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

Mahadevi R, Kavitha R*

Department of Biotechnology, Periyar University PG Extension Centre, Dharmapuri – 636701, Tamil Nadu, India

**Article History:**

Received on: 10 Feb 2020  
Revised on: 28 Mar 2020  
Accepted on: 28 Apr 2020

**Keywords:**

Curcuma amada, Phytoconstituents, Antimicrobial activity, Curcuminoids

**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, bis-demethoxycurcumin), 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* is 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.

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* (*Camada*) 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* is 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 *Curcuma* genus, *Camada also* 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 in digestive complaints such as abdominal gas prob-
### 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 | Singh and Phucho (2015) |
| 7     | Phlobatannin   | Ethanol, Methanol, Distilled water | Singh and Phucho (2015) |
| 8     | Cardiac glycosides | Chloroform, Ethanol, Methanol, Distilled water | Singh and Phucho (2015) |
| 9     | Protein        | Ethanol, Methanol | Singh and Phucho (2015) |
| 10    | Coumarin       | Chloroform, Ethanol, Methanol, Distilled water | Singh and Phucho (2015) |
| 11    | Gum            | Chloroform, Ethanol, Methanol, Distilled water | Singh and Phucho (2015) |
| 12    | Emodins        | ——              | Singh and Phucho (2015) |
| 13    | Phytosterol    | Ethanol, Methanol, Distilled water | Singh and Phucho (2015) |
| 14    | Anthraquinone  | Ethanol, Methanol | Singh and Phucho (2015) |
| 15    | Chalcones      | ——              | Singh and Phucho (2015) |
| 16    | Cysteine       | ——              | Singh and Phucho (2015) |
| 17    | Ligands        | Ethanol, Distilled water | Singh and Phucho (2015) |
| 18    | Leucoanthocyanin | ——              | Singh and Phucho (2015) |
| 19    | Elagic acid    | Ethanol, Methanol | Singh and Phucho (2015) |
| 20    | Glycosides     | Ethanol         | Singh and Phucho (2015) |
| 21    | Steroids       | ——              | Prema *et al.* (2014) |
| 22    | Sterols        | ——              | Prema *et al.* (2014) |
| 23    | Reducing sugar | Aqueous, Ethanol | Prema *et al.* (2014) |
| 24    | Phenolic com-  |                 | Prema *et al.* (2014) |
|       | pounds         |                 | Prema *et al.* (2014) |
| 25    | Terpenoids     |                 | Prema *et al.* (2014) |
| 26    | Volatile oils  |                 | Prema *et al.* (2014) |
lems, 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. amada* is useful in the treatment of sprains, wounds, bruises and ulcers.

**Figure 1: Structure of curcumin, demethoxycurcumin, bismethoxycurcumin present in *Camada***

**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 *Camada* 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 Phuco, 2015*) positive results for tannins in ethanol, methanol and distilled water (*Singh and Phuco, 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 *Camada* exhibited optimistic results for maximum therapeutic chemical constituents.

**Curcuminoids in Camada**

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 bismethoxycurcumin. 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 *Camada* (*Gupta et al., 1999*). Figure 1 illustrated the structure of curcumin, demethoxycurcumin, bismethoxycurcumin present in *Camada*.

**Volatile compounds in Camada**

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 *Camada* 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 Camada**

*Camada* is a potent anti-microbial and other biological activity. Tables 3 and 4 articulated the biological importance of *Camada* 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 *Camada* rhizome
Table 2: Volatile compounds present in *Camada*

| 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%), curz-erenone (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 *Camada* is a potent anti-microbial and anti-oxidant, being helpful in treat skin problems. It really helpful to detoxify the body and improves skin tone. *Camada* 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) prepared 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 digestibility, 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 *Camada*

| S. No. | Type of extract                      | Microbes                                                                 | References                                      |
|--------|-------------------------------------|--------------------------------------------------------------------------|------------------------------------------------|
| 1      | Aqueous extract                     | E.Coli, B.Subtilis, S.aureus                                              | Chandaran *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 fæcalis 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. falcatus*. | Singh *et al.* (2002)                           |
| 6      | rhizomes essential oil              | *P.aeruginosa*, *M. luteus*, *S.aureus*, E. coli, S. typhi, E. fæcalis, *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. tropicalis*. |                                                 |
| 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.albicans* | Khairunnisa and Anjana (2018)                   |
| 12     | Hexane, chloroform methanol and essential oil | Ralstonia solanacearum                                                   | Karthika *et al.* (2018)                       |
| 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. Curcumin, phenoilic compounds present in mango ginger responsible for antioxidant activity. | Prakash et al. (2007) |
| 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 Chandrasekhar (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     | Antispermatic 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 few 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.

Funding Support

None.

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