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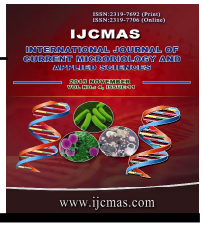

Original Research Article

Biological evaluation of Turmeric (*Curcuma longa*)

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Keywords

Turmeric, antibacterial, Radish seed bioassay, Seed germination, Phytochemical screening, Thin layer chromato-graphy

A B S T R A C T

Medicinal plants like turmeric with highest degree of pharmacological activities can be used for the development of new drugs. Present study was conducted to find out antibacterial activity of turmeric as well as to find out the potential herbicides from aqueous, ethyl acetate, n-hexane, cyclo Hexane extracts of turmeric against radish seeds by radish seed bioassay at different concentrations. The maximum growth inhibition was observed in aqueous and ethyl acetate extracts at both concentration (10,000 ppm and 1000 ppm) on 3rd and 5th day. The lowest inhibition was measured in n-hexane extract at low concentration (1000 ppm) on 3rd day and cyclo hexane on 5th day. Similarly highest seed germination inhibition was observed in ethyl acetate high concentration (7500 ppm) and minimum activity was in cyclo hexane low concentration (1000 ppm). The interesting feature of present study is the stimulatory effects observed in growth on cyclo hexane extract at high concentration (10,000 ppm) and seed germination stimulation was observed in n-hexane high concentration (7500 ppm) on 5th day which is actually due to presence of natural herbicides. Phytochemical screening revealed the presence of alkaloids, phenol, tannins and saponins. This study revealed that the plants can be used as remedy for herbicides, tumor, and various infectious diseases. Further studies required to isolate specific compounds with final purpose of application of our results.

Introduction

Curcuma longa also known as 'Turmeric' belongs to family Zingiberaceae and is extensively used as a seasoning in various foods due to its piquancy as well as therapeutic purposes (Luthra *et al.,* 2001). Turmeric is a long spectrum medicament with variety of bioprotective functions like antioxidant, anti-carcinogenic, anti-mutagenic, anticoagulant, antidiabetic, antifertility, antibacterial and antifungal activities (Ishitha *et al.*, 2004).

Compounds derived from plant sources are of utmost importance in having beneficial effects on health and can be use as a potent source against various infectious agents

(Ushimaru *et al.,* 2007). Development of antibiotic or drug resistance against numerous bacteria has led an increase in demand for compounds derived from these natural sources. Normally extracts of plants are screened for their antifungal, antimicrobial as well as antiviral properties. It is now well established that more than 400,000 plants around the globe have medicinal properties and this has made it an alternative to the otherwise modern medicine (Odugbemi, 2006).

In one study conducted by Chandrana *et al.* (2005) reported that *Curcuma longa* is effective against bacterial strains like *B. subtilus*, *S. aureus* and *E. coli* owing to the different phenolic composition in turmeric like curcuminoids. The essential oil, alkaloid, curcumin, turmerol and veleric acid are responsible for imparting antimicrobial activity to turmeric. Oil derived from Turmeric has proved potent against seven different fungi which were found to be accountable for the adulteration of stored agriculture commodities. Significant fungistatic activity was shown by *Aspergillus parasiticus, Fusarium moniliforme, Penicillium digitatum* and *Aspergillus flavus* (Jayaprakasha *et al.,* 2001). In one assay for antibiotics, turmeric has shown considerable broad-spectrum antimicrobial activity. Turmeric oil along with its ether extracts was effective against *Bacillus coagulans*, *Bacillus subtilus*, *Bacillus cereus*, *Staphylococcus aureus*, *Pseudomonas aeruginosa* and *Escherichia coli* (Chandrana *et al.,* 2005).

The phytochemical constituents of turmeric contain (5.1%) protein, (6.3%) carbohydrates, (69.4%) minerals and moisture (13.1%). Essential oil obtained through steam distillation of turmeric rhizomes possesses sabinene (0.6%), borneol (0.5%), *a*-phellandrene (1%), sesquiterpines (53%), zingiberene (25%) curcumin (diferuloylmethane) (3–4%). Turmeric comprises volatile as well as nonvolatile compounds. Volatile compounds are turmerone, zingiberene, curlone. The nonvolatile components include the curcuminoids (Chattopadhyay *et al.,* 2004).

The effects of *Oldenlandia diffusa* extract are the potential source of variety of biologic activities such as anti-tumor, enzyme inhibitor, immunosuppressive agents. The nature of biological active compound depends on the type of solvent by which the extract is obtained. So the methanolic extract of *Oldenlandia diffusa* has significantly inhibited the root length and seeds germination at different concentrations. These results show the presence of potential biologically active compounds which are secondary metabolites. These active allelochemical compounds have great importance in drug discovery. The major biological active plant metabolites are (terpenoids, phenol and alkaloid) most important in potential medicine (Soriful- Islam *et al.,* 2009). In case of lettuce seed germination assay no phytotoxic effect was observed on root growth for n-Hexane extract. The cytotoxic activity of plant may have anti cancer potential (Razavi *et al.,* 2011). Main objective of the study is to find out antibacterial activity against different strains of Gram negative bacteria along with phytochemical as well as herbicidal properties of Turmeric on radish seeds.

Materials and Methods

Materials and solvents

Turmeric (*Curcuma longa*), radish seeds, mercuric chloride 0.1% solution, ethyl acetate, n-hexane, cyclo hexane, distilled water, 95 % ethanol and methanol, simple (10 gm) and nutrient agar (30 gm).

Test organisms for antimicrobial assay

A total of five test organisms were used for the antibacterial assay. Gram negative bacteria which encompasses *Escherichia coli* (ATCC® 25922™), *Pseudomonas aeruginosa* (ATCC® 27853™), *Salmonella typhimurium* (ATCC 14028), *Shigella dysenteriae* (ATCC® 11835™) and *Klebsiella pneumoniae* (ATCC® 1705™) were used as test organisms which were obtained from Department of Microbiology, Hazara University, Mansehra.

Preparation of plant extracts for antibacterial activty

About 100 gm of Turmeric was taken for this study. To acquire the extraction with aqueous solution about 25 gm of powdered plant material was dissolved in enough distilled water to make 100 ml of aqueous extract (25 % w/v). The methanolic (95 %) as well as ethanolic (95 %) extracts were prepared along the same lines i.e. 25 gm of test substance miscible in enough methanol and ethanol to make 100 ml solution (25% w/v).

Protocol for antibacterial, phytochemical composition and herbicidal activity of turmeric

The antimicrobial activity of extracts of turmeric was screened against five strains of Gram negative bacteria by employing a method known as Agar Well Diffusion method. A sterile cork borer was used to make a cut on the seeded media and inoculated with 100 µl of a standard inoculum (1.5 +10_8 CFU/ml) of each bacterium was uniformly spread on the Petri plates. 100 µl of plant extract was added to the seeded media. These plates were left at room temperature for 15 minutes allowing diffusion of Turmeric on the media and then were transferred to an oven for incubation at 37°C for 24 hours. Antibacterial activity was determined by observing zone of inhibition which is expressed in millimeters and <9mm was taken as inactive, 9–12 was taken as partially inactive, 13–18 mm was considered as active and above 18mm as highly active (Junior and Zanil, 2000). For the Phytochemical analysis four different extracts of turmeric root is screened for the detection of secondary metabolites including alkaloids, phenols, tannins, and saponnins (Mali *et al.*, 2008). For herbicidal activity two different concentrations of Turmeric (10,000 ppm and 1000 ppm) along with four solvents (Water, n-hexane, cyclo-hexane and ethyl acetate) with each concentration is used to check for its inhibitory effect on root length by a standard method known as radish seed phytotoxicity assay as proposed by Turker and Camper (2002).

In this method Petri plates having Whatmann No: 1 filter papers was poured with 5 ml of each extract of two different concentrations of four turmeric extracts. Each of the solvent was evaporated and 5 ml of distilled water was added to Petri plates and plates were sealed off with Para films to avoid the loss of moisture and placed at room temperature in dark. While in control plates 5 ml of aqueous, n-hexane, cyclo – hexane and ethyl acetate was added and 20 surface sterilized with 0.1% mercuric chlorides ($HgCl_2$) radish seeds was added in each plates. The growth of root length was measured after 3^{rd} and 5^{th} day respectively. These steps were repeated in triplicates. In second step for inhibition of radish seeds two different concentrations of turmeric (7500 ppm and 1000 ppm) extracts were used. Same procedure was adopted for second step except the difference in concentration and number of seeds in which 100 surfaces sterilized with 0.1% mercuric chloride solution seeds was used in each plate. This step is also repeated in triplicate and reading was measured at 5^{th} day of

seeds germination. Root length and seed germination inhibition were calculated by using following formula:

% inhibition of Growth=100- R S/ RC × 100

Where RS= Root Length in Sample, RC= Root Length in Control (Samia *et al.,* 2007).

Similarly to check out the active phytotoxic component of turmeric phytochemical analysis was done by TLC. TLC is a technique used for the separation of active chemical constituents present in different extracts of turmeric (Laurence *et al.,* 2007). For this purpose we used commercially available TLC plates for the separation of different component in different extracts. R_f values of separated component were measured and then these values compared with standard R_f values to mention the suggested components. The R_f values of the separated component were determined by using formula.

R_f values = Distance travel by substance/ Distance travel by solvent

Statistical analysis

Statistical analysis was performed by using ANOVA which is a standard method for statistically analysis of radish seed bioassay as shown in table 5.

Results and Discussion

This study was conducted to investigate the antibacterial activity against 5 different strains of Gram negative bacteria as well as phytotoxic and phytochemical composition of different extracts of turmeric root at different concentrations on radish seeds. For antimicrobial activity ethanolic extracts of turmeric was effective against all the test microorganisms while hot and cold water extract show no activity at all with methanolic extract showing moderate activity. The results for antibacterial activity are shown in the table 1.

Similarly % inhibition of turmeric on root root length at 10,000 ppm and 1000 ppm against different extracts were measured at 3^{th} and 5^{th} day and subsequently % seed inhibition at 7500 ppm and 1000 ppm on 5 day only as elucidated in table 2 and 3. In the same way alkaloids, tannins and polyphenols were tested in all solvent extracts which appeared positive except that of aqueous extract of Turmeric which was negative against ferric chloride reagant. Similarly saponnins did not show any activity except that of n-hexane extract while there was no detection of any phytochemical constituent against ninydrin reagent also sown in the table 4. For further fractionation and elucidation of turmeric four different extracts TLC was performed. For this purpose different modified solvent systems were used. The solvent system which revealed the best separation was n-hexane: ethyl acetate: water (11: 81: 8).

Curcuma longa is a highly important medicinal plant, used to treat various diseases. Medicinal plants are the primary source of health in whole world. Use of synthetic drugs may cause harmful effects so medicinal plants are now used as an alternative to synthetic drugs (Awal *et al.,* 2004: Jaing *et al.,* 2006). According to WHO report, 70% of the world population uses medicinal plants to cure the diseases through their traditional practice. In subcontinent plant oriented medicine is used extensively since eons (Gilani *et al.,* 2001).

Curcumin is used for the treatment of cancer and certain neurodegenerative diseases, such as Alzheimer's disease with specific attention to the cell death process induced by curcumin. It slows down the rate of aging. It also contributes in the inhibition of

tumor formation, and progression (Salvioli *et al.,* 2007). Another apoptotic effect of curcumin is the ability to inhibit the hTERT, the active subunit of telomerase (Notarbartolo *et al.,* 2005). The inhibition of hTERT is a separate mechanism by which curcumin can induce cell death in cancer cells (Ramachandran *et al.,* 2002).

Çıkrıkçı *et al.* (2008) carried out isolation and biological assessment of turmeric and curcumin against standard bacterial and mycobacterial strains such as *E. coli, S. aureus, E. faecalis, P. aeruginosa, M. smegmatis, M. simiae, M. kansasii, M. terrae, M. szulgai and the fungi Candida albicans* and showed moderate antibacterial and antifungal activity for the turmeric extracts and pure curcumin. Keeping in view the important role of turmeric in inhibition of different cultures of bacteria and its role as antibacterial, the present study was carried out to evaluate the antibacterial activity of *C. longa* on five bacterial strains against Aqueous, methanolic as well as ethanolic extracts. Turmeric show no antibacterial activity at all against hot and cold water extracts because of the fact that water is a polar compound and only miscible in itself due to which it cannot extract non polar compounds from turmeric. Intrinsic tolerance of the microorganisms may also have a key role in not manifesting antibacterial activity against water and methanolic extracts. Ethanolic extract show maximum activity in comparison to methanol. Methanolic extracts showed moderate activity against *Escherichia coli* (ATCC® 25922™), *Pseudomonas aeruginosa* (ATCC® 27853™) with negligible effect against *Salmonella typhimurium* (ATCC 14028), and no activity against *Shigella dysenteriae* (ATCC® 11835™) and *Klebsiella pneumoniae* (ATCC® 1705™). Highest and best antibacterial activity was shown by ethanolic extracts which were active against all bacterial strains. This is in conformity with the study carried out by Laohakunjit *et al.* (2007) who demonstrated that ethanol extracts of turmeric gave the highest antimicrobial activity.

The qualitative phytochemical screening of plants showed the potent phytochemical constituents of the plant. Prior study accomplished by Gills (1992) investigated that plants having tannins are used in medicine for the treatment of asthma, cough and hay fever. In our current study for the screening of bioactive constituents phytochemical analysis was carried out to detect the presence of alkaloids, phenolics, tannins and saponnins against different reagents. Alkaloids, tannins and polyphenols were tested in all solvent extracts which appeared positive except that of aqueous extract of Turmeric which was negative against ferric cloride reagant. Similarly saponnins did not show any activity except that of n-hexane extract while was no detection of any phytochemical constituent against ninydrin reagent.

Previous studies on phytotoxic effect of different plant species was carried out on radish seeds and growth of root length and seed germination was measured. Radish seeds have been used generally for toxicity studies because they are sensitive to phytotoxic compounds and “Radish Seed Bioassay” is a standard assay for allelopathic studies (Samia *et al.,* 2007). Soriful -Islam *et al.* (2011) determined the phytotoxic seed germination inhibition of *O. diffusa* methanolic extract at two different concentrations (7500 ppm and 1000 ppm). Similarly Razavi *et al.* (2011) studied phytotoxic effects of *Astrodaucus orientalis* (L) with n-hexane showing the Lettuce seed germination inhibition. Additional evidence comes from the study carried out by Goncalves *et al.* (2009) that aqueous and n-

hexane extracts of *Drosophyllum lusitanicum* leaf showed significant seed germination inhibition on lettuce seed and wheat seeds.

Table.1 Antibacterial activity of turmeric against different strains of bacteria

	Zone of inhibition (mm) by Test microorganisms				
Extracts of turmeric	*E. coli*	*P. aeruginosa*	*S. typhimurium*	*K. pneumoniae*	*S. dysenteriae*
Hot water extract	-	-	-	-	-
Cold water extract	-	-	-	-	-
Methanolic extract	12.66 ± 0.88	11 ± 1	7.66 ± 0.88	_	_
Ethanolic extract	16 ± 1.52	12.33 ± 0.88	12 ± 0.57	9.33 ± 0.33	6.33 ± 0.88

Table.2 % inhibition at two different concentrations on 3rd and 5th day reading

% Inhibition of root length at two different concentrations					
	on 3rd day Reading			on 5th Day Reading	
S.N	Extracts	10,000 ppm	1000 ppm	10,000 ppm	1000 ppm
1	Aqueous	100 ± 0	100 ± 0	100 ± 0	99.55 ± 0.17
2	Ethyl Acetate	100 ± 0	99.21 ± 0	100 ± 0	99.75 ± 0.03
3	n-Hexane	73.30 ± 7.49	40.20 ± 2.68	82.21 ± 9.74	55.50 ± 11.09
4	Cyclo Heaxne	140.49 ± 62.43	69.40 ± 7.38	225.56 ± 22.87	43.81 ± 23.10

Table.3 % Seed germination inhibition at two different concentrations on 5th day

% Seed germination inhibition at two concentrations on 5th day			
S.N	Extracts	7500 ppm	1000 ppm
1	Aqueous	77.19 ± 9.64	44.10 ± 3.67
2	Ethyl Acetate	63.94 ± 24.05	100 ± 0
3	n-Hexane	76.69 ± 6.76	44.59 ± 25.67
4	Cyclo Hexane	46.37 ± 5.22	19.56 ± 7.83

Table.4 Phytochemical screening against different reagents

Phytochemical Analysis of Different Extracts Of turmeric						
S.N	Test	Reagents	Ethyl Acetate	Cyclo Hexane	n-Hexane	Aqueous
1	Alkaloids	Wagner's Reagent	+	+	+	+
		Mayer's Reagent	+	+	+	+
		Hager's Reagent	+	+	+	+
2	Phenolic and Tannins	Acetic Acid Solution	+	+	+	+
		5 % Fecl3 Solution	-	-	-	+
		Dil. Iodine Solution	+	+	+	+
3	Saponnins	Distilled Water	-	-	+	-
4	Ninhydrin	5% Ninhydrin Solution	-	-	-	-

+: Presence and -: Absence of metabolites in the extract

Table.5 Statistical tests of equal and unequal variances for % inhibition at two different concentrations on 3rd and 5th day reading for root length as well % seed germination inhibition at two concentrations on 5th day

t-Test: Two-sample assuming equal variances inhibition of root length on 3rd day

Aqueous extract of Turmeric	***10,000ppm***	***1000ppm***
Mean	100	100
Variance	0	0
Observations	4	4
Pooled Variance	0	
Hypothesized Mean Difference	0	
df	6	
t Stat	65535	
t Critical one-tail	1.9431802805	
t Critical two-tail	2.4469118511	

t-Test: Two-sample assuming unequal variances %inhibition of root length on 5th day

	10,000 ppm	***1000 ppm***
Mean	100	99.5566666667
Variance	0	0.0901333333
Observations	3	3
Hypothesized Mean Difference	0	
df	2	
t Stat	2.5576923077	
P(T<=t) one-tail	0.0624337085	
t Critical one-tail	2.9199855804	
P(T<=t) two-tail	0.1248674171	
t Critical two-tail	4.3026527297	

t-Test: Two-sample assuming equal variances inhibition of root length on 3rd day

ethyl acetate extract of turmeric	***10,000 ppm***	***1000 ppm***
Mean	100	99.21
Variance	0	0
Observations	4	3
Pooled Variance	0	
Hypothesized Mean Difference	0	
df	5	
t Stat	65535	
t Critical one-tail	2.0150483733	
t Critical two-tail	2.5705818356	

t-Test: Two-sample assuming unequal variances %inhibition of root length on 5th day

	10,000 ppm	***1000 ppm***
Mean	100	99.7566666667
Variance	0	0.0033333333
Observations	3	3
Hypothesized Mean Difference	0	
df	2	
t Stat	7.3	
P(T<=t) one-tail	0.00912652	
t Critical one-tail	2.9199855804	
P(T<=t) two-tail	0.01825304	
t Critical two-tail	4.3026527297	

t-Test: Two-sample assuming unequal variances
Inhibition of root length on 3rd day

n-Hexane extract of Turmeric	***10,000 ppm***	***1000 ppm***
Mean	73.3033333333	40.2066666667
Variance	168.6116333333	21.6462333333
Observations	3	3
Hypothesized Mean Difference	0	
df	3	
t Stat	4.1559811774	
P(T<=t) one-tail	0.0126640589	
t Critical one-tail	2.3533634348	
P(T<=t) two-tail	0.0253281179	
t Critical two-tail	3.1824463053	

t-Test: Two-sample assuming unequal variances
%inhibition of root length on 5th day

	10,000 ppm	***1000 ppm***
Mean	82.21	55.5533333333
Variance	284.8825	367.8320333333
Observations	3	3
Hypothesized Mean Difference	0	
df	4	
t Stat	1.8071942132	
P(T<=t) one-tail	0.0725098258	
t Critical one-tail	2.1318467863	
P(T<=t) two-tail	0.1450196516	
t Critical two-tail	2.7764451052	

t-Test: Two-sample assuming unequal variances
Inhibition of root length on 3rd day

Cyclo Hexane extract of turmeric	***10,000 ppm***	***1000 ppm***
Mean	140.4933333333	69.4033333333
Variance	11693.5365333333	163.6041333333
Observations	3	3
Hypothesized Mean Difference	0	
df	2	
t Stat	1.1307827	
P(T<=t) one-tail	0.187751516	
t Critical one-tail	2.9199855804	
P(T<=t) two-tail	0.3755030319	
t Critical two-tail	4.3026527297	

t-Test: Two-Sample assuming unequal variances
% Inhibition of root length on 5th day

	10,000 ppm	***1000 ppm***
Mean	225.5666666667	43.8133333333
Variance	1569.4922333333	1601.7358333333
Observations	3	3
Hypothesized Mean Difference	0	
df	4	
t Stat	5.5902248138	
P(T<=t) one-tail	0.0025119099	
t Critical one-tail	2.1318467863	
P(T<=t) two-tail	0.0050238198	
t Critical two-tail	2.7764451052	

% Seed Germination Inhibition at two different concentrations on 5th Day only

t-Test: Two-sample assuming unequal variances

Aqueous extract of Turmeric		***7500 ppm***	***1000 ppm***
Mean		77.1966666667	44.1066666667
Variance		278.9472333333	40.5536333333
Observations		3	3
Hypothesized Mean Difference		0	
df		3	
t Stat		3.2064271282	
	P(T<=t) one-tail	0.0245450135	
	t Critical one-tail	2.3533634348	
	P(T<=t) two-tail	0.049090027	
	t Critical two-tail	3.1824463053	

t-Test: Two-sample assuming unequal variances

ethyl acetate extract of turmeric	***7500 ppm***	***1000 ppm***
Mean	63.9466666667	100
Variance	1736.5976333333	0
Observations	3	3
Hypothesized Mean Difference	0	
df	2	
t Stat	-1.4984989702	
P(T<=t) one-tail	0.1363680178	
t Critical one-tail	2.9199855804	
P(T<=t) two-tail	0.2727360356	
t Critical two-tail	4.3026527297	

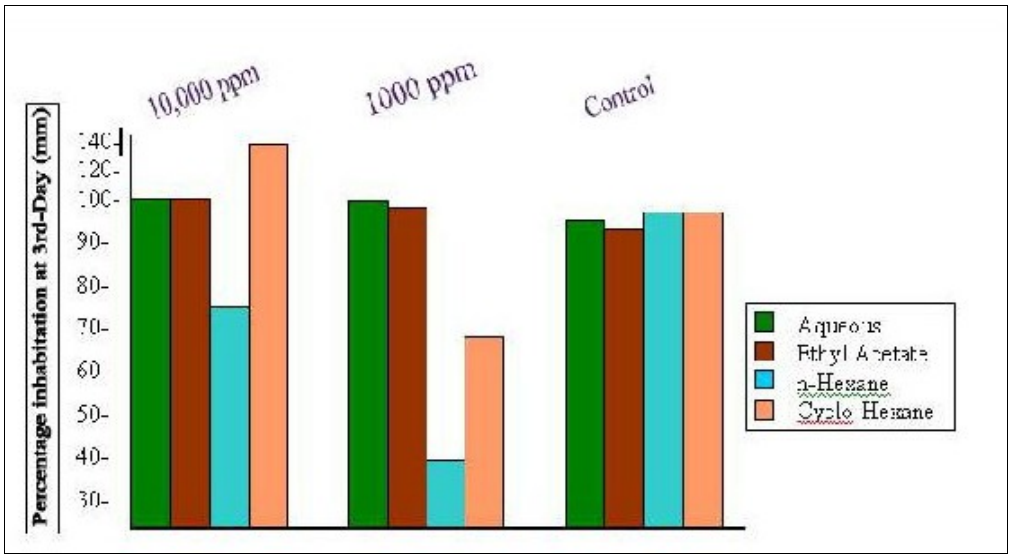
t-Test: Two-sample assuming unequal variances

n-Hexane extract of turemric	***7500 ppm***	***1000 ppm***
Mean	79.6933333333	44.59
Variance	137.2194333333	1978.0903
Observations	3	3
Hypothesized Mean Difference	0	
df	2	
t Stat	1.3219712233	
P(T<=t) one-tail	0.1585595799	
t Critical one-tail	2.9199855804	
P(T<=t) two-tail	0.3171191598	
t Critical two-tail	4.3026527297	

t-Test: Two-sample assuming unequal variances

Cyclo Hexane extract of turmeric	*7500 ppm*	*1000 ppm*
Mean	46.3733333333	19.56
Variance	81.9250333333	184.3639
Observations	3	3
Hypothesized Mean Difference	0	
df	3	
t Stat	2.8459998676	
P(T<=t) one-tail	0.0326616982	
t Critical one-tail	2.3533634348	
P(T<=t) two-tail	0.0653233964	
t Critical two-tail	3.1824463053	

Figure.1 Graphical presentation of root length inhibition on 3rd day and 5th day at different concentrations i.e. 1000 ppm and 10,000 ppm of different solvents (shown in green, brown blue and pink color) of turmeric against radish seeds. Maximum and consistent activity is shown by aqueous extract followed by ethyl acetate extract of turmeric. N-hexane showed moderate activity at high concentration while it exhibits little at low concentration. Cyclo hexane shows tremendous inhibition at high concentration on both 3rd and 5th day with significant activity at low (1000 ppm) concentration on 3rd day and little activity at low concentration on 5th day



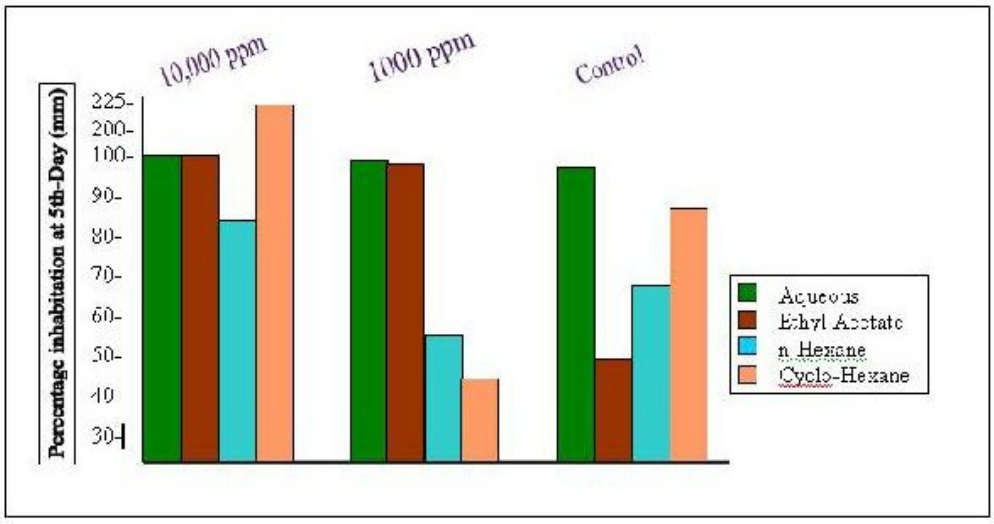


Figure.2 Graphical presentation of seed germination inhibition at 1000 ppm and 7500 ppm concentrations. At 5th day analysis the maximum seed germination inhibition was showed in Ethyl Acetate extract at low concentration (1000 ppm). The lowest germination inhibition was measured in Cyclo Hexane low concentration (1000 ppm). An important feature is the seed germination stimulation at high concentration (7500 ppm) of n-Hexane extract

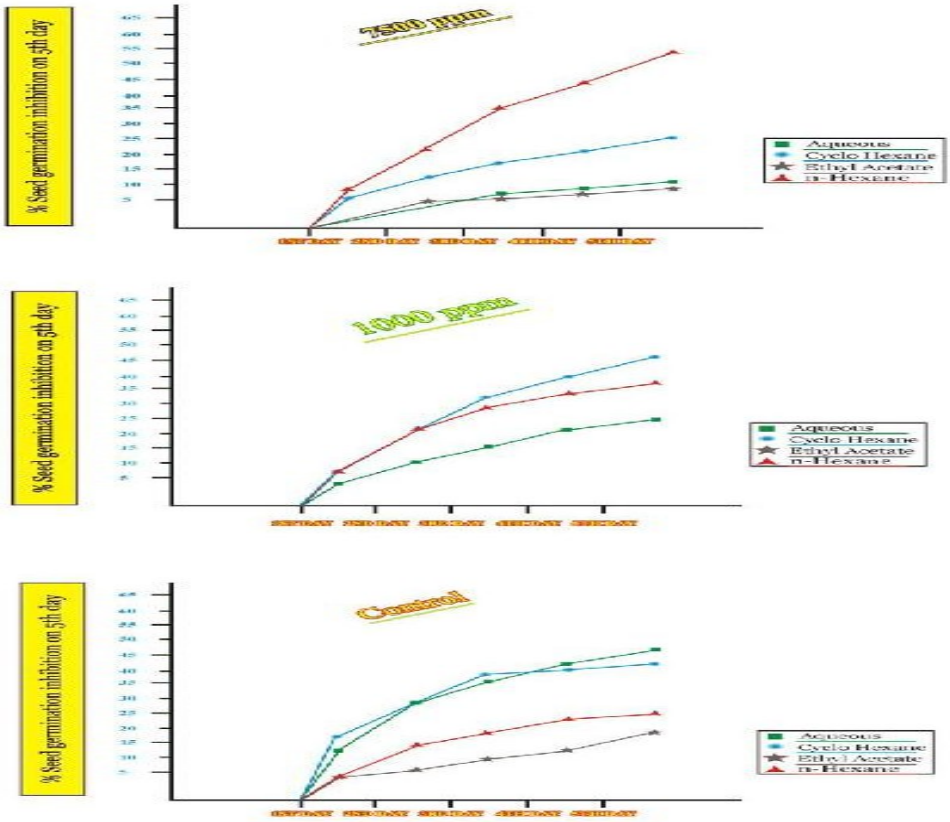
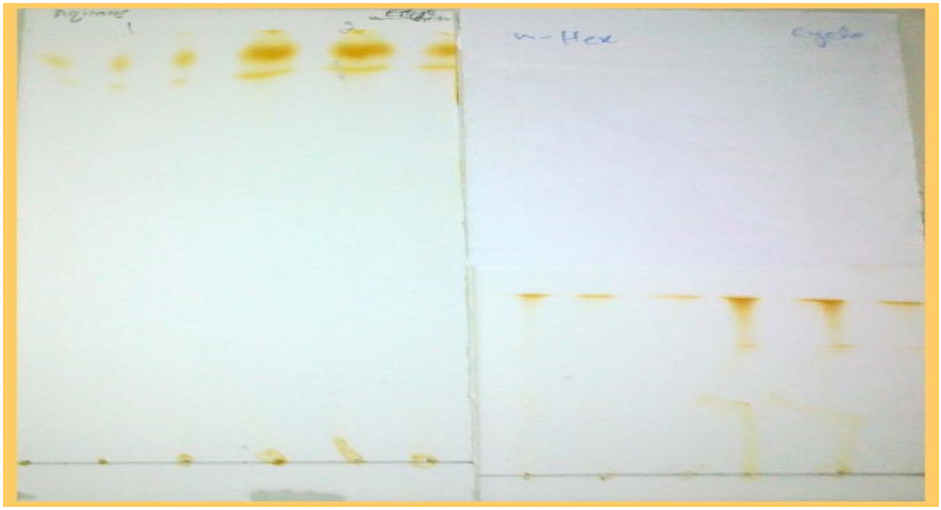


Figure.3 TLC profiling of different extracts of turmeric which showed the presence of alkaloids, phenolic and tannins compounds.



The present study demonstration of herbicidal activity of turmeric against radish seeds by using crude botanical n-hexane, aqueous, ethyl acetate, cyclo hexane extracts at two different concentrations (10,000 ppm and 1000 ppm) on root length was performed. Aqueous and Ethyl Acetate extracts showed highest inhibition of growth at 3rd day and 5th day on both low and high concentrations. The lowest % growth inhibition was observed at low concentration (1000 ppm) of n-hexane while cyclo hexane showed tremendous growth inhibition at high concentration(10,000 ppm).The very important feature of the present study is the growth stimulation at high concentration (10,000 ppm) of cyclo hexane at both 3rd and 5th day observation as evident by figure 1 while in case of seed germination inhibition same four different crude extracts of turmeric at two different concentrations (7500 ppm and 1000 ppm) were used which was measured on 5 th day only. At 5th day analysis the maximum seed germination inhibition was showed in ethyl acetate extract at low concentration (1000 ppm) with significant inhibition showing by aqueous extract at both low and high concentrations. The lowest germination inhibition was measured in cyclo hexane at low concentration (1000 ppm). The important aspect of the current study is the seed germination stimulation at high concentration (7500 ppm) of n-Hexane extract which manifests that Turmeric contains phytotoxic compounds which inhibit the growth of root length and seed germination. Graphical presentation of Seed Germination Inhibition at 1000 ppm and 7500 ppm concentrations is shown in figure 2.

In conclusion, *Curcuma Longa* contains phytotoxic compounds which inhibit the growth of root length and seed germination and expressed good allelopathic potential. Further detailed study requires isolating the active components and their exact mechanism of action will significantly be helpful for the development of new pharmaceuticals without having sides effects.

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