International Journal of Sciences & Applied Research

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An antimicrobial effect of *Curcuma longa* in comparison to the standard antibiotics

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Abstract
According to WHO report, 80% population of the world relies primarily on traditional medicine. Globally, various plant extracts are used for their antibacterial, antifungal and antiviral activities. The continuous progression of bacterial resistance to presently available antibiotics has necessitated the search for novel & effective antimicrobial agents. In India, *Curcuma longa* which is known as 'turmeric', is widely used as a spice and a colouring agent and is also known for its medicinal properties. The present study was conducted to observe the antimicrobial effect of different extracts of *Curcuma longa* in compare to the standard antimicrobial agents. Various extracts of *Curcuma longa* were prepared by using different solvents water, chloroform and methanol. The antibacterial activity were evaluated against pathogenic Gram-Negative (*Escherichia coli* and *Pseudomonas aeruginosa*) and Gram Positive (Coagulase Positive *Staphylococci* and Coagulase Negative *Staphylococci*) bacteria comparing with standard antibiotics (Gentamycin, Ampicillin and Erythromycin) by using disc diffusion method. According to the results among the all extracts essential oil had the best inhibitory activity against the all tested bacteria in comparison to the other extracts and the standard antimicrobials used. Turmeric, may thus offer an effective alternative in prevention and treatment of bacterial infections.

Keywords: *Curcuma longa*, essential oil, bacteria, antimicrobial effect

Introduction

According to World Health Organization (WHO) report, 80% population of the world relies primarily on traditional medicine; and in majority of the traditional therapies plant extracts or their active constituents are used[1]. Globally, various plant extracts are used for their antibacterial, antifungal and antiviral activities[13]. The continuous progression of bacterial resistance to presently available antibiotics has necessitated the search for novel & effective antimicrobial agents. One way is to screen new, inexpensive and effective drugs from different sources like plants, for their antimicrobial activity that can act for longer periods before development of resistance[13].

Antimicrobial agents from Medicinal Plants have many advantages, like- less side effects, less expensive, better patient

tolerance and acceptance due to long usage history.

A famous Medicinal plant which is commonly known and found in India is *Curcuma longa* that belongs to the Zingiberaceae family[4]. *Curcuma longa* is commonly known as 'turmeric' and widely used as a spice and a colouring agent and is well known for its medicinal properties also[4.] The active components of turmeric are Curcuminoids, include mainly Curcumin (diferuloyl methane) which is principally responsible for the biological activities of turmeric[3].

This study was undertaken to observe the antimicrobial effect of different extracts of *Curcuma longa* (turmeric) on the various clinical isolates in comparison to the standard antimicrobial agents. This comparative antimicrobial susceptibility pattern will provide a better picture to enable the whole Medical Fraternity to recognize the clinical significance of the traditional indigenous 'INDIAN' Medicinal herb and thus prove the age old myth of 'Ramban dava'.

Materials and methods

This study was done at Department of Microbiology, Jawahar Lal Nehru Medical College, Ajmer to find out the antimicrobial effects of the different extracts of *Curcuma longa*, on the various clinical isolates from the samples received. Antimicrobial susceptibility tests were performed using Standard antibiotics discs (Gentamycin, Ampicilin and Erythromycin) and four Extracts of *Curcuma longa* (oily extract, chloroform extract, methanol extract and water extract) by Kirby Bauer Disc Diffusion Method. To prepare extracts, 100 gm dry rhizomes of *C. longa* were crushed finely adding distilled water and subjected to steam distillation. The oily extract (fraction-A, 0.951 gram) was collected and the residue in water was filtered. To obtain water extract, the filtrate was evaporated under vacuum (fraction-D, 1.823 gram). The residue was air-dried and left overnight in chloroform (100 ml), filtered and re-extracted twice with chloroform (2X100ml). All chloroform extracts were combined and solvent was evaporated to give chloroform extract (fraction-B, 0.875gram). The residue left after chloroform was extracted with methanol to give the methanol extract (fraction-C, 2.6 gram) [17].

The Gram-negative *Escherichia coli*, *Pseudomonas aeruginosa* and the Gram-positive bacteria Coagulase Positive *Staphylococci* (COPS) and Coagulase Negative *Staph*ylococci (CONS) were used as test organisms. They were obtained from department of Microbiology, J.L.N. Medical College, Ajmer. The extracts were dissolved in ethylene glycol then filtered through membrane filter (0.45μm) sterilized and tested for antibacterial activity using disc diffusion method[16]. Sterile 6.mm diameter filter paper discs were impregnated with 2000 μg of the sterile test material and placed onto nutrient agar surface spread with 0.1 ml of bacterial culture (2.5×10^8 cells /ml using pour plate method. The plates were incubated at 37ºc for 24-48h. The Antibacterial activity of *C. longa* extracts were recorded if the zone of inhibition (in mm) was greater than 8 mm. Less than 9 mm zone was considered as inactive, more than or equal to 9 mm was considered as active[9]. These results were compared to the zone of inhibition (in mm) of standard antibiotics used. The mean and standard deviation of the diameter of inhibition zones were calculated and activity as percentage calculated in accordance to Gentamycin as positive control with 100% inhibition.

Results

The antibacterial activity of different extract of *Curcuma longa* observed was compared with standard antibiotics such as Gentamycin, Ampicillin and Erythromycin against pathogenic bacteria. Table 1 show

that, Fraction A was found more active (44.3%) in compare to other extracts and standard antimicrobial (Ampicillin and Erythromycin) for all clinical isolates. Fraction A and D have shown more activity for Gram Positive bacteria (54.3% and 37.1% respectively) than Gram Negative bacteria (34.3% and 17.1% respectively). Fraction B for Gram Negative bacteria and Fraction C for Gram Positive bacteria shows negligible activity (0% and 2.9% respectively).

Among Gram Positive bacteria, Table 2 shows that for CONS, fraction A and D was found more active (57.1 and 42.9% respectively) than the standard antibiotics. They showed good antimicrobial activity for COPS also (51.4% and 31.4% respectively). Fraction B & C for COPS and fraction C for CONS have shown negligible activity (<6%).

Table 3 showing that For *E. coli* fraction A was more active (54.3%) than the standard antimicrobials (Ampicillin and Erythromycin) used. While for *Pseudomonas aeruginosa*, all fractions of *C. longa* (>14%) except faction B have shown more activity than standard antimicrobials (<6%). Activity of fraction A was more for E. coli than *P. aeruginosa* (54.3% & 14.3% respectively) while fraction C & D was found more active for *P. aeruginosa* (22.9% & 25.7% respectively) than E. coli (5.7% & 8.6% respectively).

The result is promoting, as all other antibiotics were not much active against these bacteria. It has been suggested that the antibacterial effect of *C. longa* extracts is associated to the presence of hydroxyl and phenol groups in the molecule of turmeric beings essential for the inhibition of bacteria.

Table 1: Zone of inhibition for various extracts of *C. longa* compared with standard antibiotics: comparable activity against Gram Positive and Gram Negative Bacteria.

Antimicrobials	GPC		GNB		TOTAL	
	Mean ± SD	%	Mean ± SD	%	Mean ± SD	%
Gentamycin	21.8 ± 2.81	100	23.1 ± 2.25	100	22.4 ± 2.61	100
Ampicillin	10.3 ± 3.55	38.6	8.5 ± 3.21	24.3	9.4 ± 3.48	31.4
Erythromycin	14.3 ± 5.78	40	8.4 ± 3.94	7.1	11.3 ± 5.74	23.6
Fraction A	9.5 ± 3.11	54.3	8.9 ± 3.30	34.3	9.2 ± 3.21	44.3
Fraction B	6.8 ± 1.54	11.4	6.0 ± 0.0	0	6.4 ± 1.16	5.7
Fraction C	6.2 ± 0.80	2.9	7.1 ± 1.62	14.3	6.7 ± 1.35	8.6
Fraction D	8.6 ± 2.56	37.1	7.5 ± 1.95	17.1	8.0 ± 2.33	27.1

Table 2: Zone of inhibition for various extracts of *C. longa* compared with standard antibiotics: activity against Gram Positive Bacteria.

Antimicrobials	COPS		CONS		GPC	
	Mean ± SD	%	Mean ± SD	%	Mean ± SD	%
Gentamycin	23.2 ± 2.20	100	21.3 ± 3.26	100	21.8 ± 2.81	100
Ampicillin	11.1 ± 3.70	51.4	9.4 ± 3.21	25.7	10.3 ± 3.55	38.6
Erythromycin	17.1 ± 5.52	62.9	11.4 ± 4.54	17.1	14.3 ± 5.78	40
Fraction A	9.1 ± 2.92	51.4	9.8 ± 3.30	57.1	9.5 ± 3.11	54.3
Fraction B	6.0 ± 0.00	0	7.6 ± 1.97	22.9	6.8 ± 1.54	11.4
Fraction C	6.0 ± 0.00	0	6.5 ± 1.09	5.7	6.2 ± 0.80	2.9
Fraction D	8.4 ± 2.60	31.4	8.8 ± 2.53	42.9	8.6 ± 2.56	37.1

Table 3: Zone of inhibition for various extracts of *C. longa* compared with standard antibiotics: activity among Gram Negative Bacteria.

Antimicrobials	*E. coli*		*P. aruginosoa*		Total GNB	
	Mean ± SD	%	Mean ± SD	%	Mean ± SD	%
Gentamycin	22.9 ± 1.96	100	23.3 ± 2.52	100	23.1 ± 2.25	100
Ampicillin	10.5 ± 3.27	42.9	6.6 ± 1.50	5.7	8.5 ± 3.21	24.3
Erythromycin	10.8 ± 4.42	14.3	6.0 ± 0.00	0	8.4 ± 3.94	7.1
Fraction A	10.5 ± 3.66	54.3	7.4 ± 1.93	14.3	8.9 ± 3.30	34.3
Fraction B	6.0 ± 0.00	0	6.0 ± 0.00	0	6.0 ± 0.0	0
Fraction C	6.7 ± 1.18	5.7	7.5 ± 1.90	22.9	7.1 ± 1.62	14.3
Fraction D	6.9 ± 1.22	8.6	8.1 ± 2.32	25.7	7.5 ± 1.95	17.1

Discussion

Antimicrobial agents are associated with various adverse effects on the host like, hypersensitivity, immune suppression and allergic reactions. Also, the continuous evolution of bacterial resistance to currently available antimicrobial agents has necessitated the search for novel and effective antimicrobial compounds. Various authors have shown the antimicrobial activity of *Curcuma longa* extracts against an array of pathogens[14,16,17]. In the present study, it was seen that all extracts of *C. longa* have shown a range of antimicrobial activity against all tested bacteria in compare to the standard antibiotics. Consecutive extraction and isolation of botanical compounds from plant material is largely dependent on the type of solvent used in the extraction procedure. Water was used by the traditional healers as the primary solvent. In Present study, the antimicrobial property of essential oil was found to be better than the other extracts. These findings were in similarity to the results reported by various authors stating that essential oil showed better antimicrobial properties than other extracts[2,16,17]. In our study the aqueous extract of *C. longa* showed good inhibitory activity against CONS and COPS in accordance to other studies[12,14]. Our findings agree with the study in that the activity of Methanolic and Chloroform extract of *C. longa* had antibacterial potential against the gram positive bacteria[7]. Activity of Chloroform extract of *C. longa* were comparable for the gram positive bacteria but against for gram negative bacteria[7].

The results of our study were in contrast to a study reported that methanol extract of *Curcuma longa* have antibacterial activity against pathogenic bacteria[11]. In our study we found that the turmeric extract is effective against the test bacteria *E. coli* accordance to the study[8]. The presence of essential oil, curcumin, turmerol and veleric acid are responsible for antibacterial activity of turmeric. The mechanism of antibacterial action of spices involves the hydrophobic and hydrogen bonding of phenolic compounds to membrane proteins, membrane disruption, destruction of electron transport systems and cell wall disruption[15]. The antimicrobial activity of aqueous extracts could be due to anionic components such as thiocyanate, nitrate, chlorides and sulphates in addition to many other compounds naturally present in plants[6].

Conclusion

The antimicrobial resistance observed in our study against selected standard antimicrobial agents obliged our search for inexpensive, readily procured, locally available, easily acceptable traditional alternatives such as the indigenous Medicinal herb 'Turmeric' (*Curcuma longa*) which is quite active against these resistant pathogens. All

extracts of *C. longa* have shown some activity, it has been observed that the essential oil was more effective in comparison to the other extracts of *C. longa* and the standard antimicrobials used. It is necessitate of further studies for various *C. longa* extracts against other pathogenic bacteria and the mechanisms of such interaction and interacting compounds of plants and antibiotics have to be explored to cope with multi dug resistant bacteria.

Acknowledgement

I express my deep indebtedness to my supervisor Late Dr. Blossum Priya Peter, Associate Professor, Department of Microbiology, J.L.N. Medical College of Ajmer for her unfailing guidance, valuable implication and constant help throughout the period of study.

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