Comparison study of ginger (*Zingiber officinale*) and selected antibiotics against infectious bacteria

M. A. Jasim
College of Education for Women\ Al-Anbar University

Abstract

This study aimed to compare inhibitory activity of Ginger (*Zingiber officinale*) and selected antibiotics (Amikiacin, Cefoxitin, Streptomycin, Chloramphenicol and Ampicillin) against local virulent bacteria obtained from Al-Ramadi teaching hospital (*Escherichia coli*, *Pseudomonas aeruginosa*, *Staphylococcus aureus*, *Proteus spp.*, *Bacillus subtilis*). The results showed that approved previous studies as ginger having antibacterial potency able to establish valuable inhibition zones *in vitro*. Ginger demonstrated varied inhibitory zones on all the test bacterial organisms while bacterial test organisms resistant to two of five antibiotics. Ginger Extract at concentration (50 mg/ml) showed an inhibition zone against *Staph. aureus* (37 mm) exceeded the used antibiotics in these study.

دراسة مقارنة لتأثير المستخلص المائي لنبات الزنجبيل ومضادات الحيوية مختارة ضد مجموعة من البكتريا الممرضة

محمد عباس جاسم
كلية التربية للبنات/ جامعة الأنبار

الخلاصة

استهدفت الدراسة مقارنة التأثير المثبط لنبات الزنجبيل (*Zingiber officinale*) ومضادات حيوية مختارة (أميكاسين، سيفوكسيتين، ستربتومايسين، كلورامفينيكول والأمبسيلين) ضد بكتريا مرضية تم الحصول عليها من مستشفى الرمادي التعليمي (*Escherichia coli*، *Pseudomonas aeruginosa*، *Staphylococcus aureus*، *Proteus spp*، *Bacillus subtilis*). أكدت النتائج إمكانية استخدام زنجبيل كمضاد بكتيري مع اختلاف قدرة التثبيط مختبرياً إذ اختلفت قدرة الزنجبيل باختلاف التراكيز المستخدمة بمناطق تثبيط متباينة كانت أحياناً أعلى مقارنة بالمضادات المستخدمة في حين أظهرت جميع عزلات البكتريا المستخدمة مقاومة لنوعين من مضادات الحيوية المستخدمة هما سيفوكسيتين والأمبسيلين. أبدى المستخلص المائي للزنجبيل (50 ملغم/ مل) تأثيراً الجنس البكتيري *Staphylococcus aureus* فاق جميع المضادات الحيوية المستخدمة في هذه البحث.

Introduction

Medicinal plants has a great contribution in recent medical and synthetic production as a major source of drugs, it has been used as precursors for different medicinal chemicals or as herbal derived drugs, the active plant ingredients that used as drugs are alkaloids, glycosides, volatile oils, tannins, resins, saponins …etc. These days herbal plants used regularly because its use has no side effects or may have a less side effects in humans when compared to synthetic (chemical) drugs, on the other hand it was the cure for wide spectrum of known diseases and to control microorganisms. Ginger is the root or rhizome of tropical, Latin Americans grow much of their own ginger, Indonesia, Thailand and Taiwan, being the major producers. Hawaii produced nearly 4000 tons in 1989, worth nearly 6 million dollars, Fiji was the major source of U.S. imports, followed by China and Brazil (1). Some reports are available on the anti-microbial property of the volatile oil from the rhizomes of ginger. It was studied for antimicrobial

activity against *Lactobacillus acidophilus* and *Bacillus cereus*, Antimicrobial activity of the oils against *Pseudomonas aeruginosa*, *Bacillus subtilis*, *Enterococcus faecalis*, *Morganella morganii*, *Providencia* sp, *Escherichia coli*, *Klebsiella pneumoniae*, *Proteus mirabilis* and *Proteus vulgaris*, *Salmonella typhi*, *Shigella dysenteriae; Candida albicans*, was assessed by disc diffusion method and results obtained are comparable with the reference compounds as determined by paper agar diffusion method (1, 2, 3, 4, 5, 6, 7). *In vivo, In vitro* and some clinical evidences about ginger's anti-allergic, antiemetic, anti-hepatotoxic, anti-inflammatory, anti-nauseate, anti-oxidant, anti-parasitic, anti-platelet, anti-pyretic, anti-septic, cardiovascular, digestive, and hypoglycemic activities were cited by (8). Chinese are using ginger as spice and for different diseases cure. The bruised leaves are used as a digestive stimulant and for bruise. Sprouts are used for diarrhea, dysentery, marasmus, and worms. They also use the root for alopecia, bleeding, cancer, cholera, colds, congestion, diarrhea, dropsy, rheumatism, dysmenorrhea, nausea, snakebite, stomachache, and toothache (1), Ginger starch were take part in enhancing honey antibacterial activity (9). Opportunistic bacteria are generally harmless unless they enter the body through a cut or other wound, and even then they often cause only minor skin problems in healthy people for example *Escherichia coli* which is a wide spreaded intestinal commensal organism found in human and animal, resulting from fecal contamination or contamination during animal slaughter. *Staphylococcus aureus* resisting the action of practically all antibiotics, *Pseudomonas aeruginosa* considered as one of the most resistant bacteria with a wide infectious range (10, 11, 12).

Materials and Methods

- **Microorganisms:** Bacterial isolates isolated from patients and classified using protocols of classification.
- **Plant materials:** Fresh ginger rhizomes obtained from traditional market, then prepared to extraction by chopping and grinding using grinder.
- **Aqueous extraction:** 18 g of dry and powdered ginger were added to 200 ml of distilled water, then mixed using magnetic stirrer for 1h in room temperature, mixture separated using centrifuge at 3000 rpm for 15 min, supernatant collected and dried using oven at 40̊c (13).
- **Preparation of ginger concentrations:** As stock solution, 1g of dry aqueous extract were added to 10 ml of sterilized distilled water and mixed for 10 min at magnetic stirrer. Then desirable solutions made (25 mg/ml, 50 mg/ml, 75 mg/ml, and 100 mg/ml).
- **Ginger antibacterial activity test:** Antibacterial activity tested *against E. coli, P. aeruginosa, Staph. aureus, Proteus sp.* and *B. subtilis*. 4-5 colonies of pure culture of each isolates transferred to nutrient broth tubes and incubated at 37̊c for 1h. After incubation period, 0.1 ml of each isolate inoculate and spread on nutrient agar plates, extract discs (Whatman No. 1 filter paper discs) applied, plates incubated for 24h and inhibition zone of measured (14).
- **Antibiotics susceptibility test:** Antibacterial activity tested against *E. coli, P. aeroginosa, Staph. aureus, Proteus sp., & B. subtilis*. 4-5 colonies of pure culture of each isolates transferred to nutrient broth tubes and incubated at 37̊c for 1h. After incubation period, 0.1 ml of each isolate inoculate and spread on nutrient agar plates, antibiotic discs applied, plates incubated for 24h and inhibition zone of measured.

Results and Discussion

Inhibitory activity of aqueous ginger extract studied and the results (Fig. 1) showed that all concentrations have the ability to inhibit bacterial growth with differences of activity between studied isolates and concentrations as below:

The concentration 25 mg/ml inhibits the growth of *P. aeruginosa, Proteus spp., E. coli, B. subtilis, and Staph. aureus* with inhibition zone 11.7 mm, 9.2 mm, 4.5 mm, 6.2 mm and 11 mm respectively. At 50 mg/ml of ginger aqueous extract concentration the results showed that the activity was better than 25 mg/ml, inhibition zone for *P.*

aeruginosa, Proteus spp., E. coli, B. subtilis, and Staph. aureus was 12.2 mm, 11.5 mm, 7.2 mm, 9.5 mm and 37 mm respectively. Concentration 75 mg/ml of ginger aqueous extract showed differences with 25 mg/ml and 50 mg/ml, it gave good activity against *P. aeruginosa, Proteus spp., E. coli, B. subtilis, and Staph. aureus* it gave an inhibition zone 12.2 mm, 9.7 mm, 11.7 mm, 5.7 mm, 11 mm respectively. Aqueous extract of ginger 100 mg/ml was active against studied isolates, inhibitions zone for *P. aeruginosa, Proteus spp., E. coli, B. subtilis, and Staph. aureus* was 9.7 mm, 9.7 mm, 14 mm, 5 mm, 10.7 mm.

- **Antibacterial sensitivity test:** Antibiotics with a wide range use recent days were used for this test, these antibiotics were Amikiacin, Cefoxitin, Streptomycin, ampicillin and Chloramphenicol. Fig. 2 showing inhibition results: Amikiacin, Streptomycin and Chloramphenicol had good activity against *B. subtillis*, zone of inhibition was 35 mm, 40 mm, 30 mm respectively. These three antibiotics had also an activity against *P. aeruginosa* with an inhibition zone 30 mm, 25 mm, 30 mm respectively. Amikiacin, Streptomycin and Chloramphenicol had less activity towards *E. coli* with an inhibition zone 25 mm, 20 mm, and 15 mm respectively. Also they showed an activity against Proteus spp., which was 30 mm, 30 mm, 32.5 mm respectively, and against *Staph. aureus* these antibiotics gave an inhibition as 30 mm, 20 mm, and 20 mm respectively. Amikacin and Streptomycin have a good activity as antibacterial agent as its mechanism of action which it affect ribosomal subunit 30S specialized with ribosomal activity and protein production leading to bacterial death, while Chloramphenicol conjugate with ribosomal subunit 50S and complex leading to prevent peptide chain production. On the other hand, Cefoxitin and ampicillin had no antibacterial activity against studied isolates which are resistant to these two antibiotics.

Conclusions, Obtained results in this study approved previous studies as ginger (*Z. officinale*) having antibacterial potency able to establish valuable inhibition zones in vitro. Ginger demonstrated varied inhibitory zones on all the test bacterial organisms while bacterial test organisms were not susceptible to two antibiotics as they persist resistance. Ginger Extract (50 mg/ml) showed an inhibition zone against *Staph. aureus* (37 mm) which exceeded used antibiotics in these study.

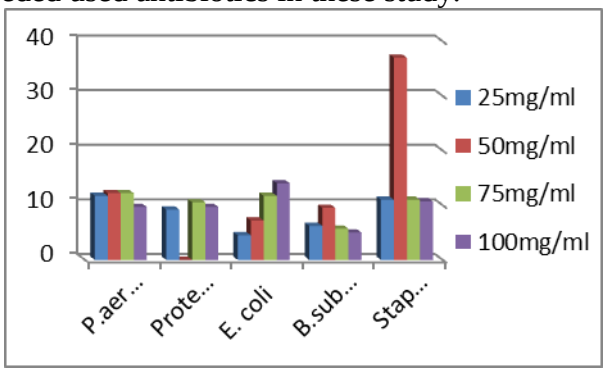

Fig. (1) Inhibition activity of aqueous ginger extract against bacteria

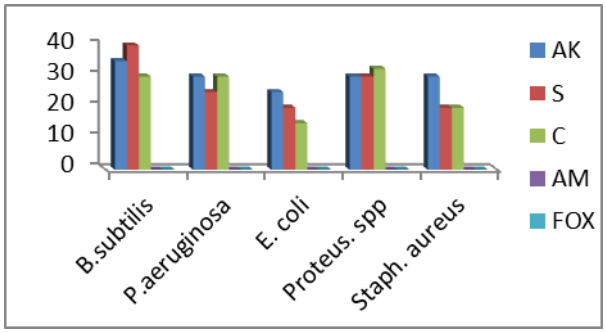

Fig. (2) Susceptibility of bacterial isolates to antibiotics (AK= Amikiacin, S=Streptomycin, C=Chloramphenicol, AM= Ampicillin, FOX=Cefoxitin)

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