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Phytochemical and Pharmacological Review and Importance of Curcuma longa

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ABSTRACT: Curcuma longa L., a member of the Zingiberaceae family of plants, is widely used in traditional medicine to treat a wide range of conditions. Curcuma longa rhizomes are commonly referred to as turmeric or haldi. Rhizomes are horizontal underground stems from which roots and shoots protrude. Curcumin (deferulolyl methane), the primary pigment responsible for the yellow colour of Indian curries, is among the fat-soluble, polyphenolic pigments known as curcuminoids that make up turmeric. Other curcuminoids include demethoxy and bisdemethoxy curcumin. Turmeric is a natural antiseptic and is sometimes referred to as "Indian saffron." Turmeric is rich in nutrients and has therapeutic uses. Turmeric is regarded as a medicinal plant because it contains phytochemical constituents. Plant chemicals known as phytochemical constituents, which are nonnutritive, have the ability to prevent disease.Turmeric is used as a spice and food medicine due to its flavouring qualities and numerous other significant health benefits. Turmeric is also available as root powder. Numerous studies have been conducted on a variety of topics, including morphology, phytochemical profiles of the plant's entire parts, and other characteristics that have also been noted and documented.

Keywords: Curcuma longa, Taxonomical Classification, Phytochemical, Uses Pharmacological, Description

INTRODUCTION

Plant parts have been used by humans as a phytomedicine since ancient times. Because they contain both primary and secondary compounds that are bioactive, plants are important. It has been discovered that secondary metabolites are remarkably distinct compounds in terms of both taxonomy and chemistry. These metabolites are used in a wide range of fields, including veterinary medicine, scientific research, agriculture, and human therapy.They are extensively employed in veterinary medicine, scientific research, agriculture, human therapy, and numerous other fields. Approximately 80% of people in developed nations use traditional medicine, which is derived from medicinal plants, as a source of potent and potentially effective drugs, according to the World Health Organisation (WHO). Curcuma longa is a leafy, upright perennial herb that grows up to one metre tall on a short stem. It has yellow flowers that resemble funnels and oblong, pointed leaves. It is a member of the Zingiberaceae family. It is widely grown in tropical and subtropical regions of the world, mostly in China and India, and is typically grown in Asian

nations. "Haldi" is a plant that is commonly known in India and has oblong, ovate, pyriform, and frequently short branches on its rhizomes. According to recent research, curcumin has anti-inflammatory and anticancer properties, giving it a new level of potential. Curcumin, a yellow powder made from rhizomes, has therapeutic applications. Curry powder is made from dried Curcuma longa, the plant from which turmeric is derived. It has a yellow colour. Turmeric is widely used in food due to its flavour and colour, and it is also used in Hindu religious ceremonies and traditional Indian medicine. Turmeric powder has recently gained popularity as a traditional remedy for gastrointestinal disorders, particularly hepatic and biliary disorders, diabetic wounds, rheumatism, inflammation, sinusitis, anorexia, coryza, and cough. In order to fight AIDS, turmeric has anti-HIV activity as well as anti-cancer, antidiabetic and other types of properties.

TAXONOMICAL CLASSIFICATION

Kingdom: Plantae
Subkingdom: TracheobiontaSuperdivision: Spermatophyta
Division: Magnoliophyta
Subclass: Zingiberidae
Order: Zingiberales
Family: Zingiberaceae
Genus: Curcuma
Species: longa
Scientific name: Curcuma longa

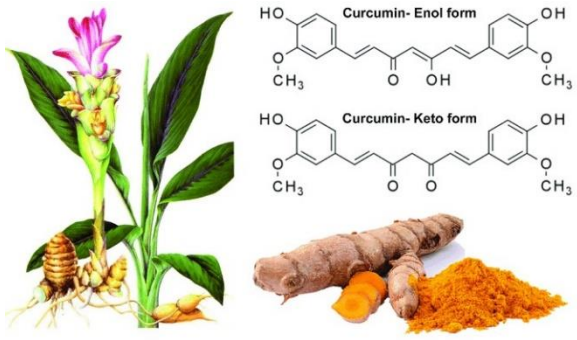

Figure1. Curcuma longa

DESCRIPTION

Herb with a root stock and no stem. Largely lanceolate or oblong leaves with a rich ferruginous purple colour. Sheath and petiole length equal to blade length. sprouting up ahead of the leaves. Bract green with a ferruginous tinge, pale yellow flower with a reddish hue at the outer border.

MEDICINAL USES

Rhizome: Clears blood, strengthens the heart and brain, treats leucoderma, piles, bronchitis, asthma, tumours, enlarged spleen, and regulates leucorrhal and gonorrhoeal discharge.

PHYTOCONSTITUENTS

(a) 1,8-cineole, 2-bornanol, 2-hydroxymethyl-anthraquinone, 4-hydroxybisabola-2.

(b) 10-diene-9-one; 4-methoxy-5-hydroxybiosabola; 4-hydroxy-cinnamoyl-(Feruloyl)-methane, Alpha-atlantone, Alphapinene, Alphaterpineol, Ar-turmerone, Arabinose.

(c) Ascorbic-acid, Ash, Azulene, Betacarotene, Beta-pinene, Betasesquiphellandrene, Bis-(Para-hydroxycinnamoyl)-methane.

(d) Bis-desmethoxycurcumin, Bisabolene, Bixin, Borneol, Boron, Caffeic-acid, Calcium,

Caprylic-acid, Caryophyllene, Chromium, Cineole, Cinnamic-acid, Cuminyl-alcohol, 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-methoxycinnamic-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 chemicals compound are copper/zinc, campesterol, stigmasterol, betasitosterol, cholesterol, fatty acids and metallic elements potassium, sodium, magnesium, calcium, manganese, iron.

PRELIMINARY PHYTOCHEMICAL SCREENING

Qualitative chemical tests have been employed in the chemical evaluation process to identify the different phytoconstituents found in the powdered crude drug. Using widely used precipitation and coloration reactions, several researchers conducted preliminary phytochemical investigations of the aqueous, acetone, ethanolic, chloroform, and methanolic extracts of the Curcuma longa rhizome. The results revealed the presence of various compounds, including proteins, carbohydrates, alkaloids, glycosides, terpenes, steroids, flavonoids, tannins, and saponins. The following describes the standard published literature from which the corresponding tests conducted by different researchers were compiled.

Preparation of the Extract

The rhizomes of Curcuma longa were collected and sun dried, cut into small pieces The small piece of dried rhizome was then grinded to get a fine powder, which is ready for use.

Test for Alkaloid

The extract was mixed with 3 ml of dilute hydrochloric acid and then filtered thoroughly. The filtrate was tested carefully with following test:

(a) Mayer's Test: A few drops of Mayer's reagent are added by the test tube's side to one or two millilitres of filtrate. The presence of alkaloids, as indicated by the white or creamy precipitate, indicated a positive test.

(b) Wagner Test: After treating 1 or 2 millilitres of the filtrate extract with Wagner's reagent, the

formation of a brown, reddish precipitate indicates a positive alkaloids result.

(c) Dragendorff's Test: 1-2 millilitres of the reagent were added to a few millilitres of filtrate, and the formation of a noticeable yellow precipitate indicates the presence of alkaloids.

Test for Glycosides

(a) Fehling's solutions A and B were added in equal amounts to a 2 ml test solution. The solution was then heated to produce a glycoside result. There was a precipitation that was brick red.

(b) Legal's Test: Pyridine and alkaline sodium nitroprusside were added to 2 ml or 1 ml test solution; the mixture turned blood red or pink, indicating the presence of glycoside.

(c) Keller-Killani Test: Add a drop of extract-treated FeCl3 to two millilitres of glacial acetic acid.A brown colour ring that forms indicates the presence of glycoside.

(d) Bruntrager's Test: The extract was first heated to a boil with diluted sulfuric acid, then filtered. Chloroform was then added to the filtrate and thoroughly shaken. After the organic layer was separated, ammonia was gradually added. Additionally, the ammonical layer's pink to red colour indicates a successful outcome.

Test for Flavonoids

(a) Shinoda Test: H2SO4 was added dropwise after 2 millilitres of test solution and a few pieces of magnesium ribbon were added. The colour of the results is either crimson red or pink scarlet.

(b) Alkaline Reagent Test: Sodium hydroxide solution was added to the test solution, causing it to turn yellow or red.

(c) Zn Test: Two millilitres of extract were combined with zinc dust and concentrated HCl; a red colour was seen after a short while, indicating the presence of flavonoids.

Test for Tannins

(a) Ferric Chloride Test: Combine drops of ferric chloride solution with the extract solution. Gallic tannins were found to be blue in colour, whereas catecholic tannins were found to be green-black in colour.

(b) Gelatin Test: By combining 2 millilitres of the test solution with 1% Gelatin solution that contains 10% sodium chloride, a white precipitate is produced.

Test for Saponins

(a) Foam Test: Researchers use this test to determine whether saponins are present. Following a 20 ml distilled water shake, 5 ml of extract was brought to a boil. Saponins are evident in frothing.

Test for Triterpenoids

(a) Salkowski Test: The test solution was mixed thoroughly after adding 2 ml of chloroform and a few drops of concentrated sulfuric acid (3 ml). Steroids are indicated by the formation of a reddish brown colour at the bottom layer, and triterpenoids are indicated by the formation of a yellow colour.

(b) Test for Phenol Ferric Chloride: The test extract was mixed with four drops of an alcoholic FeCl3 solution. The presence of phenol is indicated by a bluish black appearance.

Test for Fats and Fixed Oils

(a) Stain Test: A tiny amount of the extract was pressed between the two filter sheets; the stain

on the filter paper shows the presence of fixed oils.

(b) Saponification Test: A small amount of the extract solution containing a drop of phenolphthalein was heated for one to two hours in a water bath after being treated with a few drops of 0.5 N alcoholic potassium hydroxide. The presence of fats and fixed oils is indicated by the formation of soap or partial neutralisation for the alkali in the results.

Test for proteins and amino acids

(a) Millon's Test: Adding 2 millilitres of the test solution to Millon's reagent produces a white precipitate that turns red when heated.

(b) Ninhydrin Test: Ninhydrin solution was treated and then boiled in 2 millilitres of test solution. Amino acid presence is indicated by the formation of blue colour. Once more, a 2 ml test solution containing 0.2% ninhydrin solution was treated with proteins and amino acids before boiling to reveal a violet colour.

Test for Carbohydrates The extract was dissolved in 5–10 ml of distilled water and filtered through Whatmann No.1 filter paper and the filtrate is used for the following test of carbohydrates.

(a) Molish Test: A test tube containing two millilitres of solution was first filled with one drop of Molish Reagent. Conc. HCl was added in a volume of 2 millilitres via the test tube walls. There was a violet ring visible in the test tube. Carbs are present when a violet ring forms at the intersection of the two liquids.

(b) The Fehling test:involved hydrolyzing diluted HCl with two millilitres of extract, neutralising the extract with alkali, and heating Fehling's solutions A and B. The formation of a red precipitate signifies the presence of reducing sugar.

(a) Benedict's Test: After adding Benedict's reagent to the filtrate and gently heating it, the presence of reducing sugar is indicated by the appearance of an orange-red precipitate.

(b) Iodine Test: After treating five drops of Iodine solution with two millilitres of extract, the test is positive when the colour turns blue.

PHYTOPHARMACOLOGY

Turmeric has several therapeutic and pharmacologic activities. The following is the most important phytopharmacology and therapeutic properties of turmeric.

Anti-inflammatory- Because curcumin and volatile oils have strong anti-inflammatory properties, Curcuma longa exhibits them. When taken orally, half of curcumin has been shown to be as beneficial for treating chronic inflammation as cortisone or phenylbutazone is for treating acute inflammation. Due to its unique ability to inhibit lipoxygenase and COX-2, turmeric is recognised for its hot potency and anti-inflammatory effects. Inflammatory alterations in the joints are frequently linked to rheumatic complaints. It treats inflammation's pathological alterations and etiological factors. The properties of curcuminoids include their inhibition of phospholipases, TNF, and interleukin-12. Application of curcumin at doses ranging from 50 to 200 mg/kg has inhibited oedema in mice used as an animal model. Curcumin applied at a dose of 48 mg/kg body weight can reduce oedema by 50%. At comparable dosages, it has the same efficacy as

cortisone and phenylbutazone. Once again, paw oedema and inflammation were reduced in rats when a lower dose of 20–80 mg/kg was administered. Rats treated with formaldehyde-induced arthritis were able to avoid acute toxicity with doses of curcumin as high as 40 mg/kg, even at daily doses of up to 2 g/kg. In an animal study, it was demonstrated that intraperitoneal injections of turmeric extract, containing 4 mg total curcuminoids/kg/day for four days prior to induction of arthritis, inhibited both acute (75%) and chronic (68%) phases of joint inflammation in rheumatoid arthritis induced by streptococcal cell wall.

Antimicrobial Properties

The essential oil of Curcuma longa and turmeric extract inhibit the growth of numerous parasites, bacteria, and pathogenic fungus.an investigation on chicks with a caecal parasite infection. Turmeric supplements have been shown by Eimera maxima to improve weight gain and lower small intestinal lesion scores. In another study, when guinea pigs were infected with either pathogenic moulds, yeast, or dermatophytes, topically applied turmeric oil inhibited the growth of fungi and dermatophytes. The guinea pigs with fungal and dermatophyte infections showed no more lesions seven days after the turmeric treatment. Curcumin has been shown to have moderate efficacy against Leishmania major organisms and Plasmodium falciparum.

Antidiabetic Properties

An experimental study has demonstrated the important role that turmeric plays in diabetes. Adipocyte differentiation has been observed to be dose-dependently stimulated by a hexane extract containing ar-turmerone, an ethanolic extract containing ar-turmerone, curcumin, demethoxycurcumin, and bisdemethoxycurcumin, and an ethanolic extract from the residue of the hexane extraction containing curcumin, demethoxycurcumin, and bisdemethoxycurcumin. The findings indicate that the ethanolic turmeric extract, which contains both sesquiterpenoids and curcuminoids, has a stronger hypoglycemic effect than either compound alone. Turmeric has amazing effects on insulin and postprandial plasma glucose. Six grammes of Curcuma longa were found to have no discernible impact on the glucose response. After the OGTT, insulin levels significantly increase for 30 and 60 minutes, encompassing Curcuma longa. Additionally, it has been noted that consuming Curcuma longa and OGTT significantly raises the AUC of insulin. Additionally, diabetes mellitus complications are reduced by turmeric.

Antioxidant Effects

Strong antioxidant activity is exhibited by water- and fat-soluble extracts of turmeric and its curcumin component, which is comparable to that of vitamins C and E. Pre-treatment with curcumin reduces the effects of ischemia-induced heart changes. Curcumin's effect on endothelial hemeoxygenase-1, an inducible stress protein, was measured in vitro using endothelial cells from cows' aortas. In this study, an 18-hour curcumin incubation period also improved cellular resistance to oxidative damage. Haemoglobin or lipids may be shielded from oxidation by it. Due to its antioxidant qualities, curcumin can effectively prevent activated macrophages from producing reactive oxygen species (ROS) like H2O2, superoxide

anions, and nitrite radicals. Due to the antioxidant properties of its derivatives, demethoxycurcumin and bisdemethoxycurcumin, cholelithiasis can be prevented and treated.

Hepatoprotective Effects

Due to its antioxidant qualities and capacity to prevent the production of pro-inflammatory cytokines, turmeric showed both hepatoprotective and reno-protective characteristics akin to those of silymarin (3– 5). Studies on animals have demonstrated the hepatoprotective properties of turmeric against a range of hepatotoxic insults, such as Aspergillus aflatoxin, galactosamine, acetaminophen (paracetamol), and carbon tetrachloride (TCC). Administration of curcumin significantly reduced liver injury in test animals compared to controls in rats with $CCl4$-induced acute and subacute liver injury.When tested on ducklings infected with Aspergillus parasiticus, turmeric extract was found to be highly effective in preventing and treating cholelithiasis.

Anti-Cancer Effect

Turmeric's impact on carcinogenesis has been studied extensively in vitro using human cell lines and in animals, including rats and mice. Curcumin has been shown in multiple in vitro experiments to regulate the three stages of carcinogenesis: angiogenesis, tumour promotion, and tumour growth. Two studies involving colon and prostate cancer have shown that curcumin inhibits the growth of tumours and the proliferation of cells. The anti-carcinogenic properties of curcumin and turmeric have been linked to their capacity to indirectly raise glutathione levels, which helps the liver detoxify carcinogens and mutagens and prevents the formation of nitrosamines, as well as their direct antioxidant and free-radical scavenging effects. It has also been demonstrated that curcumin prevents UV radiation from inducing mutagenicity.

Turmeric in the diet has been shown to be an effective chemopreventive agent in benzo-(alpha)-pyrene-induced stomach tumours in Swiss mice. It has been observed that applying an ointment containing curcumin and an ethanolic extract of turmeric can significantly reduce symptoms in patients with external cancerous lesions. Turmeric's antioxidant properties show that they can neutralise free radicals that cause cancer. Acetyl curcumin was discovered to be inertThe expression of intercellular adhesion molecule-1 (ICAM-1), vascular cell adhesion molecule-1 (VCAM-1), and eselectin by human umbilical vein endothelial cells was shown to be inhibited by turmeric in several reports. Turmeric also acted as an antitumor agent and helped induce apoptosis or programmed cell death (PCD) in human myeloid leukaemia cells (HL—60). The test clearly shows the cytotoxic, antioxidant, and anti-inflammatory effects of curcumin I, II, and III from turmeric. Numerous studies have shown that these substances have potent intrinsic properties that inhibit the growth of leukaemia cells as well as those from the colon, brain, melanoma, kidney, and breast cancer cell lines.

Cardiovascular Effects

Turmeric's antioxidant properties protect the cardiovascular system by reducing triglyceride and cholesterol levels, reducing low-density lipoprotein (LDL) susceptibility to lipid peroxidation, and preventing platelet

aggregation. According to a study, giving low-dose turmeric extract (1.6–3.2 mg/kg body weight daily) to eighteen atherosclerotic rabbits has been shown to reduce the susceptibility of low-density lipoprotein (LDL) to lipid peroxidation, as well as to lower levels of triglycerides and plasma cholesterol. Turmeric's antioxidant properties protect the cardiovascular system by reducing triglyceride and cholesterol levels, reducing low-density lipoprotein (LDL) susceptibility to lipid peroxidation, and preventing platelet aggregation. According to a study, giving low-dose turmeric extract (1.6–3.2 mg/kg body weight daily) to eighteen atherosclerotic rabbits has been shown to reduce the susceptibility of low-density lipoprotein (LDL) to lipid peroxidation, as well as to lower levels of triglycerides and plasma cholesterol.

Gastrointestinal Effects

Sodium curcuminate and p-tolymethylcarbinol, two components of Curcuma longa, have a number of gastrointestinal tract-protecting properties. Sodium curcuminate is known to increase the secretion of pancreatic enzymes and secretin, secretin, gastrin, and bicarbonate while inhibiting intestinal spasm and p-tolymethylcarbinol. Turmeric has also been observed to significantly increase gastric wall mucus in rats exposed to gastrointestinal insults, such as stress, alcohol, indomethacin, pyloric ligation, and reserpine, thereby inhibiting the formation of ulcers. In an open, phase II trial, 600 mg of powdered turmeric was administered five times a day to 25 patients with endoscopically diagnosed gastric ulcers. The results showed that 48 percent of the patients had fully healed. No negative reactions or blood abnormalities are shown by the results. Curcumin was found to lessen mucosal damage in mice that had colitis that was created artificially. Curcumin was found to reduce inflammation in rat models of pancreatitis induced through experimentation.

CONCLUSION

A thorough analysis of the literature has shown that Curcuma longa, which has a variety of pharmacological properties, is regarded as a herbal medicine's universal cure-all. Because it contains a variety of chemical compounds, this plant is regarded as a versatile medicinal herb that has multiple uses. Therefore, it is clear that extensive research is needed to determine the therapeutic utility of these treatments in order to combat the diseases. Since the beginning of time, it has been known that crude extracts from various plant parts have been used medicinally. Today, the process of developing new drugs involves extensive research on the pharmacotherapeutics, toxicity, manufacturing process, bioactivity, and other factors. Proper standardisation and clinical trials are then necessary.An effort should also be made to investigate the potential for real-world clinical applications as well as the specifics of unexplored and hidden areas of its potential benefit to human welfare.

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