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Influence of Curcumin on the Synthetic Drug Amoxicillin

Ramesh Yadav, Ginpreet Kaur and Meena Chintamaneni
Department of Pharmacology, SPP School of Pharmacy and Technology Management, SVKM's NMIMS, V.L Mehta Road, Vile Parle (W), Mumbai, 400056, India

ABSTRACT

Background and Objective: During the last two decades it was proven that turmeric is a potent herbal. Curcumin has been subjected to a variety of antimicrobial activity due to extensive traditional uses and less side effects. Antimicrobial activity for curcumin against different bacterial strains has been already reported. Indeed, numerous investigations have been carried out to amplify the antimicrobial potential of curcumin, including synthesis of different chemical derivatives to increase its water solubility as well as bioavailability. This study aims to investigate the effect of antimicrobial activity of curcumin in combination with synthetic drug. So, as to reduce the dose of synthetic drug and so will the chance of resistance caused due to antibiotics be by a large reduced. Curcumin is a key component of turmeric and turmeric is widely used as a dietary component in everyday life especially in India. Hence, the objective was to be study the effect of curcumin and antibiotic when taken concurrently. **Methods:** Pour plate method was used against standard bacterial strains such as *Staphylococcus aureus* (ATCC-29213), *Escherichia coli* (ATCC-8739), *Proteus vulgaris* (ATCC-13315), *Salmonela typhi* (ATCC-23564). **Results:** Curcumin showed prominent anti-microbial activity at 100 μg mL^{-1} observed individually against following strains *E. coli*, *S. aureus*, *P. vulgaris*, *E. aerogenes* and *S. typhi.* Where zone of inhibition was found to be 13, 11, 12, 13 and 14 mm, respectively. Antimicrobial activity of amoxicillin was compared with a combination (Curcumin 100 μg mL^{-1} and Amoxicillin 10 μg mL^{-1}) and the results demonstrated that the activity in combination as compared to amoxicillin alone which was evident from the zone of inhibition *Escherichia coli* from 20-15 mm (25%), *Staphylococcus aureus* from 30-25 mm (17%), *Proteus vulgaris* from 25-22 mm (12%), *Enterobacter aerogenes* from 25-22 mm (12%) and *Salmonella typhi* from 25-21 mm (16%). **Conclusion:** Thus the present study revealed that curcumin has an antagonistic effect when used in combination with amoxicillin. Thus, the study gives clear evidence that microbial activity of antibiotics is reduced when used in combination with turmeric.

Key words: Curcumin, antimicrobial activity, antibiotic resistance, drug herb interaction, amoxicillin

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INTRODUCTION

Curcumin and curcuminoids constitute the main phytochemicals of *Curcuma longa* L. belonging to the family Zingiberaceae[1]. This polyphenolic chemical compound due to a variety of biological activities has been gained more attention of researches all over the world[2]. Curcumin is a very old coloring spice of Asia is usually used for various remedies[3] and used as a dietary component.

Currently there is a phenomenal interest to understand and study nature of activity of antibiotics in compared with herbs to explore its synergistic or antagonistic effect.

Corresponding Author: Ginpreet Kaur, Department of Pharmacology, SPP School of Pharmacy and Technology Management, SVKM's NMIMS, V.L. Mehta Road, Vile Parle (W), Mumbai, 400056, India Tel: 42332000/2035

Curcumin has a beneficial effects including antioxidant, antimicrobial, anti-inflammatory and anticancer activities[4,5]. Mixture of curcumin with other antimicrobial agents is used for the development of antimicrobial skin gels and emulsions with improved skin protection and wound dressing properties[6].

The emergence of bacterial resistance to antibiotics and its dissemination, however, are major health issues, leading to treatment drawbacks for a large number of medicines[7,8]. Consequently there has been increasing interest in the use of inhibitors of antibiotic resistance for combination therapy[9-11]. Recently some edible natural products and food ingredients have been reported to enhance the antibacterial activity of different antibiotics such as nitrofurantoin, clindamycin[12-14]. As mentioned above the investigations have been carried out on the biological activities of curcumin but the

combination effect of these herbs with different antibiotics has not been explored. Thus, the present investigation was conducted to determine the activity of amoxicillin in combination with curcumin against the gram positive as well as gram negative bacterial strains.

MATERIALS AND METHODS

Collection of samples: The test organisms used in this study were collected from N.C.I.M (National collection of Industrial Microorganism), Pune, India. Curcumin and amoxicillin were purchased from sigma Aldrich. Nutrient agar and nutrient broth were purchased from Hi-media, dimethyl sulphoxide from s d fine-chem limited.

Bacterial strains and maintenance: Five different strains were used for testing antibacterial activity including *Staphylococcus aureus* (ATCC-29213 and NCIM-5022), *Escherichia coli* (ATCC-8739 and NCIM-2056), *Proteus vulgaris* (ATCC-13315 and NCIM-2027), *Salmonela typhi* (ATCC-23564 and NCIM-2501). The strain was cultured on nutrient agar slants. The cultures were maintained by sub culturing periodically and preserved at 4ºC.

Antibacterial study: The drug substance in this study was curcumin and amoxicillin. Stock solution of the test agent was made in DMSO (Dimethyl sulfoxide) for complete solubilization. The nutrient agar was cooled to 60°C and bacterial concentration of 1×10^8 colony forming units CFU mL^{-1} was added into nutrient agar ($1\,\mu g\,mL^{-1}$). Before solidifying it was poured in to sterile Petri dish and plate were allowed to solidify agar. Well was prepared by using metal borer (8 mm), drug substance were injected in to well (20 μL) and plates were placed for incubation at 37°C for 24 h.

RESULTS AND DISCUSSION

Antimicrobial activity of amoxicillin, curcumin and its combination were tested against following strains (Table 1) *Salmonella typhi*, *Staphylococcus aureus*, *Escherichia coli*, *Proteus vulgaris*, *Enterobacter aerogenes.* Marathe *et al.*[15] reported that activity of ciprofloxacin decreases when taken concurrently with curcumin against *Salmonella typhi*[15]. Marathe *et al.*[15] also disclosed that curcumin interferes with the action of ciprofloxacin and there by increases the proliferation of *Salmonella typhi.*

In pour plate method, curcumin showed minimum zone of inhibition at 100 $\mu g\ mL^{-1}$ against

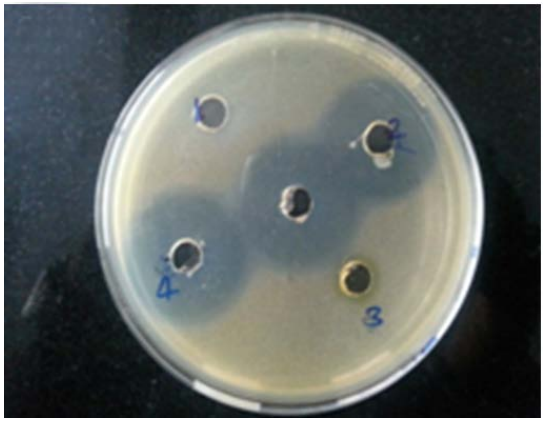

Fig. 1: Antimicrobial activity of curcumin, amoxicillin and its combination against *Staphylococcus aureus*, where 1 = Negative control (DMSO), 2 = Combination (Amoxicillin 10 ppm+ Curcumin 100 ppm), 3 = Curcumin (100 ppm), 4 = Amoxicillin (10 ppm) and positive control (Amoxicillin 10 ppm) in center

Fig. 2: Antimicrobial activity of curcumin, amoxicillin and its combination against *Proteus vulgaris*, where 1 = Negative control (DMSO), 2 = Combination (Amoxicillin 10 ppm + Curcumin 100 ppm), 3 = Curcumin (100 ppm), 4 = Amoxicillin (10 ppm) and positive control (Amoxicillin 10 ppm) in center

Staphylococcus aureus (11 mm) (Fig. 1) followed by *Proteus vulgaris* (12 mm) (Fig. 2), *Escherichia coli* (13 mm) (Fig. 3), *Enterobacter aerogenes* (13 mm) (Fig. 4) and *Salmonella typhi* (14 mm) (Fig. 5). The antimicrobial activity of amoxicillin using pour plate method,

Table 1: Zone of inhibition of curcumin, amoxicillin and its combination

Strains	Control -Ve (mm)	Control +Ve (mm)	Combination (Curcumin+Amoxicillin) (mm)	Curcumin 100 μg mL^{-1} (mm)	Amoxicillin 10 μg mL^{-1} (mm)
Salmonella typhi	00	25	21	14	25
Staphylococcus aureus	00	30	25	11	30
Escherichia coli	11	20	15	13	20
Proteus vulgaris	00	25	22	12	25
Enterobacter aerogenes	00	25	22	13	25

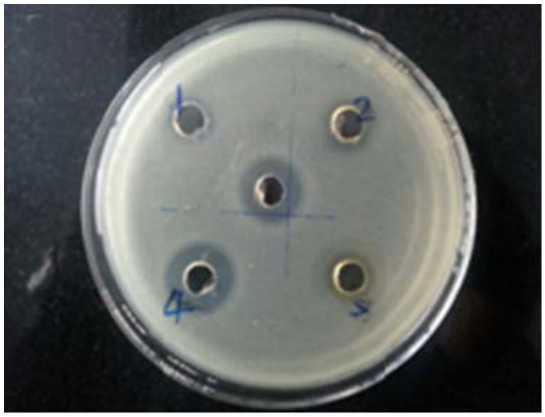

Fig. 3: Antimicrobial activity of curcumin, amoxicillin and its combination against *Escherichia coli*, where 1 = Negative control (DMSO), 2 = Combination (Amoxicillin 10 ppm+Curcumin 100 ppm), 3 = Curcumin (100 ppm), 4 = Amoxicillin (10 ppm) and positive control (Amoxicillin 10 ppm) in center

Fig. 4: Antimicrobial activity of curcumin, amoxicillin and its combination against *Enterobacter aerogenes*, where 1 = Negative control (DMSO), 2 = Combination (Amoxicillin 10 ppm+Curcumin 100 ppm), 3 = Curcumin (100 ppm), 4 = Amoxicillin (10 ppm) and positive control (Amoxicillin 10 ppm) in center

showed minimum zone of inhibition at 10 μg mL^{-1} (20 mm) against *Escherichia coli* (Fig. 3) followed by *Salmonella typhi* (25 mm) (Fig. 5), *Proteus vulgaris* (25 mm) (Fig. 2), *Enterobacter aerogenes* (25 mm) (Fig. 4) and highest inhibition at 10 μg mL^{-1} was found (30 mm) against *Salmonella typhi* (Fig. 5). The antimicrobial activity in combination decreased by (25%) in gram-negative (*Escherichia coli*) as compared to gram-positive (*Staphylococcus aureus*) strains (17%). Result also showed as decrease 16% in *Salmonella typhi*,

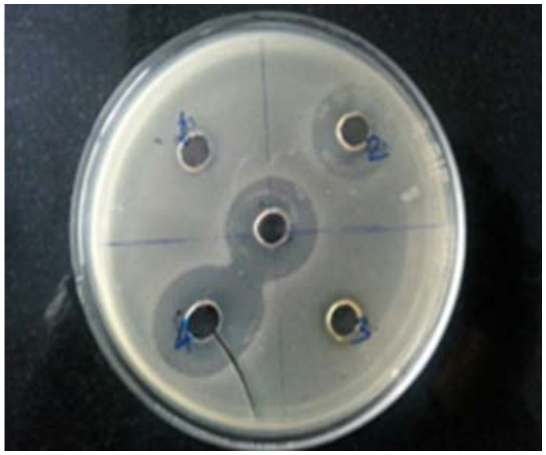

Fig. 5: Antimicrobial activity of curcumin, amoxicillin and its combination against *Salmonella typhi*, where 1 = Negative control (DMSO), 2 = Combination (Amoxicillin 10 ppm+Curcumin 100 ppm), 3 = Curcumin (100 ppm), 4 = Amoxicillin (10 ppm) and positive control (Amoxicillin 10 ppm) in center

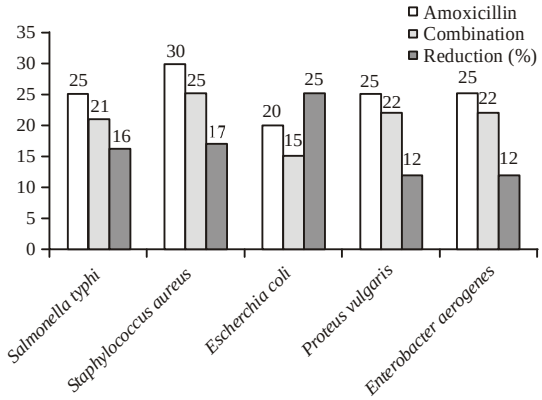

Fig. 6: Percent reduction in microbial activity

Proteus vulgaris 12% and *Enterobacter aerogenes* 12%. There was no zone of inhibition observed in negative control.

In the present investigation it was found that curcumin showed antagonistic effect in combination with amoxicillin, the activity of amoxicillin decreases from 20-15 mm (25%) against *Escherichia coli* (gram-negative). Activity decreases by 17% against *Staphylococcus aureus*, 16% in *Salmonella typhi*, *Proteus vulgaris* 12% and *Enterobacter aerogenes* 12% (Fig. 6).

CONCLUSION

Based on the above results it was found that curcumin showed clear antagonistic effect in combination with amoxicillin. Hence, the combination of curcumin with antibiotics (Amoxicillin) reduced the potency of antibiotic. Further study is required to examine the mechanism of interaction between curcumin and amoxicillin.

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