

An Overview of the Traditional and Modern Applications of Ginger

KODDUS ALI¹, ADRIAN FLARE¹, AND GEORGE FLINN.¹

¹Department of Herbal Medicine, Institute of Research Scholar, Birmingham, UK

Corresponding author: Koddus Ali (e-mail: koddus.ali@researchscholar.com).

ABSTRACT Ginger has been traditionally used in Indian and Chinese medicine for its anti-emetic, anti-inflammatory, and digestive properties. Scientific studies confirm its efficacy in reducing nausea and inflammation, and promoting digestive health. Ethnobotanical surveys emphasise its cultural significance and widespread use across various communities. Additionally, ginger's role in pharmaceuticals, dietary supplements, and functional foods highlights its pharmacological benefits and culinary versatility. In skincare, ginger shows promise for its antioxidant and anti-inflammatory effects, supporting its application in cosmetic formulations. Furthermore, ginger emerges as a multifaceted herb with significant therapeutic potential, rooted in traditional knowledge and validated by modern research. Its bioactive compounds, including gingerols and shogaols, contribute to its diverse health benefits, ranging from gastrointestinal support to skincare applications.

INDEX TERMS Ginger, Modern medicine, Traditional medicine, *Zingiber officinale* Roscoe

I. INTRODUCTION

GINGER, also known as *Zingiber officinale* Roscoe, is a plant that has garnered significant attention due to its diverse array of bioactive compounds and associated health benefits. Research has highlighted the presence of polysaccharides in ginger that exhibit notable biological activities, contributing to its anti-influenza, anti-colitis, anti-tussive, antioxidant, and anti-tumour effects [1]. Additionally, ginger has been found to possess a multitude of bioactivities, including antioxidant, anti-inflammatory, antimicrobial, anticancer, neuroprotective, cardiovascular protective, respiratory protective, antiobesity, antidiabetic, antinausea, and antiemetic properties [2]. These findings highlight the extensive therapeutic potential of ginger in promoting human health and well-being.

The medicinal properties of ginger extend to its role in combating various health conditions. Studies have shown that ginger offers benefits such as anticancer, antioxidant, anti-proliferative, anti-inflammatory, and antidiabetic effects [3]. Furthermore, the bioactive compounds present in ginger, particularly gingerol derivatives and other volatile constituents, contribute to its characteristic pungent flavour and health-promoting properties [4]. This dual functionality of ginger as a flavourful ingredient and a source of health benefits underlines its versatility and widespread use.

Ginger's significance is further underlined by its historical

and cultural importance. For centuries, ginger has been utilised as a functional food with wide-ranging applications. It has been integrated into traditional medicine practices globally, owing to its medicinal properties and therapeutic potential [5]. In Chinese medicine, ginger has been employed for its antiemetic, antitussive, expectorant, and perspiration-inducing properties, highlighting its diverse uses in promoting health and treating various ailments [6]. The enduring legacy of ginger as a dietary adjunct and medicinal herb emphasises its enduring relevance in different cultural contexts.

Furthermore, ginger's bioactive compounds have been investigated for their potential in cancer prevention and treatment. Research has demonstrated that ginger extracts contain molecules that can inhibit cancer cell proliferation and enhance the efficacy of anticancer therapies [7]. By modulating signalling pathways and exerting antioxidant effects, ginger compounds show promise in mitigating the side effects of conventional chemotherapeutic agents and improving overall treatment outcomes [8]. This dual action of ginger in targeting cancer cells while protecting healthy tissues accentuates its potential as a complementary therapy in oncology.

The chemical composition of ginger, including its essential oils and volatile organic compounds, plays a crucial role in determining its biological activities and health benefits. Studies have highlighted the diverse chemical profiles of

ginger, with compounds belonging to terpenoids and phenolics groups exhibiting significant biological activity [9]. The aromatic volatiles present in ginger contribute to its distinctive smell and taste, making it a valuable ingredient not only in culinary applications but also in pharmaceutical, medical, and cosmetic industries [10]. The rich phytochemical composition of ginger highlights its multifaceted utility across various sectors.

Furthermore, ginger's potential in preventing and managing chronic conditions like diabetes has been explored. Extracts from ginger have been found to enhance glucose uptake and activate key pathways involved in glucose metabolism, suggesting a role in regulating blood sugar levels [11]. By promoting the translocation of glucose transporters and modulating cellular signalling, ginger compounds offer a natural approach to addressing metabolic disorders such as diabetes and prediabetic states [11]. This emerging area of research highlights the holistic benefits of ginger in supporting metabolic health.

In this review, we will explore the traditional and modern applications of ginger, emphasising its diverse bioactive compounds and health benefits. By bridging traditional knowledge with contemporary research, this review aims to highlight ginger's broad therapeutic potential across cultural and medicinal areas.

II. METHOD

The literature search for this review focused on identifying relevant studies and articles related to the traditional medicinal uses of ginger in aiding digestion, reducing inflammation, and alleviating nausea. Electronic databases including PubMed, Scopus, and Google Scholar were queried using combinations of keywords such as ginger, *Zingiber officinale*, traditional medicine, digestive, anti-inflammatory, anti-nausea, bioactive compounds, and modern medicine.

III. ANTI-INFLAMMATORY, AND ANTI-NAUSEA APPLICATIONS

Ginger, has a long history in traditional medicine, dating back thousands of years. It has been used for various purposes such as aiding digestion, reducing inflammation, and alleviating nausea. The therapeutic properties of ginger are attributed to active compounds like gingerol and shogaol, which have been shown to have cholinergic antagonism and serotonin inhibition effects [12]. In Indian and Chinese traditional medicines, ginger has been traditionally used for its anti-emetic effects, digestive stimulation, relief of coughs and colds, and anti-inflammatory actions [13]. Scientific studies have supported ginger's effectiveness as an anti-emetic agent, demonstrating its ability to prevent nausea and vomiting in different conditions [14].

The rhizome of ginger contains bioactive compounds that contribute to its medicinal properties and has been widely used in food and traditional medicine [15]. Ginger has also been utilised in cosmetics, beverages, and health functional foods [16]. In traditional oriental medicine, ginger

has been employed for common colds, digestive disorders, and rheumatism [17].

Gingerols and shogaols, the nutraceutical principles of ginger, are crucial for its therapeutic effects. These compounds are integral to various traditional medicines such as Ayurveda, Chinese, Arabic, and African practices, where ginger is used to treat headaches, nausea, colds, arthritis, and inflammation [18]. Iranian Traditional Medicine recognises ginger as an anti-oedema drug and a remedy for conditions like atherosclerosis, gastric ulcers, respiratory disorders, migraines, and depression [19].

Research has shown that ginger is effective in reducing nausea and vomiting, particularly in pregnancy-induced cases [13]. Additionally, scientific investigations have validated ginger's anti-inflammatory, antioxidant, antitumor, and antiulcer properties, confirming its traditional applications as a home remedy [20]. Systematic reviews of randomised controlled trials have highlighted the wide-ranging health benefits of ginger, emphasising its significance in addressing conditions like metabolic syndrome, nausea, inflammation, and digestive issues [21].

The nutritional content and bioactive compounds in ginger contribute to its therapeutic potential, making it a valuable resource in traditional medicine [22]. Systematic reviews of clinical trials have supported the use of ginger in gastrointestinal disorders, showcasing its anti-inflammatory and antioxidant effects [20]. Ginger's efficacy in reducing nausea and vomiting has also been well-documented, aligning with its historical use as a remedy for digestive ailments [23]. The traditional use of ginger in treating various conditions such as stomach disorders, respiratory issues, infections, and anxiety further solidifies its reputation as a versatile medicinal herb [24].

IV. ETHNOBOTANICAL USES

The ethnobotanical uses of ginger have been well-documented, showcasing its significance in traditional medicine and healing practices. Studies have highlighted the diverse pharmacological benefits of ginger, ranging from its anti-inflammatory and antioxidant properties to its potential in combating various ailments [25–27]. The rich bioactive compounds present in ginger, such as gingerols, paradols, and shogaols, contribute to its therapeutic effects and make it a valuable resource in herbal medicine [28].

Ethnobotanical surveys have revealed the widespread use of ginger in different communities for treating a myriad of health conditions. In regions like Tamenglong district in Manipur, Northeast India, ginger has been traditionally employed for its medicinal properties [29]. Similarly, in Mae Hong Son, Northern Thailand, the ethnobotanical significance of ginger within the Zingiberaceae family has been recognised, with numerous species being identified for their medicinal value [30]. These findings highlight the cultural and traditional importance of ginger as a natural remedy in diverse geographical settings.

Furthermore, the anti-inflammatory and antimicrobial activities of ginger have been extensively studied, showcasing its potential in combating infections and inflammatory disorders [26, 31]. The antibacterial properties of compounds like gingerol and its derivatives have been investigated, highlighting their efficacy against periodontal bacteria and other pathogens [26]. Additionally, ginger has shown promise in the management of conditions like osteoarthritis, with meta-analyses supporting its use in alleviating symptoms and improving the quality of life for affected individuals [32].

The therapeutic potential of ginger extends beyond its anti-inflammatory and antimicrobial properties. Studies have explored its role in cancer prevention and treatment, emphasising the presence of phenolic substances in ginger that exhibit anticarcinogenic effects [33]. Furthermore, the pharmacological benefits of ginger in traditional Asian and Chinese medicine have been well-documented, emphasising its historical significance and continued use in modern healthcare practices [27].

The cultivation and characterisation of ginger varieties have also been a subject of interest, with research focusing on the agro-morphological aspects of different cultivars in regions like South Benin [34]. Understanding the diversity within ginger species and their medicinal properties is crucial for harnessing the full potential of this plant in healthcare and wellness practices. Additionally, the isolation and identification of bioactive compounds from ginger, such as cyclo-(tryptophanyl-prolyl) and chloramphenicol, have provided insights into its antimicrobial properties and therapeutic applications [35].

V. HERBAL MEDICINE AND PHARMACEUTICAL USAGE

The therapeutic and pharmaceutical potential of ginger has been well recognised, with its bioactive compounds, including gingerols and shogaols, being attributed to its health benefits [2]. These phenolic compounds are responsible for the pungent taste and pharmacological activities of ginger, making it a valuable resource for health-promoting agents [36].

Ginger is not only used as a spice and flavouring agent but also finds extensive application as a dietary supplement and herbal medicine [37]. Its medicinal properties have been linked to its ability to modulate macrophage functions, aiding in the treatment of inflammatory diseases and pain [38]. Furthermore, ginger has been shown to have anti-emetic effects, making it beneficial for managing nausea and vomiting, particularly in pregnancy [39]. The efficacy of ginger in alleviating symptoms of nausea and motion sickness has been acknowledged, leading to its widespread use as a complementary medicine [40].

The pharmacological properties of ginger are primarily attributed to its rich composition of phenolic and terpene compounds [41]. These bioactive components play a crucial role in the health benefits associated with ginger, making it a valuable source of therapeutic and pharmaceutical compounds [42]. Additionally, ginger has been found to possess antioxidant, antimicrobial, and immunostimulatory

properties, highlighting its potential as a natural remedy for various health conditions [43]. The inclusion of ginger in the diet has been shown to reduce abdominal fat and gizzard weight in a dose-dependent manner, indicating its potential role in improving metabolic health [44].

Standardising ginger formulations is essential due to its widespread use in various products such as dietary supplements, teas, creams, and herbal formulations [45]. High-performance liquid chromatography and mass spectrometry techniques have been employed to quantify the bioactive compounds in ginger products, ensuring their quality and efficacy [46]. The concentration of major active anti-emetic constituents in commercial ginger products has been determined, emphasising the importance of quality control in ginger-based supplements [40]. Furthermore, the effects of different drying methods on the volatile components of ginger have been studied, shedding light on the optimal processing techniques to preserve its medicinal properties [37].

Despite its numerous health benefits, caution is advised regarding the use of ginger, especially in certain populations. Pregnant women, in particular, need to be aware of the potential risks associated with ginger consumption, as it may increase the risk of bleeding and stillbirth due to its pharmacologically active substances [47]. Safety data on ginger, especially in maternal health, remains limited, emphasising the need for further research to establish its safety profile conclusively [39].

VI. FLAVOURING, PRESERVATION AND FUNCTIONAL FOODS

Ginger, renowned for its distinctive flavour and medicinal properties, plays a significant role in the food industry as a flavouring agent, preservative, and functional food ingredient. The use of ginger extract produced through supercritical carbon dioxide extraction without chemical solvents presents an advantage for its application in functional foods [48]. This aligns with the trend of incorporating ginger into functional foods and nutraceuticals due to its potential health benefits [49]. Additionally, ginger is widely consumed globally to enhance food flavours, indicating its importance in the culinary world [50].

The versatility of ginger is evident in its applications across various industries. It has been traditionally used in medicine and serves as a raw material for cosmetics, beverages, and health functional foods [16]. Furthermore, ginger's potential as a source of fibre and antioxidants, along with its impact on the rheological characteristics of dough and physicochemical properties of cookies, highlights its functional properties in food products [51]. Various processing strategies such as fermentation, steaming, aging, and roasting have been explored to enhance the functionality of ginger in food products [52].

In the context of health benefits, ginger has been studied for its effects on insulin secretion, body fat reduction, and potential as a hypoglycaemic agent [53]. The bioactive compounds in ginger, particularly gingerols and shogaols,

contribute to its health-promoting properties [2]. The unique compounds found in ginger, such as gingerols, are responsible for its flavour profile and health benefits. Metabolomic studies have identified biomarkers [54] in ginger, further supporting its pharmacological properties [55].

Furthermore, ginger's antimicrobial properties make it a valuable food preservative, capable of eliminating harmful bacteria like *Salmonella* [56]. The use of ginger in dairy products as a functional ingredient has also been explored, showcasing its potential in a variety of food applications [57]. Additionally, ginger's safety and efficacy as a sensory additive in animal feed further emphasise its versatility and widespread use in different sectors [58].

VII. SKINCARE AND HAIRCARE PRODUCTS

The cosmetic industry, particularly in skincare and haircare products, has seen a surge in the utilisation of natural ingredients like ginger due to their perceived health benefits and therapeutic properties. Ginger has gained popularity for its antioxidant, anti-inflammatory, and antibacterial characteristics. These properties make ginger a valuable component in skincare products, where it can help combat various skin issues and promote overall skin health. Additionally, ginger's high content of gingerol has been linked to improved blood circulation and enhanced hair growth, making it a sought-after ingredient in haircare formulations [59].

Research has highlighted the diverse applications of ginger beyond skincare and haircare. Studies have shown that ginger exhibits anti-inflammatory properties, immune-boosting effects, and can aid in alleviating conditions related to dermatology, gastrointestinal, neoplastic, and respiratory health [60, 61]. Furthermore, the synergistic action of ginger with other natural compounds like curcumin has been demonstrated to have potential benefits for human skin, particularly in wound healing and skin protection [62, 63]. The bioactive compounds present in ginger, when combined with other botanical extracts, offer a wide range of therapeutic and biological efficacy [64].

In traditional medicine and natural remedies, ginger has been revered for its holistic health benefits. Its anti-inflammatory properties have been associated with improved blood flow, joint pain relief, and even potential anti-neoplastic effects [65]. Furthermore, the use of ginger in conjunction with other herbs like lemongrass has shown promise in controlling blood glucose levels, which can be beneficial for individuals at risk of diabetes and those with skin concerns [66]. Additionally, the incorporation of ginger in functional beverages alongside turmeric and pineapple has been explored for its physiochemical properties and sensory appeal, indicating the versatility of ginger in various product formulations [67].

The therapeutic potential of ginger extends beyond skincare and haircare into broader health applications. Studies have investigated the use of ginger in mitigating inflammation, enhancing vitality, and even supporting

reproductive health in women [68–70]. The incorporation of ginger in herbal supplements has shown efficacy in reducing menopausal symptoms and improving overall well-being [68]. Furthermore, the utilisation of ginger in products like herbal soaps and face washes emphasises its versatility in personal care formulations, where its antibacterial and skin-soothing properties can be harnessed [71].

VIII. DISCUSSION

Ginger stands out for its extensive range of bioactive compounds, which underpin its therapeutic potential. Traditional medicine systems, particularly in Chinese and Indian cultures, have long leveraged ginger for its antiemetic, antitussive, expectorant, and anti-inflammatory properties. These traditional uses have been substantiated by modern scientific research, validating ginger's role in treating nausea, vomiting, inflammation, and various other ailments [13, 14].

Modern applications of ginger have expanded significantly, driven by its diverse bioactivities, including antioxidant, anti-inflammatory, antimicrobial, anticancer, neuroprotective, cardiovascular protective, respiratory protective, anti-obesity, and antidiabetic effects [2]. Gingerol derivatives and other volatile constituents contribute to these health benefits and its characteristic flavour, making ginger a dual-purpose plant both as a flavourful ingredient and a health-promoting agent [4].

Ginger's impact on chronic diseases is particularly noteworthy. Its anticancer properties, through inhibition of cancer cell proliferation and enhancement of chemotherapy efficacy, position it as a promising complementary therapy in oncology [7, 8]. Additionally, ginger's role in diabetes management, enhancing glucose uptake and modulating glucose metabolism pathways, emphasises its potential in supporting metabolic health [11].

In the food industry, ginger's unique flavour and aromatic properties are widely utilised, from traditional culinary applications to modern functional foods. The trend towards incorporating ginger into health-focused food products is driven by its rich nutritional profile and health benefits [48, 50]. Research has shown ginger's effectiveness as a food preservative due to its antimicrobial properties, adding to its value in food safety and shelf-life extension [56].

Pharmaceutical and dietary supplement sectors also benefit from ginger's bioactive compounds. Standardisation of ginger formulations ensures the delivery of consistent therapeutic effects, addressing conditions such as gastrointestinal disorders, pain, and inflammatory diseases [43, 46]. Additionally, ginger's efficacy as an antiemetic agent has been particularly beneficial in managing nausea and vomiting in pregnancy and motion sickness [39].

The cosmetic industry has embraced ginger for its skin and hair care benefits. Its antioxidant, anti-inflammatory, and antibacterial properties enhance skin health and promote hair growth, making it a valuable ingredient in various cosmetic products [59]. The synergistic effects of ginger with other

natural compounds further expand its applicability in holistic skin and hair care solutions [62, 64].

Ethnobotanical studies highlight the cultural and traditional importance of ginger across different regions. Its use in traditional medicine practices in Northeast India and Northern Thailand, among other places, highlights ginger's longstanding role in local healthcare systems [29, 30]. These traditional uses are supported by modern research demonstrating ginger's efficacy in treating inflammation, infections, and even cancer [31, 33].

IX. CONCLUSION

Ginger's diverse applications in traditional and modern contexts illustrate its significant therapeutic potential. Its bioactive compounds provide a wide array of health benefits, making it a valuable resource in medicinal, culinary, pharmaceutical, and cosmetic industries. Continued research and standardisation efforts will enhance the understanding and utilisation of ginger's therapeutic properties, ensuring its continued relevance in promoting human health and well-being.

X. CONFLICT OF INTEREST STATEMENT

The authors declare that there is no conflict of interest regarding the publication of this paper. We have no affiliations, financial involvement, or personal relationships with any organisations or individuals that could be perceived as influencing the content or conclusions of this manuscript.

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