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ANTIBACTERIAL ACTIVITY AND MEDICINAL PROPERTIES OF GINGER (zingiber *officinale*)

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ABSTRACT

The antibacterial activity and medicinal properties of ginger extracts were studied. Ginger extracts were obtained using solvents, n-hexane, ethyl acetate, ethanolic soxhlet and water. The extracts were assayed for antibacterial activity and bacterial growth inhibition activity. The results showed that all the extracts except the water extract have antibacterial activity and that the inhibition of bacterial growth was dose dependent. The results also showed that ginger extracts possesses antibacterial properties and could be used for the treatment of bacterial infections.

KEY WORDS: Ginger, Antibacterial activity, inhibition of bacterial growth, medicinal properties and bacterial infections.

INTRODUCTION

Ginger (zingiber *officinale*), Roscoe belonging to the Family Zingiberaceae, is a perennial herb with thick tuberous rhizomes. The erect leafy aerial stem grows up to approximately 1 meter in height and has purple flowers (fig.1). Its roots are used as spice in cooking throughout the world. The ginger plant has a long history of cultivation known to originate in China and then spread to India, South East Asia, West Africa and the Caribbean (Weiss, 1997; McGee, 2004). Ginger contains up to 3% of an essential oil that causes the fragrance of the spice (O'Hara et al,1998). The main constituents are sesquiterpenoids with (-)-

Figure1: An erect stem of ginger *zingiber officinale*)

Figure 2: A thick tuberous rhizome of ginger root.

zingiberene as the main component. Other components include β-sesquiphellandrene bisabolene and farnesene which are also sesquiterpenoids,(β-sesquiphellandrene, cineol and citral)(Opdyke,1974 ;O'Hara et al,1998).

The pungent taste of ginger is due to non-volatile phenylpropanoid – derived compounds, gingerols and shogaols. The shogaols are formed from gingerols when ginger is dried or cooked. Zingerone is

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also produced from gingerols during this process, and it is less pungent and has a sweet aroma (O'Harold, 2004). Ginger is a minor chemical irritant, and has a sialagogue action, stimulating the production of saliva (O'Hara et al, 1998). Mature ginger roots are fibrous and nearly dry. They can be cooked as an ingredient in many dishes. They can be stewed in boiling water to make ginger tea, to which honey is often added as a sweetener; sliced orange or lemon fruit may also be added. The juice of ginger roots is extremely potent and is often used as spice to flavour dishes such as seafood, mutton, snacks or stew. Powdered dry ginger roots (ginger powder) are typically used to add spiciness to ginger bread and other recipes. Ginger is also made into candy and used as flavoring for cookies, crackers and cakes as well as flavour in ginger ale-a sweet, carbonated, non-alcoholic beverage. ginger bread, ginger snaps, ginger cake and ginger biscuits (McGee,2004).

Medically ginger is used as a stimulant and carminative, and is used frequently for drypepsia and colic (O'Hara et al, 1998). It has a sialaggogue action, stimulating the production of saliva. It is also used to disguise the taste of medicines. Ginger promotes the release of bile from the gall bladder (Opdyke, 1974; Kato et al, 1993; O'Hara et al, 1998). Ginger may also decrease joint pain from arthritis, may have blood thinning and cholesterol lowering properties and may be useful for the treatment of heart diseases and lungs diseases (Opdyke, 1974; Kato et al, 1993; O'Hara et al, 1998; Kuschener and Stark, 2003). The characteristic odour and flavour of ginger root is caused by a mixture of gingerone, shoagoles and gingerols, volatile oils that make up about 1-3% of the weight fresh ginger.

The gingerols increase the motility of the gastrointestinal tract and have analgesic, sedative and antibacterial properties (O'Hara et al, 1998). Ginger has been found effective by multiple studies for treating nausea caused by seasickness, morning sickness and chemotherapy (Ernst and Phittler, 2000). Ginger has been reported to be effective for the treatment of inflammation, rheumatism, cold, heat cramps, and diabetes (Al-Amin, 2006; Afshari, 2007).

Allergic reactions to ginger include heartburn, bloating, gas, belching and nausea (particularly if taken in powdered form). Unchewed fresh ginger may result in intestinal blockage, and individuals who have had ulcers, inflammatory bowel diseases or blocked intestines may react badly to large quantities of fresh ginger (Opdyke, 1974; O'Hara et al, 1998). Ginger can also adversely affect individuals with gallstones, and may affect blood pressure, clotting, and heart rhythms (O'Hara et al, 1998).

The aim and objective of the present study was to investigate the antibacterial activity and bacterial growth inhibition of ginger extracts.

MATERIAL AND METHODS

Collection and treatment of sample

The ginger roots were obtained at the Marian Market (Calabar, Nigeria). The roots were sun dried for seven days and ground into fine powder using an electric grinder. Then 100g of the powdered mass obtained was stored in clean sterile bottles at room temperature and used for the extractions.

The soxhlet ethanolic extracts was obtained by soxhlet extraction of 20g of ginger powder in 100ml of 95% ethanol at 78^{o}C using soxhlet apparatus. The extract was then concentrated to 20ml on a water bath and dried at room temperature.

The n-hexane extract was obtained by dissolving 20g of the powdered ginger in 100ml of n-hexane in a conical flask. The mixture was stirred, covered, and allowed to stand for 24hrs, and filtered using sterile Whitman No.1 filter paper. The filtrate was concentrated to 20ml on a water bath and evaporated to dryness at room temperature.

The ethyl acetate and water extracts were obtained by repeating the above procedure for n-hexane. The various extracts were used for the analysis of antibacterial activities and bacterial inhibition assay.

Antibacterial activity

The antibacterial activity was determined by the diffusion method of Kirby Bauer described by Duguid et al, (1989). This method determines the antibacterial activity of the extracts.

Preparation of the nutrient medium

Nutrient agar medium was prepared by dissolving 2.8g of nutrient agar in 100ml distilled water. The solution was sterilized in an autoclave at 121^{o}C (1.1N pressure) for 15 min. The suspension was cooled and poured into sterile Petri-dishes to solidify. The agar depth of the medium was 4.0mm.

Preparation of cultures and innoculation

Pure cultures of coli form bacillus, staphylococcus epidermidis and streptococcus viridans obtained from the Microbiology Laboratory in the Department of Microbiology, Cross River University of Technology, Calabar, Nigeria, were separately used to inoculate the Petri-dishes. This was done by streaking the surface of the plates in a zigzag manner until the entire surface was then covered. The inoculated plates were then incubated at room temperature for 24hours.

Assay of antibacterial activity

The extracts were serially diluted to obtain 1.0%, 0.5%, 0.25%, and 0.125% solutions in sterile test tubes. Sterilized 9mm filter paper disc soaked in the diluted extracts were placed on the plates and incubated for 24hours at room temperature.

The plates were examined for clear zones of inhibition. Presence of zones of inhibition indicated activity. The zones were measured.

RESULTS

Table 1 presents the results of antibacterial activity of the ginger extracts. The results showed that the extracts except the water extract have antibacterial activity. The results that ginger roots extracts, viz.n-hexane, ethyl acetate and soxhlet extracts have antibacterial activities on colliform bacillus, staphylococcus epidermidis and streptococcus viridians while the water extract did not have antibacterial activity on these bacterial. The results may suggest that n-hexane; ethyl acetate and soxhlet extract of ginger root could be potent against bacterial infections while the water extract of ginger roots could be ineffective.

Table 2 presents the results of inhibition of bacterial growth by the extracts. The results showed that n-hexane, ethyl acetate and soxhlet extracts showed inhibition of bacterial growth of coliform bacillus, strapylococcus epidermidis and streptococcus viridans. However, there was no bacterial growth inhibition with the water extract of the ginger roots. futhermore, the inhibition of bacterial growth appeared to be dose dependent since no activiy was observed at low concentrations. Since no activity was observed at very low concentrations.

Table 1.The antibacterial activity of the ginger roots extracts

Test organism	n-hexane extract	Ethyl acetate extract	Soxhlet extract	Water extract
Coliform bacillus	+	+	+	-
Staphylococcus Epidermidis	+	+	+	-
Streptococcus viridans	+	+	+	-

+ = Active
- = Not active

Table 2. Inhibition of bacterial growth by the ginger extracts

Test organism	Dilution (%)	Zone of inhibition (mm)			
		n-hexane	Ethyl acetate	Soxhlet	Water
Coliform bacillus	1.00	4.0	5.0	5.5	_
	0.50	1.5	2.5	3.0	_
	0.25				_
	0.125				_
Straphylococcus epidermidis	1.00	4.5	5.0	6.5	_
	0.50	2.5	3.5	4.0	_
	0.25		1.0	2.5	_
	0.125		_	_	_
Streptococcus viridans	1.00	5.0	5.6	7.0	_
	0.50	3.0	4.0	4.5	_
	0.25				
	0.125				

DISCUSSION

The results for the antibacterial screening have shown that the entire extracts except the water extracts have antibacterial activity. The results of the inhibition of bacterial growth have shown that the extracts are active at high concentration and inactive at very low concentrations. Thus the study may suggest that the inhibition of bacterial growth activity of the extracts is dose dependent. The soxhlet appears to be most active and can be beneficial in the treatment of bacterial infections.

The antibacterial activity and inhibition activity of ginger extracts could be attributed to the chemical properties of ginger. The main constituents of ginger are sesquiterpenoids with zingiberene as the main component. Other components include β-sesquiphellandrene, bisabolene and farnesene, which are sesquiterpenoids, and trace monoterpenoid fraction,(β-sesquiphellandrene, cineol and citral)(O'Hara et al,1998).

The terpenoids are of important in pharmacy due to their relationship with such compounds as vitamin A and could be of immense medical applications. Terpenoids are reactive compounds (Ekam and Ebong, 2007). Ginger has a sialagogue action, which stimulate the production of saliva, and can be used to disguise the taste of medicines (O'Hara et al,1998). The gingerols could make ginger available for treatment of stomach acidity and may have analgesic and sedative properties (O'Hara et al, 1998).

In conclusion, this study has shown that ginger extracts possess medicinal properties, antibacterial activity and that the inhibition of bacterial growth was dose dependent.

The results of this may suggest that the n-hexane, ethyl acetate and soxhlet extracts of the ginger roots could be used for treating bacterial infections, drypepsia and colic. these extracts may also be used for treating common cold, digestive disorders, hypercholesterolemia, heart diseases, lung diseases and could also be used as analgesic, particularly, in relieving pains from arthritis.

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