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ZINGIBER ZERUMBET: A REVIEW ON PHARMACOLOGICAL ACTIVITY

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ABSTRACT: Introduction: The *Zingiber zerumbet* (L.) Roscoe ex Smith plant, popularly known as shampoo ginger, is a member of the Zingiberaceae family also popular as wild ginger, pine cone ginger, Martinique ginger, and pinecone lily. The species is indigenous to Malaysia, Indonesia, and tropical Indo-Malesian India. It is commonly grown in the Asian tropics, specifically in China (Guangdong, Guangxi, Yunnan), Taiwan, Cambodia, India, Laos, Indonesia, Malaysia, Myanmar, Sri Lanka, Thailand, and Vietnam. The distribution of it is currently pantropical. Zerumbet Ginger is a subterranean tuberous rhizome that is pale yellow on the interior and a tall, erect, herbaceous plant with pseudostems that grows in bunches up to 0.6-2 m tall. The rhizome powder is used in many places to treat severe pain, toothache, asthma, cough, worms, leprosy, and other stomach problems. **Method:** Utilizing databases such as Research Gate, Science Direct, Web of Science, and Google Scholar, Pub Med, Scopus, and online books along with some botanical websites a literature review was completed. **Results:** The result or the review study *of Zingiber zerumbet* concluded that it have a wide potential for further medical research and uses as it poses a wide range of pharmacological activity like anti inflammatory, anti bacterialanti viral, anti-asthmatic, antileishmanial, cytotoxic, analgesis, anti oxidant, anti mutagenic, anti allergic, anti nociceptic, anti antherosclerotic, immunomodulatory, anti pyretic, anti protozoal, anti tumour, anti cancer. Due to the presence of phytoconstituents like alkaloids, flavonoids, saponins, lipids, polyphenols and terpenoids and isolated compound called Zerumbone medical activity can be triggered and below a comprehensive review of its has been given. **Conclusion:** This review can help us better understand regarding the plant *Zingiber zerumbet* from medical and research prospective for further research.

INTRODUCTION: One of the most significant sources of medication throughout time is considered to be plant sources. More than 80,000 species are being used as medicine. The usage of medicinal plants is widespread worldwide and serves as a critical resource of livelihood and healthy security for a significant portion of the global population, according to world health organization (WHO) research.

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More than 80% of the world's population is estimated to rely directly on conventional primary plant-based medicine to address their immediate healthcare needs. Additionally, 40% of pharmaceutical businesses are thought to rely extensively on medicinal plants [1]. Since 1944 various studies have been conducted in *Zingiber zerumbet*, as it has proven beneficial in various medical fields.

This plant is a member of Zingiberaceae, a group of plants related to the ginger family, with a leafy stem growing up to 1.2 meters (3.9ft) tall. *Zingiber zerumbet* is native to tropical and subtropical Asia, precisely in Assam, Bangladesh, Borneo, Cambodia, China-south-central, eastern Himalaya

India, Myanmar, Philippines, Taiwan, Thailand, and Vietnam. It can be found growing in the wild next to rivers, waterfalls, and other water sources because it prefers a damp habitat. It is frequently cultivated as a houseplant. The Zerumbone is the main bioactive constituent of *Zingiber zerumbet* (L.) and is commonly known as a pinecone, bitter ginger, pinecone ginger, pinecone lily, shampoo ginger, and wild ginger. It was previously known as *Amomum zerumbet* [2].

MORPHOLOGY: *Zingiber zerumbet* belongs to the family Zingiberaceae, the largest family of the plant kingdom. It is a tall, upright, clump-forming herbaceous plant with predecessor nodes. Leaves are green, simple, whole, lanceolate or oblong-lanceolate, numerous in number, distichous, sessile and briefly petiolate leaves are present. The flower is roughly 6-12 cm long, which is initially green and turns red as it ages. The bract and corolla tube is of the same length, and the style is long and filiform. The stigma's edge is ciliate and projected. One of the distinct characteristics of the plant and plants belonging to these genes is the stamen, which divides lengthwise, and is joined to the plant by a long, curving appendage that resembles a beak or horn. The two staminodes of the inner whorl are one fertile stamen bear the appearance of petals. The ovary is trilocular and inferior, with placentation in the axile [3].

FIG. 1: *ZINGIBER ZERUMBET* FLOWER

FIG 2: *ZINGIBER ZERUMBET* RHIZOME

Taxonomical Classification

Kingdom	**:**	Plantae
Clade	**:**	Tracheophytes
Clade	**:**	Angiosperms
Clade	**:**	Monocots
Clade	**:**	Commelinids
Order	**:**	Zingiberales
Family	**:**	Zingiberaceae
Genus	**:**	Zingiber

Ethnomedical Uses: There are roughly 1200 species in the genus Zingiberaceae, which is a significant source of essential oil used in the perfume, cosmetics, and medical sectors [4, 5]. Other medicinal uses are as anti-allergic, immunomodulators [6]. Traditional medicinal uses of *Zingiber zerumbet* include treating inflammatory condition fever, toothache, indigestion, constipation, diarrhea, severe sprain, and an antispasmodic and pain reliever and diuretic medication [7, 8]. Boiled rhizomes juice of *Z. zerumbet* has been given to children with worm infestation for treatment [9]. A decoction of the rhizome is used as an appetizer and for stomach aches in Indonesia. In the Philippines, a decoction is prescribed for asthma and as a topical for rheumatism (Stuart 2012). The Chinese macerate the rhizomes in alcohol and use it as a tonic, depurative stimulant, while the Taiwanese used the plant as an anti-inflammatory adjuvant for stomach ache, sprain, and fever.

In Thailand, fresh rhizomes are also used as antiflatulent agents. For the treatment of extreme pain, ripe *Morinda citrifolia* is combined with the rhizome powder of *Zingiber zerumber* in India. It is a component of numerous pharmaceuticals used to treat diarrhoea and ear irritation in Polynesia. The Hawaiians applied the crushed RZZ to sore areas, bruises, and cuts. They also used it to cure stomach problems, toothaches, ringworm, and other skin conditions. They also utilised burnt *Z. zerumbet* leaves, along with ashes from *Schizostachyum glaucifolium*, *Aleurites moluccana*, and *Z. zerumbet*

tuber sap, as a treatment for cuts and damaged skin, and the RZZ was mashed with salt and applied topically to alleviate headaches [10, 11]. The milky juice obtained from the pine cones is famously used as a shampoo in Hawaii [12].

Pharmacological Activity:

Anti Oxidant: In Fiji, it was reported that *Zingiber zerumbet* was a widely used herb taken before meal and was reported that it has the richest source of anti-oxidant compared to other species of this family of Zingiberaceae. Other zingiber species contain a trace amount of kaempferol, whereas *Zingiber zerumbet* contains kaempferol (240mg/100gm), (<1mg/100gm) of myricetin, fisitin, quercetin [13]. In the study investigating the phase II detoxification enzyme induction of ZER (Zerumbone) using a cultured rat normal liver epithetical cell line, exposure of RL34 cell to ZER has the significant ability to suppress oxidation stress possibly through induction of the endogenous antioxidants such as the phase II xenobiotic metabolizing enzyme as well as glutathione (GSH) [14].

Cytotoxic Activity: *Zingiber zerumbet* rhizomes of were compared with several Zingiberaceae rhizomes commonly found in Malaysia and screened using a short-term assay of inhibition of 12-0-tetradecane phorbol-13-acetate. (TPA) induced Epstein Barr virus early antigen (EBV-EA) in Raji cells [15]. For comparison purposes, ascorbic acid (known anti-tumor promoter) was used as standard and exhibited a 50% inhibitory effect against TPA-induced EBA-EA activation. According to the MMT assay, bimolecular zerumbone had no appreciable cytotoxic effect, up to 100 g/ml. At concentrations 25, 50 and 100µl/ml, the percentage of cell viability was 100, 97, and 92% respectively after 24 hours of treatment. The cell viability slightly changed at concentrations of 50µg/ml (93%) and 100µl/ml (87%) after 48 hours of treatment. The results clearly showed that the zerumbone has no cytotoxic effect on normal mammalian cells at the concentration tested [16]. Other MTT assay with slight modification was done Human prostatic carcinoma (PC-3) leukemia (K562), lung cancer (A549), and fetal lung fibroblasts (MRC-5) cell lines were maintained in RPMI 1640 medium (2mM glutamine, 10% fetal borine serum, 100 U/ml penicillin, and 100U/ml streptomycin were incubated at 37ºC with 5% CO_2 atmosphere. The cell was selected at the density of 5×10^3 cells per well in 80µl of culture media and incubated for 24 hours. FR-EO, DR-EO, and zerumbone were dissolved in DMSO and diluted serially with the medium. Diluted solution (20µl) was each well and incubated for 24, 48, and 72 hours. The medium was removed MTT in EO, DR-EO and zerumbone exhibited significant cytotoxicity against all tested tumor cell lines. The cytotoxic capacity against tumor cells lined with the oils and zerumbone were zerumbone> FR-EO > DR-EO [17].

Zerumbone has substantial cytotoxic activity in some types of cancer. Zerumbone showed growth inhibition in a concentration-dependent manner when exposed to GBM cells (U-87 MG). It induced apoptosis and caused the cell-cycle arrest of the human GBM (U-87 MG) cell G2/M phase of the cell cycle. Moreover, zerumbone enhances the generation of reactive oxygen species (ROS) and N-acetyl cysteine (NAC) as an anti-oxidant reverse the ROS- induce cytotoxicity of U-87 MG cells. Analysis like western blot suggests that zurumbone activates the Nuclear factor kappa B(NF-kB), which is partly inhibited by NAC treatment. Therefore, it confirms that Zerumbone causes cytotoxicity via producing ROS [18].

Anti Bactrial Activity: An investigation aimed to screen the medicinal plants which could attribute antibiotic properties, lead to the finding of rhizomes of *Zingiber zerumbet*, when extracted with solvents like chloroform, methanol, and aqueous gave the extractive yield of 1.87% 4.26%, and 14.12% respectively. When treated with gram-negative and gram-positive bacteria like MRSASK1, *Staphylococcus aureus*, *Streptococcus mutans*, and *Salmonella typhi* it concluded that the chloroform extract f *Zingiber zerumbet* gave a positive result of 9.5, 9.8,8.6 respectively [19]. Chloroform extract of *Zingiber zerumbet* when investigated for their anti-bacterial activity against important food born pathogenic bacteria which include *Bacillus cereus*, *Staphylococcus aureus*, *Methicillin-resistant S. aureus*, (MRSA), *Escherichia coil*, *Salmonella typhi*, and *Shigella sp*. *Zingiber zerumbet* extract against most clinical S. aureus isolates were 0.01, 0.19, and 0.79. 1.57 and >12.5 mg/ml. Significant growth inhibition

of *MRSA* was observed in cultures incubated in the presence of *Zingiber zerumbet* [20]. Fresh rhizomes of *Zingiber zerumbet* when extracted with chloroform, and petroleum ether, against pathogenic bacteria, at a concentration of 400µg/disc compound showed mild to moderate anti-bacterial activity, producing zone of inhibition ranging from 6mm-10mm. Among the sample, the crude ethanol extract showed the highest activity against *Vibrio parahemolyticus.* The (MIC) minimum inhibitory concentration of ethanol extract was within the range of 128-256 µg/ml [21]. A unique compound, with a cross-conjugated ketone in an 11-membrane ring known as Zerumbone was isolated from the rhizomes of *Zingiber zerumbet*, which was examined for its anti-microbial activity using the disc diffusion method against Staphylococcus aureus, *Pseudomonas aeruginosa*, *Samonella choleraesuis Salmonella cerevisiae* which resulted in a dose-dependent antibacterial effect on *Samonella choleraesuis* [22].

Zederone, isolated from ethanolic extract of the rhizomes of *Zingiber zerumbet*, when examined for its anti-bacterial activity against multi-drug resistant and methicillin-resistant *Staphylococcus aureus* strain (SA1199B, ATCC25923, XU212, RN4220 and EMRSA 15), MIC minimum inhibitory concentration value were found to be in the range of 64-128µg/ml [23]. Two new compounds, azazerumbone I and azazerumbone II were synthesized by ZnCl2 – catalyzed Beekmann, rearrangement of zerumbone oximes from the rhizomes of *Zingiber zerumbet* to carry out the study for its anti-bacterial activity, which was tested among the bacteria *Bacillus cereus* which was most sensitive and *Yersinia enterocolitica* was found to be most resistant [24].

Methanol, chloroform, and aqueous extract of *Zingiber zerumbet* when investigated for their anti-bacterial activity, against pathogenic bacteria commonly associated with AIDs in Thailand. Bacteria including *Strephylococcus mulans, and Salmonella typhi* tested using the paper disc agar diffusion method. Gram-positive bacteria proved to be susceptible to chloroform extract of *Zingiber zerumbet* [25]. Metabolic extraction from the rhizomes of *Zingiber zerumbet* using a solvent of varying polarity revealed the highest anti-microbial activity in isopropanol fraction, test for anti-bacterial activity, was done against human pathogenic bacteria which include (gram positive) *Staphylococcus aureus* and *Enterococcus faecalis* (gram-negative) *Escherichia coli*, *Klebsiella pneumonia* and *Pseudomonas aeruginosa* cultures. By the agar-well diffusion method and when compared with standard penicillin, the results revealed that ethanolic extract had the highest inhibitory activity against *S. aureus*, *E. coli*, and *P. aeruginosa* [26]. Biomoleculezerumbone obtained from *Zingiber zerumbet*, which exhibited untapped anti-bacterial potential, after 6 hours of bacteria Streptococcus mutans – zerumbone interaction by using microdilution method. All the concentrations started killing the bacteria *S. mutans* between 48-72 hours, at the concentration of 500µg/ml (99.99% of bacteria was killed) [27].

Zerumbone showed the strongest anti-microbial potential against *Staphylococcus aureus*, *Bacillus subtilis*, *Escherichia coli*, and *Proteus vulgaris* with the MIC ranging from 31.25-156.25 µg/ml and MBC (minimum bactericidal concentration) ranging 62.59-625.00 µg/ml. Moreover, FR-EO (fresh rhizome essential oil) was more effective against bacteria than DR-EO (dried rhizome essential oil) [28]. Enterotoxigenic Bacteroides fragilis (ETBF) is a human intestinal commensal bacterium and a potent initiator of colitis through the secretion of the metalloprotease Bacteroids fragilis toxin (BFT). BFT induces cleavage of E-cadherin in colon cells, which subsequently leads to NF-kB activation. Zerumbone a compound isolated from *Zingiber zerumbet* was orally administered in a murine model of ETBF infection (30 /60 mg/kg)once a day for 7 days and was demonstrated as a *in-vitro* result indicated that zerumbone directly inhibited BFT- induced NF-kB activation in colon epithelial cell, which indirectly proved that zerumbone has anti-bacterial potential [29].

Anti-inflammatory Activity: Aqueous extract of *Zingiber zerumbet* was tested for its anti-inflammatory activity against the acute inflammation mode (PGE-2- induced paw edema) with the pre-treated rat in the given concentration of (50-100mg/kg). A positive result was concluded [30]. *Zingiber zerumbet* has been reported to have anti-inflammatory potential, especially in asthmatic patients. A study was conducted to determine the

capacity of the aqueous extract of *Zingiber zerumbet* for its anti-inflammatory potential using BALB/c mice models, which were sensitized and challenged with ovalbumin to induce anaphylaxis. The anti-inflammatory of aqueous extract was evaluated using both in vitro and *in vivo* methods. Results concluded that there was a decrease in the release of tumor necrosis factor-alpha and interleukin-4 (IL-4) in vitro and effectively suppressed LTC4 release from lung tissue *in-vivo* ($p<0.05$), therefore aqueous extract of *Zingiber zerumbet* can be beneficial in the treatment of inflammation in the asthmatic patient as it can inhibit the synthesis of LTC4 and through the immune modulation of Th1/ Th2 cytokines production [31].

Powdered rhizomes (1.2kg) of *Zingiber zerumbet* in 80% methanol in a ratio of 1.20 (w/v) were prepared to determine its anti-inflammatory activity using various experimental models like carrageenan-induce paw edema test (acute inflammation) and cotton-pellet-induced granuloma test (chronic inflammation). The results concluded the anti-inflammatory effect of (MEZZ) Methanolic extract of *Zingiber zerumbet* could be observed due to the involvement in cyclo – oxygenase -2 (COX-2) pathway, either at the peripheral/central level, thus the ability of MEZZ to inhibit/reverse the nociceptive response associated with the test could suggest an action to inhibit peripheral action of prostaglandin or COX-2 [32].

The study was carried out to evaluate the acute and chronic anti-inflammatory activities of the essential oil of the rhizomes of *Zingiber zerumbet* (Zingiberaceae) using the carrageenan-induced paw edema and cotton pellet-induced granuloma tests, respectively. The effect of the essential oil on inflammatory- and non-inflammatory-mediated pain was also assessed using the formalin test. Essential oil of *Z. zerumbet*, at doses of 30, 100, and 300 mg/kg, was administered intraperitoneally to rats. The substance exhibited significant anti-inflammatory activity both in acute and chronic animal models. [33]. Osteoarthritis (OA) is the most frequent form of knee arthritis. The ginger characteristics have been studied for its anti-inflammatory effect. It has been reported that its dried ethanolic extract could interdict the inflammation caused *via* carrageenans and induce inflammation of egg albumin [34]. *Zingiber zerumbet* belonging to the ginger family could be applied for the reduction of Osteoarthritis (OA) symptoms because of its circulatory stimulant and anti-inflammatory effects [35]. A study was conducted, and the purpose of this study was to evaluate zerumbone's ability to reduce inflammation in a mouse model of (Enterotoxigenic *Bacteroides fragilis*) ETBF infection. ETBF was given orally to wild-type C57BL/6 mice, and zerumbone (30 or 60 mg/kg) was given once daily for seven days. Zerumbone treatment shielded ETBF-infected mice from splenomegaly, weight loss, and decreased macrophage infiltration and intestinal inflammation.

Zerumbone therapy IL-17A, TNF-, KC, and inducible nitric oxide synthase (iNOS) production were markedly reduced in mice's intestinal tissues with ETBF infection [29]. Effective zerumbone (ZER), isolated mostly from the rhizomes of *Zingiber zerumbet* (Z. zerumbet), was identified in response to several inflammatory. In LPS-stimulated U937 human macrophages, this study was conducted to investigate the dramatic impacts of ZER on inflammatory-mediated NF-B/MAPK/PI3K-Akt signaling pathways. In LPS-induced human macrophages, ZER dramatically reduced the upregulation of pro-inflammatory mediators such as TNF-, IL-1, PGE2, and COX-2 protein [36].

An acute pulmonary inflammatory condition with a high morbidity and mortality rate caused by acute lung injury (ALI). Studied in the current work, sought the mechanisms through which zerumbone protects against ALI caused by endotoxin and lipopolysaccharide (LPS). Mice were given a 30-minute zerumbone pretreatment at varying doses, after which LPS was injected intravenously for six hours. Zerumbone pretreatment not only decreased but LPS-induced ALI was prevented by leukocyte infiltration into the alveolar space, which also reduced lung edema [37]. The study aimed to ascertain if nuclear factor (NF-kB) modulation and NF-kB-controlled gene products involved in inflammation, proliferation, and apoptosis were modulated by zerumbone to provide anti-inflammatory effects. It was discovered that Zerumbone reduced the NF-kB activation brought on by various inflammatory and carcinogenic substances, regardless of the cell type inhibition of

NF-kB correlated with IkBa kinase (IKK). The fact that zerumbone inhibits the NF-kB activation brought on by TNF, okadaic acid, cigarette smoke condensate, PMA, and H_2O_2 indicates that zerumbone functions at a step that each of these activators shares [38].

Anti-Leishmanial Activity: In this study, extract from the *Zingiber zerumbet* rhizomes was taken and tested for its effectiveness as an anti-Leishmanial, and it was discovered that the essential oil (EO) gave 0.19 0.05 IC_{50} value. Leishmania Mexicana is one of the pathogens causing cutaneous leishmaniasis, which is associated with patient morbidity [39].

Anti-asthmatic Activity: Solvent extraction of rhizome of *Zingiber zerumbet* by ethanol, and dichloromethane was done for the extraction of essential oil through the process of hydro distillation, supercritical CO_2 method using *in-vivo* (Fournier *et al.,* 2013; Shieh *et al.,* 2015). Zerumbone relative quantities of essential oil 35.5-84.8% were collected.

This extract was demonstrated in BALC/c mice in the concentration of 0.1-10mg /kg through the oral route. BALB/c mice exhibited anti-asthmatic activity by decreasing the severity of airway hyper-responsive, cytokines secretion, and inflammatory cell infiltration. Another experiment using a different solvent system like petroleum ether, pentene, benzene, and a different experimental model that is (*In-vivo* Nam *et al.,* 2014) was done on rhizomes of *Zingiber zerumbet*. The extract was demonstrated on BALB/c mice, a dose of compound (pinene) used was 0.1-10mg\kg through the oral route for 24 days.

The results concluded that rhizomes of *Zingiber zerumbet* exhibited anti-allergic activities by reducing infiltration cells, IgE level, and release of allergic mediators in allergic rhinitis (AR)-induce BALB/c mice. Compound name Humulene extracted from the rhizomes of *Zingiber zerumbet* through the process of extraction using petroleum ether, pentene, benzene exhibited anti-asthmatic activity (*in-vivo* Rogerio *et al.,* 2009) by reducing eosinophil recruitment into the airways of BALB/c mice, induced with allergic inflammation [40].

Anti-allodynic: From the rhizomes of *Zingiber zerumbet* Zerumbone was isolated and kept at -20°C before the use and was prepared by dissolving DMSO (Dimethylsulfoxide) Tween 20 and normal saline (0.99%) NaCl) at the ratio of 5:5:90 (v/v)[41]. Using the Dynamic Plantar Aesthesiometer von Frey test and the Hargreaves plantar test, respectively, a mouse model for chronic constriction injury evaluated the serotonergic system's involvement in zerumbone-induced antihyperalgesic. Before administering zerumbone, the serotonin (5-HT)-depleting drug P chlorophenyl alanine (PCPA, 100 mg/kg, i.p.) prevented the drug's anti-allodynic effects.

The antiallodynic effects of zerumbone (10 mg/kg) were significantly reduced by further research using 5-HT receptor antagonists methiothepin (5-HT1/6/7 receptor antagonist, 0.1 mg/kg), WAY-100635 (5-HT1A receptor antagonist, 1 mg/kg), isomaltase (5-HT1B receptor antagonist, 2.5 mg/kg), ketanserin (5-HT2A receptor antagonist, 0.3 mg/kg), and ondansetron.

These results show that zerumbone reduces mechanical allodynic in chronic constriction injury neuropathic pain mice via acting on 5-HT receptors 1A, 1B, 2A, 3, 6, and 7. [41]. And the demonstrated study showed significant dose-dependent inhibition of mechanical and thermal aerodynamic in the left hind limb of CCL- induced neuropathic pain symptoms when assessed with von Frey and cold plate test on a mouse model. However, this study concluded that Zerumbone possesses anti allodynia properties.

Anti-hyperalgesic Activity: The bioactive sesquiterpene zerumbone, isolated from *Zingiber zerumbet*, has an antineuropathic effect. The study aimed to ascertain whether the serotonergic system, a component of the descending pain regulation pathway, contributes to this effect. Using the Dynamic Plantar Aesthesiometer von Frey test and the Hargreaves plantar test, respectively, a mouse model for chronic constriction injury evaluated the serotonergic system's involvement in zerumbone-induced antihyperalgesic. Before the administration of zerumbone, the serotonin (5-HT)-depleting drug P chlorophenyl alanine (PCPA, 100 mg/kg, i.p.) prevented the drug's antihyperalgesic effects.

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Zingiber zerumbet in an animal model of neuropathic pain brought on by chronic constriction injury (CCI). The Hargreaves plantar test, cold plate, Randall-Selittoanalgesiometer, and single and repeated doses of zerumbone (5, 10, 50, and 100 mg/kg) intraperitoneal injection effectively reduced the CCI-induced neuropathic pain, according to our findings. Zerumbone dramatically reduced mechanical and thermal hyperalgesia, Results are contrasted with those obtained using the positive controls, gabapentin (20 mg/kg i.p.) and morphine (1 mg/kg i.p.). These findings collectively demonstrated that zerumbone, a possible lead chemical for further investigation, provided significant antihyperalgesic effects in CCI-induced neuropathic pain in mice [43].

The effects of zerumbone treatment on hyperalgesia in a mouse model of chronic constriction injury (CCI)-induced neuropathic pain were investigated. Zerumbone (5–50 mg/kg) was administered intraperitoneally starting on day 1 following surgery to track the onset and development of the pain condition. Three, five, seven, nine, eleven, and fourteen days after surgery were used to evaluate responses to mechanical and thermal hyperalgesia. On day 15, interleukin (IL)-1, IL-6, tumor necrosis factor, and IL-10 levels in the plasma and the spinal cord were measured using an enzyme-linked immunosorbent assay. On all days of behavioral testing, Zerumbone (10 and 50 mg/kg) reduced pain feelings without causing any drowsiness in the rotarod test. Thermal and mechanical hyperalgesia had ED50 values of 8.289 and 9.801 mg/kg, respectively. In contrast to IL-10, IL-1, IL-6, and tumor necrosis factor levels in the spinal fluid were significantly (p0.05) decreased by no therapy [44].

Anti-Mutagenic Activity: The *Salmonella typhimurium* tester strains (TA 98 and TA1538) were used in the conventional plate incorporation test to determine the antimutagenicity of zerumbone and its equivalents through Maron and Ames Based on this, the antimutagenicity assay on the test samples' ability to reduce sodium azide's mutagenicity as measured by the quantity of His+ revertants in the dish.

The samples for testing (312.5, 625, 1250, 2500, 3750, 5000, 6250, and 7500 LG) were measured using molten soft agar plating. (2 ml) containing 0.1 ml of 10-hour-old solution and 0.5 mM of histidine/biotin *S. typhimurium* strains are grown on minimum glucose agar plates. Plates without test samples were utilized as negative controls, while sodium azide was used as a diagnostic mutagen (1.5 LG per plate) as a positive control. The formula% Inhibition = [1 T/M] 100 was used to compute the percentage of inhibition, where T represents the number of revertants present on each plate in the presence of the mutagen and the test sample, and M represents the number of revertants present on each plate in the positive control. Azazerumbone 1 and 2 which are the compound from Zerumbone synthesized by ZnCl2-catalysed Beckmann rearrangement of the zerumbone oxime. Azazerumbone 2 had better anti mutagenic activity [45].

Anti-Allergic Activity: *Zingiber zerumbet* dry plant was powdered and progressively extracted by reflux for 3 hours with 200 ml of ethanol (EtOH) and water; the ethanolic extract was 8.7% (w/w) and the water extract was 24.6% (w/w). The extracts' stock solutions (10 mg/ml) were made in DMSO. The following modified approach (Matsuda *et al.*, 2004) was used to examine inhibitory effects on the release of -hexosaminidase from RBL-2H3 cells (bought from ATCC) to determine whether their effects were caused by the inhibition of enzyme activity or by degranulation. The plant extracts, therefore, did not affect -hexosaminidase enzyme activity [46]. Only a few zingiber genera have been reported to contain anti-allergic properties. Zerumbone is an isolated compound of Zingiber zerumbet essential oil (35.5–84.8%) and pinene (10.3% to 31.4%) [47]. According to a study, zerumbone from *Z. zerumbet* reduced the number of eosinophils that

accumulated in the bronchoalveolar lavage fluid (BALF) taken from female BALB/c mice that had undergone an OVA challenge. Additionally, oral treatment of zerumbone (0.1, 1, and 10 mg/kg) dramatically decreased mouse serum anti-OVA IgE levels. It subsequently led to a decrease in the cytokine secretions (IL-4, IL-5, IL-10, and IL-13) caused by OVA in the BALF that was collected. Consequently, it was hypothesized that zerumbone may have an anti-allergic impact on allergic asthma by inhibiting the release of Th2-related cytokines (IL-4, IL-5, IL-10, and IL-13) and, as a result, lowering the production of IgE by B cells [48].

Anti-Nociceptive Activity: Using a Shimadzu GC-17A gas chromatograph, the essential oil from Zingiber zerumbet (EOZZ) rhizomes was extracted from the fresh rhizomes. Male adult ICR mice weighing 25–30 g were used in the experiments. The experiments described in this article were carried out in compliance with the most recent standards. (1983, Zimmermann) Acetic acid-induced abdominal writhing test. Mice were pretreated with EOZZ (50, 100, 200, or 300 mg/kg, i.p. or p.o.) for 30 minutes either intraperitoneally or orally before i.p. injection of 0.6% (vol/vol) acetic acid The oversight group the same amount of vehicle (10 mL/kg, i.p.) was administered. Acetylsalicylic acid (ASA, 100 mg/kg, intravenously or orally) served as the reference medication 30 minutes before the nociceptive agent. Subsequently, the i.p. administering acetic acid.

The outcome demonstrated the impact of systemic EOZZ administration (50, 100, 200, or 300 mg/kg via i.p. or p.o.). When injected intraperitoneally, showed strong dose-dependent suppression of abdominal writhing with percentages of inhibition of 23.02, 53.89, 83.63, and 98.57%. Since the i.p. administration of Ethanolic extract of *Zingiber zerumbet* (EOZZ) was more effective than the p.o. this method was chosen for all subsequent studies to prevent nociception brought on by acetic acid. nociception brought on by capsaicin. The process followed was comparable to what was previously explained (Meotti *et al.,* 2006). Mice were given intraplantar injections of 20 L of capsaicin (1.6 g/paw) 30 min after receiving EOZZ (50, 100, 200, and 300 mg/kg, i.p.), ASA acetylsalicylic acid (100 mg/kg, i.p.), capsazepine (0.17 mmol/kg, i.p.). According to the capsaicin-induced nociception results, the administration of EOZZ at doses of 50, 100, 200, and 300 mg/kg resulted in a dose-dependent inhibition of the nociception, with respective percentages of inhibition of 8.75, 33.00, 73.40, and 97.64%.Induced nociception by glutamate. The experiment was conducted using the previously outlined methodology (Beirith *et al.*, 2002). Injection of 20 L of glutamate (10 mol/paw) into the mice's right hind paw's ventral surface 30 minutes before the injection of glutamate, mice were given injections of EOZZ (50, 100, 200, and 300 mg/kg, i.p.), ASA (100 mg/kg, i.p.).

The glutamate-induced nociception result demonstrated that i.p. administration of EOZZ (50, 100, 200, and 300 mg/kg) resulted in dose-dependent inhibition of the glutamate-induced nociception, with the observed percentages of inhibition being 11.27, 41.70, 64.81, and 99.30%. The ID50 value for EOZZ in glutamate-induced nociception was 124.8 mg/kg (111.4–139.7 mg/kg) [49]. According to the findings of the study, systemic (i.p.) administration of 1 at doses of 10, 50, and 100 mg/kg resulted in a consistent and dose-dependent inhibition of acetic acid-induced visceral nociceptive response in mice, with inhibition of 19.3%, 40.4%, and 64.8%, respectively, as compared to controls. In conclusion, the present work offers compelling evidence that 1 isolated from *Z. zerumbet*, at the levels examined, exerts notable peripheral and central antinociceptive effects in laboratory animals [50].

The essential oil from *Zingiber zerumbet* (Zingiberaceae) was extracted by hydrodistillation from the plant's rhizome. Its nociceptive activity was conducted after the analysis. Chemical evaluation to conduct the GC/MS analyses, a Shimadzu GC-17A gas chromatograph was interfaced with a Shimadzu GCMS-QP5050A quadrupole mass spectrometer (ionization voltage 70 eV). Male Balb C mice (24-34 g) and Sprague-Dawley rats (150-220 g) were used in the experiments, as morphine hydrochloride, and acetylsal (Sigma Chemical Co.). In physiological saline (0.9% NaCl), all medications were dissolved. In 1% (v/v)dimethyl sulfoxide (DMSO) dissolved in salt water, the EOZZ was dissolved. The vehicle used for the corresponding controls was 1% DMSO. Over 50 ingredients were detected in the

EOZZ according to the GC and GC/MS analysis findings, with 27 chemicals accounting for 97.2% of the oil. As opposed to the control, the EOZZ (30, 100, and 300 mg/kg) elicited a dosage-dependent inhibition of the writhing response brought on by acetic acid, with 80.2% of inhibition being noted at the dose of 300 mg/kg (n = 10). Abdominal writhing test made with acetic acid. Using a modified version of the procedure outlined by (Koster *et al*). EOZZ was administered three times to mice via i. p. or p. o. routes (30, 100, and 300 mg/kg) 30 minutes before the injection of acetic acid solution (0.8%, v/v). Animals used as controls were given either the vehicle (1% DMSO) or ASA (100 mg/kg, i.p. and p.o.). Postal route the discomfort brought on by acetic acid was partially but significantly inhibited by EOZZ (300 mg/kg) 30 min prior (64.3%). injection of the EOZZ (30, 100, and 300 mg/kg) and ASA (100 mg/kg; as positive control) during a formalin test intraperitoneally.

The behavioral reactions to nociception, such as biting, licking, and scratching the injected paw, were documented, and the duration of the behavior was recorded for up to 30 seconds. The hot-plate test the approach of (Eddy and Leimbach), with a minor adjustment. On the heated surface of a hot-plate analgesia meter (Ugo Basile, model-7280) kept at 55.0 2 °C, each mouse was placed inside a Perspex cylinder injections of the EOZZ in three doses (30, 100, and 300 mg/kg), the control group's vehicle, or morphine (5 mg/kg). Jumping and paw licking were the metrics used to assess heat reactivity acute toxicology evaluation.

The approach Lorke described was used. For three hours the test was observed for the control group which merely received the vehicle, the experimental group received EOZZ at the dosage of 300,1000, and 5000mg/kg, and the mice were watched for any unusual behavior. rotation-rod test Only mice that could successfully stay on the rotating bar (14 rpm) of the rota-rod apparatus while being given EOZZ (30, 100, and 300 mg/kg, i. p.) and either the vehicle (1% DMSO, i. p.) or diazepam (4 mg/kg, i. p.) were chosen for the test 24 hours prior. According to the research findings, EOZZ has strong central and peripheral anti-nociceptive effects on lab animals. These effects are likely caused by EOZZ's ability to block the synthesis of inflammatory mediators as well as to activate an opioidergic pathway [51]. In a Soxhlet apparatus, water and an ethanolic extract of *Zingiber zerumbet* were made, and the extract was subsequently distilled with 98% ethyl alcohol and utilized for the experiment. Male Balb/C mice (25 to 30g) and male Sprague Dawley rats (180 to 200g) were housed in polypropylene cages with wood shavings as bedding at a constant temperature of 27°C for a 12-hour light/dark cycle. Acetic acid-induced writhing was studied using the Dambisya and Lee method, with mice separated into (10,20,50 and 100mg). Equal amounts of standard saline IV were given to the control animals. Acetic acid (10mLkg) at 0.6% (w/v) was administered intraperitoneally 30 minutes later. The dose-dependent analgesic effect of the ethanolic extract of *Zingiber zerumbet* was significantly different from the control. The rhizome's extract in 25 mg kg of ethanol was equivalent to 0.2 mg kg of morphine, and the extract in 100 mg kg of ethanol was equivalent to 0.8 mg kg of morphine. At 50 and 100 mg kg concentrations, *Zingiber zerumbet's* aqueous extract had no analgesic properties [52].

Anti Proliferative: After researching to ascertain how extracts and fractions of RZZ affected the development of human breast carcinoma (MCF-7) cell lines, Abd Rashid and Lope Pihie [50], reported that thepetroleum ether extract of *Zingiber zerumbet* (PEZZ), followed by ethyl aceta extract of *Zingiber zerumbet* (EAZZ) and methanol extract of *Zingiber zerumbet* (MEZZ), exhibited antiproliferative activity with EC_{50} values of 4.25 0.05, 8.38 0.08, and 21.31 0.43, respectively [53].

ZER's IC_{50} value was calculated after its anti-proliferative effect on Hep-2 cells was investigated using the MTT test. According to the findings, ZER had a considerable anti-proliferative impact *in-vitro*, with an IC_{50} value of 15 mM after 48 hours [54]. Zerumbone-induced anti-proliferative against the human hormone-resistant prostate cancer (HRPC) cell lines PC-3 and DU-145. Zerumbone reduced PC-3 and DU-145 cell growth in a concentration- and time-dependent manner [55]. Zerumbone inhibits the expression of NF-B-dependent anti-apoptotic gene products generated by TNF. The goal of the study was to ascertain whether NF-kB and NF-kB controlled gene products involved in proliferation and apoptosis

were modulated to mediate the anti-proliferative effects of zerumbone. Furthermore, regardless of the cell type, zerumbone decreased NF-kB activation brought on by numerous carcinogens and inflammatory agents [56].

Anti Atherosclerotic Activity: Zerumbone inhibited the expression of several scavenger receptor genes controlling macrophage scavenger receptors such as lectin-like ox-LDL receptor-1 (LOX-1), a crucial step in atherosclerosis that up-regulated the uptake of oxidized low-density lipoproteins, in THP-1 human monocytic cells (ox-LDL) [57].

Anti-viral Activity: Zerumbone an organic extract which was obtained from *Zingiber zerumbet* was used to produce 4''-O-acetylafzelin. Zerumbone had cytotoxic and HIV-inhibitory properties, but 4''-O-acetyl afzelin's showed no activity in either assay [58].

Nephroprotective Activity: As indicators of kidney function, serum creatinine and BUN levels were measured. To examine the effect of zerumbone on the extent of tissue damage in cisplatin-induced nephrotoxicity in rats. The rats received a single dose injection of 10 mg/kg cisplatin. Other groups of rats received zerumbone (100 and 200 mg/kg. The findings of this investigation demonstrated that cisplatin significantly decreased renal function as evidenced by noticeably elevated serum creatinine and BUN (blood urea nitrogen) levels. Through microscopic observations and lesion scoring, it was revealed that zerumbone reduced the kidney damage and preserved renal functions. Zerumbone (p 0.05) reduced the kidney malondialdehyde (MDA) rise and concurrent glutathione (GSH) reduction in the cisplatin-treated group. It was determined that zerumbone helps treat renal impairment brought on by cisplatin [59]. For eight weeks, diabetic rats have orally given either metformin (100 mg kg1 per day) or EEZZR (200 and 300 mg kg1 per day). In diabetic rats, plasma glucose, creatinine, blood urea nitrogen, urine protein, and the kidney weight-to-body weight ratio were markedly increased. EEZZR displayed similar characteristics to those of metformin in reducing hyperglycemia and renal dysfunction in diabetic rats [60]. Seven phytochemicals were isolated from *Zingiber zerumbet* and one of the natural products was synthesized from the isolated compounds. All the isolated compounds were screened for the a-glucosidase enzyme, aldose reductase enzyme, and protein glycation reaction. As a result, it was found out that only two compounds were found to be potent a-glucosidase, aldose reductase, as well as protein glycation inhibitors, were found to potent a-glucosidase, aldose reductase as well as protein glycation inhibitors that were Kaempferol and kaempferol-3-O-methyl ether. The flavonoid compounds of *Z. zerumbet* showed more activity against the a-glucosidase and aldose reductase enzymes than the four sesquiterpene components did [61].

Immunomodulatory Activity: By examining the zerumbone isolated from *Zingiber zerumbet* it was found that zerumbone was able to activate mice thymocytes, splenocytes, and PBMC at dosage dependent pattern where the best concentration was 7.5 µg/mL By assessing this compound's effects on lymphocyte proliferation (mouse thymocytes, mouse splenocytes, and human peripheral blood mononuclear cells, PBMC), cell cycle progression, and cytokine (interleukin 2 and 12) induction [62].

Zerumbone may be employed as an immunomodulatory drug because it increased the production of human interleukin-2 and human interleukin-12 cytokines in lymphocytes. When compared to the control group's (6.2%) T cells, the chloroform extract of Z. zerumbet rhizome significantly increased CD69 antigen expression by 31.6%, while the methanol and aqueous extracts significantly decreased CD69 antigen expression by 5.8% and 2.3%, respectively [63].

Antihyperglycaemic Activity: When *Zingiber zerumbet*'s aqueous extract was studied for it anti hyperglycemic activity it was found that *zingiber zerumbet* had a potential blood glucose-lowering effect in normoglycemic and streptozotocin-induced hyperglycemic rats [64]. A test was conducted to determine the blood glucose-lowering effect in normoglycaemic and Streptozotocin-induced hyperglycaemic rats. No significant reduction in blood glucose level was shown in hyperglycaemic rats treated with an aqueous extract of *Zingiber zerumbet* [65]. A test was conducted to assay the anti-diabetic activity of *Z. zerumbet* in

streptozotocin (STZ)- induced diabetic rats. The diabetic rats were given an aqueous extract of *Z. zerumbet* (200 mg/kg) and glibenclamide (10 mg/kg) for 21 days, and their hypoglycemic activity and effect on body weight were assessed. The efficacy of aqueous extract of *Zingiber zerumbet* was not as significant as glibenclamide when both were treated for hypoglycemic activity [66].

Anti-pyretic Activity: Anti-pyretic properties of ethanol and aqueous extracts of *Zingiber zerumbet* rhizomes were assessed. Rats were given Brewer's yeast to induce pyrexia, and the antipyretic efficacy of *Zingiber zerumbet* (25, 50, and 100 mg kg-1) was examined. For an 8-hour observation period, *Zingiber zerumbet* aqueous and ethanol extracts significantly inhibited Brewer's yeast-induced pyrexia in rats [67].

Rats were used in the study to assess the zerumbone extracted from *Z. zerumbet's* anti-inflammatory properties. The rats were given 0.05 ml of either carrageenan (1%) or prostaglandin E2 (100 IU) by intraplantar injection into the right hind paw thirty minutes after zerumbone (10 and 20 mg/kg) was administered intraperitoneally (i.p.). The findings showed that zerumbone effectively inhibited inflammation brought on by both -carrageenan and prostaglandin E2 and that it was statistically comparable to the NSAID piroxicam [68].

Analgesis Activity: Used for its analgesic effects *Z. zerumbet* an evaluation was made to assess the rat in vivo analgesic effects of zerumbone extracted from *Z. zerumbet*. The test of abdominal writhing brought on by acetic acid was carried out.

Rats were given 0.6% acetic acid (10 ml/kg; subcutaneous) 30 minutes after receiving zerumbone (10 and 20 mg/kg; i.p.). Similar to an NSAID, zerumbone effectively reduced pain during the abdominal writhing test [68]. Evaluation of the analgesic properties of aqueous and ethanol extracts of *Zingiber zerumbet* rhizomes using acetic acid-induced writhing in mice, was conducted the analgesic efficacy of *Zingiber zerumbet* (10, 25, 50, and 100 mg kg-1) was investigated. However, in an acetic acid-induced writhing test, the ethanol extract of *Zingiber zerumbet* rhizomes dramatically reduced the writhing movements in mice [67].

Anti-protozoal Activity: A study was conducted where 12 medicinal plants' chloroform, methanol, and water extracts were tested for their ability to treat diarrhea. 2•105 trophozoites of *Giardia intestinalis* per milliliter of growth medium were incubated with the plant extracts and a common medication, metronidazole, for 24 hours in anaerobic conditions in 96-well tissue culture plates. The chloroform extract of *Zingiber zerumbet* was classified as ‘‘active’’, i.e. with an IC_{50} of <100 µg/ml [69].

Anti-tumour Activity: Zerumbone is an active component of *Zingiber zerumbet* can perform a diverse range of antitumor activities. The goal of the current investigation was to look into antitumor effects. In hepatoma HepG2 cells, zerumbone treatment significantly increased apoptosis and, in a dose-dependent manner, inhibited the cells' invasion and metastasis. Further investigation revealed that treatment with zerumbone led to the dose dependent induction of apoptosis and cell cycle arrest at the G2/M phase in cancer cells [70].

In some kinds of cancer, *Zingiber zerumbet* is said to have antitumor growth characteristics. An investigation into the anti-tumor effects of zerumbone in stomach cancer angiogenesis was done. By using real-time RT-PCR and an enzyme-linked immunosorbent assay, an expression of vascular endothelial growth factor (VEGF) in gastric cancer cell lines both in their basal state and after being treated with Zerumbone (ELISA). Using the WST-1 assay, the proliferation of stomach cancer cells was evaluated. At doses of 10 M, zerumbone reduced the growth of AGS cells. In a dose-dependent way, zerumbone also reduced the growth of other gastric cancer cell lines [71]. The chemopreventive potentials of ZER were examined in several cell culture experiments. ZER reduced the development of normal human dermal (2F0-C25) and colon (CCD-18 Co) fibroblasts, but it had less of an impact on the proliferation of human colonic cancer cell lines (LS174T, LS180, COLO205, and COLO320DM) [72]. Diethyl ether was used to separate the fresh rhizomes of *Zingiber zerumbet* after extracting them with 95% EtOH. In cultured P-388D, CDF-bearing mice, the diethyl ether extract's anticancer activity was evaluated.

The outcomes showed that at a dosage of 5 mg/kg body weight, the extract could significantly extend the lives of P-388D, carrying CDF mice (ILS%=127.8) and induce DNA breakage in P-388D cells *in-vitro* [73].

Anti-cancer Activity: Zerumbone from *Zingiber zerumbet* has been used as a promising chemopreventive agent. It was discovered that COX-2 and NQ01, two pro-inflammatory genes, were suppressed by Zerumbone in RAW264.7 macrophages. Utilizing the Keap1 and HuR proteins that are linked to Zerumbone and serve important roles in these molecular mechanisms [74]. The fresh rhizomes of *Zingiber zerumbet* were examined for their potential anti-cancer activity using the MTT assay on cancer cells from the human cervix (HeLa), breast, and ovary, as well as normal cells from the Chinese hamster ovary. The assay results revealed that ZER has less of an impact on normal cells than cancer cells. On HeLa cells, the ZER IC_{50} was shown to be the lowest. In addition, HeLa cells treated with ZER have more caspase-3 in their cells. One could conclude that ZER could induce specific morphological signs of apoptosis [75].

One typical cancer is pancreatic carcinoma. The research was done to see if pancreatic carcinoma cell lines would respond favorably to zerumbone, a naturally occurring cyclic sesquiterpene obtained from *Zingiber zerumbet*. The outcomes demonstrated that the effects of zerumbone on the viability of PANC-1 cells were inhibited in a concentration- and time-dependent manner. In addition, it was demonstrated that zerumbone caused PANC-1 cells to undergo apoptosis using Hoechst 33342, AO/EB, TUNEL staining, and a caspase-3 activity assay.

In PANC-1 cells treated with zerumbone, the expression of the p53 protein was noticeably increased, and the amount of p21 was also clearly increased. It was discovered that zerumbone might cause pancreatic carcinoma cell lines to undergo apoptosis, suggesting that it might be a promising treatment for cancer [76]. It was discovered that zerumbone prevented the growth of the benign Chang Liver and MDBK cell lines. The obtained IC50, however, was larger than the IC_{50} for HepG2 cells (> 10 g/ml). The Tdt-mediated dUTP nick end labeling method was used to assess the degree of DNA fragmentation, and the results revealed that zerumbone dramatically boosted apoptosis in HepG2 cells over time. As a result, it was shown that zerumbone causes HepG2 cells to undergo apoptosis without the assistance of functioning p53 activity *via* up- and down-regulating the Bax/Bcl-2 protein [77].

A cultured rat normal liver epithelial cell line was employed in a study to examine the phase II detoxification enzymes' ability to induce ZER. Glutathione S-transferase was significantly induced in RL34 cells after exposure to ZER, but it was not induced in these cells after exposure to its reduced counterparts, a-humulene, and 8-hydroxy-a-humulene. The current study's findings offer biological proof that ZER significantly reduces oxidative stress, presumably by triggering the production of endogenous antioxidants such as GSH and phase II xenobiotic metabolizing enzymes. The antioxidant action of ZER can be investigated as a cancer chemopreventive agent focused towards inflammation-related carcinogeneses, such as skin cancer and colon cancer, given the significance of oxidative damage in carcinogenesis [78].

Initially associated with leukocyte trafficking, CXC chemokine receptor 4 (CXCR4) is now recognized to be expressed in many tumors, including those of the breast, ovary, prostate, gastrointestinal, head and neck, bladder, brain, and melanoma. A study was evaluated that present evidence that zerumbone, a substance found in subtropical ginger (*Zingiber zerumbet*), regulates the expression of CXCR4. On HER2-overexpressing breast cancer cells, this sesquiterpene reduced CXCR4 expression in a dose- and time-dependent manner.

As CXCR4 expression was eliminated in leukemic, skin, kidney, lung, and pancreatic cancer cell lines, it was discovered that the reduction in CXCR4 caused by zerumbone was not cell-type specific. Zerumbone inhibits CXCL12-induced invasion of both pancreatic and breast cancer cells by suppressing CXCR4 expression. A-humulene, a zerumbone analog without a carbonyl group, was discovered to not affect CXCR4 downregulation. Overall, findings demonstrate that zerumbone is a

novel CXCR4 expression inhibitor, suggesting that it may be used to prevent cancer spread [79].

CONCLUSION: There are over 1200 species of Zingiberaceae that are known and widely used in treating various ailments. Despite being readily available in both locations, a plant that was used in one location for one sickness was later discovered to be utilized in another location for a different disease. Examining the literature discussed in this study is extremely pertinent because numerous recent investigations have shown that *Zingiber zerumbet* has pharmacological effects. The results imply that *Zingiber zerumbet* is a plant with significant medicinal potential due to its pharmacological action based on various scientific references. Additional research is necessary to pinpoint the advantages of using it as a medicinal plant.

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