



# The Use of *Ocimum gratissimum* L. in the Treatment of Gastrointestinal Ailments

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## Abstract

Diseases that affect the digestive tract are referred to as Gastrointestinal ailments. Gastrointestinal (GI) ailments contribute substantially to healthcare costs all over the world. *Ocimum gratissimum*, commonly known as African basil is a well-known medicinal herb with a wide therapeutic potential. In most West African homes, it is employed as a home remedy for treating GI ailments such as diarrhoea, colitis, stomach ulcers, bloating, among several other conditions. Anecdotal reports support its efficacy in the treatment of these disease conditions. This review summarizes ethnomedicinal data for the use of *O. gratissimum* in the management of gastrointestinal ailments, and its potential clinical application based on its pharmacological activity.

**Keywords:** *Ocimum gratissimum*, African Basil, Gastrointestinal Ailments, Pharmacological Activity

## 1. Introduction

A gastrointestinal (GI) ailment is a term encompassing various conditions affecting the gastrointestinal tract, which may commonly manifest itself as unformed stools. These ailments can be caused by both infectious and non-infectious agents<sup>1</sup>. In the United States for example, the annual cost associated with the treatment of GI ailments for the year 2015 totalled \$135.9 billion, an amount greater than most diseases. The diseases accounting for this cost included hepatitis, oesophageal disorders, biliary tract disease, abdominal pain, and inflammatory bowel disease. Annually, ambulatory visits that are related to GI ailments exceed 54.4 million, of which three million were hospital admissions<sup>2</sup>. Diarrhoea is also a major GI problem among children. Approximately 1.87 million children are known to die from diarrhoea before turning 5 years<sup>3</sup>. Diarrhoeal diseases account for one-fifth of child deaths, 78% of which are concentrated in South East Asian and Africa.

GI ailments are particularly high in poverty-stricken areas on the African continent<sup>3</sup> and in Asia<sup>4</sup>.

Herbal remedies have a long history of use in the treatment of various diseases<sup>5</sup>, and these are the most reliable sources of traditional medicine<sup>6</sup>. They tend to be readily available. It will therefore be appropriate to investigate them in order to establish such readily available and efficacious medicines. *Ocimum gratissimum*, which is commonly called clove basil or African basil is a polymorphic branched, shrub with aromatic properties. It develops up to a height of 3 m and belongs to the family Lamiaceae<sup>7</sup>. The herb is mostly found in the tropical, subtropical regions, and it is native to South Asia, Africa, South America, Polynesia, Bismarck Archipelago, Brazil, and the West Indies<sup>8-11</sup>. This plant is found both in the wild and in cultivation<sup>8</sup>. The plant has opposite decussate leaves with slender and pubescent petiole of length ranging from 2 to 4.5 cm. The leaf has an elliptical to ovate shape and often darker adaxially<sup>12</sup>.

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The whole plant, but more especially the leaves, seeds, and flowers are consumed for ethnomedicinal reasons. This plant is also consumed as a nutritional supplement and also used for flavouring meals in many tropical, subtropical, as well as temperate countries<sup>13</sup>. *O. gratissimum* is a popular plant medicine used widely in the treatment of numerous ailments<sup>13</sup>. The juice obtained from the leaves is used to treat malaria fever and snake bites<sup>14</sup>. Studies have shown the dry leaves to have better disease preventive properties in comparison to the fresh leaves<sup>13-16</sup>. All parts of the plant are together employed in treating influenza, dysmenorrhea, abscess, headache, dystocia, sunstroke, vomiting, and used after child birth to eliminate blood clots<sup>16</sup>. The volatile oil obtained from it is employed in the treatment of ear or eye disorders, stomach ache, fever, diarrhoea, throat inflammations, and skin diseases<sup>7</sup>. The plant has been scientifically investigated for its antibiotic, antioxidant, antimalarial, antidiarrheal, anticarcinogenic, antidiabetic, insecticidal, antimutagenic, antiurolithiatic, as well as activities in the treatment of gastrointestinal problems, and gonorrhoea<sup>13,16-18</sup>.

*O. gratissimum* is known to have a variety of phytoconstituents such as polyphenols and flavonoids. It also contains volatile compounds like eugenol, thymol, and geraniol<sup>11</sup>. The aqueous, methanolic and ethanolic extracts have been reported to have similar constituents such as terpenoids, tannins, flavonoids, saponins, alkaloids, insulins, phenolic compounds, betacarotene, glycosides, carotenoids, reducing sugars, phlobatannins, anthraquinones, deoxy-sugar polyphenols, quinones, coumarins and catechins and cardiac glycosides with a steroidal ring<sup>7,13,19,20</sup> to be present in the hexane, chloroform and methanol fractions. The young leaves has been shown to possess the highest phenol content and the petroleum ether extract of mature leaves the highest flavonoids<sup>21</sup>. The analysis of the whole plant have shown the presence of essential oils, thymol, p-cymene,  $\gamma$ -terpene, t-sabiene hydrate,  $\beta$ -phellandrene, limonene, eugenol, eugenol spathulenol, geraniol, eugenol-murolene, 1,8-cineole, germacrene-D, gratissimol and  $\beta$ -caryophyllene and external flavones mainly xantomicrol, beta-selinene and cirsimaritin<sup>22,23</sup>. The plant-seed mucilage contains pentoses, hexoses, uronicacid, lipids and essential oil thymol and eugenol<sup>24</sup>.

## 2. Methodology

Published literature on *O. gratissimum* were accessed from electronic search engines including Google Scholar, Science Direct, SciFinder, Wiley, Academic Journals and Scopus from December 2020 to

January 2021. Keywords used in the search included *O. gratissimum*, phytochemistry, bioactive compounds and pharmacological activities. Relevant information to the use of *O. gratissimum* in GI conditions was extracted and reviewed.

## 3. Ethno Medicinal Usage of *O. gratissimum* L. in Gastrointestinal Ailments

Table 1 summarizes the reported uses of *O. gratissimum* in the treatment of various ailments related to the gastrointestinal system. Figure 1 displays a picture of leaves and flowers of *Ocimum gratissimum*.

## 4. The Pharmacological Activity of *O. gratissimum* related to Gastrointestinal Ailments

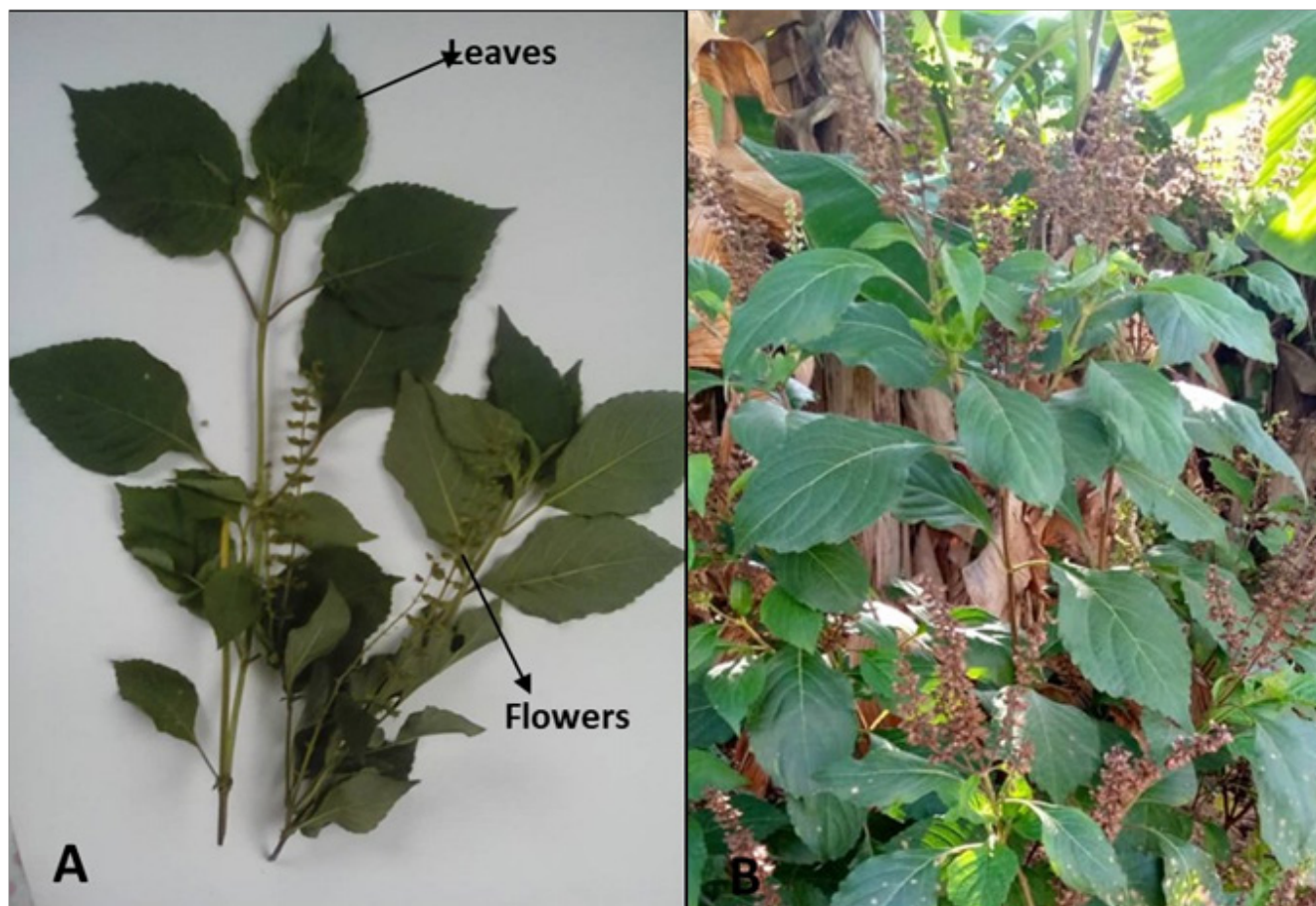
Several studies have reported the activity of various extracts of *O. gratissimum* against pathogenic bacteria that are implicated in gastrointestinal related infections, inflammation, and ulcers. Details of these studies are provided in Table 2. These reported pharmacological activities support the possible efficacy of *O. gratissimum* in treating GI ailments such as enteritis, colitis, worm infestation, and peptic ulcer disease.

## 5. Conclusion

In conclusion, *O. Gratissimum* L. is a plant of great value and potential, especially in its use as a treatment option for various gastrointestinal conditions. Its traditional use for the treatment or management of many GI ailments worldwide has been supported by *in vitro* and *in vivo* experiments. Its worldwide availability as well as its many uses in traditional medicine makes *O. gratissimum* a good candidate for drug discovery studies for novel bioactive compounds that could be useful for the treatment of gastrointestinal diseases.

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**Figure 1.** Picture of leaves and flowers of *Ocimum gratissimum*.

**Table 1.** Demographic characteristics of the study sample

Disease	Region	Preparation	References
Diarrhoea	Nigeria	Aqueous decoction, leaf macerates and cold infusion of the leaves	9, 10, 13, 25,26
Dysentery	Africa	Leaves decoction	13
Stomach ache	South Asia	Whole plant decoction	13
Indigestion	India	Fresh leaf juice	15
Stomach disorders	India	Leaf decoction	15, 26
Inflammatory bowel diseases	Nigeria	Leaves decoction	27, 28
Peptic ulcer	Nigeria	Aerial parts decoction	29

**Table 2.** Pharmacological activities of *O. gratissimum* relevant to the management of gastrointestinal ailments

Pharmacological activity	Plant part/ Extract	Activity	Comment
<b>Antimicrobial activity</b>	Ethanol and hexane fraction of leaf	Active against <i>Vibrio cholera</i> and <i>Escherichia coli</i> <sup>28,30</sup> .	Activity against these pathogenic organisms that are highly correlated to gastrointestinal infections could be an indication of the efficacy of the plant in diarrheal treatment <sup>30</sup> . These bacteria infect the gut leading to stomach and intestinal inflammation <sup>30</sup> . The antibacterial effects of the oil could be due to the cell membrane disruption of microorganisms <sup>31</sup> .
	Leaf oil	Active against virulent strains of <i>Staphylococcus aureus</i> , <i>Escherichia coli</i> , <i>Salmonella typhimurium</i> , and <i>Shigella flexneri</i> <sup>31,32</sup> .	
	Leaf extract	Active against <i>Staphylococcus aureus</i> , <i>Salmonella enteritidis</i> , <i>Plesiomonas shigelloides</i> , <i>Escherichia coli</i> , <i>Klebsiella sp.</i> , <i>Proteus mirabilis</i> , <i>Aeromonas sobria</i> , <i>Shigella flexneri</i> and <i>Shigella dysenteriae</i> <sup>33,34</sup> .	
<b>Anti-ulcerogenic activity</b>	Methanol extracts of leaves	Protects against ulcers induced by different ulcerogens <sup>15</sup> .	The methanolic and aqueous extracts have gastro-protective properties and antiulcer properties against various ulcerogens, thus justifying the ethno medicinal use of the plant in the treatment of ulcer <sup>35</sup> .
	Aqueous infusion of leaves	Decreases gastric motility, inhibits the contractile effect of histamine, relaxation of spontaneous contraction <sup>36</sup> .	
	Methanol leaves extract	Minimizes ulcer score and ulcer index, and also increases the percentage of superoxide dismutase in the treated experimental animals <sup>37</sup> . The methanol extract of the leaf of <i>O. gratissimum</i> offers protection against ulcers caused by stress and indomethacin <sup>35</sup> .	
	Aqueous leaf extract	Significantly reduces ulcer formation, gastric secretion volume, and dose-dependent acid output. The aqueous extract of the leaf also reduced parietal cell mass while luminal pH and gastric mucous cell population increased accordingly upon comparison with the control group. Data were comparable to the antisecretory effect of omeprazole <sup>38</sup> .	

Table 2 continued.

<b>Anti-inflammatory activity</b>	Aqueous leaf extract	The extract significantly caused a dose-dependent inhibition of pain induced by acetic acid-induced and heat. The extract showed significant anti-inflammatory effect at all the tested doses <sup>39</sup> .	The extract contains pharmacologically active principles that supports its use to manage pain and inflammation <sup>39</sup> .
	Phenolic-enriched ethyl acetate fraction of the leaves	Reduced oedema, leucocyte count, exudate volume, nitrite, TNF- $\alpha$ , and myeloperoxidase activity. It also protected against carrageenan-induced lipid peroxidation and glutathione depletion <sup>40,41</sup> .	Phenolic components of the leaves could be responsible for the protective activity against acute inflammation and oxidative stress <sup>40,41</sup> .
<b>Anthelmintic activity</b>	Ethanol leaves	Caused a 100% elimination of the eggs and larvae of <i>Heligmosomoides bakeri</i> . The anthelmintic effect compared favourably with that of Albendazole (30mg/kg) <sup>42</sup> .	These findings suggest possible efficacy in the treatment of gastrointestinal nematodes infestation.
<b>Anti-diarrhoeal activity</b>	Aqueous extract of the leaves	The extract inhibited castor oil-induced diarrhoea in rats. This was indicated by a decrease in the amount of copious faeces. It again reduced the responses of guinea-pig ileum to acetylcholine, nicotine and histamine <sup>43</sup> .	These findings suggested the ability of the aqueous extract of <i>O. gratissimum</i> leaves to elicit an anti-diarrheal effect by inhibiting intestinal motility, partly by means of muscarinic receptor inhibition <sup>43</sup> .
<b>Anti-colitis activity</b>	Polyphenol-rich extract of leaves	Extract attenuated inflammation and decreased disease activity index scores of colitis in rats. It also decreased plasma concentrations of Interleukin-(IL)-6, tumour necrosis factor (TNF alpha), as well as concentrations of nitric oxide, myeloperoxidase, cyclooxygenase-2 and malondialdehyde in the colon. It increased the plasma concentrations of IL-4, IL-10, superoxide dismutase and catalase, and caused a reduction of glutathione in the colon <sup>44</sup> .	The polyphenol-rich extract of <i>O. gratissimum</i> leaves ameliorates colitis by attenuating injury within the colonic mucosa and regulating pro-inflammatory cytokines production and oxidative stress <sup>27,44</sup> .

## 7. Conflict of Interest

Authors have no conflict of interest to declare.

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