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# Antimicrobial Activity of *Zingiber officinale* (Ginger) Oil against Bacteria Isolated from Children Throat

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## Abstract

Traditional medicines became main source of primary health in different part of Sudan as result of cost effectiveness and viability of antibiotic in addition of antibiotic resistance and their side effect. Ginger oil was screened for in vitro antibacterial activity against bacteria isolated from children throat (*Streptococcus pyogenes*, *Streptococcus viridians*, *Staphylococcus aureus*, *Bacillus lichenformis*, *Bordetella pertussis*, *Corynebacterium pseudodiphtheriticum*, and *Corynebacterium ulcerans*) by disc diffusion method. Ginger oil showed significant effect to the isolated bacteria, concentration at (25µg/ml) showed highest activity to the tested bacteria while no activity was observed at concentration (6.25µg/ml).

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# Introduction

Investigation of higher plants and their extracts throw traditional medicinal plants as potential sources of antimicrobial agents old as humankind and increasing in the past two decades. (Bonjar et al., 2004) Natural products are a major source of new natural drugs and their use as an alternative medicine for treatment of various diseases has been increased in the last few decades (Vuorelaa, et al., 2004; Ansari, et al., 2006), particularly those of plants origin which are easily available and have considerably less side effects. (Khulbe and Sati. 2009)

Ginger (Zingiber) is a perennial herb belongs to Zingiberaceae family, the rhizome is part used its horizontal, branched, fleshy, aromatic, white or yellowish to brown. Leaves are narrowly, up to 20 cm long and 1.5-2 cm wide, flowers are produced in a dense spike, yellow green with purple endings. (Sharma et al., 2010)

In the fresh ginger rhizome, the gingerols were identified as the major active components and gingerol one is the most abundant constituent in the gingerol series. (Ali et al., 2008)

Nutrient Composition Fresh ginger contains 80.9% moisture, 2.3% protein, 0.9% fat, 1.2% minerals, 2.4% fiber and 12.3% carbohydrates. The minerals present in ginger are iron, calcium and phosphorous. It also contains vitamins such as thiamine, riboflavin, niacin and vitamin C. (Govindarajan, 1992)

Sudan, tropics and subtropics Africa Southeastern Asia, China, parts of Japan, Austria, and Latin America and different other places are native place of grown ginger. It was known in Germany and France in the ninth century and in England in 10th century for its medicinal properties. (Sasidharan and Nirmala, 2010) Various publications in many parts of the world have documented the medicinal and culinary values of Z. officinale. (Omoya and Akharaiyi. 2012)

The volatile oil gingerol and other pungent principles not only give ginger its pungent aroma, but are the most medically powerful because they inhibit prostaglandin and leukotriene formation, which are products that influence blood flow and inflammation. (Omoya and Akharaiyi. 2012; Longe, et al., 2005)

Ginger compounds are active against diarrhea which is leading to cause death in infant in developing countries. Moreover, it has been found that ginger is effective in treating nausea caused by sea sickness, morning sickness and chemotherapy, though it was found superior over a place for post operative nausea. (Ernst and Pittler. 2000; Sebiomo, et al., 2011)

In addition, it has been reported that the main ingredients of ginger like volatile oil, gingerol, shogaol and diarylheptanoids work as antioxidant, anti-inflammatory, anti-lipid, anti-diabetic, analgesic, antipyretic and anti-tumor . (Demin and Yingying. 2010; Sasidharan and Nirmala. 2010) Several reports had been published that describe the antibacterial and antifungal properties of different herbs and spices. However, still there is little information about the exact mechanism of their antimicrobial action. (Gur, et al., 2006; Pattaratanawadee, et al., 2006)

The antimicrobial activity of spices is due to specific phytochemicals or essential oils. (Avato et al., 2000) The main factors that determine the antimicrobial activity are the type and composition of the spice, amount used, and type of microorganism, composition of the food, pH value and temperature of the environment. (Sagdic. 2003) Ginger has strong antibacterial activity and to some extent antifungal properties. (Nielsen and Rios. 2000) In vitro studies have shown that active constituents of ginger inhibit multiplication of colon bacteria, these bacteria ferment undigested carbohydrates causing flatulence, this can be counteracted with ginger. (Gupta and Ravishankar. 2005) It inhibits the growth of *Escherichia coli, Proteus sp, Staphylococci, Streptococci and Salmonella.* (Ernst and Pittler. 2000; White. 2007)

This study aimed to determine in vitro antimicrobial activity of ginger oil, investigating its effects on inhibition of biological activity of isolated bacteria from children throat.

# Materials and Methods

Plant Material: The fresh rhizomes of (Zingiber) ginger collected from different area in Khartoum state, throat samples collected from Ear, Nose and Throat hospital (E.N.T), Khartoum state, during October 2012-March 2013.

Preparation of oil extracts: The fresh rhizomes (400g) of (Zingiber) ginger plant was coarsely powdered using mortar and pestle and put in 1000ml rounded bottom capacity flask, 1000 ml of distilled water was added and the Clevenger receiver (lighter than water) and condenser attached to the top of the flask .The essential oils were extracted by hydro distillation using a vertical hydro distillation unit. System was heated at 100° C for about 4 hours till the volume of oil above water layer at the receiver constant. Oil was pipette and dried over sodium sulphate anhydrous and a stored in dark container in a refrigerator till used.

Preparation of oil dilution (concentration): Five test tubes were prepared which contain nine ml of Dimethylsulfoxide (DMSO) in the first tube and five ml in the four test tubes. One ml of ginger oil was added in first test tube, mixed well and transferred 5ml from the first tube and added to second tube followed this procedure till the last tube to yield concentration as fellow 100µg/ml,50µg/ml,25µg/ml,12.5µg/ml and 6.25µg/ml.

Test organisms: Tested bacterial were isolated from children suffer from pharyngitis with running nostrils, cough and catarrh. Isolation and identification of bacteria done according to standard laboratory methods, (Cheesbrough, 2000) Isolated bacteria include: Gram positive coccibacteria (*Streptococcus pyogenes, Streptococcus viridians, Staphylococcus aureus*) Gram positive bacilli bacteria (*Bacillus lichenformis, Bordetella pertussis, Corynebacterium pseudodiphtheriticum* and *Corynebacterium ulcerans*).

## Antibacterial sensitivity testing

Antibacterial susceptibility testing of antibiotics was performed by disc diffusion method. (Cheesbrough, 2000) For susceptibility testing, a suspension from one-day-old bacterial cells of each isolate was prepared agar broth (2 ml) equivalent to the McFarland turbidity standard; the suspensions were spread on to the surface of the Mueller Hinton agar with sterile cotton swabs. The plates were briefly dried and then the antibiotic disks of Ginger were added to each plate and incubate over night at 37 ºC. The inhibition zone diameters measured in millimeters, with a ruler. Resistance determined by a zone of growth inhibition diameters. Greater zones of complete growth inhibition indicated the presence of susceptible strains. The procedure repeated for cultures that were defined as resistant.

# Results and discussions

This study emphasized ginger oil as having antibacterial activity in the treatment bacterial infection of children throat, antibacterial effect of ginger was evaluated by disc diffusion method.

The results showed that the ginger oil had an antimicrobial activity against tested bacteria. This is in conformity with the work of previous studies by some other authors. (Akoachere et al., 2002; Malu et al., 2008; Yu et al., 2009; Gao and Zhang, 2010; Sebiomo et al., 2011; Gull et al., 2012). Furthermore, other studs elsewhere in line with our founding, reported that ginger essential oils exhibited an inhibitory effect against a wide range of pathogenic bacteria and fungi, and their effect was probably due to their main components of oil. (Baratta et al., 1998; Senhaji et al., 2007; Ali et al., 2005)

The antimicrobial activity of ginger may be attributed to the fact that it contains antimicrobial substances such as zingiberol, zingiberine and bisabolene. (Michael. 1999; Melvin et al., 2009)

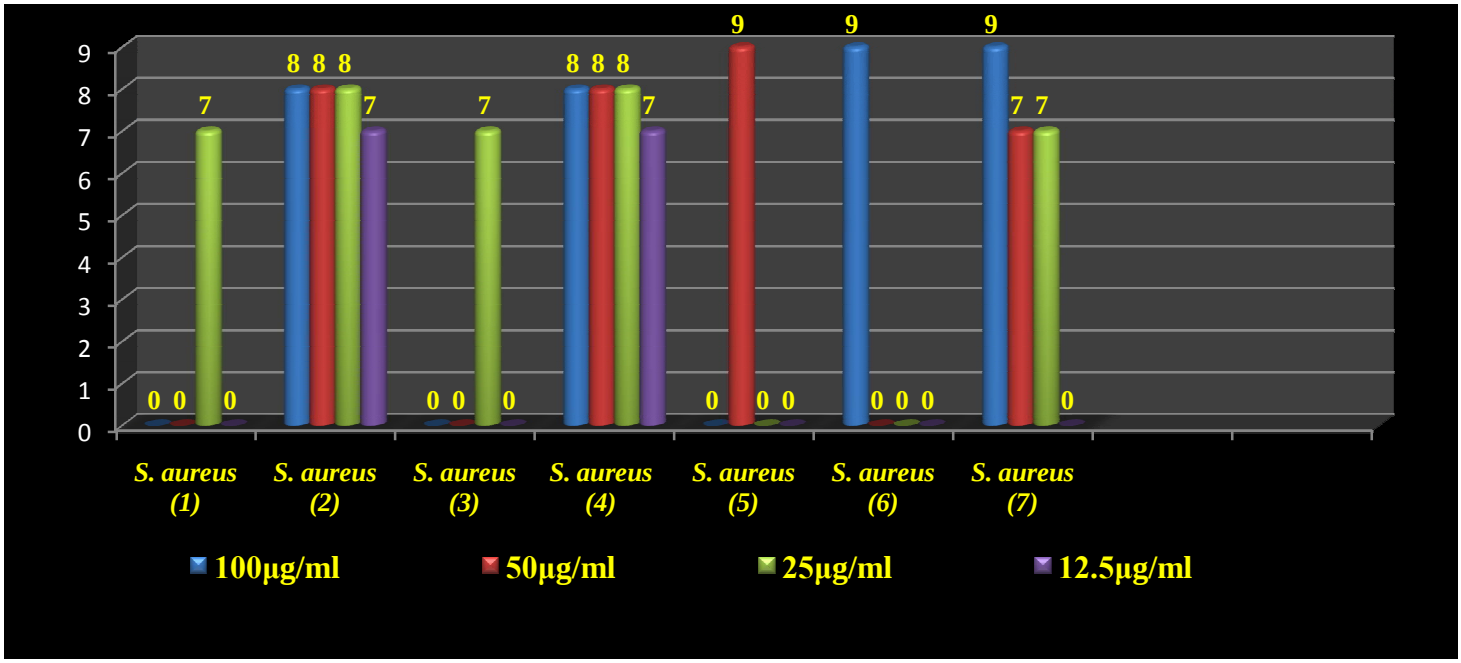
Ginger oil showed considerable activity against seven isolated *S. aureus*, no activity was observed at concentration (6.25µg/ml), S. aureus(1, 3, 6) showed sensitivity to only one concentration (25µg/ml, 25µg/ml, 100µg/ml) respectively. Concentration at (25µg/ml) showed highest activity to tested bacteria. (figure. 1)Our results corroborate by (Kamal and Dhruva. 2013), who founded that, ginger oil showed strong antibacterial activity against *Staphylococcus aureus*. Similarly to (Pattaratanawadee et al., 2006; Sebiomo et al., 2011) found ginger ethanolic extracts inhibit the growth of *S. aureus* and *E. coli.* In contrast, study by (Melvin et al. 2009)also reported, ginger showed moderate antimicrobial activity against *S. aureus.*

*Streptococcus pyogenes* are the most frequently isolated pathogen in pharyngitis among school going children worldwide, *S. pyogenes* (no. 2) was the most sensitive isolated to the ginger oil, it showed activity to all oil concentration, and highest activity to three isolate observed at (100µg/ml) while lowest was detected in (6.25µg/ml). Maximum inhibition zone size was (12mm) measure with *S. viridans* (no. 2) at concentration (6.25µg/ml), while *S. viridans* (no. 1, 3) showed variable sensitivity.(figure. 2)

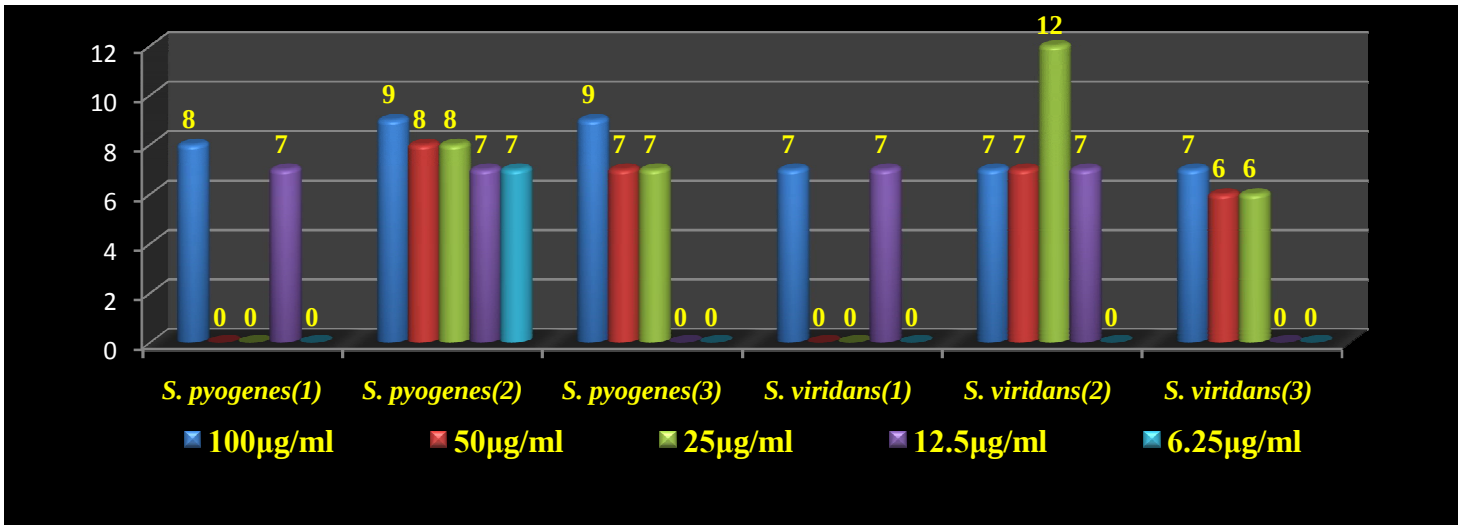
(Suhad et al., 2012) evaluated the antibacterial activity in the ginger against different pathogenic bacteria include *Streptococcus pyogenes* and *Staphylococcus aureus*, founded that, latest concentration (0.4mg/ml) of the extract gave highest activity against tested bacteria which in agree with our result.

Among the pathogenic non diphtheria *Corynebacterium, Corynebacterium pseudodiphtheriticum* has rarely been reported to cause disease in humans, despite its frequent presence in the flora of the upper respiratory tract. (Clarridge et al., 1995; Austrian. 1992)

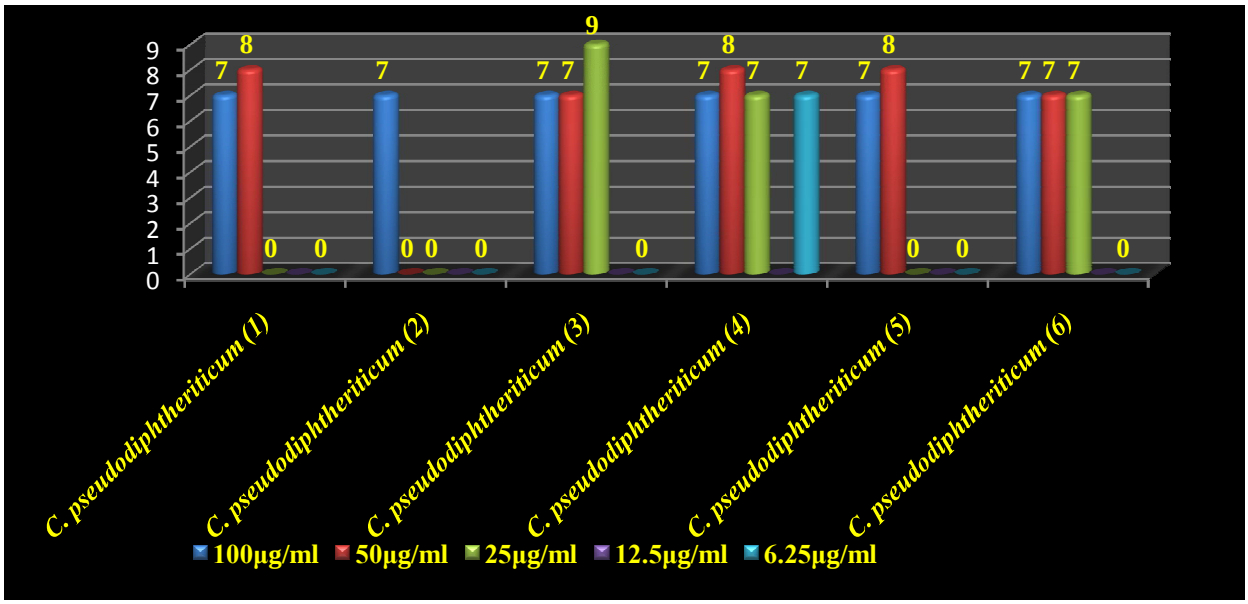
*C. pseudodiphtheriticum* because of its resemblance with *C. diphtheriae* was difficult to differentiating immediately. Different concentration of Ginger oil was tested against Six isolated of *C. pseudodiphtheriticum*, there was no activity detected at (25µg/ml, 6.25µg/ml) except in isolated (no. 4). Best antibacterial activity observed at concentration (50µg/ml).*C. pseudodiphtheriticum* (no.2) showed sensitivity to (100µg/ml) only. (figure. 3), *C. ulcerans* and *B. lichenformis* did not show suitability at concentration (12.5µg/ml, 6.25µg/ml). (figure. 4)



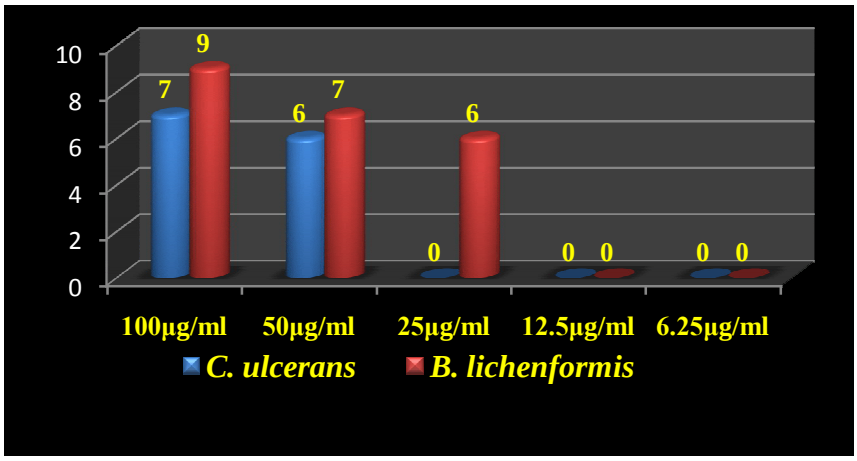

*(figure.1) Antimicrobial activity of Ginger oil against S. aureus*




*(figure.2) Antimicrobial activity of Ginger oil against S. pyogenes and S. viridans*




*(figure.3) Antimicrobial activity of Ginger oil against C. pseudodiphtheriticum*




*(figure.4) Antimicrobial activity of Ginger oil against C. ulcerans and B. lichenformis*

# Conclusion

Ginger (Zingiber), an important medicinal plant, is one of the most widely cultivated species of the family Zingiberaceae. Ginger oil showed varying degrees of antimicrobial activity on the microorganism tested. Further work is needed to investigate more pharmacological from extract in order to support antimicrobial activity of ginger. Further clinical evaluation of ginger in vivo experiments is required to be carried for low cost treatment with few side effects and for prevention of recurrent infection. Our study result emphasizes the usefulness of ginger in the treatment of throat bacterial infection.

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