Nature's Precious Treasure: A Comprehensive Review on the Phytochemical and Pharmacological Significance of Turmeric (Curcuma Longa)

***Ram Singh Meena**

Abstract:

Curcuma longa L., a member of the Zingiberaceae family of gingers, is used extensively in traditional medicine to treat a variety of illnesses. Due of its high curcumin concentration, Indian turmeric is very well-known worldwide. The roots of Curcuma longa, often referred to as turmeric or haldi, are essential. These horizontal subterranean stems, or rhizomes, produce roots as well as shoots.

The primary ingredient giving Indian curries their vivid yellow hue is curcumin (deferulolyl methane), one of the several fat-soluble polyphenolic pigments found in turmeric called curcuminoids. Demethoxy and bisdemethoxy curcumin are two more curcuminoids. Turmeric, also known as the "Indian saffron," has inherent antibacterial qualities. Turmeric's reputation as a medicinal plant is attributed to a variety of phytochemical ingredients, which contribute to its significant nutritional and therapeutic significance. The potential of phytochemical ingredients to prevent diseases is highlighted by their existence, which are non-nutritive plant substances. Turmeric, when ground into a powder, has many important medical uses in addition to being a flavouring agent that adds taste to food. The plant's shape, phytochemical profiles in each section of the plant, and other notable features have all been the subject of many research and have all been painstakingly recorded. This work aims to highlight current research trends in this subject and conduct a thorough study of the uses, botanical description, taxonomical categorization, phytochemical ingredients, and pharmacological activity related to turmeric.

Keywords: Taxonomy, Phytochemical Composition, Applications, Pharmacological Characteristics, and Description of Turmeric (Curcuma longa).

1. INTRODUCTION

The indigenous spice of Southeast Asia Turmeric has long been used as a colouring and condiment. Most of it is cultivated in Bangladesh, Sri Lanka, China, Taiwan, and Java. Peru. Australia and the Caribbean. It is still used in Hindu ceremonies and as a dye for garments considered holy because of its organic, unprocessed, and reasonably priced characteristics. Turmeric is really one of the least costly spices. While it may be used as a colour akin to saffron, the culinary uses of the two spices should not be confused, and they should never be substituted for saffron in food preparations. It was used as a spice in food preparation and has considerable religious significance in India's ancient Vedic civilization, which goes back more than 4,000 years. The Latin word terra merita, which describes the

hue of crushed turmeric that has a mineral-like appearance, is where the name "meritorious earth" originates. People have been using curcuma longa, often known as turmeric, for over 4,000 years to cure a variety of ailments. Turmeric may be useful in treating a number of disorders, according to several research. But there are a few things you should be aware of when you read news articles on turmeric's medicinal properties.

Firstly, the herb may not work as effectively in people as it does in animals and test tubes, where a number of research have been done. Second, several studies have used intravenous administration of curcumin, the active component of turmeric. Lastly, conflicting information is presented in several of the studies. Turmeric, however, may be useful in the management of gastrointestinal problems, the avoidance of some infections and cancers, and the decrease of inflammation. Turmeric, a ubiquitous culinary colouring, gives Indian curry its distinct flavour and golden hue. It's also used to produce mustard and to colour cheese and butter.

Turmeric has long been used in Ayurvedic and Chinese medicine as an anti-inflammatory and to treat wounds, skin disorders, liver and digestive problems, and wounds. the turmeric plant's whole, segmented, rough-skinned rhizome. The rhizome's drab orange, brownish-yellow inside becomes brilliant yellow when ground into a powder. The rhizome is 2.5–7.0 cm long, 2.5 cm in diameter, and has tiny tubers that branch out. Turmeric was highly regarded in Indian ancient Ayurvedic therapy. In Ayurveda, it was given to treat a wide range of ailments, including constipation and skin disorders. It was used to treat fever, inflammation, wounds, infections, diarrhoea, arthritis, injuries, and trauma in addition to being a digestive aid and a therapy for jaundice and other liver problems. Turmeric is the greatest herb to use for all blood disorders in unani medicine since it strengthens, cleanses, and stimulates blood. The majority of Indians, especially housewives and hermits living in the Himalayas, lovingly refer to turmeric, the main culinary spice, as the "KITCHEN QUEEN." Using triphala, tulsi, and turmeric over time is similar to doing a short Pancha Karma process. Turmeric's antifungal spectrum is really broad.

2. HISTORICAL CONTEXT:

Curcuma longa L., a perennial plant that grows up to one metre tall and has a short stem, is a member of the Zingiberaceae family and is commonly grown in Asia, mostly in India and China. It is found across tropical and subtropical parts of the globe. Known as "Haldi" in India, Malaysia, Indonesia, and India have all been extensively researched because of their respective economies. In Nepal, its rectangular, ovate, pyriform rhizomes are used as a common home cure and are often short-branched (Eigner & Scholz 1999). Turmeric, a powder, is used extensively for flavouring and as a spice in both vegetarian and non-vegetarian culinary dishes. It also has digestive qualities (Govindarajan 1980). Its powder is said to be used in modern traditional Indian medicine to treat a variety of conditions, including rheumatism, sinusitis, anorexia, coryza, cough, diabetic wounds, hepatic diseases, and sinusitis (Ammon et al. 1992). The primary component of turmeric, curcumin, was identified as the colouring agent in the 19th century. It was derived from the yellow-colored rhizomes of C. longa L. and is primarily responsible for the plant's anti-inflammatory properties. is often used in traditional Hindu medicine to treat sprains and swellings brought on by trauma (Ammon & Wahl 1991). China's traditional medicine employs C. longa L. to treat conditions linked to stomach discomfort.

Turmeric is still used in numerous ways in religious rites.

3 PLANT PROFILE:

Common name: urcuma, saffron from India

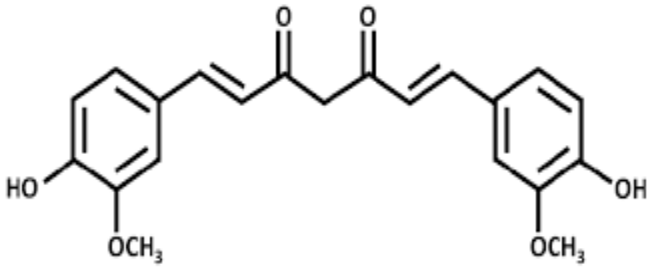
Figure 1. Curcuma Longa (Turmeric) Plant

Biological source: Turmeric derived from the domestic valeton (rhizome) of Curcuma longa Linn., a member of the Zingiberaceae family of plants.

Geographical source: Commonly discovered locations for it include Vietnam, Cambodia, China, India, Nepal, Indonesia, Madagascar, Malaysia, and the Philippines. Indian context: West Bengal, Tamil Nadu, Maharashtra, and Madras are the usual locations for it.

Family: The Zingiberaceae family

Chemistry: Curcumin, or diferruloylmethane, is the main ingredient in the most significant portion of C. longa L. Roughly and Whiting (1973) identified the chemical structure of curcumin. When it melts, reddish-brown salts with alkalis are formed at 176–177°C. Curcumin is insoluble in water but soluble in ethanol, alkalis, ketone, acetic acid, and chloroform. The curcumin molecule has an unsaturated, aliphatic main chain with a variable aryl group that may or may not be replaced.



Chemical Structure of Curcumin

4 Natural Habitat:

Curcumin is the primary curcuminoid found in turmeric, an Indian spice that belongs to the Zingiberaceae family, which also includes ginger. The other two curcuminoids are bisdemethoxycurcumin and desmethoxycurcumin. The polyphenols known as curcuminoids are responsible for the yellow colour of turmeric. Two of the potential tautomeric derivatives of curcumin include keto and enol. The enol form has more energy stability in both the solid phase and the solution. Curcumin may be used to quantify boron according to a technique known as the "curcumin method." It reacts with boric acid to form the red chemical rosocyanine. Curcumin's bright yellow hue makes it suitable for use as food colouring.

5 Chemical Components:

Polyphenolic curcuminoids, which include diferuloylmethane (curcumin), cyclocurcumin, and desmethoxycurcumin, are the primary components of these classes.Curcumin (3–4%), which is composed of curcumin I (94%), curcumin II (6%) and curcumin III (0.3%), is what gives the area its yellow colour (Fig. 3). Typically, the 2%–5% of the root that are yellow-pigmented curcuminoids consist of 10% desmethoxycurcumin, 5% bisdemethoxycurcumin, and curcumin. Of them, 85% consist of curcumin. Curcumin has been studied the most out of all the components.Turmeric also contains sesquiterpene and (6S)-2-methyl-6-(4-hydroxyphenyl-3-methyl). Protein, carbohydrates, resins, caffeic acid, and 2-hepten-4-one (turmerone, atlantone, zingiberene, turmeronol, and bisabolene) are the components of this mixture.

6 Structure-Activity Relationships:

Curcumin, which may be derived from C. longa L., is known to be related to diarylheptanoids and is a member of the curcuminoids class. Some authors have linked the hydroxyl and phenol groups in curcumin and its derivatives' anti-inflammatory properties to their essential role in inhibiting prostaglandin synthetase (PG synthetase) and leucotrienes (LT) (Kiuchi et al. 1982, 1992, Iwakami et al. 1986). However, some writers proposed that the presence of the β-dicarbonylic system, which contains conjugated double bonds (dienes), is what causes the anti-inflammatory effect (Claeson et al. 1993, 1996). It seems that this mechanism is in charge of both the anti-inflammatory and antiparasitic properties (Araújo et al. 1998, 1999). The chemicals have a lipophilicity due to the diene ketone system, which likely improves skin penetration. One may also cite other characteristics, such as the existence of double bonds (α, β unsaturated system), which seems to improve certain drugs' potency.

7 CURCUMA LONGA'S PHYTOPHARMACOLOGICAL ASPECTS:

Turmeric has many pharmacological and medical applications. The most important medical and phytopharmacological properties of turmeric are listed below.

7.1 Anti-inflammatory Properties:

Turmeric longa has potent anti-inflammatory qualities because to its volatile oils and curcumin. It has been shown that half of curcumin, when given orally, is as effective as cortisone or phenylbutazone in

treating chronic inflammation. Turmeric is said to have potent anti-inflammatory properties and special qualities that prevent COX-2 and lipoxygenase. Rheumatic symptoms are often associated with inflammation of the joints. Both the clinical signs and the underlying causes of inflammation are treated by it. The properties of curcuminoids suppress LOX, COX, phospholipases, leukotrienes, prostaglandins, thromboxane, nitric oxide elastase, hyaluronidase, collagenase, monocyte chemoattractant protein-1, interferon inducible protein, TNF, and interleukin-12. Mice utilised as an animal model had less edoema after receiving therapy with curcumin at doses ranging from 50 to 200 mg/kg. Applying 48 mg/kg body weight of curcumin may diminish edoema by fifty percent. It is just as effective as cortisone and phenylbutazone at similar dosages. Once again, in rats, paw edoema and inflammation were reduced at lower doses of 20–80 mg/kg. At dosages as high as 2 g/kg/day, curcumin did not produce acute toxicity in rats, and at 40 mg/kg, it prevented formaldehyde-induced arthritis.

In an animal investigation, an intraperitoneal injection of turmeric extract containing 4 mg of total curcuminoids/kg/day for four days before to the injection prevented 75% of the acute phase and 68% of the chronic phase of rheumatoid arthritis induced by streptococcal cell wall.

7.2 Antimicrobial Properties:

Turmeric extract and Curcuma longa essential oil both prevent the development of several pathogenic fungus, parasites, and bacteria. an analysis of chicks with caecal parasite infection. Turmeric has been shown by Eimera maximum to increase weight growth and lessen the severity of mild intestine lesions. In another research, it was shown that topically applied turmeric oil inhibited the development of pathogenic fungus and dermatophytes in guinea pigs infected with yeast, pathogenic moulds, or dermatophytes. Seven days after turmeric was given to the guinea pigs, the lesions caused by dermatophytes and fungus disappeared. It has been discovered that curcumin has a modest level of activity against the two main types of Leishmania and Plasmaodium falciparum.

7.3 Antidiabetic Properties:

Experimental studies has shown that turmeric has a significant impact on diabetes. Hexane extracts (containing arturmerone), ethanolic extracts (containing arturmerone, curcumin, desmethoxycurcumin, and bisdemethoxycurcumin), and ethanolic extracts from the residue of hexane extractions (containing curcumin, desmethoxycurcumin, and debisdemethoxycurcumin) have all been shown to stimulate adipocyte differentiation in a dose-dependent manner.The result shows that the turmeric extract, which has both curcuminoids and sesquiterpenoids, has a stronger hypoglycemic effect than sesquiterpenoids or curcuminoids by themselves. The effects of turmeric on insulin and postprandial plasma glucose levels are remarkable.
It was discovered that the glycemic response was not much changed by ingesting 6 g of curcumin. Insulin, including curcumin, rises dramatically after 30 and 60 minutes after the OGTT. Furthermore, it has been shown that taking Curcuma longa and taking part in an OGTT significantly raises the AUC of insulin. Turmeric also decreases the effects of diabetes mellitus. Researchers employing the polyol route found that both curcumin and turmeric decreased blood sugar levels in diabetes induced by alloxan. An experimental study on albino rats illustrates the blood sugar-lowering properties of

turmeric.

7.4 Antioxidant Effects:

Turmeric's water soluble and fat soluble extracts, together with its curcumin component, have strong antioxidant qualities when compared to vitamins C and E. Curcumin pretreatment lessens the impact of cardiac changes brought on by ischemia. An in vitro experiment was conducted using bovine aortic endothelial cells to investigate the effect of curcumin on endothelial hemeoxygenase-1, an inducible stress protein. In this study, an 18-hour curcumin incubation period improved cellular resistance to oxidative dam ageing.
It might protect lipids or haemoglobin from oxidation. Curcumin's antioxidant properties allow it to significantly lower the quantity of reactive oxygen species (ROS), such as nitrite radicals, superoxide anions, and H2O2, that are formed by activated macrophages. Cholelithiasis may be treated and prevented using its derivatives, bisdemethoxycurcumin and desmethoxycurcumin, since they also possess antioxidant qualities.

7.5 Effects on Hepatoprotection:

Turmeric has been shown to share hepatoprotective and Reno protective properties with silymarin because of its antioxidant properties and ability to inhibit the generation of pro-inflammatory cytokines. Research conducted on animals has shown that turmeric had hepatoprotective qualities against many hepatotoxic stimuli, including Aspergillus aflatoxin, galactosamine, acetaminophen (paracetamol), and carbon tetrachloride (CCl4). When test animals with acute and subacute liver damage caused by CCl4 were compared to controls, the administration of curcumin dramatically decreased liver injury. Turmeric extract is highly effective and can reduce the production of the fungus aflatoxin by 90% when tested on ducklings infected with Aspergillus parasiticus. This is because sodium curcuminate, a salt of curcumin, also exerts choleretic effects by increasing biliary excretion of bile salts, cholesterol, and bilirubin as well as increasing bile solubility.

7.6 Antitumor Effects:

Numerous in vitro studies using human cell lines and rat and mouse models have been conducted to investigate the effects of turmeric on carcinogenesis. Numerous in vitro studies have shown that curcumin may control the three phases of carcinogenesis: angiogenesis, tumour promotion, and tumour development. Curcumin has been shown in two trials to decrease tumour development and cell proliferation. research on colon and prostate cancer. The effects of some common mutagens and Curcumin, another carcinogen, is likewise suppressed by turmeric. Turmeric and curcumin have the ability to directly scavenge free radicals and antioxidants, which has an anti-carcinogenic effect. They can also gently raise glutathione levels, which aids in liver mutagen detoxification, nitrosamine inhibition, and the formation of carcinogens. Additionally, curcumin has been shown to lessen UV radiation's capacity to trigger mutagenesis. Research has shown that dietary turmeric is an effective chemopreventive medication when used to treat stomach tumours in Swiss mice that were generated with benzo-(alpha)-pyrene. It has been observed that there is a discernible clinical improvement in patients with external malignant lesions when a turmeric ethanolic extract and ointment containing curcumin are used. Using turmeric as an example, we can see how its antioxidant qualities aid in the

fight against free radicals that cause cancer. It has been shown that acetyl curcumin is inactive. Several investigations have shown that turmeric inhibits the expression of selectin, vascular cell adhesion molecule-1 (VCAM-1), and intercellular adhesion molecule-1 (ICAM-1) by human umbilical vein endothelial cells. It also functioned as an anticancer drug, helping to induce programmed cell death (PCD), commonly known as apoptosis, in human myeloid leukaemia cells. I, II, and III have anti-inflammatory, antioxidant, and cytotoxic properties. Numerous studies have shown that curcumin is present in turmeric. These materials possess potent inherent qualities that protect against leukaemia and colon, central nervous system (CNS), melanoma, kidney, and breast cancer cell lines.

7.7 Impact on the Heart:

Turmeric has antioxidant qualities that protect the cardiovascular system by lowering triglyceride and cholesterol levels, decreasing the vulnerability of low-density lipoprotein (LDL) to lipid peroxidation, and inhibiting platelet aggregation. A research found that when given in modest dosages (1.6–3.2 mg/kg body weight daily) to 18 atherosclerotic rabbits, turmeric extract lessens the susceptibility of LDL to lipid peroxidation. Additionally, it reduces triglyceride and plasma cholesterol levels. Although the higher dosage reduced cholesterol and triglyceride levels, it had no effect on LDL lipid peroxidation. Turmeric extract's possible effects on cholesterol levels may result from enhanced bile acid synthesis in the liver and reduced cholesterol absorption in the intestines. Furthermore, it was discovered that C. longa inhibits the production of thromboxane and increases the synthesis of prostacyclin, which reduces platelet aggregation.

7.8 Impact on the Digestive System:

Two of Curcuma longa's constituents, sodium curcuminate and polymethyl carbinol, are beneficial to the digestive system in many ways. Sodium curcuminate increases gastrin, secretin, biocarbonate, and pancreatic enzyme production while inhibiting intestinal spasm and polymethyl carbinol.

Additionally, in rats subjected to gastrointestinal insults such alcohol, stress, indomethacin, pyloric ligation, and reserpine, turmeric has been shown to greatly increase stomach wall mucus. In an open, phase II study, 25 patients with endoscopically proven stomach ulcers received 600 mg of powdered turmeric five times a day; 48 percent of the patients showed complete healing. The findings show no adverse effects or anomalies in the blood. It was discovered that curcumin reduced mucosal damage in animals given fake colitis. In rat models of experimentally induced pancreatitis, curcumin was able to reduce inflammation. Curcumin was also shown to be able to lower inflammatory mediators in histology, pancreatic trypsin, serum amylase, and neutrophil infiltration in different forms of ethanol- or cerulean-induced pancreatitis.

8. RESEARCH METHODOLOGY

8.1 Phytoconstituents:

(a)

- 2-bornanol
- 4-hydroxybisabola-2
- 2-hydroxymethyl-anthraquinone

- 1,8-cineole

(b)

- Alpha-atlantone
- Alphapinene
- Alpha terpineol
- Ar-turmerone
- Arabinose
- 4-methoxy-5-hydroxybiosabola
- 4-hydroxy-cinnamoyl-(Feruloyl)-methane

(c)

- Ascorbic acid
- Ash
- Azulene
- Bis-(parahydroxycinnamoyl)-methane
- Beta-carotene
- Beta-pinene
- Besesquiphellandrene

(d)

- Borneol
- Boron
- Bixin
- Bis-desmethoxycurcumin
- Bis-abolene
- Cobalt
- Copper
- Chromium
- Cineole
- Cinnamic acid
- Cuminyl alcohol
- Curcumene
- Curcumenol
- Curcumin
- Curdione
- Calcium
- Caprylic acid

- Caryophyllene

(e)

- Guaiacol
- Isoborneol
- L-alphacurcumene
- Feruloyl-p-coumaroyl-methane
- Gamma-atlantone
- Germacrone
- Germacrone13-al
- Eugenol
- Epiprocurcumenol
- Eucalyptol

(f)

- Ocoumaric acid
- P-coumaric acid
- P-methoxy cinnamic acid
- Pcymene
- Ptolymethylcarbinol
- Phosphorus
- Protocatechuic acid
- Procurcumadiol
- L-beta-curcumene
- Limonene
- Manganese
- Monodesmethoxycurcumin
- Niacin
- Nickel
- Norbixin

(g)

- Utonan A
- Utonan B
- Utonan C
- Utonan D

(h)

- Turmerone
- Arturmerone
- Curcumene
- Germacrone
- Ar-curcumene

(i)

- Traditional Chinese Herbal Materia Medica (CHMMs)

(j)

- Protein (6.3%)
- Fat (5.1%)
- Minerals (3.5%)
- Carbs (69.4%)
- Moisture (13.1%)
- Curcumin (diferuloylmethane)
- Curcumin I (94%)
- Curcumin II (6%)
- Curcumin III (0.3%)

(k)

- Copper/zinc
- Cholesterol
- Fatty acids
- Beta-sitosterol
- Campesterol
- Stigmasterol
- Calcium
- Manganese
- Iron
- Metallic elements: potassium, sodium, magnesium, and calcium

8.2 Preliminary Phytochemical Screening:

The chemical assessment includes the qualitative chemical tests that are carried out to determine the different phytoconstituents present in the powdered crude medication. Using widely established precipitation and colouring procedures, researchers performed preliminary phytochemical investigations of Curcuma longa rhizome extracts in aqueous, acetone, ethanolic, chloroform, and methanolic forms. Substances such as proteins, carbohydrates, alkaloids, glycosides, terpenes,

steroids, flavonoids, flavonols, saponins, and tannins were found in these studies. Similar tests have been developed using a variety of researcher data that was compiled into standardised published publications, some of which are included below.

8.3 Preparation of the Extract:

The rhizomes of Curcuma longa were collected, desiccated in the sun, and then diced. The little dried rhizome fragment was ground into a fine powder and put to use.

8.3.1 Alkaloids Test:

The extract was combined with 3 millilitres of diluted hydrochloric acid and then carefully filtered. The filtrate was carefully subjected to the next test.

(a) Mayer's Test: Add a few drops of Mayer's reagent to one or two millilitres of filtrate near the test tube's edge. The whitish or creamy precipitate was found to contain alkaloids.

(b) Wagner Test: The presence of alkaloids is indicated by the formation of a brown or reddish precipitate when 1 or 2 millilitres of the filtrate extract were treated with Wagner's reagent.

(c) Dragendroff's Test: A tiny quantity of filtrate is mixed with 1-2 ml of Dragendroff's reagent to identify alkaloids. This produces a precipitate that is clearly yellow.

8.3.2 Test for Glycosides:

(a) Glycoside is positively identified when Fehling's solutions A and B are added in equal parts to a 2 ml test solution and the combination is heated. A brick-red precipitate was seen.

(b) Legal's Test: In a 2 ml or 1 ml test solution, pyridine and alkaline sodium nitroprusside were added. The presence of glycoside was shown by a blood red or pink colour.

(c) The Keller-Killani test: this involves adding a drop of extract-treated $FeCl_3$ to two millilitres of glacial acetic acid. The emergence of a brown hue ring indicates the presence of glycosides

(d) The Borntrager test included heating the extract with diluted sulfuric acid, filtering it, and then adding and agitatingly mixing chloroform into the filtrate. Ammonia is progressively added to the organic layer after it has been separated. A favourable result is also indicated by the ammonical layers' pink to crimson hue.

8.3.3 FLAVONOID TEST:

(a) To perform the Shinoda test, add two millilitres of test fluid, a few bits of magnesium ribbon, and one drop of H_2SO_4 at a time. The items are either crimson red or pink scarlet in colour. (b) Alkaline Reagent Test: The test solution was treated with sodium hydroxide solution, which gives it a yellow or red hue.

(c) Zn Test: Red coloration was seen, indicating the presence of flavonoids, after combining 2 millilitres of extract with strong HCl and zinc dust.

8.3.4 Tannin Testing:

(a) Ferric Chloride Test: The extract solution was mixed with a few drops of ferric chloride solution.
There were gallic tannins, which had a blue tint, and catecholic tannins, which had a green-black colour.

(b) Gelatin Test: A white precipitate is obtained by mixing 2 millilitres of the test solution with 1% Gelatin solution that contains 10% sodium chloride.

8.3.5 Saponin Testing:

(a) To ascertain the presence of saponins, researchers use a foam test. Before boiling, 20 millilitres of distilled water and 5 millilitres of extract were combined. Foaming is a sign of saponins.

8.3.6 Test for Terpenes:

(a) Salkowski Test: The test solution was shaken well after 2 millilitres of chloroform and 3 millilitres of strong sulfuric acid were added. Steroids are identified by the production of a reddish brown colour at the bottom layer, while triterpenoids are indicated by a yellow hue.

8.3.7 Test for Phenols:

(a) Ferric Chloride Test: Four drops of an alcoholic FeCl3 solution were added to the test extract. The blue black colouring indicates the presence of phenol.

8.3.8 Fats and Fixed Oils Test:

(a) Stain Test: The presence of fixed oils is shown by the stain on the filter paper, which was created by squeezing a little quantity of extract between the two filter sheets.

(b) Saponification Test: A small portion of the extract solution containing a drop of phenolphthalein was heated for one to two hours on a water bath after being treated with a few drops of 0.5 N alcoholic potassium hydroxide. Fats and fixed oils are indicated by the production of soap or the partial neutralisation of the alkali by the outcomes.

8.3.9 Protein and Amino Acid Testing:

(a) Millon's Test: When 2 millilitres of test solution are added to Millon's reagent, a white precipitate is produced that, when heated, becomes red.

(b) Ninhydrin Test: A 2 ml test solution was made by treating and boiling a ninhydrin solution. An amino acid's presence is indicated by the production of blue hue.

Again, proteins and amino acids were added to a 2 ml test solution containing a 0.2% ninhydrin solution before it was brought to a boil.

8.3.10 Carbohydrate Test:

After diluting the extract with 5–10 millilitres of distilled water, it was run through Whatman No. 1 filter paper.

The second test for carbs was conducted using the filtrate.

(a) Molisch Test: One drop of the Molisch Reagent was introduced to a test tube that had been filled with two millilitres of solution. Concentrated hydrochloric acid (2 ml) was applied from the test tube's sides.The test tube had a violet ring. When a violet ring develops at the junction of the two liquids, carbohydrates are present.

(b) Fehling Test: Diluted HCl was hydrolyzed with 2 ml of extract, neutralised with alkali, and heated with Fehling's solutions A and B to identify the presence of reducing sugar. This resulted in the formation of a crimson precipitate.

(c) Benedict's Test: An orange-red precipitate developed, indicating the presence of reducing sugar, when the filtrate was gently heated and treated with Benedict's reagent. (d) Iodine Test: After adding 2 millilitres of extract to 5 drops of iodine solution, the mixture became blue, indicating that the test was successful.

9. CONCLUSION

Based on a comprehensive analysis of the literature, Curcuma longa is considered the all-purpose plant among herbal medicines due to its wide range of pharmacological qualities. Because of its diverse spectrum of chemical components, this plant is considered a versatile medicinal plant with a broad range of uses. It implies that in order to determine the illnesses' therapeutic value, a great deal of study will be required. Although the medical benefits of many plant components have long been recognised, the creation of new pharmaceuticals currently usually entails a thorough investigation of the drugs' pharmacotherapeutics, bioactivity, manufacturing method, and toxicity, which necessitates appropriate standardisation and clinical trials. To fully realise the therapeutic potential of curcuma longa, a non-toxic plant product utilised in traditional medicine today, extensive research and development effort was required. Additionally, efforts should be made to look into the global therapeutic uses of this technology as well as the details of its uncharted and hidden applications in order to determine its value for human welfare.

***Associate Professor**
Department of Botany
Govt. College Karauli

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