Sudan Journal of Medical Sciences
Volume 20, Issue no. 3, DOI 10.18502/sjms.v20i3.13229
Production and Hosting by KnE Publishing

Review Article

Traditional Sudanese Medicine for Gastrointestinal and Hepatobiliary Disorders: A Narrative Review

Abdalbasit Mariod[1,2]*, Haroon Elrasheid Tahir[3], Mohamed Ahmed Agab[4], and Ahmed Mohamedain[5,6]

[1]College of Science, University of Jeddah, Kingdom of Saudi Arabia
[2]Indigenous Knowledge and Heritage Centre, Ghibaish College of Science and Technology, Ghibaish, Sudan
[3]School of Food and Biological Engineering, Jiangsu University, Jiangsu, China
[4]Department of Internal Medicine, Faculty of Medicine and Health Sciences, University of Kordofan, Sudan
[5]Department of Biomedical Sciences, College of Medicine, King Faisal University, Kingdom of Saudi Arabia
[6]Department of Biochemistry, Faculty of Medicine, Khartoum University, Khartoum, Sudan

Abstract

Herbs such as *Mentha piperita*, *Cymbopogon citratus*, *Zingiber officinale*, *Cichorium intybus*, *Elettaria cardamomum*, *Acacia nilotica*, *Boswellia papyrifera*, and *Balanites aegyptiaca* are part of the Sudanese medicinal plants used to treat internal diseases, especially since inflammations of the digestive system are common across different regions of Sudan. These plants are widely used in Sudanese traditional medicine for gastrointestinal complaints, and their potential benefits warrant further investigation. This article reviews the availability of these herbs and highlights their use as traditional alternatives to pharmaceutical medicines in Sudan. It uses current data by manually screening the titles, and in some cases the abstracts, of retrieved articles containing the following keywords: "medicinal herbs," "Sudanese medicinal herbs," "traditional medicine," "healers," "digestive system disorder," "*Helicobacter pylori*," *(H. pylori)* and "jaundice" from the electronic databases PubMed and Google Scholar. Preference has been given to scientific articles, reports, and literature published within the past five years.

Keywords: Sudanese medicinal herbs, traditional medicine, traditional healers, digestive system disorder, *Helicobacter pylori*, jaundice

Corresponding Author:
Abdalbasit Mariod; email:
basitmariod58@gmail.com;
aalnadif@uj.edu.sa

Received: 17 April 2023
Accepted: 12 August 2025
Published: 16 October 2025

Production and Hosting by KnE Publishing

Editor-in-Chief:
Prof. Nazik Elmalaika Obaid Seid Ahmed Husain, MD, M.Sc, MHPE, PhD.

1. Introduction

Gastroenteritis is an inflammation of the stomach and intestines often caused by a virus, bacteria, or a specific parasite [1]. Gastrointestinal (GI) disorders comprise illnesses affecting the digestive tract from the mouth to the anus, with severity varying by etiology and host factors. Common contributors include a low-fiber diet, inadequate physical activity, travel-related lifestyle changes, high dairy intake, and use of calcium- or aluminum-containing antacids. Typical symptoms include abdominal pain or cramps, excessive gas, bloating, irregular stools, and alternating constipation and diarrhea. Pharmacologic options commonly used for digestive complaints include antacids for acid-related symptoms, analgesics for pain, and, when indicated, antibiotics for confirmed bacterial or parasitic infections [2, 3].

GI symptoms are frequently precipitated by ingestion of contaminated food or water that carries bacteria, viruses, or parasites [1, 3]. Overeating, eating rapidly, and diets high in fatty or spicy foods can aggravate symptoms, and excessive caffeine or alcohol may provoke indigestion; psychological stress and anxiety can also contribute [4]. Certain medications can irritate the gastrointestinal mucosa and lead to dyspeptic symptoms [5]. Conditions that commonly present with "stomach" symptoms include indigestion, gastroesophageal reflux disease, *Helicobacter pylori* infection, and gastritis, as well as functional bowel disorders such as irritable bowel syndrome; however, such symptoms can also signal other underlying conditions that require evaluation [6]. GI disorders commonly discussed in this context include gastritis, peptic ulcer disease, gastroesophageal reflux disease, Crohn's disease, and ulcerative colitis; hepatobiliary diseases such as hepatitis affect the liver and are considered separately [7].

Fecal-oral transmission is the spread of enteric pathogens from feces to a new host via contaminated hands, food, water, or surfaces [8]. Infections also occur after touching the mouth following contact with contaminated objects or environments. Individuals or large groups can become infected through contaminated food or water, and many foods can harbor pathogens and cause gastroenteritis if not cooked thoroughly or pasteurized [9].

This review examines traditional healing practices used by traditional healers in Sudan and elsewhere for GI disorders. It outlines Sudanese medicinal plants used for specific conditions and the cultural contexts guiding their use, and it summarizes available evidence regarding their applications. The review aims to highlight natural therapeutic options and encourage further research that could inform integration with conventional care.

2. Traditional Herbal Treatment for Gastrointestinal Symptoms

In Sudan, traditional healers play an important role in the health-care landscape, especially in remote or hard-to-reach settings. They draw on knowledge and skills passed down over generations to assess symptoms and provide care, using folk recipes, healing ceremonies, and medicinal plants and herbs as part of culturally grounded practice [10].

Within this tradition, numerous herbs are used for gastrointestinal (GI) symptoms alongside dietary measures and preventive practices. For gastroenteritis and related complaints, community remedies may include ginger, fenugreek, and olive oil, as

well as foods or preparations intended to soothe the GI tract; these approaches are used for symptom relief and typically complement clinical care rather than replace it [8, 11]. Some of the herbs used for gastrointestinal conditions in Sudan are summarized below.

2.1. *Mentha piperita* (peppermint)

Mint is a fragrant herb with long-standing traditional use for digestive complaints. Peppermint volatiles (particularly menthol) exhibit antispasmodic effects on gastrointestinal smooth muscle, and the aroma may have soothing effects; these actions have been linked to modulation of gut sensory pathways [12, 13]. Mint may reduce intestinal gas and attenuate discomfort from luminal distension; Peppermint volatiles have been reported to activate pain-modulating channels in the colon [13].

In many parts of Sudan, mint infusion is commonly used for digestive health. It is taken as a gentle laxative for constipation and is traditionally believed to promote bile flow into the duodenum, supporting fat digestion and bowel movements [14, 15]. It is also used culturally as a remedy against intestinal worms; its oils show antimicrobial/antiparasitic activity in laboratory settings, though clinical evidence is limited [14, 15]. Recent studies suggest potential benefits for diarrhea in children, but findings are preliminary and context dependent [16].

Mint is considered carminative, helping the passage of gas and limiting its accumulation that can cause bloating, cramping, and discomfort [17]. In Sudanese practice, mint infusion is also recommended to reduce nausea and vomiting; antispasmodic properties may relieve epigastric pain, and anti-inflammatory effects have been proposed [13, 18].

2.2. *Cymbopogon citratus (alhamareeb)*

Cymbopogon citratus (lemongrass), known locally in Sudan as *alhamareeb,* is a perennial herb with coarse, threadlike leaves forming dense clumps from a firm base and reaching 60–90 cm (2–3 ft) in height. It has a lemony aroma and contains potassium, manganese, magnesium, citral, sterols, and flavonoids [19–21]. In Sudanese practice, *alhamareeb* is used as a traditional remedy for digestive complaints, including calming nausea and relieving abdominal discomfort, and is also used in folk practice for oral health [22]. Traditionally described as carminative, antispasmodic, and diaphoretic, *C. citratus* is used for flatulence and intermittent cramping, particularly cramps associated with defecation; symptom relief has been reported, though clinical evidence remains limited [23]. Preliminary reports suggest possible benefits for functional gastrointestinal complaints such as irritable bowel syndrome and for slow-transit constipation, but robust, well-controlled trials are lacking [23, 24]. Laboratory studies indicate antifungal, antibacterial, and antiprotozoal activity, including effects against Candida spp., helminths/parasites, and bacteria such as *H. pylori* and *Salmonella*; however, clinical efficacy for eradicating these pathogens has not been established [25]. Beyond the gastrointestinal context, antioxidant and anti-inflammatory properties have been described, with exploratory applications in infection-related symptoms, rheumatic disorders, and supportive cancer care, but these remain investigational [25].

2.3. *Zingiber officinale* (ginger)

Ginger is a medicinal herb whose rhizome is commonly used as a spice and remedy. It can be

consumed fresh, as an infusion or decoction, in powdered form, or as an essential oil for medicinal purposes [26]. With its long-standing use in Chinese and Indian medicine, ginger is frequently employed to address digestive complaints. Ginger tea may reduce gas-related discomfort and pain [27], and it may help people with functional dyspepsia characterized by upper abdominal pain, early satiety, and bloating [28]. Proposed actions include support of digestion through enhanced gastric motility and secretions, with possible effects on bile flow into the duodenum [29]. Faster gastric emptying after meals has also been reported, which can improve postprandial discomfort and may secondarily reduce constipation symptoms [29].

In Sudanese practice, ginger tea is used for colds and as a digestive aid to help prevent cramps and relieve gas; it is also used for gout and is locally avoided during pregnancy [15]. Ginger contains gingerol, a principal pungent constituent linked to several bioactivities. Numerous studies report antiemetic effects potentially via improved GI motility and modulation of serotonergic (5-HT3) pathways in the gut [30, 31].

Additional studies describe prokinetic effects, including promotion of bowel movements and accelerated gastric emptying, which may facilitate movement of food through the GI tract and lessen dyspeptic symptoms [32]. Ginger may influence digestive enzymes such as pancreatic lipase, which is relevant to small-intestinal fat digestion [33]. Reports also note reductions in gas-related symptoms; these benefits are more plausibly attributed to motility and sensory modulation [34]. Finally, experimental work suggests anthelmintic activity of ginger extracts in the gastrointestinal tract; however, mechanisms are not established, and clinical confirmation remains limited [35].

2.4. *Cichorium intybus (molaita)*

Cichorium intybus is an herbaceous plant that grows wild in many regions; although considered tropical, it also occurs in cooler climates. In Sudan, it is known as *molaita* and has a distinctly bitter taste; when eaten as a salad, the leaves are typically washed and may be mixed with peanuts, onions, chili, and salt. The plant contains compounds that have been investigated in the context of digestive, liver, and inflammatory conditions [36]. It is used in Sudanese practice for a range of ailments; *C. intybus* contains fixed fats/oils and is cited in folk use for diabetes, hypertension, and jaundice. It is rich in potassium and calcium and is used as a digestive aid; the seeds are also employed medicinally. Reported constituents include sugars such as inulin, fructose, and glucose, as well as a bitter glycoside referred to as *intepine*, along with vitamins B and C, choline, proteins, pectin, tannins, organic acids, carotene, and various micro- and macro-minerals [37].

Molaita is caffeine-free and is traditionally used to support gastrointestinal function. Ethnobotanical sources describe uses for gastrointestinal and hepatobiliary complaints and for infections of the mucous membranes of the stomach and intestines, as well as conditions of the liver, gallbladder (e.g., gallstones/bile stones), kidneys, and urinary tract [38]. An infusion of the plant's roots is reported to reduce bloating, a sense of fullness, temporary loss of appetite, and indigestion [39].

2.5. *Elettaria cardamomum* (cardamom)

Cardamom (*Elettaria cardamomum*), popular in Sudan and locally known as *habahan,* is traditionally used for gastrointestinal complaints. Owing to antispasmodic and analgesic properties and its

volatile oils, it is employed for dyspeptic symptoms and "stomach" discomfort [40].

Cardamom is taken to relieve flatulence and other functional digestive symptoms and may help ease acid-related discomfort [39]. When combined with cloves, ginger, and coriander, cardamom seeds are used as a household remedy for indigestion, with the mixture reported to support digestive function and comfort [41]. It is also used to help reduce nausea after anesthesia or surgery [42] and to alleviate nausea and vomiting more generally; reports also describe use for diarrhea, peptic-ulcer symptoms, and gastroesophageal reflux, although clinical evidence remains limited [43].

Proposed actions include modulation of gastric secretions and motility. In traditional descriptions, *habahan* is said to promote bile flow into the duodenum (choleretic/cholagogue activity), which may aid fat digestion and postprandial comfort; related claims about weight control and fat metabolism remain preliminary and require confirmation in controlled studies [44].

2.6. *Acacia nilotica (garadh)*

Acacia nilotica contains notable amounts of potassium, magnesium, iron, and phosphorus, as well as fiber, proteins, carbohydrates, and fatty acids, which contribute to its overall nutritional value [45]. In traditional use, *A. nilotica* is taken for gastrointestinal complaints such as indigestion and bloating; it is also described as anthelmintic, and its antioxidant constituents are cited in relation to general health [46]. Extracts from different plant parts are used in folk practice for digestive issues, including diarrhea, dysentery, hemorrhoids, abdominal pain, and sore throat [47].

Preclinical studies report gastroprotective effects and anthelmintic activity (e.g., inhibition of egg hatching and larval development), as well as antidiarrheal effects; however, clinical confirmation remains limited [48, 49].

Patients with colonic symptoms sometimes seek complementary herbal remedies alongside prescribed treatments; *A. nilotica* is among the plants mentioned in this context, though evidence is preliminary and should not replace medical care [50]. In Sudanese ethnomedicine, *A. nilotica* is used to treat diarrhea, symptoms attributed to gastric ulcers, and intestinal worms, as well as for acid-related dyspepsia and irritable bowel syndrome [51].

2.7. *Trigonella foenum-graecum* (fenugreek)

Fenugreek contains fiber, proteins, fixed oils, alkaloids (notably trigonelline and choline), flavonoids, saponins, vitamins (A, B, C), and minerals (phosphorus, iron, sulfur, calcium, magnesium), as well as mucilage and volatile oils [52, 53]. Its soluble fiber (especially galactomannan) may help regulate bowel movements. Reported flavonoids include apigenin, luteolin, orientin, quercetin, vitexin, and isovitexin [54–56].

In traditional use, fenugreek is taken for gastrointestinal complaints; it is described as soothing irritated mucosa, reducing inflammation, supporting digestion, and easing constipation [57]. Fenugreek can help calm inflamed tissues in the stomach and intestines. The fiber in fenugreek seeds aids in improving bowel movements and facilitates digestion. The seeds contain antioxidants that help fight inflammation in the digestive system [56, 58]. Antioxidant constituents may contribute to these effects [56, 58]. The mucilage is reported to form a protective coating on the gastric and intestinal lining, which may lessen acid-related irritation [57].

Owing to its fiber content, fenugreek is also used as a gentle laxative in constipation [57].

A 14-day study of a fenugreek-fiber product reported reduced heartburn severity and lower need for mild antacids, with effects comparable to over-the-counter acid-reducing medications [59]. Seeds rich in alkaloids and flavonoids show antioxidant activity and have been investigated for ulcerative colitis–related inflammation, though evidence remains preliminary [60][60].

2.8. Olive oil

Olive oil is a natural oil extracted from olives and is composed mainly of triglycerides (99%). The principal fatty acids are oleic (55–70%) and linoleic (8–13%), with palmitic as the main saturated fatty acid (7.5–15%). Minor constituents' phenolic compounds, tocopherols, sterols, chlorophylls, carotenoids, and aromatic compounds make up the remaining 1–3% [61]. Extra-virgin olive oil is the highest grade (low free acidity, no sensory defects) and is widely used as an edible fat; as a dietary fat, it can aid the absorption of fat-soluble vitamins and is incorporated into diets linked with digestive well-being [62].

In digestive contexts, olive oil is commonly used as a gentle laxative and may help with constipation. It may also assist in a regimen aimed at managing *H. pylori*, though evidence is limited and protocol dependent [63]. Owing to its high content of monounsaturated fatty acids, olive oil may support digestion and reduce dyspeptic symptoms; proposed protective roles against ulcers or gastritis remain inconclusive [64].

Olives and olive oil contain compounds such as squalene and terpenoids, alongside the peroxidation-resistant fatty acid oleic acid. In a preclinical study, rats fed an olive oil diet had a lower incidence of colon tumors than those fed safflower oil; these findings are hypothesis-generating and not directly generalizable to humans [65].

2.9. *Boswellia papyrifera* (frankincense)

Frankincense is the aromatic resin obtained from *Boswellia* species native to India, the Middle East, and North Africa (notably Sudan and Ethiopia). In Sudanese practice, it is used in multiple forms, including chewing the resin, using expressed oil, burning as incense with inhalation, and preparing an infusion [66]. It is widely used for aromatherapy and in folk medicine and religious practices, and even as a household item. Traditional Sudanese healers attribute benefits such as relief of coughs and colds, support for digestive comfort, calming effects, and aid for certain skin conditions [66, 67].

Boswellic acids and other constituents exhibit anti-inflammatory and antioxidant activity; preliminary studies suggest potential for improving gastrointestinal symptoms, but the evidence base remains limited and heterogeneous [68]. Traditional use of frankincense infusion includes aims such as reducing diarrhea, bloating, and cramping and supporting general digestive comfort; some reports also explore possible effects on ulcer risk, though confirmatory clinical trials are lacking [68, 69].

Laboratory and exploratory studies have examined activity against *Helicobacter pylori*, a bacterium associated with peptic ulcer disease and gastritis; any antibacterial effects remain investigational, and frankincense should not replace standard eradication therapy [70]. Emerging work also discusses possible microbiome-modulating ("prebiotic-like") effects, but these findings are preliminary and require validation in well-designed human studies [71].

2.10. *Balanites aegyptiaca (heglig)*

Balanites aegyptiaca (locally *laloub/heglig)* is widely distributed across Sudan and valued for its edible fruit. Mature trees can yield substantial quantities of fruit, eaten by humans and animals. The plant contains proteins, vitamins, minerals, saponins, and steroids; the mesocarp (pulp) is rich in sugars and saponins [72, 73]. The kernel contains >50% oil and a high protein content (50%) with amino acids such as lysine, supporting its use as a food resource [74].

In Sudanese practice, *heglig* is used for gastrointestinal complaints: the fruit and seeds are taken as laxatives, leaves are applied to wounds, and roots are used for GI symptoms such as diarrhea. Experimental studies report activity of plant extracts against schistosome parasites and intestinal helminths [75, 76]. Root and bark extracts are also described in ethnomedicine for jaundice, intestinal worm infections, dysentery, constipation, diarrhea, and hemorrhoids; fruits are used for lowering uric acid, and cancer prevention has been claimed in folk use [77].

Heglig remains an important component of traditional Sudanese medicine. Reported uses include supporting lactation and employing seeds/fruits as laxatives; leaves for wounds; and roots for conditions such as infertility and epilepsy. Research on *heglig* compounds has explored anticancer, anti-inflammatory, antibacterial, and antifungal activities, though clinical evidence is still preliminary [78, 80, 89].

3. Traditional Herbal Treatment for Jaundice and Hepatitis

Jaundice and hepatitis are related but distinct. Jaundice is the yellowing of skin and eyes due to elevated bilirubin, whereas hepatitis is liver inflammation from causes such as viral infection, alcohol, or medications. Hepatitis can lead to jaundice, but not all jaundice is due to hepatitis [81, 82].

Although many jaundice cases require medical evaluation and standard care, certain foods and herbs are traditionally used in Sudan to support comfort and convalescence; these practices aim to ease symptoms and support diet while formal clinical evidence remains limited [83, 84].

Within Sudanese traditional medicine, basil and Wormwood are used with the intent of liver support. Basil is typically prepared by boiling the leaves to make an infusion [85]. Wormwood is taken by soaking dried leaves and drinking the liquid on an empty stomach; reported “hepatoprotective” properties are largely based on traditional use and early studies rather than definitive clinical trials [86, 87].

Traditional healers also recommend green tea for jaundice or hepatitis. Its catechins have antioxidant activity that may help protect hepatocytes; laboratory and early translational studies have explored effects on hepatitis C virus (HCV) and liver carcinogenesis, but findings remain preliminary and are not a substitute for antiviral therapy [88, 89]. Another Sudanese practice involves consuming foods prepared with *kawal*, a traditional fermented food; some healers also suggest drinking a *kawal* infusion on an empty stomach. These uses are anecdotal and intended to support well-being during recovery rather than to replace medical treatment [90].

4. Traditional Herbal Treatment for Stomach Ulcers

Helicobacter pylori is a bacterium that colonizes the gastric mucosa and is implicated in gastritis, peptic ulcer disease, and gastric cancer [91]. A peptic ulcer is an erosion in the gastric or duodenal mucosa. Normally, a mucus layer protects the epithelium from acid, but multiple factors can weaken this barrier [98]. *Helicobacter pylori* adheres to the mucus layer and induces inflammation that disrupts mucosal defenses; despite high prevalence, only 10–15% of infected individuals develop ulcers [99]. In Sudanese practice, herbs such as garlic, ginger, turmeric, and green tea are used adjunctively for digestive comfort; some show antibacterial activity in laboratory or preliminary studies, but they should, if used, be combined with standard medical treatment and taken under clinical supervision [92].

Green tea has been reported to inhibit *H. pylori* growth and may attenuate gastritis in experimental settings; traditional recommendations therefore include green tea for symptomatic relief, although eradication claims remain unproven [93]. Honey—particularly manuka—and olive oil also demonstrate antibacterial activity against *H. pylori* in vitro or exploratory work, but they are not substitutes for guideline-based therapy [93].

Aloe vera is traditionally used for dyspeptic symptoms such as constipation, nausea, and vomiting; experimental studies suggest growth-inhibitory effects on *H. pylori*, including drug-resistant strains, and explore use alongside antibiotics, though clinical confirmation is limited [94, 95].

Lactoferrin, a milk glycoprotein, has shown inhibitory effects on *H. pylori*; in one study, adding bovine lactoferrin to antibiotics reportedly achieved very high eradication rates, but findings require replication and should be interpreted within contemporary treatment protocols [96].

Lemongrass essential oil has been studied for anti-*H. pylori* effects, including in animal models with inhalation exposure; such approaches remain investigational and are not standard management [97].

In Sudanese ethnomedicine, ginger is used for dyspepsia, gas, and ulcer-related symptoms; limited studies suggest potential symptom relief, but definitive anti-ulcer efficacy has not been established, and cautious use is advised [100]. Turmeric (curcumin) is also used for ulcer symptoms; small studies have reported improvement, yet the evidence base is preliminary and does not replace standard care [101]. Garlic, rich in organosulfur compounds, shows antibacterial activity against *H. pylori* in experimental studies and may be considered only as a supportive measure alongside prescribed therapy [102].

5. Challenges and Opportunities

Traditional medicine faces ongoing challenges related to evidence quality, standardization, and regulation. In many settings, high-quality clinical research (e.g., randomized trials and well-reported observational studies) remains limited, which complicates incorporation into mainstream care [103]. Biodiversity pressures, including overharvesting and habitat loss, together with variability in cultivation and preparation methods, can affect the quality, safety, and reproducibility of herbal products [104, 105]. Regulatory pathways are heterogeneous across countries, and approval and quality-control requirements can be difficult to meet without standardized processing and labelling [106]. Safety considerations include adverse effects,

herb–drug interactions, and occasional contamination/adulteration, underscoring the need for pharmacovigilance and clinician oversight [107].

At the same time, there are opportunities. Thoughtfully designed integrative models that pair conventional care with selected traditional therapies where evidence and safety permit may enhance culturally responsive, patient-centred care [108]. Medicinal plants remain an important source of bioactive leads for drug discovery and development [109]. With appropriate stewardship, integration efforts can also support sustainable cultivation and conservation, equitable benefit-sharing with local communities, and capacity-building/education for traditional healers and health professionals [110, 111].

6. Conclusion

In Sudan and elsewhere, medicinal herbs and traditional therapies are widely used for gastrointestinal and other internal complaints. Within these practices, some plants are taken to address symptoms or complications (e.g., colic, diarrhea), and many show in vitro antimicrobial/antiviral activity, though clinical relevance varies. The evidence base spans preclinical studies and small or pilot clinical trials, with relatively few robust randomized trials. Accordingly, while Sudanese communities commonly incorporate medicinal plants into care for gastrointestinal symptoms, current data support their use as adjuncts to, not replacements for, standard therapy, and further high-quality clinical trials are needed.

Declarations

Acknowledgments

None.

Ethical Considerations

Not applicable.

Competing Interests

None to declare.

Availability of Data and Materials

All data underlying this narrative review are available within the cited publications. No new datasets were generated or analyzed.

Funding

None.

Abbreviations and Symbols

HCV: Hepatitis C virus

AI Use Disclosure

QuillBot Grammar Checker was used only to assist with grammar and phrasing. All authors have critically reviewed and revised all AI-suggested text and accept full responsibility for the content. No AI was used for data collection, data analysis, drawing conclusions, or generating figures/tables.

Author Contributions

Concept or design of the work: AM, MAA, AM; Acquisition, analysis, or interpretation of data for the work: AM, HET; Drafting the work or reviewing it critically for important intellectual content: AM, HET, MAA, AM; Final approval of the version to be published: AM; Accountability for all aspects of the work: AM.

References

[1] Negrut, N., Khan, S. A., Bungao, S., Zaha, D. C., Anca, C. A. R., Bratu, O., Diaconu, C. C., & Ionita-Radu, F. (2020). Diagnostic challenges in gastrointestinal infections. *Romanian Journal of Military Medicine,123*(2), 83–90.

[2] Fikree, A., & Byrne, P. (2021). Management of functional gastrointestinal disorders. *Clinical Medicine, 21*(1), 44–52. https://doi.org/10.7861/clinmed.2020-0980

[3] Paul, J. (2024). Gastrointestinal tract infections. In *Disease causing microbes* (pp. 149–215). Springer. https://doi.org/10.1007/978-3-031-28567-7_4

[4] Mayer, E. A., Craske, M., & Naliboff, B. D. (2001). Depression, anxiety, and the gastrointestinal system. *The Journal of Clinical Psychiatry, 62*(Suppl 8), 28–36.

[5] Domagała-Rodacka, R., Cibor, D., Szczeklik, K., Rodakhi, T., Mach, T., & Owczarek, D. (2016). Gastrointestinal tract as a side-effect target of medications. *Przeglad Lekarski*, *73*(9), 652–658.

[6] Sands, B. E. (2004). From symptom to diagnosis: Clinical distinctions among various forms of intestinal inflammation. *Gastroenterology, 126*(6), 1518–1532. https://doi.org/10.1053/j.gastro.2004.02.072

[7] Mrouf, A., Albatish, I., Mosa, M., & Abu Naser, S. S. (2017). Knowledge based system for long-term abdominal pain (stomach pain) diagnosis and treatment. *International Journal of Engineering and Information Systems, 1*(4), 71–88.

[8] Ryabokon, E. V., Onishchenko, T. E., Furyk, E. A., & Mashko, O. P. (2014). *Infections diseases with fecai-oral transmission: Manual for practical training and independent work of students for the 5th year of the Medical Faculty on Infectious Diseases (Module No.1)*.

[9] Crum-Cianflone, N. F. (2008). Salmonellosis and the gastrointestinal tract: More than just peanut butter. *Current Gastroenterology Reports, 10*(4), 424–431. https://doi.org/10.1007/s11894-008-0079-7

[10] Eldam, A. G. (2004). *Tendency of patients towards medical treatment and traditional healing in Sudan*. Universität Oldenburg.

[11] Schulz, R. M., Ahuja, N. K., & Slavin, J. L. (2022). Effectiveness of nutritional ingredients on upper gastrointestinal conditions and symptoms: A narrative review. *Nutrients*, *14*(3), 672.

[12] Best, R. (2022) Mint and menthol: A review of potential health benefits and wider human effects. *Preprints*. https://doi.org/10.20944/preprints202212.0273.v1

[13] Hejna, M., Kovanda, L., Rossi, L., & Liu, Y. (2021). Mint oils: In vitro ability to perform anti-inflammatory, antioxidant, and antimicrobial activities and to enhance intestinal barrier integrity. *Antioxidants, 10*(7), 1004. https://doi.org/10.3390/antiox10071004

[14] Valussi, M. (2011). Functional foods with digestion-enhancing properties. *International Journal of Food Sciences and Nutrition. 63*(sup1), 82–89. https://doi.org/10.3109/09637486.2011.627841

[15] Al-Worafi, Y. M. Complementary and alternative medicine (CAM) in Sudan. In *Handbook of complementary, alternative, and integrative medicine* (pp. 364–394). CRC Press. https://doi.org/10.1201/9781003328759-20

[16] Silva, H. (2020). A descriptive overview of the medical uses given to Mentha aromatic herbs throughout history. *Biology, 9*(12), 484. https://doi.org/10.3390/biology9120484

[17] Khalid, H., Abdalla, W. E., Abdelgadir, H., Opatz, T., & Efferth, T. (2012). Gems from traditional North-African medicine: Medicinal and aromatic plants from Sudan. *Natural Products and Bioprospecting, 2*(3), 92–103. https://doi.org/10.1007/s13659-012-0015-2

[18] Al-Worafi, Y. M. (2025). Evidence-based complementary, alternative, and integrated medicine and efficacy and safety: Nausea and vomiting. In *Handbook of complementary, alternative, and integrative*

medicine (pp. 329–347). CRC Press.

[19] Madi, Y. F., Meselhy, M. R., El-Kashoury, E.-S. A., & Choucry, M. A. (2022). Morphological and anatomical characterization of *Cymbopogon citratus* (DC.) Stapf cultivated in Egypt. *Bulletin of Faculty of Pharmacy, Cairo University, 60*(1), 6. https://doi.org/10.54634/2090-9101.1032

[20] Gupta, R. C., Srivastava, A., & Lall, R. (2019). *Nutraceuticals in veterinary medicine* (Vol. 120). Springer. https://doi.org/10.1007/978-3-030-04624-8

[21] Nimenibo-Uadia, R., & Nwosu, E. (2020). Phytochemical, proximate, and mineral elements composition of lemongrass (*Cymbopogon citratus* (DC) Stapf) grown in EkoSodin, Benin City, Nigeria. *Nigerian Journal of Pharmaceutical and Applied Science Research, 9*(2), 52–56.

[22] Nambiar, V. S., & Matela, H. (2012). Potential functions of lemon grass (*Cymbopogon citratus*) in health and disease. *International Journal of Pharmaceutical and Biological Archives,3*(5), 1035–1043.

[23] Chen, H., Li, J., Zhao, Y., Sheng, J., Tian, Y., & Fan, Y. (2023). *Cymbopogon citratus* (DC.). The potential role of gut microbiome in animal gut-linked diseases.

[24] Gao, X., Hu, Y., Tao, Y., Liu, S., Chen, H., Li, J., Zhao, Y., Sheng, J., Tian, Y., & Fan, Y. (2022). *Cymbopogon citratus* (DC.) Stapf aqueous extract ameliorates loperamide-induced constipation in mice by promoting gastrointestinal motility and regulating the gut microbiota. *Frontiers in Microbiology, 13*, 1017804. https://doi.org/10.3389/fmicb.2022.1017804

[25] Oladeji, O. S., Adelowo, F. E., Ayodele, D. T., & Odelade, K. A. (2019). Phytochemistry and pharmacological activities of *Cymbopogon citratus*: A review. *Scientific African, 6*, e00137. https://doi.org/10.1016/j.sciaf.2019.e00137

[26] Shahrajabian, M. H., Sun, W., & Cheng, Q. (2019). Clinical aspects and health benefits of ginger (*Zingiber officinale*) in both traditional Chinese medicine and modern industry. *Acta Agriculturæ Scandinavica. Section B, Soil and Plant Science, 69*(6), 546–556. https://doi.org/10.1080/09064710.2019.1606930

[27] Ali, K., Flare, A., & Flinn, G. (2024). An overview of the traditional and modern applications of ginger. *Journal of Health Science and Research, 4*(10), 10–16. https://doi.org/10.5281/ZENODO.13254798

[28] Khodaie, L., & Sadeghpoor, O. (2015). Ginger from ancient times to the new outlook. *Jundishapur Journal of Natural Pharmaceutical Products, 10*(1), e18402. https://doi.org/10.17795/jjnpp-18402

[29] Wu, K.-L., Rayner, C. K., Chuah, S. K., Changchien, C. S., Lu, S. N., Chiu, Y. C., Chiu, K. W., & Lee, C. M. (2008). Effects of ginger on gastric emptying and motility in healthy humans. *European Journal of Gastroenterology & Hepatology, 20*(5), 436–440. https://doi.org/10.1097/MEG.0b013e3282f4b224

[30] Giacosa, A., Morazzoni, P., Bombardelli, E., Riva, A., Bianchi Porro, G., & Rondanelli, M. (2015). Can nausea and vomiting be treated with ginger extract? *European Review for Medical and Pharmacological Sciences, 19*(7), 1291–1296.

[31] Claudya, R. P., Sugiaman, H. A., Labiba, S. I., Utari, M. P., & Gunawan, D. (2023). The therapeutic effects of ginger extract on gastrointestinal disorders to adults. *Science Midwifery, 11*(1), 251–261. https://doi.org/10.35335/midwifery.v11i1.1183

[32] Temmante, K., Chaachouay, N., Benkhingue. O., & Azeroul. A. (2025). Ginger *(Zingiber officinale Roscoe Zingiberaceae)*. In *Comprehensive guide to hallucinogenic plants* (pp. 394–410). CRC Press.

[33] Javed, K., Rasheed, M., Farrukh, N., Niaz, S., Hameed, T., Maqsood, M. A., Sabir, A., Javed, M., Asghar, A., & Shafi, N. (2024). Use of 6-Gingerol as potential prebiotics to promote gut health. *Complementary and Alternative Medicine: Prebiotics and Probiotics*, 75–81.

[34] Haniadka, R., Saldanha, E., Sunita, V., Palatty, P. L., Fayad, R., & Baliga, M. S. (2013). A review of the gastroprotective effects of ginger (*Zingiber*

officinale Roscoe). *Food & Function,4*(6), 845–855. https://doi.org/10.1039/c3fo30337c

[35] Lin, R. J., Chen, C. Y., Lu, C. M., Ma, Y. H., Chung, L. Y., Wang, J. J., Lee, J. D., & Yen, C. M. (2014). Anthelmintic constituents from ginger (*Zingiber officinale*) against *Hymenolepis nana*. *Acta Tropica, 140*, 50–60. https://doi.org/10.1016/j.actatropica.2014.07.009

[36] Saxena, R., Sulakhiya, K. B., & Rathore, M. (2014). *Cichorium intibus* Linn.: A review of pharmacological profile. *International Journal of Current Pharmaceutical Research, 6*(4), 11–15.

[37] Das, S., Vasudeva, N., & Sharma, S. (2016). *Cichorium intybus*: A concise report on its ethnomedicinal, botanical, and phytopharmacological aspects. *Drug Development and Therapeutics, 7*(1), 1–12. https://doi.org/10.4103/2394-6555.180157

[38] Janda, K., Gutowska, I., Geszke-Moritz, M., & Jakubczyk, K. (2021). The common cichory (*Cichorium intybus* L.) as a source of extracts with health-promoting properties—A review. *Molecules, 26*(6), 1814. https://doi.org/10.3390/molecules26061814

[39] Ozturk, M., Altay, V., & Younessi-Hamzekhanlu, M. (2023). Traditional and modern medicinal uses of *Cichorium intybus* roots. In R. K. Bachheti & A. Bachheti (Eds.), *Medicinal roots and tubers for pharmaceutical and commercial applications* (1st ed., p. 101). CRC Press. https://doi.org/10.1201/b22924

[40] Mehvish, S., & Barkat, M. Q. (2018). Phytochemical and antioxidant screening of *Amomum subulatum*, *Elettaria cardamomum*, *Emblica officinalis*, *Rosa damascene*, *Santalum album* and *Valeriana officinalis* and their effect on stomach, liver and heart. *Matrix Science Pharma, 2*(2), 21–26. https://doi.org/10.26480/msp.02.2018.21.26

[41] Qiblawi, S., Kausar, M. A., Shahid, S. M. A., Saeed, M., & Alazzeh, A. Y. (2020). Therapeutic interventions of cardamom in cancer and other human diseases. *Journal of Pharmaceutical Research International, 32*(22), 74–84. https://doi.org/10.9734/jpri/2020/v32i2230774

[42] Khatiban, M., Mirzaie, M., Fazeli, A., Tapak, L., & Khalili, Z. (2022). Effect of cardamom inhalation therapy on intra-and postoperative nausea and vomiting of mothers undergoing spinal anesthesia for elective cesarean section. *Journal of Perianesthesia Nursing, 37*(4), 452–457. https://doi.org/10.1016/j.jopan.2021.09.008

[43] Banerjee, S., & Bose, S. (2024). Role of the Indian spice cardamom (*Elettaria cardamomum*) in natural and herbal medicine. In *Medicinal spices and herbs from India* (pp. 299–313). Apple Academic Press. https://doi.org/10.1201/9781003511694-16

[44] Heam, T. (2022). *Effects of administration clove (Syzygium aromaticum) and cardamom (Elettaria cardamomum) extract and their combination via drinking water on performances and blood parameters of white leghorn.* Haramaya University. https://afribary.com/works/effects-of-administration-clove-syzygium-aromaticum-and-cardamom-elettaria-cardamomum-extract-and-their-combination-via-drinking-water-on-performances-and-blood-parameters-of-white-leghorn-la

[45] Ndamitso, M., Mustapha, S., Etsuyankpa, B. M., & Alexander, A. I. (2017). Evaluation of chemical composition of *Acacia nilotica* seeds. *FUW Trends in Science & Technology Journal, 2*(2), 927–931.

[46] Sadiq, M. B., Tharaphan, P., Chotivanich, K., Tarning, J., & Anal, A. K. (2017). In vitro antioxidant and antimalarial activities of leaves, pods and bark extracts of *Acacia nilotica* (L.) Del. *BMC Complementary and Alternative Medicine, 17*(1), 372. https://doi.org/10.1186/s12906-017-1878-x

[47] Koubé, J., Dongmo, S. S., Guiama. V. D., Bum, E. N. (2016). Ethnomedicinal survey of Gavdé (*Acacia nilotica*): A medicinal plant used in Sahelian zone of Cameroon, Central Africa. *International Journal of*

Innovation and Applied Studies, 16(4), 820–827.

[48] Badar, N., Iqbal, Z., Khan, M. N., & Akhtar, M.S. (2011). *In vitro* and *in vivo* anthelmintic activity of *Acacia nilotica* (L.) willd. ex delile bark and leaves. *Pakistan Veterinary Journal, 31*(3), 185–191.

[49] Bansal, V. K., & Goel, R. K. (2012). Gastroprotective effect of *Acacia nilotica* young seedless pod extract: Role of polyphenolic constituents. *Asian Pacific Journal of Tropical Medicine, 5*(7), 523–528. https://doi.org/10.1016/S1995-7645(12)60092-3

[50] Amadou, I., Soulé, M., & Salé, A. (2020). An overview on the importance of *Acacia nilotica* (L.) willd. ex del.: A review. *Asian Journal of Research in Agriculture and Forestry, 5*(3), 12–18. https://doi.org/10.9734/ajraf/2020/v5i330085

[51] Hafez, L. O., Brito-Casillas, Y., Abdelmageed, N., Alemán-Cabrera, I. M., Morad, S. A. F., Abdel-Raheem, M. H., & Wägner, A. M. (2024). The acacia (*Vachellia nilotica* (L.) P.J.H. Hurter & Mabb.): Traditional uses and recent advances on its pharmacological attributes and potential activities. *Nutrients, 16*(24), 4278. https://doi.org/10.3390/nu16244278

[52] Mahmood, N., & Yahya, K. (2017). Nutrient and phytochemical of fenugreek (*Trigonella foenum* graecum) seeds. *International Journal of Sciences, Basic and Applied Research, 36*(3), 203–213.

[53] Krayem, M., Baydoun, M., Khaled, S., El Khatib, S., & Nasrallah, K. (2025). Nutritional, biochemical composition and health benefits of fenugreek plant and its applications in food industry: A review. In *Natural products* (pp. 1–20). Springer. https://doi.org/10.1007/978-3-642-36202-6_280-1

[54] Dhull, S.B., Chandak, A., Bamal, P., Malik, A., & Kidwai, M.K. (2021). Fenugreek (*Trigonella foenum-graecum*): Nutritional, health properties and food uses. In M. Naeem, T. Aftab, M. M. A. Khan (Eds.) *Fenugreek*. Springer. https://doi.org/10.1007/978-981-16-1197-1_10

[55] Mehrafarin, A., Qaderi, A., Rezazadeh, Sh., Naghdi, B. H., Noorhammadi, Gh., & Zand, E. (2010). Bioengineering of important secondary metabolites and metabolic pathways in fenugreek (*Trigonella foenum-graecum* L.). *Journal of Medicinal Plants, 9*(35), 1–18.

[56] Thakurdesai, A. (2023). *P.,* Characterization, preclinical efficacy and toxicity evaluations of flavonoids glycosides based standardized fenugreek seed extract FEFLG. *Pharmacognosy Journal, 15*(1), 90–105. https://doi.org/10.5530/pj.2023.15.13

[57] Singh, U., Chamoli, M., Singh, K. P., Ram, L., Jangir, S., Maheshwari, R. K. (2022). Amazing health benefit of fenugreek (*Trigonella foenum-graecum* LINN.). *International Journal of Environment and Health Sciences, 4*(2), 19–27. https://doi.org/10.47062/1190.0402.03

[58] Srinivasan, K. (2006). Fenugreek (*Trigonella foenum-graecum*): A review of health beneficial physiological effects. *Food Reviews International, 22*(2), 203–224. https://doi.org/10.1080/87559120600586315

[59] DiSilvestro, R. A., Verbruggen, M. A., & Offutt, E. J. (2011). Anti-heartburn effects of a fenugreek fiber product. *Phytotherapy Research, 25*(1), 88–91. https://doi.org/10.1002/ptr.3229

[60] Mandegary, A., Pournamdari, M., Sharififar, F., Pournourmohammadi, S., Fardiar, R., & Shooli, S. (2012). Alkaloid and flavonoid rich fractions of fenugreek seeds (*Trigonella foenum-graecum* L.) with antinociceptive and anti-inflammatory effects. *Food and Chemical Toxicology, 50*(7), 2503–2507. https://doi.org/10.1016/j.fct.2012.04.020

[61] Isaakidis, A., Maghariki, J. E., Carvalho-Barros, S., Gomes, A. M., & Correia, M. (2023). Is there more to olive oil than healthy lipids? *Nutrients, 15*(16), 3625. https://doi.org/10.3390/nu15163625

[62] Schirone, L., Overi, D., Carpino, G., Carnevale, R., De Falco, E., Nocella, C., D'Amico, A., Bartimoccia, S., Cammisotto, V., Castellani, V., Frati, G., Sciarretta, S., Gaudio, E., Pignatelli, P., Alvaro, D., & Violi, F. (2024). Oleuropein, a component of extra virgin olive

oil, improves liver steatosis and lobular inflammation by lipopolysaccharides–tlr4 axis downregulation. *International Journal of Molecular Sciences, 25*(11), 5580. https://doi.org/10.3390/ijms25115580

[63] Tafti, L. D., Shariatpanahi, S. M., Damghani, M. M., & Javadi, B. (2017). Traditional Persian topical medications for gastrointestinal diseases. *Iranian Journal of Basic Medical Sciences, 20*(3), 222–241.

[64] Kaur, R., Sood, A., Kanotra, M., Arora, S., Subramaniyan, V., Bhatia, S., Al-Harrasi, A., Aleya, L., & Behl, T. (2021). Pertinence of nutriments for a stalwart body. *Environmental Science and Pollution Research International, 28*(39), 54531–54550. https://doi.org/10.1007/s11356-021-16060-1

[65] Bartolí, R., Fernández-Ba nares, F., Navarro, E., Castellà, E., Ma né, J., Alvarez, M., Pastor, C., Cabré, E., & Gassull, M. A. (2000). Effect of olive oil on early and late events of colon carcinogenesis in rats: Modulation of arachidonic acid metabolism and local prostaglandin E(2) synthesis. *Gut, 46*(2), 191–199. https://doi.org/10.1136/gut.46.2.191

[66] Hamidpour, R., Hamidpour, S., Hamidpour, M., & Shahlari, M. (2013). Frankincense (rǔ xiāng; *Boswellia* species): From the selection of traditional applications to the novel phytotherapy for the prevention and treatment of serious diseases. *Journal of Traditional and Complementary Medicine, 3*(4), 221–226. https://doi.org/10.4103/2225-4110.119723

[67] Abdelwahab, S. I., Taha, M. M. E., Jerah, A. A., Farasani, A., Abdullah, S. M., Aljahdali, I. A., Oraibi, O., Oraibi, B., Alfaifi, H. A., Alzahrani, A. H., & Babiker, Y. O. H. (2024). Insights into frankincense and myrrh research: A comprehensive analytical study of patterns and perspectives. *Heliyon, 10*(19), e38102. https://doi.org/10.1016/j.heliyon.2024.e38102

[68] Almeida-da-Silva, C. L. C., Sivakumar, N., Asadi, H., Chang-Chien, A., Qoronfleh, M. W., Ojcius, D. M., & Essa, M. M. (2022). Effects of frankincense compounds on infection, inflammation, and oral health. *Molecules, 27*(13), 4174. https://doi.org/10.3390/molecules27134174

[69] Su, S., Duan, J., Chen, T., Huang, X., Shang, E., Yu, L., Wei, K., Zhu, Y., Guo, J., Guo, S., Liu, P., Qian, D., & Tang, Y. (2015). Frankincense and myrrh suppress inflammation via regulation of the metabolic profiling and the MAPK signaling pathway. *Scientific Reports, 5*, 13668. https://doi.org/10.1038/srep13668

[70] Suther, C., Daddi, L., Bokoliya, S., Panier, H., Liu, Z., Lin, Q., Han, Y., Chen, K., Moore, M. D., & Zhou, Y. (2022). Dietary *Boswellia serrata* acid alters the gut microbiome and blood metabolites in experimental models. *Nutrients, 14*(4), 814. https://doi.org/10.3390/nu14040814

[71] Al-Yasiry, A. R., & Kiczorowska, B. (2016). Frankincense—Therapeutic properties. *Postępy Higieny i Medycyny Doświadczalnej, 70*, 380–391. https://doi.org/10.5604/17322693.1200553

[72] Khamis, G., Saleh, A. M., Habeeb, T. H., Hozzein, W. N., Wadaan, M. A. M., Papenbrock, J., & AbdElgawad, H. (2020). Provenance effect on bioactive phytochemicals and nutritional and health benefits of the desert date *Balanites aegyptiaca*. *Journal of Food Biochemistry, 44*(6), e13229. https://doi.org/10.1111/jfbc.13229

[73] Murthy, H. N., Yadav, G. G., Dewir, Y. H., & Ibrahim, A. (2020). Phytochemicals and biological activity of desert date (*Balanites aegyptiaca* (L.) Delile). *Plants, 10*(1), 32. https://doi.org/10.3390/plants10010032

[74] Friday, O. A., Ojuto, E. M., Abraham, G. T., & Oneh, A. J. (2022). Comparative evaluation of amino acid profile and in vitro antioxidant activity of *Balanites aeqyptiaca* (L.) delile meal, defatted and concentrate. *Journal of Food Chemistry and Nanotechnology, 8*(4), 201–210.

[75] Mariod, A. A., & AhmedIsmail, E. M. (2022). Biological activities of *Balanites aegyptiaca* (Heglig) kernel oil. In *Multiple biological activities of unconventional seed oils* (pp. 339–344). Elsevier.

[76] Isa, M. (2021). Laboratory assessment of molluscicidal and cercaricidal activities of *Balanites aegyptiaca* against vectors of schistosomiasis (*Biomphalaria pfeifferi*). *International Journal of Research and Review, 8*(5), 479–486. https://doi.org/10.52403/ijrr.20210558

[77] Dey, H., & Shaili, S. (2023). Exploring the phytochemical diversity and pharmacological potentials of *Balanite aegyptiaca*: A review. *International Journal of Newgen Research in Pharmacy & Healthcare, 1*(2), 53–63. https://doi.org/10.61554/ijnrph.v1i2.2023.34

[78] Al Faki Adam, I. A. (2019). The role of wild fruits in mitigating hunger. In A. Mariod (Ed.), *Wild fruits: Composition, nutritional value and products*. Springer. https://doi.org/10.1007/978-3-030-31885-7_1

[79] Ya'u, J., Abdulmalik, U. N., Yaro, A. H., Chindo, B. A., Anuka, J. A., & Hussaini, I. M. (2011). Behavioral properties of *Balanites aegyptiaca* in rodents. *Journal of Ethnopharmacology,135*(3), 725–729. https://doi.org/10.1016/j.jep.2011.04.003

[80] Hassan, L. E. A., Dahham, S. S., Saghir, S. A., Mohammed, A. M., Eltayeb, N. M., Majid, A. M., & Majid, A. S. (2016). Chemotherapeutic potentials of the stem bark of *Balanite aegyptiaca* (L.) Delile: An antiangiogenic, antitumor and antioxidant agent. *BMC Complementary and Alternative Medicine, 16*(1), 396. https://doi.org/10.1186/s12906-016-1369-5

[81] Abbas, M. W., Shamshad, T., Ashraf, M., & Javaid, R. (2016). Jaundice: A basic review. *International Journal of Research in Medical Sciences, 4*(5), 1313–1319. https://doi.org/10.18203/2320-6012.ijrms20161196

[82] Thomas, H. C., Lok, A. S. F., Locarnini, S. A., & Zuckerman, A. J. (2013). *Viral hepatitis*. John Wiley & Sons. https://doi.org/10.1002/9781118637272

[83] Ali, S. A., Sharief, N. H., & Mohamed, Y. S. (2019). Hepatoprotective activity of some medicinal plants in Sudan. *Evidence-Based Complementary and Alternative Medicine: eCAM, 2019*(1), 2196315. https://doi.org/10.1155/2019/2196315

[84] Tewari, D., Mocan, A., Parvanov, E. D., Sah, A. N., Nabavi, S. M., Huminiecki, L., Ma, Z. F., Lee, Y. Y., Horbańczuk, J. O., & Atanasov, A. G. (2017). Ethnopharmacological approaches for therapy of jaundice: Part I. *Frontiers in Pharmacology, 8*, 518. https://doi.org/10.3389/fphar.2017.00518

[85] Kumar, K. P. S., Bhowmik, D., Biswajit, Chiranjib, Pankaj, Tripathi, K. K., & Chandira, M. (2010). Traditional Indian herbal plants tulsi and its medicinal importance. *Research Journal of Pharmacognosy and Phytochemistry, 2*(2), 93–101.

[86] Crabb, C. (2004). Science meets tradition and identifies herbal treatment for jaundice. *Bulletin of the World Health Organization, 82*(2), 154.

[87] Tobyn, G., Denham, A., & Whitelegg, M. (2011). *Artemisia absinthium*, wormwood. In *The Western herbal tradition: 2000 years of medicinal plant knowledge* (1st ed., pp. 105–121). London, UK: Singing Dragon.

[88] Mariod, A., Mohamedain, A., & Tahir, H. E. (2023). Medicinal plants and phytomedicines are used to treat or prevent illnesses in Sudan: A review. *Traditional Medicine Research, 8*(1), 3. https://doi.org/10.53388/TMR20220323003

[89] Fangbo, A., Wilfred, N. D., Joseph, C. N., Mbaiguinam, M., & Nicolas, N. Y. (2024). Production, nutritional value and toxicity of Kawal, a fermented product from the leaves of *Cassia obtusifolia* (L.): A review. *European Journal of Nutrition & Food Safety, 16*(2), 30–41. https://doi.org/10.9734/ejnfs/2024/v16i21385

[90] Yagi, S., Tigani, S. E., & Adam, S. (1998). Toxicity of *Senna obtusifolia* fresh and fermented leaves (kawal), *Senna alata* leaves and some products from *Senna alata* on rats. *Phytotherapy Research, 12*(5), 324–330. https://doi.org/10.1002/(SICI)1099-1573(199808)12:5<324::AID-PTR300>3.0.CO;2-2

[91] Bauer, B., & Meyer, T. F. (2011). The human gastric pathogen *Helicobacter pylori* and its association

with gastric cancer and ulcer disease. *Ulcers, 2011*(1), 340157.

[92] Ghasemian, A., Fattahi, A., Shokouhi Mostafavi, S. K., Almarzoqi, A. H., Memariani, M., Ben Braiek, O., Yassine, H. M., Mostafavi, N. S. S., Ahmed, M. M., & Mirforughi, S. A. (2019). Herbal medicine as an auspicious therapeutic approach for the eradication of *Helicobacter pylori* infection: A concise review. *Journal of Cellular Physiology, 234*(10), 16847–16860. https://doi.org/10.1002/jcp.28363

[93] Stoicov, C., Saffari, R., & Houghton, J. (2009). Green tea inhibits *Helicobacter* growth in vivo and in vitro. *International Journal of Antimicrobial Agents, 33*(5), 473–478. https://doi.org/10.1016/j.ijantimicag.2008.10.032

[94] Panahi, Y., Khedmat, H., Valizadegan, G., Mohtashami, R., & Sahebkar, A. (2015). Efficacy and safety of *Aloe vera* syrup for the treatment of gastroesophageal reflux disease: A pilot randomized positive-controlled trial. *Journal of Traditional Chinese Medicine, 35*(6), 632–636. https://doi.org/10.1016/S0254-6272(15)30151-5

[95] Yahya, R., Al-Rajhi, A. M. H., Alzaid, S. Z., Al Abboud, M. A., Almuhayawi, M. S., Al Jaouni, S. K., Selim, S., Ismail, K. S., & Abdelghany, T. M. (2022). Molecular docking and efficacy of *Aloe vera* gel based on chitosan nanoparticles against *Helicobacter pylori* and its antioxidant and anti-inflammatory activities. *Polymers, 14*(15), 2994. https://doi.org/10.3390/polym14152994

[96] Imoto, I., Yasuma, T., D'Alessandro-Gabazza, C. N., Oka, S., Misaki, M., Horiki, N., & Gabazza, E. C. (2023). Antimicrobial effects of lactoferrin against *Helicobacter pylori* infection. *Pathogens, 12*(4), 599. https://doi.org/10.3390/pathogens12040599

[97] El-Sherbiny, G. M., & Elbestawy, M. K. (2022). A review–Plant essential oils active against *Helicobacter pylori*. *The Journal of Essential Oil Research, 34*(3), 203–215. https://doi.org/10.1080/10412905.2022.2025464

[98] Ravisankar, P., Koushik, O. S., Reddy, A. A., Kumar, U. E., Anvith, P. S., & Pragna, P. (2016). A detailed analysis on acidity and ulcers in esophagus, gastric and duodenal ulcers and management. *IOSR Journal of Dental and Medical Sciences (IOSR-JDMS)*, *15*(1), 94–114. https://doi.org/10.9790/0853-1511094114

[99] Oppong, P., Majumdar, D., Atherton, J., & Bebb, J. (2015). *Helicobacter pylori* infection and peptic ulcers. *Medicine, 43*(4), 215–222. https://doi.org/10.1016/j.mpmed.2015.01.008

[100] Nikkhah Bodagh, M., Maleki, I., & Hekmatdoost, A. (2018). Ginger in gastrointestinal disorders: A systematic review of clinical trials. *Food Science & Nutrition, 7*(1), 96–108. https://doi.org/10.1002/fsn3.807

[101] Thavorn, K., Mamdani, M. M., & Straus, S. E. (2014). Efficacy of turmeric in the treatment of digestive disorders: A systematic review and meta-analysis protocol. *Systematic Reviews, 3*(1), 71. https://doi.org/10.1186/2046-4053-3-71

[102] Hussein, H. J., Hameed, I. H., & Hadi, M. Y. (2017). A review: Anti-microbial, anti-inflammatory effect and cardiovascular effects of garlic: *Allium sativum*. *Research Journal of Pharmacy and Technology, 10*(11), 4069–4078. https://doi.org/10.5958/0974-360X.2017.00738.7

[103] Gagnier JJ, Boon H, Rochon P, Moher D, Barnes J, Bombardier C; CONSORT Group. Reporting randomized, controlled trials of herbal interventions: an elaborated CONSORT statement. Ann Intern Med. 2006 Mar 7;144(5):364-7. https://doi.org/10.7326/0003-4819-144-5-200603070-00013

[104] Chen, S. L., Yu, H., Luo, H. M., Wu, Q., Li, C. F., & Steinmetz, A. (2016). Conservation and sustainable use of medicinal plants: Problems, progress, and prospects. *Chinese Medicine*, *11*, 37. https://doi.org/10.1186/s13020-016-0108-7

[105] Noviana, E., Indrayanto, G., & Rohman, A. (2022). Advances in fingerprint analysis for standardization and quality control of herbal

medicines. *Frontiers in Pharmacology*, *13*, 853023. https://doi.org/10.3389/fphar.2022.853023

[106] Dubale, S., Usure, R. E., Mekasha, Y. T., Hasen, G., Hafiz, F., Kebebe, D., & Suleman, S. (2025). Traditional herbal medicine legislative and regulatory framework: A cross-sectional quantitative study and archival review perspectives. *Frontiers in Pharmacology*, *16*, 1475297. https://doi.org/10.3389/fphar.2025.1475297

[107] Izzo, A. A., Hoon-Kim, S., Radhakrishnan, R., & Williamson, E. M. (2016). A critical approach to evaluating clinical efficacy, adverse events and drug interactions of herbal remedies. *Phytotherapy Research*, *30*(5), 691–700. https://doi.org/10.1002/ptr.5591

[108] Jama, N., Nyembezi, A., Ngcobo, S., & Lehmann, U. (2024). Collaboration between traditional health practitioners and biomedical health practitioners: Scoping review. *African Journal of Primary Health Care & Family Medicine, 16*(1), 11. https://doi.org/10.4102/phcfm.v16i1.4430

[109] Newman, D. J., & Cragg, G. M. (2020). Natural products as sources of new drugs over the nearly four decades from 01/1981 to 09/2019. *Journal of Natural Products*, *83*(3), 770–803. https://doi.org/10.1021/acs.jnatprod.9b01285

[110] Smith-Hall, C., Pyakurel, D., Meilby, H., Pouliot, M., Ghimire, P. L., Ghimire, S., Madsen, S. T., Paneru, Y. R., Subedi, B. P., Timoshyna, A., & Treue, T. (2023). The sustainability of trade in wild plants – A data-integration approach tested on critically endangered *Nardostachys jatamansi*. *PNAS Nexus*, *2*, pgad328. https://doi.org/10.1093/pnasnexus/pgad328

[111] Moeta, M., Musie, M., Seretlo, R., Ledimo, M., Rasweswe, M., Makhavhu, E., & Mulaudzi, F. (2023). Traditional health practitioners' training needs on biomedical knowledge and skills in a South African township. *African Journal of Primary Health Care & Family Medicine, 15*(1), 9. https://doi.org/10.4102/phcfm.v15i1.3923