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Investigation of phytochemical screening and antimicrobial activity of *Curcuma longa*

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Abstract

Many plants have been screened for antimicrobial activity and drug properties. The aim of the present study encourages the use of spices as alternative or supplementary medicine to reduce the burden of high cost, side effects and progressively increasing drug resistance of pathogens. In present study methanol and chloroform extracts of *Curcuma longa* (fresh and dry) were prepared from the rhizome. The antimicrobial properties of both of the extract were studied by testing the antibacterial as well as antifungal activity. The antibacterial test was done by agar well diffusion method against bacterial species such as *Escherichia coli, Staphylococcus aureus, Klebsiella pneumoniae, Protease vulgaris, Pseudomonas aeruginosa, Bacillus cereus, Bacillus megatarium, Bacillus subtilis* and fungal species such as *Aspergillus niger.* The zone of inhibition of the extract were determined and compared with the standard drug streptomycin to know the efficiency. The methanol extract of rhizome was found to be more effective when compared with other solvent like chloroform. The phytochemical analysis of both of the extract revealed the presence of alkaloids, flavonoids, terpenoids, tannins, saponin and steroids.

Keywords: *Curcuma longa*, antimicrobial activity, phytochemical analysis, alkaloids.

Introduction

Plants as a source of medicinal compounds have continued to play a dominant role in the maintenance of human health since ancient times [1]. They contain active constituents that are used in the treatment of many human diseases. The plant extracts have been developed and proposed for use as antimicrobial substances. Many of the plant materials used in the traditional medicine are readily available in rural areas at relatively cheaper than modern medicine. Thus it is important to characterized different types of medicinal plants for their antioxidant and antimicrobial potential. Due to a rapid increase in the rate of infections, antibiotic resistance in microorganisms and due to side effects of synthetic antibiotics, medicinal plants are gaining popularity over these drugs. Antimicrobial activities of many plants have been reported by the researchers and antimicrobial activities of medicinal plants can be attributed to be the secondary metabolites such as alkaloids, flavonoides, tannins, terpenoides that are present in these plants. Medicinal plants represents a rich source of antimicrobial agents and plants are used medicinally in different countries and are a source of many potent and powerful drugs. A wide range of medicinal plants parts is used for extracts as raw drugs and they possesses varied medicinal properties. They contain active constituents that are used in the treatment of many human diseases [2]. The plant extract have been developed and proposed for use as antimicrobial substances [3]. Plants used in traditional medicine contain a vast array

of substances that can be used to treat chronic and infectious diseases. The genus *Curcuma* contains approximately 40 mostly tropical Asian species. Best known is turmeric (*C. longa*), a cultigen of likely Indian origin, which is widely used as a spice and as an orange and yellow dye [4]. Several other species are also used for culinary purposes including mango ginger (*C. amada*). More than a dozen species of *Curcuma* have been used in traditional systems of medicine [5]. *Curcuma longa* (*C. longa*), a perennial herb, is a member of the *Zingiberaceae* family and has a long tradition of use in the Chinese and Ayurvedic systems of medicine. Curcuminoids, a group of phenolic compounds isolated from the roots of *C. longa*, exhibited a variety of beneficial effects on health and has the ability to prevent certain diseases [6]. In East Asia, the rhizomes from *C. longa*, are considered to have natural medicinal properties, including antibacterial, anti-inflammatory, antineoplastic, and analgesic activities because they contains a number of moniterpenoids, sesquiterpenoids, and curcuminoids [7]. In present study *Curcuma* was used to evaluate it's photochemical and antimicrobial characteristics.

Materials and Methods

Collection of plant materials

Fresh rhizome and dried powder of Curcuma longa were collected from the local market of Vapi, Gujarat, India. Fresh rhizome were washed with the help of distilled water to remove dust particles, dried for 2 to 3 days, and crushed in mechanical grinder in order to make fine powder. The powder was stored in air tight container and kept at room temperature for further use [8].

Extract Preparation

Methanol extract

In the conical flask 20g of air-dried powder was macerated with 150 ml of 96% methanol were kept overnight at shaking condition. The liquid was then stained off, the solid material was pressed and then liquid was clarified by using muslin cloth. The filtrates were air dried at room temperature and residual moisture was removed in a vacuum oven at 50 to 52°C. The dried extracts were weighted to analyze the total extract yield then dried extract was dissolved in Dimethyl sulfoxide (DMSO) and stored in refrigerator for further uses [9].

Chloroform extract

In the conical flask 20g of air-dried powder was macerated with 150 ml of chloroform was kept overnight at shaking condition. The liquid was then stained off, the solid material was pressed and then liquid was clarified by using muslin cloth. The filtrates were air dried at room temperature and residual moisture was removed in a vaccum oven at 50˚C to 52°C. The dried extracts were weighted to analyze the total extract yield and dissolved in Dimethyl sulfoxide (DMSO) and stored in refrigerator for further use. [9].

Maintenance and preservation of culture

The bacterial species used in present study were gram positive (Bacillus subtilis, Bacillus cerus, Bacillus megaterium, staphylococcus aureus) and gram negative (Pseudomonas aeruginosa, Escherichia coli, Protease vulgarisn, Klebsiella pneumonia). The fungus species used for the test were Aspergillus niger.Various non pathogenic organisms were procured from MTCC. All cultures were maintain by sub culturing on nutrient agar slant and PDA slants and stored at 4°C in refrigerator [8].

Phytochemical screenining of different crude extract:

Phytochemical tests were done to find the presence of the active chemical constituents such as Alkaloids, Flavonoids, Tannins, Saponins, Carbohydrates, Sterols, Terpenoids, Quinones, Gycosides.

Test for Alkaloid:

Dilution of 0.5 ml of plant extract was done with 10 ml of acid alcohol, boiled and filtered, 5 ml of filtrate was added to 2 ml of diluted ammonia and 5 ml of chloroform. Solution was shaken gently to extract the alkaloidal base. The chloroform layer was extracted with 10 ml of acetic acid. Mayer's reagent was added and the formation of cream or reddish brown precipitate was regarded as positive for the presence of alkaloids.

Test for Flavanoides: NaOH Test

Few drops of aqueous NaOH and few drops of HCL was treated with 2 ml of plant extract. Formation of yellow orange colour indicates the presence of flavonoids.

Test for Tannins: Ferric Chloride Test

Treat 2 ml of plant extract with 1ml alcohol and treated with 1 ml of neutral ferric chloride solution and observed for formation of blue or greenish colour solution which indicates the presence of tannins.

Test for saponins: Foam Test

Add 3 ml of water in 2 ml of plant extract and shake vigorously. Formation of foam indicates the presence of saponins.

Test for Carbohydrates: Molisch's Test

Few drops of molisch's reagent was added to 1 ml of plant extract and was followed by addition of 1ml of Conc. H2SO4 by the side of the test tube. The mixture was then allowed to stand for two minutes and then diluted with 5 ml of distilled water. Formation of red or dull violet colour at the interphase of the two layers indicates the presence of carbohydrates.

Test for Sterols: H_2SO_4 Test

Few ml of ethanol and 1 ml of H_2SO_4 was treated with 1 ml of plant extract. Formation of violet or green colour indicates the presence of sterols.

Test for Terpenoides: Salkowski Test

Add 2 ml of chloroform to 0.5 gm of each of the extract. Concentrated H_2SO_4 (3 ml) was carefully added to form a layer. A reddish brown coloration of the interface indicates the presence of terpenoids.

Test for Quinones :

Few drops of the plant extract were treated with 2 ml of Con. HCL.Formation of yellow colour precipitate indicates the presence of quinones.

Test for Glycosides: Killer- killiani test

Few drops of glacial acetic acid & ferric chloride were added to test solution .Add few drops of H2SO4to it. Observe for the formation of two layers. Lower layer apperes reddish and upper layer bluish green in colour.

Antimicrobial activity

Nutrient agar broth (Hi-media, India) was used as the media for the culturing of bacterial strains. A loop full of bacterial cultures were inoculated in the nutrient broth and incubated at 37˚C for 24 hrs .Sabouraud's Dextrose broth and Sabouraud's Dextrose Agar (SDA) (Himedia, India) were used as the media for the culturing fungal strains. The freshly grown culture was used for antimicrobial activity.

Antibacterial activity

The extracts were screened for their antibacterial activity by well diffusion method, and streptomycin was kept as positive control (50µg/ml). The lawn culture of test organism on nutrient agar media were used for well diffusion methods. With the help of sterile cup borer wells were made in the inoculated plates. The rhizome extract of fresh and dry *Curcuma longa* (50 mg/ml) was added into the well and allow to diffuse in the agar medium. The plates were incubated at 37˚C for overnight. The antibacterial activity of the extract was determined by measuring the diameters of zone of inhibition. For each bacterial strain, controls were maintained of pure solvents without extracts [8].

Antifungal activity

The etracts were also screened for their antifungal activity by well diffusion method. Fluconazole (50mg/ml) was kept as positive control. The lawn culture of test organisms such as *Aspergillus niger* and *Penicillium* sp. on Sabouraud's Dextrose Agar (SDA) and Czapek solution agar were used for well diffusion methods. With the help of sterile cup borer wells were made in the inoculated plates. The extract of rhizome of fresh and dry Curcuma longa were added into the well and allowed to diffuse in the agar medium. The plates were incubated at room temperature for 48hrs. The activity of the extract was determined by measuring the zone of inhibition. For each fungal strain controls were maintained where pure solvents were used [8].

MIC (Minimum inhibitory concentration) determination: Agar macro-dilution method

The strain of microorganisms obtained were inoculated in conical flask containing 50 ml of nutrient broth. These conical flask were incubated at 37˚C for 24 hour and were referred to as seeded broth. Media were prepared using Muller Hinton Agar, poured on petri dishes and inoculated with the test organisms from the seeded broth using cotton swabs. Once the agar was solidified, it was punched with 6mm well. The extracts were added in each well in a concentration ranging from 2,00,000 µg/ml to

195.31µg/ml. The plates were incubated aerobically for 24 hour at 37˚C. A growth control of each tested strain was included. MIC was defined as the lowest concentration of extract in which no growth was observed after incubation.

Results and Discussion

Phytochemical screening

Phytochemical analysis were studied by following methods, Glycosides were estimated by Killer-Killiani test, Terpenoids by Salkowski test, Flavonoids with the use of lead acetate, Saponins by foam test, Tannins by ferric chloride test, Alkaloids by Hager's test, Carbohydrates by Molish test, Protein by biuret test [11].

Phytochemical analysis of methanol extract of Curcuma sp.

By performing comparitive phytochemical screening of methanolic extract of Fresh *Curcuma longa* and Dry *Curcuma longa* (Table 1) revealed that the Alkaloids, Flavonoids, Quinones, Saponins, Steroids, Terpenoids and carbohydrates were present in Fresh *Curcuma longa*. Whereas Alkaloids, Flavonoids, Quinones, Steroids, Terpenoids and Carbohydrates were present in Dry *Curcuma longa*.

Table 1 Phytochemical screening of Methanol extract of Curcuma sp.

Compounds	Methanol extract	
	Fresh *Curcuma longa*	**Dry *Curcuma longa***
Alkaloids	+	+
Flavonoids	+	+
Glycosides	-	-
Quinones	+	+
Steroids	+	+
Saponins	+	-
Tannins	-	-
Terpenoids	+	+
Carbohydrates	+	+

Negative Sign= Absent; **Positive Sign** = Present

Phytochemical analysis of Chloroform extract of Curcuma sp.

By performing comparitive phytochemical screening of chloroform extract of Fresh *Curcuma longa* and Dry *Curcuma longa* (Table 2) revealed that the Alkaloids, Flavonoids, Quinones, Saponins, Terpenoids and carbohydrates were present in Fresh *Curcuma longa*. Whereas Alkaloids, Flavonoids, Quinones and Terpenoids were present in Dry *Curcuma longa*.

Table 2 Phytochemical screening of Chloroform extract of Curcuma sp.

Compounds	Chloroform extract	
	Green *Curcuma longa*	**Dry *Curcuma longa***
Alkaloids	-	-
Flavonoids	+	+
Glycosides	-	-
Quinones	+	+
Steroids	-	-
Saponins	+	-
Tannins	-	-
Terpenoids	+	+
Carbohydrates	+	-

Negative Sign= Absent; **Positive Sign** = Present

Antimicrobial activity

In the present study, the antimicrobial activity The methanol and chloroform extracts of *Curcuma longa* towards clinically significant microbes is reported. The extract obtained from rhizome of Fresh and Dry *Curcuma longa* was found to be effective against the bacteria species such as *Escherichia coli, Staphylococcus aureus, Klebsiella pneumoniae, Protease vulgaris, Pseudomonas aeruginosa, Bacillus cereus, Bacillus megatarium, Bacillus subtilis* and fungal species such as *Aspergillus niger* and *Panicillium crysogenum.*

Antibacterial activity of Methanol extract of Curcuma longa

Methanol extract obtained from the rhizome of Fresh *Curcuma longa* and Dry *Curcuma longa* were found to effective against the bacteria *Escherichia coli, Staphylococcus aureus, Protease vulgaris, , Bacillus cereus, Bacillus megatarium, Bacillus subtilis.* Showing zone of inhibition in table 3.

Table 3 Antibacterial activity of Methanol extracts of *Curcuma longa*.

Test Organisms	Zone of inhibition in mm		
	Fresh *Curcuma longa*	**Dry *Curcuma longa***	**Positive control**
Bacillus cereus	29	27	24
Bacillus megatarium	27	26	22
Bacillus subtilis	27	23	20
Klebsealla pneumoniae	-	-	11
Staphylococccus aureus	27	25	23
Escherichia coli	26	24	22
Psuedomonas aeruginosa	-	-	12
Protease vulgaris	22	19	19

Antibacterial activity of Chloroform extract of Curcuma sp.

Chloroform extract obtained from the rhizome of Fresh *Curcuma longa* and Dry *Curcuma longa* were found to effective against the bacteria *Escherichia coli, Staphylococcus aureus, Protease vulgaris, , Bacillus cereus, Bacillus megatarium, Bacillus subtilis.* Showing zone of inhibition in table 4.

Table 4 Antibacterial activity of Chloroform extracts of *Curcuma longa*.

Note: - sign indicates = No zone of inhibition

Test Organisms	Zone of inhibition in mm		
	Fresh *Curcuma longa*	**Dry *Curcuma longa***	**Streptomycin (P.C)**
Bacillus cereus	27	26	24
Bacillus megatarium	26	23	22
Bacillus subtilis	24	23	20
Klebsealla pneumoniae	-	-	11
Staphylococccus aureus	24	22	23
Escherichia coli	25	23	22
Psuedomonas aeruginosa	-	-	12
Protease vulgaris	23	19	19

There was a significant deference between the inhibitions effects on microorganisms by different extract used in this study. Results obtained in the present study relieved that the tested Methanol and Chloroform extract of *Curcuma longa* exhibits potential antibacterial activity against *Escherichia coli, Staphylococcus aureus, Protease vulgaris, Bacillus cereus, Bacillus megatarium, Bacillus subtilis.* Whereas *Pseudomonas aeruginosa* and *Klebsiella pneumoniae* were resistant to these extracts. When tested by the well diffusion method, the methanol and chloroform extracts of Fresh and Dry *Curcuma longa* showed significant activity against the tested micro organisms. The high antibacterial activity recorded in Methanol extract (29mm) compared with Chloroform extract (27mm) of rhizome. Fresh *Curcuma longa* gives higher antibacterial activity than Dry *Curcuma longa* of both of the extract.

Minimum inhibitory Concentration (MIC) Determination

The MIC value of Fresh *Curcum longa* and Dry *Curcuma longa* were determined against the selected bacteria i.e. *Bacillus cereus, Bacillus megatarium, Bacillus subtilis, Klebsealla pneumoniae, Staphylococccus aureus, Escherichia coli, Psuedomonas aeruginosa, Protease vulgaris* using Methanol and Chloroform as a solvent.

MIC of methanol extract of Fresh and Dry *Curcuma longa*

The MIC determination was carried out using Agar diffusion method. The minimum inhibitory concentration of the methanol extracts of Fresh *Curcuma longa* on bacteria *Bacillus cereus, Bacillus megatarium, Bacillus subtilis, E.coli, and S.aureus* was observed as 50,000 µg/ml, whereas bacteria *Protease vulgaris* was found to be 100,000 µg/ml.

The MIC determination was carried out using Agar diffusion method. The minimum inhibitory concentration of the methanol extracts of Dry *Curcuma longa* on bacteria *E.coli, and P. vulgaris* was observed as 50,000 µg/ml, whereas bacteria *Bacillus cereus, Bacillus megatarium, Bacillus subtilis,* was found to be 100,000 µg/ml.

Table 5 MIC of Methanol extract of Fresh *Curcuma longa* for various microorganisms

Concentration (µg/ml)	*B. cereus*	*B. subtilis*	*B.megatarium*	*E. coli*	*S. aureus*	*K.pneumonia*	*P. vulgaris*	*P. aeruginosa*
200,000	-	-	-	-	-	+	-	+
100,000	-	-	-	-	-	+	-	+
50,000	-	-	-	-	-	+	+	+
25,000	+	+	+	+	+	+	+	+
12,500	+	+	+	+	+	+	+	+
6,250	+	+	+	+	+	+	+	+
3,125	+	+	+	+	+	+	+	+
1562.5	+	+	+	+	+	+	+	+
781.25	+	+	+	+	+	+	+	+
390.62	+	+	+	+	+	+	+	+
195.31	+	+	+	+	+	+	+	+

Negative Sign= Showed no turbidity; **Positive Sign** = Showed turbidity

Table 6 MIC of Methanol extract of Dry *Curcuma longa* for various microorganisms

Concentration (µg/ml)	*B. cereus*	*B. subtilis*	*B. megatarium*	*E. coli*	*S. aureus*	*K.pneumonia*	*P. vulgaris*	*P. aeruginosa*
200,000	-	-	-	-	-	+	-	+
100,000	-	-	-	-	-	+	-	+
50,000	+	+	+	-	+	+	-	+
25,000	+	+	+	+	+	+	+	+
12,500	+	+	+	+	+	+	+	+
6,250	+	+	+	+	+	+	+	+
3,125	+	+	+	+	+	+	+	+
1562.5	+	+	+	+	+	+	+	+
781.25	+	+	+	+	+	+	+	+
390.62	+	+	+	+	+	+	+	+
195.31	+	+	+	+	+	+	+	+

Negative Sign= Showed no turbidity; **Positive Sign** = Showed turbidity

MIC of Chloroform extract of Fresh and Dry *Curcuma longa*

The MIC determination was carried out using Agar diffusion method. The minimum inhibitory concentration of the chloroform extracts of Fresh *Curcuma longa* on bacteria *Bacillus cereus*, *Bacillus megatarium*, *Bacillus subtilis* and *E.coli*, was observed as 50,000 µg/ml, whereas bacteria *Protease vulgaris* and *S.aureus* was found to be 100,000 µg/ml.

The MIC determination was carried out using Agar diffusion method. The minimum inhibitory concentration of the methanol extracts of Fresh *Curcuma longa* on bacteria *E.coli*, was observed as 50,000 µg/ml, whereas bacteria *Bacillus cereus*, *Bacillus megatarium*, *Bacillus subtilis*, *S.aureus* and *P.vulgaris* was found to be 100,000 µg/ml.

Table 7 MIC of Chloroform extract of Fresh *Curcuma longa* for various microorganisms

Concentration (µg/ml)	*B. cereus*	*B. subtilis*	*B.megatarium*	*E. coli*	*S. aureus*	*K.pneumoniae*	*P. vulgaris*	*P. aeruginosa*
200,000	-	-	-	-	-	+	-	+
100,000	-	-	-	-	-	+	-	+
50,000	-	-	-	-	+	+	+	+
25,000	+	+	+	+	+	+	+	+
12,500	+	+	+	+	+	+	+	+
6,250	+	+	+	+	+	+	+	+
3,125	+	+	+	+	+	+	+	+
1562.5	+	+	+	+	+	+	+	+
781.25	+	+	+	+	+	+	+	+
390.62	+	+	+	+	+	+	+	+
195.31	+	+	+	+	+	+	+	+

Negative Sign= Showed no turbidity; **Positive Sign** = Showed turbidity

Table 8 MIC of Chloroform extract of Dry *Curcuma longa* for various microorganisms

Concentration (µg/ml)	*B. cereus*	*B. subtilis*	*B. megatarium*	*E. coli*	*S. aureus*	*K.pneumoniae*	*P. vulgaris*	*P. aeruginosa*
200,000	-	-	-	-	-	+	-	+
100,000	-	-	-	-	-	+	-	+
50,000	+	+	+	-	+	+	+	+
25,000	+	+	+	+	+	+	+	+
12,500	+	+	+	+	+	+	+	+
6,250	+	+	+	+	+	+	+	+
3,125	+	+	+	+	+	+	+	+
1562.5	+	+	+	+	+	+	+	+
781.25	+	+	+	+	+	+	+	+
390.62	+	+	+	+	+	+	+	+
195.31	+	+	+	+	+	+	+	+

Negative Sign= Showed no turbidity; **Positive Sign** = Showed turbidity

Antifungal activity

Anti-fungal activity was determined using agar diffusion technique. Two tested fungi i.e *Aspergillus niger* and *Penicillium crysogenum* were used to study the effect of Methanol and Chloroform extracts of Fresh and Dry *Curcuma longa.*

Antifungal activity of Methanol extract of *Curcuma longa*

Methanol extract obtained from the rhizome of Fresh Curcuma longa and Dry *Curcuma longa* were found to effective against two fungi i.e *Aspergillus niger* and *Penicillium crysogenum.*

Table 9 Antifungal acivity of Methanol extract of *Curcuma longa*

Fungus	Zone of inhibition in mm		
	Fresh *Curcuma longa*	Dry *Curcuma longa*	Positive control
Aspergillus niger	**24**	**15**	**20**
Penicillium crysogenum	**25**	**17**	**21**

Antifungal activity of Chloroform extract of *Curcuma longa*

Chloroform extract obtained from the rhizome of Fresh Curcuma longa and Dry *Curcuma longa* were found to effective against two fungi i.e *Aspergillus niger* and *Penicillium crysogenum.*

Table 10 Antifungal acivity of Chloroform extract of *Curcuma longa*

Fungus	Zone of inhibition in mm		
	Fresh *Curcuma longa*	Dry *Curcuma longa*	Positive control
Aspergillus niger	**22**	**13**	**20**
Penicillium crysogenum	**24**	**16**	**21**

Minimum inhibitory Concentration (MIC) Determination

The MIC value of Fresh *Curcum longa* and Dry *Curcuma longa* were determined against the selected fungi i.e *Aspergillus niger* and *Penicillium crysogenum* using Methanol and Chloroform as a solvent.

MIC of methanol extract of Fresh and Dry *Curcuma longa*

The MIC determination was carried out using Agar diffusion method. The minimum inhibitory concentration of the methanol extracts of Fresh *Curcuma longa* on fungi i.e *Aspergillus niger* and *Penicillium crysogenum was observed as 400,000 µg/ml.*

Table 11 MIC of methanol extract of Fresh and Dry *Curcuma longa*

Concentration (µg/ml)	Fresh *Curcuma longa*		Dry *Curcuma longa*	
	Aspergillus niger	***Penicillium crysogenum***	***Aspergillus niger***	***Penicillium crysogenum***
400,000	-	-	-	-
200,000	+	+	+	+
100,000	+	+	+	+
50,000	+	+	+	+
25,000	+	+	+	+
12,500	+	+	+	+
6,250	+	+	+	+
3,125	+	+	+	+
1562.5	+	+	+	+
781.25	+	+	+	+
390.62	+	+	+	+
195.31	+	+	+	+

Negative Sign= Showed no turbidity; **Positive Sign** = Showed turbidity

MIC of Chloroform extract of Fresh and Dry *Curcuma longa*

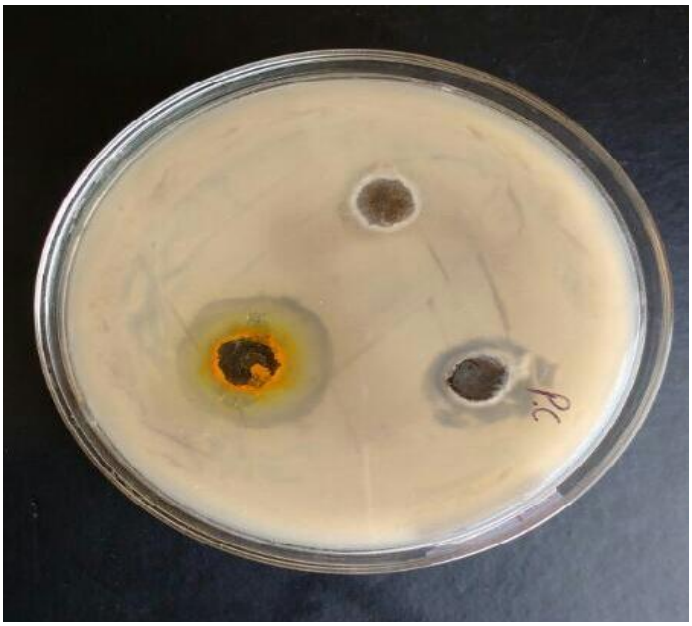
The MIC determination was carried out using Agar diffusion method. The minimum inhibitory concentration of the Chloroform extracts of Fresh *Curcuma longa* on fungi i.e *Aspergillus niger* and *Penicillium crysogenum* was observed as 400,000 µg/ml.

Table 12 MIC of Chloroform extract of Fresh and Dry *Curcuma longa.*

Concentration (µg/ml)	Fresh *Curcuma longa*		Dry *Curcuma longa*	
	Aspergillus niger	*Penicillium crysogenum*	*Aspergillus niger*	*Penicillium crysogenum*
400,000	-	-	-	-
200,000	+	+	+	+
100,000	+	+	+	+
50,000	+	+	+	+
25,000	+	+	+	+
12,500	+	+	+	+
6,250	+	+	+	+
3,125	+	+	+	+
1562.5	+	+	+	+
781.25	+	+	+	+
390.62	+	+	+	+
195.31	+	+	+	+

Negative Sign= Showed no turbidity; **Positive Sign** = Showed turbidity

Figure:1 Antibacterial activity of *Curcuma longa*



Summary and Conclusion

The study was carried out for studying antimicrobial activity and minimum inhibitory concentration of fresh and dry rhizome *Curcuma longa*. Phytochemical analysis of Methanol and Chloroform extract of fresh and dry *Curcuma longa* releaved presence of Alkaloids, flavanoids, Quinones, steroids, saponins, and Terpenoid. Both the extract of fresh and dry rhizome of *Curcuma longa* found to be effective against the bacteria *Bacillus cereus, Bacillus subtilis, Bacillus megaterium, Escherichia coli, Staphylococcus aureus* and *Proteus vulgaris* and the fungi *Aspergillus niger* and *Penicillium crysogenum.*

From the whole study we concluded that antimicrobial activity of extracts of medicinal plants depends on some parameters like plant material used, technique employed, growth medium and most importantly micro-organism tested. For better research better quality of plant material should be selected. The solvent and the extraction system may both modify the final results. Different extracts of a medicinal plant may show the different results. In vitro testing of turmeric shows that the activity of turmeric powder against most bacteria was higher than for the crude drug i.e. streptomycine.

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