UK) (1996)
10. Fennane, M., Ibn Tattou, M., Mathez, J., Ouyahya, A., El Oualidi, J, 1999. Flore

Pratique du Maroc. Institut Scientific Serie Botanique, Rabat, Morocco.

11. D.R. Given, W. Harris (1994): Techniques and Methods in Ethnobotany. Commonwealth Secretariat, London (1994)
12. M.R. González-Tejero, J. Molero-Mesa, M. Casares-Porcel, M.J. Martínez-Lirola (1995): New contributions to the ethnopharmacology of Spain. Journal of Ethnopharmacology, 45 (1995), pp. 157–165.
13. W. Greuter (1991): Botanical diversity, endemism, rarity, and extinction in the Mediterranean area: an analysis based on the published volumes of Med-Checklist. Botanika Chronika, 10 (1991), pp. 63–79
14. P.M. Guarrera, G. Salerno, G. Caneva (2005): Folk phytotherapeutical plants from Maratea area (Basilicata, Italy). Journal of Ethnopharmacology, 99 (2005), pp. 367–378
15. Heywood, V.H., 1999. The Mediterranean region a major centre of plant diversity. In: Heywood V.H., Skoula M. (Eds.), Wild food and non-food plants: Information networking. Chania: CIHEAM-IAMC: 5–13. Cahiers Options Méditerranéennes, v. 38.
16. H. Jouad, M. Maghrani, M. Eddouks(2002): Hypoglycaemic effect of *Rubus fructicosus* L. and *Globularia alypum* L. in normal and streptozotocin-induced diabetic rats. Journal of Ethnopharmacology, 81 (2002), pp. 351–356
17. E.A. Khalil, F.A. Afifi, M. Al-Hussaini (2007): Evaluation of the wound healing effect of some Jordanian traditional medicinal plants formulated in Pluronic F127 using mice (*Mus musculus*). Journal of Ethnopharmacology, 109 (2007), pp. 104–112
18. Lemus, R. García, E. Delvillar, G. Knop (1999): Hypoglycaemic activity of four plants used in Chilean popular medicine. Phytotherapy Research, 13 (2) (1999), pp. 91–94
19. Maire, R., 1952–1987. Flora de l'Afrique du Nord 16 vols. P. Lechevalier, Paris.
20. M. Maoz, I. Neeman (2000): Effect of *Inula* v*iscosa* extract on chitin synthesis in dermatophytes and *Candida albicans*. Journal of Ethnopharmacology, 71 (2000), pp. 479–482
21. M.J. Martínez Lirola, M.R. González-Tejero, J. Molero Mesa (1996): Ethnobotanical resources in the province of Almeria: Campos de Nijar . Economic Botany, 50 (1) (1996), pp. 40–56
22. F. Medail, P. Quézel (1999): Biodiversity hotspots in the Mediterranean Basin: setting global conservation priorities. Conservation Biology, 13 (6) (1999), pp. 1510–1513
23. Meikle, R.D., 1977–1985. Flora of Cyprus, 2 vols. Bentham-Moxon Trust, Royal Botanic Gardens, Kew., UK.

24. Merzouki, F. Ed-Derfoufi, J. Molero-Mesa (2000): Contribution to the knowledge of Rifian traditional medicine. II. Folk medicine in Ksar Lakbir district (NW Morocco). Fitoterapia, 71 (2000), pp. 278–307
25. D.E. Moerman, R.W. Pemberton, D. Kiefer, B. Berlin (1999): A comparative analysis of five medicina flora . Journal of Ethnobiology, 19 (1999), pp. 49–70
26. N. Myers, R.A. Mittermeier, C.G. Mittermeier, G.A.B. da Fonseca, J. Kent (2000):Biodiversity hotspots for conservation priorities. Nature, 403 (2000), pp. 853–858
27. M.H. Novais, I. Santos, S. Mendes, C. Pinto-Gomes (2004): Studies on pharmaceutical ethnobotany in Arrabida Natural Park (Portugal). Journal of Ethnopharmacology, 93 (2004), pp. 183–195
28. Paparisto, K., Qosja, X. (Eds.), 1988–2000. Flora de l'Albanie , 4 vols. Akademia e Shkecave e Republikes se Shqiperise, Tirana, Albania.
29. Pieroni (2000): Medicinal plants and food medicines in the folk traditions of the upper Lucca Province, Italy. Journal of Ethnopharmacology, 70 (2000), pp. 235–273
30. Pieroni, A., Giusti, M.E., de Pasquale, C., Lenzarini, C., Censorii, González-Tejero, M.R., Sánchez-Rojas, C., Ramiro-Gutiérrez, J., Skoula, M., Johnson, Ch., Sarpaki, A., Della, A., Paraskeva-Hadijchambi, D., Hadjichambis, A., Hmamouchi, M., El-Jorhi, S., El-Demerdash, M., El-Zayat, M., Al-Shahaby, O., Houmani, Z., Scherazed, M., 2006. Circum-Mediterranean cultural heritage and medicinal plant uses in traditional animal healthcare: a field survey in eight selected areas within the RUBIA project, Journal of Ethnobiology and Ethnomedicine 2, 16.
31. Pignatti, S. 1982. Flora d'Italia. Ed. Edagricole Bologna (Italy).
32. F.D. Pineda, J.M. de Miguel, A. Casado, J. Montalvo (2002a): La Diversidad Biológica de España
33. Prentice Hall, Madrid (2002) pp. XV. Journal of Ethnobiology and Ethnomedicine 2, 16.
34. Pignatti, S. 1982. Flora d'Italia. Ed. Edagricole Bologna (Italy).
35. F.D. Pineda, J.M. de Miguel, A. Casado, J. Montalvo (2002a):La Diversidad Biológica de España. Prentice Hall, Madrid (2002) pp. XV
36. F.D. Pineda, J.M. de Miguel, A. Casado, J. Montalvo (2002b):Claves para comprender la "diversidad biológica" y conservar la "biodiversidad"
37. F.D. Pineda, J.M. de Miguel, A. Casado, J. Montalvo (Eds.), (2002), La Diversidad Biológica de España, Prentice Hall, Madrid pp. 7–30
38. Plant Conservation Alliance and Medicinal Plant Working Group's, 2006. In
39. P. Quézel (1985):Definition of the Mediterranean region and the origin of its

flora
40. Gómez Campo (Ed.), Plant Conservation in the Mediterranean Area, W. Junk, Dordrecht, The Netherlands (1985), pp. 9–24
41. P. Quézel, S. Santa (1962–1963):Nouvelle Flore de l'Algérie et des Régions Désertiques Méridionales, 2 vols. Éditions du Centre National de la Recherche Scientifique, Paris (1962–1963)
42. O. Said, K. Khalil, S. Fulder, H. Azaizeh (2002): Ethnopharmacological survey of medicinal herbs in Israel, the Golan Heights and the West Bank region. Journal of Ethnopharmacology, 83 (2002), pp. 251–265
43. A.M. Scherrer, R. Motti, C. Weckerle (2005):Traditional plant use in the areas of Monte Vesole and Ascea, Cilento National Park (Campania, Southern Italy). Journal of Ethnopharmacology, 97 (2005), pp. 129–143
44. V. Täckholm (1974): Student Flora of Egypt. Cairo University Press, Cairo, Egypt (1974)
45. T.G. Tutin, V.H. Heywood, N.A. Burges, D.H. Valentine, S.M. Walters, D.A. Webb (Eds.), (1964–1980): Flora Europaea, 5 vols, Cambridge University Press
46. Valdés, B., Talavera, S., Fernández-Galiana, E. (Eds.), 1987. Flora de Andalucía Occidental, 3 vols. Ketres Editora, Barcelona.
47. J.B. Walker, K.J. Sytsma, J. Treutlein, M. Wink (2004). *Salvia* (Lamiaceae) is not monophyletic: implications for the systematics, radiation, and ecological specializations of *Salvia* and Tribe Mentheae. American Journal of Botany, 91 (7), pp. 1115–1125

2. Wild and semi-domesticated food plant consumption in seven circum-Mediterranean areas

Hadjichambis, AC (Hadjichambis, Andreas Ch.)[1]; Paraskeva-Hadjichambi, D (Paraskeva-Hadjichambi, Demetra)[1]; Della, A (Della, Athena)[1]; Giusti, ME (Giusti, Maria Elena)[2]; De Pasquale, C (De Pasquale, Caterina)[2]; Lenzarini, C (Lenzarini, Cinzia)[2]; Censorii, E (Censorii, Elena)[2]; Gonzales-Tejero, MR (Gonzales-Tejero, Maria Reyes)[3]; Sanchez-Rojas, CP (Sanchez-Rojas, Cristina Patricia)[3]; Ramiro-Gutierrez, JM (Ramiro-Gutierrez, Jose M.)[3]; Skoula, M (Skoula, Melpomeni)[4]; Johnson, C (Johnson, Chris)[4]; Sarpaki, A (Sarpaki, Anaya)[4]; Hmamouchi, M (Hmamouchi, Mohamed)[5]; Jorhi, S (Jorhi, Said)[5]; El-Demerdash, M (El-Demerdash, Mohamed)[6]; El-Zayat, M (El-Zayat, Mustafa)[6]; Pieroni, A (Pieroni, Andrea)[7]

[1] Univ Granada, Dept Bot, E-18071 Granada, Spain
[2] Univ Bradford, Med Biosci Res Focus Grp, Bradford BD7 1DP, W Yorkshire, England
[3] Univ Florence, Dept Art Mus & Performance, I-50121 Florence, Italy
[4] Inst Agr Res, CY-1516 Nicosia, Cyprus
[5] Blida Univ, Dept Agron Agrovet & Biol, Blida 09100, Algeria
[6] Mansoura Univ, Dept Bot, Mansoura, Egypt
[7] Rabat Inst, Inst Natl Plantes Med & Aromat, Rabat, Morocco

a.chadjihambi@cytanet.com.cy

Abstract

The use of local Mediterranean food plants is at the brink of disappearance. Even though there is relatively abundant information on inventories of wild edible taxa, there is also a crucial need to understand how these plants are consumed and when and how these consumption phenomena change over time and place around the Mediterranean. Additionally, it is important to study such knowledge systems and find innovative ways of infusing them to the future Mediterranean generations. During the years 2003-2006 a circum-Mediterranean ethnobotanical field survey for wild food plants was conducted in selected study sites in seven Mediterranean areas (European Union-funded RUBIA Project). Structured and semi-structured questionnaires have been administered to indigenous people and 294 wild food plant taxa were documented in the survey. A comparative analysis of the data was undertaken showing that the quantity and quality of traditional knowledge varies among the several study areas and is closely related to the traditions, environment and cultural heritage of each country. More similarities of wild edible popular use were

revealed between the Eastern Mediterranean and the Western Mediterranean.

Keywords: Ethnobotany; Mediterranean diet; ethnobiology; wild food plants; food medicine

Published In: INTERNATIONAL JOURNAL OF FOOD SCIENCES AND NUTRITION **Volume:** 59 **Issue:** 5 **Pages:** 383-414 **DOI:** 10.1080/09637480701566495 **Published:** 2008

3. NaCl ENHANCES GROWTH AND MORPHOGENESIS POTENTIAL OF *ALHAGI GRAECORUM*

S. M. A. ZOBAYED[1], S. J. MURCH[2], M. A. EL-DEMERDASH[3], AND PRAVEEN K. SAXENA[4]

1Faculty of Horticulture, Chiba University, Matsudo, Chiba, 2718510, Japan
2Chemistry, University of British Columbia Okanagan, Kelowna, BC, Canada, V1V 1V7
3Botany Department, Faculty of Science, Mansoura University, Mansoura, Egypt
4Department of Plant Agriculture, University of Guelph, Guelph, Ont., Canada, N1G 2W1

Abstract

The contamination of soils with excess salts is one of the greatest challenges to plant survival, but some unique species have evolved to thrive in highly saline environments. One such species, *Alhagi graecorum* Boiss., has been previously shown to accumulate high levels of sodium while growing in salt marshes. The aim of this research was to investigate the effects of saline conditions on the growth and the regeneration capacity of this species. Plantlets and explants of *A. graecorum* were cultured on a medium supplemented with various concentrations of NaCl, where *A. graecorum* tissues accumulated up to 8% Na. The capacity for regeneration was enhanced by the excess sodium, indicating a requirement of salt for optimal growth and development in this species. Further study of this species may provide new concepts and understanding of the metabolism of sodium in higher plants.

Keywords: *Alhagi graecorum*; light; morphogenesis; salt tolerance; TDZ.

Published In: In Vitro Cellular & Developmental Biology - Plant Volume 42, Issue 6 , pp 607-613

References

1. Awmack, C. S.; Lock, J. M. The genus Alhagi (Leguminosae: Papilionoideae) in the Middle East. Kew Bull. 57:435–443; 2002.
2. Chowdhury, J. B.; Jain, S.; Jain, R. K. Biotechnological approaches for developing salt tolerant field crops. J. Plant Biochem. Biotech.2:1–7; 1993.
3. dos Santos, V. C. L.; Gomes, S.; Caldeira, G. Comparative responses of Helianthus annuus plants and calli exposed to NaCl: selection of stable salt

tolerant calli cell lines and evaluation of osmotic adjustment and morphogenetic capacity. J. Plant Physiol. 156:68–74; 2000.

4. El-Demerdash, M. A.; Amin, A. A.; Shawakat, E. Ecological studies on Alhagi graecorum Boiss. 1: Ecology and populations of Alhagi graecorum Boiss. J. Env. Sci. Mansoura Univ. 2:90–113; 1991a.
5. El-Demerdash, M. A.; El-Habibi, A. M.; Shawahat, E. Ecological studies on Alhagi graecorum Boiss. 2: Phytochemical studies on Alhagi graecorum Boiss. J. Env. Sci. Mansoura Univ. 2:114–119; 1991b.
6. Flowers, T. J.; Troke, P. F.; Yeo, A. R. The mechanism of salt tolerance in halophytes. Ann. Rev. Plant Physiol. 28:89–121; 1977.
7. Gamborg, O. L.; Miller, R. A.; Ojima, K. Nutrient requirement of suspension cultures of soybean root cells. Exp. Cell Res. 50:150–158; 1968.
8. Hassanein, A. M.; Mazen, M. A. Adventitious bud formation in Alhagi graecorum. Plant Cell Tiss. Organ Cult. 65:31–35; 2001.
9. Havaux, M.; Strasser, R. J.; Greppin, H. A theoretical and experimental analysis of the qp and qN coefficients of chlorophyll fluorescence quenching and their relation to photochemical and nonphotochemical events. Photosynth. Res. 27:41–55; 1991.
10. Hutchinson, M. J.; Murch, S. J.; Saxena, P. K. Morphoregulatory role of thidiazuron: Evidence of the involvement of endogenous auxin in thidiazuron-induced somatic embryogenesis of geranium (Pelargonium £ hortorum Bailey). J. Plant Physiol. 149:573–579; 1996.
11. Hutchinson, M. J.; Saxena, P. K. Role of purine metabolism in thidiazuron induced somatic embryogenesis of geranium(Pelargonium £ hortorum Bailey) hypocotyl cultures. Physiol. Plant. 98:517–522; 1996.
12. Jacobsen, J.; Adams, R. M. Salt and silt in ancient Mesopotamian agriculture. Science 128:1251–1258; 1958.
13. Kitajima, M.; Butler, W. L. Quenching of chlorophyll fluorescence and primary photochemistry by dibromothymoquinone. Biochem. Biophys. Acta 376:105–111; 1975.
14. Kozai, T.; Fujiwara, K.; Watanabe, I. Fundamental studies on environments in plant tissue culture vessels 2. Effects of stoppers and vessels on gas

exchange rates between inside and outside of vessels closed with stoppers. J. Agr. Meteorol. 42:119–127; 1986.

15. Kurban, H.; Saneoka, H.; Nehira, K.; Adilla, R.; Premachandra, G. S.; Fujita, K. Effect of salinity on growth, photosynthesis and mineral composition in leguminous plant Alhagi pseudoalhagi (Bieb.). Soil Sci. Plant Nutr. 45:851–862; 1999.
16. Malik, K. A.; Saxena, P. K. In vitro regeneration of plants: A novel approach. Naturwissenschaften 79:136–137; 1992.
17. Meikle, R. D. Flora of Cyprus, Vol. I. Bentham-Moxon Trust, Royal Botanic Gardens; kew: 1977.
18. Mukherjee, A. Effect of NaCl on in vitro propagation of sweet potato (Ipomoea batatas L.). Appl. Biochem. Biotech. 102:431–441;2002.
19. Munns, R. Physiological processes limiting plant growth in saline soils: some dogmas and hypotheses. Plant Cell Environ. 16:15–24; 1993.
20. Munns, R.; Termaat, A. Whole-plant responses to salinity. Aust. J. Plant Physiol. 13:143–160; 1986.
21. Murashige, T.; Skoog, F. A revised medium for rapid growth and bioassays with tobacco tissue culture. Physiol. Plant. 15:473–497; 1962.
22. Murch, S. J.; KrishnaRaj, S.; Saxena, P. K. Thidiazuron-induced morphogenesis of Regal geranium (Pelargonium domesticum): a potential stress response. Physiol. Plant. 101:183–191; 1997.
23. Murch, S. J.; Saxena, P. K. Molecular fate of thidiazuron and its effects on auxin transport in hypocotyls tissues of Pelargonium £ hortorum Bailey. Plant Growth Regul. 35:269–275; 2001.
24. Murch, S. J.; Victor, R. M. J.; KrishnaRaj, S.; Saxena, P. K. The role of proline in thidiazuron-induced somatic embryogenesis of peanut (Arachis hypogaea L.). In Vitro Cell Dev. Biol.—Plant 35:102–105;1999.
25. Murthy, B. N. S.; Murch, S. J.; Saxena, P. K. Thidiazuron-induced somatic embryogenesis in intact seedlings of peanut (Arachis hypogaea):Endogenous growth regulator levels and significance of cotyledons. Physiol. Plant. 94:268–276; 1995.
26. Rechinger, K. H. Flora Iranica 157: Papilionaceae II. Graz. Austria:

Akademische Druckund Verlagsanstalt; 1984.

27. Serrano, R.; Culinaz-Marcia, F. A.; Moreno, V. Genetic engineering of salt and drought tolerance with yeast regulatory genes. Sci. Hortic.78:261–269; 1999.
28. Skoog, F.; Miller, C. O. Chemical regulation of growth and organ formation in
29. plant tissues cultured in vitro. Symp. Soc. Exp. Biol. 11:118–131; 1957.
30. Taiz, L.; Zeiger, E. Plant Physiology. New York: Benjamin/Cummings Publishing Co.; 1991.
31. Yusufov, A. G.; Alieva, Z. M. Initial stages of morphogenetic changes in detached cotyledons, hypocotyls, and leaves of kidney beans and eggplants under salinity conditions. Russ. J. Plant Physiol. 49:789–791; 2002.
32. Zobayed, S. M. A.; Armstrong, J.; Armstrong, W. Cauliflower shoot-culture: effects of different types of ventilation on growth and physiology. Plant Sci. 141:221–231; 1999.

4. *Artemisia judaica* L.: micropropagation and antioxidant activity

Liu, CZ (Liu, CZ); Murch, SJ (Murch, SJ); El-Demerdash, M (El-Demerdash, M); Saxena, PK (Saxena, PK)

a State Key Laboratory of Biochemical Engineering, Institute of Process Engineering, Chinese Academic of Sciences, Beijing 100080, PR China
b *Institute for Ethnobotany, National Tropical Botanical Garden, 3530 Papalina Road, Kalaheo, HI, USA*
c *Faculty of Science, University of Mansoura, Mansoura, Egypt*
d *Department of Plant Agriculture, Biotechnology Division, Edmund C. Bovey Complex, University of Guelph,*
Guelph, Ont., Canada, N1G 2W1

Abstract

Artemisia judaica L., an Egyptian medicinal plant used in the treatment of gastrointestinal disorders, was mass-propagated and grown using solid, paper-bridge-support liquid, liquid-flask and bioreactor cultures. The liquid-flask culture using 50 ml MS liquid medium in 250 ml flask yielded significantly greater shoot proliferation than either solid cultures or paper-bridge-support liquid cultures. Increasing flask capacity from 100 to 500 ml improved shoot proliferation and growth. Mass-propagation efficiencies of various bioreactor systems, viz. temporary immersion reactors and bubble column reactors, were also compared. The temporary immersion bioreactor was found to have significant advantages for A. judaica shoot proliferation. The shoot cultures from the temporary immersion reactor formed complete plantlets when subcultured onto a medium containing 1 mumol l(-1) indole-3-butyric acid (IBA), and mature plants were established, acclimatized and thrived in standard greenhouse conditions. Assays of antioxidant activity and total flavonoid content of in vitro and in vivo grown tissues were evaluated as gross parameters of medicinal efficacy. Significantly higher antioxidant activity and flavonoid contents were observed in the tissues of mature greenhouse-grown plants. The efficient in vitro production systems developed in this study provided sterile, consistent tissues for investigation of bioactivity and germplasm conservation of A. judaica.

Keywords: *Artemisia judaica* L.; Egyptian medicinal plant; shoot culture; bioreactor; flavonoids; antioxidant activity

Published In: JOURNAL OF BIOTECHNOLOGY **Volume:** 110 **Issue:** 1 **Pages:** 63-71 **DOI:** 10.1016/j.biotec.2004.01.011 **Published:** MAY 13 2004

References

1. Abdalla, S.S., Abu-Zagra, M.H., 1987. Effects of cirsimaritin, a flavone isolated from *Artemisia judaica*, on isolate guinea-piileum. Planta Med. 53, 322–324.
2. Aitken-Christie, J., Kozai, T., Takayama, S., 1995. Automation in plant tissue culture-general introduction and overview. In: Aitken-Christie, J., Kozai, T., Smith, M.A.L. (Eds.), Automation and environmental control in plant tissue culture. Kluwer Academic Publishers, Boston, pp. 1–18.
3. Akita, M., Ohta, Y., 1996. Development of a system for mass propagation of *Colocasia* in large scale without forced aeration. Acta Hort. 440, 554–559.
4. Boulos, L., 1997. Endemic flora of the Middle East and North Africa. In: Barakat, H.N. (Ed.), Reviews in Ecology: Desert Conservation and Development. Metropole, Cairo, Egypt, pp. 229–260.
5. Cozzi, R., Ricordy, R., Aglitti, T., Gatta, V., Petricone, P., De-Salvia, R., 1997. Ascorbic acid and B-carotene as modulators of oxidative damage. Carcinogenesis 18, 223–228.
6. Eberhardt, M., Lee, C.Y., Liu, R.H., 2000. Antioxidant activity of fresh apples. Nature 405, 903–904.
7. El-Demerdash, M., 2001. Medicinal plants of Egypt. In: Saxena, P.K. (Ed.), Development of Plant-Based Medicines: Conservation, Efficacy and Safety. Kluwer Academic Publishers, Dordrecht, The Netherlands, pp. 69–93.
8. Etienne, H., Berthouly, M., 2002. Temporary immersion systems in plant micropropagation. Plant Cell Tiss. Org. Cult. 69, 215– 231.
9. Gamborg, O.L., Miller, R.A., Ojima, K., 1968. Nutrient requirements of suspension cultures of soybean root cells. Exp. Cell Res. 50, 151–158. *C.Z. Liu et al. / Journal of Biotechnology 110 (2004) 63–71* 71
10. Honda, H., Liu, C.Z., Kobayashi, T., 2001. Large-scale plant micropropagation. Advances in Biochem. Eng. Biotechnol. 72, 158–182.

11. Jia, Z., Tang, M., Wu, J., 1999. The determination of flavonoid contents in mulberry and their scavenging effects on superoxide radicals. Food Chem. 64, 555–559.
12. Khafagy, S.M., El-Din, A.A., Jakupovic, J., Zdero, C., Bohlmann, F., 1988. Glaucolide-like sesquiterpene lactones from *Artemisia judaica*. Phytochemistry 27, 1125–1128.
13. Khafagy, S.M., Tosson, S., 1968. Crystallographic optical and chromatograph studies of judaicin bitter, principle of *Artemisia judaica* L. Planta Med. 16, 446–449.
14. Liu, C.Z., Wang, Y.C., Guo, C., Ouyang, F., Ye, H.C., Li, G.F., 1998. Production of artemisinin by shoot cultures of *Artemisia annua* L. in a modified inner-loop mist bioreactor. Plant Sci. 135, 211–217.
15. Liu, C.Z., Moon, K.H., Honda, H., Kobayashi, T., 2000. Immobilization of rice (*Oryza sativa* L.) callus in polyurethane foam using a turbine blade reactor. Biochem. Eng. J. 4, 169–175.
16. Liu, C.Z., Moon, K.H., Honda, H., Kobayashi, T., 2001. In situ regeneration of rice (*Oryza sativa* L.) callus immobilized in polyurethane foam. J. Biosci. Bioeng. 91, 76 80.
17. Liu, C.Z., Murch, S.J., Saxena, P.K., 2003. Regeneration of the Egyptian medicinal plant *Artemisia judaica* L. Plant Cell Rep.21, 525–530.
18. Liu, M., Li, X.Q., Weber, C., Li, C.Y., Brown, J., Liu, R.H., 2002.Antioxidant and antiproliferative activities of raspberries. J. Agric. Food Chem. 50, 2926–2930.
19. Luximon-Ramma, A., Bahorum, T., Soobratle, M.A., Aruoma, O.I., 2002. Antioxidant activities of phenolic, proanthocyanidin, and flavonoid components in extracts of *Cassia fistula*. J. Agric.Food Chem. 50, 5042–5047.
20. Murashige, T., Skoog, F., 1962. A revised medium for rapid growth and biossays with tobacco tissue cultures. Physiol. Plant 15,473–497.
21. Murch, S.J., KrishnaRaj, S., Saxena, P.K., 2000. Phytopharmaceuticals: mass production, standard, and conservation. Sci. Rev. Altern. Med. 4, 39–43.
22. Saleh, M.A., 1985. Volatile components of *Artemisia monosperma* and *Artemisia judaica* L. growing in the Egyptian deserts. Biochem. Syst. Ecol.

13, 265–269.

23. Saleh, N.A.M., El-Ghazooly, S.I., Abou-Zaid, M.M., 1987. Flavonoid of *Artemisia judaica*, *A. monosperma* and *A.herba-alba*. Phytochemistry 26, 3059–3064.
24. Saxena, P.K., 2001. Preface to special issue on in vitro culture ofmedicinal plants. Plant Cell Tiss. Org. Cult. 62, 167.
25. Simonton, W., Robacker, C., Krueger, S.A., 1991. A programmable micropropagation apparatus using cycled liquid medium. Plant Cell Tiss. Org. Cult. 27, 211–218.
26. Takahata, Y., Ohnishi-Kameyama, M., Furuta, S., Takahashi, M.,Suda, I., 2001. Highly polymerized procyanidins in brown soybean seed coat with a high radical-scavenging activity. J.Agric. Food Chem. 49, 5843–5847.
27. Teisson, C., Alvard, D., Berthouly, B., Cote, F., Escalant, J.V., Etiene, H., Lartaud, M., 1996. Simple apparatus to perform plant tissue culture by temporary immersion. Acta Horticult. 440, 521–526.
28. Thomas, D.S.G., 1988. The biogeomorphology of acid and semi-acid environments. In: Viles, H.A. (Ed.), Biogeomorphology. Basil Blackwell, Oxford, UK, pp. 193–221.
29. Tsukahara, M., Hirosawa, T., Kishine, S., 1996. Efficient plantlet regeneration from cell suspension cultures of rice (*Oryza sativa*L.). J. Plant Physiol. 149, 157–162.
30. Weathers, P.J., Giles, K.L., 1988. Regeneration of plants using nutrient mist culture. In Vitro Cell. Dev. Biol. Plant 24, 727–732.
31. Ziv, M., 1991. Vitrification: morphological and physiological disorder of in vitro plants. In: Debergh, P.C., Zimmerman, R.H. (Eds.), Micropropagation. Kluwer Academic Publishers,Dordrecht, pp. 45–69.
32. Ziv, M., Ronen, G., Raviv, M., 1998. Proliferation of meristematic clusters in disposable presterilized plastic bioreactors for the large-scale micropropagation of plants. In Vitro Cell. Dev. Biol. Plant 34, 152–158.
33. Ziv, M., Shemesh, D., 1996. Propagation and tuberization of potato bud clusters from bioreactor culture. In Vitro Cell. Dev. Biol. Plant 32, 31–36.

5. Circum-Mediterranean cultural heritage and medicinal plant uses in traditional animal healthcare: a field survey in eight selected areas within the RUBIA project.

Andrea Pieroni*1,2, Maria Elena Giusti3, Caterina de Pasquale3, Cinzia Lenzarini3, Eleonora Censorii3, María Reyes Gonzáles-Tejero4,Cristina Patricia Sánchez-Rojas4, Jose M Ramiro-Gutiérrez4, Melpomeni Skoula5, Chris Johnson5, Anaya Sarpaki5, Athena Della6, Demetra Paraskeva-Hadijchambi6, Andreas Hadjichambis6, Mohammed Hmamouchi7, Said El-Jorhi7, Mohamed El-Demerdash8, Mustafa El-Zayat8, Omar Al-Shahaby8, Zahia Houmani9 and Mekious Scherazed9

Address

(1)SCH Group, Department of Social Sciences, Wageningen University and Research Centres, Postbus 8060 6700 DA Wageningen, The Netherlands, (2) Medical Biosciences Research Focus Group, University of Bradford, Richmond Rd., Bradford BD71DP, UK, (3)Department of Art,Music and Performance, University of Florence, Via della Pergola, 48, 50121 Firenze, Italy, (4) Department of Botany, University of Granada, Campus Universitario de Cartuja, 18071 Granada, Spain, (5) Park for the Preservation of Flora and Fauna, Technical University of Crete, Plateia Ag. Markou,Terma Ag. Titou, 73100 Chania, Greece, (6)Agricultural Research Institute (ARI) of Cyprus, P.O. Box 22016, 1516 Nicosia, Cyprus, (7)Institut Nationaldes Plantes Médicinales et Aromatiques, B.P 6388 Rabat Institut, Rabat, Morocco, (8) Department of Botany, Mansoura University, 60 Al-Gamorhria St., 35516 Mansoura, Egypt and (9)Department of Agronomy, Agro-Veterinary and Biology, Blida University, Douirete Route de Soumaa, 09100 Blida, Algeria

Email:

Andrea Pieroni* - a.pieroni@bradford.ac.uk; Maria Elena Giusti - elenagiusti@tin.it; Caterina de Pasquale - ciddippi@yahoo.it; Cinzia Lenzarini - clenzarini@yahoo.com; Eleonora Censorii - ecensorii@libero.it; María Reyes Gonzáles-Tejero - mreyes@platon.ugr.es;Cristina Patricia Sánchez-Rojas - artemisa@ugr.es; Jose M Ramiro-Gutiérrez - mreyes@platon.ugr.es; Melpomeni Skoula - mskoula@mail.tuc.gr;Chris Johnson - chrimelp@otenet.gr; Anaya Sarpaki - asarpaki@otenet.gr; Athena Della - Athena.Della@arinet.ari.gov.cy; Demetra Paraskeva-Hadijchambi d.chadjihambi @cytanet.com.cy; Andreas Hadjichambis - chadjiha@cytanet.com.cy;Mohammed Hmamouchi - hmamouchim@wanadoo.net.ma; Said El-Jorhi - said.eljohri@caramail.com; Mohamed El-Demerdash - mdash@mans.edu.eg; Mustafa El-Zayat - mzayat2002@yahoo.com; Omar Al-Shahaby - mdash@mans.edu.eg; Zahia Houmani - zhoumani@yahoo.fr; Mekious Scherazed - zhoumani@yahoo.fr

Abstract

During the years 2003-2005, a comparative ethnobotanical field survey was conducted on remedies used in traditional animal healthcare in eight Mediterranean areas. The study sites were selected within the EU-funded RUBIA project, and were as follows: the upper Kelmend Province of Albania; the Capannori area in Eastern Tuscany and the Bagnocavallo area of Romagna, Italy; Cercle de Ouezanne, Morocco; Sierra de Aracena y Picos de Aroche Natural Park in the province of Huelva, Spain; the St. Catherine area of the Sinai Peninsula, Egypt; Eastern and

Western Crete, Greece; the Paphos and Larnaca areas of Cyprus; and the Mitidja area of Algeria.One hundred and thirty-six veterinary preparations and 110 plant taxa were recorded in the survey, with Asteraceae and Lamiaceae being the most quoted botanical families. For certain plant species the survey uncovered veterinary phytotherapeutical indications that were very uncommon, and to our knowledge never recorded before. These include Anabasis articulata (Chenopodiaceae), Cardopatium corymbosum (Asteraceae), Lilium martagon (Liliaceae), Dorycnium rectum (Fabaceae), Oenanthe pimpinelloides (Apiaceae), Origanum floribundum (Lamiaceae), Tuberaria lignosa (Cistaceae), and Dittrichia graveolens (Asteraceae). These phytotherapeutical indications are briefly discussed in this report, taking into account modern phytopharmacology and phytochemistry.The percentage of overall botanical veterinary taxa recorded in all the study areas was extremely low (8%), however when all taxa belonging to the same botanical genus are considered, this portion increases to 17%. Nevertheless, very few plant uses were found to be part of a presumed "Mediterranean" cultural heritage in veterinary practices, which raises critical questions about the concept of Mediterraneanism in ethnobotany and suggests that further discussion is required.Nearly the half of the recorded veterinary plant uses for mammals uncovered in this survey have also been recorded in the same areas in human folk medicine, suggesting a strong link between human and veterinary medical practices, and perhaps also suggesting the adaptive origins of a few medical practices. Since most of the recorded data concern remedies for treating cattle, sheep, goats, and camels, it would be interesting to test a few of the recorded phytotherapeuticals in the future, to see if they are indeed able to improve animal healthcare in breeding environments, or to raise the quality of dairy and meat products in the absence of classical, industrial, veterinary pharmaceuticals.

Published In: Journal of ethnobiology and ethnomedicine Volume: 2 Pages: 16
DOI: 10.1186/1746-4269-2-16 Published: 2006 Mar 24

References

1. UNESCO Safeguarding of the Intangible Cultural Heritage Paris. 2005. 26th September 2005.
2. Herzfeld M. Meaning and morality: a semiotic approach to evil eye accusations in

a Greek village. Am Ethnologist. 1981; 8:560 – 517. doi :10.1525 / ae.1981.8.3.02a00090.

3. Galt AH. The evil eye as synthetic image and its meanings on the Island of Pantelleria. Am Ethnologist. 1982;9: 664–681. doi: 10.1525/ae.1982.9.4.02a00030.
4. Herzfeld M. The horns of the Mediterraneanist dilemma. Am Ethnologist. 1984; 11:439–454. doi: 10.1525/ae.1984.11.3.02a00020.
5. Herzfeld M. Of horns and history: The Mediterraneanist dilemma again. Am Ethnologist. 1985; 12:778–780. doi: 10.1525/ae.1985.12.4.02a00140.
6. Galt AH. Does the Mediterraneanist dilemma have straw horns? Am Ethnologist. 1985; 12:369–371. doi: 10.1525/ae.1985.12.2.02a00110.
7. Schneider J, Schneider P. Mafia, antimafia and the plural cultures in Sicily. Current Anthropology. 2004; 46:501–520. doi: 10.1086/431529.
8. Herzfield M. Practical Mediterraneanism: excuse for everything, from epistemology to eating. In: Harris WV, editor. Rethinking the Mediterranean. Oxford, UK: Oxford University Press; 2005. pp. 45–63.
9. RUBIA Circum-Mediterranean Ethnobotanical and Ethnographic Heritage in Traditional Technologies, Tools, and Uses of Wild and Neglected Cultivated Plants for Food, Medicine, Textiles, Dyeing, and Handicrafts. Wageningen (Netherlands); 2006. 15th February 2006.
10. Pieroni A, Münz H, Akbulut M, Baser KHC, Durmuskahya C. Traditional phytotherapy and trans-cultural pharmacy among Turkish migrants living in Cologne, Germany. J Ethnopharmacol. 2005; 102:69–88. doi: 10.1016/j.jep.2005.05.018.
11. McCorkle C. An introduction to ethnoveterinary research and development. J Ethnobiol Ethnobiology. 1986; 6:129–149.
12. Hirschkind L. Sal/Manteca/Panela: ethnoveterinary practice in Highland Ecuador. Am Anthropologist. 2000; 102:290–302. doi: 10.1525/aa.2000.102.2.290.
13. Lans C, Harper T, Georges K, Bridgewater E. Medicinal plants used for dogs in Trinidad and Tobago. Prev Vet Med. 2000; 45:201–220. doi: 10.1016/S0167-5877(00)00123-9.
14. Scarpa GF. Plants employed in traditional veterinary medicine by the Criollos of the Northwestern Argentine Chaco. Darwiniana. 2000; 38:253–265.
15. Lans C, Harper T, Georges K, Bridgewater E. Medicinal and ethnoveterinary

remedies of hunters in Trinidad. BMC Complement Altern Med. 2001; 1:10. doi: 10.1186/1472-6882-1-10.

16. Adewumni CO, Agbedahunsi JM, Adebajo AC, Aladesanmi AJ, Murphy N, Wando J. Ethno-veterinary medicine: screening of Nigerian medicinal plants for trypanocidal properties. J Ethnopharmacol. 2001; 77:19–24. doi: 10.1016/S0378-8741(01)00247-1.
17. Nfi AN, Mbanya JN, Ndi C, Kameni A, Vabi M, Pingpoh D, Yonkeu S, Moussa C. Ethnoveterinary medicine in the Northern Province of Cameroon. Vet Res Commun. 2001; 25:71–76. doi: 10.1023/A:1026766219786.
18. Alawa JP, Jokthan GE, Akut K. Ethnoveterinary medical practice for ruminants in the subhumid zone of Northern Nigeria. Prev Vet Res. 2002; 54:79–90. doi: 10.1016/S0167-5877(01)00273-2.
19. Ghotge NS, Ramdas SR, Ashalata S, Mathur NP, Broome VG, Sanyasi Rao ML. A social approach to the validation of traditional veterinary remedies – The Anthra project. Trop Anim Health Prod. 2002; 34:121–143. doi: 10.1023/A:1014266106237.
20. Ole-Miaron JO. The Maasai ethnodiagnostic skill of livestock diseases: a lead to traditional bioprospecting. J Ethnopharmacol. 2003; 84:79–83. doi: 10.1016/S0378-8741(02)00283-0.
21. Tabuti JR, Dhillion SS, Lye KA. Ethnoveterinary medicines for cattle (*Bos indicus*) in Bulamogi county, Uganda: plan species and mode of use. J Ethnopharmacol. 2003; 88:279–286. doi: 10.1016/S0378-8741(03)00265-4.
22. Muhammad G, Khan MZ, Hussain MH, Iqbal Z, Athar M. Ethnoveterinary practices of owners of pneumatic-cart pulling camels in Faisalabad City (Pakistan) J Ethnopharmacol. 2005; 97:241–146. doi: 10.1016/j.jep.2004.11.008.
23. Martin M, McCorkle C, Mathias E. Ethnoveterinary Medicine An Annotated Bibliography of Community Animal Healthcare. London (UK): ITDG Publishing; 2001.
24. Corrain C, Zampini P. Note di veterinaria popolare riguardanti il Polesine. Archivio Antropologia Etnologia. 1961; XCI: 249–263.
25. Manzi A. Piante utilizzate nella veterinaria popolare a Gessopalena. Rivista Abruzzese. 1989; 3:253–260.
26. Brag S, Hansen HJ. Treatment of ruminal indigestion according to popular belief in Sweden. Rev Sci Tech. 1994; 13:529–535.

27. Vučevat-Bajt V, Karlović M. Traditional methods for the treatment of animal diseases in Croatia. Rev Sci Tech. 1994; 13:499–512.
28. Blanco E, Macía MJ, Morales R. Medicinal veterinary plants of El Caurel (Galicia, northwest Spain) J Ethnopharmacol. 1999; 65:113–124. doi: 10.1016/S0378-8741(98)00178-0.
29. Pieroni A., (Ed) Herbs, Humans and Animals/Erbe, Uomini e Bestie. Cologne (Germany): experiences Verlag; 1999.
30. Viegi L, Bioli A, Vangelisti R, Cela Tenzoni G. Prima indagine sulle piante utilizzate in medicina veterinaria popolare in alcune località dell'Alta Val di Cecina. Atti della Società Toscana di Scienze Naturali – Memorie Serie B. 1999; 106:131–140.
31. Viegi L, Pieroni A, Guarrera PM, Maccioni S. Piante usate in Italia in medicina veterinaria popolare. Annali della Facoltà di Medicina Veterinaria di Pisa. 2001; LIV:405–420.
32. Walzer PJ, Bernes G, Thamsborg SM, Sutura A, Richter SH, Ingebrigtsen K, Höglund J. Plants as de-worming agents of livestock in the Nordic countries: historical perspective, popular beliefs and prospects for the future. Acta Vet Scand. 2001; 42:31–44.
33. Viegi L, Pieroni A, Guarrera PM, Vangelisti R. A review of plants used in folk veterinary medicine in Italy as basis for a databank. J Ethnopharmacol. 2004; 89:221–244. doi: 10.1016/j.jep.2003.08.003.
34. Uncini Manganelli RE, Camangi R, Tomei PE. Curing animals with plants: traditional usage in Tuscany (Italy) J Ethnopharmacol. 2001; 78:171–191. doi: 10.1016/S0378-8741(01)00341-5.
35. Pieroni A, Howard P, Volpato G, Santoro RF. Natural remedies and nutraceuticals used in ethnoveterinary practices in inland southern Italy. Vet Res Commun. 2004; 28:55–80. doi: 10.1023/B:VERC.0000009535.96676.eb.
36. Alexiades NM, Sheldon JE., (Eds) Selected Guidelines for Ethnobotanical Research: A Field Manual. New York (USA): New York Botanical Garden; 1996.
37. Cotton C. Ethnobotany Principles and Applications. Chichester (UK): Wiley; 1996.
38. O'Reilly K. Ethnographic Methods. London (UK): Routldege; 2005.
39. Tutin TG., (Ed) Flora Europaea 1963–1984. Cambridge (UK): Cambridge University Press;

40. Pignatti S. Flora d'Italia. Bologna (Italy): Edizioni Ed agricole; 1982.
41. Valdés B, Talavera S, Fernández-Galiana E. Flora de Andalucía Occidental. Barcelona (Spain): Ketres Editora; 1987.
42. Paparisto K, Qosja X., (Eds) Flora e Shqipërisë/Flore de l'Albanie 1988–2000. 1–4. Tirana (Albania): Akademia e Shkecave e Republikes se Shqipërisë;
43. Meikle RD. Flora of Cyprus. 1–2. Kew (UK): Bentham-Moxon Trust; 1977.
44. Maire R. Flore de l'Afrique du Nord (Maroc, Algérie, Tunisie, Tripolitaine, Cyrénaïque et Sahara) 1952–1987. Vol. 16. Paris: P. Lechevalier;
45. Boulos L. Flora of Egypt 1999–2002. 1–3. Cairo (Egypt): Al Hadara Publishing;
46. Quézel P, Santa S. Nouvelle Flore de l'Algérie et des Régions Désertiques Méridionales 1962–1963. Paris: Éditions du Centre National de la Recherche Scientifique;
47. Fennane M, Ibn Tattou M, Mathez J, Ouyahyia A, El-Oualidi J. Flore Practique du Maroc 1 Pteridophyta, Gymnospermae, Angiospermae (Lauraceae-Neuradaceae) Rabat (Morocco): Institut Scientifique Série Botanique; 1999.
48. Moerman ED, Pemberton RW, Kiefer D, Berlin B. A comparative analysis of five medicinal flora. J Ethnobiol. 1999; 19:49–70.
49. Brett J, Heinrich M. Culture, perception, and the environments. J Appl Bot. 1998;72:67–69.
50. Leonti M, Sticher O, Heinrich M. Medicinal plants of the Popoluca, México: organoleptic properties as indigenous selection criteria. J Ethnopharmacol. 2002;81:307–315. doi: 10.1016/S0378-8741(02)00078-8.
51. Pieroni A, Nebel S, Quave C, Münz H, Heinrich M. Ethnopharmacology of *liakra*: traditional weedy vegetables of the Arbëreshë of the Vulture area in southern Italy. J Ethnopharmacol. 2002; 81:165–185. doi: 10.1016/S0378-8741(02)00052-1.
52. Sathiyamoorthy P, Lugasi-Evgi H, Van-Damme P, Abu-Rabia A, Gopas J, Golan-Goldhirsh A. Larvicidal activity in desert plants of the Negev and Bedouin market plant products. Int J Pharmacognosy. 1997; 35:265–273.
53. Pieroni A, Dibra B, Grishaj G, Grishaj I, Maçai SG. Traditional phytotherapy of the Albanians of Lepushe, Northern Albanians Alps. Fitoterapia. 2005; 76:379–399. doi: 10.1016/j.fitote.2005.03.015.
54. Molan AL, Waghorn CG, Min BR, McNabb WC. The effect of condensed tannins from seven herbages on *Trichostrongylus colubriformis* larval migration in vitro. Folia Parasitol. 2002; 47:39–44. doi: 10.1159/000048687.

55. Abad MJ, Bermelo P, Villar A, Palomino SS, Carrasco L. Antiviral activity of medicinal plant extracts. Phytother Res. 1997;11:198–202. doi: 10.1002/(SICI)1099-1573(199705)11:3<198::AID-PTR78>3.0.CO;2-L.
56. Bedoya LM, Sanchez-Palomino S, Abad MJ, Bermejo P, Alcami J. Anti-HIV activity of medicinal plant extracts. J Ethnopharmacol. 2001;77:113–116. doi: 10.1016/S0378-8741(01)00265-3.
57. Huffman MA. Self-medicative behaviour in the African great apes: an evolutionary perspective into the origins of human traditional medicine. BioScience. 2001; 51:651–661.
58. Huffman MA. Animal self-medication and ethno-medicine: exploration and exploitation of the medicinal properties of plants. Proc Nutr Soc. 2003;62:371–381. doi: 10.1079/PNS2003257.
59. Garber PA, Kitron US. Seed swallowing in tamarins: evidence of a curative function or enhanced foraging efficiency? Int J Primatol. 1997; 18:523–538. doi: 10.1023/A:1026359105653.
60. Krief S, Hladik CM, Haxaire C. Ethnomedicinal and bioactive properties of plants ingested by wild chimpanzees in Uganda. J Ethnopharmacol. 2005; 101:1–15. doi: 10.1016/j.jep.2005.03.024.