

MEDICINAL PLANTS WITH ANTI-ULCER POTENTIAL:

PHARMACOLOGICAL REVIEW OF *ZINGIBER OFFICINALE* AND

BRUCEA JAVANICA

Sivaranjani T.*¹, K. Adithya², S. Adithyan², A. Anitha², V. Arunachalam², T. Aswath²

*¹Assistant Professor, Department of Pharmacology, ²B. Pharm Final Year.

Aadhibhagawan College of Pharmacy, Rantham, Thituvannamalai.

Article Received: 06 March 2026

Article Revised: 26 March 2026

Published on: 15 April 2026

*Corresponding Author: Sivaranjani T.

Assistant Professor, Department of Pharmacology, Aadhibhagawan
College of Pharmacy, Rantham, Thituvannamalai.

DOI: <http://doi.org/10.5281/zenodo.19930392>,

ABSTRACT

Ulcer disease is a widespread global health concern characterized by the formation of open sores on the skin or mucosal linings, most commonly in the gastrointestinal tract. Factors such as *Helicobacter pylori* infection, prolonged use of non-steroidal anti-inflammatory drugs (NSAIDs), smoking, stress, and impaired mucosal defense mechanisms contribute significantly to ulcer development. Although conventional therapies such as proton pump inhibitors are effective, long-term use is often associated with adverse effects, prompting interest in herbal alternatives. Medicinal plants offer promising anti-ulcer activity through mechanisms including reduction of gastric acid secretion, enhancement of mucosal defense, antioxidant action, and anti-inflammatory effects. This review highlights the pharmacological potential of *Zingiber officinale* (ginger) and *Bruceajavanica*, focusing on their botanical description, chemical constituents, and medicinal properties related to ulcer prevention and healing. Additionally, an extensive literature review of herbal plants with documented anti-ulcer activity supports the growing evidence that plant-based therapies may serve as effective and safer alternatives for ulcer management.

KEYWORDS: Ulcer disease, Peptic ulcer, Herbal anti-ulcer agents, Gastro-protective activity, Medicinal plants.

1. INTRODUCTION

ULCER

- The word ulcer is derived from latin word “ulcer”(Genitive:ulceris) which is stands for sore, wound or an ulcer
- An ulcer is an open sore or break in the skin or lining of an organ that develops when tissue is damaged and doesn't heal properly.

Ulcers most commonly occur:

- In the stomach or small intestine (peptic ulcers)
- On the skin (e.g., pressure or diabetic ulcers)
- In the mouth (mouth ulcers)

They often cause pain, inflammation, and sometimes bleeding, and are usually the result of infection, poor blood flow, pressure, or irritation from chemicals or medications

Peptic ulcers, a public health issue with significant morbidity and mortality rates, have sparked research due to their widespread presence in the global population. Peptic ulcers are typically caused by an imbalance of destructive and defensive forces in the stomach.

HCl, pepsin, biliary reflux, lipid peroxidation, and the production of reactive oxygen species (ROS) are endogenous factors in the stomach, while excessive ethanol consumption, indiscriminate use of non-steroidal anti-inflammatory drugs (NSAID), stress, smoking, and Helicobacter pyloribacteria infection are exogenous factors. Mucus-bicarbonate barrier, mucin production, surface phospholipids, prostaglandins (PGs), nitric oxide (NO), mucosal blood flow, cell renewal, growth factors, and antioxidant enzymes are the defensive factors.

There Are Various of Ulcer Which May Include:

- Peptic ulcer
- Mouth ulcer
- Skin ulcer
- Genital ulcer
- Corneal ulcer

The mostly standard drugs like proton pump inhibitors are used

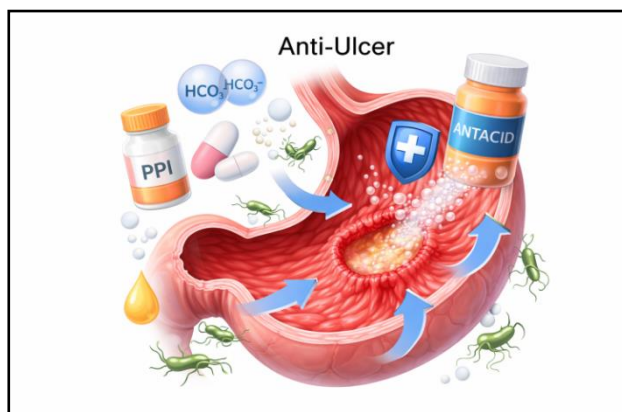


Fig. 1: Ulcer

Plant Profile

1. Ginger:

- Ginger possesses significant antiulcer and gastro-protective activities.
- Ginger is effective in preventing and helping to heal various types of gastric ulcers.

1.1 Biological Source: The underground stem {rhizome} of the plant *Zingiber officinale* {Roscoe}.

1.2 Family: Zingiberaceae



Fig 2: Ginger

1.3 Synonyms

- Zingiber
- *Zingiberofficinale* (botanical name)
- Common ginger
- True ginger
- Root ginger (culinary term)
- Fresh ginger
- Green ginger

1.4 The Taxonomical Classification Of Ginger (*Zingiber officinale*) Is:

- Domain: Eukaryota
- Kingdom: Plantae
- Clade: Angiosperms
- Clade: Monocots
- Order: Zingiberales
- Family: Zingiberaceae
- Genus: *Zingiber*
- Species: *Zingiberofficinale*

1.5 Morphology of Ginger (*Zingiber officinale*):

Ginger is a perennial, herbaceous monocot plant. Its main morphological features are:

1. Root / Rhizome:

- The edible part is a rhizome (underground modified stem).
- Thick, branched, irregular in shape with nodes and internodes.
- Covered with scaly leaves.
- Yellowish inside, aromatic, and pungent.
- Produces adventitious roots from the lower surface.

2. Stem

- The aerial stem is a pseudostem, formed by overlapping leaf sheaths.
- Erect, smooth, and green.
- Grows up to about 60–120 cm in height.

3. Leaves:

- Simple, narrow, and lanceolate.
- Arranged alternately.
- Long leaf sheath surrounds the pseudo stem.
- Parallel venation (typical of monocots).
- Leaf blade is about 15–30 cm long.

4. Inflorescence:

- Arises on a separate shoot directly from the rhizome.
- A spike with closely packed bracts.
- Bracts are green with yellowish margins.

5. Flowers:

- Zygomorphic (bilaterally symmetrical).
- Bisexual.
- Calyx tubular with 3 sepals.
- Corolla with 3 petals.
- One fertile stamen.
- Ovary inferior.

6. Fruit and Seeds:

- Fruit is a capsule (rarely formed in cultivated ginger).
- Seeds are seldom viable.

7. Vernacular name:

The vernacular (common) names of ginger in different languages are:

- English: Ginger
- Hindi: Adrak
- Sanskrit: Śuṅṭhi (dry ginger), Ārdraka (fresh ginger)
- Tamil: Inji
- Telugu: Allam
- Malayalam: Inchi
- Kannada: Shunti
- Bengali: Ada
- Marathi: Aale
- Gujarati: Adu
- Urdu: Adrak

1.6 Chemical Constituents Of Ginger (*Zingiber officinale*)

Ginger contains both volatile (essential) oils and non-volatile pungent compounds.

1. Volatile Oil (1–3%)

Responsible for aroma.

- Zingiberene (major component)
- β -sesquiphellandrene
- β -bisabolene
- α -farnesene

- Camphene
- Cineole
- Citral

2. Non-volatile Pungent Compounds

Responsible for taste and medicinal activity.

- Gingerols (especially 6-gingerol)
- Shogaols (formed on drying)
- Zingerone
- Paradols

3. Other Constituents

- Starch
- Proteins
- Fats
- Resins
- Mucilage
- Sugars
- Organic acids
- Minerals (calcium, phosphorus, iron)

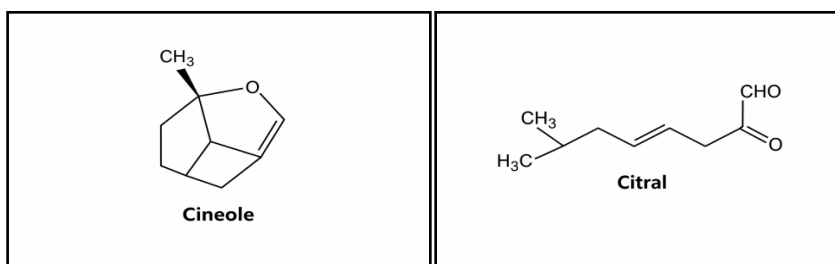


Fig. 3: Cineole

Fig. 4: Citral

1.7 Medicinal Uses of Ginger (*Zingiber officinale*):

Ginger is widely used in traditional and modern medicine due to its anti-inflammatory, digestive, and antioxidant properties.

1. Digestive Aid

- Stimulates digestion and appetite
- Relieves indigestion, flatulence, and colic
- Used in dyspepsia

2. Anti-emetic

- Effective against nausea and vomiting
- Used in motion sickness, morning sickness, and post-operative nausea

3. Anti-inflammatory & Analgesic

- Reduces joint pain and muscle pain
- Helpful in arthritis and rheumatism

4. Respiratory Disorders

- Used in cough, cold, asthma, and bronchitis
- Acts as an expectorant

5. Carminative

- Prevents formation of gas in the gastrointestinal tract

6. Antimicrobial

- Shows antibacterial and antifungal activity

7. Circulatory Stimulant

- Improves blood circulation
- Helps in relieving cold extremities

8. Antioxidant

- Protects cells from oxidative stress

9. Other Uses

- Used in fever and headache
- Helpful in menstrual pain (dysmenorrhea)

2. Bruce javanica:

- Reduces gastric ulcer formation in experimental models
- Protects gastric mucosa against damage caused by ethanol, stress, and NSAIDs

- Decreases gastric acid secretion
- Improves mucus production, strengthening the stomach's protective barrier
- Promotes ulcer healing

2.1 Biological source:

Bruce ajavanica consists of the dried seeds obtained from the plant Bruceajavanica.

2.2 Family: simaroubaceae



Fig. 5: Bruce Ajavanica

2.3 Taxonomical classification:

- Kingdom: Plantae
- Division: Magnoliophyta (Angiosperms)
- Class: Magnoliopsida (Dicotyledons)
- Order: Sapindales
- Family: Simaroubaceae
- Genus: Brucea
- Species: Bruceajavanica (L.) Merr.

2.4 Morphology of bruceajavanica:

a) Habit

- Erect shrub or small tree
- Height: about 2–7 m
- Bitter taste in all parts

b) Stem

- Woody, erect, branched
- Bark greyish-brown
- Young branches pubescent (hairy)

c) Leaves

- Alternate, imparipinnate
- Leaflets 5–13, ovate to lanceolate
- Margin entire or slightly toothed
- Upper surface dark green, lower surface pale and hairy
- Strongly bitter

d) Inflorescence

- Axillary or terminal panicles

e) Flowers

- Small, greenish-white to yellowish
- Unisexual, plant usually dioecious
- Calyx 4–5 lobed
- Petals 4–5
- Stamens in male flowers; ovary superior in female flowers

f) Fruit

- Drupe, ovoid to ellipsoid
- Turns dark purple or black on ripening
- Usually 1–4 drupes clustered

g) Seeds

- Ovoid, hard
- Dark-colored
- Highly bitter
- Medicinally important part

2.5 Vernacular names of Brucea javanica:

- English: Java brucea, Java olive
- Hindi: Makal, Kurchibeej (regional usage)
- Tamil: (Karungollivithai)
- Malayalam: Karingotta
- Telugu: Nallavepa

- Kannada: Kari nimb
- Sanskrit: Bruhatibija
- Chinese: Ya Dan Zi (鸦胆子)
- Malay / Indonesian: BuahMakasar, Melur

2.6 Chemical constituents of Bruceajavanica:

The medicinal activity of Bruceajavanica is mainly due to quassinoids and other bioactive compounds present in the seeds.

2.7 Chemical constituents:

1. Quassinoids (major constituents)

- Bruceine A, B, C, D
- Brusatol
- Bruceantin
- Bruceoside
- Yadanziolides

2. Alkaloids

- Canthin-6-one alkaloids (in small amounts)

3. Glycosides

- Quassinoid glycoside

4. Fixed oils

- fatty acids present in seeds (used in Bruceajavanica oil emulsion)

5. Triterpenoids

- Contribute to anti-inflammatory effects

6. Flavonoids

- Minor constituents with antioxidant activity

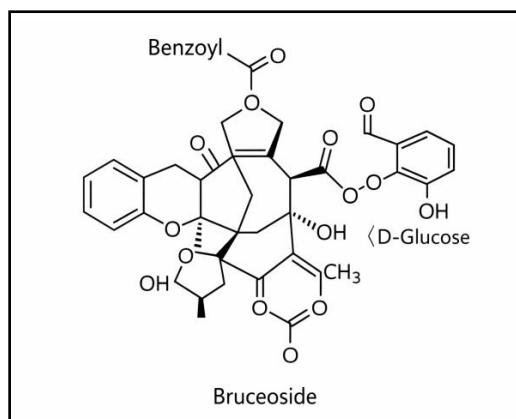


Fig. 6: Bruceoside

2.8 Medicinal uses:

1. Anti-ulcer

- Protects gastric mucosa
- Reduces gastric acid secretion
- Promotes healing of peptic ulcers

2. Anticancer / Antitumor

- Used in traditional Chinese medicine (Bruceajavanica oil emulsion)
- Effective against lung, liver, gastric, and colorectal cancers

3. Antimalarial

- Quassinoids show activity against Plasmodium species

4. Antidiarrheal & Antidysenteric

- Used in amoebic dysentery and chronic diarrhea

5. Anti-inflammatory

- Reduces inflammation and tissue damage

6. Antimicrobial

- Active against certain bacteria and fungi

7. Antiparasitic

- Used for intestinal worm infestations

8. Appetite stimulant

- Bitter principle helps stimulate digestion.

3. LITERATURE REVIEW:

Table 1: Review or Herbal Plant Used Anti – Ulcer.

SI NO.	BOTANICAL NAME	PARTS USED	ACTIVITY	EXTRACT/ SOLVENT USED	REFERENCES
1	<i>Arctiumlappa</i> L.	Roots	Anti ulcer, Anti oxidant, Anti inflammatory	Percolation Ethanol	Strong activity de M. Burci L, Crestani S, et al-2018 ^[7]
2	<i>Morinda citrifolia</i> L	Leaves	Anti ulcer, anti inflammatory, Respiratory issues	Maceration: Ethanol	Weak activity Rezeki S, VidirachmillaN, et al-2017 ^[8]
3	<i>Terminalia chebula</i>	Fruits;	Antiulcer, Cardio protective	Maceration Ethanol	Strong activity. Gautam MK, GoelS, et al-2013 ^[9]
4	<i>Taraxacumofficinale</i>	Root	Antiulcer, Diuretic activity	Water	Strong activity Ding A, Wen X,et al- 2018 ^[10]
5	<i>Tagetes erecta</i>	Flowers	Antiulcer, Analgesics	Hydroalcoholic; Methanol-Water	Strong activity. Meurer M, GonçalvesB,et al-2022 ^[11]
6	<i>Polygonumcuspidatu m</i> Siebold&Zucc.	Whole plant	Antiulcer, Anti atherosclerosis	Maceration; Ethanol	Medium activity, Junaid M, Ullah F, et al-2017 ^[12]
7	<i>Oleaeuropaea</i> Hoffma nnsegg	Leaves	Antioxidant, Anti inflammatory	Percolation; Ethanol	Strong activity Motawea MH, DesokyA A, et al- 2021 ^[13]
8	<i>Morindacitrifolia</i> L.	Fruits	Antiulcer, Anticancer	Maceration; Distiled water	Strong activity de Aguiar Magalhães D, Sousa SG, et al-2020 ^[14]
9	<i>Ilex kudingcha</i> C.J. Tseng	Leaves;	Antiulcer, Anti diabetic	Maceration; Methanol	Strong activity. Le Song J, Qian Y,et al-2013 ^[15]
10	<i>Gymnemasylvestre</i>	Leaves	Antiulcer, Hepato protective activity	Soxhlet;Ethanol	Strong activity Aleisa AM, Al-RejaieSS, et al-2014 ^[16]
11	<i>Vitisvinifera</i>	Seeds	Antiulcer, Anti inflammatory	Maceration; Water-Ethanol	Medium activity, Wang Y, Shen W, et al-2020 ^[17]
12	<i>Garcinia kola</i>	Seeds	Antiulcer, Antimicrobial	Soxhlet; Petroleum ether	Strong activity, Adedara IA, AjayiBO, et al-2013 ^[18]
13	<i>Forsythia koreana</i>	Flowers	Antiulcer, Hepatoprotective activity	Maceration; Hydroalcoholic solvent	Strong activity. Kim TW, Shin JS,et al-2019 ^[19]
14	<i>Evodiarutaecarpa</i>	Fruits	Antiulcer, Neuro protective	Soxhlet; Ethanol	Strong activity Zhang Z, Zhu K, et al-2018 ^[20]
15	<i>Eucheumacottonii</i>	Seaweed	Antiulcer, Antioxidant	Maceration; Ethanol	Medium activitySudirman S, Hsu YH,et al-2018 ^[21]
16	<i>Centellaasiatica</i> L.	leaves	Antiulcer, Antioxidant	Maceration Ethanol	Strong activity Li H, Chen X, Liu J, et al.-2021 ^[22]
17	<i>Canna x generalis</i>	Rhizome	Antiulcer, Analgesic	Sonication Methanol	Medium activity Mahmoud TN, El- Maadawy WH, et al -

					2021 ^[23]
18	<i>Bruceajavanica L.</i>	Fruits	Antiulcer, Antidiarrhoeal	Soxhlet extraction chloroform	Strong activity Dou YX, Zhou JT, Wang TT, et al.-2018 ^[24]
19	<i>Berberislycium Royle</i>	Fruits	Antiulcer, Antidiabetic	Percolation water	Strong activity Sharma A, Tirpude NV, Kulurkar PM, Sharma R, Padwad Y ,et al-2020 ^[25]
20	<i>Belamcandachinensis L.</i>	Rhizome	Antiulcer, Antimicrobial	Maceration Methanol	Strong activity Szandruk M, Merwid-Lad A, SzelagA,et al,2018 ^[26]
21	<i>Annesleafragrans Wal l.</i>	Leaves	Antiulcer, Antipyretic	Ultrasonic assisted extraction Methanol	Strong activity Deng X, Wang Y, Tian L, et al.-2021 ^[27]
22	<i>Amphiterygiumadstrin gens</i>	Bark	Antiulcer	Maceration Ethanol	Strong activity Rodriguez-Canales M, Jimenez-Rivas R, Canales- Martinez MM, et al. 2016 ^[28]
23	<i>Terminalia catappa</i>	Leaves	Antiulcer, Antioxidant	Percolation Absolute ethanol	Strong activity Silva LP, De Angelis CD, Bonamin F, et al. 2014 ^[29]
24	<i>Spondiasmombin L.</i>	Leaves	Antiulcer, Hepatoprotective	Percolation Absolute ethanol	Strong activity Brito SA, de Almeida Almeida CLF, de Santana TI, et al.2014 ^[30]
25	<i>Phyllanthusniruri L</i>	Leaves	Antiulcer, Antiviral	Maceration, Methanol	Strong activity Mostofa R, Ahmed S, Begum MM, et al.2017 ^[31]
26	<i>Melissa officinalis L</i>	Leaves	Antiulcer, Antidepressant	Maceration Methanol	Weak activity Saberi A, Abbasloo E, Sepehri G, et al. 2016 ^[32]
27	<i>Emexspinosa (L.) Campd.</i>	Leaves	Antiulcer, Antidiabetic	Maceration Methanol	Strong activity Ajaib M, Ishtiaq S, Ishtiaq M, et al.2022 ^[33]
28	<i>Cinnamomumglanduli ferum Wall.</i>	Leaves	Antiulcer, Antimicrobial	Hydrodistillation Water	Strong activity Azaba SS, Abdel Jaleelb GA, Eldahshanc OA. Et al, 2017 ^[34]
29	<i>Ceibaspeciosa A.</i>	Stem bark	Antiulcer,Antiinflam matory	Maceration Ethanol	Strong activity Dörr JA, Majolo F, Bortoluzzi L, et al 2022 ^[35]
30	<i>Caseariasylvestris</i>	Leaves	Antiulcer, Antioxidant	Infusion Distilled water	Strong activity de Oliveira BMM, Serpa PZ, da Costa Zanatta ME, et al 2022 ^[36]
31	<i>Bryophyllumpinnatum L.</i>	Leaves	Antiulcer, Analgesic	Maceration Methanol	Strong activity Kouitcheu Mabeku LB, Eyoum Bille B, TchouangueuTF,et al 2017 ^[37]
32	<i>Artemisia absinthium L.</i>	Aerial part	Antiulcer, Antimicrobial	Maceration water	Strong activity Boeing T, de Souza de Souza J, da Silva RCV, et al 2023 ^[38]

33	<i>Annona muricata L</i>	Leaves	Antiulcer, Antipyretic	Maceration Ethanol	Strong activity Bento EB, de B. Júnior FE, de Oliveira DR, et al 2017 ^[39]
34	<i>Punica granatum</i>	Flower	Antiulcer, Antioxidant	Percolation Ethanol	Medium activity Gavanji S, Larki B, Bakhtari A et al 2014 ^[40]
35	<i>Zingiber officinale</i>	Root	Antiulcer, Antiemetic	Maceration Methanol	Strong activity Zhang M, Viennois E, Prasad M, et al 2016 ^[41]

4. CONCLUSION

Ulcer disease remains a significant health problem worldwide, affecting quality of life and imposing a considerable healthcare burden. While conventional anti-ulcer drugs are effective, their limitations highlight the need for safer and more sustainable therapeutic options. Herbal medicines have gained attention due to their multi-targeted actions, lower toxicity, and traditional usage. Plants such as *Zingiber officinale* and *Brucea javanica* exhibit potent anti-ulcer activity through antioxidant, anti-inflammatory, antisecretory, and mucosal protective mechanisms. The extensive literature reviewed further confirms that numerous medicinal plants possess strong gastro-protective properties. Therefore, herbal anti-ulcer agents represent a promising area for future research and drug development. Further clinical studies and standardization of herbal formulations are essential to establish their efficacy and safety for widespread therapeutic use.

5. REFERENCE

1. P. Malfertheiner, F. K. Chan, and K. E. McColl "Peptic ulcer disease," *The Lancet*, 2009; 374(9699): 1449-1461.
2. J. Calam and J. H. Baron, "ABC of the uppp. 2001; 980 982.
3. M. Gasparetto, M. Pescarin, and G. Guariso, "Helicobacter pylori eradication therapy: current availabilities," *ISRN Gas troenterology*, vol. 2012, Article ID 186734, 8 pages, 2012.
4. S. Alqasoumi, M. al-Sohaibani, T. AlHowiriny, M. AlYahya, and S. Rafatullah, "Rocket "Erucasativa": a salad herb with potential gastric anti-ulcer activity," *World Journal of Gastro enterology*, 2009; 15(16): 1958–1965.
5. T. Prabha, M. Dorababu, S. Goel et al., "Effect of methanolic extract of Pongamiapinnata Linn seed on gastro-duodenal ulceration and mucosal offensive and defensive factors in rats," *Indian Journal of Experimental Biology*, 2009; 47(8): 649–659.

6. A. S. AlRashdi, S. M. Salama, S. S. Alkiyumi et al., "Mechanisms of gastroprotective effects of ethanolic leaf extract of *Jasminumsambac* against HCl/ethanol-induced gastric mucosal injury in rats," *Evidence-based Complementary and Alternative Medicine*, vol. 2012, Article ID 786426, 15 pages, 2012.
7. da SilvadaSilvada Silva LM, de M. Burci L, Crestani S, et al. Acid-gastric antisecretory effect of the ethanolic extract from *Arctiumlappa* L. root: role of H⁺, K⁺-ATPase, Ca²⁺ influx and the cholinergic pathway. *Inflammopharmacology.*, 2018; 26(2): 521–530. doi: 10.1007/s10787-017-0378-4 [DOI] [PubMed] [Google Scholar]
8. Rezeki S, Vidirachmilla N. The effect of noni leaves extract (*Morindacitrifolia* L) on wound healing percentage of traumatic ulcer in oral mucosa of Wistar rats (*rattusnorvegicus*) by in vivo. *Biomed Pharmacol J.*, 2017; 10(4): 1735–1740. doi: 10.13005/bpj/1286.
9. Gautam MK, Goel S, Ghatule RR, Singh A, Nath G, Goel RK. Curative effect of *Terminalia chebula* extract on acetic acid-induced experimental colitis: role of antioxidants, free radicals and acute inflammatory marker. *Inflammopharmacology.*, 2013; 21(5): 377–383. doi: 10.1007/s10787-012-0147-3 [DOI] [PubMed] [Google Scholar]
10. Ding A, Wen X. Dandelion root extract protects NCM460 colonic cells and relieves experimental mouse colitis. *J Nat Med.*, 2018; 72(4): 857–866. doi: 10.1007/s11418-018-1217-7 [DOI] [PubMed] [Google Scholar]
11. Meurer M, Gonçalves B, Cury BJ, et al. Extract of *Tagetes erecta* L., a medicinal plant rich in lutein, promotes gastric healing and reduces ulcer recurrence in rodents. *J Ethnopharmacol.*, 2022; 293: 115258. doi: 10.1016/j.jep.2022.115258 [DOI] [PubMed] [Google Scholar]
12. Ayaz M, Junaid M, Ullah F, et al. GC-MS analysis and gastroprotective evaluations of crude extracts, isolated saponins, and essential oil from *Polygonumhydropiper* L. *Front Chem.*, 2017; 1–11. doi: 10.3389/fchem.2017.00058 [DOI] [PMC free article] [PubMed] [Google Scholar]
13. Elmaksoud HAA, Motawea MH, Desoky AA, Elharrif MG, Ibrahim A. Hydroxytyrosol alleviate intestinal inflammation, oxidative stress and apoptosis resulted in ulcerative colitis. *Biomed Pharmacother.*, 2021; 142: 112073. doi: 10.1016/j.biopha.2021.112073 [DOI] [PubMed] [Google Scholar][Ref list]
14. Batista JA, de AguiarMagalhães D, Sousa SG, et al. Polysaccharides derived from *Morindacitrifolia* Linn reduce inflammatory markers during experimental colitis. *J*

- Ethnopharmacol., 2020; 248: 112303. doi: 10.1016/j.jep.2019.112303 [DOI] [PubMed] [Google Scholar][Ref list]
15. Le Song J, Qian Y, Li GJ, Zhao X. Anti-inflammatory effects of kudingcha methanol extract (*Ilex kudingcha* C.J. Tseng) in dextran sulfate sodium-induced ulcerative colitis. *Mol Med Rep.*, 2013; 8(4): 1256–1262. doi: 10.3892/mmr.2013.1635 [DOI] [PubMed] [Google Scholar][Ref list]
 16. Aleisa AM, Al-Rejaie SS, Abuohashish HM, Ola MS, Parmar MY, Ahmed MM. Pretreatment of *Gymnemasylvestre* revealed the protection against acetic acid-induced ulcerative colitis in rats. *BMC Complement Altern Med.*, 2014; 14(1): 1–11. doi: 10.1186/1472-6882-14-49 [DOI] [PMC free article] [PubMed] [Google Scholar][Ref list]
 17. Wang Y, Wang Y, Shen W, et al. Grape seed polyphenols ameliorated dextran sulfate sodium-induced colitis via suppression of inflammation and apoptosis. *Pharmacology*, 2020; 105(1–2): 9–18. doi: 10.1159/000501897 [DOI] [PubMed] [Google Scholar]
 18. Farombi EO, Adedara IA, Ajayi BO, Ayepola OR, Egbeme EE. Kolaviron, a natural antioxidant and anti-inflammatory phytochemical prevents dextran sulphate sodium-induced colitis in rats. *Basic ClinPharmacolToxicol.*, 2013; 113(1): 49–55. doi: 10.1111/bcpt.12050 [DOI] [PubMed] [Google Scholar][Ref list]
 19. Kim TW, Shin JS, Chung KS, Lee YG, Baek NI, Lee KT. Anti-inflammatory mechanisms of koreanaside a, a lignan isolated from the flower of *forsythia koreana*, against LPS-induced macrophage activation and DSS-induced colitis mice: the crucial role of AP-1, NF- κ B, and JAK/STAT signaling. *Cells.*, 2019; 8(10): 1163. doi: 10.3390/cells8101163 [DOI] [PMC free article] [PubMed] [Google Scholar][Ref list]
 20. Shen P, Zhang Z, Zhu K, et al. Evodiamine prevents dextran sulfate sodium-induced murine experimental colitis via the regulation of NF- κ B and NLRP3 inflammasome. *Biomed Pharmacother.*, 2019; 110: 786–795. doi: 10.1016/j.biopha.2018.12.033 [DOI] [PubMed] [Google Scholar][Ref list]
 21. Sudirman S, Hsu YH, He JL, Kong ZL, Nakano H. Dietary polysaccharide-rich extract from *Eucommia albertiana* modulates the inflammatory response and suppresses colonic injury on dextran sulfatesodiuminduced colitis in mice. *PLoS One.*, 2018; 13(10): 1–15. doi: 10.1371/journal.pone.0205252 [DOI] [PMC free article] [PubMed] [Google Scholar][Ref list]
 22. Li H, Chen X, Liu J, et al. Ethanol extract of *Centellaasiatica* alleviated dextran sulfate sodium-induced colitis: restoration on mucosa barrier and gut microbiota homeostasis. *J*

- Ethnopharmacol., 2021; 267: 113445. doi: 10.1016/j.jep.2020.113445 [DOI] [PubMed] [Google Scholar][Ref list]
23. Mahmoud TN, El-Maadawy WH, Kandil ZA, Khalil H, El-fiky NM, El Alfy TSMA. Canna x generalis L.H. Bailey rhizome extract ameliorates dextran sulfate sodium-induced colitis via modulating intestinal mucosal dysfunction, oxidative stress, inflammation, and TLR4/ NF- κ B and NLRP3 inflammasome pathways. J Ethnopharmacol., 2021; 269: 113670. doi: 10.1016/j.jep.2020.113670 [DOI] [PubMed] [Google Scholar][Ref list]
24. Dou YX, Zhou JT, Wang TT, et al. Self-nanoemulsifying drug delivery system of bruceine D: a new approach for anti-ulcerative colitis. Int J Nanomed., 2018; 13: 5887–5907. doi: 10.2147/IJN.S174146 [DOI] [PMC free article] [PubMed] [Google Scholar][Ref list]
25. Sharma A, Tirpude NV, Kulurkar PM, Sharma R, Padwad Y. Berberislycium fruit extract attenuates oxi-inflammatory stress and promotes mucosal healing by mitigating NF- κ B/c-Jun/MAPKs signalling and augmenting splenic Treg proliferation in a murine model of dextran sulphate sodium-induced ulcerative colitis. Eur J Nutr., 2020; 59(6): 2663–2681. doi: 10.1007/s00394-019-02114-1 [DOI] [PubMed] [Google Scholar][Ref list]