



# A REVIEW ON IMPORTANCE OF PHYTOCHEMICAL AND PHARMACOLOGICAL SIGNIFICANCE OF TURMERIC (*CURCUMA LONGA*)

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**Abstract:** *Curcuma longa* L., a member of the ginger family (Zingiberaceae), holds a significant place in traditional medicine for treating diverse ailments. Its high curcumin content has made Indian turmeric particularly renowned globally. The rhizomes of *Curcuma longa*, commonly known as Haldi or Turmeric, play a crucial role. These rhizomes, which are horizontal underground stems, give rise to both shoots and roots.

Turmeric is rich in fat-soluble, polyphenolic pigments known as curcuminoids, among which curcumin (deferuloyl methane) is the predominant compound responsible for the vibrant yellow color seen in Indian curries. Other curcuminoids include demethoxy curcumin and bisdemethoxy curcumin. Often referred to as the 'Indian saffron,' turmeric also boasts natural antiseptic properties. With its considerable nutritive and medicinal value, turmeric contains various phytochemical constituents, which attribute to its status as a medicinal plant. The presence of non-nutritive plant chemicals (phytochemical constituents) underscores its disease-preventive potential.

In its powdered form, turmeric serves not only as a spice, lending flavor to dishes, but also as a medicinal ingredient, offering a range of significant benefits. Numerous studies have explored various aspects of the plant, including its morphology, phytochemical profiles across all parts of the plant, and other noteworthy characteristics, which have been meticulously documented. This paper endeavors to comprehensively review the applications, botanical description, taxonomical classification, phytochemical constituents, and pharmacological activities associated with turmeric, while also presenting current research trends in this field.

**Index Terms** - Turmeric (*Curcuma longa*): Taxonomy, Phytochemical Composition, Utilizations, Pharmacological Properties, and Description.

## I. INTRODUCTION

### 1.1 INTRODUCTION:

The South East Asian native spice turmeric has a long history of use as a condiment and dye. It is mostly grown in Bangladesh, China, Taiwan, Sri Lanka, and Java. Peru. West Indies and Australia. Due to its natural, unprocessed, and affordable qualities, it is still utilized in Hindu rituals and as a dye for sacred clothing. In fact, one of the least expensive spices is turmeric. Although it is used similarly to saffron as a dye, the two spices' culinary applications should not be confused, and they should never take the place of saffron in food preparations. It was employed as a culinary spice and had some religious importance in the Vedic culture of India, where it dates back over 4000 years. The term "meritorious earth" comes from the

Latin terra merita, which refers to the colour of crushed turmeric, which resembles a mineral colour. For more than 4,000 years, people have used turmeric (*Curcuma longa*) to treat a range of illnesses. Numerous studies have suggested that turmeric may be effective in treating a variety of diseases. However, when you read news headlines regarding the therapeutic benefits of turmeric, it's crucial to keep a few things in mind. First, the herb may not function as well in humans as it does in test tubes and animals, where several studies have been conducted. Second, curcumin, the turmeric's key ingredient, has been administered intravenously in several experiments. Finally, some of the investigations present contradictory data. However, turmeric may show promise in the treatment of digestive issues, the prevention of some malignancies and infections, and the reduction of inflammation. Indian curry gets its characteristic flavor and golden colour from turmeric, a common food colouring. Additionally, it is used to colour butter and cheese and to make mustard. Both Ayurvedic and Chinese medicine have traditionally used turmeric as an anti-inflammatory, to heal wounds, skin conditions, digestive and liver issues, and wounds. The entire, segmented, rough-skinned rhizome of the turmeric plant. When powdered, the rhizome's dull orange inside, which is brownish-yellow in colour, appears bright yellow. 2.5–7.0 cm long and 2.5 cm in diameter, with little tubers branching off, is the size of the rhizome. In Indian traditional Ayurveda medicine, turmeric was revered. It was prescribed in Ayurveda to cure a variety of illnesses, from skin conditions to constipation. It was used as a digestive aid and a treatment for jaundice and other liver issues, as well as for fever, inflammation, wounds, infections, dysentery, arthritis, injuries, and trauma. Since it purifies, stimulates, and strengthens blood, turmeric is regarded in unani medicine as the best plant to use for all blood ailments. The majority of Indians refer to turmeric, the primary kitchen spice, affectionately as the "KITCHEN QUEEN," including housewives and hermits living in the Himalayas. Long-term use of turmeric, tulsi, and triphala is comparable to a quick Pancha Karma procedure. Turmeric has a comparatively wide antifungal range.

**1.2 HISTORICAL BACKGROUND:** *Curcuma longa* L., which belongs to the Zingiberaceae family, is a perennial herb that measures up to 1 m high with a short stem, distributed throughout tropical and subtropical regions of the world, being widely cultivated in Asiatic countries, mainly in India and China. In India is popularly known as "Haldi", in Malaysia, Indonesia and India has been well studied due to its economic importance. Its rhizomes are oblong, ovate, pyriform, often short-branched and they are a household remedy in Nepal (Eigner & Scholz 1999). As a powder, called turmeric, it has been in continuous use for its flavoring, as a spice in both vegetarian and non-vegetarian food preparations and it also has digestive properties (Govindarajan 1980). Current traditional Indian medicine claims the use of its powder against biliary disorders, anorexia, coryza, cough, diabetic wounds, hepatic disorder, rheumatism and sinusitis (Ammon et al. 1992). The coloring principle of turmeric was isolated in the 19th century and was named curcumin, which was extracted from the rhizomes of *C. longa* L., with yellow color and is the major component of this plant, being responsible for the anti-inflammatory effects. In old Hindu medicine, is extensively used for the treatment of sprains and swellings caused by injury (Ammon & Wahl 1991). The traditional medicine in China uses *C. longa* L. in diseases, which are associated with abdominal pains. Religious ceremonies still use turmeric in many forms.

### 1.3 PLANT PROFILE:

**Common name:** *Curcuma*, Indian saffron

#### Synonyms:

<b>Sanskrit:</b>	Ameshta
<b>English:</b>	Indian saffron
<b>Hindi:</b>	Haldi
<b>Bengali:</b>	Halud
<b>Telugu:</b>	Haridra
<b>Tamil:</b>	Ameshta
<b>French:</b>	Curcuma
<b>Indonesian:</b>	Kunyit
<b>Malay:</b>	Kunyitbasah

**Biological source:** Turmeric obtained from the rhizome of *Curcuma longa* Linn. (curcumadomestic valetion) belonging to the natural order Zingiberaceae.

**Geographical source:** It is commonly found in Cambodia, China, India, Nepal, Indonesia, Madagascar, Malaysia, Philippines and Vietnam.

**Indian scenario:** It is commonly found in West Bengal, Tamil Nadu, and Maharashtra and also in Madras.

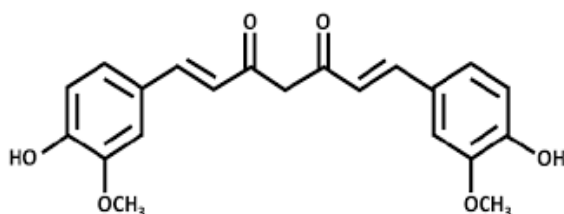
**Family:** Zingiberaceae



**Figure 1. Curcuma Longa (Turmeric) Plant**

### Chemistry:

The major constituent, curcumin (diferuloylmethane) is in the most important fraction of *C. longa* L. and its chemical structure, was determined by Roughly and Whiting (1973). It melts at 176-177°C and forms red-brown salts with alkalis. Curcumin is soluble in ethanol, alkalis, ketone, acetic acid and chloroform; and is insoluble in water. In the molecule of curcumin, the main chain is aliphatic, unsaturated and the aryl group can be substituted or not.



**Chemical Structure of Curcumin**

### TAXONOMY:

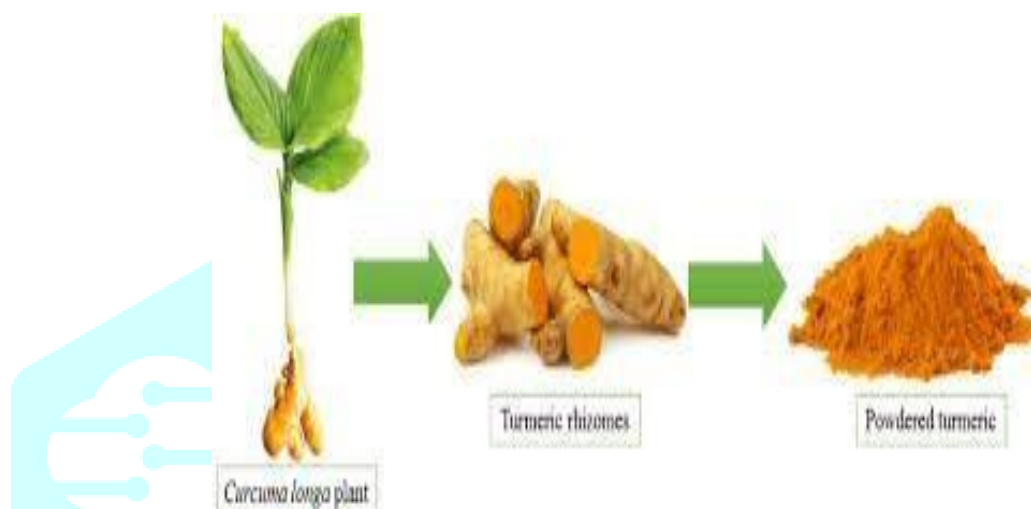
<b>Scientific Name:</b>	<i>Curcuma longa</i>
<b>Kingdom:</b>	Plantae
<b>Sub-kingdom:</b>	Tracheobionta-Vascular plants
<b>Super division:</b>	Spermatophyta
<b>Division:</b>	Magnoliophyta– Flowering plants
<b>Class:</b>	Lilliopsida- monocotyledons
<b>Subclass:</b>	Zingiberidae
<b>Order:</b>	Zingiberales
<b>Genus:</b>	<i>Curcuma</i> L. <i>curcuma</i>
<b>Species:</b>	<i>Curcuma longa</i> L

#### 1.4 Natural Habitat:

The main curcuminoid in turmeric, a popular spice from India and a member of the ginger family (Zingiberaceae), is called curcumin.

Desmethoxycurcumin and bisdemethoxycurcumin are the other two curcuminoids. Turmeric's yellow colour is a result of the polyphenols called curcuminoids. Keto and enol are two of the possible tautomeric derivatives of curcumin. Both in the solid phase and in solution, the enol form has greater energy stability. The so-called curcumin method allows for the measurement of boron using curcumin. It combines with boric acid to produce rosocyanine, a red-colored chemical. Curcumin can be used as food colouring because of its vivid yellow colour.

**1.5 Microscopic characters:** The main rhizome (round turmeric) is up to 4 cm long and 3 cm thick, with an ovate or pear-shaped shape (Fig. 2.). The lower section is distinguished by secondary rhizomes and roots scars, while the upper part is supported by leaf scars. It is cut into pieces before drying. The secondary



rhizomes (long turmeric) are simple or sparingly branching, elongated, and 0.5–1.5 cm thick.

**Figure 2. Turmeric Rhizomes and Powder**

Prior to drying, the Rhizomes are scorched in order to kill their life force, turning the grains into lumps to which the mixture of oil and curcumin released from the oil cells gives a deep yellow hue. The product is harsh, hard, and sinks in water as it is found on the market. The surface of the fractures is waxy, smooth, and orange-yellow in colour. The rind is thicker than in ginger, making up approximately a quarter of the rhizome's thickness, as can be seen in the cross section. Scraping is not an option for removing it. The outermost 4 to 6 layers of brick-shaped parenchymatous cork are visible in the transverse section of turmeric rhizomes, followed by cork cabin. The cortex is composed of spherical, thin-walled parenchymatous cells with sporadic vascular bundles. Collateral oleo-resin cells are found in the cortex and have brownish vascular bundles. Vascular bundles in the pith area are dispersed, forming a ring-like structure under the endodermis. The endodermis is clearly defined, and the starch granules (5–15 m in diameter) are numerous.

#### 1.6 Chemical Constituents:

The main constituents of these classes are poly phenolic curcuminoids, which comprise cyclocurcumin, desmethoxycurcumin, and diferuloylmethane (curcumin). The yellow colour is caused by curcumin (3-4%), which is made up of curcumin I (94%), curcumin II (6%) and curcumin III (0.3%) (Fig.3). The yellow pigmented curcuminoids, which make up 2% to 5% of the root, are normally made up of curcumin, 10% desmethoxycurcumin and 5% bisdemethoxycurcumin. Curcumin makes up 85% of these compounds. The component with the most research is curcumin. Sesquiterpene and (6S)-2-methyl-6-(4-hydroxyphenyl-3-methyl) are additional components of turmeric. Carbohydrates, protein, resins, and caffeic acid, as well as the compound 2-hepten-4-one (turmerone, atlantone, zingiberene, turmeronol, and bisabolene).

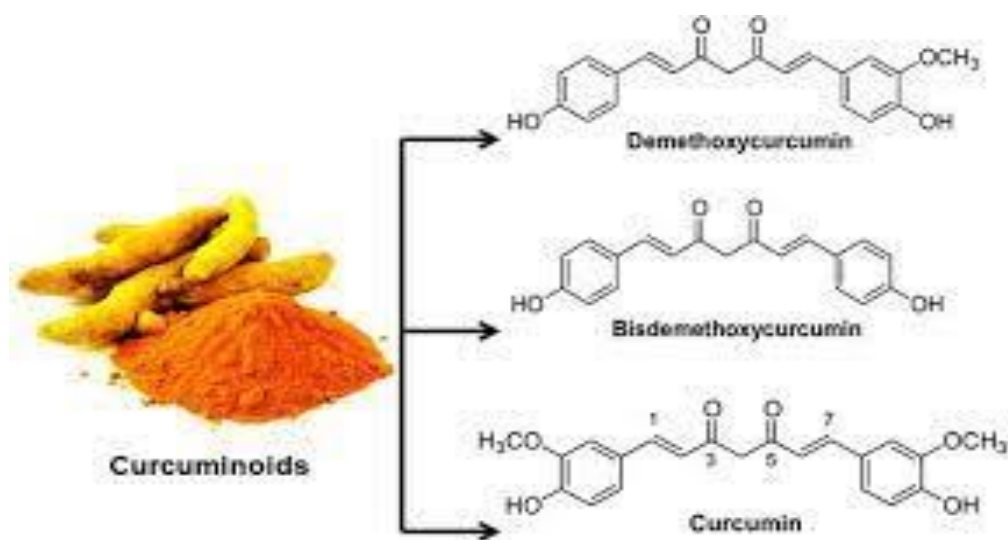


FIGURE 3. CHEMICAL CONSTITUENTS OF CURCUMIN

### 1.7 Structure-Activity Relationships:

It is known that curcumin, which can be extracted from *C. longa* L., belongs to the class of curcuminoids and is very similar to diarylheptanoids. In the literature we can find some authors that associate the anti-inflammatory activity of curcumin and its derivatives to the presence of hydroxyl and phenol groups in the molecule, being essential for the inhibition of prostaglandins (PG synthetase) and leucotrienes (LT) (Kiuchi et al. 1982, 1992, Iwakami et al. 1986). On the other hand, some authors suggested that the anti-inflammatory action is associated to the existence of the  $\beta$ -dicarbonylic system, which has the conjugated double bonds (dienes), being responsible for this activity (Claeson et al. 1993, 1996). This system seems to be responsible not only for anti-inflammatory power, but also to antiparasitic activity (Araújo et al. 1998, 1999). The presence of diene ketone system provides a lipophilicity to the compounds, and thus probably better skin penetration. Other factors can be mentioned here, like the presence of double bonds ( $\alpha$ ,  $\beta$  unsaturated system), which seems to increase the potency of some substances.

### 1.8 Traditional Uses of Curcumin:

- i. Before being used in Ayurvedic compositions, commiphora mulmul (guggul) gum resin must be purified with this material.
- ii. Turmeric is used in veterinary medicine to treat animal wounds and ulcers.
- iii. Turmeric powder is used to safeguard the vessels by sprinkling it around them to deter insects and ants.
- iv. Turmeric and its components are essential to our lives.
- v. The volatile oils, curcumin, and turmeric all have significant anti-inflammatory properties.
- vi. Turmeric has been discovered to have a hepatoprotective property similar to that of silymarin.
- vii. The components of turmeric provide a number of benefits for the digestive system.
- viii. The components of turmeric have an impact on Alzheimer's.
- ix. Turmeric extract reduces the signs and symptoms of arthritis.
- x. Turmeric compounds can lead to radioprotection.
- xi. Turmeric and its extract prevent angiogenesis.
- xii. Vascular smooth muscle cell growth is inhibited by components of turmeric.
- xiii. The serum cholesterol levels are decreased with turmeric.
- xiv. The components of turmeric prevent HIV from replicating.

## 1.9 PHYTOPHARMACOLOGICAL PROPERTIES OF CURCUMA LONGA:

There are a number of medicinal and pharmacologic uses for turmeric. The following are turmeric's most significant medicinal and phytopharmacological qualities.

**1.9.1 Anti-inflammatory Properties:** Due to its volatile oils and curcumin, turmeric longa has strong anti-inflammatory properties. When taken orally, one half of curcumin has been shown to be just as efficient for treating chronic inflammation as cortisone or phenylbutazone. It is said that turmeric has strong anti-inflammatory effects and has unique characteristics that inhibit COX-2 and lipoxygenase. Joint inflammation is frequently linked to rheumatic symptoms. It treats the underlying causes of inflammation as well as its clinical manifestations. LOX, COX, phospholipases, leukotrienes, prostaglandins, thromboxane, nitric oxide elastase, hyaluronidase, collagenase, monocyte chemoattractant protein-1, interferon inducible protein, TNF, and interleukin-12 are all inhibited by curcuminoids' characteristics. Curcumin treatment at levels between 50 and 200 mg/kg decreased edema in mice used as an animal model. Edema can be reduced by 50% when curcumin is applied at a dose of 48 mg/kg body weight. At comparable doses, it is equally efficacious to cortisone and phenylbutazone. Again, in rats, paw inflammation and edema were reduced when a lower dose of 20–80 mg/kg was used. At doses up to 2 g/kg/day, curcumin showed no acute toxicity while inhibiting the arthritis caused by formaldehyde in rats at a level of 40 mg/kg. In an animal study, rheumatoid arthritis caused by streptococcal cell wall was inhibited in both the acute (75%) and chronic (68%) phases by intraperitoneal injection of turmeric extract containing 4 mg of total curcuminoids/kg/day for four days before hand.

**1.9.2 Antimicrobial Properties:** The essential oil of *Curcuma longa* and turmeric extract both inhibit the growth of several bacteria, parasites, and harmful fungi. An examination of caecal parasite-infected chicks. *Eimeria maximum* demonstrated that adding turmeric to meals can promote weight gain and reduce the severity of minor intestinal lesions. In another study, when guinea pigs were infected with dermatophytes, pathogenic moulds, or yeast, turmeric oil administered topically was found to prevent the growth of dermatophytes and pathogenic fungi. The dermatophyte- and fungi-infected guinea pigs' lesions vanished seven days after turmeric administration. Curcumin has been found to have moderate action against the major *Leishmania* and *Plasmodium falciparum* species.

**1.9.3 Antidiabetic Properties:** That turmeric plays a substantial influence in diabetes has been demonstrated by experimental research. Adipocyte differentiation has been seen to be dose-dependently stimulated by hexane extracts (which contain ar-turmerone), ethanolic extracts (which contain ar-turmerone, curcumin, desmethoxycurcumin, and bisdemethoxycurcumin), and ethanolic extracts from the residue of hexane extractions (which contain curcumin, desmethoxycurcumin, and bisdemethoxycurcumin). The outcome demonstrates that the turmeric extract, which contains both sesquiterpenoids and curcuminoids, is more powerfully hypoglycemic than either sesquiterpenoids or curcuminoids alone. Turmeric has extraordinary effects on postprandial plasma glucose and insulin levels. It was found that consuming 6 g of curcumin did not significantly alter the glycemic response. Following the OGTT, insulin significantly increases at 30 and 60 minutes, including curcumin. Additionally, it has been noted that consuming *Curcuma longa* and participating in an OGTT causes a considerable increase in the AUC of insulin. Additionally, turmeric lessens problems from diabetes mellitus. An experimental investigation on albino rats demonstrates the blood sugar-lowering effects of turmeric, and researchers using the polyol route discovered that both curcumin and turmeric lowered blood sugar levels in diabetes caused by alloxan.

**1.9.4 Antioxidant Effects:** When compared to vitamin C and E, turmeric's curcumin component and its water soluble and fat-soluble extracts have potent antioxidant properties. Pre-treatment with curcumin reduces the effects of ischemia-induced alterations in the heart. Bovine aortic endothelial cells were used in an in vitro experiment to see how curcumin affected endothelial hemoxygenase-1, an inducible stress protein. In this work, curcumin incubation for 18 hours increased cellular resilience to oxidative damage. Hemoglobin or lipids may be shielded from oxidation by it. Due to its antioxidant qualities, curcumin can greatly reduce the amount of reactive oxygen species (ROS) produced by activated macrophages, including H<sub>2</sub>O<sub>2</sub>, superoxide anions, and nitrite radicals. Because its derivatives (bisdemethoxycurcumin and desmethoxycurcumin) also have antioxidant properties, they can be used to treat and prevent cholelithiasis.

**1.9.5 Hepatoprotective Effects:** Due to its antioxidant characteristics and capacity to reduce the production of pro-inflammatory cytokines, turmeric has been shown to have similar hepatoprotective and Reno protective qualities as silymarin. Studies on animals have shown that turmeric has hepatoprotective properties against a number of hepatotoxic stimuli, such as acetaminophen (paracetamol), galactosamine, carbon tetrachloride (CCl<sub>4</sub>), and Aspergillus aflatoxin. Administration of curcumin significantly reduced liver injury in test animals when compared to controls in rats with CCl<sub>4</sub>-induced acute and subacute liver injury. Due to sodium curcumin, a salt of curcumin, which also exerts choleric effects by increasing biliary excretion of bile salts, cholesterol, and bilirubin as well as increasing bile solubility, turmeric extract is very effective and can reduce the production of the fungus aflatoxin by 90% when tested on ducklings infected with Aspergillus parasiticus.

**1.9.6 Anticancer Effects:** The effects of turmeric on carcinogenesis have been studied extensively in rat and mouse models as well as in vitro experiments using human cell lines. Curcumin is able to regulate three stages of carcinogenesis: angiogenesis, tumour promotion, and tumour growth, according to numerous in vitro studies. Two studies have found that curcumin inhibits the growth of tumours and cell proliferation. studies on prostate and colon cancer. The action of a number of typical mutagens and Turmeric also suppresses carcinogens curcumin, too. Curcumin and turmeric have the relationship between anti-carcinogenic effects and directly scavenging free radicals and antioxidants impacts, as well as how they can subtly boost glutathione levels to help with mutagen detoxification in the liver and nitrosamine inhibition and carcinogens formation It's also been demonstrated that curcumin decrease UV's ability to cause mutagenesis rays. It has been found that dietary turmeric can effectively be used as a chemo preventive drug in benzo-(alpha)-pyrene induced for stomach cancers in Swiss mice. When a curcumin- containing ointment and an ethanolic extract of turmeric are applied to individuals with external malignant lesions, there is reportedly a noticeable clinical improvement. Using turmeric as an example, we can see how its antioxidant properties help it to combat cancer-causing free radicals. Acetyl curcumin was discovered to be inert. Numerous studies demonstrated that turmeric prevented the expression of the adhesion molecules intercellular adhesion molecule-1 (ICAM-1), vascular cell adhesion molecule-1 (VCAM- 1), and selectin by human umbilical vein endothelial cells. It also acted as an antitumor agent to aid in the induction of apoptosis or programmed cell death (PCD) in human myeloid leukemia cells. I, II and III possess cytotoxic, antioxidant and anti-inflammatory effects. Turmeric's curcumin according to extensive study. These substances have strong intrinsic properties against leukemia and cell lines from the colon, central nervous system (CNS) melanoma, renal and breast cancers.

**1.9.7 Cardiovascular Effects:** As a result of turmeric's antioxidant properties, the cardiovascular system is protected by lowering cholesterol and triglyceride levels, reducing the susceptibility of low density lipoprotein (LDL) to lipid peroxidation, and preventing platelet aggregation. According to a study, turmeric extract reduces the susceptibility of LDL to lipid peroxidation when fed to 18 atherosclerotic rabbits in low doses (1.6–3.2 mg/kg body weight daily). It also lowers plasma cholesterol and triglyceride levels. The greater dose lowers triglyceride and cholesterol levels but did not lower LDL lipid peroxidation. The potential impact of turmeric extract on cholesterol levels from increased liver bile acid production and decreased intestinal absorption of cholesterol. Additionally, it was found that *C. longa* prevents platelet aggregation by enhancing prostacyclin synthesis and suppressing thromboxane synthesis.

**1.9.8 Gastrointestinal Effects:** Sodium curcumin and polymethyl carbinol, two of *Curcuma longa*'s components, have a number of benefits for the digestive system. Intestinal spasm and polymethyl carbinol are inhibited by sodium curcumin, whereas gastrin, secretin, bicarbonate, and pancreatic enzyme output are increased.

Additionally, it has been demonstrated that turmeric can significantly increase stomach wall mucus in rats exposed to gastrointestinal insults such as alcohol, stress, indomethacin, pyloric ligation, and reserpine. When 600 mg of powdered turmeric was administered five times daily to 25 patients with endoscopically confirmed stomach ulcers as part of an open, phase II trial, 48% of the patients demonstrated full healing. No negative reactions or blood abnormalities are evident from the results. Curcumin was found to lessen mucosal damage in mice with artificially induced colitis. Curcumin had the ability to lessen inflammation in rat models of pancreatitis brought on by experimentation. Curcumin was also able to reduce

inflammatory mediators in various types of induced pancreatitis, including those caused by cerulean or ethanol, as determined by histology, pancreatic trypsin, serum amylase, and neutrophil infiltration.

## II. RESEARCH METHODOLOGY

### Phytoconstituents:

- (a) 1,8-cineole, 2-bornanol, 2-hydroxymethyl-anthraquinone, 4-hydroxybisabol-2. (b) 10-diene-9-one; 4-methoxy-5-hydroxybisabol; 4-hydroxy-cinnamoyl- (Feruloyl)-methane, Alpha-atlantone, Alphapinene, Alpha terpineol, Ar-turmerone, Arabinose.
- (c) Ascorbic-acid, Ash, Azulene, Beta-carotene, Beta-pinene, Besesquiphellandrene, Bis- (Para-hydroxycinnamoyl)-methane.
- (d) Bis-desmethoxycurcumin, Bis-abolene, Bixin, Borneol, Boron, Caffeic-acid, Calcium, Caprylic-acid, Caryophyllene, Chromium, Cineole, Cinnamic- acid, Cuminyalcohol, Curcumene, Curcumenol, Curcumin, Curdione, Cobalt, Copper.
- (e) Eugenol, Epiprocurcumenol; Eucalyptol; Eugenol; Feruloyl-p-coumaroyl-methane, Gamma- atlantone, Germacrone, Germacrone13-al; Guaiacol, Isoborneol, L-alphacurcumene.
- (f) L- beta-curcumene, Limonene, Manganese, Monodesmethoxycurcumin, Niacin, Nickel, norbixin; O-coumaric-acid, P-coumaric-acid, P-methoxy cinnamic-acid, Pcymene, Ptolymethylcarbinol, Phosphorus, Protocatechuic-acid, Procurcumadiol. (g) Acidic polysaccharides: utonan A, B, C, D.
- (h) Volatile Oil (4.2%), its main content is turmerone, arturmerone, curcumene, germacrone, ar-curcumene,
- (i) The herbal classics CHMM (Chinese Herbal Materia Medica).
- (j) Other chemicals: Turmeric contains protein (6.3%), fat (5.1%), minerals (3.5%), carbohydrates (69.4%) and moisture (13.1%). Phenolic diketone, curcumin (diferuloylmethane) (3-4%) is responsible for the yellow colour, and comprises curcumin I (94%), curcumin II (6%) and curcumin III (0.3%).
- (k) Other chemical compounds are copper/zinc, campesterol, stigmasterol, beta sitosterol, cholesterol, fatty acids and metallic elements potassium, sodium, magnesium, calcium, manganese, iron.

### 1.10 Preliminary Phytochemical Screening:

The qualitative chemical tests performed for identifying the various phytoconstituents contained in the powdered crude medicine are part of the chemical evaluation. Researchers conducted preliminary phytochemical analyses of *Curcuma longa* rhizome extracts in aqueous, acetone, ethanolic, chloroform, and methanolic forms using commonly used precipitation and coloration reactions. These analyses revealed the presence of substances like carbohydrates, proteins, alkaloids, glycosides, terpenes, steroids, flavonoids, and flavanols, saponins and tannins. The similar tests are out by various data from researchers was being collated standardized published works that are as outlined below.

### 1.11 Preparation of the Extract:

*Curcuma longa* rhizomes were gathered, sun dried, and cut into little pieces. The small dried rhizome piece was crushed into a fine powder and made suitable for use.

#### 1.11.1 Test for Alkaloids:

The extract was thoroughly filtered after being mixed with 3 ml of diluted hydrochloric acid. The filtrate underwent the subsequent test with great care.

- (a) **Mayer's Test:** A few drops of Mayer's reagent are added by the side of the test tube to 1 or 2 ml of filtrate. The presence of alkaloids was detected in the white or creamy precipitate.
- (b) **Wagner Test:** After treating 1 or 2 ml of the filtrate extract with Wagner's reagent, brown or reddish precipitate formed, indicating the presence of alkaloids.
- (c) **Dragendroff's Test:** Alkaloids can be detected by adding 1-2 ml of Dragendroff's reagent to a small amount of filtrate. This results in a noticeable yellow precipitate.

#### 1.11.2 Test for Glycosides:

- (a) When Fehling's solutions A and B are introduced in equal amounts to a 2 ml test solution and the mixture is heated, glycoside is detected positively. A precipitate that was brick red was seen.
- (b) **Legal's Test:** Pyridine and alkaline sodium nitroprusside were added to a 2 ml or 1 ml test solution, and a blood red or pink hue indicated the presence of glycoside.



- (c) **Keller-Killani test:** is applied to 2 ml of glacial acetic acid that contains a drop of extract-treated  $\text{FeCl}_3$ . The development of brown colour ring denotes glycoside presence.
- (d) **Borntrager Test:** First, the extract was heated with diluted sulphuric acid, filtered, and then chloroform was added and vigorously mixed into the filtrate. After separating the organic layer, ammonia is gradually added to it. Additionally, the ammonical layers pink to red coloration indicates a successful outcome.

### 1.11.3 TEST FOR FLAVONOIDS:

- (a) The Shinoda test involved adding 2 ml of test fluid along with a few pieces of magnesium ribbon and adding  $\text{H}_2\text{SO}_4$  drops at a time. The hue of the products is pink scarlet or crimson red.
- (b) **Alkaline Reagent Test:** Sodium hydroxide solution was used to treat the test solution, which results in a yellow or red colour.
- (c) **Zn Test:** After mixing 2 ml of extract with Zn dust and concentrated HCl, red colour was seen, indicating the presence of flavonoids.

### 1.11.4 Test for Tannins:

- (a) **Ferric Chloride Test:** A few drops of ferric chloride solution were added to the extract solution. Gallic tannins were present; blue hue was seen, while catecholic tannins were green black.
- (b) **Gelatin Test:** By combining 2 ml of test solution with 1% Gelatin solution containing 10% sodium chloride, a white precipitate is produced.

### 1.11.5 Test for Saponins:

- (a) Researchers use a foam test to determine whether saponins are present. 20 ml of distilled water and 5 ml of extract were mixed together before boiling. Saponins can be detected by foaming.

### 1.11.6 Test for Terpenes:

- (a) **Salkowski Test:** After adding 2 ml of chloroform and 3 ml of concentrated sulfuric acid to the test solution, the mixture was thoroughly shaken. The formation of a reddish brown colour at the lower layer indicates the presence of steroids, and the presence of triterpenoids is indicated by a yellow hue.

### 1.11.7 Test for Phenols:

- (a) **Ferric Chloride Test:** In the test extract, 4 drops of an alcoholic  $\text{FeCl}_3$  solution were added. The presence of phenol is indicated by the coloration being bluish black.

### 1.11.8 Test for Fats and Fixed Oils:

- (a) **Stain Test:** A tiny amount of the extract was squeezed between the two filter papers; the stain on the filter paper denotes the presence of fixed oils.
- (b) **Saponification Test:** To test for saponification, a little amount of the extract solution containing a drop of phenolphthalein was treated with a few drops of 0.5 N alcoholic potassium hydroxide and heated on a water bath for 1–2 hours. The creation of soap or the partial neutralization of the alkali by the results point to the existence of fats and fixed oils.

### 1.11.9 Test for Proteins and Amino Acids:

- (a) **Millon's Test:** Adding 2 ml of test solution to Millon's reagent results in a white precipitate that turns red when heated.
- (b) **Ninhydrin Test:**  
Ninhydrin solution was treated and then boiled to create a 2 ml test solution. Blue colour formation indicates the presence of an amino acid.  
Once more, a 2ml test solution containing a 0.2% ninhydrin solution was treated with proteins and amino acids before being boiled.

### 1.11.10 Test for Carbohydrates:

The extract was diluted in 5–10 ml of distilled water and passed through Whatman No. 1 filter paper. The filtrate was then utilized for the next test of carbohydrates.

- (a) **Molisch Test:** A test tube containing 2 ml of solution was first filled, after which 1 drop of the Molisch Reagent was added. 2 ml of concentrated HCl was added from the test tube's sides. There was a violet ring in the test tube. Carbohydrates are present when a violet ring forms at the intersection of the two liquids.
- (b) **Fehling Test:** The presence of reducing sugar was detected by the production of a red precipitate when diluted HCl was hydrolyzed with 2 ml of extract, neutralized with alkali, and heated with Fehling's solutions A and B.
- (c) **Benedict's Test:** After the filtrate was heated gently and treated with Benedict's reagent, orange-red precipitate formed, indicating the presence of reducing sugar.
- (d) **Iodine Test:** 2 ml of extract was added to 5 drops of iodine solution, and the resultant blue colour indicates a successful test.

## III. CONCLUSION

A thorough review of the literature has shown that *Curcuma longa*, which has a variety of pharmacological properties, is regarded as an all-purpose cure all among herbal medicines. This plant is regarded as a versatile medicinal plant with a wide range of applications since it contains a variety of chemical components. Therefore, it follows that extensive research will be needed to identify the diseases' therapeutic value. It has long been known that various plant parts have medicinal uses, and today the development of modern drugs typically involves extensive research into their bioactivity, manufacturing process, pharmacotherapeutics, and toxicity, which then calls for proper standardization and clinical trials. *Curcuma longa*, a non-toxic plant product used in traditional medicine today, needed intensive research and development work to fully exploit its medicinal value. Effort should also be made to investigate the world clinical applications as well as the specifics of hidden and unexplored areas to its usefulness for the welfare of mankind.

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