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Research Article

COMPARATIVE EVALUATION OF ANTIMICROBIAL PROPERTIES OF RED AND WHITE GINGER

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ABSTRACT

Background: *Zingiber officinale* (Zingiberaceae), has been cultivated in many tropical and subtropical countries on account of its culinary and medicinal properties. Its antimicrobial properties are well known. There are two varieties of ginger available in Malaysian market i.e. red ginger (*Zingiber officinale* Var. Rubra) and white ginger (*Zingiber officinale* Roscoe).
Objective: The present study aimed to compare the antimicrobial properties of red and white ginger.
Methods: The antibacterial properties of methanol and water extracts of two varieties of ginger by disc diffusion method against *Streptococcus pyogenes, Staphylococcus aureus, Escherichia coli* and *Pseudomonas aeruginosa*.
Results: All the extracts showed potent antibacterial activity and produced zone of inhibition ranging from 10-28 mm. Among the tested extracts, the crude methanol extracts of red ginger showed better activity against the entire tested organism when compared to all the other extracts. However, the standards showed better activity than all the tested extracts at lower concentrations.
Conclusion: These results showed that the methanol extract of red ginger is the good candidate for further investigation.

Keywords: *Zingiber officinale*; Red and white ginger; Antibacterial

INTRODUCTION

Natural products, including plants, animals and minerals have been the basis of treatment of human diseases. History of medicine dates back practically to the existence of human civilization. The current accepted modern medicine or allopathy has gradually developed over the years by scientific and observational efforts of scientists. However, the basis of its development remains rooted in traditional medicine and therapies. The history of medicine includes many ludicrous therapies. Nevertheless, ancient wisdom has been the basis of modern medicine and will remain as one important source of future medicine and therapeutics.

Ginger, derived from the rhizomes of *Zingiber officinale* (Zingiberaceae), is one of the most widely used spices around the world and is common condiment for a variety of compounded foods and beverages [1]. Ginger bears an enormous number of biological activities such as cardio protective, anti-inflammatory, antimicrobial, antioxidant, anti-proliferative, neuroprotective and hepatoprotective activities which have been proved [2].

Medicinal plants represent a rich source of antimicrobial agents. There is also an urgent need to search for new antimicrobial compounds with novel mechanisms of action because there has been an alarming increase in the incidence of new infections diseases, as well as the development of resistance to the antibiotics in current clinical trials [3].

A numeral of commercial variety of ginger exists. In Malaysia, red ginger (*Zingiber officinale* Var. Rubra) and white ginger (*Zingiber officinale* Roscoe) were available in the market. They are different from colour, size, appearance and taste. The flavours of fresh and dried ginger are somewhat different and some of constituents may be different from each other. Ginger studied for inhibition and treatment of infections by pathogenic microorganisms including bacteria, viruses, protozoa and parasites [4,5]. However, so far there is no comparative study has been reported in ginger varieties especially its antimicrobial activities. Hence, in the present study, we aimed to carry out a comparative investigation of its antimicrobial properties of different varieties of ginger using standard methods.

MATERIALS AND METHODS

Collection and authentication of plant materials

The rhizomes of red ginger (*Zingiber officinale* Var. Rubra) and white ginger (*Zingiber officinale* Roscoe) were collected from the local market, Ipoh District, Perak, Malaysia and authenticated.

Extraction of fresh ginger rhizomes

The non-edible parts of the fresh rhizomes of red and white ginger (Fig. 1) were removed from the edible part. The edible portions were washed thoroughly in distilled water to remove contaminants, chopped into small pieces and blended making use of an electronic blender and separately subjected to extraction by maceration method.

The blended rhizomes of red and white ginger (100 g) were subjected to maceration extraction using distilled water and methanol (250 mL) at room temperature with occasional shaking for seven days. The macerates were filtered and the filtrates were dried at low temperature (40-50 °C). The extracts were stored in air-tight containers in a refrigerator at 4 °C until further use.

Antimicrobial screening

Test microorganisms

A panel of four common pathogenic microorganisms were used in the study, which includes gram-positive bacteria (*Streptococcus pyogenes* and *Staphylococcus aureus),* gram-negative bacteria (*Escherichia coli* and *Pseudomonas aeruginosa*).

Disc-diffusion method

A suspension of the tested microorganisms was uniformly swabbed on agar. Sterile blank discs were individually impregnated with different concentration of extracts (10, 20, 40 mg/mL and 100, 250, 500 µg/mL) and placed onto the inoculated agar plates [3]. The plates were inverted and incubated at 37 °C for 24 h. The antimicrobial activity was measured by measuring diameter of the resulting zone of inhibition against the tested organisms. The test for positive control and negative control were performed in duplicate.

RESULTS

Table 1: Yields and nature of white and red ginger methanol extract

Plant Source	Quantity used for methanol extraction		Nature of the extracts	Yield (%)
	Powder (g)	Solvent (mL)		
Red Ginger	100	250	Brown sticky semisolid	5.19
White Ginger	100	250	Yellow semisolid	2.89

Table 2: Yields and nature of white and red ginger water extract

Plant Source	Quantity used for water extraction		Nature of the extract	Yield (%)
	Powder (g)	Solvent (mL)		
Red Ginger	100	250	Dark Brown solid	6.34
White Ginger	100	250	Light brown semisolid	9.45

Table 3: Antimicrobial activity of red and white ginger extracts by disc diffusion method at higher concentrations

S. No	Organism used	Concentration in mg/mL												Control	Standard
		Red ginger methanol extract			White ginger methanol extract			Red ginger water extract			White ginger water extract				
		10	20	40	10	20	40	10	20	40	10	20	40		
		Gram positive bacteria													
1	*Streptococcus pyogenes*	+++	+++	+++	+++	+++	+++	+++	+++	+++	+++	+++	+++	---	Bacitracin (+++)
2	*Staphylococcus aureus*	+++	+++	+++	+++	+++	+++	+++	+++	+++	+++	+++	+++	---	Penicillin (+++)
		Gram negative bacteria													
3	*Escherichia coli*	+++	+++	+++	+++	+++	+++	+++	+++	+++	+++	+++	+++	---	Cefriaxone (+++)
4	*Pseudomonas aeruginosa*	+++	+++	+++	+++	+++	+++	+++	+++	+++	+++	+++	+++	---	Ciprofloxcin (+++)

+++Indicates higher level of inhibition, ---Indicates no inhibition

Table 4: Antimicrobial activity of red and white ginger extracts by disc diffusion method at lower concentrations

S. No	Organism used	Concentration in µg/mL												Control	Standard
		Red ginger methanol extract			White ginger methanol extract			Red ginger water extract			White ginger water extract				
		100	250	500	100	250	500	100	250	500	100	250	500		
		Zone of inhibition (mm)													
		Gram positive bacteria													
1	*Streptococcus pyogenes*	16	17	23	10	12	13	12	16	17	13	14	15	0	Bacitracin (4 µg/mL, 25 mm)
2	*Staphylococcus aureus*	18	23	25	11	16	18	16	18	20	15	16	18	0	Penicillin (10 µg/mL, 17 mm)
		Gram negative bacteria													
3	*Escherichia coli*	21	23	28	17	20	23	20	22	25	15	19	22	0	Cefriaxone (30 µg/mL, 26 mm)
4	*Pseudomonas aeruginosa*	17	21	27	16	19	21	16	19	21	13	17	19	0	Ciprofloxcin (5 µg/mL, 21 mm)

Figure 1: Rhizome part of red (*Zingiber officinale* Var. Rubra) and white ginger (*Zingiber officinale* Roscoe)

The nature of two varieties of ginger extracts and yields were mentioned in Table 1 and 2. The antibacterial activity of crude methanol and water extracts of the rhizome of red and white ginger were presented in Table 3 and 4. The crude methanol and water extracts of both the varieties of ginger produced higher level of zone of inhibition in higher concentration against the pathogenic bacteria tested.

The zone of inhibition produced by the crude methanol extract and water extract of red ginger ranged from 16-28 mm and 12-25 mm, respectively at a concentration of 100, 200 and 500 µg/mL against all pathogenic bacteria. The crude methanol and water extract of white ginger produced zone of inhibition ranged from 10-23 mm and 13-22 mm, respectively at a concentration of 100, 200 and 500 µg/mL against all pathogenic bacteria.

The results revealed that the red ginger methanol and water extracts were produced higher zone of inhibition than white ginger in all the concentrations against both gram positive and gram negative pathogenic bacteria. The results also revealed that the crude methanol extract of red ginger produced higher zone of inhibition (16-28 mm) when compare to water extract of red ginger (12-25 mm). However, the standards showed better activity with lower

concentration when compared to all the tested extracts against the entire organisms.

DISCUSSION

The results indicate that the methanol and water extracts of two varieties of ginger showed antibacterial activity toward gram positive (*Streptococcus pyogenes* and *Staphylococcus aureus)* as well as gram negative bacteria (*Escherichia coli* and *Pseudomonas aeruginosa*).

The methanol extracts of red and white ginger showed more effective result than those of aqueous extracts against all bacterial strains. It was seen that all the extracts showed better result in gram negative bacteria than those gram positive bacteria. The highest anti bacterial activity was recorded in all the extracts against *Escherichia coli*. The presence of active phytoconstituents in the extracts may be responsible for the antibacterial activity.

The results of this study reflect that potent phytochemicals are present in red ginger methanol and water extracts than white ginger extracts. These findings are supported by the reported results of earlier study showed that the red ginger contains more vitamin C, phenol, flavonol content compare to white ginger [6]. The crude methanol extract of red ginger was biologically active when compared to red ginger water extract as well as white ginger methanol and water extracts. These results showed that the methanol extract of red ginger is the good candidate for further investigation.

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