A Review on Medicinal potential of the *Zingiber officinale*

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Abstract

Herbs and spices have received much interest in the world due to their ability to be absorbed into food and their potential health benefits. 70% to 80% of the world's population relies on complementary and alternative traditional medicine for their basic healthcare problems (herbal medicine). It was exported from India to the Roman Empire more than 2,000 years ago as a highly prized commodity. After the fall of the Roman Empire, Arab traders dominated the trade in ginger and spices, bringing their expertise to Europe. Ginger contains a variety of substances, including phenolic and terpene compounds. Anthraquinones, phenolic aldehydes and aldehydes are some of the most common phenolic compounds in plants. Ginger and other phytochemicals are being studied for their therapeutic properties. Ginger has a wide range of therapeutic properties, and can be used in a variety of ways. The anti-inflammatory, anti-diabetic and anti-obesity effects of ginger have been demonstrated in preclinical studies. Diabetes, obesity, and the SARS CoV-2 virus were all examined in silico as possible side effects of the medicine. A decade of research has been done on ginger.

Keywords: Ginger, Herbs, Pharmacological Activity, SARSCoV-2

1.1 Introduction

Herbs and spices have long been prized for their culinary, medicinal, and therapeutic properties. Despite their low cost, herbs and spices were prized in ancient Egypt, India, and China. Their popularity is rising due to the belief that they are more effective and safer than synthetic drugs in preventing or treating numerous illnesses [Abdillahi et.al]. Herbs and spices have attracted significant attention in the food industry due to their absorption into meals and health benefits. The global population uses complementary and alternative traditional medicine (herbal medicine) for 70–80% of main primary healthcare concerns[Abifarin et.al].

Unlike herbs, which are obtained from the plant's leaves, spices are generated from the plant's seeds and arils, as well as fruit berries, pods, rhizomes, and roots. Among the Zingiberaceae is Zingiber officinale (Roscoe), generally known as ginger (rhizomes). Most of the 53 genera and 1300 species of Zingiber are found in Asia[Abinaya et.al].

Zea mays (Z. officinale) is a popular blooming plant that produces ginger root (rhizome). Ginger's rhizome (underground stem) can be coloured by scraping and treating it first. The economic value of ginger has been constrained by biotic stress, climate change (drought or floods), other external shocks, and considerable food price volatility. Temperature, pH (6.0–6.5), and relative humidity (70–90%) are optimum for ginger growth[Adebowale et.al].

An economic impact was observed in TMR's analysis of ginger. The top ten ginger-producing countries include India, China, Nepal, Indonesia, Nigeria, Thailand, Bangladesh, Japan, Cameroon, and the Philippines, say Dhanik et al. On average, 3.3 million tonnes of ginger were produced in 2017[Adegbaju et.al]. India, Nigeria, China, and Indonesia all made major contributions. Because of this, China produced 0.58 million tonnes of ginger, which was sent to Japan, Korea and Vietnam, ranking second globally. Ginger is anticipated to expand by 7.5% by 2022, reaching a market value of $4.18 billion, making it one of the fastest-growing foods[Adegbola et.al].

Ginger has been used to improve health since the 13th century. They make powder, syrup, volatile oil, and oleoresin. Worldwide, both fresh and dried ginger are utilised for culinary and medicinal purposes. The written word describes its pungent, piercing, spicy, hot, and biting properties[Ademosun et.al]. Light and air may diminish or even eliminate these properties. In Asian and Ayurvedic medicine, ginger is supposed to relieve diabetes, flatulent bowel colic, indigestion, infertility, inflammation, and insomnia. Aside from its pharmacological benefits, ginger contains anticancer and anti-diabetic potential.

These are some of the most popular items made using ginger in the food and medicinal industries. This paper discusses ginger's phytochemical diversity, nutritional value, economic benefits, and exportability. Ginger is anti-inflammatory, anti-diabetic, and anti-obesity, say researchers[Afkhami et.al]. Other research have shown that ginger has analgesic, anti-inflammatory, anti-diabetic and anti-obesity properties that have been shown in preclinical tests. The drug's effects on diabetes, obesity, and the SARS CoV-2 virus were also studied in silico. Ginger has been studied for a decade. Following these findings, it is apparent that ginger has numerous health benefits[Ahn et.al].

1.2 History and origin of zinger

Ginger is related to cardamom and turmeric. In many studies on ginger's health benefits, gingerols are cited as the source of its pungent fragrance and flavour. Much of the ginger is eaten as rhizome, or horizontal root stem[Al-Shathly et.al]. The term srngaveram, or "horn root," comes from the Sanskrit language and refers to the appearance of ginger. Ziggiberis (Greek) zinziberi (Latin) Ginger is not found in nature, so its origins are unknown.

Ginger has been used as a tonic root in India and China for over 5000 years. Now grown in the humid tropics, mostly in India. Ginger has been used as a flavouring since ancient times. It was a valuable commodity traded from India to the Roman Empire over 2,000 years ago. Following the fall of the Roman Empire, Arab traders dominated the trade in ginger and other spices, bringing their expertise to Europe. In the 13th and 14th centuries, a pound of ginger was worth a sheep. By the Middle Ages, it was preserved and used in sweets. Christmas would not be the same without Queen Elizabeth I's gingerbread man[Alp et.al].

1.3 Ginger Rhizome Nutrition and Mineral Composition from Different Geographical Locations

Ginger, like many other spices, is loaded with nutrients and beneficial proximate composition and mineral components. Ginger growing in Bangladesh, India, Nigeria and Pakistan is shown in Table 1. varying widely around the globe. Protein and crude fat were shown to be the most variable nutrients[Anita et.al] .

Compared to earlier research, ginger produced in Hisar, India has the lowest moisture content (3.7± 0.08 percent). A food sample will last longer if it is low in moisture. Various studies show that dry foods and agricultural goods help reduce microbial growth and deterioration during storage[Arch et.al]. Table 1 shows that samples from Enugu, Nigeria had the highest ash content (6.63± 0.00%), followed by samples from other locations. Ash-rich plants are high in dietary fibres, which help protect intestinal digestive organisms. More ash in food and plant material means more mineral nutrients[Aryaceian et.al].

The literary canon is replete with references to the importance of dietary fibre. A crude fibre content of 10.36 ± 0.67 percent was observed in ginger grown in Imo State, Nigeria (Table 1). According to nutritionists, foods with a high dietary fibre content are essential for proper peristaltic action, assisting trace element absorption and lowering cholesterol absorption[Badooei et.al].

The crude fat content of ginger rhizome powder varies from 0.90 ± 0.02 to 11.15 ± 0.00 percent. Some studies suggest that only 1–2% of one's calorie intake should include fat. While the crude fat content of ginger cultivated in Hispar, India and Dhaka, Bangladesh is low compared to other areas, other locations have higher fat content[Balogun et.al]. Excess dietary fat intake has been linked to heart disease, cancer, and ageing.

Table 1 shows that ginger grown in Kwara and River States, Nigeria, has protein content less than 8.58 ± 0.01 percent. Proteins are essential to human health because they help produce and preserve various organic substances required by the body[Banihani et.al].

Globally, carbohydrate is the most nutrient-dense component of ginger. Table 1 shows that ginger from Hisar, India has the highest composition (80.3 percent 0.40 percent) compared to ginger from other places. Ginger's carbs make it a great way to boost meal caloric content.

Gingerol and shogaol are two compounds with molecular structures that can impact food's thermic effect (TEF). However, ginger's thermogenic potential is questionable [Bashir et.al]. Minerals are essential for human health. They help provide necessary nutrients for mental and physical wellbeing.

Table 1 : Dry weight data from several geographical locations comparing the nutritional makeup of ginger rhizome.

Composition (%)	**Dhaka, Bangladesh**	**Hisar, India**	**Mysore, India**	**Enugu, Nigeria**	**Kano, Nigeria**	**Faisalabad, Pakistan**
Moisture	7.16 ±0.04	3.70 ±0.08	15.02± 0.04	6.45± 0.00	4.74 ±0.30	8.60± 0.23
Ash	3.31± 0.12	3.50± 0.04	3.85± 0.61	6.63 ±0.00	5.05± 0.10	1.74± 0,04
Crude fiber	4.80± 0.12	5.4 ±0.08	ND	0.92 ±0.18	0.20± 0.05	ND
Crude fat	1.39± 0.25	0.90± 0.02	3.72± 0.03	5.71± 0.00	11.15± 0.00	5.03± 0.43
Crude protein	6.32 ±0.03	5.80 ±0.09	5.087± 0.09	8.83± 0.00	4.92± 0.10	7.88± 0.01
Carbohydrate	77.21± 0.22	80.3± 0.40	38.35± 0.1	71.46 ±0.00	73.94± 0.20	76.4 ±1.30

Comparing eleven key elements and two heavy metals in powdered rhizome samples from distinct geographic regions (Table 2). The ginger rhizome from numerous understudied places included high amounts of calcium, potassium, phosphorus, and magnesium, as well as copper, cobalt, iron, nickel, manganese, sodium, and zinc[Bauer Faria et.al]. These minerals are needed for bone growth, biological reactions, and energy metabolism. Various studies have indicated that the mineral antioxidants zinc, cobalt, and nickel present in ginger rhizome have therapeutic effects against growth issues and anaemia. Ginger rhizome mineral concentration varies by nation, including Bangladesh, China, Ethiopia, India, Nigeria, and Pakistan (Table 2). The nutritional and mineral content of ginger rhizomes varies depending on the type and environmental factors such as climate and location[Baughn et.al].

No heavy metals were identified in any of the ginger rhizomes. Metal concentrations in plants are highly controlled by their geochemical environment. Micronutrients like Co, Cu, and Fe were abundant, as were Mg and Mn but not Zn (Table 2).

Parameter	Dhaka, Bangladesh	China	Mysore, India	Imo, Nigeria
Ca	2085± 0,01	2812± 0.01	8340 ±87.00	34.76± 1.40
Mg	2354± 0,00	2656± 0.01	ND	ND
Na	440.32± 0,8	475.32± 0.6	ND	37.76 ±3.87
K	27654± 14322	19876± 9876	ND	35.76± 3.98
P	ND	ND	ND	ND
Zn	ND	ND	5.53 ±3.87	38.8± 0.53
Mn	ND	ND	385.32± 8.80	4.30± 0.04

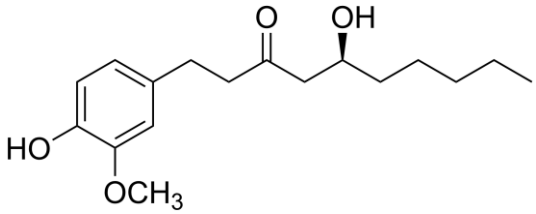
Heavy metals in nutraceuticals and functional meals prepared from medicinal herbs and spices must be monitored, argue. Postharvest and storage conditions can raise heavy metal levels in therapeutic food plants. [Bernard et.al].

2.1 Phytochemical activities of Ginger

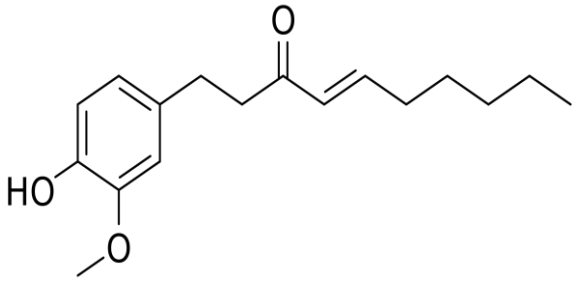
Ginger contains phenolic and terpene compounds, among others. Gingerols, shogaols, and paradols are the main phenolic compounds. Gingerols (6, 8, and 10) are the main polyphenols in fresh ginger. Heat or long-term storage of gingerols yields shogaols. Hydrogenation turns shogaols into paradols. QZ, gingerenone-A, and 6-DEH are only a handful of the phenolic compounds present in ginger. Among the terpenes found in ginger essential oils include bisabolene, zingiberene, farnesene, and sesquiphellandrene. Ginger also has polysaccharides, lipids, organic acids, and raw fibres[Bode et.al].

A. Phenolic Compound:

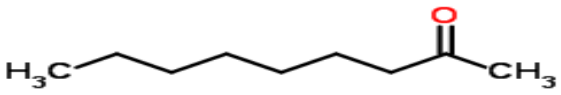
1. **Gingerol**: [6]-gingerol, a phenol phytochemical compound found in fresh ginger, activates tongue spice receptors. Molécularly, capsaicin and piperine are relatives of gingerol, but not bioactively. Ginger rhizomes frequently contain a spicy yellow oil, though it can also be a crystalline solid. This chemical component is found in all Zingiberaceae members, including Grain of Paradise and African Ginger. Zingerone has a spicy-sweet aroma and is less intense than gingerol. When ginger is dried or mildly burned, shogaols (almost twice as pungent as gingerol) develop. This explains that dried ginger tastes stronger than fresh ginger[Boheemen et.al].



2. **Shogaols**: Gingerol is a pungency component found in ginger. The most common is [6]-shogaol. Like zingerone, zingerone is generated when ginger is dried or cooked. Heat breaks down hogaol (and gingerol) into other chemicals, which is why ginger loses some of its heat when processed[Chan et.al]. The name shogaol comes from the Japanese word meaning ginger. Hogaol has a Scoville score of 160,000, making it more pungent than piperine but less pungent than capsaicin.

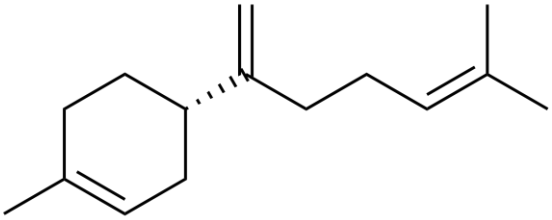


3. **Paradol**: Is the taste of Guinea pepper seeds (Aframomum melegueta or grains of paradise). Ginger also has it. Paradol has antioxidant and anticancer effects in a mouse model. Its essential oil gives meals a smokey flavor[Chen et.al].



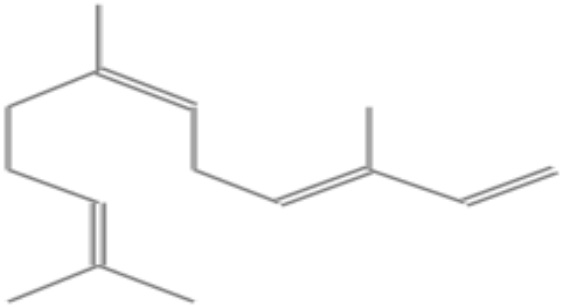
B. Terpenoid Compound

1. **Bisabolenes:** A family of sesquiterpenes. Bisabolenes are present in essential oils of bisabol, cubeb, lemon, and oregano. Insects like stink bugs and fruit flies respond to some derivatives. Bisabolenes are produced by fungi, but their biological significance is unknown[Cheng et.al].



2. **α-curcumene:** For imipenem, ciprofloxacin, amoxicillin-clavulanic acid, and finally amoxicillin-clavulanic acid. The cells were grown overnight (18-20 hours) at 35°C in Trypticase soy broth and neutral phosphate buffer with 107 CFU/mL[Choi et.al]. The overlayagar made from Iso-Sensitest broth (Oxoid, Ogdensburg, New York) was heated at 50°C and blended properly before use. Curcumene was vortexed into the cell overlays mixture. After vortexing, treated cell overlays were poured on Iso-Senitest agar plates (2 percent agar). The plates were gently swirled around and counterclockwise to ensure consistent distribution of -curcumene throughout the overlay. Stiffened agar overlays with antibiotic discs were incubated at 35°C for 24 hours[Crichton et.al]. A ruler was used to measure the diameter of inhibitory zones on each plate.

3. **α-Farnesene**: Two of the alpha form's three internal double bonds can be varied in geometry, but the third double bond is identical. There are two -farnesene stereoisomers discovered in nature, one with a different geometry than the other. The most common isomer of this chemical is E,E-farnesene. This molecule in the fruit's outer layer gives it a green apple fragrance. The air oxidises it, generating harmful compounds[De.B et.al]. Termites and the codling moth use these two isomers as alarm and feeding pheromones. Also, -Farnesene dominates the gardenia scent, accounting for over 65% of the headspace constituents.



3. Pharmacology Activity of Ginger:

3.1 Antioxidant Activity:

An overabundance of free radicals, such as reactive oxygen species, is one of the main causes of many chronic diseases (ROS). Herbal infusions and medicinal herbs are natural antioxidants. Examples of these products are vegetables and fruits. Ginger has been shown to be an antioxidant in several investigations[Donkor et.al]. The strongest antioxidant activity was seen in dried ginger. Gingers varied in their antioxidant properties: Fresh ginger is superior to all other gingers. Polyphenols were frequently blamed. So fresh ginger was roasted to get dried ginger with enhanced antioxidant activity. Dry ginger loses its antioxidant properties when stir-fried. This extraction solvent may be harmful to ginger's antioxidants. An ethanolic ginger extract's antioxidant activity and ferric reductibility[Ebrahimzadeh Attari et.al]. Antioxidant levels rose after ginger extract therapy. Ginger and its bioactive components have been shown to reduce inflammation in vitro and in vivo. Several disorders are thought to be caused by the excessive formation of reactive oxygen species (ROS) in the human body. Factors that may affect antioxidant bioavailability and accessibility include health conditions, individual variances, dietary components, lifestyle choices, antioxidant dosage, solubility, and administration route. Antioxidants, which are chemicals, can minimise oxidative stress and free radical damage[El Gayar et.al]. Antioxidant enzymes such superoxide dismutase, catalase, glutathione peroxidase, and GSH can be regulated by gingerols, reducing oxidative stress. Ginger aqueous extract is an antioxidant and anti-chelating dietary supplement. Ginger oil is an antioxidant and oxygen radical scavenger.

3.2 Anti-Inflammatory Activity:

No previous studies have looked into the benefits of the ginger component 12dehydrogingerdione, the researcher claims (12DHGD). They investigated 12DHGD's anti-inflammatory capabilities on lipopolysaccharide-primed 264.7 cells (LPS). 12DHGD had no influence on LPS-induced IL1 or TNF production[El-Naggar et.al]. 12DHGD, a key component of the ginger plant, inhibits proinflammatory mediator production in raw 264.7 macrophage cells. This discovery led to ginger's anti-inflammatory properties. Gingerol, a major ingredient, is analgesic and anti-inflammatory. Various gingerol concentrations were injected intraperitoneally in this study. These trials demonstrated gingerol to be analgesic and anti-inflammatory[El-Sayed et.al]. Anti-inflammatory effects of ginger are likely to be responsible. Ginger root and its active components can stop angiogenesis and cellular proliferation. Drying Z.officinale maximises the expression of LPS-induced IL-6 and IFN-.Ginger inhibits cyclooxygenases 1 and 2, reducing prostaglandin production. It may also

inhibit 5-lipoxygenase, preventing leukotriene formation[Elseweidy et.al]. Ginger is pharmacologically different from NSAIDs (Non-Steroidal Anti-Inflammatory Drugs). Cyclooxygenase and 5-lipoxygenase inhibitors may have a superior therapeutic profile than NSAIDs.

3.3 Antimicrobial Activity:

Antimicrobial resistance has made bacterial, fungal, and viral infections important public health concerns. Herbs and spices are the most widely utilised natural antibacterial agents. Ginger has been shown to treat bacterial, fungal, and viral illnesses[Elshopakey et.al]. Infections and antibiotic resistance almost invariably involve biofilms. This study found that ginger could slow the growth and spread of multidrug-resistant bacteria like Pseudomonas. Antibiotics reduced Streptococcus mutans-induced caries in rats, in vitro findings show. Ginger none-A and 6-shogaol suppressed Staphylococcus aureus growth in vitro. For example, ginger essential oil is lipophilic, allowing cell walls and cytoplasmic membranes to leak, causing fungus to lose membrane integrity[Fagundes et.al]. Ginger In vitro, ginger essential oil suppressed Fusarium verticillioides growth by lowering ergosterol synthesis and altering membrane integrity. When administered to human respiratory syncytial virus (HRSV) cell lines, fresh ginger inhibited plaque growth (HRSV). Ginger was particularly good at preventing viral attachment and internalization[Fajrin et.al]. Gingerol and related chemicals are antimicrobial. These two Mycobacteria are potent inhibitors of 10-gingerol production. Ginger inhibits Aspergillus, a fungus that produces aflatoxin, a carcinogen. Ginger root ethanolic extract has anti-Salmonella typhi and anti-Candida albicans action. A scientific study compared garlic and ginger extracts. Insignificant changes in the extracts' sensitivity patterns between the two organisms[Fan et.al]. This investigation found both plant extracts to be antibacterial. Ginger contains antibacterial properties. The study's purpose was to test ginger extract's phytochemicals and antibacterial activity against pathogenic microorganisms that cause food spoilage. Ginger extracts contain anthraquinones, saponin, phenols, flavonoids, terpenoids, and glycosides. The average zone of inhibition for ethanol extracts was 13.77 2.16 mm, followed by aqueous (11.67 ±1.54) and n-hexane (11.67 ± 1.54) extracts (9.64 ± 1.22 mm). The average zone of inhibition for E. coli is the largest, followed by Shigella, Salmonella typhi, S. aureus, and Pseudomonas, with Klebsiella having the smallest. Ginger extracts contain antimicrobial properties, although the effect is dose dependent[Farhadi et.al].

3.4 Antinausea and Antiemetic Activities:

Ginger has been used for thousands of years to treat stomach issues. A recent study says ginger may help relieve nausea and diarrhoea. Those who inhaled ginger essence three and six hours following a nephrectomy had less nausea and emesis than those who did not[Fitriyanti et.al]. Pregnant women who got dried ginger powder before caesarean sections felt better. Chemotherapy causes nausea and vomiting. All three compounds decreased emetic signal transmission by inhibiting the 5-HT receptor, with 6-shogaol exhibiting the best inhibitory activity[Ghayur et.al]. Ginger extract's anti-nausea properties were linked to 5-HT receptor suppression in enteric neurons. A double-blind RCT and PCT indicated that chemotherapy patients benefited from ginger supplementation. The efficacy of ginger in treating nausea and vomiting caused by antituberculosis drugs and antiretroviral therapy was assessed using these

tools[Gregersen et.al]. Ginger has been shown to reduce pregnancy-induced nausea and vomiting. Recent studies have focused on ginger's potential to reduce nausea and vomiting after surgery or chemotherapy.

3.5 Anti Lipidemic Activity:

Oral ginger extract lowers cholesterol, lipids, and prevents atherosclerosis in cholesterol-fed rats. The methanol extract had more 6-gingerol than the ethyl acetate extract[Grzanna et.al]. The methanolic extract of ginger outperforms the ethyl acetate extract in fructose-induced hyperlipidemia. Ginger's hypoglycemic properties were observed in diabetic rats administered daily (500 mg/kg) STZ and an aqueous extract of raw ginger (for seven weeks). A study found that ginger can help lower blood sugar, cholesterol, and triacylglycerol levels. Compared to diabetic rats that only got ginger therapy[Guan et.al].

3.6 Hepato-protective Activity:

Oral ginger aqueous extract reduced acetaminophen-induced liver damage. This therapy boosted antioxidant enzyme activity in the liver. Ginger may also reduce liver toxicity from mancozeb and other fungicides. Recent research shows that ginger extracts protect against alcohol, bromobenzene, and ethionine toxicity[Gungor et.al]. Ginger also treats lead poisoning. An acetaminophen and ginger pretreatment study on rat acute hepatic injury was administered to participants. Ginger, like vitamin E, helps prevent oxidative stress and thus liver damage. Ginger and acetaminophen should be taken together in cases of hepatic issues or high APAP doses, said the study's authors. We sought to test if ethanolic extract of Z. officinale could protect rats against thioacetamide-induced liver injury. It was possible to see the liver damage in all of the rats. The ethanolic extract worked well on Hep-G2 cells. The ethanolic extract of Z. officinale was found to be hepatoprotective[Haddy et.al].

3.7 Immunomodulatory Activity:

Ginger is a potent immunological modulator. In vitro, ginger slowed lymphocyte growth. The aqueous ginger extract increased splenocyte proliferation and cytokine generation in activated peritoneal mice macrophages. Dietary ginger rhizome consumption enhanced hematocrit and haemoglobin levels as well as MCH and MCHC levels in the blood after 13 weeks[Han et.al]. Ginger essential oil improved humoral and cell-mediated immunity in immunosuppressed rats. Using powdered ginger rhizome improves the non-specific immune response of rainbow trouts. Alternative treatment for cystic echinococcosis using ginger and gingerol was proven to be immunomodulatory. Both IFN- and this infection induced NO production, whereas both extracts inhibited it. These herbal remedies may also protect cells from oxidative stress by reducing NO levels. Ginger was found to be more effective than gingerols[Hao et.al].

3.8 Anti-cancer Activity:

This study's purpose was to show how gingerols and paradols, chemically related compounds, affect EGF-induced cell transformation and AP-1 activation. For the first time, both inhibit EGF-induced cell transformation. Ginger extract increased NFB and TNF-expression in liver cancer rats. NFB and TNF- were associated in the choline-deficient diet group, but not in the ginger extract group[Hashmi et.al]. A drug that inhibits NFB and reduces pro-inflammatory

TNF- was identified in this investigation. This work examines NFB and TNF expression in liver cancer-induced rats. Ginger ethanolic extract reduced NFB and TNF- expression in liver cancer rats. Experts believe ginger can fight cancer and inflammation by inhibiting NFB and reducing pro-inflammatory TNF-. In vitro studies showed several mechanisms involved in ginger leaf's anti-cancer activities. Ginger leaf lowered cell viability and mortality in colorectal cancer cells by activating the ATF3 promoter and raising ATF3 expression[Hayat et.al].

3.9 Gastrointestinal Activity:

Human stomach emptying is not affected by ginger, which prevents post-operative nausea and vomiting. Ginger's rhizome (root) promotes stomach acid production. PPIs, H2 antagonists, and antacids can all cause difficulties. Ginger powdered rhizome has long been used to alleviate gastrointestinal disorders[Heidari-Beni et.al]. The anti-inflammatory qualities of ginger's active components (gingerol) may help prevent dyspepsia, peptic necrosis of the stomach or colon, and stomach or colon cancer. Free phenolic and hydrolyzed flavonoids in ginger inhibit stomach cell proton potassium ATPase function and H. pylori development, the Ginger study found. Dual fractions could also be employed as cheap multistep ulcer blockers[Hoffmann et.al].

3.10 Cardiovascular Activity:

Ginger extracts and 6- and 8-gingerol have been shown to alter eicosanoid reactivity in smooth vascular muscles. Ginger's heart rate climbed with her blood pressure. Cardiotomy effects were seen in high dose shogaols and gingerols in in vitro investigations. An aqueous methanol extract of fresh ginger reduced the arterial blood pressure of anaesthetized rats dose-dependently[Hong et.al]. This effect's principal mechanism is voltage-dependent calcium channel blockage. In a Guinea pig's paired atria, the crude ex Ginger includes several nutritional components that are needed for good health, making it a worthwhile investment for many countries, especially developing ones. There are around 400 pungent chemicals in this plant, including gingerols, hogaols, and zingerone[Hori et.al]. Ginger's antioxidants and minerals are vital to numerous physiological and biochemical processes. The anti-inflammatory effects of ginger could be utilised to treat diabetes, male infertility, obesity, nausea, and emesis. Inhibition of SARS-COV-2 by ginger phytochemicals was tested. In silico molecular docking could revolutionise drug discovery. By interacting with numerous receptors, novel medications and inhibitors can be produced to fight obesity, diabetes, and SARS-CoV-2-induced nausea and vomiting (e.g. 3-AR). But their action mechanism and safety need more research[Horiguchi et.al]. Only a few scientific investigations have demonstrated ginger and its components safe and beneficial in treating male infertility. This necessitates large-scale randomised clinical trials to assess the efficacy and safety of ginger or phytocompounds as potential medicines. Due to its diverse pharmacological properties, ginger can also be used to boost our immune system.

The tract slowed the rate and severity of spontaneous contractions. [Hosseini et.al]] In this study, ginger ethanolic extract protected rats from ISO-induced myocardial infarction. A study quantified gingerols and shogaols detected in ethanolic ginger extracts. In rats given 400 mg/kg ginger extract, all heart enzyme activity was reduced, including cardiac troponin, creatine kinase MB isozyme, lactate dehydrogenase, aspartate transaminase, and alanine transaminase.

Compared to the ISO-control group, pre-treated animals had higher glutathione peroxide, catalase, and superoxide dismutase activity. An ethanolic ginger extract showed cardioprotective effects after ISO therapy in myocardial infarction [Hu.Y.W. Zhang J et.al] Inhibiting calcium channels while activating muscarinic receptors lowers blood pressure. The material tested positive for a range of compounds, including saponins, flavonoids, amines, alkaloids, and terpenoids, and was partially inhibited by atropine. In addition to L-NAME sensitive atropine-resistant vasodilator activity, 6-shogaol and 6, 8, and 10 gingererol demonstrated mild vasodilator action. Ginger has a powerful mechanism in hypertension and palpitations[Huang et.al]

3.11 Lipolytic or Cholesterol-lowering Activity:

ginger ethanolic extract on cholesterol-fed rabbits Ginger may help lower BMI by slowing weight gain (BMI). This study compared ethanolic ginger extract to gemfibrozil, a commonly used oral hypolipidemic drug. These mice showed more severe aortic atherosclerosis than those given ginger extract together with cholesterol. Ginger appears to be an anti-hyperlipidaemic agent [Hussain et.al]. An ethanolic extract from Zingiber officinale was tested for its cholesterol-lowering and antioxidant activities in diabetic rats. The ethanolic extract of Zingiber officinale (200 mg/kg) had antihyperglycemic actions in diabetic rats. The extract reduced total serum cholesterol and triglycerides while boosting HDL-cholesterol in diabetic rats. The extract lowered cholesterol levels in diabetic rats[Ibrahim et.al].

3.12 Antiarthritic Activity:

Rats with chronic adjuvant arthritis suffering from severe pain responded favourably to eugenol and ginger oil, according to this study[Idris et.al]. Male Sprague-Dawley rats were injected with 5 mg/ml of a fine suspension of dead Mycobacterium tuberculosis bacilli in liquid paraffin to induce severe arthritis in the right knee and the right paw. We administered eugenol (33 mg/kg) and ginger oil (33 mg/kg) orally for 26 days to significantly reduce joint swelling and paw swelling. The anti-inflammatory and anti-rheumatic properties of eugenol and ginger oil were discovered as a result. [Iwasaki et.al] The anti-inflammatory effect of Zingiber officinale aqueous extract on carrageenan-induced inflammation in Sprague Dawley (SD) rats was examined in this study. SD rats were divided into six groups of five and allowed to acclimate for one week. Carrageenan was injected into the right paw of the animal to cause inflammation. When compared to untreated SD rats, treatment with 400 mg/kg aqueous ginger extracts significantly reduced the paw edoema in carrageenan-induced SD rats ($p<0.001$). Z.officinale aqueous extract has anti-inflammatory properties, according to this study. Transdermal delivery of Z. officinale dense extract was used to study its analgesic and anti-inflammatory properties[Jimenez-Aguilar et.al]. When applied 10 minutes prior to a pain inducing agent, 0.5% ointment with ginger extract was found to be effective in inhibiting the growth of inflammation, and 0.5% was found to have the greatest anti-nociceptive effect. That's why Zingiber officinale-dense extract was found to have significant antinociceptive and antiinflammatory effects when applied transdermally[Jimoh et.al].

4. Conclusion

Ginger is high in nutrients needed for good health, which could improve many countries' economies, especially those in the developing world. Some of the plant's medicinal characteristics include gingerol, shogaol, zingerone, and others. Ginger also contains antioxidants and nutrients that help many biological functions and metabolic interactions. Anti-inflammatory and anti-diabetic effects of ginger appear promising. Ginger phytochemicals have been shown to inhibit SARS-Cov-2 and bind to it. In silico molecular docking can reveal revolutionary new therapeutics. Molecular studies on ginger components that interact with a range of receptors or proteins are being used to treat obesity, diabetes, inflammation, nausea and vomiting as well as SARS-CoV-2 (e.g. 3-AR, TRPV1). But their mechanism of action and safety require more research. A few studies have proven ginger and its components to be beneficial and safe in treating male infertility. Future large-scale randomised clinical trials with long-term effects are required to assess the efficacy and safety of ginger or phytocompounds as potential therapeutic candidates. Due to its diverse pharmacological properties, ginger can also be used to boost our immune system.

5. References

1. Abdillahi, H. S., and Van Staden, J. (2012). South African Plants and Male Reproductive Healthcare: Conception and Contraception. *J. Ethnopharmacol.* 143, 475–480. doi:10.1016/j.jep.2012.06.047
2. Abifarin, T. O., Otunola, G. A., and Afolayan, A. J. (2021). Nutritional Composition and Antinutrient Content of Heteromorpha Arborescens (Spreng.) Cham. & Schltdl. Leaves: An Underutilized Wild Vegetable. *Food Sci. Nutr.* 9, 172–179. doi:10.1002/FSN3.1978
3. Abinaya, S., Gayatri Devi, R., and Lakshmanan, G. (2020). Knowledge and Awareness about Ginger and Turmeric as a Herbal Cure for COVID-19. *Ijpr* 12, 768–777. doi:10.31838/ijpr/2020.SP2.093
4. Adebowale, K. O., Nwokocha, L. M., and Agbaje, W. B. (2013). Composition of Cissus Populnea Stem. *J. Food Compost. Anal.* 30, 41–46. doi:10.1016/J.JFCA.2013.01.001
5. Adegbaju, O. D., Otunola, G. A., and Afolayan, A. J. (2019). Proximate, mineral, Vitamin and Anti-nutrient Content of Celosia Argentea at Three Stages of Maturity. *South Afr. J. Bot.* 124, 372–379. doi:10.1016/J.SAJB.2019.05.036
6. Adegbola, P. I., Fadahunsi, O. S., Ajilore, B. S., Akintola, A. O., and Olorunnisola, O. S. (2021). Combined Ginger and Garlic Extract Improves Serum Lipid Profile, Oxidative Stress Markers and Reduced IL-6 in Diet Induced Obese Rats. *Obes. Med.* 23, 100336. doi:10.1016/j.obmed.2021.100336
7. Ademosun, M. T., Omoba, O. S., and Olagunju, A. I. (2021). Antioxidant Properties, Glycemic Indices, and Carbohydrate Hydrolyzing Enzymes Activities of Formulated Ginger-Based Fruit Drinks. *J. Food Biochem.* 45, e13324–10. doi:10.1111/jfbc.13324
8. Adeyemi, A. A., Yekini, S. D., and Oloyede, O. J. (2020). Antioxidant Impact of Zingiber Officinale and Allium Sativum on Rabbit Semen. *J. Vet. Androl.* 5, 18–22.
9. Afkhami Fathabad, A., Shekarforoush, S., Hoseini, M., and Ebrahimi, Z. (2018). Attenuation of Sulfite-Induced Testicular Injury in Rats by Zingiber Officinale Roscoe. *J. Diet. Suppl.* 15, 398–409. doi:10.1080/19390211.2017.1349233

10. Ahmad, B., Rehman, M. U., Amin, I., Mir, M. U. R., Ahmad, S. B., Farooq, A., et al. (2018). Zingerone (4-(4-Hydroxy-3-Methylphenyl) Butan-2-One) Protects against Alloxan-Induced Diabetes via Alleviation of Oxidative Stress and Inflammation: Probable Role of NF-kB Activation. *Saudi Pharm. J.* 26, 1137–1145. doi:10.1016/j.jsps.2018.07.001
11. Ahn, S. I., Lee, J. K., and Youn, H. S. (2009). Inhibition of Homodimerization of Toll-like Receptor 4 by 6-shogaol. *Mol. Cell* 27, 211–215. doi:10.1007/s10059-009-0026-y
12. Al-Muswie, R. T., Majid, A., Al-Rekabi, E. A., and Al-Fartosi, K. G. (2021). Prophylactic Role of Curcuma Longa and Zingiber Officinale on Histological Changes of Testis and Kidney of Male Rats Treated with Hydrogen Peroxide. *Ann. Rom. Soc. Cel Biol.* 25, 3883–3891.
13. Al-Sanea, M. M., Abelyan, N., Abdelgawad, M. A., Musa, A., Ghoneim, M. M., Al-Warhi, T., et al. (2021). Strawberry and Ginger Silver Nanoparticles as Potential Inhibitors for Sars-Cov-2 Assisted by In Silico Modeling and Metabolic Profiling. *Antibiotics (Basel)* 10. doi:10.3390/antibiotics10070824
14. Al-Shathly, M. R., Ali, S. S., and Ayuob, N. N. (2020). Zingiber Officinale Preserves Testicular Structure and the Expression of Androgen Receptors and Proliferating Cell Nuclear Antigen in Diabetic Rats. *Andrologia* 52, e13528–8. doi:10.1111/and.13528
15. Ali, A., and Gilani, A. H. (2007). Medicinal Value of Ginger with Focus on its Use in Nausea and Vomiting of Pregnancy. *Int. J. Food Properties* 10, 269–278. doi:10.1080/10942910601045297
16. Alp, D., and Bulantekin, Ö. (2021). The Microbiological Quality of Various Foods Dried by Applying Different Drying Methods: a Review. *Eur. Food Res. Technol.* 247, 1333–1343. doi:10.1007/S00217-021-03731-Z
17. Alsahli, M. A., Almatroodi, S. A., Almatroudi, A., Khan, A. A., Anwar, S., Almutary, A. G., et al. (2021). 6-Gingerol, a Major Ingredient of Ginger Attenuates Diethylnitrosamine-Induced Liver Injury in Rats through the Modulation of Oxidative Stress and Anti-inflammatory Activity. *Mediators Inflamm.* 2021, 1–17. doi:10.1155/2021/6661937
18. Anh, N. H., Kim, S. J., Long, N. P., Min, J. E., Yoon, Y. C., Lee, E. G., et al. (2020). Ginger on Human Health: A Comprehensive Systematic Review of 109 Randomized Controlled Trials. *Nutrients* 12, 1–28. doi:10.3390/nu12010157
19. Anita, N., Sartini, , and Alam, G. (2020). Ginger Candy (Zingiber Officinale) Reduces the Frequency of Vomiting of First-Trimester Pregnant Women with Emesis Gravidarum. *Enferm. Clin.* 30, 536–538. doi:10.1016/j.enfcli.2020.03.014
20. Antia, B. S., .Akpan, E. J., Okon, P. A., and Umoren, I. U. (2006). Nutritive and Anti-nutritive Evaluation of Sweet Potatoes (Ipomoea Batatas) Leaves. *Pakistan J. Nutr.* 5, 166–168. doi:10.3923/PJN.2006.166.168
21. Antia, T. M., Ikram, N., Najam-ul-Haq, M., Fayyaz, I., Fayyaz, Q., and Ghafoor, I. (2004). Essential Trace Metal (Zinc, Manganese, Copper and Iron) Levels in Plants of Medicinal Importance. *J. Biol. Sci.* 4, 95–99. doi:10.3923/jbs.2004.95.99
22. Arch, J., and Ainsworth, A. (1983). Thermogenic and Antiobesity Activity of a Novel Beta-Adrenoceptor Agonist (BRL 26830A) in Mice and Rats. *Am. J. Clin. Nutr.* 38, 549–558. doi:10.1093/AJCN/38.4.549
23. Aryaeian, N., Shahram, F., Mahmoudi, M., Tavakoli, H., Yousefi, B., Arablou, T., et al. (2019). The Effect of Ginger Supplementation on Some Immunity and Inflammation Intermediate

Genes Expression in Patients with Active Rheumatoid Arthritis. *Gene* 698, 179–185. doi:10.1016/j.gene.2019.01.048

24. Badooei, F., Imani, E., Hosseini-Teshnizi, S., Banar, M., and Memarzade, M. (2021). Comparison of the Effect of Ginger and Aloe Vera Mouthwashes on Xerostomia in Patients with Type 2 Diabetes: A Clinical Trial, Triple-Blind. *Med. Oral* 26, e408–e413. doi:10.4317/medoral.23998

25. Bag, B. (2018). Ginger Processing in India (Zingiber Officinale): A Review. *Int.J.Curr.Microbiol.App.Sci* 7, 1639–1651. doi:10.20546/ijcmas.2018.704.185
26. Balogun, F. O., Tayo AdeyeOluwa, E., and Omotayo Tom Ashafa, A. (2019). Pharmacological Potentials of Ginger. *Ginger Cultiv. Its Antimicrob. Pharmacol. Potentials*. doi:10.5772/intechopen.88848
27. Banihani, S. A. (2019). Effect of Ginger (Zingiber Officinale) on Semen Quality. *Andrologia* 51, e13296–7. doi:10.1111/and.13296
28. Bashir, N., Ahmad, S. B., Rehman, M. U., Muzamil, S., Bhat, R. R., Mir, M. U. R., et al. (2021). Zingerone (4-(four-Hydroxy-3-Methylphenyl) Butane-Two-1) Modulates Adjuvant-Induced Rheumatoid Arthritis by Regulating Inflammatory Cytokines and Antioxidants. *Redox Rep.* 26, 62–70. doi:10.1080/13510002.2021.1907518
29. Bauer Faria, T. R., Furletti-Goes, V. F., Franzini, C. M., de Aro, A. A., de Andrade, T. A. M., Sartoratto, A., et al. (2021). Anti-inflammatory and Antimicrobial Effects of Zingiber Officinale Mouthwash on Patients with Fixed Orthodontic Appliances. *Am. J. Orthod. Dentofacial Orthopedics* 159, 21–29. doi:10.1016/j.ajodo.2019.10.025
30. Baughn, L. B., Sharma, N., Elhaik, E., Sekulic, A., Bryce, A. H., and Fonseca, R. (2020). Targeting TMPRSS2 in SARS-CoV-2 Infection. *Mayo Clin. Proc.* 95, 1989–1999. doi:10.1016/j.mayocp.2020.06.018
31. Bernard, M., Furlong, S. J., Power Coombs, M. R., and Hoskin, D. W. (2015). Differential Inhibition of T Lymphocyte Proliferation and Cytokine Synthesis by [6]-Gingerol, [8]-Gingerol, and [10]-Gingerol. *Phytother Res.* 29, 1707–1713. doi:10.1002/ptr.5414
32. Bode, A., and Dong, Z. (2011). The Amazing and Mighty Ginger. *Herb. Med. Biomol. Clin. Asp*, 131–156. doi:10.1201/b10787-8
33. Boheemen, S. V., Graaf, M. D., Lauber, C., Bestebroer, T. M., Raj, V. S., Zaki, A. M., et al. (2012). Genomic Characterization of a Newly Discovered Coronavirus. *MBio* 3, 1–9. doi:10.1128/mBio.00473-12
34. Butt, M. S., and Sultan, M. T. (2011). Ginger and Its Health Claims: Molecular Aspects. *Crit. Rev. Food Sci. Nutr.* 51, 383–393. doi:10.1080/10408391003624848
35. Chan, K. (2003). Some Aspects of Toxic Contaminants in Herbal Medicines. *Chemosphere* 52, 1361–1371. doi:10.1016/S0045-6535(03)00471-5
36. Chen, C.-Y., and Yeh, Y.-T. (2011). Two New Phenylalkanoids from the Rhizomes of Zingiber Officinale. *Nat. Prod. Res.* 25, 62–67. doi:10.1080/14786419.2010.490917
37. Chen, C. Y., Yeh, Y. T., and Yang, W. L. (2011). New Phenylalkanoids from Zingiber Officinale. *Nat. Prod. Commun.* 6, 855–856. doi:10.1177/1934578x1100600624
38. Cheng, Q., Feng, X., Meng, Q., Li, Y., Chen, S., Wang, G., et al. (2020). [6]-Gingerol Ameliorates Cisplatin-Induced Pica by Regulating the TPH/MAO-A/SERT/5-HT/5-HT3 Receptor System in Rats. *Drug Des. Devel Ther.* 14, 4085–4099. doi:10.2147/DDDT.S270185

39. Choi, J., Kim, K. J., Kim, B. H., Koh, E. J., Seo, M. J., and Lee, B. Y. (2017). 6-Gingerol Suppresses Adipocyte-Derived Mediators of Inflammation *In Vitro* and in High-Fat Diet-Induced Obese Zebra Fish. *Planta Med.* 83, 245–253. doi:10.1055/s-0042-112371
40. Crichton, M., Marshall, S., Marx, W. M., McCarthy, A. L., and Isenring, E. (2019). Efficacy of Ginger (Zingiber Officinale) in Ameliorating Chemotherapy-Induced Nausea and Vomiting and Chemotherapy-Related Outcomes: A Systematic Review Update and Meta-Analysis. *J. Acad. Nutr. Diet.* 119, 2055–2068. doi:10.1016/J.JAND.2019.06.009
41. De, B., Bhandari, K., Singla, R. K., Saha, G., and Goswami, T. K. (2020). In Silico molecular GRIP Docking of Some Secondary Metabolites Combating Diabesity. *Bull. Natl. Res. Cent.* 44. doi:10.1186/s42269-020-00327-7
42. Kumar, R., Saha, P., Lokare, P., Datta, K., Selvakumar, P., & Chourasia, A. (2022). A Systemic Review of Ocimum sanctum (Tulsi): Morphological Characteristics, Phytoconstituents and Therapeutic Applications. *International Journal for Research in Applied Sciences and Biotechnology*, *9*(2), 221-226.
43. Donkor, Y. O., Abaidoo, C. S., Abaidoo, C. S., Tetteh, J., Darko, N. D., Atuahene, O. O.-D., et al. (2018). The Effect of Zingiber Officinale (Ginger) Root Ethanolic Extract on the Semen Characteristics of Adult Male Wistar Rats. *Ijar* 6, 5481–5487. doi:10.16965/ijar.2018.245
44. Ebrahimzadeh Attari, V., Ostadrahimi, A., Asghari Jafarabadi, M., Mehralizadeh, S., and Mahluji, S. (2016). Changes of Serum Adipocytokines and Body Weight Following Zingiber Officinale Supplementation in Obese Women: a RCT. *Eur. J. Nutr.* 55, 2129–2136. doi:10.1007/s00394-015-1027-6
45. El Gayar, M. H., Aboromia, M. M. M., Ibrahim, N. A., and Abdel Hafiz, M. H. (2019). Effects of Ginger Powder Supplementation on Glycemic Status and Lipid Profile in Newly Diagnosed Obese Patients with Type 2 Diabetes Mellitus. *Obes. Med.* 14, 100094. doi:10.1016/j.obmed.2019.100094
46. El-Naggar, H. A. E.-M., El-Safty, F. E.-N. A., El-mehi, A. E., and Reafie, A. A. (2020). Effect of Chronic Stress on the Testis of the Adult Male Albino Rat and the Role of Ginger. *Egypt. J. Hosp. Med.* 81, 2184–2194. doi:10.21608/ejhm.2020.127968
47. El-Sayed, S. M., and Youssef, A. M. (2019). Potential Application of Herbs and Spices and Their Effects in Functional Dairy Products. *Heliyon* 5, e01989. doi:10.1016/J.HELIYON.2019.E01989
48. Elseweidy, M. M., Abdallah, F. R., Younis, N. N., Aldohmy, S., and Kassem, H. M. (2013). 10-Dehydrogingerdione Raises HDL-Cholesterol through a CETP Inhibition and Wards off Oxidation and Inflammation in Dyslipidemic Rabbits. *Atherosclerosis* 231, 334–340. doi:10.1016/j.atherosclerosis.2013.09.024
49. Kumar, R., Saha, P., Nyarko, R. O., Kahwn, I., Boateng, E. A., Boateng, P. O., ... & Bertram, A. (2021). Role of Cytokines and Vaccines in Break through COVID 19 Infections. *Journal of Pharmaceutical Research International*, *33*(60B), 2544-2549.
50. Elseweidy, M. M., Zaghloul, M. S., and Younis, N. N. (2016). 10-DHGD Ameliorates Cisplatin-Induced Nephrotoxicity in Rats. *Biomed. Pharmacother.* 83, 241–246. doi:10.1016/j.biopha.2016.06.032
51. Elshopakey, G. E., Almeer, R., Alfaraj, S., Albasher, G., Abdelgawad, M. E., Abdel Moneim, A. E., et al. (2021). Zingerone Mitigates Inflammation, Apoptosis and Oxidative Injuries

Associated with Renal Impairment in Adriamycin-Intoxicated Mice. *Toxin Rev.* 0, 1–12. doi:10.1080/15569543.2021.1923528

52. Fagundes, G. B. P., Rodrigues, A. M. d. S., Martins, L. B., Monteze, N. M., Correia, M. I. T. D., Teixeira, A. L., et al. (2021). Acute Effects of Dry Extract of Ginger on Energy Expenditure in Eutrophic Women: A Randomized Clinical Trial. *Clin. Nutr. ESPEN* 41, 168–174. doi:10.1016/j.clnesp.2020.10.001
53. Daharia, A., Jaiswal, V. K., Royal, K. P., Sharma, H., Joginath, A. K., Kumar, R., & Saha, P. (2022). A Comparative review on ginger and garlic with their pharmacological Action. *Asian Journal of Pharmaceutical Research and Development*, *10*(3), 65-69
54. Fajrin, F. A., Nugroho, A. E., Nurrochmad, A., and Susilowati, R. (2020a). Ginger Extract and its Compound, 6-shogaol, Attenuates Painful Diabetic Neuropathy in Mice via Reducing TRPV1 and NMDAR2B Expressions in the Spinal Cord. *J. Ethnopharmacol.* 249, 112396. doi:10.1016/j.jep.2019.112396
55. Fajrin, F. A., Nugroho, A. E., Susilowati, R., and Nurrochmad, A. (2018). Molecular Docking Analysis of Ginger Active Compound on Transient Receptor Potential Cation Channel Subfamily V Member 1 (TRPV1). *Indones. J. Chem.* 18, 179–185. doi:10.22146/ijc.28172
56. Fajrin, F. A., Rahmayanti, F., and Pratoko, D. K. (2020b). The Binding Prediction of 6-Paradol and its Derivatives on TRPV1 Agonist as a New Compound for Treating Painful Diabetic Neuropathy. *J. Dasar* 21, 133. doi:10.19184/jid.v21i2.15501
57. Fan, C., Lu, W., Li, K., Ding, Y., and Wang, J. (2021). ACE2 Expression in Kidney and Testis May Cause Kidney and Testis Infection in COVID-19 Patients. *Front. Med.* 7, 1–9. doi:10.3389/fmed.2020.563893
58. Farhadi, M., Homaee, H., and Farzanegi Arkhazlou, P. (2020). The Effect of Aerobic Training and Ginger Extract on Lipid Profiles, Body Composition and Liver Enzymes in Obese Menopausal Women. *Ijdoj. Diabetes Obes.* 12. doi:10.18502/ijdo.v12i3.4458
59. Feng, T., Su, J., Ding, Z. H., Zheng, Y. T., Li, Y., Leng, Y., et al. (2011). Chemical Constituents and Their Bioactivities of “Tongling White Ginger” (Zingiber Officinale). *J. Agric. Food Chem.* 59, 11690–11695. doi:10.1021/JF202544W
60. Fitriyanti, D., and Sulung, R. (2020). Effectiveness of Ginger to Overcome Nausea and Vomiting Caused by Chemotherapy in Breast Cancer Patients. *Can. Oncol. Nurs. J.* 30, 3–5. doi:10.5737/2368807630135
61. Kumar, R., Saha, P., Pathak, P., Mukherjee, R., Kumar, A., & Arya, R. K. (2009). Evolution Of Tolbutamide In The Treatment Of Diabetes Mellitus. *Jour. of Med. P’ceutical & Alli. Sci*, *9*.
62. Ghayur, M. N., and Gilani, A. H. (2005). Pharmacological Basis for the Medicinal Use of Ginger in Gastrointestinal Disorders. *Dig. Dis. Sci.* 50, 1889–1897. doi:10.1007/s10620-005-2957-2
63. Gholamnezhad, Z., Ghorani, V., Saadat, S., Shakeri, F., and Boskabady, M. H. (2018). The Effects of Medicinal Plants on Muscarinic Receptors in Various Types of Smooth Muscle. *Phytother Res.* 32, 2340–2363. doi:10.1002/ptr.6179
64. Gregersen, N. T., Belza, A., Jensen, M. G., Ritz, C., Bitz, C., Hels, O., et al. (2013). Acute Effects of Mustard, Horseradish, Black Pepper and Ginger on Energy Expenditure, Appetite, Ad Libitum Energy Intake and Energy Balance in Human Subjects. *Br. J. Nutr.* 109, 556–563. doi:10.1017/S0007114512001201

65. Saha, P., Nyarko, R. O., Lokare, P., Kahwa, I., Boateng, P. O., & Asum, C. (2022). Effect of Covid-19 in Management of Lung Cancer Disease: A Review. *Asian Journal of Pharmaceutical Research and Development*, *10*(3), 58-64.
66. Grzanna, R., Lindmark, L., and Frondoza, C. G. (2005). Ginger--an Herbal Medicinal Product with Broad Anti-inflammatory Actions. *J. Med. Food* 8, 125–132. doi:10.1089/jmf.2005.8.125
67. Guan, W. J., Ni, Z. Y., Hu, Y., Liang, W. H., Ou, C. Q., He, J. X., et al. (2020). Clinical Characteristics of Coronavirus Disease 2019 in China. *N. Engl. J. Med.* 382, 1708–1720. doi:10.1056/nejmoa2002032
68. Gungor, H., Ekici, M., Onder Karayigit, M., Turgut, N. H., Kara, H., and Arslanbas, E. (2020). Zingerone Ameliorates Oxidative Stress and Inflammation in Bleomycin-Induced Pulmonary Fibrosis: Modulation of the Expression of TGF-B1 and iNOS. *Naunyn. Schmiedebergs. Arch. Pharmacol.* 393, 1659–1670. doi:10.1007/s00210-020-01881-7
69. Guo, T., Tan, S. B., Wang, Y., and Chang, J. (2018). Two new monoterpenoid glycosides from the fresh rhizome of Tongling White Ginger (Zingiber officinale). *Nat. Prod. Res.* 32, 71–76. doi:10.1080/14786419.2017.1333994
70. Haddy, F. J., Vanhoutte, P. M., and Feletou, M. (2006). Role of Potassium in Regulating Blood Flow and Blood Pressure. *Am. J. Physiol. Regul. Integr. Comp. Physiol.* 290, 546–552. doi:10.1152/ajpregu.00491.2005
71. Hajimoosayi, F., Jahanian Sadatmahalleh, S., Kazemnejad, A., and Pirjani, R. (2020). Effect of Ginger on the Blood Glucose Level of Women with Gestational Diabetes Mellitus (GDM) with Impaired Glucose Tolerance Test (GTT): a Randomized Double-Blind Placebo-Controlled Trial. *BMC Complement. Med. Ther.* 20, 116–117. doi:10.1186/s12906-020-02908-5
72. Nalimu, F., Oloro, J., Kahwa, I., & Ogwang, P. E. (2021). Review on the phytochemistry and toxicological profiles of Aloe vera and Aloe ferox. *Future Journal of Pharmaceutical Sciences*, *7*, 1-21.
73. Han, Y. A., Song, C. W., Koh, W. S., Yon, G. H., Kim, Y. S., Ryu, S. Y., et al. (2013). Anti-inflammatory Effects of the Zingiber Officinale roscoe Constituent 12-dehydrogingerdione in Lipopolysaccharide-Stimulated Raw 264.7 Cells. *Phytother Res.* 27, 1200–1205. doi:10.1002/ptr.4847
74. Hao, L., Scott, S., Abbasi, M., Zu, Y., Khan, M. S. H., Yang, Y., et al. (2019). Beneficial Metabolic Effects of Mirabegron In Vitro and In High-Fat Diet-Induced Obese Mice. *J. Pharmacol. Exp. Ther.* 369, 419–427. doi:10.1124/jpet.118.255778
75. Haridas, M., Sasidhar, V., Nath, P., Abhithaj, J., Sabu, A., and Rammanohar, P. (2021). Compounds of Citrus Medica and Zingiber Officinale for COVID-19 Inhibition: In Silico Evidence for Cues from Ayurveda. *Futur. J. Pharm. Sci.* 7. doi:10.1186/s43094-020-00171-6
76. Hashmi, D. R., Ismail, S., and Shaikh, G. H. (2007). Assessment of the Level of Trace Metals in Commonly Edible Vegetables Locally Available in the Markets of Karachi City. *Pakistan J. Bot.* 39, 747–751.
77. Hayat, I., Ahmad, A., Ahmed, A., Khalil, S., Gulfraz, M., and Kashmir, A. (2014). Exploring the Potential of Red Kidney Beans (Phaseolus Vulgaris l.) to Develop Protein Based Product for Food Applications. *J. Anim. Plant Sci.* 24, 860–868.
78. Saha, P., Kumar, A., Bhanja, J., Shaik, R., Kawale, A. L., & Kumar, R. (2022). A Review of Immune Blockade Safety and Antitumor Activity of Dostarlimab Therapy in Endometrial

Cancer. *International Journal for Research in Applied Sciences and Biotechnology*, *9*(3), 201-209.

79. Heidari-Beni, M., Moravejolahkami, A. R., Gorgian, P., Askari, G., Tarrahi, M. J., and Bahreini-Esfahani, N. (2020). Herbal Formulation "turmeric Extract, Black Pepper, and Ginger" versus Naproxen for Chronic Knee Osteoarthritis: A Randomized, Double-Blind, Controlled Clinical Trial. *Phytother Res.* 34, 2067–2073. doi:10.1002/ptr.6671
80. Hoffmann, M., Kleine-Weber, H., Schroeder, S., Krüger, N., Herrler, T., Erichsen, S., et al. (2020). SARS-CoV-2 Cell Entry Depends on ACE2 and TMPRSS2 and Is Blocked by a Clinically Proven Protease Inhibitor. *Cell* 181, 271–e8. doi:10.1016/j.cell.2020.02.052
81. Hong, S. S., and Oh, J. S. (2012). Phenylpropanoid Ester from Zingiber Officinale and Their Inhibitory Effects on the Production of Nitric Oxide. *Arch. Pharm. Res.* 35, 315–320. doi:10.1007/S12272-012-0211-Y
82. Keshamma, E., Paswan, S. K., Kumar, R., Saha, P., Trivedi, U., Chourasia, A., & Otia, M. (2022). Alkaloid Based Chemical Constituents of Ocimum santum & Cinchona Bark: A Meta Analysis. *Journal for Research in Applied Sciences and Biotechnology*, *1*(2), 35-42.
83. Hori, Y., Miura, T., Hirai, Y., Fukumura, M., Nemoto, Y., Toriizuka, K., et al. (2003). Pharmacognostic Studies on Ginger and Related Drugs-Ppart 1: Five Sulfonated Compounds from Zingiberis Rhizome (Shokyo). *Phytochemistry* 62, 613–617. doi:10.1016/S0031-9422(02)00618-0
84. Horiguchi, H., Loftus, T. J., Hawkins, R. B., Raymond, S. L., Stortz, J. A., Hollen, M. K., et al. (2018). Innate Immunity in the Persistent Inflammation, Immunosuppression, and Catabolism Syndrome and its Implications for Therapy. *Front. Immunol.* 9, 1–20. doi:10.3389/fimmu.2018.00595
85. Hosseini, J., Mardi Mamaghani, A., Hosseinifar, H., Sadighi Gilani, M. A., Dadkhah, F., and Sepidarkish, M. (2016). The Influence of Ginger (Zingiber Officinale) on Human Sperm Quality and DNA Fragmentation: A Double-Blind Randomized Clinical Trial. *Int. J. Reprod. Biomed.* 14, 533–540. doi:10.29252/ijrm.14.8.533
86. Hu, Y., Amoah, A. N., Zhang, H., Fu, R., Qiu, Y., Cao, Y., et al. (2020). Effect of Ginger in the Treatment of Nausea and Vomiting Compared with Vitamin B6 and Placebo during Pregnancy: a Meta-Analysis. *J. Matern. Fetal Neonatal. Med.* 0, 1–10. doi:10.1080/14767058.2020.1712714
87. Hu, Y. W., Zhang, J., Wu, X. M., Cao, L., Nie, P., and Chang, M. X. (2018). TANK-binding Kinase 1 (TBK1) Isoforms Negatively Regulate Type I Interferon Induction by Inhibiting TBK1-IRF3 Interaction and IRF3 Phosphorylation. *Front. Immunol.* 9, 84–17. doi:10.3389/fimmu.2018.00084
88. Huang, H. C., Chou, Y. C., Wu, C. Y., and Chang, T. M. (2013). [8]-Gingerol Inhibits Melanogenesis in Murine Melanoma Cells through Down-Regulation of the MAPK and PKA Signal Pathways. *Biochem. Biophys. Res. Commun.* 438, 375–381. doi:10.1016/j.bbrc.2013.07.079
89. Singh, Y., Paswan, S. K., Kumar, R., Otia, M. K., Acharya, S., Kumar, D., & Keshamma, E. (2022). Plant & Its Derivative Shows Therapeutic Activity on Neuroprotective Effect. *Journal for Research in Applied Sciences and Biotechnology*, *1*(2), 10-24.

90. Hussain, J., Latif Khan, A., ur Rehman, N., ., Z., Khan, F., Tasleem Hu, S., et al. (2009). Proximate and Nutrient Investigations of Selected Medicinal Plants Species of Pakistan. *Pakistan J. Nutr.* 8, 620–624. doi:10.3923/PJN.2009.620.624
91. Ibrahim, M. A. A., Abdelrahman, A. H. M., Hussien, T. A., Badr, E. A. A., Mohamed, T. A., El-Seedi, H. R., et al. (2020). In Silico drug Discovery of Major Metabolites from Spices as SARS-CoV-2 Main Protease Inhibitors. *Comput. Biol. Med.* 126, 104046. doi:10.1016/j.compbiomed.2020.104046
92. Amle, V. S., Rathod, D. A., Keshamma, E., Kumar, V., Kumar, R., & Saha, P. (2022). Bioactive Herbal Medicine Use for Eye Sight: A Meta Analysis. *Journal for Research in Applied Sciences and Biotechnology*, *1*(3), 42-50.
93. Idris, O. A., Wintola, O. A., and Afolayan, A. J. (2019). Comparison of the Proximate Composition, Vitamins (Ascorbic Acid, α-Tocopherol and Retinol), Anti-nutrients (Phytate and Oxalate) and the GC-MS Analysis of the Essential Oil of the Root and Leaf of Rumex Crispus L. *Plants* 8. doi:10.3390/plants8030051
94. Iwasaki, Y., Morita, A., Iwasawa, T., Kobata, K., Sekiwa, Y., Morimitsu, Y., et al. (2006). A Nonpungent Component of Steamed Ginger--[10]-shogaol--increases adrenaline secretion via the activation of TRPV1. *Nutr. Neurosci.* 9, 169–178. doi:10.1080/110284150600955164
95. Jalali, M., Mahmoodi, M., Moosavian, S. P., Jalali, R., Ferns, G., Mosallanezhad, A., et al. (2020). The effects of ginger supplementation on markers of inflammatory and oxidative stress: A systematic review and meta-analysis of clinical trials. *Phytother Res.* 34, 1723–1733. doi:10.1002/ptr.6638
96. Pandey, M., Singh, A., Agnihotri, N., Kumar, R., Saha, P., Pandey, R. P., & Kumar, A. (2022). Clinical Pharmacology & Therapeutic uses of Diuretic Agents: A Review. *Journal for Research in Applied Sciences and Biotechnology*, *1*(3), 11-20.
97. Javid, A. Z., Bazyar, H., Gholinezhad, H., Rahimlou, M., Rashidi, H., Salehi, P., et al. (2019). The effects of ginger supplementation on inflammatory, antioxidant, and periodontal parameters in type 2 diabetes mellitus patients with chronic periodontitis under non-surgical periodontal therapy. A double-blind, placebo-controlled trial. *Diabetes Metab. Syndr. Obes.* 12, 1751–1761. doi:10.2147/DMSO.S214333
98. Jiang, H., Sólyom, A. M., Timmermann, B. N., and Gang, D. R. (2005). Characterization of gingerol-related compounds in ginger rhizome (Zingiber officinale Rosc.) by high-performance liquid chromatography/electrospray ionization mass spectrometry. *Rapid Commun. Mass. Spectrom.* 19, 2957–2964. doi:10.1002/RCM.2140
99. Kumar, R., Singh, A., & Painuly, N. (2022). Investigation of in-vitro anti-oxidant & anti-ulcer activity of polyherbal medicinal plants. *Journal of Pharmaceutical Negative Results*, 2077-2088.
100. Jiang, H., Timmermann, B. N., and Gang, D. R. (2007). Characterization and identification of diarylheptanoids in ginger (Zingiber officinale Rosc.) using high-performance liquid chromatography/electrospray ionization mass spectrometry. *Rapid Commun. Mass. Spectrom.* 21, 509–518. doi:10.1002/RCM.2858
101. Keshri, S., Kumar, R., Kumar, D., Singhal, T., Giri, S., Sharma, I., & Vatsha, P. (2022). Insights Of Artificial Intelligence In Brain Disorder With Evidence Of Opportunity And Future Challenges. *Journal of Pharmaceutical Negative Results*, 10853-10867.

102. Jiménez-Aguilar, D. M., and Grusak, M. A. (2017). Minerals, vitamin C, phenolics, flavonoids and antioxidant activity of Amaranthus leafy vegetables. *J. Food Compost. Anal.* 58, 33–39. doi:10.1016/J.JFCA.2017.01.005

103. Jimoh, M. O., Afolayan, A. J., and Lewu, F. B. (2020). Nutrients and antinutrient constituents of Amaranthus caudatus L. Cultivated on different soils. *Saudi J. Biol. Sci.* 27, 3570–3580. doi:10.1016/J.SJBS.2020.07.029