OPEN ACCESS
Scholars International Journal of Traditional and Complementary Medicine
Abbreviated Key Title: Sch Int J Tradit Complement Med
ISSN 2616-8634 (Print) |ISSN 2617-3891 (Online)
Scholars Middle East Publishers, Dubai, United Arab Emirates
Journal homepage: https://saudijournals.com

Original Research Article

Phytochemical Screening of Ginger (*Zingiber officinale*), a Medicinal Plant

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DOI: 10.36348/sijtcm.2023.v06i04.002 | **Received:** 27.03.2023 | **Accepted:** 02.05.2023 | **Published:** 06.05.2023

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Abstract

Ginger has potent values as a medicinal plant which originated from China and India. Currently there is a renewed interest in ginger because of its various active pharmacological ingredients including gingerols, beta-carotene, capsaicin, caffeic acid, curcumin, and salicylate making it a potential source of research to use as a drug. The present study was aimed at extraction of ginger root extract in acetone and methanol solvents by Soxhlet extraction method, screening of phytochemical constituents of ginger extract in acetone and methanol and evaluation of its antimicrobial activity against known pathogenic microorganism. The qualitative analysis of phytochemicals revealed the presence of saponins, alkaloids, flavonoids, and steroids in the extracts of ginger. Results of antimicrobial activity showed that ginger in acetone was having highest activity against *Escherichia coli* MTCC 334 with 24 mm of clear zone and lowest activity with ginger in methanol against *Bacillus subtilis* MTCC 441 with 10 mm of clear zone.

Keywords: Zingiber offcinale, Medicinal plant, Soxhlet, Phytochemicals, Qualitative Analysis, Antimicrobial activity.

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INTRODUCTION

Medicinal plants are relatively inexpensive, have less side effects, and are more palatable to patients. They also offer a high therapeutic potential which is receiving a lot of interest today as natural alternatives to synthetic medications. About 420 medicinal plants are used in Ayurvedic practices [1]. We discuss the use of medicinal plants and their bioactive compounds in this chapter. Ginger is prominent as herbal medicine all over India and it originally came from China and India, where it has been used for the last 4000 years in cooking. Ginger is known for its spicy and sharp flavour [2]. Its scientific name is *Zingibe*r which is taken from the Greek zingiberis, derived from the Sanskrit name of the spice, singabera; the Latin word, *Zingiber*, means fashioned like a horn and relates to the roots, which resemble a deer's antlers. In Sanskrit the plant is known as Sringavera [3]. Ginger is a rhizome belonged to the family of Zingiberaceae which is an herbaceous perennial plant probably from south-eastern Asia. It has 47 genera and 1400 species [4]. There are over hundred recognised ingredients in this complex blend of pharmacological chemicals, including gingerols, beta-carotene, capsaicin, caffeic acid, curcumin, and salicylate [5]. Ginger's strong flavour is attributable to non-volatile phenylpropanoid-derived chemicals called gingerols and shogaols. When ginger is dried or cooked, shogaols are generated from gingerols [6]. It is estimated that in India, the average consumption of fresh ginger root is about 8-10 grams per day as a flavouring agent [7]. Ginger can be used as an ingredient in a variety of recipes. They can be cooked in boiling water to make ginger tea, which is usually sweetened with honey; sliced orange or lemon fruit can also be added. Ginger root juice is very strong and is frequently used as a spice to flavour dishes such as shellfish, mutton, appetisers, or stew. Ginger powder (powdered dry ginger roots) is commonly used to spice up ginger bread and other dishes. Ginger is frequently used to flavour biscuits, crackers, and cakes, as well as to flavour ginger ale, a sweet, fizzy, non-alcoholic beverage, ginger bread, ginger snaps, ginger cake, and ginger biscuits [8]. Several investigations have been carried out which focused on finding new sources of bioactive compounds with antioxidant and/or antimicrobial properties from natural products and evaluating their potential application in foods such as ginger [9] Ginger is used as a carminative, diaphoretic, antispasmodic, expectorant, peripheral circulatory

stimulant, astringent, appetite stimulant, anti-inflammatory agent, diuretic, and digestive aid in Ayurveda [10]. It is progressively considered as a preferable treatment for vomiting and nauseousness. Also shows effect in morning sickness related to pregnancy and also acts as a natural analgesic and an anti-inflammatory in the treatment of osteoarthritis and rheumatoid arthritis. Additionally, it helps to treat ulcers and prevent heart attacks and strokes [11].

Figure 1: *Zingiber officinale* Rhizome

Figure 2: *Zingiber officinale* Plant

MATERIALS AND METHODS

Sample Collection

Ginger was collected in month of September, 2022 from the local market of Hatkeshwar at CTM, Ahmedabad, Gujarat. Then the fresh ginger was packed in a polyethylene bag and transported to home and kept at room temperature until processing.

Sample Extraction (Soxhlet Method)

Firstly, the ginger was washed with tap water for 2-3 times to remove dirt and then washed with the distilled water. After that ginger was sliced into pieces and dried in sunlight for 2- 3 days. The dried ginger was mortar and pestle and powder form was used for the extraction. The dried powder sample of Ginger (20 gram) were extracted with methanol and acetone (200 mL) using Soxhlet extractor for 3 days until complete extraction. After extraction it was kept in hot air oven at 50-60℃ to give solid extract.

Qualitative Analysis of Phytochemicals [12]

The plant extracts were screened for the presence of the phytochemicals like Alkaloids, Tannin, Flavonoids, Carbohydrates, Steroids, Saponin, Protein and all the chemicals are of analytical grade which are procured form Disha Life Sciences Ltd., Pvt. Ahmedabad.

Test for Carbohydrates

2 ml of 1% aqueous extract of ginger in acetone and methanol was mixed with the 1ml of Molisch reagent. Few drops of concentrated sulfuric acid were slowly added from the side wall. Resulted solution was shaken carefully. Violet ring at the interface of the two liquid indicates presence of carbohydrates.

Test for Tannin

1 ml of 1% aqueous extract of ginger in acetone and methanol mixed with 2 ml of 5% FeCl3. Dark bluish/Greenish black color indicates the presence of the Tannin.

Test for Flavonoids

In 2 ml of 1% aqueous extract of ginger in acetone and methanol add 1 ml of 2N NaOH. Yellow color indicates the presence of flavonoid.

Test for Steroid

5 ml of chloroform added in the 1 ml of 1% aqueous extract of ginger in acetone and methanol. After that 5 ml of H2SO4 was added drop by drop in solution. Upper layer turns red and H2SO4 turns yellow-green.

Test for Saponin

2 ml of 1% aqueous extract of ginger in acetone and methanol was mixed with 2 ml of distilled water. The mixture was shaken for 15 min in a test tube. Formation of 1 cm foam layer indicates the presence of saponin.

Test for Alkaloids

Hager's Test: In 2 ml of 1% aqueous extract of ginger in acetone and methanol, add 2 ml of Hager's reagent. Yellow precipitates indicate the presence of alkaloids.

ANTIMICROBIAL ACTIVITY

The antimicrobial activity of the *Zingiber officinale* extracts was assessed by using agar well diffusion method as described by Kirby-Bauer (1996). The plates were spread with young culture of *Escherichia coli* MTCC 334, *Bacillus subtilis* MTCC 441 *and Candida albicans* MTCC 227 (procured from the preserved culture collection of Disha Life Science Pvt., Ltd. cultures) 100 µL of 10^6 CFU. A sterile cork borer of 6 mm diameter was used to make four wells on the freshly prepared nutrient agar plates for bacteria and soybean casein dextrose agar plate for yeast. The wells were dispensed with 100 µL of 5% samples (GA and GM) and Acetone and Methanol are used as control. The plates were allowed to stand for few minutes and let the samples diffuse for some time and then incubated at 37 ºC for 24 hours. Using a HI media antibiotic scale, the diameter of the inhibitory zones was measured after the incubation period and recorded in millimetres [13].

RESULT AND DISCUSSION

To obtain the final extracts, excess methanol and acetone were evaporated. The entire weight of the extract is determined after evaporation. The result of total weight of extract using acetone and methanol is shown in Table 1. The total weight of Ginger in acetone is 1.742 gm and Ginger in methanol is 1.52 gm.

Table 1: Total weight of plate after extraction

Samples	Pre weight (gm)	Post weight (gm)	Total weight (gm)
Ginger in Acetone	43.58	45.322	1.742
Ginger in Methanol	45.072	46.592	1.52

Figure 3: Ginger in Acetone

Figure 4: Ginger in Methanol

The results of the present study showed the primary screening of phytochemical investigation which was done using two solvents (Acetone and Methanol). Table 2 showed result the presence of phytochemicals namely alkaloids, flavonoids, steroids, saponin and absence of carbohydrate and tannin.

Table 2: Qualitative Analysis of Phytochemicals

Sr. No	Test	Sample	Reagents	Observation	Result
1	Carbohydrates	GA	Molisch's Test	Violet ring	-
		GM			-
2	Tannin	GA	5% FeCl3	No colour	-
		GM			-
3	Flavonoids	GA	2N NaOH	Yellow colour	+
		GM			+
4	Steroids	GA	Salkowski Test	Red colour at lower layer	+
		GM			+
5	Saponin	GA	Froth test	Stable Froth	+
		GM		No froth	-
6	Alkaloids	GA	Hager's test	Orangish yellow colour	+
		GM		Yellow Colour	+

Key: *GA- Ginger in Acetone; GM- Ginger in Methanol

Table 3: Antimicrobial activity against pathogenic microorganism

Sr. No	Plant Extraction (5%)	Pathogenic microorganism		
		E. coli MTCC 334	***B. subtilis MTCC 441***	***C. albicans MTCC 227***
1	Ginger in Acetone	24 mm	15 mm	14 mm
2	Ginger in Methanol	-	10 mm	14 mm

Table 3 showed the zone of inhibition by Ginger extract against. *B. Subtilis* MTCC 441, *E. coli* MTCC 334 *and C. albicans* MTCC 227. The highest activity was observed with ginger in acetone at the concentration of 5% against *E. coli* MTCC 334 (24 mm) while the lowest was observed with Ginger in methanol at 5% concentration against *B. subtilis* MTCC 441 (10 mm). The result of antimicrobial activity of aqueous extract of ginger showed that all tested microbes were resistant to ginger in acetone but *E. coli* MTCC 334 is susceptible to ginger in methanol.

The present study on phytochemicals showed the presence of saponins, alkaloids, flavonoids and steroids in the extracts of ginger in acetone and absence of carbohydrate and tannin in the extracts of ginger in methanol as well as in ginger in acetone. It was noted that water is generally not ideal for the discovery of new antimicrobial agents because water cannot extract nonpolar molecules. [14]. Alkaloids are well-known for their therapeutic properties of anesthetic, cardioprotective, and anti-inflammatory properties. Morphine, strychnine, quinine, ephedrine, and nicotine are among the well-known alkaloids utilized in clinical settings [15]. Multiple biological properties, including anti-microbial, cytotoxic, anti-inflammatory, and anti-tumor properties, have been observed in the flavonoids; however, the capacity to function as potent antioxidants is the flavonoids most well-known property [16]. As antioxidants, saponins have also been shown to kill protozoans and mollusks, disrupt protein digestion, and prevent the gut from absorbing vitamins and minerals., to cause hypo-glycaemia and show antifungal and antiviral activity [17]. Steroids show the analgesic properties and central nervous system activities [18]. The tested bacterial species responded differently to the ginger obtained from the different organic solvents. The results from the present study showed that ginger in acetone had better activity compared to ginger in methanol. The presence of saponins, alkaloids, flavonoids and steroids in the extracts of ginger may explain the reason for its antimicrobial activities since the antimicrobial properties of most of these phytochemicals have been reported previously [19].

CONCLUSION

Ginger collected from the local market of Ahmedabad showed the presence of potential phytochemicals including alkaloids, saponin, flavonoids and steroids. Further study is needed so it can be used as a potential source novel antibiotic and the experiment needs to be conducted to isolate the active components responsible for the bioactivity of extracts.

Conflict of Interest: Authors have no conflict of interest.

ACKNOWLEDGEMENT

We sincerely like to acknowledge Disha Lifesciences Pvt, Ltd. for its support and cooperation during this work.

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