Evaluation of Proximate Analysis and Antibacterial activity of *Zingiber officinale*

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ABSTRACT: *In vitro antibacterial activity of crude aqueous extracts of rhizome of Zingiber officinale Roscoe (ginger) was studied against antibacterial activity. The aqueous extracts of Zingiber officinale were used traditionally in India for the treatment of skin diseases. The present study was investigated for invitro antibacterial activity against bacterial pathogens namely Staphylococcus aureus, Bacillus subtilis, Streptococcus pyogenes, Pseudomonas auroginosa and Klebsiella pnemonia using the agar well diffusion method. The results relevant that the aqueous extract of rhizome were the highest inhibitory activity against Klebsiella pnemonia (22 mm) and Bacillus subtilis (15 mm). In parallel study was performed to identify the distribution and the concentration of the phytochemical screening, proximate and mineral elements analysis of Zingiber officinale. For this purpose we have prepared aqueous extracts from each part of the plant and we have studied them separately.*

Key Words: *Antibacterial activity, Zingiber officinale, Proximate, Phytochemical analysis*

Introduction

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, many of them based on their use in traditional medicine. Various medicinal plants have been used for daily life to treat disease all over the world. They have been used as a source of medicine. The widespread use of herbal remedies and healthcare preparations, such as those described in ancient texts like the Vedas and the Bible has been traced to the occurrence of natural products with medicinal properties. In fact plants produce a diverse range of bioactive molecules making them a rich source of different types of medicines. Higher plants as sources of medicinal compounds have continued to play a dominant role in the maintenance of human health since ancient times. Over 50% of all modern clinical drugs are of natural product origin and natural products play an important role in drug development programs in the pharmaceutical industry (Boominathan and Ramamurthy, 2009).

There has been a revival of interest in herbal medicines. This is due to increased awareness of the limited ability of synthetic pharmaceutical products to control major diseases and the need to discover new molecular structures as lead compounds from the plant kingdom. Plants are the basic source of knowledge in modern medicine. The basic molecular and active structures for synthetic fields are provided by rich natural sources. The worldwide interest in medicinal plants reflects recognition of the validity of many traditional claims regarding the value of natural products in health care. The use of plants and plant products as medicines could be traced as far back as the beginning of human civilization. The earliest mention of medicinal use of plants in Hindu culture is founds in "Rigveda", which is said to have been written between 4500-1600 B.C. and is supposed to be the oldest repository of human knowledge. It is Ayurveda, the foundation of medicinal science of Hindu culture, in its eight division deals with specific properties of drugs and various aspects of science of life and the art of healing (Rastogi and Mehrotra, 2002).

Nowadays multiple drug resistance has developed due to the indiscriminate use of commercial antimicrobial drugs commonly used in the treatment of infectious disease. In addition to this problem, antibiotics are sometimes associated with adverse effects on the host including hypersensitivity, immune-suppression and allergic reactions. This situation forced scientists to search for new antimicrobial substances. Given the alarming incidence of antibiotic resistance in bacteria of medical importance, there is a constant need for new and effective therapeutic agents. Therefore, there is a need to develop alternative antimicrobial drugs for the treatment of infectious diseases from medicinal plants (Ramamurthy and Naveen, 2017).

Ginger, the rhizome of Zingiber officinale, is one of the most widely used species of the ginger family (Zingiberaceae) and is a common condiment for various foods and beverages. It has a long history of medicinal use dating back 2,500 years in China and India for conditions such as headaches, nausea,

rheumatism, and colds. Ginger is native to Southern Asia, but it is now extensively cultivated in Jamaica, Nigeria, China, India, Fiji, Sierra Leone and Australia.

Zingiber officinale Roscoe is a common household spice originated from Southeast Asia; a city with its Sanskrit name Shuntiwas already in existence in 200 B. C. Ginger is also called as "The Great Medicament" in Ayurvedic medicines (Tan and Vanitha, 2004). It belongs to family Zingiberaceae and is a perennial plant with thick tuberous rhizomes, which are the medicinally useful part of this plant. The medicinal history of ginger has been extensively searched throughout the world and found to possess anti-inflammatory, cholesterol-lowering and antithrombotic properties (Zaika, 1975). Important secondary metabolites present in the rhizome are curcumene, non-volatile hydroxyaryl compounds e.g. zingerone, gingeroles and shogaoles (phenylalkanones), volatile sesquiterpenes (e.g. zingiberene and bisabolene) and monoterpenoids (e.g. citral) (Bensky and Gamble, 1993). Although, the antimicrobial activity and chemical analysis of essential oil and olioresins of this plant has been investigated (Singh *et al*., 2008), the present study was focussed to investigate the antibacterial potential of crude extracts of rhizome of *Zingiber officinale*. Furthermore, active extracts were evaluated for their antibacterial efficacy of *Zingiber officinale* rhizome and also characterizing them by screening preliminary by proximate analysis.

Materials and Methods

The rhizomes of ginger were purchased from Thanjavur district of Tamil Nadu. The rhizome of Zingiber officinale was dried in an oven at a steady temperature of 60°C. The dried samples were milled with an electric blender before being ground into powder and stored in desiccators until required for analysis.

Proximate Analysis

Proximate analysis was carried out in all the rhizome samples studied moisture, ash, crude fat (CF), fibre and crude protein (CP) were determined by the method adopted by AOAC (1990). All determination was done in triplicates.

Mineral Elements Analysis

The mineral elements were determined by first ashing the Zingiber officinale samples as described by Osabor *et al*. (2010). Sodium and potassium were determined by flame photometer. Iron, copper, zinc, calcium, manganese, chromium, cadmium, lead, nickel and mercury were determined by Atomic Absorption Spectrophotometer according to the method adopted by AOAC (2000).

Phytochemical Screening

The Phytochemical screening for the presence of alkaloids, saponins, flavonoids, phlobatanins, reducing sugars, anthranoids, cardiac glycosides, anthraquinones and polyphenols were carried out according to the method adopted by harborne (Harborne, 1973; Sofowora, 1993; Trease and Evans, 1989).

Antimicrobial Assay

The following organisms were employed for this study as test organisms such as *Staphylococcus aureus, Bacillus subtilis, Streptococcus pyogenes, Pseudomonas auroginosa* and *Klebsiella pnemonia.* The test bacterial pathogen cultures were obtained from the stock cultures maintained in specific agar medium.

Antibacterial activity of above mentioned extracts were tested using the agar diffusion method described by Collins and Lyne, (1970). All the above-mentioned bacteria were inoculated into nutrient agar medium. The well of 8 mm diameter was punctured in the culture medium using sterile cork borer. Different extracts were administered to fullness in each well. Culture plates were incubated at 37^{o}C for 24 h in bacteria. Bioactivity was determined by measuring diameter of inhibition zones in mm. Solvents used for extraction served as control.

Result and Discussion

The results of proximate analysis of Zingiber officinale (ginger) is presented in Table 1. These include those of moisture, ash, fibre, fat, protein and available carbohydrate. This work was carried out to evaluate the potential of the rhizome of Zingiber officinale (ginger) for its nutritional and therapeutic utility. The moisture content of the rhizome of Zingiber officinale was higher than those of some common rhizomes such as Alpina rhizomes (Laden *et al*., 1996), Adanonia digitata, Xanthosen sagitifolium, Vernonia amygdalina reported by Tunde (1998). The moisture content of Zingiber officinale is lower than reported for some leafy vegetables (Laden *et al*., 1996). The value of moisture contents of Zingiber officinale indicates it can be stored for a long time without spoilage.

The ash content of *Zingiber officinale* rhizome was found to be 4.20±0.11% DM. This result is higher than 3.85±0.61% DM reported by Ladan (1996) for *Z. officinale*. The ash content is an indication of the total

inorganic mineral elements content. The results obtained indicate that *Z. officinale* rhizome samples have low mineral elements compositions. The results obtained from the analysis of *Z. officinale* rhizome for crude fibre (CF) Table 1. Dietary fibre helps to reduce serum cholesterol levels, risk of coronary heart disease, colon and breast cancer and hypertension (Ganong, 2003). The recommended daily allowance (RDA) for fibre is 18 – 35 g (NRC, 1989). This indicates that *Z. officinale* rhizome cannot provide the daily fibre requirement of the body.

Table 2 shows the result of mineral elements composition of *Zingiber officinale* rhizome. The result of the mineral elements composition Table 3 revealed that *Z officinale* rhizome constitutes a rich source of mineral elements. The mineral elements composition showed increased levels in iron, sodium, copper, zinc, calcium and manganese and low levels in chromium, cadmium, nickel and mercury. Iron is required for the formation of blood cells and its deficiency causes anaemia (Umoh *et al*., 2014). Manganese is an essential trace element in higher animals, it participates in the action of many enzymes, lack of manganese causes testicular atrophy. Higher levels of this mineral element in plants and animal has toxic effects. Zinc is an essential trace element in the human body when it is found in high levels in the red blood cells as an essential part of the enzyme carbonic anhydrate which promotes many reactions relating to carbondioxide metabolism. Zinc present in the pancreas may aid in the storage of insulin. Zn in plants could serve in the management of diabetes which results from insulin malfunction (Okaka and Okaka, 2001). The sodium content of Z. officinale rhizome was considered too low. This is an added advantage since high sodium levels intake is implicated with hypertension (Dah, 1972). Calcium is one of the major contributors for strong bones and teeths, from the present study *Z. officinale* is a good source of calcium. Normal extra cellular calcium levels are necessary for blood coagulation and for the intracellular cement substances (Okaka and Okaka, 2001).

Table 3 show results of Phytochemical screening of *Zingiber officinale* rhizome. The results obtained revealed the presence of alkaloids, saponins, flavonoids, polyphenols and reducing sugars in the aqueous extracts while cardiac glycosides, saponins, flavonoids, polyphenols and reducing sugars were present in the aqueous extracts. The results of Phytochemical screening of *Z. officinale* extract revealed the presence of saponins in aqueous extract. Saponins are heterogeneous groups of natural products with a marked hormonal activity, strong expectorant and aid in the absorption of nutrients (Rahman, 2010). The results of the Phytochemical screening of Z. officinale revealed the presence of flavonoids in aqueous extracts. Flavonoids possess antioxidant properties and ensure healthy circulation of blood. It helps to strengthen capillaries wall. The compound is sometimes referred to as phytoestrogens. Phytoestrogens are associated with relief of menopausal systems, reduction of osteoporosis, improvement of blood cholesterol levels, and lowering the risk of certain hormone-related cancers and coronary heart disease (Rahman, 2010). The phytochemical screening of *Z. officinale* rhizome also revealed the presence of polyphenols and reducing sugars this results compared favourable well with the one reported by Osabor *et al*. (2015) for cola lepidota seeds. Polyphenols have been implicated in medical circle to protect person against ageing and can inhibit cancer growth (Rahman, 2010).

Ethanolic extracts were tested against bacteria. Among the extracts, the *Z. officinale* rhizome was effective against bacteria. The antibacterial activity crude extract is shown in Table 4. The extracts showed maximum activity against *Staphylococcus aureus, Streptococcus pyogens, Klebsiella pnemonia* and *Pseudomonas aurogonosa*. These data revealed that *Z. officinale* rhizome exhibited significant antimicrobial activity. In testing, inhibition zone increased with increase in drug concentrations and thus exhibiting concentration dependent activity. The plants are the vital source of innumerable number of antimicrobial compounds. Several phytoconstituents like flavanoids (Tsuchiya *et al.,* 1996), phenolics and polyphenols (Mason and Wasserman, 1987), tannins (Ya *et al.,* 1988), terpenoids (Scortichini and Pia Rossi, 1991), sesquiterpenes (Goren, 1996) etc., are effective antimicrobial substances against a wide range of microorganisms.

H. indicum and *C. procumbens* are used for the treatment of inflammation, wound healing, antitumor and antianelgesic, hence different formulations could be prepared for clinical trials (Boominathan and Ramamurthy, 2009). It is hoped that this study would lead to the establishment of some compounds that could be used to formulate new and more potent antimicrobial drugs of natural origin. Studies are in progress to further evaluate the mechanisms of action *Z. officinale* rhizome extracts on some organisms associated with human diseases. Hence, the present study suggests that pathogenic microorganisms may become resistant to existing drugs. Moreover, this study shows that some plants show much promise in the development of phytomedicines having antimicrobial properties. In this endeavour, traditional herbal medicines must perforce be granted the benefits of modern science and technology to serve further global needs. The drugs derived from herbs may have the possibility of use in medicine because of their

antibacterial activity. With onset of scientific research in Ayurvedic system of medicine, it is becoming clearer that the medicinal herbs have a potential in today's synthetic era, as numbers of medicines are becoming resistant. According to one estimate only 20% of the plant flora has been studied and 60% of synthetic medicines owe their origin to plants. Ancient knowledge coupled with scientific principles can come to the forefront and provide us with powerful remedies to eradicate the diseases.

Table 1. Proximate composition of rhizome of *Zingiber officinale*

S. No.	Nutrients	Values (%)
1	Moisture	29.31 ± 0.45
2	Ash	4.52 ± 0.08
3	Crude fibre	9.89 ± 0.18
4	Lipid	4.15 ± 0.05
5	Crude protein	0.61 ± 0.15
6	Carbohydrate	78.89 ± 0.87

Table 2. Mineral elements composition of *Zingiber officinale* rhizome

S. No.	Mineral elements	Values (mg/100gDM)
1	Calcium	48.01 ± 0.18
2	Sodium	32.07 ± 0.27
3	Iron	27.15 ± 0.21
4	Copper	22.17 ± 0.12
5	Zinc	23.19 ± 0.37
6	Manganese	27.98 ± 0.61

Table 3: Phytochemical screening of *Zingiber officinale* rhizome

S. No	Chemical constituents	Observation
1	Alkaloids	+
2	Flavonoids	++
3	Cardiac glycoside	+
4	Tannins	-
5	Saponins	+++
6	Polyphenols	+++
7	Reducing sugars	+
8	Phlobatannius	-
9	Anthraquinone	-
10	Protein	+

-, absents; +, present;

Table 4. Antimicrobial efficacy of *Zingiber officinale* rhizome

S. No	Organism	Zone of inhibition in mm
1	*Staphylococcus aureus*	21
2	*Bacillus subtilis*	15
3	*Streptococcus pyogens*	24
4	*Pseudomonas aurogonosa*	18
5	*Klebsiella pnemonia*	22

Conclusion

Zingiber officinale rhizome contains high levels of available carbohydrates, moisture and crude fiber however, other proximate parameters such as fat, protein and ash were relatively low. The mineral elements composition revealed increased levels in calcium, manganese, copper, iron and sodium. The phytochemcial screening of *Zingiber officinale* rhizome shows the presence of cardiac ghycosides, alkaloids, saponins, flavonoids, polyphenols and reducing sugars in aqueous extracts. As a rich source Phytochemical and mineral contents *Zingiber officinale* can be considered a potential source of medicinal herb.

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