



## REVIEW ARTICLE

**Zingiber officinale: A Natural Remedy with Multifaceted Pharmacological Actions****Tushar D Mahajan<sup>1\*</sup>, Yogesh B More<sup>1</sup>, Vaibhav S Dhanwate<sup>1</sup>, Aarti S Deore<sup>1</sup>, Shruti A Kharote<sup>1</sup>, Priyanka N Darade<sup>1</sup>, Vivekanand A Kashid<sup>1</sup>**<sup>1</sup>Department of Pharmacology, M.A.B.D. Institute of Pharmaceutical Education and Research, Babhulgoan, Yeola, Nashik, Maharashtra, India

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## ABSTRACT

*Zingiber officinale* (*Zingiber officinale* Roscoe), a perennial herbaceous plant from the Zingiberaceae family, has been utilized for centuries in traditional medicine systems worldwide, including Ayurveda, Traditional Chinese Medicine, and Unani-Tibb. This review comprehensively examines the pharmacological potential of *Zingiber officinale*, focusing on its phytochemical composition and diverse therapeutic actions. A systematic literature analysis was conducted to investigate key bioactive compounds—*Zingiber officinale* ols, shogaols, paradols, and zingerone—and their roles in various therapeutic pathways using preclinical and clinical evidence. *Zingiber officinale* demonstrates remarkable pharmacological activities through multiple mechanisms. The major constituents, particularly 6-*Zingiber officinale* ol and 6-shogaol, exhibit significant anticancer properties by inhibiting angiogenesis, inducing apoptosis, and suppressing inflammatory pathways (COX-2, NF- $\kappa$ B) in colon, ovarian, lung, and breast cancers. Anti-inflammatory effects are mediated through COX-1, COX-2, and 5-LOX enzyme inhibition, along with cytokine modulation (TNF- $\alpha$ , IL-1 $\beta$ , IL-6). Potent antioxidant activity involves free radical scavenging, lipid peroxidation inhibition, and Nrf2 signalling activation. In metabolic disorders, *Zingiber officinale* enhances insulin sensitivity, inhibits carbohydrate-digesting enzymes ( $\alpha$ -glucosidase,  $\alpha$ -amylase), and protects pancreatic  $\beta$ -cells. Cardiovascular benefits include blood pressure reduction via ACE inhibition, lipid profile improvement, and endothelial function enhancement. *Zingiber officinale* represents a promising natural therapeutic agent with a well-established safety profile (GRAS status). Its synergistic bioactive compounds offer potential applications in cancer prevention, the management of inflammatory diseases, the treatment of metabolic syndrome treatment, and cardiovascular protection. However, well-designed clinical trials are essential to establish standardized dosing protocols and optimize bioavailability, underscoring *Zingiber officinale*'s promise as a functional food and nutraceutical in contemporary healthcare.

**Keywords:** Zingiber officinale, Zingiber officinale, Zingiber officinale ol, Shogaol, Anti-inflammatory, Antioxidant, Anticancer, Antidiabetic, Cardiovascular protection, Phytotherapy

## INTRODUCTION

*Zingiber officinale* (*Zingiber officinale* Roscoe) is a globally significant spice and medicinal plant, renowned for its distinctive flavor and therapeutic properties. Economically,

*Zingiber officinale* holds substantial value, contributing to the agricultural and pharmaceutical sectors<sup>1</sup>. *Zingiber officinale* is known as *Zingiber officinale*, ginger, and singapura in Old English, Greek, Mediaeval Latin. The plant is known as Sringavera in Sanskrit. The Latin term Zingiber, which means "shaped like a horn" and alludes to the roots that resemble the antlers of a deer, is taken from the Greek

zingiberis, which is derived from the Sanskrit name of the spice, singabera<sup>2</sup>. Perennial *Zingiber officinale* blooms annually. Thin leaf blades on 100 cm pseudostems are characteristic of *Zingiber officinale* (*Zingiber officinale* L.). The petals of *Zingiber officinale* flowers are yellow with a purple border. The primary *Zingiber officinale* s are bitter, red, and white, and rhizomes provide single stems. There are more than 100 chemicals in *Zingiber officinale*. *Zingiber officinale* gets its strong flavor from lipids or glycolipids (9%) and oleoresin (5–8%). *Zingiber officinale* contains unpleasant compounds and 1–3% volatile oils. Constipation, ulcers, rheumatism, arthritis, atherosclerosis, diabetes, high blood pressure, nausea, and cancer can all be cured by *Zingiber officinale*. Antioxidative and inflammatory qualities slow down the aging process. The compounds *Zingiber officinale* ols, shogaols, paradols, and zingerone give *Zingiber officinale* its strong flavor. *Zingiber officinale* ol, shogaols, paradols, and zinger one all share functional pharmacological traits, such as anti-inflammatory, antioxidant, and anti-tumor effects. Due to their similar effects on energy metabolism and glucose absorption, they may be useful in the prevention and treatment of both diabetes and obesity<sup>3</sup>.

Their popularity has increased recently due to the perception that they are less harmful and provide efficient substitutes for synthetic drugs. Herbs and spices have long been used by humans to preserve food, enhance cooking, and advance health<sup>4</sup>. For generations, *Zingiber officinale* has been a key component of Ayurvedic, Unani-Tibb, and Traditional Chinese medicine herbal remedies used to cure various illnesses. Since ancient times, *Zingiber officinale* has been utilized as a medicinal and herbal remedy as well as a significant culinary spice all over the world. South-east Asian traditional medicine, Greco-Roman customs, Brazil, Australia, Africa, China, India, Bangladesh, Taiwan, Jamaica, Mexico, and Japan all employ this plant. The rhizomes are also grown for medical purposes throughout the Middle East and some regions of the United States. According to reports, *Zingiber officinale* rhizome is frequently used as a condiment or spice. One of the first eastern spices cultivated by Europeans was zingiber officinale, which was brought to northern Europe by the Romans after they acquired it from Arab traders. During the Middle Ages, it was one of the most widely used spices. In the sixteenth century, the Portuguese brought it to West Africa and other tropical regions. The spice's therapeutic qualities were recognized in Germany and France in the ninth century, and in England in the tenth.

Elzebroek and Wind discovered that Marco Polo brought some *Zingiber officinale* to Europe after being introduced to it on a trip to Sumatra and China in the thirteenth century. They have also talked about how Francesco de Mendoza, a Spaniard, started the cultivation of *Zingiber officinale* in Mexico. The earliest Chinese herbal book, She Nung Ben Cao Jing, credited to Emperor Shen Nung (c. 2000 BC), mentions dried *Zingiber officinale*, or Gan-jiang<sup>2</sup>.

This review aims to critically explore the pharmacological potential of *Zingiber officinale* (*Zingiber officinale*) as a natural remedy. It focuses on its phytochemical composition and a wide range of therapeutic actions, including anti-inflammatory, antioxidant, antimicrobial, antidiabetic, and anticancer effects.

### Taxonomical Position

Kingdom: Plantae

Division: Magnoliophytes

Class: Liliopsida

Order: Zingiberales

Family: Zingiberaceae

Genus: Zingiber

Species: *Zingiber officinale* var. Roscoe<sup>5</sup>.



Fig. 1: *Zingiber officinale* (*Zingiber officinale* Roscoe)

### 1. Anticancer:

*Zingiber officinale*, a natural antioxidant and anticarcinogenic dietary component, is rich in active components with significant potential for cancer prevention and therapy.

Important Results Regarding the Anticancer Activity of *Zingiber officinale* :

- **Active Components:** 6-*Zingiber officinale* ol, 6-shogaol, and  $\beta$ -element are the main active components found in *Zingiber officinale*.

- **Mechanism of Action:** The chemicals in *Zingiber officinale* work in a variety of ways, such as:
  - Anti-angiogenesis:** 6-*Zingiber officinale* ol is a strong anti-angiogenic drug that can stop tumor development and spread by preventing the production of new blood vessels.

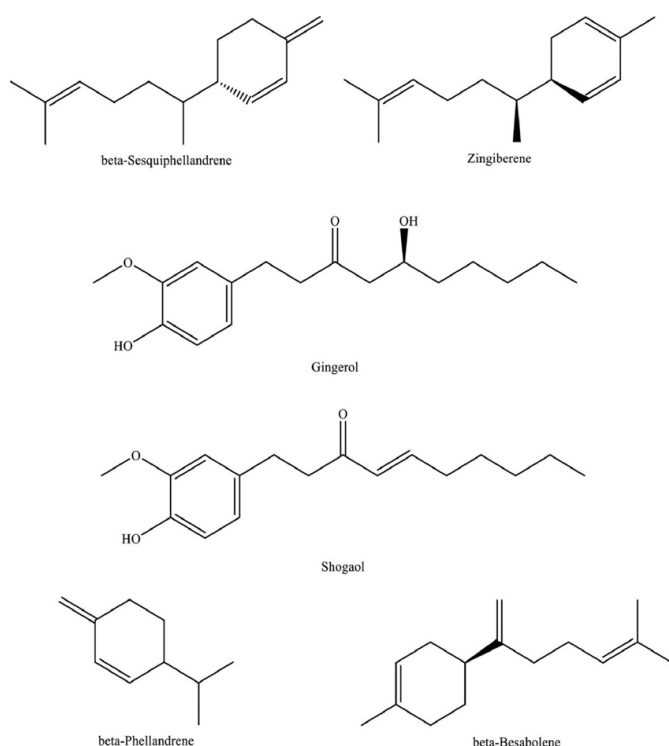


Fig. 2: Phytoconstituents present in *Z. officinale*

## PHARMACOLOGICAL ACTIONS

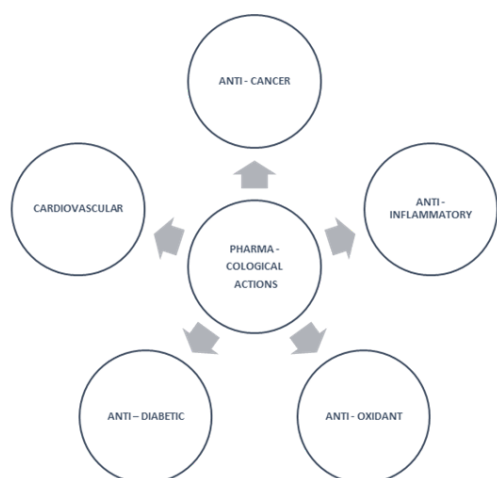


Fig. 1: Pharmacological Actions of *Zingiber Officinale*

- **b) Inhibition of Inflammatory Pathways:** Substances such as 6-*Zingiber officinale* ol and 6-shogaol reduce the activity of NF- $\alpha$  (necrosis factor kappa B) signaling pathways and suppress the production of COX-2 (cyclooxygenase-2)<sup>6</sup>
- **c) Apoptosis Induction (Programmed Cell Death):** Substances such as  $\beta$ -element and Zerumbone cause cancer cells (such as non-small-cell lung cancer and colon cancer) to undergo apoptosis, which is frequently mediated by mitochondrial pathways (cytochrome c release, caspase activation).
- **d) Antioxidant Effects:** *Zingiber officinale* is a naturally occurring antioxidant that lowers lipid peroxidation and inhibits the development of liver cancer. Additionally, it increases the activity of glutathione reductase and other antioxidant enzymes<sup>7</sup>.
- **e) Modulation of Growth Factors:** In ovarian cancer cells, *Zingiber officinale* components inhibit NF- $\alpha$  activation and reduce the secretion of angiogenic factors such as IL-8 and VEGF (vascular endothelial growth factor)<sup>7</sup>.

### Specific Cancer Targets

Table 1: Cancer Targets<sup>6</sup>

Cancer Type	Active Compounds	Mechanism / Effect
Colon cancer	6- <i>Zingiber officinale</i> ol, Zerumbone	COX-1 inhibition, apoptosis induction
Ovarian cancer	6- <i>Zingiber officinale</i> ol, 6-shogaol	$\downarrow$ NF- $\kappa$ B, $\downarrow$ VEGF, $\downarrow$ IL-8
Lung cancer	$\beta$ -Element, 6-shogaol	Mitochondrial apoptosis
Breast cancer	6-shogaol	Anti-metastatic activity
Liver cancer	<i>Zingiber officinale</i> extract	$\downarrow$ TNF- $\alpha$ , $\downarrow$ NF- $\kappa$ B, antioxidant protection
Skin cancer	6- <i>Zingiber officinale</i> ol, 6-Paradol	Inhibits COX-2 and NF- $\kappa$ B
Gastric cancer	6- <i>Zingiber officinale</i> ol, Zerumbone	Inhibits proliferation and NF- $\kappa$ B
Endometrial cancer	Terpenoids	Activates p53-mediated apoptosis

Especially active against tumor growth are the chemicals 6-, 8-, and 10-shogaols; 6-shogaol often shows more potential than 6-*Zingiber officinale* ol. All these results suggest that *Zingiber officinale* extract could represent a new tool in cancer maintenance and prevention.

### 2. Anti – Inflammmtory:

The potent anti-inflammatory qualities of *Zingiber officinale* (*Zingiber officinale*) are widely recognized. Numerous preclinical and clinical investigations support this. *Zingiber*

*officinale* ols, shogaols, and zingerone—its primary bioactive components—have an impact on a number of inflammatory molecular and cellular pathways.

#### • Mechanisms of Action:

*Zingiber officinale* has stuff in it that can help reduce swelling. It does this in a few ways, like changing how some proteins in your body behave, blocking certain enzymes, and managing the signals that cells send to each other<sup>8</sup>.

**Table 2: Mechanisms of Anti-Inflammatory Action of *Zingiber officinale***<sup>8, 9, 10</sup>

Mechanism	Molecular Target/Pathway	Effect	Outcome
Enzyme Inhibition	COX-1, COX-2, 5-LOX	Inhibits prostaglandin and leukotriene synthesis	↓ inflammation and pain
Cytokine Modulation	TNF- $\alpha$ , IL-1 $\beta$ , IL-6, chemokines	Downregulates pro-inflammatory cytokine production	Suppresses immune cell activation (T-cells, macrophages)
Signal Transduction Regulation	NF- $\kappa$ B, MAPK, PI3K/Akt	Inhibits transcription of inflammatory genes	↓ oxidative stress and inflammation

#### • Safety Profile:

The safety and tolerability profile of *Zingiber officinale* is considered satisfactory. According to several *in vivo* and clinical investigations, *Zingiber officinale* supplements are well tolerated and have few side effects. Due to its anticoagulant tendency, however, people prescribed antiplatelet or anticoagulant medication are advised to exercise caution<sup>11, 12</sup>.

**Table 3: Safety and Toxicological Summary of *Zingiber officinale***<sup>11, 12</sup>

Parameter	Observation	Clinical Evidence	Notes
General safety	Generally recognized as safe (GRAS)	Clinical and toxicological studies support safety	FDA-approved food ingredient
Adverse effects	Mild gastrointestinal symptoms (rare)	Reported in high-dose supplements	Self-limiting
Drug interactions	Potential anticoagulant effects	Interaction with warfarin, aspirin	Use with caution in such cases

### 3. Antioxidant:

#### • Mechanisms of Action

a) Free Radical Scavenging: Because of the high level of phenolics present, extracts of *Zingiber officinale* have effective scavenging characteristics against free radicals. By transferring electrons, 6-*Zingiber officinale* ol and 6-shogaol scavenge reactive oxygen species (ROS), preventing oxidative stress and cellular damage<sup>13</sup>.

b) Inhibition of Lipid Peroxidation: The phenolic chemicals present in *Zingiber officinale* inhibit the process of lipid peroxidation, which prevents oxidative damage to cell membranes. This activity adds to its preventive effect against inflammatory and cardiovascular disorders<sup>14</sup>.

c) Modulation of Gene Expression: *Zingiber officinale* enhances the expression of antioxidant enzymes, such as glutathione peroxidase and superoxide dismutase, by modulating the signaling pathways like Nrf2. Besides, it also aids in cancer chemoprevention through the regulation of survival and apoptosis-promoting genes<sup>15</sup>.

**Table 4: Summary of *Zingiber officinale*'s Antioxidant Mechanisms and Biological Effects**<sup>13-15</sup>

Mechanism	Key Compounds	Biological Effect	Relevant Pathways/Targets
Free Radical Scavenging	6- <i>Zingiber officinale</i> ol, 6-Shogaol	Neutralizes ROS, reduces oxidative stress	Electron donation, ROS scavenging
Inhibition of Lipid Peroxidation	<i>Zingiber officinale</i> ols, Paradols	Protects cell membranes from oxidation	Lipid radical chain inhibition
Gene Expression Modulation	<i>Zingiber officinale</i> ol, Zingerone	Upregulates antioxidant enzymes	Nrf2/ARE signaling
Anti-inflammatory Action	Shogaols, Zingerone	↓ oxidative inflammation	NF- $\kappa$ B, COX-2 inhibition

#### • Safety Profile

According to the U.S. FDA, *Zingiber officinale* is generally regarded as safe (GRAS). Clinical evidence and widespread traditional use support its safety, with few side effects reported. Pregnant women should be cautious, for example, and preparation, dosage, and population susceptibility all affect safety<sup>16</sup>. The foundation of *Zingiber officinale*'s therapeutic effect is its antioxidant activity. *Zingiber officinale* exhibits protective properties against disorders linked to oxidative stress through lipid peroxidation inhibition, gene expression modification, and free radical scavenging.

### 4. Anti – Diabetic:

Through a variety of mechanisms, *Zingiber officinale* (*Zingiber officinale*) has demonstrated considerable promise as an anti-diabetic agent. Improving insulin secretion and sensitivity, boosting lipid and carbohydrate

metabolism, and protecting organs frequently impacted by diabetes, such as the liver, kidneys, and nervous system, are the main ways it has anti-diabetic effects<sup>17, 18</sup>. These medicinal effects are mostly caused by important bioactive chemicals found in *Zingiber officinale*, including *Zingiber officinale* ol, shogaol, and zingerone<sup>17</sup>.

#### • Mechanisms of Action

*Zingiber officinale* exerts its anti-diabetic effects through several mechanisms:

**Table 5: Mechanisms of Anti- Diabetic Action of *Zingiber officinale*<sup>17-20</sup>**

Mechanism	Description	Key Phytoconstituents
Insulin regulation	Enhances insulin secretion and sensitivity, promotes glucose uptake and utilization	<i>Zingiber officinale</i> ol, Shogaol
Enzyme inhibition	Inhibits $\alpha$ -glucosidase and $\alpha$ -amylase, delaying carbohydrate digestion and glucose absorption	<i>Zingiber officinale</i> ol, Zingerone
Antioxidant activity	Reduces oxidative stress, protecting pancreatic $\beta$ -cells	<i>Zingiber officinale</i> ol, Shogaol
Organ protection	Supports liver, kidney, and nervous system function under diabetic conditions	<i>Zingiber officinale</i> ol, Shogaol, Zingerone

#### • Safety Profile

*Zingiber officinale* has a low toxicity and a well-established safety profile. Clinical evidence supports the safe use of steamed extracts in all populations, including pregnant women, with no negative pregnancy outcomes. Steamed extracts are safer and more effective than non-steamed forms<sup>22, 23</sup>.

**Table 6: Safety & Toxicological Profile of *Zingiber officinale*<sup>21-23</sup>**

Study Type	Findings on Safety
Animal studies	Low toxicity, safe at therapeutic doses
Human studies	No major adverse effects; safe for pregnant women

### 5. Cardiovascular:

There are several positive effects of *Zingiber officinale* (*Zingiber officinale*) on cardiovascular health. These substances work in a variety of ways, such as vasodilatory, antioxidant, lipid-lowering, anti-inflammatory, and antihypertensive effects.

#### • Mechanism of Action

**a) Antihypertensive Effects:** Studies have revealed that *Zingiber officinale* lowers blood pressure through ACE inhibition. This activity has been proposed to be because *Zingiber officinale* extracts can modulate the renin-angiotensin system, a critical pathway in blood pressure regulation<sup>23</sup>.

**b) Lipid Metabolism Control:** The improvement of lipid profiles by *Zingiber officinale* is achieved through an increase in the level of HDL while reducing the levels of triglycerides, total cholesterol, and low-density lipoprotein (LDL). As the pathways of the formation and transport of cholesterol are modulated, the risk of cardiovascular diseases is lowered<sup>24</sup>.

**c) Anti-inflammatory and Antioxidant Property:** *Zingiber officinale*'s strong anti-inflammatory and antioxidant properties are essential for minimising oxidative stress and inflammation, two major causes of cardiovascular diseases. NF- $\kappa$ B suppression and oxidative molecule modulation greatly reduce inflammation and protect vascular tissue<sup>25, 26</sup>.

**d) Vasodilation and Improved Blood Flow:** *Zingiber officinale*'s ability to promote vasodilation, which lowers blood pressure and improves blood flow, is what gives it its cardiovascular protective properties. It does this by preventing the growth of vascular smooth muscle cells and affecting nitric oxide synthesis<sup>11</sup>.

**Table 7: Mechanisms of Action of *Zingiber officinale* in Cardiovascular Protection<sup>11, 23-27</sup>**

Mechanism	Physiological Effect	Proposed Molecular Pathway(s)
Antihypertensive Effects	↓ systolic and diastolic blood pressure	Inhibition of angiotensin I-converting enzyme (ACE); modulation of the renin-angiotensin system
Lipid Metabolism Regulation	↓ Total cholesterol, ↓ LDL, ↓ triglycerides, ↑ HDL	Regulation of hepatic cholesterol synthesis and lipid transport pathways
Anti-inflammatory and Antioxidant Activities	↓ vascular inflammation and oxidative stress	Inhibition of NF- $\kappa$ B activation; scavenging of reactive oxygen species (ROS); upregulation of antioxidant enzymes
Vasodilation and Blood Flow Improvement	Promotes vasodilation and ↑ endothelial function	Stimulation of nitric oxide (NO) synthesis; inhibition of vascular smooth muscle cell proliferation

#### • Safety Profile

At normal dietary and supplement levels, *Zingiber officinale* is safe and generally recognized as safe (GRAS). On high intakes, the most common and mild side effect is gastrointestinal discomfort. However, because *Zingiber officinale* can intensify the effects of anticoagulant or

antiplatelet medications, care should be taken when using them<sup>2</sup>.

**Table 8 : Safety and Toxicological Profile of *Zingiber officinale***<sup>2, 11, 25, 27</sup>

Parameter	Observation	Clinical Implication
General Tolerability	Well-tolerated in dietary and therapeutic doses	Safe for chronic use
Drug Interactions	May enhance effects of anticoagulants	Monitor coagulation parameters in at-risk patients
Toxicity	No major toxicity reported in standard doses	Indicates strong safety margin
Gastrointestinal Effects (rare)	Mild nausea or heartburn at high doses	Dose adjustment recommended

## FUTURE DIRECTION

This medicinal plant's phytoconstituents share a variety of pharmacological properties. To find new active phyto-compounds, like phytosterol, with stronger activity, greater target-selectivity, and fewer adverse medication reactions, more research is necessary. The development of the formulation needs to be given greater attention because it is the most important plant for human civilization.

## CONCLUSION

*Zingiber officinale*, or *Zingiber officinale*, is a common herb used for both medicinal and seasoning purposes. Without a doubt, *Zingiber officinale* is still an important medicinal plant with a wide range of therapeutic applications in contemporary medicine. This review is based on *Z. officinale*'s pharmacological characteristics, phytochemicals, and traditional uses. because it has been used to safeguard people's health and fend off disease for thousands of years and is based on natural ingredients. To sum up, *Zingiber officinale* has a wide range of bioactivities, such as anti-inflammatory, anti-bacterial, anti-cancer, and antioxidant properties. Among the many bioactive substances it contains are paradols, shogaols, and *Zingiber officinale* ols. Additionally, *Zingiber officinale* can be a component of nutraceuticals or functional foods. Notably, to demonstrate the efficacy of *Zingiber officinale* against these illnesses in humans, well-planned clinical trials utilising its numerous bioactive components are required. More research is needed to develop clinical protocols, improve bioavailability, and standardise the use of *Zingiber officinale* in modern medicine. In order to manage and treat chronic illnesses, we hope that our updated review study will demonstrate the potential uses of *Zingiber officinale* in foods and nutraceuticals.

## References

- Zimazi KG, Montcho D, Bocco R, Hlanga N, Agbangla C. Unveiling the Secrets of *Zingiber officinale* (*Zingiber officinale* Roscoe): Current Knowledge, Research Gaps, and Future Perspectives. *International Journal of Agriculture and Biosciences*. 2025; 14 (5) :898-907 . Available from: <https://doi.org/10.47278/journal.ijab/2025.059>
- Shahrajabian MH, Sun W, Cheng Q. Clinical aspects and health benefits of *Zingiber officinale* (*Zingiber officinale*) in both traditional Chinese medicine and modern industry. *Acta Agriculturae Scandinavica, Section B — Soil & Plant Science*. 2019; 69 (6) :546-556 . Available from: <https://doi.org/10.1080/09064710.2019.1606930>
- Samota MK, Rawat M, Kaur M, Garg D. *Zingiber officinale* ol: extraction methods, health implications, bioavailability and signaling pathways. *Sustainable Food Technology*. 2024; 2 (6) :1652-1669 . Available from: <https://doi.org/10.1039/d4fb00135d>
- Paudel KR, Orent J, Penela OG. Pharmacological properties of *Zingiber officinale* (*Zingiber officinale*): What do meta-analyses say? A review. *Frontiers in Pharmacology*. 2025; 16 . Available from: <https://doi.org/10.3389/fphar.2025.1619655>
- Ozkur M, Özkur M, Erdemir A. *Zingiber officinale* for healthy ageing: A systematic review on current evidence of its antioxidant, anti-inflammatory, and anticancer properties. *Oxidative Medicine and Cellular Longevity*. 2022; 2022 (1) . Available from: <https://doi.org/10.1155/2022/4748447>
- Sindhoora D, Bhattacharjee A. A Brief Review on Pharmacological Profile of *Zingiber officinale*. *Rajiv Gandhi University of Health Sciences Journal of Pharmaceutical Sciences*. 2020; 10 (2) . Available from: [https://doi.org/10.26463/rjps.10\\_2\\_7](https://doi.org/10.26463/rjps.10_2_7)
- Ramakrishnan R. (2013). Anticancer properties of *Zingiber officinale*–*Zingiber officinale*: A review. *International Journal of Pharmaceutical Science and Medicine*, 3(5), 11-20.
- Grzanna R, Lindmark L, Frondoza CG. *Zingiber officinale*- an herbal medicinal product with broad anti-inflammatory actions. *Journal of Medicinal Food*. 2005; 8 (2) :125-132 . Available from: <https://doi.org/10.1089/jmf.2005.8.125>
- Pázmándi K, Fekete T, Szöllösi AG. The “root” causes behind the anti-inflammatory actions of ginger compounds in immune cells. *Frontiers in Immunology*. 2024; 15 . Available from: <https://doi.org/10.3389/fimmu.2024.1400956>
- De Lima RMT, Khan IN, Ferreira JRDO, De Alencar MVOB, Mubarak MS, De Menezes APM, et al. Protective and therapeutic potential of *Zingiber officinale* (*Zingiber officinale*) extract and [6]-*Zingiber officinale* ol in cancer: A comprehensive review. *Phytotherapy Research*. 2018; 32 (10) :1885-1907 . Available from: <https://doi.org/10.1002/ptr.6134>
- Crichton M, Marx W, Isenring E, Marshall S, Lohning A. Therapeutic health effects of *Zingiber officinale* (*Zingiber officinale*): updated narrative review exploring the mechanisms of action. *Nutrition Reviews*. 2023; 81 (9) :1213-1224 . Available from: <https://doi.org/10.1093/nutrit/nuac115>
- Matin M, Matin FB, Ksepka N, Wysocki K, Mickael ME, Wiecek M, et al. The Clinical Research on *Zingiber officinale* (*Zingiber officinale*): Insights from ClinicalTrials.gov analysis. *Planta Medica*. 2024; 90 (11) :834-843 . Available from: <https://doi.org/10.1055/a-2357-7064>
- Masuda Y, Hisamoto M, Kikuzaki H, Nakatani N. Antioxidant properties of *Zingiber officinale* ol related compounds from *Zingiber officinale*. *BioFactors*. 2004; 21 (1-4) :293-296 . Available from: <https://doi.org/10.1002/biof.552210157>
- Haniadka R, Baliga MS, Palatty PL, Fayad R, Saldanha E, Sunita V. A review of the gastroprotective effects of *Zingiber officinale* (*Zingiber officinale* Roscoe). *Food & Function*. 2013; 4 (6) :845 . Available from: <https://doi.org/10.1039/c3fo30337c>

15. Mao QQ, Xu XY, Cao SY, Corke H, Beta T, Li HB, *et al.* Bioactive Compounds and Bioactivities of *Zingiber officinale* (*Zingiber officinale* Roscoe). *Foods*. 2019; 8 (6) :185 . Available from: <https://doi.org/10.3390/foods8060185>
16. Li Y, Tran VH, Duke CC, Roufogalis BD. Preventive and Protective Properties of *Zingiber officinale* (*Zingiber officinale*) in Diabetes Mellitus, Diabetic Complications, and Associated Lipid and Other Metabolic Disorders: A Brief Review. *Evidence-Based Complementary and Alternative Medicine*. 2012; 2012 (9785) :1-10 . Available from: <https://doi.org/10.1155/2012/516870>
17. Van B, Algarni AS, Khalid A, Aumeeruddy MZ, Zengin G, Abdalla AN, *et al.* *Zingiber officinale* Roscoe (*Zingiber officinale*) and its Bioactive Compounds in Diabetes: A Systematic Review of Clinical Studies and Insight of Mechanism of Action. *Current Medicinal Chemistry*. 2024; 31 (7) :887-903 . Available from: <https://doi.org/10.2174/0929867330666230524122318>
18. Priya Rani M, Padmakumari KP, Sankarikutty B, Lijo Cherian O, Nisha VM, Raghu KG. Inhibitory potential of *Zingiber officinale* extracts against enzymes linked to type 2 diabetes, inflammation and induced oxidative stress. *International Journal of Food Sciences and Nutrition*. 2011; 62 (2) :106-110 . Available from: <https://doi.org/10.3109/09637486.2010.515565>
19. Son MJ, Miura Y, Yagasaki K. Mechanisms for antidiabetic effect of *Zingiber officinale* ol in cultured cells and obese diabetic model mice. *Cytotechnology*. 2015; 67 (4) :641-652 . Available from: <https://doi.org/10.1007/s10616-014-9730-3>
20. Nam,YH, Hong BN, Rodriguez I, Park MS, Jeong SY, Lee YG, *et al.* Steamed *Zingiber officinale* May Enhance Insulin Secretion through KATP Channel Closure in Pancreatic  $\beta$ -Cells Potentially by Increasing 1-Dehydro-6-*Zingiber officinale* dione Content. *Nutrients*. 2020; 12 (2) :324 . Available from: <https://doi.org/10.3390/nu12020324>
21. Stanisiere J, Lafay S, Mousset PY. How Safe Is *Zingiber officinale* Rhizome for Decreasing Nausea and Vomiting in Women during Early Pregnancy?. *Foods*. 2018; 7 (4) :50 . Available from: <https://doi.org/10.3390/foods7040050>
22. Borrelli F, Capasso R, Pittler MH, Aviello G, Izzo AA. Effectiveness and safety of *Zingiber officinale* in the treatment of pregnancy-induced nausea and vomiting. *Obstetrics & Gynecology*. 2005; 105 (4) :849-856 . Available from: <https://doi.org/10.1097/01.aog.0000154890.47642.23>
23. Akinyemi AJ, Ademiluyi AO, Oboh G. Aqueous extracts of two varieties of *Zingiber officinale* (*Zingiber officinale*) inhibit angiotensin I-converting enzyme, iron(II), and sodium nitroprusside-induced lipid peroxidation in the rat heart in vitro. *Journal of Medicinal Food*. 2013; 16 (7) :641-646 . Available from: <https://doi.org/10.1089/jmf.2012.0022>
24. Elrokhsy ESM, Yassin NAZ, El-Shenawy SMA, Ibrahim BMM. Antihypercholesterolaemic effect of *Zingiber officinale* rhizome (*Zingiber officinale*) in rats. *Inflammopharmacology*. 2010; 18 (6) :309-315 . Available from: <https://doi.org/10.1007/s10787-010-0053-5>
25. Roudsari NM, Lashgari N, Abdolghaffari AH, Sahebkar A, Roufogalis B, Momtaz S. *Zingiber officinale*: A complementary approach for management of cardiovascular diseases. *BioFactors*. 2021; 47 (6) :933-951 . Available from: <https://doi.org/10.1002/biof.1777>
26. Guo H, Zhang Y, Sun S, Liu Q, Qiao Y, Li S, *et al.* [6]- *Zingiber officinale* ol: a novel AT<sub>1</sub> antagonist for the treatment of cardiovascular disease. *Planta Medica*. 2013; 79 (05) :322-326 . Available from: <https://doi.org/10.1055/s-0032-1328262>
27. Beristain-Bauza SDC, Hernández-Carranza P, Cid-Pérez TS, Ávila-Sosa R, Ruiz-López II, Ochoa-Velasco CE. Antimicrobial Activity of *Zingiber officinale* (*Zingiber officinale*) and Its Application in Food Products. *Food Reviews International*. 2019; 35 (5) :407-426 . Available from: <https://doi.org/10.1080/87559129.2019.1573829>