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A PERSPECTIVE REVIEW ON PHYTOCHEMICALS AND PHARMACOLOGICAL SIGNIFICANCE OF *CURCUMA LONGA*

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ABSTRACT

Curcuma longa is a member of the ginger family (Zingiberaceae) and used widely by the traditional medical practitioners for the treatment of various ailments. Due to high curcumin content Indian turmeric is very popular as compared to other countries. Rhizomes derived from *Curcuma longa* is commonly known as Haldi or Turmeric. Rhizomes are horizontal underground stems that send out shoot as well as roots. Turmeric constitutes of fat-soluble, polyphenolic pigments known as curcuminoids which include mainly curcumin is responsible for yellow colour for Indian curries, others are demethoxy curcumin and bisdemethoxy curcumin. Turmeric is a natural antiseptic. Turmeric offers significant medical and nutritional benefits. Since turmeric has phytochemical components, it is regarded as a medicinal plant. Nonnutritive plant chemicals, or phytochemical components, have the ability to prevent illness. Turmeric is used as a spice, dietary medicine, and for its flavoring capabilities as root powder because it has a number of significant health benefits. In this review paper plant profile, phytoconstituents, preliminary phytochemical screening tests and pharmacological significance of *Curcuma longa* are mentioned.

KEY-WORDS: *Curcuma longa*, Phytoconstituents, Anti-inflammatory, Analgesic, Cardioprotective.

INTRODUCTION

The perennial herb *Curcuma longa* is upright, leafy, and a member of the Zingiberaceae family. It may grow up to 1 m tall with a shorter stem & has oblong, pointy leaves with funnel-like yellow flowers. It is widely used in tropical and subtropical areas of the world and is mostly grown in Asian nations, namely in India as well as China. India's traditional name for this plant is "Haldi," and its rhizomes are rectangular, ovate, pyriform, and frequently short branched.[1,2, 3] Recent studies have revealed that curcumin possesses a new level of potential and has anti-inflammatory & antitumor properties.[4] Curcumin, a yellow powder made from rhizome extract, is used medically. Curry powder is made from dried *Curcuma longa*, which is the plant from which the spice turmeric is derived. Turmeric is commonly used in dishes for its flavor and color, as well as in traditional Indian medicine and Hindu religious events. Turmeric is regarded as an aromatic stimulator & carminative in ancient Hindu writings.[2,3] Turmeric powder has historically been used as a traditional remedy for gastrointestinal illnesses, particularly gallbladder and liver diseases, wounds caused by diabetes, arthritis, inflammatory processes, sinusitis, coryza, as well as cough. Turmeric has been shown to have anti-HIV action and is anti-cancer, anti-diabetic, antioxidant, hypolipidemic, anti-inflammatory, antibacterial, anti-fertility, anti-venom, and hepatoprotective properties.[3, 5, 6]

PLANT PROFILE

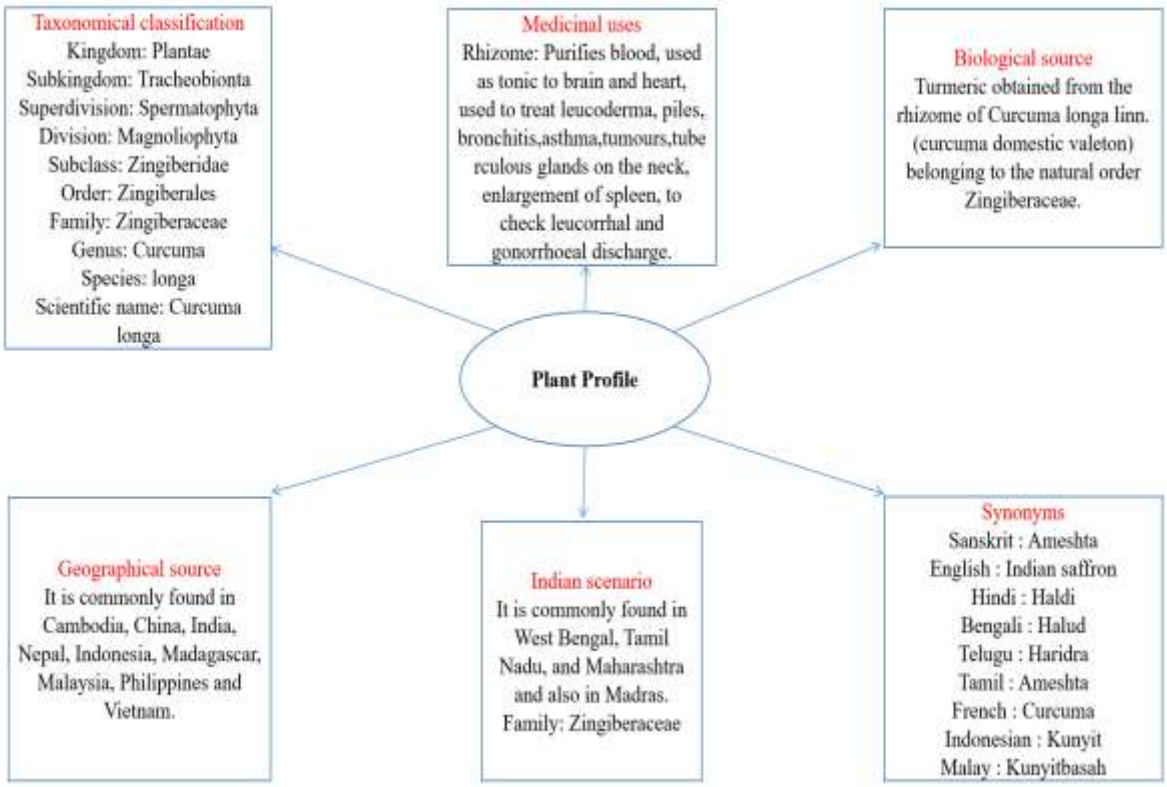

Figure 1: Profile of *Curcuma longa.*

Macroscopic characters

The primary rhizome (rounded turmeric) is up to 4 cm long and 3 cm thick, with an ovate or pears like form. The bottom section is distinguished by secondary rhizomes and roots scars, while the top part is surrounded by leaf scars. It is cut into pieces before drying. The secondary rhizomes (long turmeric) are simple or sparsely branching, elongated, and 0.5–1.5 cm thick. Prior to drying, the rhizomes are scorched in order to kill their life force, turning the grains into lumps to which the combination of oil and curcumin released from the oil cells gives a rich yellow hue. The product is harsh, hard, and sinks in water as it is available on the market. The surface of the fractures is waxy, smooth, and orange-yellow in hue.

Microscopic characters

The outermost four to six layers of brick-shaped parenchymatous cork are visible in the transverse slice of turmeric rhizomes, followed by cork cabin. The cortex is composed of spherical, thin-walled parenchymatous cells with sporadic vascular bundles. Cortex contains oléo-resin cells that are collateral and have vascular bundles that are brownish in color. Vascular bundles in the pith area are dispersed, producing a ring-like structure under the endodermis. The endodermis is clearly defined, and the starch granules (5–15 m in diameter) are numerous.[7,8]

Figure 2: Rhizomes and powders of *Curcuma longa.*

PHYTOCONSTITUENTS[9]

Table 1: Phytoconstituents of *Curcuma longa.*

S.N.	Phytoconstituents
1.	10-diene-9-one, 4-methoxy-5- hydroxybiosabola, 4-hydroxy-cinnamoyl-(Feruloyl)-methane, Alpha-atlantone, Alpha-pinene, Alphaterpineol, Ar-turmerone, Arabinose.
2.	L-beta-curcumene, Limonene, Manganese, Monodesmethoxycurcumin, Niacin, Nickel, O-coumaric-acid, P-coumaric-acid, P-methoxycinnamic-acid, Pcymene, P tolymethylcarbinol, Phosphorus, Protocatechuic-acid, Procurcumadiol.
3.	1,8-cineole, 2-bornanol, 2-hydroxy-methyl-anthraquinone, 4-hydroxybisabola-2
4.	Eugenol, Epiprocurcumenol, Eucalyptol, Feruloyl-p-coumaroyl-methane, Gamma-atlantone, Germacrone, Germacrone- 13-al, Guaiacol, Isoborneol, L-alpha curcumene.
5.	Bis-desmethoxycurcumin, Bisabolene, Bixin, Borneol, Boron, Caffeic-acid, Calcium, Caprylic-acid, Caryophyllene, Chromium, Cineole, Cinnamic-acid, Cuminyl-alcohol, Curcumene, Curcumenol, Curcumin, Curdione, Cobalt, Copper
6.	Ascorbic-acid, Azulene, Beta-carotene, Beta-pinene, Beta-sesquiphellandrene, Bis-(Para-hydroxy-cinnamoyl)-methane.
7.	Volatile Oil(4.2%),its main content is turmerone, arturmerone, curcumene, germacrone, ar-curcumene,
8.	Acidic polysaccharides: utonan A, B, C, D.
9.	Other chemicals compound are copper/zinc, campesterol, stigmasterol, beta sitosterol, cholesterol, fatty acids and metallic elements potassium, sodium, magnesium, calcium, manganese, iron.
10.	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%).

PRELIMINARY PHYTOCHEMICAL SCREENING

The qualitative chemical tests performed for identifying the different phytoconstituents contained in the powdered crude medicine are part of the chemical assessment. 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, revealing the presence of substances like protein, carbohydrates, alkaloids, glycosides, flavonoids, terpenes, steroids, tannins, and saponins.[10–12] The relevant tests conducted by many experts were gathered from the below-mentioned officially available publications.

Preparation of the Extract

Curcuma longa rhizomes were gathered, sun dried, and divided into little pieces.

The little dried rhizome piece was ground into a fine powder and is now suitable for usage.[11, 12]

Tests

Table 2: Different Phytoconstituents of *Curcuma longa*, relevant test & Procedures.

S.N.	Phytoconstituents	Test	Procedure
1.	Tannins	Ferric Chloride Test	Droplets of ferric chloride solution were added to the extract solution. Presence of gallic tannins, blue colour was observed and green black for catecholic tannins.[10, 4, 11]
		Gelatin Test	By combining 2 ml of test solution with 1% gelatin solution that contains 10% sodium chloride, a white sediment is produced.[11]
2.	Flavonoids	Shinoda Test	2 ml test solution added with few fragments of Magnesium ribbon, dropwise conc. H2SO4 was added. The results shows pink scarlet or crimson red colour.[10, 11]

		Alkaline Reagent Test	A solution of sodium hydroxide was used to treat the test solution, which results in a yellow or reddish color.[10, 11]
3.	Alkaloid	Mayer's Test	The extract was carefully filtered after being combined using 3 ml of diluted hydrochloric acid. One acquired the filtrate. A few drops of Mayer's reagent are added to 1 or 2 ml of filtrate at the edge of the test tube. The presence of alkaloids was detected in the white or creamy precipitate.[10, 4, 11]
		Dragendroff's Test	The extract was carefully filtered after being combined using 3 ml of diluted hydrochloric acid. One acquired the filtrate. A little amount of filtrate was mixed with 1-2 ml of Dragendorff's reagent to produce a noticeable yellow precipitate, which denotes an existence of alkaloids.[4, 11]
4.	Triterpenoids	Salkowski Test:	Two milliliters of chloroform and three milliliters of concentrated sulfuric acid were added to the test solution and thoroughly mixed. The formation of a reddish brown color at the bottom layer indicates the presence of steroids, whereas the existence of triterpenoids is indicated by a yellow color.[11]
5.	Glycosides	Legal's Test	Pyridine with alkaline sodium nitroprusside were added to a 2 ml or 1 ml test solution, and an appearance of a blood red or pink color indicated the existence of glycoside.[10–12]
		Keller-Killani Test:	To 2 ml glacial acetic acid containing a drop of FeCl3 treated with extract. The development of a brown color ring reveals glycoside presence.[10, 12]
6.	Carbohydrates	Molish Test	The filtrate was created by dissolving the extract in 5 to 10 ml of water that was distilled and filtering it using Whatmann No. 1 filter paper. A test tube had 2 ml of fluid in it, and then 1 drop of Molish Reagent was introduced. 2 ml of concentrated HCl was introduced from the test tube's sides. The test tube had a violet ring. Carbohydrates are present when a violet ring forms at the intersection of the two liquids.[4, 12]

		Benedict's Test	The filtrate was created by dissolving the extract in 5 to 10 ml of water that was distilled and filtering it using Whatmann No. 1 filter paper. Benedict's reagent was applied to the filtrate and it was gently heated; the formation of an orange-red precipitate shows the existence of reducing sugar.[10]
7.	Proteins and amino acids	Ninhydrin Test	To 2 ml test solution, ninhydrin solution was treated and then boiled. Formation of blue colour indicates the presence of amino acid. Again 2ml test solution, 0.2% ninhydrin solution was treated with amino acids and proteins, then boiled shows a violet colour.[10, 11]
8.	Saponins	Foam Test	20 ml of distilled water and 5 ml of extract were mixed together before boiling. Saponins can be detected by foaming.[10, 4]

PHARMACOLOGICAL SIGNIFICANCE OF *CURCUMA LONGA*

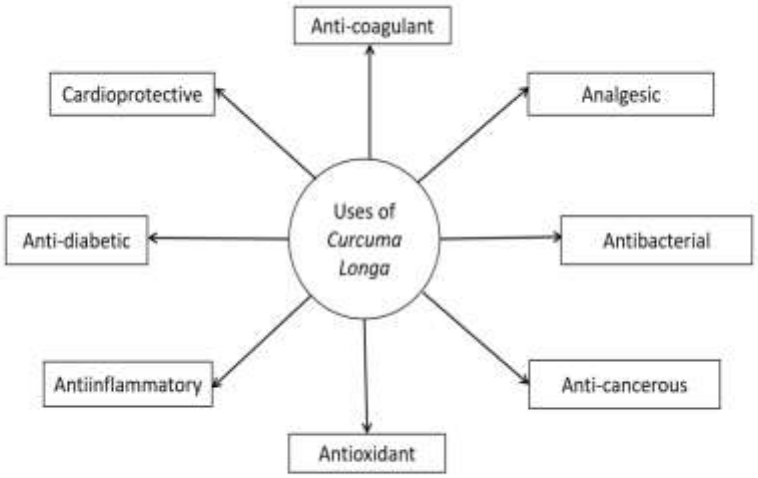

Figure 3: Pharmacological significance of *Curcuma longa.*

1. Analgesic activity

Rhizome powder is useful for treating inflammation and sprains. Sprains are frequently treated with hot turmeric paste combined with some juice of lime and salt.[13]

2 Anti-bacterial activity

All leaf and rhizome extracts were examined for their antibacterial properties. A promising alternative to chemical medications for the prevention and treatment of boil infections is the use of turmeric rhizome essential oil, a unique and potent natural antibacterial agent. Future in vivo clinical trials on infected humans and animals are necessary to support the results.[14]

3. Anti-cancerous activity

It has now been established that the antioxidants in turmeric counteract free radicals that cause cancer. The anticancer efficacy of turmeric has been examined and proven. The activation of apoptosis in human leukemia cells was proven to be the cause of curcumin's antioxidant and antitumor-promoting activities, and this idea was researched and successfully demonstrated. supporting research into dietary curcumin's particular inhibition of cyclooxygenase (cox)-2's effects on human colon cancer cells. Human breast cancer cells have demonstrated a suppressive impact from curcumin.[15]

4. Anti-inflammatory
Due to its volatile oils and curcumin, *curcuma longa* has strong anti-inflammatory properties. In cases of acute inflammation, it was discovered that taking one half of curcumin orally is just as efficient as cortisone or phenylbutazone.[16]

5. Anti-diabetic activity
The amount of TG, TC, and LDL was greatly decreased and the amount of HDL was dramatically increased in diabetic rats after oral administration of *Curcuma longa*'s aqueous rhizome extract. According to the findings, *Curcuma longa* rhizome aqueous extract may be useful in treating atherosclerosis, one of the main consequences of diabetes, by reducing blood lipid levels, notably those of total cholesterol, triglycerides, and low density lipoprotein.[17]

6. Anti-Hyper lipidemic
Both curcumin and turmeric have been shown to decrease the absorption of cholesterol from the stomach, raise HDL cholesterol levels, and lower LDL cholesterol levels. Additionally, it can prevent serum LDL from becoming peroxidized, which can result in atherosclerotic plaques. When cholesterol-fed rats received curcumin treatment, the levels of blood and liver cholesterol reportedly fell to half. [18]

7. Antioxidant activity
The most extensive research on curcumin's antioxidant properties may be found in the literature. Numerous in vitro and in vivo studies have shown that the chemical structure of curcumin, which contains carbon double bonds, b-diketo groups, phenyl rings with hydroxyl groups, and o-methoxy groups, is connected to the antioxidant properties of the compound. Many different mechanisms, such as the coupling of free radicals, hydrogen atom donors, and electron donors to neutralize free radicals, can be used to explain antioxidant action. Utilizing pulse radiolysis & laser flash photolysis, the antioxidant activity of curcumin's mode of action has been clarified.[19]

8. GIT protective activity
Turmeric functions as a carminative and a preventative against the production of intestinal gas in the digestive tract. Due to its high heat content, turmeric has anti-flatulent, digestive, and stimulating properties. It is said to have anti-spasmodic properties that prevent the intestine's excessive peristaltic motions.[20]

9. Cardio protective activity
The main bioactive ingredient in these plant extracts, curcumin, raises the amount of cardiac glutathione, which suggests that it may enhance the function of these naturally occurring sulfhydryl groups to retain membrane integrity with concurrent reduction of enzyme leakage from the cardiocytes, protecting cardiac tissue from damage.[21]

10. Anti-coagulant property
The ability of curcumin to thin the blood has just lately been investigated. According to studies, curcumin was effective at extending both the APPT (Activated Partial Thromboplastin Time, a test that assesses blood coagulation levels) and PT (Prothrombin Time, a test that assesses how long it takes for a blood clot to form).[22] This was confirmed by other study, which discovered that curcumin has both antiplatelet and anticoagulant characteristics, suggesting that it might effectively help thin the blood.[23]

CONCLUSION
The ancient Indians employed turmeric as a natural marvel since it is one of the most significant and potent plants on the planet. From cancer to Alzheimer's disease, turmeric is proven effective in the treatment of several illnesses. In the battle against HIV/AIDS, turmeric could be incredibly important. Curcumin became a desirable study subject since it may affect several cellular targets. To properly explore its potential, larger, well-controlled clinical studies are now required. because curcuinoids are present. Turmeric's active pharmacological properties in-vivo and in-vitro, along with curcumin's shown chemopreventive and therapeutic potential, have elevated curcumin to the status of a priceless natural remedy.

CONFLICT OF INTEREST
The authors declare that the review was conducted in the absence of any commercial or financial relationships that could be construed as a potential conflict of interest.

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