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RESEARCH ARTICLE

Antibacterial Effect of *Cinnamomum zeylanicum* and *Curcuma longa* Extracts and their Synergistic Effect with Antibiotic Sulfamethoxazole

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ABSTRACT

Study focused on evaluation of antibacterial effect of *Cinnamomum zeylanicum* and Curcuma longa extracts and their synergistic effect with antibiotic Sulfamethoxazole. Antimicrobial activity of plant extracts against *Escherichia coli*. *C. longa* was showed the highest effect against *E. coli* with a zone of inhibition 13 and 14.5 mm.at a concentration of 100 and 200 mg/mL, respectively. Antimicrobial activity was observed by *C. zeylanicum*, with a zone of inhibition 9 and 13.9 mm at a concentration of 100 and 200 mg/mL, respectively. *C. longa* was showed the highest effect against Staphylococcus aureus with a zone of inhibition 11 and 16.8 mm at a concentration of 100 and 200 mg/mL, respectively. No antimicrobial activity was observed by *C. zeylanicum*, at a concentration of 100 mg/mL and a zone of inhibition 10 mm at a concentration of 200 mg/mL, antibiotic activity of Sulfamethoxazole (50 mg and 100 mg) against *S. aureus* and *E. coli* activity was observed by Sulfamethoxazole, which showed the strongest activity against *S. aureus* and *E. coli* with a zone of inhibition 17 and 18.5 mm at a concentration of 50 mg, respectively. While was zone of inhibition using Sulfamethoxazole (100 mg)19.2 and 21 mm. against *S. aureus* and *E. coli*. respectively. We evaluated in vitro synergism between extracts of *Cinnamomum Zeylanicum* and *Curcuma longa* extracts and antimicrobial drugs utilized against *S. aureus* and *E.coli* using well diffusion method, was *C. zeylanicum* extract has the best synergistic effect on *E. coli* when added on Sulfamethoxazole. As for Sulfamethoxazole, it has been the highest effect on bacteria when add *C. zeylanicum* extract (20 mm) and also when add *C. longa* extract (21 mm). *C. zeylanicum* extract has the best synergistic effect on *S. aureus* when added on Sulfamethoxazole. As for Sulfamethoxazole, it has been the highest effect on bacteria when add *C. zeylanicum* extract (19.6 mm) and also when add *C. longa* extract (21.2 mm).

Keywords: Antibacterial, *Cinnamomum zeylanicum*, Curcuma longa, Sulfamethoxazole

INTRODUCTION

Antibiotics can be described as a compound that works to either stop bacteria from growing (bacteriostatic agents) or by killing them entirely (bactericidal agents) (Sommer and Dantas, 2011). The WHO has listed seven bacteria of international concern; *Klebsiella pneumoniae*, *Escherichia coli*, *Staphylococcus aureus*, non-typhoidal *Salmonella, Neisseria gonorrhoeae, Shigella* species, and *Streptococcus pneumoniae* (Chaudhary, 2016). Medicinal plants are abundant in phytochemicals such as flavonoids, terpenoids, glycosides, and alkaloids, which have remedial antimicrobial potential (Ullah *et al*., 2017).

Several studies have reported the broad-spectrum antimicrobial activity for curcumin including antibacterial, antiviral, antifungal, and antimalarial activities. Due to the extended antimicrobial activity of curcumin and safety property even at high doses (17 g/day) assessed by clinical trials in human, it was used as a structural sample to design the new antimicrobial agents with modied and increased antimicrobial activities through the synthesis of various derivatives related to curcumin (Anand *et al*., 2007). Curcumin finished wool had semidurable antimicrobial activity, less durable to

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light exposure than home laundering with 45% and 30% inhibition rates against *S. aureus* and *E. coli*, respectively, after 30 cycles of home laundering (Han and Yang, 2005).

The antibacterial study on aqueous extract of Curcuma longa rhizome demonstrated the MIC value of 4–16 g/L and minimum bactericidal concentration value of 16–32 g/L against *Staphylococcus epidermis*, *S. aureus*, *Klebsiella pneumonia*, and *E. coli* (Niamsa and Sittiwet, 2009). The methanol extract of turmeric revealed MIC values of 16 µg/mL and 128 µg/mL against *Bacillus subtilis* and *S. aureus*, respectively (Ungphaiboon *et al*., 2005).

The renewed interest in medicinal plants allowed researchers to investigate the antibacterial potential of some spices of medicinal background dating back to thousands of years, such as cinnamon bark. It was published that the essential oils of *Cinnamomum cassia* (bark) showed remarkable inhibitory effect against thee MDR-pathogens, namely, *E. coli*, *Pseudomonas aeruginosa*, and *S. aureus*; moreover, it was observed that there is a considerable synergistic inhibition of that essential oil with *streptomycin* (El Atki *et al*., 2019). The essential oils and cinnamaldehyde extracted from *Cinnamomum zeylanicum* showed good antibacterial activities against seven Gram-negative and nine Gram-positive fish pathogenic bacteria and recommended as a safe alternative to control bacterial infections in aquaculture (Pathirana *et al*., 2019). The main aim of this project was the characterization of natural products for *C. zeylanicum* and *C. longa* as antibacterial agents and their synergistic effect with Antibiotic Sulfamethoxazole.

MATERIALS AND METHODS

The plant materials used in this study consisted of *C. zeylanicum* and *C. longa* which are find in Iraq. These plants collected from different area in Local markets/Baghdad city in November of 2021 [Table 1]. After that, it was cleaned and isolated from foreign materials, crushed by an electric mill, and then, the powder was collected in plastic polythene bags and kept in the laboratory at room temperature until use.

Microbial Pathogens used for Antimicrobial Activities

The pathogenic microorganisms were used as a reference strains for testing the antimicrobial activities are listed in Table 2. Bacterial species selected for the study were one Gram-positive *S. aureus* and one Gram-negative *E. coli*.

All the cultures of Pathogenic strains were maintained on Brain Heart Infusion (BHI) agar medium (HiMedia) at 4°C for further experiments. The cells were inoculated and incubated at 37°C in Mueller–Hilton broth for 12 h before the screening procedure.

Culture Media

Types of media were required for carrying out this study, BHI broth, MacConkey agar, Nutrient agar, Mannitol Salt Agar, and Mueller–Hinton agar (MHA) (HiMedia), according to (Atlas *et al*., 2004; Jawtez *et al*., 2010).

Antibiotic

Antibiotic used include: Sulfamethoxazole, Table 3 shows antibiotic potency.

Preparation of Aquatic Extracts for Antimicrobial Activity

C. zeylanicum and *C. longa* were collected from Local markets/Baghdad city. Dried plants were grinded

Table 1: Plant materials used in this study

Plant	Part used	Place	Time of collection
Cinnamomum zeylanicum	Bark	Local markets/ Baghdad city	November
Curcuma longa	Rhizomatous	Local markets/ Baghdad city	November

Table 2: Microorganisms used in this study

Strains	Source
Staphylococcus aureus	Al-Nahrain university, college of Biotechnology
Escherichia coli	Al-Nahrain university, college of Biotechnology

Table 3: List of antibiotic

Antibiotic	Antibiotics Con.	Company/Origin
Sulfamethoxazole	30 µg	Samarra/Iraq

and prepared for extraction. For aqueous extraction, a quantity of 1 g of dried powder (*C. zeylanicum* and *C. longa*) were mixed with 25 mL distilled water. The mixture was left in oven at 45°C for 24 h [Figure 1]. Preparation of plant extracts standard concentrations. One g of each aqueous extract (dry) was taken and the aqueous extract was dissolved in 100 mL sterile distilled water. Then filtered by filter paper Wattman, No. 1, the supernatant was collected at an interval of 2 h, we have a stock solution and concentration to 100 and 200 mg/mL and then used as antimicrobial activity (Almola, 2010).

Antimicrobial Activity by Well Diffusion Method Assay

The antimicrobial activity of *C. zeylanicum* and *C. longa* extracts was tested using the agar well diffusion method against bacteria *S. aureus* and *E. coli*. An inoculum suspension was swabbed uniformly to solidified 20 mL MHA for bacteria and the inoculum was allowed to dry for 5 min. Holes of 6 mm in diameter were made in the seeded agar using Glass Pasteur pipettes. Aliquot of 20 µL from each plant crude extract (100, 200 mg/mL) was added into each well on the seeded medium and allowed to stand on the bench for 1 h for proper diffusion and thereafter incubated at 37°C for 24 h. The resulting inhibition zones were measured in millimeters (mm). (Obeidat *et al*., 2012).

Synergistic Effect of Plant Extract with Antibiotics against Bacteria Pathogens

The bacterial cultures were grown in Mueller–Hinton broth at 37°C. After 4 h of growth, each bacteria were inoculated on the surface of MHA plates. Subsequently, the antibiotic and Sulfamethoxazole (50 mg) were placed on the surface of each inoculated plate and then added 20 µL of plant extract at a concentration of 200 mg/mL, to identify synergies effect between the plant extract and antibiotics, while to identify synergies between the plant extract and antibiotics, 20 µL of antibiotics, and 20 µL of plant extracts were mixed and put together on a filter paper disk which was left for 1 h to dry. The plates were incubated at 37°C for 24 h. The diameters of clearing zones were measured.

RESULTS AND DISCUSSION

Against *Escherichia coli*

The results in Table 4 revealed that the well diffusion method evaluated the antimicrobial activity of plant extracts against *E. coli*. *C. longa* was showed the highest effect against *E. coli* with a zone of inhibition 13 and 14.5 mm at a concentration of 100 and 200 mg/mL, respectively. Antimicrobial activity was observed by *C. zeylanicum*, with a zone of inhibition 9 and 13.9 mm at a concentration of 100 and 200 mg/mL, respectively, as shown in Table 4.

Against *S. aureus*

The results in Table 5 revealed that the well diffusion method evaluated the antimicrobial activity of plant extracts against *S. aureus*. *C. longa* was showed the highest effect against *S. aureus* with a zone of inhibition 11 and 16.8 mm at a

Figure 1: *Cinnamomum zeylanicum* and Curcuma longa

Table 4: Antimicrobial activity of *C. zeylanicum* and *C. longa* extracts by well diffusion method against *Escherichia coli*

Concentration of extracts (mg/mL)	Inhibition zone (mm) by *C. zeylanicum* extracts	Inhibition zone (mm) by *C. longa* extracts
100	9	13
200	13.9	14.5

C. zeylanicum: Cinnamomum zeylanicum, C. longa: Curcuma longa

Table 5: Antimicrobial activity of *C. zeylanicum* and *C. longa* extracts by well diffusion method against *Staphylococcus aureus*

Concentration of extracts (mg/mL)	Inhibition zone (mm) by *C. zeylanicum* extracts	Inhibition zone (mm) by *C. longa* extracts
100	No inhibition zone	11
200	10	16.8

C. zeylanicum: Cinnamomum zeylanicum, C. longa: Curcuma longa

concentration of 100 and 200 mg/mL, respectively. No antimicrobial activity was observed by *C. zeylanicum*, at a concentration of 100 mg/mL and a zone of inhibition 10 mm at a concentration of 200 mg/mL, as shown in Table 5.

The medicinal value of plants lies in some chemical substances that produce a definite physiological action on the human body. These phytochemicals are the active constituents that exhibit some biological activities concerning antioxidant, antimicrobial, anti-inflammatory, and anticancer activities (Goyal *et al*., 2007). The most important phytochemicals are alkaloids, flavanoids, and tannins and some other phenolic compounds which are abundantly found in plants (Duraipandiyan *et al*., 2006).

Plants as a source 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 (Kirbag *et al*., 2009).

Antimicrobial agents are the important chemicals that are widely used in modern medical practice thanks to their disease treatment features by eliminating or killing the infecting microorganisms. There are a various number of antimicrobial agents currently available. When selecting for a particular antimicrobial agent, its selective toxicity must be evaluated.

Mohamed *et al*., in 2010, evaluated the chemical constituents and biological activities of Artemisia herba-alba. Only the essential oil was found to be active against some Gram-positive bacteria (Streptococcus hemolyticus and *S. aureus*) and Gram-negative bacteria (*E. coli*, *Shigella sonnei*, and *Salmonella* Typhosa).

Abubakar (2010). Studied evaluated plants as antibacterial use crude leaf extracts of Eucalyptus camaldulensis against some pathogenic bacteria, was least activity in terms 25 of zones of growth inhibition was shown by aqueous extract against *E. coli* (7 mm), *K. pneumoniae* (9 mm), *Proteus mirabilis* (13 mm), *Salmonella* Typhi (12 mm), and *S. aureus* (12 mm), while the highest was demonstrated by the acetone, with a recorded zone diameter for *E. coli* (12 mm), K. pneumoniae (13 mm), S. Typhyi (14 mm), P. mirabilis (15 mm), and *S. aureus* (14 mm) (Abubakar, 2010). Development of bacterial resistance to the available antibiotics and increasing popularity of traditional medicine has led researchers to investigate the antibacterial compounds in plants. *C. longa* is a medicinal plant that botanically is related to Zingiberaceae family (Chattopadhyay *et al*., 2004). *C. longa*, commonly known as "turmeric," is widely used as a spice and coloring agent and is well known for its medicinal properties (Luthra *et al*., 2001). Components of turmeric are named curcuminoids, which include mainly curcumin (diferuloyl methane), demethoxycurcumin, and bisdemethoxycurcumin (Chainani-Wu, 2003). Curcumin is the most important fraction which is responsible for the biological activities of turmeric. The melting point of curcumin, C2H2OO6 is 184°C. It is soluble in ethanol and acetone, but insoluble in water (Joe *et al*., 2004). Curcumin 95%, a potent antioxidant, is believed to be the most bioactive and soothing portion of the herb turmeric and possess the properties such as antioxidant, anti-inflammatory, anti-platelet, cholesterol-lowering antibacterial, and anti-fungal effects. It contains a mixture of powerful antioxidant phytonutrients known as curcuminoids and inhibits cancer at initiation, promotion, and progression stages of tumor development. It is a strong anti-oxidant, which supports colon health, exerts neuroprotective activity, and helps to maintain a healthy cardiovascular system (Luthra *et al*., 2001).[1-10]

C. longa oil was tested against cultures of *Staphylococcus albus*, *S. aureus*, and *Bacillus typhosus*, inhibiting the growth of *S. albus* and *S. aureus* in concentrations up to 1–5,000 (Chopra *et al*., 1941). Many *C. longa* species are traditionally used for their medicinal properties. Antifungal, antibacterial, and anti-inflammatory activity have been reported for species such as *C. longa*, *Curcuma*

zedoaria, Curcuma aromatic, and *Curcuma amada* (Yoshioka *et al*., 1998; Negi *et al*., 1999; Majumdar *et al*., 2000). It is evident from the results that *B. subtilis* was the most sensitive organism to *C. longa* extract of curcuminoid and oil. Wilson *et al*. (2005) reported that antibacterial activity of ethanol extract of *C. zedoaria* (0.15 mg/mL) and *Curcuma malabarica* (0.94 mg/mL) showed higher inhibition against *B. subtilis* and their ethanol extracts were effective only at higher concentration of 3.75 mg/well. Both the species of turmeric gave MIC against B. subtilis was 8.0 mm in diameter. In has been reported that Gram-positive bacteria are more sensitive to plant oil and extract (Karaman *et al*., 2003). Alzoreky and Nakahara (2003) studied that among Gram-positive bacteria, *Bacillus cereus* was the most sensitive organism to *C. longa* extract and its ethanol extract gave MIC 12.0 mm in diameter. Eloff (2001) reported antibacterial activities against *S. aureus*, *P. aeruginosa*, *E. coli*, and *Enterococcus faecalis* using acetone extracts of bark and leaves of *Sclerocarya birrea* with MIC values from 0.15 to 3 mg/mL.

Evaluation of antibiotics activity against Bacteria pathogens

The results in Table 6 revealed that the well diffusion method evaluated the antibiotic activity of Sulfamethoxazole (50 mg and 100 mg) against *S. aureus* and *E. coli*. activity was observed by Sulfamethoxazole, which showed the strongest activity against *S. aureus* and *E. coli* with a zone of inhibition 17 and 18.5 mm at a concentration of 50 mg, respectively. While was zone of inhibition using Sulfamethoxazole (100 mg) 19.2 and 21 mm. against *S. aureus* and *E. coli*. respectively. We evaluated *in vitro* synergism between extracts of *Cinnamomum Zeylanicum* and *Curcuma longa* extracts and antimicrobial drugs utilized against *S. aureus* and *E.coli* using well diffusion method, was *C. zeylanicum* extract has the best synergistic effect on *E. coli* when added on Sulfamethoxazole, as shown in Table 6.

Table 6: Evaluation of Sulfamethoxazole activity against *S. aureus* and *E. coli* by well diffusion method

Concentration of Sulfamethoxazole (mg)	Inhibition zone (mm) of *S. aureus*	Inhibition zone (mm) of *E. coli*
50	17	18.5
100	19.2	21

S. aureus: Staphylococcus aureus, E. coli: Escherichia coli

Sulfamethoxazole is a bacteriostatic sulfonamide antibiotic that interferes with folic acid synthesis in susceptible bacteria. It is generally given in combination with trimethoprim, which inhibits a sequential step in bacterial folic acid synthesis – these agents work synergistically to block two consecutive steps in the biosynthesis of nucleic acids and proteins which are necessary for bacterial growth and division, and using them in conjunction helps to slow the development of bacterial resistance. In this combination, sulfamethoxazole is useful for the treatment of a variety of bacterial infections, including those of the urinary, respiratory, and gastrointestinal tracts.

Trimethoprim and sulfamethoxazole inhibit different enzymatic steps of the folic acid pathway, leading to cessation of bacterial synthesis of thymidine monophosphate (dTMP) through thymidylate synthase. However, the antimicrobial activity of folic acid antagonists such as SXT can be antagonized by bacterial utilization of thymidine.

Various bacteria have the ability to use an alternative pathway by uptake of extracellular thymidine and subsequent intracellular phosphorylation to dTMP by thymidine kinase. Thymidine is expected to be abundant in the airway secretions of CF patients due to the presence of necrotic cells that release DNA, which, in turn, can be catabolized through dTMP to thymidine.[11-25]

Failure rates of SXT therapy are high, in particular in the presence of necrotic cells. Recently, we demonstrated that the *in vitro* combination of SXT and a nucleoside analog showed significantly improved antimicrobial activity against *S. aureus* in the presence of thymidine because nucleoside analogies such as 5-iodo-2'-deoxyuridine (IdUrd) inhibit bacterial thymidine utilization (Zander *et al*., 2010).

Synergistic Effect of Plant Extract with Antibiotic Sulfamethoxazole against Bacteria Pathogens

Aqueous extract increase the impact of antibiotics on the bacteria when it is added on them. The

bacterial cultures were grown in Mueller–Hinton broth at 37°C. After 4 h of growth, each bacteria was inoculated on the surface of MHA plates.

Subsequently, the antibiotic Sulfamethoxazole (50 mg) was placed on the surface of each inoculated plate and then added 20 µL of plant extract at a concentration of 200 mg/mL, to identify synergies effect between the plant extract and antibiotic Sulfamethoxazole. The Synergistic Effect between plant extract and antibiotic, We evaluated in vitro synergism between extracts of *C. zeylanicum* and *C. longa* extracts and antimicrobial drugs utilized against *S. aureus* and E.coli using well diffusion method.

Against *E. coli*

C. zeylanicum and *C. longa* extracts and antibiotics as shown in Table 7. *C. zeylanicum* extract has the best synergistic effect on *E. coli* when added on Sulfamethoxazole. As for Sulfamethoxazole, it has been the highest effect on bacteria when add *C. zeylanicum* extract (20 mm) and also when add *C. longa* extract (21 mm).

Against *S. aureus*

C. zeylanicum and *C. longa* extracts and antibiotics are as shown in Table 8. *C. zeylanicum* extract has the best synergistic effect on *S. aureus* when added on Sulfamethoxazole. As for Sulfamethoxazole, it has been the highest effect on bacteria when add *C. zeylanicum* extract (19.6 mm) and also when add *C. longa* extract (21.2 mm).

Table 7: Synergism between antibiotic sulfamethoxazole and *C. zeylanicum* and *C. longa* extracts against *E. coli*

Synergism between antibiotics and plant extracts	Inhibition zone (mm) of *E. coli*
C. zeylanicum extract with Sulfamethoxazole	20
C. longa extract with Sulfamethoxazole	21

C. zeylanicum: Cinnamomum zeylanicum, C. longa: Curcuma longa, E. coli: Escherichia coli

Table 8: Synergism between antibiotic sulfamethoxazole and *C. zeylanicum* and *C. longa* extracts against *S. aureus*

Synergism between antibiotics and plant extracts	Inhibition zone (mm) of *S. aureus*
Cinnamomum zeylanicum extract with Sulfamethoxazole	19.6
Curcuma longa extract with Sulfamethoxazole	21.2

C. zeylanicum: Cinnamomum zeylanicum, C. longa: Curcuma longa, S. aureus: Staphylococcus aureus

In our study, the plant extracts had different synergistic ability to inhibit the growth of microorganism depending on the method of extraction. Plants antimicrobials have been found to be synergistic enhancers in that though they may not have any antimicrobial properties alone, but when they are taken concurrently with standard drugs that they enhance the effect of that drug (Rakholiya and Chanda, 2012).

Drug synergism between known antibiotics and bioactive plant extracts is a novel concept and could be beneficial (synergistic or additive interaction) or deleterious (antagonistic or toxic outcome) (Adwan and Mhanna, 2008). In recent years, the Infectious Diseases Society of America has highlighted a group of pathogens ESKAPE that they, currently, cause the majority of hospital infections and can effectively "escape" the biocidal action of antibiotics. *S. aureus* and K. pneumonia are members in this group which includes Enterococcus faecium, *S. aureus*, *K. pneumoniae, Acinetobacter baumannii, P. aeruginosa,* and *Enterobacter* species (Boucher *et al*., 2009). The steadily increasing in multidrug-resistant bacteria to existing antibiotics is a serious problem that significantly causing treatment failure of infections and increase mortality rates (Harbarth and Samore 2005). There is an urgent need to develop new antibacterial substances or new compounds that block resistance mechanisms and improve treatment to eradicate these resistant strains. Treatment with antibacterial combinations, using two or more antibacterial agents, is one of the most important strategies to overcome multidrug-resistant organism (Torella *et al*., 2010).

Recently, plant antimicrobials have been found to be synergistic enhancers in that though they may not have any antimicrobial properties alone, but when they are taken concurrently with standard drugs that they enhance the effect of that drug (Darwish and Aburjai, 2010).

There are some generally accepted mechanisms of this interaction, including inhibition of protective enzymes, combination of membrane active agents,

sequential inhibition of common biochemical pathways, and the use of membranotropic agents to enhance the diffusion of other antimicrobials (Bassolé and Juliani, 2012). Phytotherapy has many potentially significant advantages associated with the synergistic interactions such as increased efficiency, reduction of undesirable effects, increase in the stability, or bioavailability of the free agents and obtaining an adequate therapeutic effect with relatively small doses, when compared with a synthetic medication (Aiyegoro and Okoh, 2009).

During the past 10 years, several reviews substantiated the effectiveness of combinations of plants with conventional antimicrobials (Aiyegoro and Okoh, 2009). However, no studies were found that investigated the effect of combination of Thymbra spicata extract with antibiotics against multidrug (MDR) *S. aureus* and *K. pneumoniae. T. spicata,* (Lamiaceae), is a native plant in the flora of Syria (Mouterde, 1983). It is an evergreen perennial Shrub that tends to grow to 0.5 m on dry, sunny hillsides, and high dry meadows (Barakata *et al*., 2013). It is a well-known medicinal plant that used in folk medicine traditions. The essential oil found in different parts of *T. spicata* makes it an important antibacterial and antioxidant natural source. The infusion of this plant is used for treating of respiratory and sore throat infection. Besides, it used as a spice that gives a good flavor and taste to meals (Marković *et al*., 2011).

It is well known that antimicrobial activities of plant extract against tested bacteria differed, depending on location (Celiktas *et al*., 2007). Turmeric oil as a byproduct from curcumin manufacture also was found effective against *B. subtilis, B. coagulans, B. cereus*, *S. aureus*, *E. coli*, and *P. aeruginosa* (Negi et al.,1999). Curcumin also exhibited inhibitory activity on methicillin-resistant *S. aureus* strains with MIC value of 125–250 µg/mL.[26-46]

The in vitro investigation of three new compounds of curcumin, namely, indium curcumin, indium diacetylcurcumin, and diacetylcurcumin, against *S. aureus*, S. epidermis, *E. coli*, and *P. aeruginosa* revealed that indium curcumin had a better antibacterial effect compared to curcumin itself and it may be a good compound for further *in vivo* studies. However, diacetylcurcumin did not exhibit any antibacterial effect against tested bacteria (Tajbakhsh *et al*., 2008). These results demonstrated promising antibacterial activity for different curcumin derivatives as well. The stability and assembly of FtsZ protofilaments (FtsZ, a prokaryotic homologue of eukaryotic cytoskeletal protein tubulin, polymerizes to form a Z-ring at the mid cell that orchestrates bacterial cell division) as a crucial factor for bacterial cytokinesis are introduced as a possible drug target for antibacterial agents. Curcumin suppressed the *B. subtilis* cytokinesis through induction of filamentation. It also without significantly affecting the segregation and organization of the nucleoids markedly suppressed the cytokinetic Z-ring formation in *B. subtilis* (Rai *et al*., 2008). Turmeric contains curcumin, which has unique properties as an antioxidant and a thinner. Therefore, the medicinal benefits of turmeric are summarized in the following:

- Contains anticoagulant properties
- Antidepressant
- Effective treatment for inflammation
- Dermatological cases
- Arthritis treatment
- In cancer treatment in the treatment of diabetes.

CONCLUSION

Results showed antibacterial effect of *Cinnamomum zeylanicum* and *Curcuma longa* extracts and their synergistic effect with antibiotic Sulfamethoxazole against *Escherichia coli*. and *Staphylococcus aureus*.

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