

RESEARCH ARTICLE

An Application Study of a *Zingiber officinale* Extraction in the Biological and Medical Fields

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ABSTRACT

This study included a clarify of the biological and medical application of *Zingiber officinale* extraction, which regarded as an antibiotic against almost types of microorganisms, and as a medicine for treat of many deceases in the human body. Ginger is a spice and medicinal plant, and it is gained a very important role in agronomy production, pharmacy, and exportation because of its increased use as a raw material for the pharmaceutical industry and in everyday life. Ginger, the rhizome of *Zingiber officinale*, species of the ginger family (Zingiberaceae) has a long history of medicinal and biological uses for more than 2,000 years as one of the most versatile medicinal plants having a wide spectrum of biological activity and a common condiment for many various foods and beverages. Currently, there is a renewed interest in ginger, and several scientific investigations goal at isolation, identification of active constituents, scientific verification of its pharmacological actions for the treatment of deferent diseases and difficult conditions.

Keywords: Biology, Biosynthesis, Ginger Activities In Medicine, Ginger Extraction.

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INTRODUCTION

Zingiber officinale Roscoe (Ginger), belonging to the family Zingiberaceae. It is always grown throughout the tropical areas of the world and also commonly found in South East Asia. To produce any type of medicine, we must know one fact, that nature has been a source of medicinal agents for thousands of years, and an impressive number of modern drugs have been isolated from natural sources that play a vital role in the treatment of diseases. This family species of plants are fibrous-rooted perennial, which is cultivated in many areas.¹ The early Greeks and Romans made extensive use of *Zingiber officinale* (ginger) as a spice and as a medicine.² Also, to its most common use as a flavoring, root of the ginger has been used in conventional medicine for countless centuries. *Z officinale* is described in Ayurvedic and Tibb systems of medicine to be useful in inflammation, rheumatism, and other deceases.³ It has been used to treat stomach diarrhea, ache, stroke, diabetes, asthma, toothache, and arthritis.^{4,5} As well as, the *Z officinale* has widely been used for the treatment of many diseases, including gather osclerosis, migraine headaches, rheumatoid arthritis, high cholesterol, ulcers, depression, and impotence. Different types of active ingredients are found in ginger ranging from volatile components, which comprise approximately 1–3% of its weight to non-volatile components.⁶

There are many chemical investigations of this plant material that have led to the isolation and identification of a large number of biologically active compounds The activity of chemical constituents in the *Z officinale* plant are phenolic compounds: shogaols and gingerols, Sesquiterpenes: bisapolene, zingiberene, zingiberol, sesquiphellandrene, curcurnene and other compounds such as 6-dehydro-gingerdione, galanolactone , gingesulfonic acid, zingerone, geraniol, neral, monoacyl-digalactosylglycerols, gingersglycolipids.⁷ Ginger forms an important group with economic potential, and many members of this family yield spices, dyes, perfumes, and medicines, and some of them are ornamental. Many of them are used in ayurvedic and other native systems in the medical fields. Several reports have been published concerning the biological characters, such as (anti-cancer, anti-microbial, anti-oxidant, and a stimulating effect on the immune system).⁸

The *Z officinale* is widely used in a variety of foods because of its nutritional composition and flavoring compounds. Ginger rhizomes are a rich source of carbohydrates, vitamins, minerals, iron, and others.

This species contains biologically active constituents including the non-volatile pungent principles, like the gingerols, shogaols, paradols, and zingerone that produce a hot sensation in the mouth. The gingerols, a series of chemical homologs differentiated by the length of their unbranched alkyl

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chains, were known as the major active components in the fresh rhizome.⁹ The pungency of the dry ginger plant mainly results from shogaols, which are dehydrated forms of gingerols. Gingerols are thermally labile because of the presence of a β -hydroxy keto group and readily undergo dehydration to form the corresponding shogaols.

MATERIALS AND METHODS

Plant material (1 Kg) was percolated with ethanol (5 liters) and was allowed to stand at room temperature for 48 hrs. The percolate was collected. This process of extraction was repeated for four times, till the plant material of ginger was extracted exhaustively. The total extract was collected and filtered and concentrated under vacuum using rotavapor at about 50°C, and weighed. The extract weighed (100 g, 15% yield).

DISCUSSION

Apart from culinary uses, the *Z. officinale* plant and its major components, are known to have beneficial medicinal and biological properties. Many pre-clinical studies have supported their value in the treatment of allergies, pain, fever, diabetes, obesity, diarrhea, rheumatoid arthritis, inflammation, and various forms of cancer in different types of tissues. Tumors induced in the bowel, breast, ovaries, pancreas, liver, CNS, and cardiovascular disorders have been effectively treated in animal models with biologically active constituents of the *Z. officinale* plant (ginger). So, ginger and its metabolites have been recognized and considered as potent anti-oxidants due to their ability to inhibit the oxidation of various free radicals and the production of nitric oxide. The biological activities of several volatile and non-volatile constituents of the *Z. officinale*

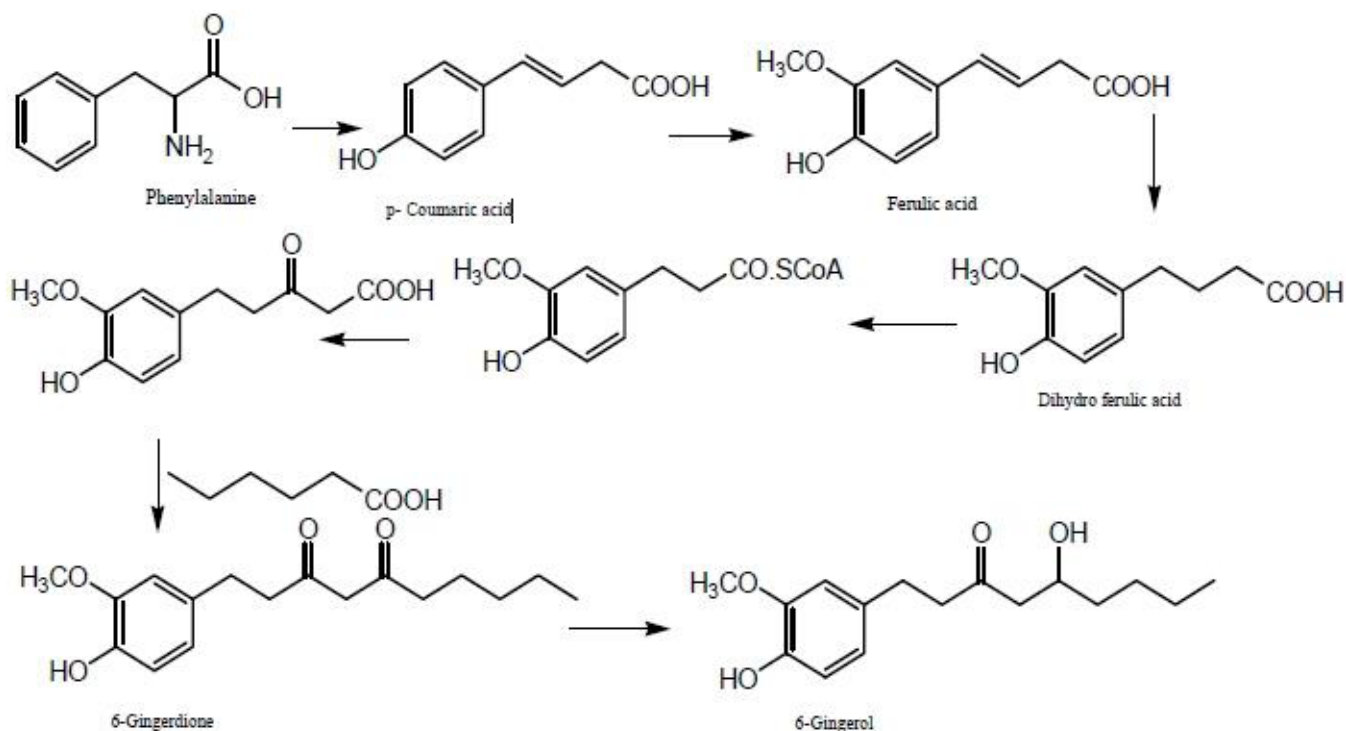
plant (ginger), through selected in-vitro and in-vivo models, are discussed in the following sections:

Biosynthesis

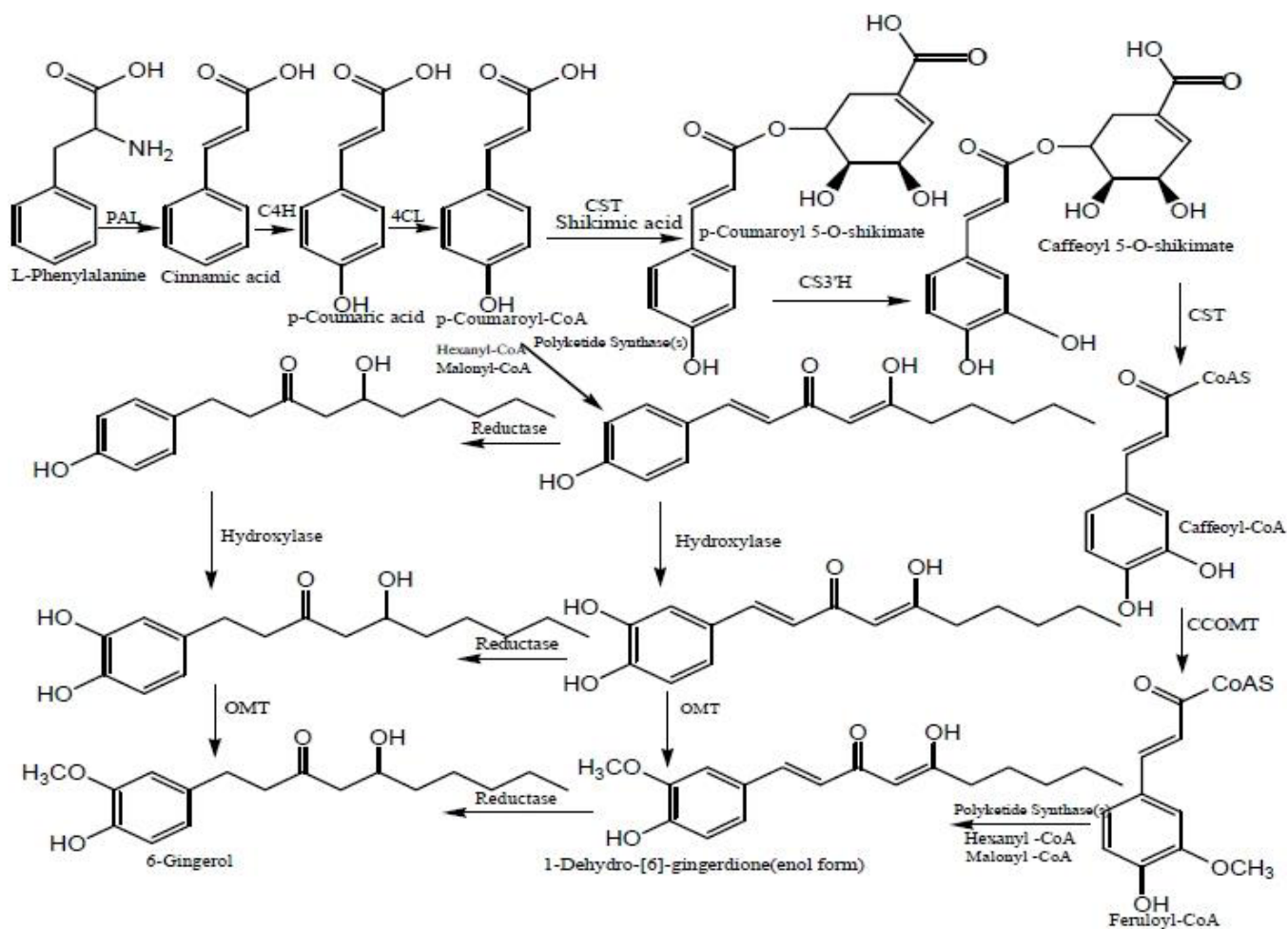
Macleod and Whiting (1979) stressed the importance of dihydro ferulic acid and hexanoic acid in the biosynthesis of (S)-6-GN in the *Z. officinale*. The roles of these compounds were further elucidated when the complete route of biosynthesis of (S)-(+)-6-GN in the ginger plant was proposed by Deniff and Whiting (1976a) and (Deniff *et al.*, 1980).¹⁰ According to these experimenters, phenylalanine is converted to dihydroferulic acid, which subsequently participates in a biological Claisen reaction with malonate and hexanoate to form 6-dehydro-gingerdione. Finally, which is converted to 6-GN (Scheme 1). Ramirez-Ahumada *et al.*, 2006 suggested an alternative pathway for 6-GN biosynthesis in the *Z. officinale*, in which particular enzymes, including the following: phenylalanine ammonia-lyase, p-coumaroyl shikimate transferase, p-coumaroyl quinate transferase, caffeic acid O-methyltransferase and caffeoyl CoA-O-methyltransferase, play an important roles in the process (Scheme 2).¹¹

Anti-microbial activity.

Foodborne illnesses are a major concern for consumers, the food industry, and safety authorities of food. In recent years, considerable effort has been made to find natural antimicrobials that can inhibit bacterial, fungal, and other growth in foods to improve quality and shelf-life. Natural extractions of plants have been used for many years for different purposes, and recently, they have been screened for their potential use as alternative remedies and food preservatives.¹² The antibacterial activities of plant extractions and oils can be useful for the



Scheme1: Biosynthetic pathway for 6-gingerol.



Scheme 2: Biosynthesis of 6-gingerol.

preservation of raw and processed food, in the pharmaceutical industry and as alternative medicines and natural therapies.¹³ The ginger plant has strong antibacterial and to some extent antifungal properties. Many studies have revealed that a methanol extract of *Z. officinale* rhizomes possesses significant antibacterial activity against *Escherichia coli*, *Salmonella enteritidis* and *Staphylococcus aureus*.¹⁴ *E. coli* induced diarrhea is the leading cause of death in developing countries and recently it was documented that zingerone exerted protective effect on *E. coli* induced diarrhea. Zingerone also showed protective effect in hypermotility mediated diarrhea that was linked to inhibition of gastrointestinal motility.¹⁵ A recent study also indicated that zingerone supplemented Pacific white shrimp (*Litopenaeus vannamei*) juveniles showed strengthening of immunity and protection against *V. alginolyticus* challenge. The essential oil from ginger, was studied for anti-microbial activity against *Aspergillus niger*, *Saccharomyces cerevisiae*, *Mycoderma sp.*, *Lactobacillus acidophilus*, and *Bacillus cereus*, as determined by paper agar diffusion method.¹⁶

Anti-inflammatory Activity

Inflammations are a host defense mechanism of the body, and it's an essential immune response that enables the body to survive during infections or injury and maintains tissues homeostasis under noxious conditions. Inflammations are localized protective reactions of cells and tissues of the body to allergic or chemical irritations, injury, or any infection. A recent study described the ability of a hexane fraction of dried *Z. officinale* methanolic extract to suppress proinflammatory gene expression in LPS-activated BV2 microglial cells, thus displaying anti-neuroinflammatory activity.¹⁷ Gingerol and structurally related pungent principles of ginger, including shogaol exert inhibitory effects on the biosynthesis of prostaglandins and leukotrienes through suppression of prostaglandin synthase or 5-lipoxygenase.¹⁸

Anti-cancer Activity

A continued increase in the incidence of cancer has alerted consumers to the use of functional foods that protect against and reduce the acceleration of the many diseases. The beneficial effects of *Z. officinale* and its metabolites against a variety of carcinomas and cell lines of the lung, colon, skin,

pancreas, prostate, liver, ovary, colon, breast, kidneys, etc. have been recognized by many researchers and discovers over the past 20 years. An ethanolic ginger extract applied topically to the mouse skin provided a highly significant protective effect against the development of skin tumours, and this was associated with the inhibition of 12-O-tetradecanoylphorbol-13-acetate (TPA), caused induction of epidermal ornithine decarboxylase, cyclo-oxygenase and lipoxygenase activity.¹⁹ A subsequent study showed [6]-gingerol to have similar activity. A more recent study showed that topical applications of [6]-gingerol inhibited COX-2 expression in mouse skin stimulated with the tumor promoter TPA.²⁰

CONCLUSION

As a result of this study, we suggest that the inhibition of COX-2 expression was the result of the blocking of the p38 MAP kinase- NFκB signaling pathways. A cytotoxic or cytostatic activity mediated by apoptosis was found for [6]-gingerol and [6]-paradol in human promyelocytic leukemia HL-60 cells, and also for four diarylheptanoids and two shogaols. So I advice all the researchers to try the experiments of the ginger plant (*Z. officinale*), which play an important role in many broads in the life of humans, such as the medical and biological side to solve almost types of the difficult health problem. Finally, we must transform the chemical compounds in the plant to the medicine for treatment.

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