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Phytochemical and pharmacological properties of *Curcuma amada*: A Review

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Abstract

Plants are considered as one of the main sources of biologically active materials. The medicinal property of a plant depends upon the physiologically active biochemical compounds called secondary metabolites. *Curcuma amada* is one of the important species of Curcuma family having medicinal and biological properties. The aim of the present paper assesses the phytochemicals, volatile compounds, antimicrobial and other biological activities, along with recent trends in research of C*. amada.* Volatile oils extracted from rhizomes of C*. amada* are rich in phytoconstituents. The major constituents found in its rhizomes are curcuminoids (curcumin, demethoxycurcumin, bisdemethoxycurcumin), penolic compounds (caffeic acid, gentisic acid, ferulic acid, gallic acid cinnamic acid), terpinoids (difurocumenol, amadannulen, amadaldehyde) and essential oil (β-myrcene and α-asarone). The curcuminoids present in C. *amada i*s responsible for its therapeutic activities. It is traditionally used to treat various diseases which includes anti-inflammatory, anti-bacterial, anti-cancer, anti-tubercular, anti -allergy, anthelmintic and antipyretic activities. It also possesses healing of various skin diseases.

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INTRODUCTION

Plants consists numerous biologically active compounds which are produced during the plant metabolic processes. These chemicals are referred as "phytochemicals or secondary metabolites". The natural phytotherapeutic constituents are identified from plants can be derived from leaves, stems, roots, fruits, rhizomes, bark, flowers and seeds etc (Gordon, 2001). The phytotherapeutic effects of plant materials are unique to the particular plant species and its medicinal effects are outstanding to the combination of secondary product present in the plant (Uddin and Rauf, 2012). Due to dearth of allopathic treatment with contemporary amenities in developing countries, 60% population of the world in the still depending on plants for treating diseases. Around 80% of the human population is following their traditional or Ayurvedic medicine.

Curcuma amada (*C.amada*) is a rhizomatous aromatic herb belongs to the species of *Curcuma* genus and the family of *Zingiberaceae*. It is commonly known as mango ginger. C*. amada i*s from east Indian origin. It has been extensively employing in food industry and alternative medicines. It has a popular spice and vegetable due to its rich flavor, which is described as sweet with subtle earthy floral and pepper overtones and similar to that of raw mango. Like other members of Cu*rcuma ge*nus, C.a*mada al*so has kind of therapeutic properties. The root contains an essential oil and pungent principles. It strengthens the stomach and digestive system, is carminative and expectorant. It gives relief

Table 1: Phytochemical screening of *Curcuma amada*

S. No	Phytochemicals	Rhizome Extract	References
1	Glycosides	Ethanol	Kaur *et al.* (2018)
2	Alkaloids	Ethanol, Methanol, Distilled water	Singh and Phucho (2015)
		Aqueous, Ethanol	Prema *et al.* (2014)
3	Tannins	Ethanol, Methanol, Distilled water	Singh and Phucho (2015)
		—–	Prema *et al.* (2014)
4	Flavanoids	Ethanol, Methanol, Distilled water	Singh and Phucho (2015)
		Aqueous, Ethanol	Prema *et al.* (2014)
5	Saponin	Distilled water	Singh and Phucho (2015)
6	Terpenoid	Chloroform, Ethanol, Methanol, Distilled water	
7	Phlobatannin	Ethanol, Methanol, Distilled water	
8	Cardiac glycosides	Chloroform, Ethanol, Methanol, Distilled water	
9	Protein	Ethanol, Methanol	
10	Coumarin	Chloroform, Ethanol, Methanol, Distilled water	
11	Gum	Chloroform, Ethanol, Methanol, Distilled water	
12	Emodins	—–	
13	Phytosterol	Ethanol, Methanol, Distilled water	
14	Anthraquinone	Ethanol, Methanol	
15	Chalcones	——	
16	Cysteine	——	
17	Ligands	Ethanol, Distilled water	
18	Leucoanthocyanin	—–	
19	Elagic acid	Ethanol, Methanol	
20	Glycosides	Ethanol	
21	Steroids	—–	Prema *et al.* (2014)
22	Sterols	—–	
23	Reducing sugar	Aqueous, Ethanol	
24	Phenolic compounds		
25	Terpenoids		
26	Volatile oils		

in digestive complaints such as abdominal gas problems, constipation, colic, indigestion, bad breath, stomach pain, loss of appetite, wind, indigestion and hiccups. It effectively reduces and cures bronchitis, asthma and cough internally. The external application of mashed and grated root of C.a*mada is* useful in the treatment of sprains, wounds, bruises and ulcers.

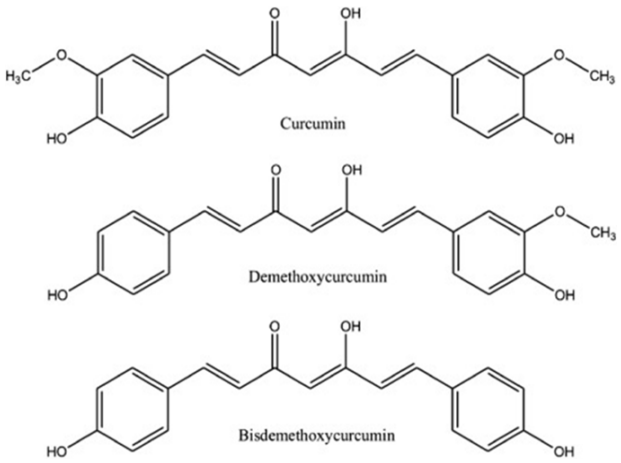

Figure 1: Structureof curcumin, demothoxycurcumin, bismethoxycurcumin present in *C.amada*

Ethnobotanical claims of *Curcuma amada*

In the present review the above mentioned plant material is used to evaluate the phytochemical constituents, antimicrobial, biological properties and value added products. *C.amada* was originated in the Indo-Malayan region and distributed widely in the tropics from Asia to Africa and Australia. It is usually found in Sri lanka, Bangladesh and South and east asian countries. It also found in the wild parts of West Bengal, and is cultivated in Gujarat, Uttar Pradesh, Kerala, Karnataka, Tamil Nadu and the north-eastern states of India.

The maximum height of plant is 1m length. The leaves are long, oblong, lanceolate, radical, sheathed, petiolate and in tufts. Rhizomes are fleshy, buff coloured, 5–10 cm long, 2–5 cm in diameter and demarcated into nodes and internodes, rhizomes have raw mango flavour and taste pungent. Flowers are huge, elongated with 4–5 flowers in respective branch.They grow well in fertilized wetlands and partially shaded areas too. Sunlight is essential for plant growth. Healthy rhizome or seed is preferred for planting. The cultivation area must be dug deeply well before monsoon. Even it grows well in sandy loam soil also. The Preferred whether condition for the plant is hot and humid with high rainfall. Semi shaded and open conditions are best cultivation method for plant growth.

Phytochemical screening of *Curcuma amada*

The preliminary phytochemical analysis was done in various rhizome extract of *C.amada* and depicted in Table 1. From Table 1 it was concluded that, chloroform, ethanol, methanol and distilled water extracts were gave good results for terpenoid, cardiac glycosides and gum (Singh and Phucho, 2015) positive results for tannins in ethanol, methanol and distilled water (Singh and Phucho, 2015). (Kaur *et al.*, 2018)revealed the presence of carbohydrates, saponins, glycosides, phytosterols, resins, and flavonoids in rhizome extracts. From Table 1 can conclude the rhizome extract of C.am*ada exh*ibited optimistic results for maximum therapeutic chemical constituents.

Curcuminoids in *C.amada*

The main active ingredient in turmeric is known as curcumin. It has better antioxidant and anti-inflammatory properties. Curcuminoids are known as polyphenolic a pigment which includes curcumin, demethoxycurcumin and bisdemethoxycurcumin. Curcumin is the primary curcuminoid in turmeric and the compound for which most studies have been done. Three major curcuminoids were present in acetone extract of *C.amada* (Gupta *et al.*, 1999). Figure 1 illustrated the structure of curcumin, demothoxycurcumin, bismethoxycurcumin present in C.*amada.*

Volatile compounds in *C.amada*

Volatile oils otherwise known as essential oils which are derived from plants are used for aromatherapy, a form of alternative medicine in which healing effects is attributing to aromatic compounds. Leaves of *C.amada* containing some volatile compounds which were shown in Table 2. These essential oils are used in aromatherapy to induce relaxation, but still there is no adequate proof that essential oils can effectively treat any condition (Padalia *et al.*, 2013).

Pharmacological properties of *C.amada*

C.amada is a potent anti-microbial and other biological activity. Tables 3 and 4 articulated the biological importance of C.*amada* in various extracts.

In Table 3 , medicinal plant showed evidence of antimicrobial activity by different mechanisms. This can be achieved by the inhibition of cell wall synthesis, interference with the permeability of cell membrane, cause membrane disruption, modifying cellular constituents, and cell damage or cell mutation (Achika and Ndukwe, 2016). The methanol, ethanol and hexane extract of the plant showed maximum inhibitory effect on gram positive and gram negative bacteria (Rao *et al.*, 2017). The *in vitro* antimicrobial activity of the C.*amada r*hizome

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Table 2: Volatile compounds present in *C.amada*

S. No.	Plant part	Type of volatile oil	References
1	Rhizome	Myrcene (80.5%)	Singh *et al.* (2002)
2	Rhizome	Myrcene (88.8%)	Padalia *et al.* (2013)
3	Fresh Rhizome	Myrcene (88.6%)	Choudhury *et al.* (1996)
4	Rhizome	(Z)-β-Farnesene (21.9%), guaia-6,9-diene (19.8%), α-longipinene (14.8%), α-guaiene (14.5%), and camphor (5.5%).	Mustafa *et al.* (2005)
5	Fresh Rhizome	(E)-Hydroocimene(15.9%), (Z)hydroocimene(14.2%), myrcene (14.9%), and linalool (13.4%)	Rao *et al.* (1989)
6	Rhizome	ar-Curcumene (28.1%), β-curcumene (11.2%), camphor (11.2%), curzerenone (7.1%), and 1,8-cineole (6.0%)	Srivastava *et al.* (2001)
7	Leaf	Camphor (17.9%), epi-curzerenone (10.8%), curzerenone (9.5%), and isoborneol (7.3%)	Srivastava *et al.* (2006)

extracts showed highly active against harmful bacteria and fungi. These results may helpful to find a route of antimicrobial treatment by replacing allopathic drugs.

From Tables 3 and 4 C.*amada* is a potent antimicrobial and anti-oxidant, being helpful in treat skin problems. It really helpful to detoxify the body and improves skin tone. C.*amada* being anti-inflammatory is also useful in treating inflammations due to injury, liver inflammation, arthritis and rheumatism. It has been found that mango ginger contains anti-oxidant, anti-inflammatory, anti-fungal and anti-bacterial properties. Various phytochemicals and bioactive constituents were reported in mango ginger rhizome. They were effective for various biological activities such as anti-cancer, anti-microbial, anti-depressant, anti-tubercular and platelet aggregation inhibitory roles. It also revealed the effects on relieving pain and itching, also helps to cure the metabolic problems. It is an analgesic and expectorant which is often used to provide relief from cold and cough. Enterokinase found in mango ginger which improves digestion process in humans and animals. This enzyme breaks down the proteins into organic compounds which are easier to digest. Its root detoxified the body and promotes digestive strength.

Value added products and culinary uses of mango ginger

(Balestra *et al.*, 2011) formulated the bread containing mango ginger powder. They also examined the rheological properties, physical properties, total phenolics content, radical scavenging activity and sensory analysis of the supplemented bread were determined. From the rheological reports of 3% bread with mango ginger powder revealed doubled antioxidant activity when compared to control bread and other studied samples. (Crassina and Sudha, 2015) repared soup sticks using mango ginger powder instead of wheat flour. Researcher also examined the nutritional characterization of the soup sticks in terms of protein and starch in *vitro d*igestibility, dietary fiber, minerals, polyphenols and antioxidant activity were determined using standard methods. Addition of gluten powder, potassium bromated and glycerol monostearate improved the texture and baking strength in soup sticks. The total dietary fiber and antioxidant activity of the soup sticks having 10 % mango ginger powder increased from 3.31 to 8.64 % and 26.83 to 48.06 % respectively as compared to the control soup sticks. As he concluded from his work, the mango ginger powder in soup sticks improved the nutritional profile.

Table 3: Antimicrobial activities of *C.amada*

S. No.	Type of extract	Microbes	References
1	Aqueous extract	E.Coli, B.Subtilis, S.aureus	Chandarana *et al.* (2005)
2	Phenolic fractions	Helicobacter pylori	Siddaraju and Dharmesh (2007)
3	chloroform extract	B. cereus, B. subtilis, Micrococcus luteus, Staphylococcus aureus, Listeria monocytogenes, Enterococcus fecalis and Salmonella typhi	Policegoudra *et al.* (2007)
4	Acetone extract	Micrococcus luteus, Listeria monocytogenes,	
5	volatile oil	Curvularia palliscens, Aspergillus niger, A. terreus, Fusarium moniliforme and F. falcatum.	Singh *et al.* (2002)
6	rhizomes essential oil	P.aeruginosa M. luteus, S.aureus,, E. coli, S. typhi, E. fecalis, B. subtilis, B. cereus K. pneumoniae, Y. enterocolitica, E. aerogenes, P. mirabilis, and L. monocytogenes.	Al-Qudah *et al.* (2017)
7	rhizome of mango ginger	S. aureus, S. typhi, S. dysenteriae, P. aeruginosa, P. mirabilis, C. albicans and C. trophicali.	
8	mango ginger essential oil	F. moniliforme, Curvularia palliscens, A. terreus, Aspergillus niger, and F. falcatum	
9	Rhizome dichloromethane (DCM) and ethanol	Staphylococcus aureus, Streptococcus pyogenes, Escherichia coli, Pseudomonas aeruginosa	Kaur *et al.* (2018)
10	Mango ginger rhizome extracts	Escherichia coli, Staphylococcus aureus, Candida albicans	Jegajeevanram and Alhaji (2016)
11	AgNPs of mango ginger	Escherichia coli, Pseudomonas aeruginosa, Klebsiella pneumonia, Bacillus cereus, Staphylococcus aureus and C.albicus	Khairunnisa and Anjana (2018)
12	Hexane, chloroform methanol and essential oil	Ralstonia solanacearum	Karthika *et al.* (2018)

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Table 4: Biological activities of *C.amada*

S. No.	Biological activities	Description	Reference
1	Wounds, cuts, itching	The rhizome extract traditionally used to treat Healing wounds, cuts and itching.	Srivastava *et al.* (2006)
2	Skin diseases	The external use of rhizome paste cures skin diseases.	Gupta *et al.* (1999)
3	Carminative properties, stomachic	The rhizome paste has carminative and useful in stomachic.	Hussain *et al.* (1992)
4	Sprains and contusions	External application of leaves extract treated for sprains and contusions.	Rao *et al.* (1989)
5	Antioxidant activity	The methanol extract of leaves showed maximum antioxidant activity compared to rhizome extract.	Prakash *et al.* (2007)
		Curcumins, phenoilic compounds present in mango ginger responsible for antioxidant activity.	Al-Qudah *et al.* (2017)
6	Lipid peroxidation inhibitory activity	The non-polarized solvents of leaves expressed high lipid peroxidation inhibitory activity.	Tarwadi and Agte (2005)
7	Anti-inflammatory activity	Ethyl alcohol extract of rhizomes showed anti-inflammatory effect on albino rats.	Mujumdar *et al.* (2000)
8	Platelet aggregation inhibitory activity	Ethyl acetate and acetone extract of rhizomes showed highest inhibitory effects than methanol extract.	Policegoudra and Aradhya (2008)
9	Cytotoxicity towards cancer cells	The ethyl acetate extract showed higher anticancer property on cancer cells.	Policegoudra and Aradhya (2008)
10	Antiallergy activity	Herbal preparation of mango ginger has Antiallergic properties.	Pushpangadan *et al.* (2006)
11	Repellent activity	Mango ginger oil showed good repellent activity	Singh and Singh (1991)
12	Biopesticide activity	C.amada oil was 100% inhibited the weevils which showed its insectide activity.	Ahmad and Ahmad (1991)
13	Hypotriglyceridemic activity	Tridon induced hyperlipidemic rats experiment shows the hypotriglyceridemic activity of mango ginger.	Srinivasan and Chandrasekhara (1993)

Continued on next page

Table 4 continued

S. No.	Biological activities	Description	Reference
14	Brine shrimp lethal activity	The aqueous extract showed toxicity against brine shrimp. This showed the bioactivity of plant.	Krishnaraju *et al.* (2006)
15	CNS depressant and analgesic activity	Observation of reduction in barbiturate sleeping time, point out CNS depressant activity	Mujumdar *et al.* (2004)
16	Antitubercular activity	The compound labdane-type diterpenoid, labda-8 (17),12-diene-15,16-dial modified analogues of C.amada have antitubercular properties.	Singh *et al.* (2010)
		Chloroform extract of rhizomes showed inhibitory activity against Mycobacterium tuberculosis.	Singh *et al.* (2010)
17	Enterokinase inhibitory activity	C. amada Posses enterokinase activity	Bhat *et al.* (1981)
18	Antipyretic activity	The Aqueous extract of rhizomes exploratory antipyretic activity on rabbits.	Kumar *et al.* (2015)
19	Anthelmintic activity	The phytocompounds present in mango ginger responsible for anthelmintic activity.	Randeep *et al.* (2011)
20	Antispermatogenic activity	Mango ginger extracts have a potential effect to get better motility, sperm count and testosterone levels.	Siddappa *et al.* (2015)
21	Anticancer	The methanol extract of leaves showed potential anticancer activity for breast cancer.	Sivaprabha *et al.* (2015)
22	Nootropic activity	Acetonic extract tubers accountable for nootropic activity in scopolamine induced memory deficit in rats	Sudeepthi *et al.* (2014)

In Indonesia, young shoots or young top rhizomes are consumed raw or cooked. Trantjam recipe was prepared by mixing coconut with rhizomes of mango ginger. Rhizomes are used in South India for making pickles also make chutneys in north India. The flower clusters are cooked in steam and consumed with rice. Raw or boiled rhizomes are preferred making pickles, candy, preserves salad, sauce and in meet.

CONCLUSION

In recent years, many possible sources of natural antibiotics have been in use for several infectious diseases. Considering the high costs of the synthetic drugs and their various side effects, the search for alternative products from plants used in folklore medicine is further justified. *C.amada* emerges to be vastly potential and had remained unexplored for their bioactive phytochemicals. The available literature on phytochemicals and biological properties and pharmaceutical activities are very impressive. It is an important constituent of numerous industrial applications that sort from food to cosmetics to pharmaceutical products. Thus this plant could be utilized as an alternative source of useful synthetic drugs. Very fewer information is existing on the aerial parts of the plant. Further studies are needed to isolate, characterize and elucidate the structure of the bioactive compounds of this plant for antimicrobial drug formulation.

Conflict of Interest

None.

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