IJARSCT
International Journal of Advanced Research in Science, Communication and Technology
International Open-Access, Double-Blind, Peer-Reviewed, Refereed, Multidisciplinary Online Journal
ISSN: 2581-9429
Volume 6, Issue 1, November 2026
Impact Factor: 8.2

A Comprehensive Review on the Phytochemistry, Pharmacological Activities and Clinical Potential of Zingiber Zerumbet

Amol V. Pore[1], Gopika Dongare[2], Sanjay K. Bais[3], Amruta Gaikwad[4], Harshita Deshpande[5]
[1] Associate Professor, [2] Professor, [3] Principal, [4] Student,[5] Student
Fabtech College of Pharmacy, Sangola, Maharashtra, India

Abstract : *Zingiber zerumbet commonly known as shampoo ginger or bitter ginger, is a medicinal plant belonging to the family Zingiberaceae. It has attracted considerable scientific interest because of its traditional medicinal uses and diverse phytochemical constituents. The rhizomes contain several bioactive compounds, particularly zerumbone, a sesquiterpene with promising pharmacological properties. Other constituents, including essential oils, terpenoids, flavonoids, and phenolic compounds, may also contribute to its biological activities. This comprehensive review focuses on the phytochemical composition, pharmacological activities, and clinical potential of Zingiber zerumbet. Reported studies have investigated its antiinflammatory, antioxidant, antimicrobial, anticancer, antidiabetic, and analgesic properties. Zerumbone has received particular attention for its potential effects on inflammatory pathways, oxidative stress, and cancer-related cellular processes. The plant is also traditionally used for various health conditions, supporting continued research into its medicinal applications. Despite these promising findings, most evidence comes from laboratory and preclinical studies, and further research is required to establish its safety, effective dosage, pharmacokinetic profile, and therapeutic efficacy in humans. Overall, Zingiber zerumbet represents a valuable source of natural bioactive compounds with potential applications in pharmaceutical and healthcare research. However, well-designed clinical trials are necessary to confirm its therapeutic benefits and support its development as a safe and effective medicinal agent.*

Keywords: Zingiber zerumbet, Shampoo ginger, Zerumbone, Phytochemical constituents, Pharmacological activities, Anti-inflammatory, Antioxidant, Antimicrobial, Anticancer, Antidiabetic, Analgesic, Essential oils, Therapeutic potential, Clinical studies, Medicinal plants.

I. INTRODUCTION

Medicinal plants have been used in traditional healthcare systems for centuries and continue to serve as important sources of bioactive compounds for modern drug discovery and development. the therapeutic properties of medicinal plants are mainly attributed to their diverse phytochemical constituents, which may exhibit various biological and pharmacological activities. Zingiber zerumbet commonly known as shampoo ginger or bitter ginger, is a perennial herbaceous plant belonging to the family Zingiberaceae. It is widely distributed in tropical and subtropical regions and is traditionally used in various systems of medicine for the management of several health conditions . The plant is characterized by its aromatic rhizomes and distinctive cone-shaped inflorescences, which contribute to its traditional and medicinal significance. Different parts of Zingiber zerumbet have traditionally been used for conditions associated with inflammation, pain, digestive disorders, and other ailments. The medicinal potential of this plant is associated with its diverse phytochemical constituents, including sesquiterpenes, essential oils, flavonoids, phenolic compounds, and other secondary metabolites. Among these constituents, zerumbone, a naturally occurring sesquiterpene, has attracted considerable scientific attention because of its promising pharmacological properties. The phytochemical composition

IJARSCT
International Journal of Advanced Research in Science, Communication and Technology
International Open-Access, Double-Blind, Peer-Reviewed, Refereed, Multidisciplinary Online Journal
ISSN: 2581-9429 Volume 6, Issue 1, November 2026 Impact Factor: 8.2

of Zingiber zerumbet may vary depending on geographical origin, plant part, cultivation conditions, and extraction methods. Various experimental studies have investigated its pharmacological activities, including antioxidant, anti-inflammatory, antimicrobial, analgesic, and anticancer effects. these activities have shown promising results in different experimental models, although the strength of evidence varies among individual pharmacological effects. However, findings from laboratory and animal studies cannot be directly considered evidence of therapeutic effectiveness in humans. Further research is required to establish the safety, efficacy, pharmacokinetic properties, and appropriate dosage of Zingiber zerumbet and its bioactive constituents. The clinical development of this plant also requires standardized extracts, comprehensive toxicological evaluation, and well-designed human clinical trials. Therefore, the present review aims to provide a comprehensive overview of the phytochemistry, pharmacological activities, clinical potential, safety considerations, and future research perspectives of Zingiber zerumbet as a potential source of natural therapeutic agents.[1]

II. PHYTOCHEMISTRY

Zingiber zerumbet, commonly known as shampoo ginger, pinecone ginger, or wild ginger, is an important medicinal plant belonging to the family Zingiberaceae. The species has attracted considerable scientific interest because of its rich phytochemical composition and broad spectrum of biological activities. Phytochemical investigations have revealed the presence of numerous secondary metabolites, particularly terpenoids, polyphenols, flavonoids, phenolic acids, steroids, and other specialized compounds that contribute to its pharmacological properties. Recent reviews indicate that approximately sixty metabolites have been isolated and identified from different parts of the plant, with terpenoids and polyphenols representing the predominant chemical classes. The rhizome is the most extensively investigated part of the plant because it serves as the principal repository of bioactive constituents. However, leaves, stems, and inflorescences also contain valuable phytochemicals that may contribute to the medicinal value of the species. Variations in phytochemical composition are influenced by geographical location, extraction technique, plant maturity, environmental conditions, and plant part analyzed [2].

Major Phytochemical Classes

Phytochemical studies have shown that Z. zerumbet contains a diverse range of natural compounds that can be broadly classified into terpenoids, polyphenols, flavonoids, phenolic acids, steroids, indole derivatives, pyridine derivatives, and volatile essential oil constituents. The majority of these compounds have been isolated from the rhizomes, which are recognized as the most pharmacologically active plant part. Among all identified constituents, sesquiterpenes are considered the most characteristic compounds of Z. zerumbet. These compounds are primarily responsible for the plant's aroma, biological activity, and therapeutic potential. The medicinal significance of the species is largely attributed to the abundance of these sesquiterpenes, especially zerumbone [3].

Terpenoids and Essential Oil Constituents

Terpenoids constitute the most important group of phytochemicals found in Z. zerumbet. Essential oil extracted from the rhizome contains numerous mono- and sesquiterpenes, which contribute substantially to its biological properties. Research has identified compounds such as zerumbone, α-humulene, and zerumbone epoxide among the principal sesquiterpenes present in the rhizome essential oil [4].

Zerumbone

Zerumbone is the major bioactive constituent and chemical marker of Z. zerumbet. It is a monocyclic sesquiterpene characterized by the presence of an α, β-unsaturated carbonyl group. This structural feature contributes significantly to its wide range of biological activities. Zerumbone occurs in high concentrations in rhizome essential oil and is regarded as the most extensively investigated compound from this species [5]. Pharmacological studies have demonstrated anti-inflammatory, antioxidant, antimicrobial, anticancer, analgesic, antipyretic, and gastroprotective properties of zerumbone. Consequently, many biological effects observed in Z. zerumbet extracts are attributed to this compound [6].

IJARSCT
International Journal of Advanced Research in Science, Communication and Technology
International Open-Access, Double-Blind, Peer-Reviewed, Refereed, Multidisciplinary Online Journal
ISSN: 2581-9429
Volume 6, Issue 1, November 2026
Impact Factor: 8.2

Other Sesquiterpenes

Besides zerumbone, α-humulene and zerumbone epoxide are important sesquiterpenes isolated from the rhizomes. These compounds may contribute synergistically to the biological properties of the plant and reflect the complexity of its terpenoid biosynthesis. [7]

Polyphenols and Phenolic Compounds

Polyphenols represent another major phytochemical group in Z. zerumbet. These compounds are important natural antioxidants that help protect biological systems from oxidative stress. The existence of diverse phenolic compounds may partly explain the antioxidant and protective effects reported for the plant in experimental studies. Polyphenolic compounds exert their activity by scavenging reactive oxygen species, reducing lipid peroxidation, and modulating cellular antioxidant defense mechanisms. Their presence contributes significantly to the medicinal value of the plant [8].

Phenolic Acids

Several phenolic acids have been isolated from Z. zerumbet, including ferulic acid and vanillic acid. These compounds possess antioxidant properties and are known to protect cells from oxidative damage. Their occurrence further strengthens the therapeutic potential of the species [9].

Flavonoids

Flavonoids constitute another important class of phytochemicals found in Z. zerumbet. These compounds are widely recognized for their antioxidant, anti-inflammatory, and cytoprotective effects. Several kaempferol derivatives have been isolated and characterized from the plant [10]. The major flavonoids reported include kaempferol-3-O-(3",4"-O-diacetyl) rhamnoside, kaempferol-3-O-(4"-O-acetyl) rhamnoside, and kaempferol-3,4'-O-dimethylether. These compounds contribute to the antioxidant capacity of the plant and may also participate in inflammatory regulation [11].

Steroids and Phytosterols

Phytochemical investigations have identified steroidal compounds such as β-sitosterol and βsitosterone in Z. zerumbet. These naturally occurring phytosterols possess structural similarities to cholesterol and are often associated with beneficial effects on lipid metabolism and cellular function. Although present in smaller quantities compared with terpenoids, these compounds contribute to the overall phytochemical diversity of the species and may participate in its pharmacological actions [12].

Indole and Pyridine Derivatives

Several nitrogen-containing metabolites have also been isolated from Z. zerumbet. These include methyl indole-3-carboxylate, indole-3-carbaldehyde, and indole-3-carboxylic acid. Such compounds are of pharmacological interest because many indole-containing natural products exhibit biological activities. In addition, pyridine derivatives such as picolinic acid, 3methylpicolinic acid, and 4-(1′-hydroxy-2′-methylpropyl) pyridine-2-carboxylic acid have been reported from the rhizomes. Identification of these compounds further demonstrates the chemical complexity of the species [13].

Distribution of Phytochemicals in Different Plant Parts

Phytochemical composition varies considerably among leaves, stems, and rhizomes. The rhizome remains the richest source of terpenoids and essential oil constituents, especially zerumbone. Leaves and stems contain substantial levels of flavonoids and phenolic compounds. Secondary metabolite production also changes during plant growth and development, influencing the concentration of bioactive constituents. Environmental conditions, harvesting stage, geographical origin, and extraction method can significantly influence phytochemical content. Therefore, standardization of plant material is essential for ensuring consistency in biological studies and future therapeutic applications. Zingiber zerumbet is a phytochemically rich medicinal plant containing a wide variety of bioactive compounds. Approximately sixty metabolites have been identified, predominantly belonging to the terpenoid and polyphenol classes. Zerumbone remains the principal phytochemical and serves as the characteristic marker compound of the species. Other important constituents include flavonoids, phenolic acids, phytosterols, indole derivatives, and pyridine derivatives. Collectively, these compounds form the chemical basis for the numerous biological activities

IJARSCT
International Journal of Advanced Research in Science, Communication and Technology
International Open-Access, Double-Blind, Peer-Reviewed, Refereed, Multidisciplinary Online Journal
ISSN: 2581-9429
Volume 6, Issue 1, November 2026
Impact Factor: 8.2

reported for Z. zerumbet. Continued phytochemical investigations are expected to reveal additional bioactive compounds and further clarify their therapeutic significance [14].



Fig.1.Botanical illustration of zingiber zerumbet

III. PHARMACOLOGICAL ACTIVITIES:

3.1Antibacterial activity:

The rhizome extract of Zingiber zerumbet possesses broad-spectrum antibacterial activity against both Gram-positive and Gram-negative bacteria. In the study conducted by Golam Kader and co-workers,the ethanolic rhizome extract, along with its petroleum ether and chloroform fractions, exhibited antibacterial effects against several pathogenic bacteria including Bacillus cereus, Bacillus subtilis, Staphylococcus aureus, Escherichia coli, Salmonella typhi, Shigella dysenteriae, Pseudomonas aeruginosa, and Vibrio parahemolyticus. The crude ethanolic extract showed stronger antibacterial activity than the solvent fractions. Notably, Vibrio parahaemolyticus was the most susceptible organism, demonstrating the highest zone of inhibition and the lowest minimum inhibitory concentration (MIC) value of 128 µg/mL. The antibacterial activity of Z. zerumbet has been attributed to the presence of bioactive phytochemicals such as zerumbone, zederone, flavonoids, phenolic compounds, sesquiterpenoids, saponins, and terpenoids. The authors concluded that the ethanolic rhizome extract contains potent antibacterial constituents and may serve as a promising natural source for the development of antimicrobial agents.[15]

3.2 Broad spectrum antimicrobial activity:

Its rhizome extract, including crude ethanolic extract, petroleum ether fraction, and chloroform fraction, showed activity against 13 bacterial strains, comprising five Gram-positive and eight Gram-negative bacteria, and three fungal species. At a concentration of 400 µg/disc, the extracts produced inhibition zones ranging from 6 to 10 mm, indicating mild to moderate antimicrobial activity. The crude ethanolic extract exhibited the highest antibacterial activity against Vibrio parahaemolyticus, with an inhibition zone of 10 mm. Antifungal activity was observed against Candida albicans, Aspergillus niger, and Saccharomyces cerevisiae. The minimum inhibitory concentration ranged from 128 to 256

IJARSCT
International Journal of Advanced Research in Science, Communication and Technology
International Open-Access, Double-Blind, Peer-Reviewed, Refereed, Multidisciplinary Online Journal
ISSN: 2581-9429
Volume 6, Issue 1, November 2026
Impact Factor: 8.2

µg/mL against the six bacterial strains selected for testing, with the lowest value of 128 µg/mL observed against V. parahaemolyticus for all three preparations. This antimicrobial activity may be associated with phytochemicals such as zerumbone, zerumbone epoxide, zederone, sesquiterpenoids, flavonoids, and phenolic compounds [16].

3.3 Antimalarial activity:

Zingiber zerumbet exhibits promising antimalarial potential due to the presence of zerumbone, a sesquiterpene isolated from its rhizomes. The antimalarial activity of zerumbone and its chemically modified derivatives was evaluated against Plasmodium falciparum, including the multidrug-resistant K1 strain. The activity was assessed using an in-vitro microdilution radioisotope assay based on the uptake of radiolabelled hypoxanthine by the parasite [17]. Zerumbone demonstrated antimalarial activity with an IC_{50} value of 11.8 µM. However, it also exhibited considerable cytotoxicity against normal Vero cells, with an IC_{50} value of 19.9 µM, limiting its suitability for further therapeutic development. To improve its biological activity and reduce toxicity, several zerumbone derivatives were synthesized and evaluated.Among the tested derivatives, the alcohol derivatives zerumbol (compound 9), zerumbol acetate (compound 10), and an epoxidized derivative (compound 11) demonstrated promising antimalarial activity, with IC_{50} values of 32.8 µM, 13.7 µM, and 9.8 µM, respectively. These derivatives showed comparatively low cytotoxicity against normal Vero cells, suggesting an improved safety profile in the experimental system. The findings indicated that chemical modification of zerumbone, particularly the conversion of its carbonyl group into alcoholrelated derivatives, may help improve its potential as an antimalarial lead compound.[18]

3.4 Anti-inflammatory activity:

Inflammation is one of the most frequently investigated pharmacological properties of Z. zerumbet. Experimental work has examined methanolic rhizome extract, essential oil and isolated zerumbone. In animal models, methanolic extract reduced inflammatory responses in selected acute-inflammation assays, while zerumbone has been investigated in carrageenan-induced paw oedema and cotton-pellet granuloma models. These models represent acute swelling and more persistent proliferative inflammation, respectively. The evidence suggests that activity may involve modulation of inflammatory mediators and pathways rather than a single mechanism.[19]

Mechanistically, the literature discusses effects on cyclooxygenase-related mediator production, prostaglandin E2 (PGE2), nitric oxide (NO), and signalling pathways associated with inflammatory gene expression. In macrophage experiments, zerumbone and some flavonoid constituents such as methylated kaempferol derivatives were reported to reduce production of selected inflammatory mediators. Such findings provide a plausible pharmacological basis for traditional use in inflammatory and pain-associated conditions, but differences in extract composition, dose, route and assay design limit direct comparison.

For a review, distinguish the whole extract from purified zerumbone. The effects of isolated zerumbone cannot automatically be attributed to every preparation of the plant. Standardisation of plant material, extraction method and chemical markers is needed before results can be compared or translated into a formulation.[20]

3.5 Analgesic and antinociceptive activity:

Analgesic and antinociceptive effects have been examined using rhizome extracts, essential oil and zerumbone. The term antinociceptive refers to reduced responses to experimentally induced noxious stimuli and should not be treated as identical to proven pain relief in people. A study of aqueous and ethanolic rhizome extracts used acetic-acid-induced writhing in mice, while other investigations used chemical and thermal nociception models such as hot-plate and formalin-induced paw licking. The ethanolic extract reduced writhing movements in mice, and the essential oil showed activity in selected experimental pain models. Methanolic extract has also been studied across inflammatory and nociceptive models. Proposed explanations include reduction of inflammatory mediators and interaction with pain-related signalling; however, the exact contribution of individual constituents and the relevance of doses to human exposure remain uncertain [21].

IJARSCT
International Journal of Advanced Research in Science, Communication and Technology
International Open-Access, Double-Blind, Peer-Reviewed, Refereed, Multidisciplinary Online Journal
ISSN: 2581-9429
Volume 6, Issue 1, November 2026
Impact Factor: 8.2

3.6 Antipyretic activity:

Antipyretic activity has been studied in yeast-induced fever in rats. In the study by Somchit and colleagues , aqueous and ethanolic rhizome extracts were evaluated at several doses, and both preparations significantly reduced fever during the observation period. Fever reduction in an induced animal model is an initial pharmacological signal; it does not establish that the plant is a safe or effective antipyretic for human illness.Potential antipyretic effects may overlap with anti-inflammatory actions because prostaglandin-mediated pathways contribute to fever regulation. Nevertheless, the cited study did not establish a complete molecular mechanism, and crude extracts contain multiple constituents.[22,23]

3.7 Anticancer activity:

Anticancer research is one of the most developed areas of zerumbone pharmacology. Studies have evaluated zerumbone or extracts in cancer cell lines and selected animal models, including reports involving P-388D cells , cervical cancer , ovarian cancer breast cancer, liver cancer and leukaemia, Reported outcomes include reduced cell proliferation, apoptosis and cell-cycle arrest.[24,25]These results are promising for discovery research but do not demonstrate that the plant or zerumbone can prevent or treat cancer in people. Zerumbone has been associated experimentally with modulation of NF-κB-related inflammatory signalling,oxidative stress, death-receptor pathways and mitochondria mediated apoptosis.[26,27] Cancer is biologically diverse, and activity in one cell line cannot be generalised to all tumour types. Concentrations used in cell culture may not be achievable in human tissues, and selectivity against cancer cells versus normal cells must be established.[28]

3.8 Antioxidant activity:

Antioxidant potential has been evaluated using chemical radical-scavenging assays and cellbased approaches. An ethanolic rhizome extract was reported to scavenge DPPH and hydroxyl radicals and to contain polyphenols and flavonoids, with kaempferol detected by HPLC analysis [29]. Other studies have explored antioxidant-related effects in experimental models. These assays provide evidence of chemical reducing or radical-scavenging capacity but do not automatically predict antioxidant benefit in the human body.

The apparent activity of an extract depends on its phenolic profile, solvent, storage, concentration and assay system. DPPH and hydroxyl-radical assays are useful screening tools but are not equivalent to measuring prevention of oxidative damage in living tissues.[30]

3.9 Antidiabetic activity:

The antihyperglycaemic potential of Z. zerumbet has been discussed in pharmacological reviews and investigated in experimental settings . The relevant question is whether a defined preparation changes blood glucose or glucose handling in a validated model, and whether this effect is reproducible at a tolerated dose. Different extracts may contain different proportions of terpenes and phenolic compounds, so findings from one preparation should not be generalised to all plant products.[31,32]

Potential mechanisms proposed for medicinal plants in this area include changes in carbohydrate digestion or absorption, insulin secretion or sensitivity, oxidative stress and inflammatory signalling. For Z. zerumbet, these mechanisms require cautious interpretation unless directly measured in the primary study. Changes in glucose in animals do not establish efficacy or safety in people with diabetes.[33]

3.10 Antihyperlipidaemic activity:

Hyperlipidaemia, characterized by elevated levels of serum cholesterol, triglycerides, and lowdensity lipoproteins (LDL), is a major risk factor for cardiovascular and metabolic diseases. Interest in plant-derived therapies has increased because many medicinal plants possess bioactive compounds capable of modulating lipid metabolism. Among these plants, Zingiber zerumbet commonly known as shampoo ginger or wild ginger, has attracted scientific attention due to

IJARSCT
International Journal of Advanced Research in Science, Communication and Technology
International Open-Access, Double-Blind, Peer-Reviewed, Refereed, Multidisciplinary Online Journal
ISSN: 2581-9429
Volume 6, Issue 1, November 2026
Impact Factor: 8.2

its diverse pharmacological properties, including antihyperlipidaemic activity. The rhizome contains several biologically active constituents, particularly zerumbone, a sesquiterpene that has been extensively investigated for its therapeutic potential [34].Comprehensive reviews of Z. zerumbet have highlighted that the plant exhibits multiple pharmacological activities, including anti-inflammatory, antioxidant, antidiabetic, and antihyperlipidaemic effects. Available evidence indicates that numerous preclinical studies have demonstrated beneficial metabolic effects; however, most investigations have been performed using crude extracts or isolated compounds in laboratory animals, and clinical evidence in humans remains unavailable.[35] Therefore, current findings should be interpreted cautiously until validated through human studies. A recent scoping review identified antihyperlipidaemic activity as one of the major pharmacological properties investigated in experimental animal models. Importantly, the review found that all available evidence originated from preclinical studies, and no published human clinical trials were available. Thus, current knowledge supports only a potential lipidlowering effect in experimental settings rather than confirmed therapeutic efficacy in humans. [36]

Animal studies explored whether preparations of Z. zerumbet could improve lipid abnormalities induced by experimental metabolic disorders. These investigations generally assessed conventional lipid parameters such as total cholesterol, triglycerides, LDL-related measures, and HDL-related measures. The collective findings suggested that treatment with Z. zerumbet preparations may improve lipid profiles in experimental animals, thereby indicating possible antihyperlipidaemic potential. However, these findings should always be interpreted in relation to the specific animal model, dose, treatment duration, and extract formulation used in each study. The antihyperlipidaemic effects of Z. zerumbet are believed to be associated with its rich phytochemical composition. Zerumbone, the major bioactive constituent, possesses antioxidant and anti-inflammatory properties. Oxidative stress and chronic inflammation are known contributors to dyslipidaemia and metabolic dysfunction. By reducing oxidative damage and inflammatory responses, zerumbone may contribute indirectly to improved lipid regulation and metabolic balance. In addition, other polyphenolic and terpenoid compounds present in the rhizome may work synergistically to influence lipid metabolism. The metabolic activity of Z. zerumbet extends beyond lipid lowering alone. According to the recent scoping review, metabolic outcomes may also be influenced by body weight regulation, food intake, glucose homeostasis, inflammation, and oxidative status. Consequently, isolated improvements in a single lipid parameter should not be overinterpreted. Changes in cholesterol or triglyceride levels may reflect broader metabolic effects occurring simultaneously within the organism. Therefore, evaluation of antihyperlipidaemic activity should include multiple metabolic endpoints rather than relying on a single biochemical marker. The review further emphasized that strong experimental design is essential when assessing antihyperlipidaemic potential. Reliable studies should include baseline measurements, appropriate disease controls, reference medicines, adequate sample size, blinding procedures, and transparent reporting of extract composition. Such methodological considerations are necessary to ensure reproducibility and to provide confidence in the reported findings. The quality of evidence is particularly important because differences in extraction methods, phytochemical composition, and experimental protocols can influence observed outcomes. Another important limitation is the lack of clinical validation. Although animal studies provide valuable preliminary evidence, results obtained in laboratory models cannot be directly translated into human therapeutic recommendations. The antihyperlipidaemic activity observed in experimental systems should not be interpreted as proof that Z. zerumbet prevents cardiovascular disease or serves as an established treatment for hyperlipidaemia in humans. Additional toxicological assessments, standardization of herbal preparations, and carefully designed clinical trials are required before clinical application can be considered. Overall, current evidence suggests that Zingiber zerumbet possesses promising antihyperlipidaemic potential in preclinical research. The plant appears capable of improving lipid profiles while also exerting beneficial metabolic effects related to oxidative stress, inflammation, glucose regulation, and body weight control. Nevertheless, all currently available evidence is derived from animal studies. Therefore, antihyperlipidaemic activity should presently be regarded as a promising area of preclinical investigation rather than clinically established evidence. Future research employing standardized

IJARSCT
International Journal of Advanced Research in Science, Communication and Technology
International Open-Access, Double-Blind, Peer-Reviewed, Refereed, Multidisciplinary Online Journal
ISSN: 2581-9429
Volume 6, Issue 1, November 2026
Impact Factor: 8.2

formulations, rigorous experimental methodologies, and well-designed human clinical trials will be necessary to clarify the therapeutic role of Z. zerumbet in the management of hyperlipidaemia and metabolic disorders.[37]

3.11 Gastroprotective activity:

Gastroprotective effects have been reported for zerumbone in experimental models. Such studies commonly assess gastric lesion formation, mucosal injury or associated biochemical changes after exposure to ulcerogenic conditions. A protective effect in an animal model may reflect modulation of inflammation, oxidative injury or mucosal defence, but the exact mechanism depends on the protocol and measured endpoints.Gastroprotection should be distinguished from treatment of established peptic ulcer disease. Animal results cannot confirm prevention of ulcers in humans, and a compound may have different effects depending on dose, route and concurrent medicines. Safety in the gastrointestinal tract also needs assessment because a preparation can have multiple biological actions.[38]

3.12 Hepatoprotective effect:

Organ-protective effects have been explored using experimental toxicant-induced injury. An ethyl acetate rhizome extract was reported to have nephroprotective effects against paracetamol-induced kidney injury and oxidative stress in rats [39]. The reported endpoints in this research area may include serum biochemical markers, oxidative stress indicators and histopathological changes. These results indicate a hypothesis for further study, not a clinical antidote or proven kidney-protective therapy.Hepatoprotective activity has also been discussed in reviews of Z. zerumbet and zerumbone . Liver-protection experiments require attention to the type of injury, timing of administration, biochemical markers, histology and possible effects on drug-metabolising enzymes.[40]

3.13 Antiviral activity:

Antiviral screening of Z. zerumbet has included work involving Epstein–Barr virus (EBV) early-antigen activation . The supplied table lists a chloroform rhizome extract in this context. EBV early-antigen assays are commonly used as experimental systems for examining virus-associated signalling or tumour-promotion-related processes; they should not be confused with demonstrating that an extract cures an EBV infection.The antiviral category must be reported precisely because effects on viral replication, viral antigen expression and virus-associated cellular pathways are different endpoints. A result in one assay does not show broad-spectrum antiviral activity. The identity and concentration of the extract, cytotoxicity controls and assay design are essential for interpretation.[41]

3.14 Immunomodulatory activity:

Studies of Zingiberaceae plants have investigated antiallergic and immunomodulatory actions, and Z. zerumbet has been included in this research area. Water extracts and selected constituents have been evaluated in experimental immune-response systems. These studies are relevant because allergic inflammation involves mediators released by immune cells, while immunomodulation may involve changes in cytokine production or other immune functions.The phrase “immunomodulatory” is broad and should be tied to a measured endpoint. Suppression of one inflammatory mediator does not necessarily mean general immune suppression, and antiallergic effects in a laboratory assay do not establish benefit for asthma, eczema or food allergy. Extract composition and concentration are especially important because immune responses can be dose-dependent.[42]

3.15Antiplatelet, larvicidal and other reported activity:

Additional activities reported in the literature include inhibition of platelet aggregation, larvicidal activity and changes in locomotor activity. Selected compounds from Zingiberaceae plants have been studied for platelet-activating-factor receptor binding [43] or human platelet aggregation while Z. zerumbet rhizome extracts have been assessed in mosquito-larval assays. These are distinct pharmacological or bioactivity categories and should not be grouped under a single therapeutic claim.Antiplatelet activity may be relevant to thrombosis research, but it also raises a safety question:

IJARSCT
International Journal of Advanced Research in Science, Communication and Technology
International Open-Access, Double-Blind, Peer-Reviewed, Refereed, Multidisciplinary Online Journal
ISSN: 2581-9429
Volume 6, Issue 1, November 2026
Impact Factor: 8.2

substances that reduce platelet function could increase bleeding risk or interact with anticoagulants and antiplatelet medicines. Larvicidal activity is primarily relevant to vector-control research and does not imply safety for human use. Locomotor-reducing effects observed in animals may reflect central nervous system effects, sedation or nonspecific toxicity and require careful follow-up. [44,45]

IV. CLINICAL SIGNIFICANCE:

Potential in the Management of Inflammatory Disorders

Inflammation is an important biological response associated with tissue injury, infection and several chronic diseases. The anti-inflammatory properties of Zingiber zerumbet have attracted attention because its bioactive constituents may influence molecular pathways involved in inflammatory reactions. Zerumbone has demonstrated the ability to regulate inflammatory mediators and cellular signalling mechanisms in experimental systems. These effects indicate possible applications in developing therapeutic agents for inflammation-associated conditions.The plant has also demonstrated antinociceptive properties, suggesting its potential relevance in pain management. Experimental findings involving extracts, essential oils and isolated constituents indicate reductions in inflammatory responses and pain-related behaviours in animal models. The combined anti-inflammatory and analgesic properties provide a scientific basis for further investigation of the plant as a source of compounds for managing inflammatory pain. Nevertheless, controlled human studies are required to establish effective dosage, clinical safety and therapeutic benefits [46,47].

Potential in Cancer Research and Supportive Care

Cancer represents an important area of investigation for the medicinal constituents of Zingiber zerumbet. Zerumbone has received particular attention because of its reported antiproliferative and antineoplastic effects in experimental research. Studies reviewed in the literature indicate that the compound can influence cellular processes involved in abnormal cell growth, programmed cell death and cancer-related signalling pathways. These properties suggest that zerumbone may provide a useful chemical starting point for the development of future anticancer agents [48].The potential value of the plant in oncology is not limited to its effects on tumour-related mechanisms. Research has also explored whether preparations derived from bitter ginger may contribute to supportive care by improving symptoms experienced by patients with advanced cancer. Such investigations provide an additional direction for clinical research, particularly regarding quality of life and symptom management. However, experimental anticancer activity does not establish effectiveness against human tumours, and the plant should not be considered a substitute for established cancer treatment [49].

Potential in Diabetes and Metabolic Disorders

Metabolic disorders, particularly diabetes mellitus and abnormal lipid metabolism, are important targets for the investigation of plant-derived bioactive substances. Experimental studies involving Zingiber zerumbet and zerumbone have reported antidiabetic and antihyperlipidemic activities, suggesting possible effects on metabolic regulation.These observations indicate that the plant may contain constituents capable of influencing biochemical processes associated with glucose and lipid metabolism. Its potential relevance to metabolic health has therefore become an area of interest in natural-product research. Further investigations are necessary to determine the mechanisms responsible for these effects, identify suitable formulations and evaluate whether the experimental findings can be reproduced in humans. Although the available evidence is encouraging, clinical effectiveness in diabetes or dyslipidaemia has not been established. [50]

Potential in Gastrointestinal and Organ Protection

Traditional medicinal applications of Zingiber zerumbet include its use for digestive complaints and other conditions affecting general health. Scientific investigations have subsequently explored its gastroprotective, hepatoprotective and nephroprotective properties in experimental models. These activities suggest that certain constituents may influence processes involved in tissue injury, inflammatory damage and cellular protection.The reported gastroprotective effects provide a basis for investigating the plant in relation to gastrointestinal tissue protection. Similarly, experimental findings concerning the liver and kidneys suggest possible research applications in conditions involving organ injury.

IJARSCT
International Journal of Advanced Research in Science, Communication and Technology
International Open-Access, Double-Blind, Peer-Reviewed, Refereed, Multidisciplinary Online Journal
ISSN: 2581-9429 Volume 6, Issue 1, November 2026 Impact Factor: 8.2

However, the number of studies examining these effects is comparatively limited, and their findings cannot yet be translated into established clinical indications. Additional investigations involving standardized preparations, appropriate toxicity assessments and controlled clinical trials are essential before such applications can be recommended.

Antioxidant and Immunomodulatory Potential

Oxidative stress is associated with cellular damage and contributes to the development of several pathological conditions. Zingiber zerumbet contains phytochemical constituents that have demonstrated antioxidant-related activities in experimental investigations. These effects may contribute to the biological actions of the plant by influencing oxidative processes and cellular defence mechanisms [51].

Immunomodulatory properties have also been reported, indicating that certain constituents may affect immune-related responses. The combination of antioxidant, anti-inflammatory and immunomodulatory activities makes the plant an interesting subject for further investigation in conditions involving oxidative injury and immune dysregulation. Nevertheless, antioxidant activity measured in experimental systems does not necessarily indicate clinical benefit, and further research is required to establish the relevance of these findings to human disease [52].

Clinical Safety and Future Therapeutic Development

The clinical development of Zingiber zerumbet depends not only on its pharmacological activity but also on the establishment of an acceptable safety profile. Preclinical toxicity investigations have suggested that certain preparations may be tolerated under specific experimental conditions. For example, some animal studies reported no major safety concerns following short-term administration of ethanolic extracts. However, the safety findings differ according to the preparation, dose and duration of exposure, and isolated zerumbone has produced adverse effects in some experimental settings.Several important challenges remain, including variations in phytochemical composition, limited pharmacokinetic information, uncertain human dosage requirements and insufficient long-term toxicity data. Standardization of extracts and accurate identification of active constituents are necessary to ensure consistency between experimental preparations. Further studies should investigate absorption, distribution, metabolism, elimination and potential interactions with conventional medicines.

V. CONCLUSION

Zingiber zerumbet is a phytochemically rich medicinal plant containing bioactive compounds such as zerumbone, flavonoids, phenolic acids, and essential oils. These constituents are associated with various pharmacological activities, including anti-inflammatory, antimicrobial, antioxidant, analgesic, anticancer, antidiabetic, and antihyperlipidaemic effects. Among them, zerumbone is recognized as the principal bioactive compound responsible for many therapeutic properties. Current studies indicate significant potential for the development of natural therapeutic agents from this plant. However, most findings are based on laboratory and animal studies. Further research is required to establish safety, efficacy, dosage, and pharmacokinetic profiles in humans. Well-designed clinical trials and standardized herbal preparations are essential to support its future use in evidence-based medicine.

ACKNOWLEDGEMENT

I would like to express my sincere gratitude to my respected guide, Mr. A.V. PORE , for his valuable guidance, continuous support, and encouragement throughout the preparation of this review article entitled "A COMPREHENSIVE REVIEW ON THE, PHYTOCHEMISTRY, PHARMACOLOGICAL ACTIVITIES AND CLINICAL POTENTIAL OF ZINGIBER ZERUMBET''

REFERENCES

1. Singh CB, Nongalleima K, Brojendrosingh S, Ningombam S, Lokendrajit N, Singh LW. Biological and chemical properties of Zingiber zerumbet Smith: a review. 2012;11(1):113-125.
2. Yob NJ, Mohd Jofrry S, Meor Mohd Affandi MMR, Teh LK, Salleh MZ, Zakaria ZA. Zingiber zerumbet (L.)

IJARSCT
International Journal of Advanced Research in Science, Communication and Technology
International Open-Access, Double-Blind, Peer-Reviewed, Refereed, Multidisciplinary Online Journal
ISSN: 2581-9429
Volume 6, Issue 1, November 2026
Impact Factor: 8.2

Smith: A review of its ethnomedicinal, chemical, and pharmacological uses. 2011;2011(1):543216.
3. Koga AY, Beltrame FL, Pereira AV. Several aspects of Zingiber zerumbet: a review. 2016;26(3):385-391.
4. Damodaran NP, Dev S. Studies in sesquiterpenes-XXXVII: Sesquiterpenoids from the essential oil of Zingiber zerumbet Smith. 1968;24(11):4113-4122.
5. Rout K, Mishra S, Sherma J. Development and validation of an HPTLC method for analysis of zerumbone, the anticancer marker from Zingiber zerumbet. 2009;21(3):443-452.
6. Dai JR, Cardellina JH II, McMahon JB, Boyd MR. Zerumbone, an HIV-inhibitory and cytotoxic sesquiterpene of Zingiber aromaticum and Z. zerumbet. 1997;10(1):115-118.
7. Dung NX, Chinh TD, Rang DD, Leclercq PA. The constituents of the rhizome oil of Zingiber zerumbet (L.) Sm. from Vietnam. 1993;5(1):553-555.
8. Ruslay S, Abas F, Shaari K, Zainal Z, Maulidiani, Sirat H, et al. Characterization of the components present in the active fractions of health gingers (Curcuma xanthorrhiza and Zingiber zerumbet) by HPLC-DAD-ESIMS. 2007;104(3):1183-1191.
9. Reddy KS, Rao KNV, Saikrishna J, Mahendra K, Varma PM. A Review on the Medicinal Plant Zingiber zerumbet: Phytochemical Composition, Traditional Uses, and Potential Health Benefits. 2024;12(4):139-146.
10. Masuda T, Jitoe A, Kato S, Nakatani N. Acetylated flavonol glycosides from Zingiber zerumbet. 1991;30(7):2391-2392.
11. Jang DS, Han AR, Park G, Jhon GJ, et al. Flavonoids and aromatic compounds from the rhizomes of Zingiber zerumbet. 2004;27(4):386-389.
12. Haque MA, Jantan I. Recent updates on the phytochemistry, pharmacological, and toxicological activities of Zingiber zerumbet (L.) Roscoe ex Sm. 2017;18(9):696-720.
13. Prakash RO, Rabinarayan A, Kumar MS. Zingiber zerumbet L. Sm., a reservoir plant for therapeutic uses: a review. 2011;2(2):1-23.
14. Srivastava AK, Srivastava SK, Shah NC. Essential oil composition of Zingiber zerumbet (L.) Sm. from India. 2000;12(6):595-597.
15. Kader G, Nikkon F, Rashid MA, Yeasmin T. Antimicrobial activities of the rhizome extract of Zingiber zerumbet Linn. 2011;1(5):409-412.
16. Hasan S, Uddin M, Faruque A, Mazumder MEH, Rana MS. In vitro antimicrobial and antioxidant activities of Zingiber zerumbet rhizome extract. 2012;5(6):3268-3272.
17. Sriphana U, Pitchuanchom S, Kongsaeree P, Yenjai C. Antimalarial activity and cytotoxicity of zerumbone derivatives. 2013;39(1):95-99.
18. Zakaria ZA, Mohamad AS, Chear CT, Wong YY, Israf DA, Sulaiman MR. Antiinflammatory and antinociceptive activities of Zingiber zerumbet methanol extract in experimental model systems. 2010;19(4):287-294.
19. Sulaiman MR, Perimal EK, Akhtar MN, et al. Anti-inflammatory effect of zerumbone on acute and chronic inflammation models in mice. 2010;81(7):855-858.
20. Chien TY, Chen LG, Lee CJ, Lee FY, Wang CC. Anti-inflammatory constituents of Zingiber zerumbet. 2008;110(3):584-589.
21. Khalid MH, et al. Antinociceptive effect of the essential oil of Zingiber zerumbet in mice: possible mechanisms. 2011;137(1):345-351.
22. Somchit MN, Shukriyah MHN, Bustamam AA, Zuraini A. Anti-pyretic and analgesic activity of Zingiber zerumbet. 2005;1(3):277-280.
23. Huang GC, Chien TY, Chen LG, Wang CC. Antitumor effects of zerumbone from Zingiber zerumbet in P-388D cells in vitro and in vivo. 2005;71(3):219-224.
24. Abdelwahab SI, Abdul AB, Devi N, et al. Regression of cervical intraepithelial neoplasia by zerumbone in female Balb/c mice prenatally exposed to diethylstilboestrol: involvement of mitochondria-regulated

IJARSCT
International Journal of Advanced Research in Science, Communication and Technology
International Open-Access, Double-Blind, Peer-Reviewed, Refereed, Multidisciplinary Online Journal
ISSN: 2581-9429
Volume 6, Issue 1, November 2026
Impact Factor: 8.2

apoptosis. 2010;62(5):461-469.
25. Abdelwahab SI, Abdul AB, Zain ZNM, Hadi AHA. Zerumbone inhibits interleukin-6 and induces apoptosis and cell cycle arrest in ovarian and cervical cancer cells. 2012;12(4):594-602.
26. Sung B, Murakami A, Oyajobi BO, Aggarwal BB. Zerumbone abolishes RANKL-induced NF-kappaB activation, inhibits osteoclastogenesis, and suppresses human breast cancer-induced bone loss in athymic nude mice. 2009;69(4):1477-1484.
27. Sharifah Sakinah SA, Tri Handayani S, Azimahtol Hawariah LP. Zerumbone induced apoptosis in liver cancer cells via modulation of Bax/Bcl-2 ratio. 2007;7(1):4.
28. Xian M, et al. Zerumbone induces G2/M cell cycle arrest and apoptosis in leukemia cells via a Fas- and mitochondria-mediated pathway. 2007;98(1):118-126.
29. Takada Y, Murakami A, Aggarwal BB. Zerumbone abolishes NF-kappaB and IkappaBalpha kinase activation leading to suppression of antiapoptotic and metastatic gene expression, upregulation of apoptosis, and downregulation of invasion. 2005;24(46):6957-6969.
30. Yodkeeree S, et al. Zerumbone enhances TRAIL-induced apoptosis through the induction of death receptors in human colon cancer cells. 2009;69(16):6581-6589.
31. Nag A, Bandyopadhyay M, Mukherjee A. Antioxidant activities and cytotoxicity of Zingiber zerumbet Smith rhizome. 2013;2(3):102-108.
32. Chang CJ, Tzeng TF, Chang YS, Liu IM. Beneficial impact of Zingiber zerumbet on insulin sensitivity in fructose-fed rats. 2012;78(4):317-325.
33. Tzeng TF, Liou SS, Chang CJ, Liu IM. The ethanol extract of Zingiber zerumbet attenuates streptozotocin-induced diabetic nephropathy in rats. 2013;2013(1):340645.
34. Tzeng TF, Lu HJ, Liou SS, Chang CJ, Liu IM. Lipid-lowering effects of zerumbone, a natural cyclic sesquiterpene of Zingiber zerumbet Smith, in high-fat diet-induced hyperlipidemic hamsters. 2014;69(1):132-139.
35. Pradhan S, Sarkar BR. Zingiber zerumbet: A Review on Pharmacological Activity. 2023;10(6):299-314.
36. Chan JSW, Lim XY, Japri N, Ahmad IF, Tan TYC. Zingiber zerumbet: A scoping review of its medicinal properties. 2024;90(3):204-218.
37. Chang CJ, Tzeng TF, Liou SS, Chang YS, Liu IM. Regulation of lipid disorders by ethanol extracts from Zingiber zerumbet in high-fat diet-induced rats. 2012;132(1):460-467.
38. Al-Amin M, Sultana GNN, Hossain CF. Antiulcer principle from Zingiber montanum. 2012;141(1):57-60.
39. Abdul Hamid Z, Budin SB, Wen Jie N, Hamid A, Husain K, Mohamed J. Nephroprotective effects of Zingiber zerumbet Smith ethyl acetate extract against paracetamol-induced nephrotoxicity and oxidative stress in rats. 2012;13(2):176-185.
40. Hamid A, Lee LS, Karim SR, Jufri NF. Hepatoprotective effects of zerumbone against paracetamol-induced acute hepatotoxicity in rats. 2018;25(1):64-71.
41. Murakami A, Takahashi M, Jiwajinda S, Koshimizu K, Ohigashi H. Identification of zerumbone in Zingiber zerumbet Smith as a potent inhibitor of 12-O-tetradecanoylphorbol-13-acetate-induced Epstein-Barr virus activation. 1999;63(10):1811-1812.
42. Chaung HC, Ho CT, Huang TC. Anti-hypersensitive and anti-inflammatory activities of water extract of Zingiber zerumbet (L.) Smith. 2008;19(2):117-129.
43. Ogawa K, Miyoshi T, Kitayama T, Ito M. Locomotor-reducing effects and structural characteristics of inhaled zerumbone and tetrahydrozerumbone derivatives. 2014;37(10):1559-1563.
44. Jantan I, Rafi IAA, Jalil J. Platelet-activating factor (PAF) receptor-binding antagonist activity of Malaysian medicinal plants. 2005;12(1-2):88-92.
45. Jantan I, et al. Inhibitory effect of compounds from Zingiberaceae species on human platelet aggregation. 2008;15(4):306-309.

IJARSCT
International Journal of Advanced Research in Science, Communication and Technology
International Open-Access, Double-Blind, Peer-Reviewed, Refereed, Multidisciplinary Online Journal
ISSN: 2581-9429
Volume 6, Issue 1, November 2026
Impact Factor: 8.2

46. Tewtrakul S, Itchayapruk J, Chaitongruk P. Mosquito larvicidal activity of Zingiber zerumbet Smith rhizomes. 1998;20(2):183-187.
47. Nhareet SM, Nur SMH. Anti-inflammatory property of ethanol and water extracts of Zingiber zerumbet. 2003;35(3):181-182.
48. Rahman HS, Rasedee A, How CW, et al. Biomedical Properties of a Natural Dietary Plant Metabolite, Zerumbone, in Cancer Therapy and Chemoprevention Trials. 2014;2014(1):920742.
49. de Queiroz LV, Favoreto Neto J, Fonseca FLA, Pinheiro CC, Del Giglio A. Bitter ginger (Zingiber zerumbet) for patients with solid tumors with no treatment options: a pilot clinical study. 2024;80(1):103021.
50. Tzeng TF, Liou SS, Chang CJ, Liu IM. Zerumbone, a tropical ginger sesquiterpene, ameliorates streptozotocin-induced diabetic nephropathy in rats by reducing the hyperglycemia-induced inflammatory response. 2013;10(1):64.
51. Hamid A, Ibrahim FW, Ming TH, Nasrom MN, Eusoff N, Husain K, et al. Zingiber zerumbet L. (Smith) extract alleviates the ethanol-induced brain damage via its antioxidant activity. 2018;18(1):101.
52. Ghazalee NS, Jantan I, Arshad L, Haque MA. Immunosuppressive effects of the standardized extract of Zingiber zerumbet on innate immune responses in Wistar rats. 2019;33(4):929-938.