

Log in



REVIEW ARTICLE | VOLUME 245, P7-12, FEBRUARY 01, 2020

Natural products: Potential lead compounds for the treatment of endometriosis

Nikolaos Machairiotis • Sofia Vasilakaki • Paraskevi Kouroutou

Published: November 21, 2019 • DOI: <https://doi.org/10.1016/j.ejogrb.2019.11.001>

Check for updates

Coronavirus Resources

Selected articles published by Elsevier on **Novel Coronavirus (2019-nCoV)** are now freely available on [ScienceDirect](#), with further resources available at the [Elsevier Novel Coronavirus Information Center](#)

[Discover Resources](#)

Abstract

Objective

Medical plants have been used for centuries for the treatment of various disorders in humans and animals. The therapeutic properties of herbs and plants have been documented for years, giving rise to ethnobotany, and have been a source for the development of novel drugs. Natural products usually have more than one pharmaceutical effects, due to the fact that they interact with more than one biological targets. This property could be used for the efficient treatment of diseases with multiple putative physiopathologic mechanisms, such as endometriosis.

Study design

In the current study, we search the literature to find recent progress in the identification of compounds, which derived from plants and herbs and have therapeutic properties against endometriosis and its symptoms. The Scopus and PubMed databases were used to search for original articles, published between January 2018 and July 2019. The words “endometriosis”, “pain”, “treatment”, “medication” were used for the query.

Results and conclusion

Compounds derived from plants and herbs have demonstrated pharmaceutical activity in experiments, including animal models and human endometriotic samples. The experimental

evidence the therapeutic effect of several natural products against endometriosis. Given that most of them are already well known for their pharmaceutical properties, these compounds should be used as leads for the development of novel drugs for the treatment of endometriosis.

Keywords

[Natural products](#) • [Endometriosis](#) • [Pain](#) • [Inflammation](#)

To read this article in full you will need to make a payment

Purchase one-time access

Subscribe to *European Journal of Obstetrics and Gynecology and Reproductive Biology*

Already a print subscriber? [Claim online access](#)

Already an online subscriber? [Sign in](#)

Register: [Create an account](#)

Institutional Access: [Sign in to ScienceDirect](#)

Coronavirus Resources

Selected articles published by Elsevier on **Novel Coronavirus (2019-nCoV)** are now freely available on [ScienceDirect](#), with further resources available at the [Elsevier Novel Coronavirus Information Center](#)

[Discover Resources](#)

References

1. Wongsrichanalai C. • Pickard A.L. • Wernsdorfer W.H. • Meshnick S.R. **Epidemiology of drug-resistant malaria.** *Lancet Infect Dis.* 2002; **2**: 209-218

[View in Article](#) ^

[Scopus \(599\)](#) • [PubMed](#) • [Abstract](#) • [Full Text](#) • [Full Text PDF](#) • [Google Scholar](#)

2. O'Neill P.M. • Posner G.H.



medicinal chemistry perspective on artemisinin and related endoperoxides.



J Med Chem. 2004; **47**: 2945-2964

[View in Article](#) ^

[Scopus \(442\)](#) • [PubMed](#) • [Crossref](#) • [Google Scholar](#)

3. Cragg G.M. • Kingston D.G. • Newman D.J.

Anticancer agents from natural products.

Taylor and Francis CRC press, 2011

[View in Article](#) ^

[Crossref](#) • [Google Scholar](#)

4. Newman D.J. • Cragg G.M.

Natural products as sources of new drugs over the 30 ye

J Nat Prod. 2012; **75**: 311-335

[View in Article](#) ^

[Scopus \(1926\)](#) • [PubMed](#) • [Crossref](#) • [Google Scholar](#)

5. Chen J. • Li W. • Yao H. • Xu J.

Insights into drug discovery from natural products through structural modification.

Fitoterapia. 2015; **103**: 231-241

[View in Article](#) ^

[Scopus \(47\)](#) • [PubMed](#) • [Crossref](#) • [Google Scholar](#)

6. Guo Z.

The modification of natural products for medical use.

Acta Pharm Sin B. 2017; **7**: 119-136

[View in Article](#) ^

[Scopus \(67\)](#) • [PubMed](#) • [Crossref](#) • [Google Scholar](#)

7. Khan R.A.

Natural products chemistry: the emerging trends and prospective goals.

Saudi Pharm J. 2018; **26**: 739-753

Coronavirus Resources

Selected articles published by Elsevier on **Novel Coronavirus (2019-nCoV)** are now freely available on [ScienceDirect](#), with further resources available at the [Elsevier Novel Coronavirus Information Center](#)

[Discover Resources](#)



[View in Article](#) ^



[Scopus \(15\)](#) • [PubMed](#) • [Crossref](#) • [Google Scholar](#)

8. Zhang Q.-W. • Lin L.-G. • Ye W.-C.

Techniques for extraction and isolation of natural products: a comprehensive review.

Chin Med. 2018; **13**: 20

[View in Article](#) ^

[Scopus \(49\)](#) • [PubMed](#) • [Crossref](#) • [Google Scholar](#)

9. Skroza D. • Mekini I.G. • Svilovi S. • Šimat V. • Katalinić M.

Investigation of the potential synergistic effect of resveratrol and curcumin on the growth of endometrial cancer cells.

compounds: a case of binary phenolic mixtures.

J Food Compos Anal. 2015; **38**: 13-18

[View in Article](#) ^

[Scopus \(36\)](#) • [Crossref](#) • [Google Scholar](#)

10. Klemmt P.A. • Starzinski-Powitz A.

Molecular and cellular pathogenesis of endometriosis.

Curr Wom Health Rev. 2018; **14**: 106-116

[View in Article](#) ^

[Scopus \(26\)](#) • [PubMed](#) • [Crossref](#) • [Google Scholar](#)

11. Kunnumakkara A.B. • Bordoloi D. • Padmavathi G. • Monisha J. • Roy N.K. •

Prasad S. • et al.

Curcumin, the golden nutraceutical: multitargeting for multiple chronic diseases.

Br J Pharmacol. 2017; **174**: 1325-1348

[View in Article](#) ^

[Scopus \(219\)](#) • [PubMed](#) • [Crossref](#) • [Google Scholar](#)

12. Prasad S. • Gupta S.C. • Tyagi A.K. • Aggarwal B.B.

Curcumin, a component of golden spice: from bedside to bench and back.

Biotechnol Adv. 2014; **32**: 1053-1064

[View in Article](#) ^



[Scopus \(334\)](#) • [PubMed](#) • [Crossref](#) • [Google Scholar](#)

Coronavirus Resources

Selected articles published by Elsevier on **Novel Coronavirus (2019-nCoV)** are now freely available on [ScienceDirect](#), with further resources available at the [Elsevier Novel Coronavirus Information Center](#)

[Discover Resources](#)

13. Ayubi M. • Karimi M. • Abdpour S. • Rostamizadeh K. • Parsa M. • Zamani M. • et al.

Magnetic nanoparticles decorated with PEGylated curcumin as dual targeted drug delivery: synthesis, toxicity and biocompatibility study.

Mater Sci Eng C. 2019; 109810

[View in Article](#) ^

[Scopus \(12\)](#) • [PubMed](#) • [Crossref](#) • [Google Scholar](#)

14. Li D. • Shi M. • Bao C. • Bao W. • Zhang L. • Jiao L. • et al.

Synergistically enhanced anticancer effect of codelivered stimuli-responsive α -lactalbumin nanospheres.

Nanomedicine. 2019; **14**: 595-612

[View in Article](#) ^

[Scopus \(2\)](#) • [PubMed](#) • [Crossref](#) • [Google Scholar](#)

15. Ni W. • Li Z. • Liu Z. • Ji Y. • Wu L. • Sun S. • et al.

Dual-targeting nanoparticles: codelivery of curcumin and synergistic treatment of hepatocarcinoma.

J Pharm Sci. 2019; **108**: 1284-1295

[View in Article](#) ^

[Scopus \(14\)](#) • [PubMed](#) • [Abstract](#) • [Full Text](#) • [Full Text PDF](#) • [Google Scholar](#)

16. Pal K. • Roy S. • Parida P.K. • Dutta A. • Bardhan S. • Das S. • et al.

Folic acid conjugated curcumin loaded biopolymeric gum acacia microsphere for triple negative breast cancer therapy in invitro and invivo model.

Mater Sci Eng C. 2019; **95**: 204-216

[View in Article](#) ^

[Scopus \(12\)](#) • [PubMed](#) • [Crossref](#) • [Google Scholar](#)

17. Schiavi M.C. • Porpora M.G. • Vena F. • Prata G. • Sciuga V. • D'Oria O. • et al.

Orally administered combination of hyaluronic acid, chondroitin sulfate, curcumin, and quercetin in the prevention of postcoital recurrent urinary tract infections: alysis of 98 women in reproductive age after 6 months of treatment.

 *male Pel Vic Med Re*. 2019; **25**: 309-312

Coronavirus Resources

Selected articles published by Elsevier on **Novel Coronavirus (2019-nCoV)** are now freely available on [ScienceDirect](#), with further resources available at the [Elsevier Novel Coronavirus Information Center](#)

[Discover Resources](#)

[View in Article](#) ^[Scopus \(3\)](#) • [PubMed](#) • [Crossref](#) • [Google Scholar](#)

18. Martnez N. • Herrera M. • Frás L. • Provencio M. • Pérez-Carrión R. • Daz V. • et al.
A combination of hydroxytyrosol, omega-3 fatty acids and curcumin improves pain and inflammation among early stage breast cancer patients receiving adjuvant hormonal therapy: results of a pilot study.
Clin Transl Oncol. 2019; **21**: 489-498

[View in Article](#) ^[Scopus \(9\)](#) • [PubMed](#) • [Crossref](#) • [Google Scholar](#)

19. Momtazi-Borojeni A.A. • Mosafer J. • Nikfar B. • Ekhlasi
 Chaichian S. • Mehdizadehkashi A. • et al.
Curcumin in advancing treatment for gynecological cancer radiotherapy-associated resistance.
Rev Physiol Biochem Pharmacol. 2018; **176** (Springer): 107-

[View in Article](#) ^[Scopus \(7\)](#) • [Crossref](#) • [Google Scholar](#)

20. Song X. • Zhang M. • Dai E. • Luo Y.
Molecular targets of curcumin in breast cancer.
Mol Med Rep. 2019; **19**: 23-29

[View in Article](#) ^[PubMed](#) • [Google Scholar](#)

21. Arablou T. • Kolahehdouz-Mohammadi R.
Curcumin and endometriosis: Review on potential roles and molecular mechanisms.
Biomed Pharmacother. 2018; **97**: 91-97

[View in Article](#) ^[Scopus \(26\)](#) • [PubMed](#) • [Crossref](#) • [Google Scholar](#)

22. Chowdhury I. • Banerjee S. • Driss A. • Xu W. • Mehrabi S. • Nezhat C. • et al.
Curcumin attenuates proangiogenic and proinflammatory factors in human eutopic endometrial stromal cells through the NF-κB signaling pathway.

Coronavirus Resources

Selected articles published by Elsevier on **Novel Coronavirus (2019-nCoV)** are now freely available on [ScienceDirect](#), with further resources available at the [Elsevier Novel Coronavirus Information Center](#)

[Discover Resources](#)

J Cell Physiol. 2019; **234**: 6298-6312

[View in Article](#) ^

[Scopus \(8\)](#) • [PubMed](#) • [Crossref](#) • [Google Scholar](#)

23. Kim K.-H. • Lee E.N. • Park J.K. • Lee J.-R. • Kim J.-H. • Choi H.-J. • et al.
Curcumin attenuates TNF- α -induced expression of intercellular adhesion molecule-1, vascular cell adhesion molecule-1 and proinflammatory cytokines in human endometriotic stromal cells.

Phytother Res. 2012; **26**: 1037-1047

[View in Article](#) ^

[Scopus \(55\)](#) • [PubMed](#) • [Crossref](#) • [Google Scholar](#)

24. Wang H.-P. • Zhang Y.-B. • Yang X.-W. • Zhao D.-Q. •
Rapid characterization of ginsenosides in the roots and by UPLC-DAD-QTOF-MS/MS and simultaneous determination by HPLC-ESI-MS.

JGR. 2016; **40**: 382-394

[View in Article](#) ^

[Google Scholar](#)

25. Ma L.-Y. • Zhou Q.-L. • Yang X.-W.
New SIRT1 activator from alkaline hydrolysate of total saponins in the stems-leaves of *Panax ginseng*.

Bioorg Med Chem Lett. 2015; **25**: 5321-5325

[View in Article](#) ^

[Scopus \(22\)](#) • [PubMed](#) • [Crossref](#) • [Google Scholar](#)

26. Bi Y.-F. • Wang X.-Z. • Jiang S. • Liu J.-S. • Zheng M.-Z. • Chen P.
Enzymatic transformation of ginsenosides Re, Rg1, and Rf to ginsenosides Rg2 and aglycon PPT by using β -glucosidase from *Thermotoga neapolitana*.

Biotechnol Lett. 2019; **41**: 613-623

[View in Article](#) ^

 [opus \(1\)](#) • [PubMed](#) • [Crossref](#) • [Google Scholar](#)

Coronavirus Resources

Selected articles published by Elsevier on **Novel Coronavirus (2019-nCoV)** are now freely available on [ScienceDirect](#), with further resources available at the [Elsevier Novel Coronavirus Information Center](#)

[Discover Resources](#)

27. Zhang L. • Wang S. • Qu B. • Chi H. • Quan Y. • Wu X.

Efficient separation determination of protopanaxatriol ginsenosides Rg1, Re, Rf, Rh1, Rg2 by HPLC.

J Pharm Biomed Anal. 2019; **170**: 48-53

[View in Article](#) ^

[Scopus \(2\)](#) • [PubMed](#) • [Crossref](#) • [Google Scholar](#)

28. Li Y. • Chen C. • Li S. • Jiang C.

Ginsenoside Rf relieves mechanical hypersensitivity, de
inflammatory reactions in chronic constriction injury rat

Phytother Res. 2019; **33**: 1095-1103

[View in Article](#) ^

[Scopus \(4\)](#) • [PubMed](#) • [Crossref](#) • [Google Scholar](#)

29. Qin X. • Liu Y. • Feng Y. • Jiang J.

Ginsenoside Rf alleviates dysmenorrhea and inflammatio
CREB pathway in a rat model of endometriosis.

Food & Function. 2019; **10**: 244-249

[View in Article](#) ^

[PubMed](#) • [Crossref](#) • [Google Scholar](#)

30. Yu J. • Francisco A.M. • Patel B.G. • Cline J.M. • Zou E. • Berga S.L. • et al.

IL-1 β stimulates brain-derived neurotrophic factor production in eutopic
endometriosis stromal cell cultures: a model for cytokine regulation of
neuroangiogenesis.

Am J Pathol. 2018; **188**: 2281-2292

[View in Article](#) ^

[Scopus \(9\)](#) • [PubMed](#) • [Abstract](#) • [Full Text](#) • [Full Text PDF](#) • [Google Scholar](#)

31. Park K.S.

The efficacy and safety of Korean herbal medicine in a patient with endometrioma of
the ovary: a case report.

plore. 2019; **15**: 142-147

Coronavirus Resources

Selected articles published by Elsevier on **Novel Coronavirus (2019-nCoV)** are now freely available on [ScienceDirect](#), with further resources available at the [Elsevier Novel Coronavirus Information Center](#)

[Discover Resources](#)



[View in Article](#) ^[Scopus \(1\)](#) • [PubMed](#) • [Crossref](#) • [Google Scholar](#)

32. WHO

Western Pacific region of the World Health Organization. WHO international standard terminologies on traditional medicine in the western pacific region.

World Health Organization, 2007: 186

[View in Article](#) ^[Google Scholar](#)

33. Jeong S.-J. • Lim H.-S. • Seo C.-S. • Jin S.-E. • Yoo S.

Anti-inflammatory actions of herbal formula Gyejibokrye inhibiting chemokine production and STAT1 activation in

Biol Pharm Bull. 2015; **38**: 425-434

[View in Article](#) ^[Scopus \(19\)](#) • [PubMed](#) • [Crossref](#) • [Google Scholar](#)

Coronavirus Resources

Selected articles published by Elsevier on **Novel Coronavirus (2019-nCoV)** are now freely available on [ScienceDirect](#), with further resources available at the [Elsevier Novel Coronavirus Information Center](#)

[Discover Resources](#)

34. Yao Z. • Shulan Z.

Inhibition effect of Guizhi-Fuling-decoction on the invasion of human cervical cancer.

J Ethnopharmacol. 2008; **120**: 25-35

[View in Article](#) ^[Scopus \(32\)](#) • [PubMed](#) • [Crossref](#) • [Google Scholar](#)

35. Choi K.-H. • Park C.-S.

An analysis of the Gongjindan's ingredients and its efficacy on anti-oxidation.

Korea J Herbol. 2007; **22**: 51-63

[View in Article](#) ^[Google Scholar](#)

36. Kim H.-J. • Hwang S.-Y. • Mok J.-Y. • Hwang B.-S. • Jeong S.-I. • Jang S.-I.

Gagam-Gongjin-dan extract attenuates immune responses to ovalbumin in Balb/c Mice.

Korea J Herbol. 2009; **24**: 127-135



[View in Article](#) ^[Crossref](#) • [Google Scholar](#)

37. Shim K.-S. • Ma C.J. • Kim D.-S. • Ma J.Y.

Yukmijihwang-tang inhibits receptor activator for nuclear factor- κ B ligand-induced osteoclast differentiation.

J Med Food. 2011; **14**: 1439-1447

[View in Article](#) ^[Scopus \(11\)](#) • [PubMed](#) • [Crossref](#) • [Google Scholar](#)

38. De V.L. • Cagnacci A. • Cappelli V. • Biasioli A. • Leone

Role of a natural integrator based on lipoic acid, palmito the treatment of chronic pelvic pain and endometriosis.

Minerva Ginecol. 2019; **71**: 191-195

[View in Article](#) ^[PubMed](#) • [Google Scholar](#)

Coronavirus Resources

Selected articles published by Elsevier on **Novel Coronavirus (2019-nCoV)** are now freely available on [ScienceDirect](#), with further resources available at the [Elsevier Novel Coronavirus Information Center](#)

[Discover Resources](#)

39. Couch D.G. • Cook H. • Ortori C. • Barrett D. • Lund J.N. • O'Sullivan S.E.

Palmitoylethanolamide and cannabidiol prevent inflammation-induced hyperpermeability of the human gut in vitro and in vivo—A randomized, placebo-controlled, double-blind controlled trial.

Inflamm Bowel Dis. 2019; **25**: 1006-1018

[View in Article](#) ^[Scopus \(4\)](#) • [PubMed](#) • [Crossref](#) • [Google Scholar](#)

40. Di Tucci C. • Di Felicianantonio M. • Vena F. • Capone C. • Schiavi M.C. •

Pietrangeli D. • et al.

Alpha lipoic acid in obstetrics and gynecology.

Gynecol Endocrinol. 2018; **34**: 729-733

[View in Article](#) ^[Scopus \(10\)](#) • [PubMed](#) • [Crossref](#) • [Google Scholar](#)

ihid T.M. • Alblowi J.A.



Anti-Inflammatory and anti-plaque effects of commiphora myrrh mouthwash: a preliminary pilot clinical study.

Open Dent J. 2019; : 13

[View in Article](#) ^

[Google Scholar](#)

42. Lete I. • Mendoza N. • de la Viuda E. • Carmona F.

Effectiveness of an antioxidant preparation with N-acetyl cysteine, alpha lipoic acid and bromelain in the treatment of endometriosis-associated pain: a randomized controlled trial.

Eur J Obstet Gynecol Reprod Biol. 2018; **228**: 221-224

[View in Article](#) ^

[Scopus \(4\)](#) • [PubMed](#) • [Abstract](#) • [Full Text](#) • [Full Text PDF](#) •

43. Mosher A. • Tsoulis M. • Lim J. • Tan C. • Agarwal S. •

Melatonin activity and receptor expression in endometriosis: a pilot study.

Hum Reprod. 2019; **34**: 1215-1224

[View in Article](#) ^

[Scopus \(5\)](#) • [PubMed](#) • [Crossref](#) • [Google Scholar](#)

44. Yilmaz B. • Kilic S. • Aksakal O. • Ertas I.E. • Tanrisever G.G. • Aksoy Y. • et al.

Melatonin causes regression of endometriotic implants in rats by modulating angiogenesis, tissue levels of antioxidants and matrix metalloproteinases.

Arch Gynecol Obstet. 2015; **292**: 209-216

[View in Article](#) ^

[Scopus \(13\)](#) • [PubMed](#) • [Crossref](#) • [Google Scholar](#)

45. Schwertner A. • Dos Santos C.C.C. • Costa G.D. • Deitos A. • de Souza A. • de Souza I.C.C. • et al.

Efficacy of melatonin in the treatment of endometriosis: a phase II, randomized, double-blind, placebo-controlled trial.

PAIN. 2013; **154**: 874-881

[View in Article](#) ^

 [opus \(59\)](#) • [PubMed](#) • [Abstract](#) • [Full Text](#) • [Full Text PDF](#) • [Google Scholar](#)

Coronavirus Resources

Selected articles published by Elsevier on **Novel Coronavirus (2019-nCoV)** are now freely available on [ScienceDirect](#), with further resources available at the [Elsevier Novel Coronavirus Information Center](#)

[Discover Resources](#)

46. Qi S. • Yan L. • Liu Z. • Mu Y. • Li M. • Zhao X. • et al.

Melatonin inhibits 17 β -estradiol-induced migration, invasion and epithelial-mesenchymal transition in normal and endometriotic endometrial epithelial cells.

Reprod Biol Endocrinol. 2018; **16**: 62

[View in Article](#) 

[Scopus \(5\)](#) • [PubMed](#) • [Crossref](#) • [Google Scholar](#)

47. Ruiz-Sanz J.-I. • Pérez-Ruiz I. • Meijide S. • Ferrando M. • Larreategui Z. • Ruiz-Larrea M.-B.

Lower follicular n-3 polyunsaturated fatty acid levels are response to ovarian stimulation.

J Assist Reprod Genet. 2019; **36**: 473-482

[View in Article](#) 

[Scopus \(4\)](#) • [PubMed](#) • [Crossref](#) • [Google Scholar](#)

48. Silva T. • Jesus M. • Cagigal C. • Silva C.

Food with influence in the sexual and reproductive health

Curr Pharm Biotechnol. 2019; **20**: 114-122

[View in Article](#) 

[Scopus \(1\)](#) • [PubMed](#) • [Crossref](#) • [Google Scholar](#)

49. Pereira F.E.X.G. • das Medeiros F.C. • Rocha H.A.L. • da Silva K.S.

Effects of omega-6/3 and omega-9/6 nutraceuticals on pain and fertility in peritoneal endometriosis in rats.

Acta Cir Bras. 2019; : 34

[View in Article](#) 

[Google Scholar](#)

50. Wang N. • Yang Z. • Yang S.

Review on the development of Herba Erigerontis Yunnan.

J Tradit Chin Med Mater Med. 2012; **33**: 69-72

[View in Article](#) 

Coronavirus Resources

Selected articles published by Elsevier on **Novel Coronavirus (2019-nCoV)** are now freely available on [ScienceDirect](#), with further resources available at the [Elsevier Novel Coronavirus Information Center](#)

[Discover Resources](#)



[Google Scholar](#)



51. Gao J. • Chen G. • He H. • Liu C. • Xiong X. • Li J. • et al.

Therapeutic effects of breviscapine in cardiovascular diseases: a review.

Front Pharmacol. 2017; **8**: 289

[View in Article](#) ^

[Scopus \(31\)](#) • [PubMed](#) • [Crossref](#) • [Google Scholar](#)

52. Liu X. • Yao L. • Sun D. • Zhu X. • Liu Q. • Xu T. • et al.

Effect of breviscapine injection on clinical parameters in diabetic nephropathy: a meta-analysis of randomized controlled trials.

Exp Ther Med. 2016; **12**: 1383-1397

[View in Article](#) ^

[Scopus \(9\)](#) • [PubMed](#) • [Crossref](#) • [Google Scholar](#)

53. Wang J. • Tan J. • Luo J. • Huang P. • Zhou W. • Chen

Enhancement of scutellarin oral delivery efficacy by vital chitosan derivatives to treat type II diabetes induced-reti

J Nanobiotechnol. 2017; **15**: 18

[View in Article](#) ^

[Scopus \(25\)](#) • [PubMed](#) • [Crossref](#) • [Google Scholar](#)

54. Yuan Y. • Fang M. • Wu C.-Y. • Ling E.-A.

Scutellarin as a potential therapeutic agent for microglia-mediated neuroinflammation in cerebral ischemia.

Neuromolecular Med. 2016; **18**: 264-273

[View in Article](#) ^


[Scopus \(27\)](#) • [PubMed](#) • [Crossref](#) • [Google Scholar](#)

55. Ding D. • Cai X. • Zheng H. • Guo S.-W. • Liu X.

Scutellarin suppresses platelet aggregation and stalls lesional progression in mouse with induced endometriosis.

Reprod Sci. 2018; 1933719118817661

[View in Article](#) ^

 [opus \(3\)](#) • [Crossref](#) • [Google Scholar](#)

Coronavirus Resources

Selected articles published by Elsevier on **Novel Coronavirus (2019-nCoV)** are now freely available on [ScienceDirect](#), with further resources available at the [Elsevier Novel Coronavirus Information Center](#)

[Discover Resources](#)

56. Liakopoulou-Kyriakides M. • Kyriakidis D.

Croscus sativus-biological active constituents. Studies in natural products chemistry. vol. 26. Elsevier, 2002: 293-312

[View in Article](#) ^

[Google Scholar](#)

57. Pashirzad M. • Shafiee M. • Avan A. • Ryzhikov M. • Fiuji H. • Bahreyni A. • et al.
Therapeutic potency of crocin in the treatment of inflammatory diseases: current status and perspective.

J Cell Physiol. 2019;

[View in Article](#) ^

[Scopus \(3\)](#) • [Crossref](#) • [Google Scholar](#)

58. Kalantar M. • Kalantari H. • Goudarzi M. • Khorsandi L
Crocin ameliorates methotrexate-induced liver injury via and inflammation in rats.

Pharmacol Rep. 2019; **71**: 746-752

[View in Article](#) ^

[Scopus \(8\)](#) • [PubMed](#) • [Crossref](#) • [Google Scholar](#)

59. Zhou Y. • Xu Q. • Shang J. • Lu L. • Chen G.
Crocin inhibits the migration, invasion, and epithelial-mesenchymal transition of gastric cancer cells via miR-320/KLF5/HIF-1 α signaling.

J Cell Physiol. 2019; **234**: 17876-17885

[View in Article](#) ^

[Scopus \(10\)](#) • [PubMed](#) • [Crossref](#) • [Google Scholar](#)

60. Liu Y. • Qin X. • Lu X.
Crocin improves endometriosis by inhibiting cell proliferation and the release of inflammatory factors.

Biomed Pharmacother. 2018; **106**: 1678-1685

[View in Article](#) ^

 [opus \(6\)](#) • [PubMed](#) • [Crossref](#) • [Google Scholar](#)

Coronavirus Resources

Selected articles published by Elsevier on **Novel Coronavirus (2019-nCoV)** are now freely available on [ScienceDirect](#), with further resources available at the [Elsevier Novel Coronavirus Information Center](#)

[Discover Resources](#)

61. Chen C.-Y. • Liu T.-Z. • Liu Y.-W. • Tseng W.-C. • Liu R.H. • Lu F.-J. • et al.
6-shogaol (alkanone from ginger) induces apoptotic cell death of human hepatoma p53 mutant Mahlavu subline via an oxidative stress-mediated caspase-dependent mechanism.

J Agric Food Chem. 2007; **55**: 948-954

[View in Article](#) ^

[Scopus \(97\)](#) • [PubMed](#) • [Crossref](#) • [Google Scholar](#)

62. Kou X. • Wang X. • Ji R. • Liu L. • Qiao Y. • Lou Z. • et al.
Occurrence, biological activity and metabolism of 6-shogaol in ginger.
Food & Function. 2018; **9**: 1310-1327

[View in Article](#) ^

[PubMed](#) • [Crossref](#) • [Google Scholar](#)

63. Choi J.G. • Kim S.Y. • Jeong M. • Oh M.S.
Pharmacotherapeutic potential of ginger and its compounds in neurological disorders.

Pharmacol Ther. 2018; **182**: 56-69

[View in Article](#) ^

[Scopus \(25\)](#) • [PubMed](#) • [Crossref](#) • [Google Scholar](#)

64. Sapkota A. • Park S.J. • Choi J.W.
Neuroprotective effects of 6-shogaol and its metabolite, 6-paradol, in a mouse model of multiple sclerosis.

Biomol Ther. 2019; **27**: 152

[View in Article](#) ^

[Scopus \(1\)](#) • [PubMed](#) • [Crossref](#) • [Google Scholar](#)

65. Nazim U.M. • Park S.-Y.
Attenuation of autophagy flux by 6-shogaol sensitizes human liver cancer cells to TRAIL-induced apoptosis via p53 and ROS.

Int J Mol Med. 2019; **43**: 701-708

Coronavirus Resources

Selected articles published by Elsevier on **Novel Coronavirus (2019-nCoV)** are now freely available on [ScienceDirect](#), with further resources available at the [Elsevier Novel Coronavirus Information Center](#)

[Discover Resources](#)

[PubMed](#) • [Google Scholar](#)

66. Chen F. • Tang Y. • Sun Y. • Veeraraghavan V.P. • Mohan S.K. • Cui C.
6-shogaol, a active constituents of ginger prevents UVB radiation mediated inflammation and oxidative stress through modulating Nrf2 signaling in human epidermal keratinocytes (HaCaT cells).

J Photochem Photobiol B. 2019; 111518

[View in Article](#) ^

[Scopus \(4\)](#) • [PubMed](#) • [Crossref](#) • [Google Scholar](#)

67. Wang D. • Jiang Y. • Yang X. • Wei Q. • Wang H.
6-Shogaol reduces progression of experimental endometriosis through regulation of VEGF and inhibition of COX-2 and PGE2-mediated inflammatory responses.

Korean J Physiol Pharmacol. 2018; **22**: 627-636

[View in Article](#) ^

[Scopus \(3\)](#) • [PubMed](#) • [Crossref](#) • [Google Scholar](#)

68. Andrade J. • Mandarino J. • Kurozawa L. • Ida E.
The effect of thermal treatment of whole soybean flour on the conversion of isoflavones and inactivation of trypsin inhibitors.

Food Chem. 2016; **194**: 1095-1101

[View in Article](#) ^

[Scopus \(32\)](#) • [PubMed](#) • [Crossref](#) • [Google Scholar](#)

69. Alivandi Farkhad S. • Khazali H.
Therapeutic effects of isoflavone-aglycone fraction from soybean (*Glycine max* L. Merrill) in rats with estradiol valerate-induced polycystic ovary syndrome as an inflammatory state.

Gynecol Endocrinol. 2019; : 1-6

[View in Article](#) ^

[Google Scholar](#)

Coronavirus Resources

Selected articles published by Elsevier on **Novel Coronavirus (2019-nCoV)** are now freely available on [ScienceDirect](#), with further resources available at the [Elsevier Novel Coronavirus Information Center](#)

[Discover Resources](#)



Mostowski R. • yelewicz D. • et al.

Evaluation of estrogenic activity of red clover (*Trifolium pratense* L.) sprouts cultivated under different conditions by content of isoflavones, calorimetric study and molecular modelling.

Food Chem. 2018; **245**: 324-336

[View in Article](#) ^

[Scopus \(17\)](#) • [PubMed](#) • [Crossref](#) • [Google Scholar](#)

71. Ribeiro A.E. • Monteiro N.E.S. • de Moraes A.V.G. • Costa Paiva L.H. • Pedro A.O.

Can the use of probiotics in association with isoflavone genitourinary syndrome of menopause? Results from a

Menopause. 2019; **26**: 643-652

[View in Article](#) ^

[Scopus \(2\)](#) • [Crossref](#) • [Google Scholar](#)

72. Takaoka O. • Mori T. • Ito F. • Okimura H. • Kataoka H.

Daidzein-rich isoflavone aglycones inhibit cell growth and endometriosis.

J Steroid Biochem Mol Biol. 2018; **181**: 125-132

[View in Article](#) ^

[Scopus \(10\)](#) • [PubMed](#) • [Crossref](#) • [Google Scholar](#)

73. Khaodh L. • Ricciotti H.A. • Li L. • Pan W. • Schickel M. • Zhou J. • et al.

Daidzein-rich isoflavone aglycones are potentially effective in reducing hot flashes in menopausal women.

Menopause (New York, NY). 2008; **15**: 125

[View in Article](#) ^

[PubMed](#) • [Google Scholar](#)

74. Ricciotti H. • Khaodh L. • Blackburn G.

Daidzein-rich isoflavone-aglycones for menopausal symptoms.

Int J Gynecol Obstet. 2005; **89**: 65-66

[View in Article](#) ^

[Scopus \(9\)](#) • [PubMed](#) • [Crossref](#) • [Google Scholar](#)

Coronavirus Resources

Selected articles published by Elsevier on **Novel Coronavirus (2019-nCoV)** are now freely available on [ScienceDirect](#), with further resources available at the [Elsevier Novel Coronavirus Information Center](#)

[Discover Resources](#)

75. ClinicalTrials.gov

Effects of soy isoflavones on menopausal hot flashes.

2019 (ClinicalTrials.gov Identifier: NCT00179556. ClinicalTrials.gov Identifier: NCT00179556; n.d.)

[View in Article](#) ^[Google Scholar](#)

76. Chen C. • Zheng H. • Qi S.

Genistein and silicon synergistically protects against ovulation through upregulating OPG/RANKL ratio.

Biol Trace Elem Res. 2019; **188**: 441-450

[View in Article](#) ^[Scopus \(6\)](#) • [PubMed](#) • [Crossref](#) • [Google Scholar](#)

77. Usategui-Martín R. • Pérez-Alonso M. • Socorro-Briongos De Luis D. • Linares L. • et al.

Estrogen receptor genes polymorphisms determine serum estradiol levels in postmenopausal women treated with calcium, vitamin D, and genistein.

J Cell Biochem. 2019; **120**: 13115-13120

[View in Article](#) ^[Scopus \(2\)](#) • [PubMed](#) • [Crossref](#) • [Google Scholar](#)

78. Frandsen J.R. • Narayanasamy P.

Neuroprotection through flavonoid: enhancement of the glyoxalase pathway.

Redoxbiology. 2018; **14**: 465-473

[View in Article](#) ^[Google Scholar](#)

79. Wang Y. • Xia Z. • Jiang X. • Li L. • An D. • Wang H. • et al.

Genistein inhibits A β 25–35-induced neuronal death with changes in the electrophysiological properties of voltage-gated sodium and potassium channels.

Cell Mol Neurobiol. 2019; : 1-14

Coronavirus Resources

Selected articles published by Elsevier on **Novel Coronavirus (2019-nCoV)** are now freely available on [ScienceDirect](#), with further resources available at the [Elsevier Novel Coronavirus Information Center](#)

[Discover Resources](#)

[PubMed](#) • [Google Scholar](#)

80. Wang K. • Hu S. • Wang B. • Wang J. • Wang X. • Xu C.
Genistein protects intervertebral discs from degeneration via Nrf2-mediated antioxidant defense system: an in vitro and in vivo study.

J Cell Physiol. 2019; **234**: 16348-16356

[View in Article](#) ^

[Scopus \(3\)](#) • [Crossref](#) • [Google Scholar](#)

81. Zhang L. • Gao M. • Zhang T. • Chong T. • Wang Z. • Z
**Protective effects of genistein against mono-(2-ethylhexy
oxidative damage in prepubertal sertoli cells.**

Biomed Res Int. 2017; **2017**

[View in Article](#) ^

[Scopus \(10\)](#) • [Crossref](#) • [Google Scholar](#)

82. Chen Y. • Du Q. • Le T.H. • Zhao Z. • Liu Y. • Zou J. • e
Genistein protects against DSS-induced colitis by inhibiting NLRP3 inflammasome via TGR5-cAMP signaling.

Int Immunopharmacol. 2019; **71**: 144-154

[View in Article](#) ^

[Scopus \(3\)](#) • [PubMed](#) • [Crossref](#) • [Google Scholar](#)

83. Yoo N. • Jeon S. • Nam Y. • Park Y.-J. • Won S.B. • Kwon Y.H.
Dietary supplementation of genistein alleviates liver inflammation and fibrosis mediated by a methionine-choline-deficient diet in db/db mice.

J Agric Food Chem. 2015; **63**: 4305-4311

[View in Article](#) ^

[Scopus \(20\)](#) • [PubMed](#) • [Crossref](#) • [Google Scholar](#)

84. Li S. • Li J. • Dai W. • Zhang Q. • Feng J. • Wu L. • et al.
**Genistein suppresses aerobic glycolysis and induces hepatocellular carcinoma cell
ath.**

J Cancer. 2017; **117**: 1518

Coronavirus Resources

Selected articles published by Elsevier on **Novel Coronavirus (2019-nCoV)** are now freely available on [ScienceDirect](#), with further resources available at the [Elsevier Novel Coronavirus Information Center](#)

[Discover Resources](#)



[View in Article](#) ^[Scopus \(37\)](#) • [PubMed](#) • [Crossref](#) • [Google Scholar](#)

85. Chen F.-P. • Chien M.-H.

Effects of phytoestrogens on the activity and growth of primary breast cancer cells ex vivo.

J Obstet Gynaecol Res. 2019; **45**: 1352-1362

[View in Article](#) ^[Scopus \(2\)](#) • [PubMed](#) • [Crossref](#) • [Google Scholar](#)

86. Sutrisno S. • Aprina H. • Simanungkalit H.M. • Andriya
Sujuti H. • et al.

Genistein modulates the estrogen receptor and suppresses inflammation in the murine model of peritoneal endometriosis.

J Tradit Complement Med. 2018; **8**: 278-281

[View in Article](#) ^[Scopus \(11\)](#) • [PubMed](#) • [Crossref](#) • [Google Scholar](#)

Coronavirus Resources

Selected articles published by Elsevier on **Novel Coronavirus (2019-nCoV)** are now freely available on [ScienceDirect](#), with further resources available at the [Elsevier Novel Coronavirus Information Center](#)

[Discover Resources](#)

87. Cermisoni G. • Alteri A. • Corti L. • Rabellotti E. • Papaleo E. • Viganò P. • et al.

Vitamin D and endometrium: a systematic review of a neglected area of research.

Int J Mol Sci. 2018; **19**: 2320

[View in Article](#) ^[Scopus \(6\)](#) • [Crossref](#) • [Google Scholar](#)

88. Dull A.-M. • Moga M.A. • Dimienescu O.G. • Sechel G. • Burtea V. • Anastasiu C.V.

Therapeutic approaches of resveratrol on endometriosis via anti-inflammatory and anti-angiogenic pathways.

Molecules. 2019; **24**: 667

[View in Article](#) ^[Scopus \(9\)](#) • [Crossref](#) • [Google Scholar](#)

le Info



Publication History

Published online: November 21, 2019

Accepted: November 20, 2019

Received in revised form: November 18, 2019

Received: July 31, 2019

Identification

DOI: <https://doi.org/10.1016/j.ejogrb.2019.11.019>

Copyright

© 2019 Elsevier B.V. All rights reserved.

ScienceDirect

[Access this article on ScienceDirect](#)

Related Articles

[Efficacy of ginger on intraoperative and postoperative nausea and vomiting in section patients](#)

European Journal of Obstetrics and Gynecology and Reproductive Biology, Vol. 169, Issue 2

[In Brief](#) • [Full-Text](#) • [PDF](#)

[Ginger treatment of hyperemesis gravidarum](#)

European Journal of Obstetrics & Gynecology, Vol. 38, Issue 1

[In Brief](#) • [Full-Text](#) • [PDF](#)

[Honokiol, a natural therapeutic candidate, induces apoptosis and inhibits angiogenesis of ovarian tumor cells](#)

European Journal of Obstetrics and Gynecology and Reproductive Biology, Vol. 140, Issue 1

[In Brief](#) • [Full-Text](#) • [PDF](#)

[Histone deacetylase inhibitors trichostatin A and valproic acid induce cell cycle arrest and p21 expression in immortalized human endometrial stromal cells](#)

European Journal of Obstetrics and Gynecology and Reproductive Biology, Vol. 137, Issue 1

[In Brief](#) • [Full-Text](#) • [PDF](#)

Coronavirus Resources

Selected articles published by Elsevier on **Novel Coronavirus (2019-nCoV)** are now freely available on [ScienceDirect](#), with further resources available at the [Elsevier Novel Coronavirus Information Center](#)

[Discover Resources](#)

[An evaluation of prognostic factors in advanced ovarian cancer](#)*European Journal of Obstetrics and Gynecology and Reproductive Biology*, Vol. 63, Issue 2[In Brief](#) • [Full-Text](#) • [PDF](#)[Effectiveness of the association micronized N-Palmitoylethanolamine \(PEA\)–transpolydatin in the treatment of chronic pelvic pain related to endometriosis after laparoscopic assessment: a pilot study](#)*European Journal of Obstetrics and Gynecology and Reproductive Biology*, Vol. 158, Issue 1[In Brief](#) • [Full-Text](#) • [PDF](#)

ADVERTISEMENT

Coronavirus Resources

Selected articles published by Elsevier on **Novel Coronavirus (2019-nCoV)** are now freely available on [ScienceDirect](#), with further resources available at the [Elsevier Novel Coronavirus Information Center](#)

[Discover Resources](#)[Home](#)[Author Information](#)[About the Journal](#)[Info for Advertisers](#)**ARTICLES & ISSUES**[Permissions](#)[Abstracting/Indexing](#)[Pricing](#)[Articles in Press](#)[Researcher Academy](#)[Activate Online Access](#)[Reprints](#)[Current Issue](#)[Submit a Manuscript](#)[Career Opportunities](#)[New Content Alerts](#)[List of Issues](#)**JOURNAL INFO**[Contact Information](#)**COLLECTIONS**[EURO Guidelines](#)[Supplements](#)[About Open Access](#)[Editorial Board](#)**SOCIETY INFO**[About Open Access](#)**FOR AUTHORS**[ORIGINAL](#)[EBCOG](#)[Subscribe](#)**MORE PERIODICALS**[Find a Periodical](#)[Go to Product Catalog](#)

We use cookies to help provide and enhance our service and tailor content and ads. By continuing you agree to the [Use of Cookies](#).

Copyright © 2020 Elsevier Inc. except certain content provided by third parties.

[Privacy Policy](#) [Terms and Conditions](#) [Accessibility](#) [Help & Contact](#)



Coronavirus Resources

Selected articles published by Elsevier on **Novel Coronavirus (2019-nCoV)** are now freely available on [ScienceDirect](#), with further resources available at the [Elsevier Novel Coronavirus Information Center](#)

[Discover Resources](#)