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Turmeric, Curcumin and Our Life: A Review

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ABSTRACT

Turmeric is a very important spice in India, which is obtained from rhizomes of plant Curcuma longa, a member of the Zingiberaceae (ginger) family. Turmeric forms a part of most Indian curry powder. It is a natural antiseptic. The spice is sometimes also called the 'Indian saffron' thanks to its brilliant colour. Components of turmeric are named curcuminoids, which include mainly curcumin (deferulolyl methane), demethoxycurcumin and bisdemethoxycurcumin. Turmeric with its active principles curcumin and curcuminoids seems to be much more than merely a yellow colorant for Indian curries. Due to its extra-ordinary molecular structure it shows strong anti-oxidative, as well as anti-inflammatory properties. It is extensively used for imparting colour and flavour to the food in the traditional Indian medicine, turmeric powder is used to treat a wide variety of diseases.

INTRODUCTION

Turmeric is the rhizome or underground stem of ginger like plant. The plant is an herbaceous perrineal, 60-90 cm high with a short stem tufted leaf. Its flowers are yellow, between 10-15 cm in length and they group together in dense spikes, which appear from the end of spring until the middle session. No fruits are known for this plant. The whole turmeric rhizome, with a rough, segmented skin. The rhizome is yellowish-brown with a dull orange interior that looks bright yellow when powdered. Rhizome measures 2.5-7.0 cm (in length), and 2.5 cm (in diameter) with small tuber branching off. Turmeric held a place of honour in Indian traditional ayurvedic medicine. In ayurvedic it was prescribed for the treatment of many medical problems ranging from constipation to skin diseases. It was used as digestive aid and treatment for fever, inflammation, wounds, infections, dysentery, arthritis, injuries, trauma, jaundice and other liver problems. In Unani turmeric is considered to be sefest herb of choice for all blood disorders since it purifies, stimulates and builds blood. To most people in India, from housewives to Himalayan hermits, turmeric affectionately called the 'KITCHEN QUEEN', the main spice of kitchen. Long term use in turmeric, tulsi and trifala can be likened to a short term Pancha Karma treatment. Turmeric is relatively broad spectrum antifungal.

Turmeric exhibits antioxidant activity and protect from free radical damage. Curcumas also exhibits anti-tumor activities and prevent cancer. It inhibits the topoisomerase enzyme, which is required for cancer.

HISTORY OF TURMERIC

Marco polo (1280 AD) refers to turmeric as Indian saffron used for dying cloths. As far as documented evidence, it is used daily in India for at least 6000 years as medicine, beauty aids, cooking spice and a dye. Obstensibly it was used to worship the Sun during the solar period of India, a time when Lord Ram Chandra walked the Earth. It was mentioned in the Artharveda of India. Buddhist monks have used turmeric as a dye for their robes for at least 2000 years. It was listed in an Assyrian herbal circa 600 BC and was mentioned by Discorides in the herbal that was the western herbal rediscovered it 700 years ago via Marco Polo and it is used in traditional lethal poison of pit vipers. In China it was mentioned in the Pent-Sao of the 7th century. For at least 1000 years Chinese are used turmeric as medicine especially for the spleen, stomach and liver medicines. They use it to stimulate and purify and as an anti-biotic, anti-viral and an analgesic. As such it is used to stimulate

and strengthen the blood and decrease blood pressure, to clean abdominal pain and stagnation in men, woman and children. They consider it one of the better herbals for woman because it stimulates the uterus and clears menstrual stagnation. In the 1870's, chemists discovered turmeric orange yellow root powder turned reddish brown when exposed to alkaline chemicals. This discovery led to the development of turmeric paper to test for alkalinity.

European and American herbalists up until the rate 20th century had little interest in turmeric. In one western herbal from the early 20th century, Maude Greve's book A Modern Herbal, in which she gives a botanical description and the constituents of the herb as if the herb was of some importance, but then under medicinal actions and uses she says; "Turmeric is a wild aromatic stimulant seldom used in medicine except as a colouring. It was once a cure for jaundice. Its chief use is in the manufacture except as a colouring. It was once a cure for jaundice. Its chief use is in the manufacture of curry powder. It is used as an adulteration of mustard and a substitute for it and forms once of the ingredients of cattle condiments. Turmeric paper is used as a test for alkaloids and boronic acid". Daniel B. Mowrey tells the story. "Serious research on turmeric began in Germany, in the early 1920's. Sesqueterpenes in the essential oil of turmeric were isolated in 1926 and to them was ascribed the therapeutic activity.

CULTIVATION

Turmeric can be cultivated in diverse tropical conditions, to upto 1,600 meters from the sea level, with temperatures varying from 20-40 ºC, and rainfall above 1500 mm. It is a nine-month crop sown in July and harvested in April. Turmeric thrives in well-drained, fertile, sandy and black, red or alluvial loams, rich in humus and uniform in texture. Rich loamy soils having natural drainage and irrigation facilities are the best. Turmeric cannot stand water stagnation or alkalinity.

HARVESTING AND CURING

The crops are ready for harvest in seven to nine months depending upon the time of sowing. The harvest is carried out during January to March. It matures in about 9 months. The marketing season is from February to May. The leaves of crop turns dry and are light brown and yellowish in colour on maturity, height of crop around 1.5 feet after the complete growth with maximum 8-10 branches with cracks development on the soil signifies good yields of turmeric. The land is ploughed and the rhizomes are carefully lifted with a spade. Harvested rhizomes are cleaned of mud and other extraneous matter adhering to them. The green rhizomes are boiled in water, which are spread out on a clean floor and allowed to dry in the sun for about 15-20 days. They are stirred 3-4 times to ensure uniform drying. The rounds and figures are dried separately. The former takes more time to dry. When fully dried, turmeric becomes hard and stiff. The dries turmeric is rubbed against the hard surface of the drying floor or trampled under feet covered with piece of gunny cloth and the scales and the root bases are separately by winnowing. Rhizomes for seed are generally heaped in the shade of these or in well-ventilated sheds and covered with turmeric leaves.

INDIAN SCENARIO

India is the largest consumer, producer and exporter of turmeric in the world. The country consumes most (80 percent) of its turmeric production and it exports the surplus. Turmeric is grown in as many as 25 states of India with Andhra Pradesh, Tamilnadu, Karnataka and Odisha being the leading producers. Other main producers of turmeric are Gujarat, West Bengal, Assam, Meghalaya and Maharastra. India has nearly 1.73 lakh hectares under turmeric cultivation with a total production of 8.55 lakh tones during the year. Andhra Pradesh, topped both in area and production during the year 2005-2006, with 69990 hectare (40.46%) and 518550 tonnes (60.60%), respectively. Tamilnadu followed with acreage of 25970 hectares (15.01%) and production of 143358 tonnes (16.75%).

INTERNATIONAL SCENARIO

Currently, India is the major producer and consumer of turmeric. China is second largest supplier of the spice and it is followed by a number of the countries in the Indian sub-continent, Southeast Asia, the Caribbean and Latin America. None of these are of significance as oleoresin suppliers; other producers in Asia include Bangladesh, Pakistan, Sri Lanka, Taiwan, China, Burma (Myanmar), and Indonesia. Turmeric is also produced in Caribbean and Latin America, Jamaica, Haiti, Costa, Rice, Peru and Brazil. The use of the spice spread widely in Oceania, but it is not used as condiment in Malanesia and Polynesia.

There are two dominant types of turmeric in the world market: 'Madras' and 'Allepy' both are named after the regions of production in India. The orange-yellow flesh Allepy turmeric is predominantly important by the US, where users prefer it as a spice and food colorant. Allepy turmeric contains about 3.05-5.5% volatile oils, and 4-7% curcumin. In contrast, the Madras type contains only 2% volatile oils and 2% of curcumin. The Madras turmeric is preferred by the British and Middle Eastern markets, for it is intense, brighter and lighter yellow colour, better suited for mustard paste and curry powder or paste used in oriented dishes. Turmeric produced in Caribbean, Central and South America has low curcumin and volatile oil contents, and is darker and is not desired by the US importers. The Bengal type is preferred for used in dyes in India. It is interesting to note that the US, turmeric is considered as a spice by the food industry, whereas the FDA classified it as a food colorant. The major produced, India, Exports to the most of the consumers. UAE, US, Bangladesh, Japan, Sri Lanka, Malaysia and UK, together account for about 65% of Indian turmeric exports.

EXPORTS

Indian accounts for about 80% of world turmeric production and 60% of world exports. Some of the important turmeric varieties exported from India are: Allepy finger turmeric, Rajapuri, Madras and Erode varieties. The processed forms of turmeric exported are dry turmeric, fresh turmeric, turmeric powder and oleoresin, United Arab Emirates is major importer, accounting for 18.35% of the total exports followed by the US with 11.44%. The other leading importers are Japan, UK and Sri Lanka. The quality stipulation followed by the US in considered being more important for export of turmeric.

Asian countries consume much of their own turmeric production, except for Japan and Sri Lanka. Major importers are the Middle East and North African countries, Iran, Japan and Sri Lanka. These importing countries represent 75% of the world turmeric trade, which is met mostly by the Asian producing countries. Europe and North America represent the remaining 15% and are supplied by India and Central and Latin American countries. Taiwan exports mostly to Japan. About 97% of US imports of turmeric come from India, with the Islands of the Pacific and Thailand supplying the rest. The increasing demand for natural product as food additives makes turmeric as ideal candidate as a food colorant, thus increasing demand for it. Additionally, recent medical research demonstrating the anti-cancer and antiviral activities of turmeric may also increase its demand in western countries.

Scientific classification

Kingdom	:	Plantae
Subkingdom	:	Tracheobionta
Superdivision	:	Spermatophyta
Division	:	Magnoliophyta
Subclass	:	Zingiberidae
Order	:	Zingiberales
Family	:	Zingiberaceae
Genus	:	Curcuma
Species	:	Longa
Scientific name	:	*Curcuma longa*

Table 1: Various names of turmeric/curcumin in different languages

Entry	Language	Name	Entry	Language	Name
1	Arabic	Kurkum	21	Kannada	Arishina
2	Armenian	Toormerik, Turmerig	22	Korean	Kolkuma, Tomerik
3	Assamese	Halodhi	23	Malayalam	Manjal
4	Bengali	Halud	24	Marathi	Halad
5	Bulgarian	Kurkuma	25	Nepali	Haldi, Hardi
6	Burmese	Hsanwen, Sanwin	26	Norwegian	Gurkemeie
7	Chinese	Wat gam	27	Portuguese	Acafrao da India
8	Dutch	Kurkuma, Tarmeriek	28	Punjabi	Haldi
9	English	Indian saffron	29	Russian	Kurkumy
10	Farsi	Zardchubeh	30	Sanskrit	Ameshta, haridra
11	French	Safran des Indes	31	Spanish	Curcuma
12	German	Indischer safran	32	Swedish	Gurkmeja
13	Greek	Kourkoumi	33	Tamil	Manjal
14	Gujrati	Halad	34	Telugu	Haridra, Pasupu
15	Hindi	Haldi	35	Thai	Kha min chan
16	Hungarian	Kurkuma	36	Tibetan	Gaser, Sga ser
17	Icelandic	Turmerik	37	Turkish	Hint safrani
18	Indonesian	Kunyit	38	Ukrainian	Kurkuma
19	Italian	Curcuma	39	Urdu	Haldi, Zard chub
20	Japanese	Ukon	40	Vietnamese	Botnghe, Uatkim

MOLECULAR CONSTITUENTS IN TURMERIC

Turmeric has hundreds of molecular constituents, each with a variety of biological activities. For instance, there are at least 20 molecules that are antibiotic, 14 are known cancer preventives, 12 that are anti-tumor, 12 are anti-inflammatory and there are at least 10 different anti-oxidants. Infect, 326 biological activities of turmeric are known. This is also testimony to the use of whole herbs and not just isolated molecules. Speaking of molecules by far the most researcher in turmeric are the three gold-coloured alkaloids curcuminoids viz. Curcumin, Demethoxycuccumin and Bisdemethoxycurcumin (Figure 1). Most of the research done is with 95% curcuminoids extract of turmeric, through in its raw state turmeric is only 3-5% curcuminoids. The yield of essential oil in various parts is 1.3% in leaf, 0.3% in flower, 4.3% in root and 3.8% in rhizome. The composition of essential oils [1] obtained from root, rhizome, leaf and flower and nutritional composition of *Curcuma longa* are given in table-1 and 2 respectively.

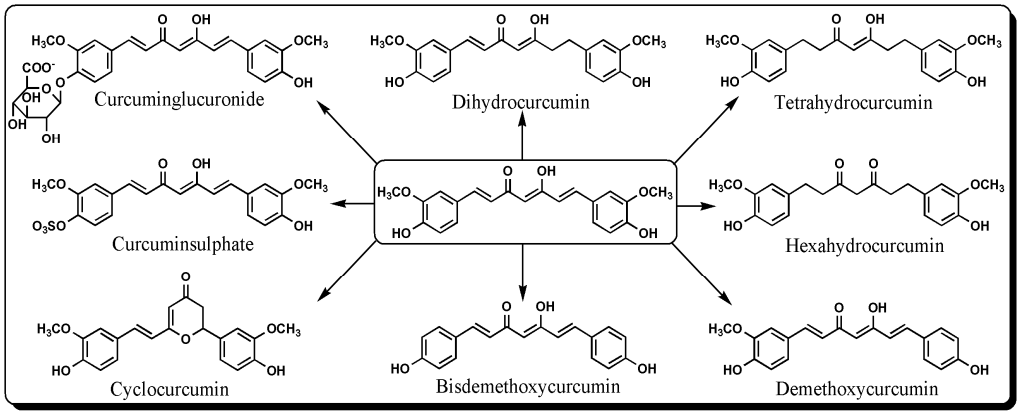

Figure 1: Natural metabolites of turmeric and curcumin

Table 2: Composition of essential oils of *Curcuma longa*

Entry	Component	Concentration (%)			
		Root	Rhizome	Leaf	Flower
1.	β-Bisabolene	2.3	1.3	-	0.9
2.	1,8-Cineole	0.7	2.4	6.5	4.1

3.	p-Cymene	3.3	3.0	5.9	1.6
4.	p-Cymen-8-ol	1.5	0.3	0.8	26.0
5.	Tr-Curcumin	7.0	6.3	0.2	1.9
6.	Curlone	0.6	10.6	0.2	0.3
7.	Dehydrocurcumin	4.3	2.2	Tr	-
8.	Myrcene	Tr	0.1	2.3	0.2
9.	α-Phellandrene	0.1	0.1	32.6	-
10.	β-Phellandrene	-	Tr	3.2	Tr
11.	α-Pinene	0.1	0.1	2.1	0.4
12.	β-Pinene	0.1	Tr	2.8	0.1
13.	Terpinolene	0.1	0.3	26.0	7.4
14.	Tr-Turmerone	46.8	31.1	0.1	1.2
15.	Turmerone	-	10.0	0.9	1.0
16.	Others	33.1	32.2	16.4	54.9

Tr-Trace

Table 3: Nutritional composition of turmeric

Entry	Constituents	Quantity per 100g
1.	Ascorbic acid (mg)	50.0
2.	Ash (g)	6.8
3.	Calcium (g)	0.2
4.	Carbohydrate (g)	69.9
5.	Fat (g)	8.9
6.	Food energy (K Cal)	390.0
7.	Iron (g)	47.5
8.	Niacin (mg)	4.8
9.	Potassium (mg)	200.0
10.	Phosphorus (mg)	260.0
11.	Protein (g)	8.5
12.	Riboflavin (mg)	0.19
13.	Sodium (mg)	30.0
14.	Thiamine (mg)	0.09
15.	Water (g)	6.0

TURMERIC, CURCUMIN AND OUR HEALTH

Turmeric exhibits a wide range of biological activities [2] (Figure 2) and is used in traditional medicines.

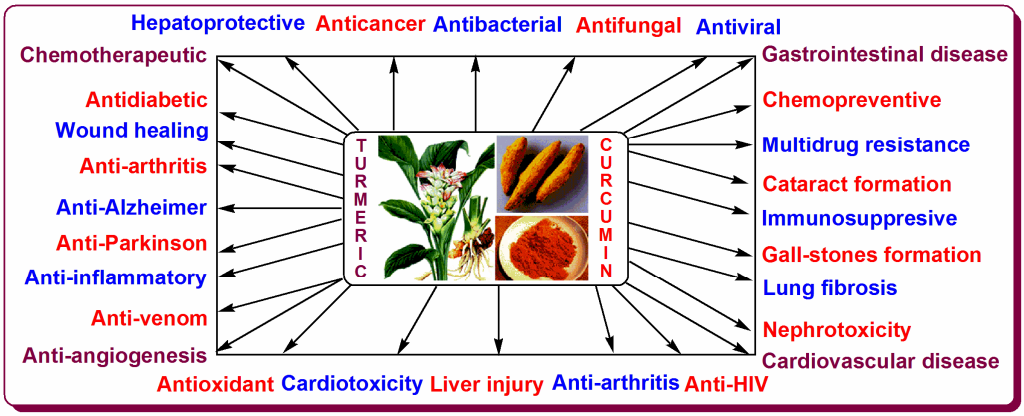

Figure 2: Medicinal properties of turmeric and curcumin

Turmeric and its constituents play an important role in our life. Which are given below:

- Turmeric has been found to have a hepatoprotective characteristic similar to that of silymarin [3].
- The volatile oils and curcumin and turmeric exhibit potent anti-inflammatory effects.

- Turmeric and curcumin are also capable of suppressing the activity of several common mutagens and carcinogens in a variety of cell types in both in vivo and in vitro studies.
- Turmeric extract and the essential oil inhibit the growth of a variety of bacteria, parasites and pathogenic fungi.
- Turmeric's protective effects on the cardiovascular system include lower cholesterol and triglyceride level, decreasing susceptibility of low density lipoprotein (LDL) to lipid peroxidation and inhibiting platelet aggregation [4].
- Constituents of turmeric exert several protective effects on the gastrointestinal tract.
- Turmeric oil exhibited potent anti-trypsin and anti-hyaluronidase activity.
- Constituents of turmeric affect Alzheimer's disease [5].
- Extract of turmeric suppresses symptoms associated with arthritis [6].
- Turmeric and its extract inhibit angiogenesis [7].
- Turmeric constituents can induce radioprotection.8
- Turmeric constituents inhibit proliferation of vascular smooth muscle cell [9].
- Turmeric lower serum cholesterol levels [10].
- Constituents of turmeric block the replication of HIV[11].
- Turmeric constituents stimulate muscle regeneration [12].
- Turmeric enhances wound healing [13].
- Turmeric extract reduces the incidence of cholesterol gall bladder stone formation.14
- Turmeric constituents protects against cataract formation in lenses [15].
- Turmeric protects against pancreatitis [16].
- Turmeric extract corrects cystic fibrosis defects [17].
- Turmeric suppresses the induction of adhesion molecules [18].
- Turmeric constituents inhibit androgen receptor and androgen receptor (AR)-related cofactor[19].
- Constitutions of turmeric inhibit farnesyl protein transferase (FTPase).
- Turmeric constituents inhibit scarring [20].
- Turmeric oil containing turmerones exhibited a potent antioxidant activity in β-carotene linoleate model system and the phosphomolybdenum method.
- Turmeric volatile oils suppress acute oedema.

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