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Turmeric-As Coloring Excipients In Pharmaceutical Dosage Forms-A Review Article

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Abstract:

Nowadays, synthetic food colorants are steadily replaced by the natural ones because of consumer preferences due to the health. Natural colorant additives are usually considered as color additives derived from plant or animal sources by extraction. Turmeric is used in this research because of their advantages especially as a source of coloring matter for food industries and textile. Plus, the application of turmeric as food colorant is limited in other research. Turmeric consists of three main components which are curcumin, demethoxy curcumin and bisdemethoxy curcumin. In pharmaceutical formulations, excipients offer add-on characteristic properties as integrity, stability, solubility, and patient compliance to those intrinsic properties exhibited by the Active Pharmaceutical Ingredients (APIs). Natural excipients are nowadays gaining a global interest compared to the synthetic ones being nontoxic, biocompatible, less expensive and widely available. This review describes the major conventional pharmaceutical applications of natural excipients.

Keywords: Natural excipients; Conventional formulations; Pharmaceutical industry; Stability

I. Introduction of Herbal Excipients

The Herbal or natural excipients have a great advantage over their synthetic analogues as these are non-toxic, less expensive and freely available. The increasing awareness about this herbal excipient, which are manly polymers of natural origin, the pharmaceutical industries is getting more inclined towards their use in formulation development. The plant derived gums, mucilage's Tromp astral jounces like carrageenan,

traumatic, lard, storax, agar, gum acacia, tragacanth and many more to make comply with many requirements of pharmaceutical excipients. These can be preferred for formulation development as being stable and involving less regulatory issues as compared to their synthetic counter parts. They can also be easily modified to meet the specific needs, thereby being potent and economic vehicle for delivering active pharmaceutical Ingredient in formulation. Thus, present study aims to throw light on the potential of natural which can be proposed to be used as diluent, binder, Disintegrants as well as lubricant in various types of formulations as they are biocompatible and capable of giving additional nutrition to the developed dosage form.[1] The specific application of natural polysaccharide polymers in pharmaceutical formulations include to aid in the processing of the drug delivery system during its manufacture, protect, support or enhance stability, bioavailability or patient acceptability, assist in product identification, or enhance any other attribute of the overall safety, effectiveness or delivery of the drug during storage or use [2].

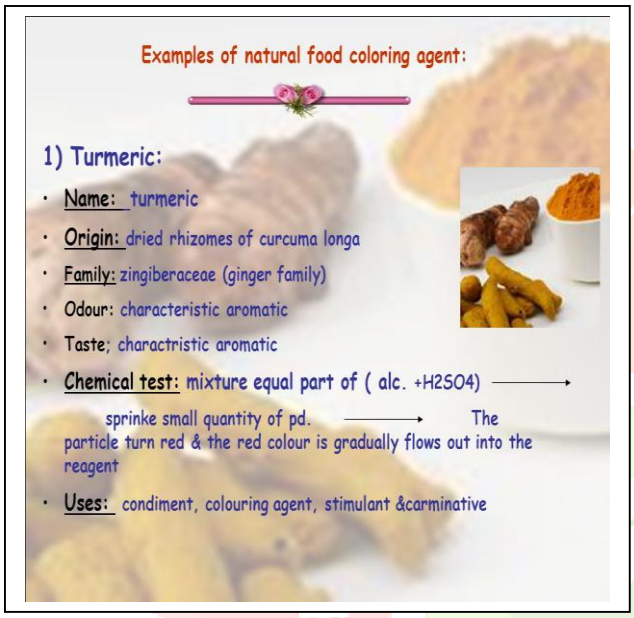

Fig. 1 Turmeric-Name, Origen, source

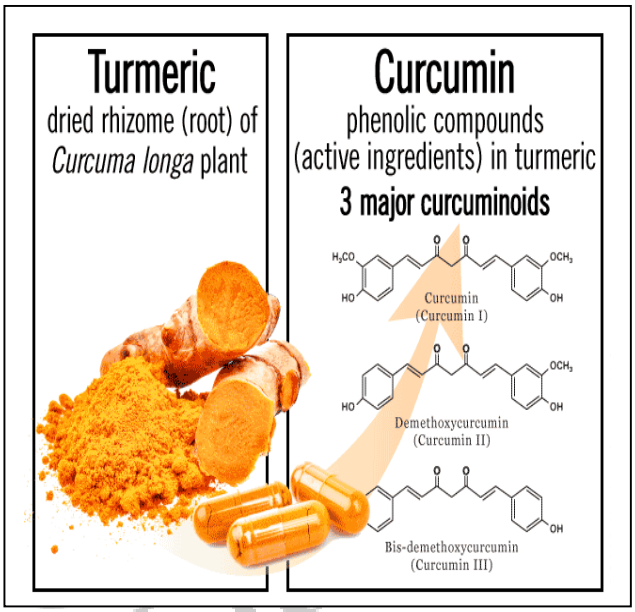

Fig. 2 Curcumin-Phenolic coumpound

Several pharmaceutical excipients of plant origin, like starch, agar, alginates, carrageen an, guar gum, xanthan gum, gelatin, pectin, acacia, tragacanth, and cellulose find applications in the pharmaceutical industry as binding agents, disintegrates, sustaining agents, protective's, colloids, thickening agents, gelling agents, bases in suppositories, stabilizers, and coating materials [3]. As plants sources are renewable and can be cultivated or harvested in sustainable manner, can supply constant availability of raw material. Waste from food industry can be achieved as a raw material to extract herbal excipients. These are other reasons for increase in demand of herbal material as excipients. However, substances from plant origin also pose several potential challenges such as being synthesized in small quantities and in mixtures that are structurally complex, which may differ according to the location of the plants as well as other variables such as the season. This may result in a slow and expensive isolation and purification process. Another issue that has become increasingly.

II. Classification of Excipients

Excipients are commonly classified according to their application and function in the drug products.

- Binder and Diluent
- Lubricants,
- Guidant's,
- Disintegrants
- Polishing film former,
- Coating Agents
- Plasticizer,
- Coloring agents, Dyes
- Suspending Agent, Preservatives
- Flavored, Sweeteners, Taste Improving Agent [5]

A. Advantage of herbal excipients:

- Biodegradable- Naturally occurring polymer produced by all living organisms. They show no adverse effects on the environment or human being.
- Biocompatible and Nontoxic- Chemically nearly all of these plant materials are carbohydrates in nature and composed of repeating monosaccharide units. Hence they are non-toxic.
- Economic- They are cheaper and their production cost is less than synthetic material.
- Safe and devoid of side effect-They are from a natural source and hence, safe and without side effects.
- Easy availability-In many countries they are produced due to their application in man [6].

B. Disadvantages of herbal excipients:

- Microbial contamination- During production, they are exposed to external environment and hence, there are chances of microbial contamination
- Variation- Synthetic manufacturing is controlled procedure with fixed quantities of ingredients while production of natural polymers is dependent on environment and various physical factors.
- The uncontrolled rate of hydration-Due to differences in the collection of natural materials at different times, as well as differences in region, species, and climate conditions the percentage of chemical constituents present in a given material may vary.
- Slow Process- As the production rate is depends upon the environment and many other factors, it can't be changed. So natural polymers have a slow rate of production
- Heavy metal contamination- There are chances of Heavy metal contamination often associated with herbal excipients [6] [7].

III. Natural Coloring agents.

Colorant/color additives a substance that is added or applied in order to change the Color of a material or surface. Colorants can be used for many purposes including printing, painting, and for Coloring many types of materials such as foods and plastics. Colorants work by absorbing varying amounts of light at different wavelengths (or frequencies) of its spectrum, transmitting (if translucent) or reflecting the remaining light in straight lines or scattered. Most colorants can be classified as dyes or pigments or containing some combination of these. Typical dyes are formulated as solutions; while pigments are made up of solid particles suspended and are generally suspended in a vehicle (e.g., linseed oil). The color a colorant imparts to a substance is mediated by other ingredients it is mixed with such as binders and fillers are added, for example in paints and inks. In addition, some colorants impart Color through reactions with other substances Colorants, or their constituent compounds may be classified chemically as inorganic (often from a mineral source) and organic [8].

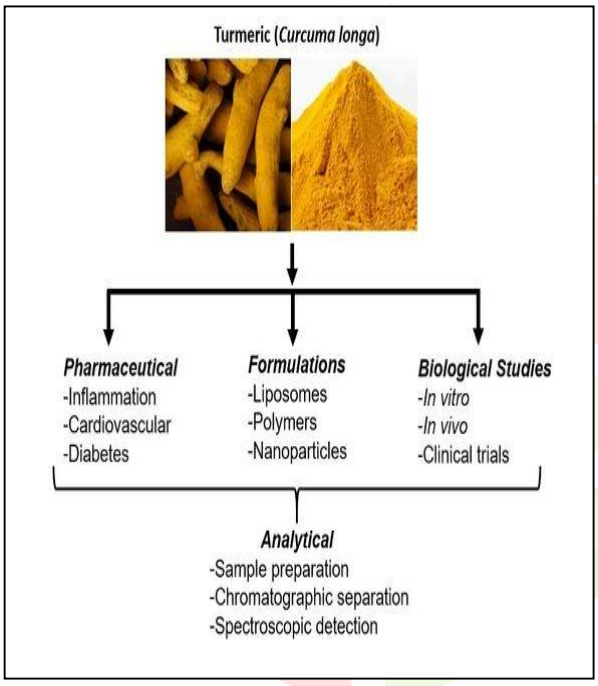

Fig. 3 Turmeric-Pharma &Biological studies

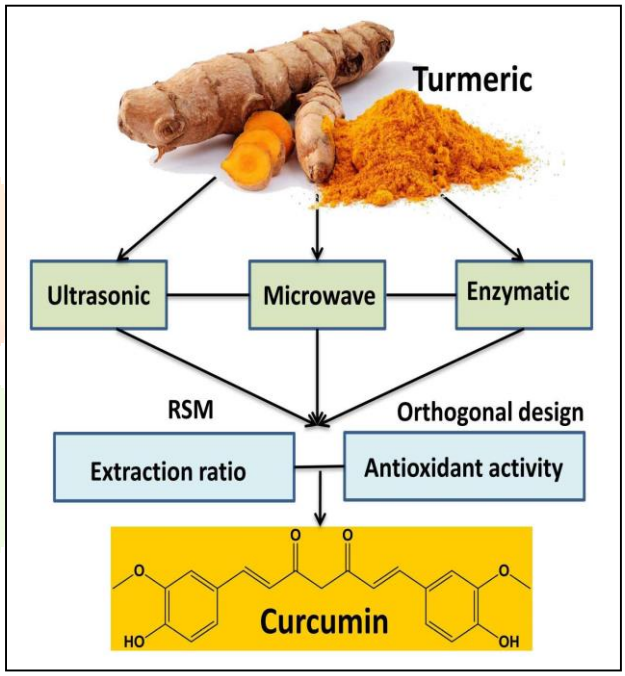

Fig. 1 Turmeric- Steps involved in Extraction of Curcumin

Coloration of food, either using natural or synthetic color additives, should indicate good quality, assist marketing, and satisfy consumers. Colorants are added to food matrices in specific technological steps in order to obtain and maintain the appropriate desired colors of food products. Colorants are also used to restore natural food colors lost by exposure to air, light, temperature, moisture, or improper storage conditions.

Food colorants can also provide appropriate color to colorless foods, protect flavors and vitamins (due to their antioxidant potential) during storage, or enhance the general appeal and nutritional value of foods. Color additives are classified as dyes (pigments) or lakes. Both types can be used as primary colors (pure colors used without dilution) or secondary colors (blended primary colorants diluted with solvents or other additives). Dyes are commercial water-soluble pigments, used as powders, granules, or liquids. They are generally used

in beverages, dry mixes, baked goods, confections, dairy products, etc. Color is an important indicator of food quality. The consumer associates food color with good processing and safety.

The color of food is the result of the presence of natural pigments or of added synthetic organic dyes. Natural colorants include the pigments occurring in unprocessed food, and those that can be formed upon heating, processing, or storage.

IV. Natural Dyes:

Natural dyes are derived from naturally occurring sources such as

- Plants (e.g., indigo and saffron)
- Insects (e.g., cochineal beetles and lac scale insects)
- Animals (e.g., some species of mollusks or shellfish)
- Minerals (e.g., ferrous sulfate, ochre, and clay) without any chemical treatment [9].

"A spectrum of beautiful natural colors ranging from yellow to black exists in the above sources."These colors are exhibited by various organic and inorganic molecules (pigments) and their mixtures are due to the absorption of light in the visible region of 400-800 nm. *This absorption of light depends on the structure or constituents of the coloring pigment/ molecules contain various chromospheres present in the dye yielding plant to display the of colors.*The use of natural products together with their therapeutic properties is as ancient as human civilization and for a long time, mineral, plant and animal products were the main sources of drugs "The current preference for naturally derived colorants is due to their healthfulness and excellent performance. “Several synthetic colorants have been banned because they cause allergy-like symptoms or are carcinogens. "Nowadays, natural dyes are commonly used in the cosmetic industry due to no side effects, UV protection and anti-aging properties. “In India, there are more than 450 plants that can yield dyes. In addition to their dye-yielding characteristics, some of these plants also possess medicinal

- Natural dyes obtained from plants - Berry, flower, bark, leaf, seed etc. (e.g. Catechu, Indigo fera, Myrobalan and Pomegranate).
- Natural dyes obtained from insects - Cochineal and lac.
- Natural dyes obtained from animal - Mollusk, murex snail, cuttlefish and shellfish.
- Natural dyes obtained from mineral - Clay, ochre and malachite. [11] [12]

V. History of turmeric

Turmeric (Curcuma longa) and several other species of the curcuma genus grow wild in the forests of Southern Asia including India, Indonesia, Indochina, nearby Asian countries, and some Pacific Islands including Hawaii. All of these areas have traditional culinary and medicinal uses going back to pre-history. In the Indian Ayurveda system of herbal medicine, turmeric is known as strengthening and warming to the whole body. Traditional uses in India include to improve digestion, to improve intestinal flora, to eliminate worms, to

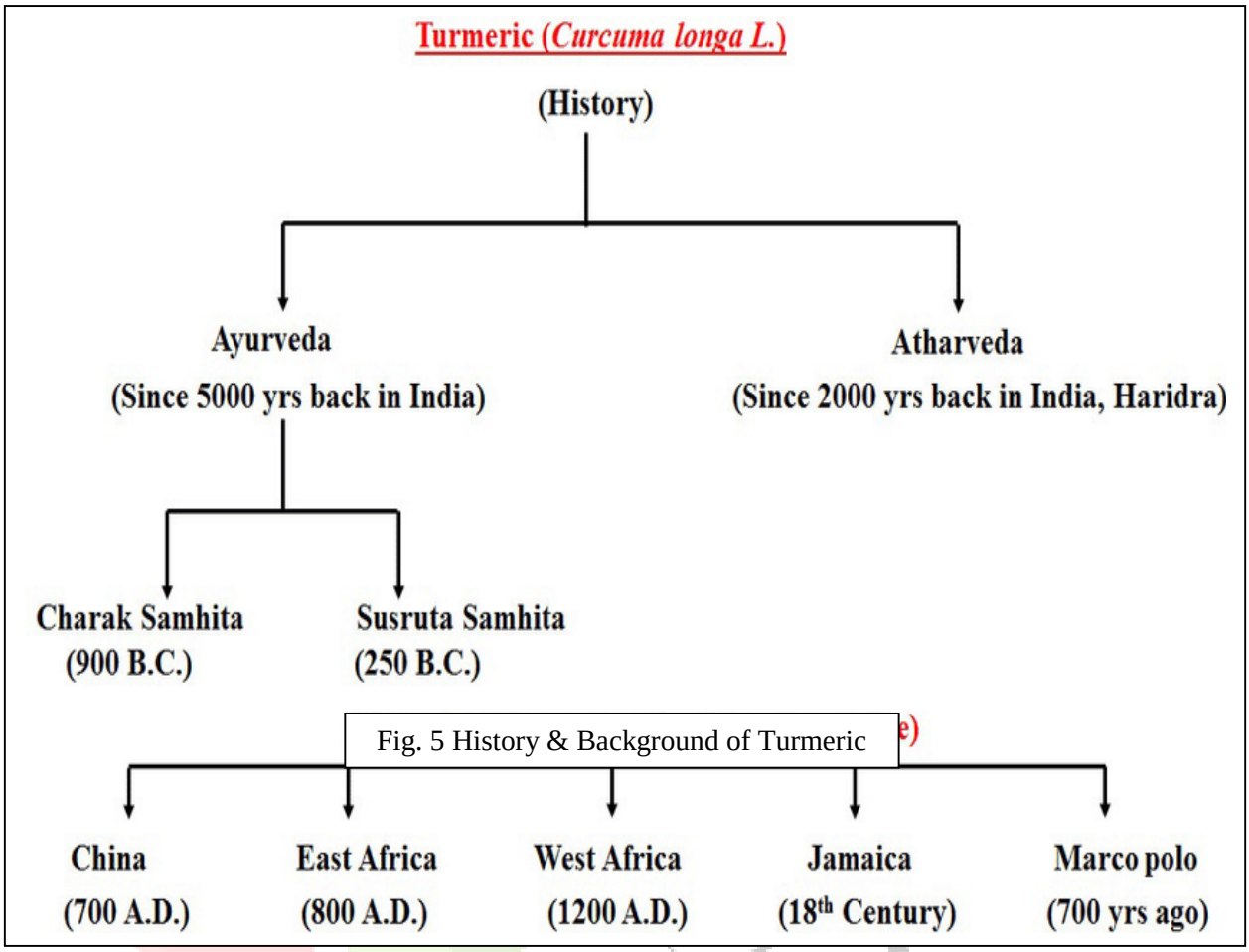

Fig. 5 History & Background of Turmeric

relieve gas, to cleanse and strengthen the liver and gallbladder, to normalize menstruation, for relief of arthritis and swelling, as a blood purifier, to warm and promote proper metabolism correcting both excesses and deficiencies, for local application on sprains, burns, cuts, bruises, insect bites and itches, for soothing action in cough and asthma, as antibacterial and anti-fungus, and in any condition of weakness or debility. According to Michael Moriarty, "The ancient Hawaiians used this herb for many things, including the prevention and treatment of sinus infections (it is very astringent and appears to pull mucus out), ear infections (swimmers ear) and gastrointestinal ulcers." Turmeric is eaten as a food both raw and cooked throughout Asia. While turmeric root looks much like ginger root, it is less fibrous and is more chewable, crunchy, and succulent. The fresh root (not the powder) has a somewhat sweet and nutty favor mixed with its bitter flavor. As a result, it is not unpleasant to eat and not difficult to chew. It is sometimes chewed plain or chopped up and put in salads raw. Traditional use includes mashing/grinding it in a mortar to make a paste to mix with other spices for flavoring in curries.

It was and is used in religious ceremonies and offerings – often representing life, purity, and prosperity. The old herbals of Europe make little if any mention of turmeric. Marco Polo refers to turmeric as Indian saffron used for dying cloth. Michael Castleman writing in 1991 says: "The ancient Greeks were well aware of turmeric, but unlike its close botanical relative, ginger, it never caught on in the West as either a culinary or medicinal herb. It was, however, used to make orange-yellow dyes. In the 1870's, chemists discovered turmeric's 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 late 20th century had little interest in turmeric. For example, in all of Dr. Christopher's writings the only mention of turmeric I can find is that it is listed as an alternative tonic. In Jethro Klauss's book Back to Eden, I can find no mention of turmeric at all. This indicates to me that the herbal schools Dr. Christopher and Jethro Klauss went to were not aware of the potential of turmeric which was well known to Asian herbalists. I also suspect that there was a dis-connect between Asian and western herbalists. Michael Castleman comments: "American chemists used turmeric paper, but not even the botanically oriented 19th century Eclectic physicians had much use for turmeric itself, except to add color to medicinal ointments." In one western herbal from the early 20th Century, I do find a discussion of turmeric. This is in Maude Grieve's book A Modern Herbal. 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 mild aromatic stimulant seldom used in medicine except as a coloring. It was once a cure for jaundice. Its chief use is in the manufacture of curry powders. It is also used as an adulterant of mustard and a substitute for it and forms one of the ingredients of cattle condiments. Turmeric paper is used as a test for alkaloids and boric acid." This disregard of turmeric as an important nutritional and medicinal herb continued in western herbalism up until the late 20th Century. However, even as Maude Grieve was writing, the roots of turmeric's emergence as a prominent healing herb were starting to grow. Daniel B. Mowrey tells the story: "Serious research on turmeric began in Germany, in the early 1920's. Sesquis-terpenes in the essential oil of turmeric were isolated in 1926 and to them was ascribed the therapeutic activity. Later, a team of scientists compared the effects of whole extract, the essential oil, and the water-soluble extract. In 1936, curcumin was compared to whole extract and several isolated constituents. … The results of the experiment show that turmeric acts in the following ways: Turmeric stimulates the flow of bile; several constituents have this property. The increased flow of bile depend in part on the contraction of the gallbladder and in part on the increase in bile secretion.

A. Biological source of Turmeric.

It consists of dried, as well as fresh rhizomes of the plant Curcuma longa Linn. Family: Zingiberaceae Turmeric is commonly known as Indian saffron.

B. Geographical source:

The plant is native to southern Asia and is cultivated extensively in temperate rigion.it is grown in Pakistan and Malaya, India, china, East Indies.

C. Cultivation and collection:

It can be grown from sea level to 1500m in the heels, at a temperature range of 20-30 degree c. with a rainfall of 1500-2250mm per annum. It is also grown as an irrigated crop.

D. Morphology:

It reaches about 1m (3.3feet) in height and bear long simple leaves with long petioles (leaf stem). The leaves emerge from the branching rhizomes that lie just below the soil surface. Older rhizomes are somewhat scaly and brown in color, while young rhizomes are pale yellow to brown orange.

E. Chemistry of pigments:

Turmeric contains about 5% of volatile oil, resin and yellow coloring substances known as curcuminoids. The chief component of curcuminoids is known as "curcumin". Chemically curcuma species contain volatile oils, starch and curcumin (50 - 60 %). Curcumin and other related curcuminoids are reported to be responsible for yellow colour of the dye [13].

F*. Plant Description*:

A relative of ginger, turmeric is a perennial plant that grows 5 - 6 feet high in the tropical regions of Southern Asia, with trumpet-shaped, dull yellow flowers. Its roots are bulbs that also produce rhizomes, which then produce stems and roots for new plants. Turmeric is fragrant and has a bitter, somewhat sharp taste. Although it grows in many tropical locations, the majority of turmeric is grown in India, where it is used as a main ingredient in curry.

G. Parts Used:

The roots, or rhizomes and bulbs, are used in medicinal and food preparations. They are generally boiled and then dried, turning into the familiar yellow powder. Curcumin, the active ingredient, has antioxidant properties, which some claim may be as strong as vitamins C and E. Other substances in this herb have antioxidant properties as well.

H. Available Forms:

Turmeric is available in the following forms:

- Capsules containing powder
- Fluid extract
- Tincture

Because bromelain increases the absorption and anti-inflammatory effects of curcumin, it is often combined with turmeric products.

VI. Health benefits of turmeric in our daily life

- It is a natural antiseptic and antibacterial agent, useful in disinfecting cuts and burns.
- When combined with cauliflower, it has shown to prevent prostate cancer and stop the growth of existing prostate cancer.
- Prevented breast cancer from spreading to the lungs in mice.
- May prevent melanoma and cause existing melanoma cells to commit suicide.
- Reduces the risk of childhood leukemia.
- Is a natural liver detoxifier.
- May prevent and slow the progression of Alzheimer's disease by removing amyloyd plaque buildup in the brain.
- May prevent metastases from occurring in many different forms of cancer.
- It is a potent natural anti-inflammatory that works as well as many anti-inflammatory drugs but without the side effects.
- Has shown promise in slowing the progression of multiple sclerosis in mice.
- Is a natural painkiller and cox-2 inhibitor.
- May aid in fat metabolism and help in weight management.
- Has long been used in Chinese medicine as a treatment for depression.
- Because of its anti-inflammatory properties, it is a natural treatment for arthritis and rheumatoid arthritis.

Fig. 6 Health Benefits of Turmeric

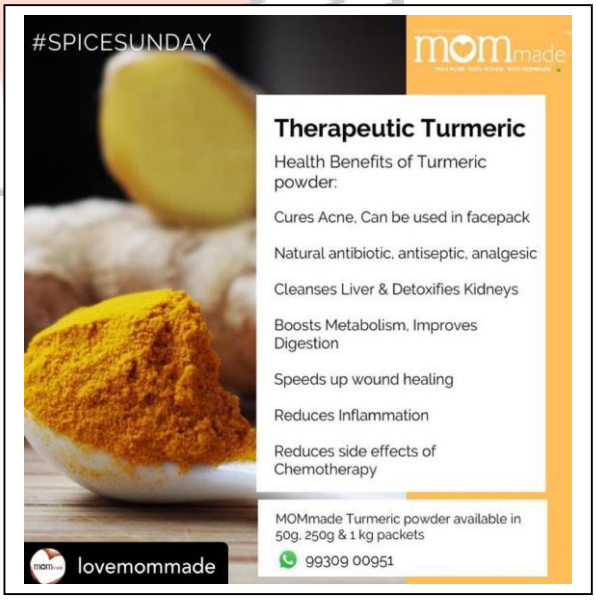

Fig. 7 Therapeutic uses of Turmeric

- Boosts the effects of chemo drug paclitaxel and reduces its side effects.
- Promising studies are underway on the effects of turmeric on pancreatic cancer.
- Studies are ongoing in the positive effects of turmeric on multiple myeloma.
- Has been shown to stop the growth of new blood vessels in tumors.
- Speeds up wound healing and assists in remodeling of damaged skin.
- May help in the treatment of psoriasis and other inflammatory skin conditions.

VII. Direction for use / Dosage / Caution:

400 milligrams of a Curcumin extract three times a day, 445 milligrams of a standardized supplement 2 to 3 times a day, 1tsp of the dried herb in a cup of warm milk daily, 1tsp to 1 tbsp of a liquid extract divided into several dosages over the course of a day, or 1/8 to ¼ tsp of turmeric tincture 3x a day. Your body will absorbed more Curcumin if you take it with lots of black pepper. The pipeline in pepper improves the body's ability to use turmeric perhaps as much as twentyfold, according to studies. Ginger is also a good companion for turmeric.

Don't take turmeric if you have bile duct obstruction, people with gallstones should consult a herb physician before taking this. Excessive dosage of curcuminoids could cause ulcers or cancer and reduce the number of red and white blood cells in the body. Too much intake can also cause hair fall. When buying turmeric, always buy from reputable seller since some species are toxic. The safety of the herb (especially the turmeric extract, curcumin) in pregnancy and during breast feeding has not been determined. Its choleretic effect may, in theory, cause an increase in symptoms in patients with gallbladder or biliary disease, but this has not been reported in humans, and the effect is unlikely.

VIII. Uses of Turmeric

Since ancient times, turmeric has been used as a traditional medicine and for beauty care. In Ayurvedic system of Indian medicine, turmeric is an important herbal medicine prescribed for various diseases. In fact, turmeric is even used in modern times to plug radiator leaks in water cooled radiators.

The various uses of turmeric are as follows:

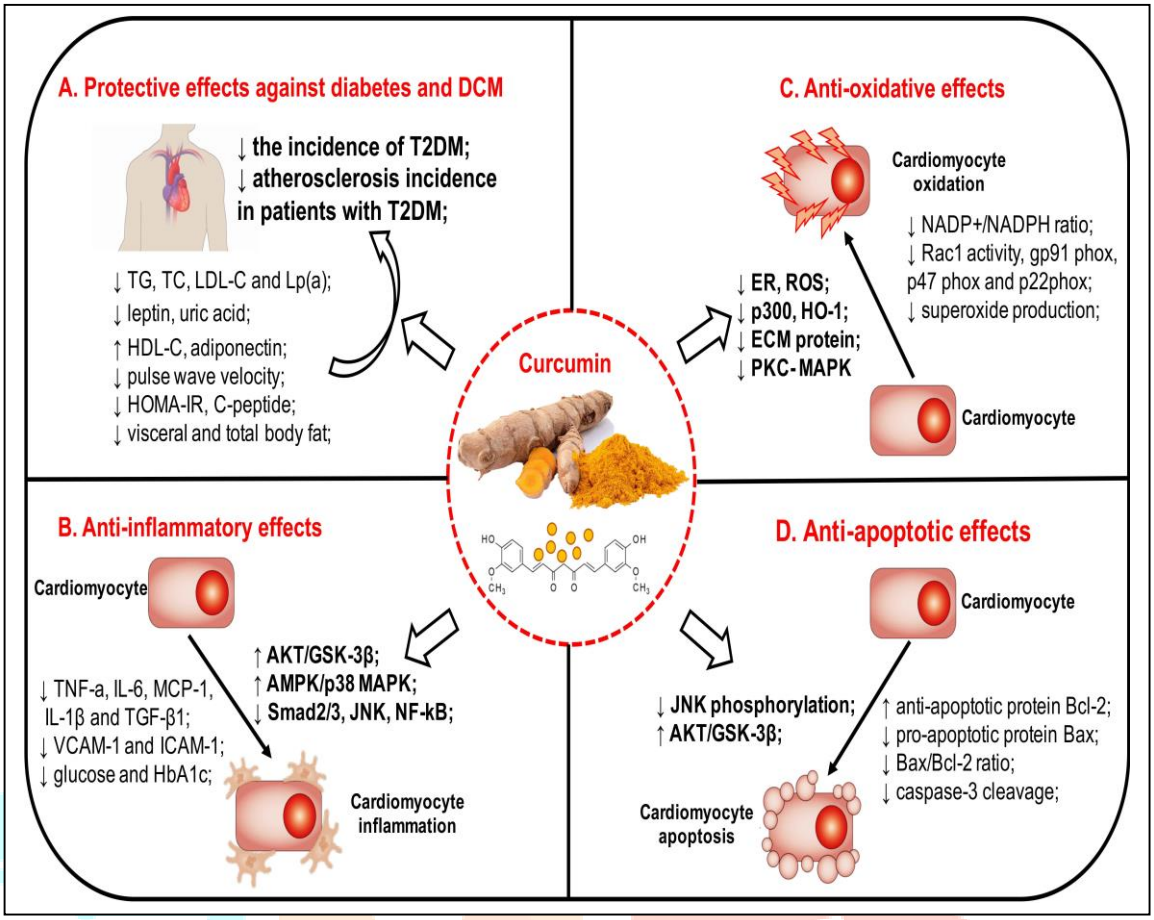

Fig. 8 Curcumin- Various Pharmacological Effect on the Human Body

A. Medicinal

- Turmeric is used for treating digestive disorders.
- Raw Turmeric juice is used to treat hyper acidity and indigestion.
- The juice of raw turmeric also acts as a blood purifier.
- Curcumin - an active component of turmeric, has anti-oxidant properties and so turmeric is used in alternative medicine.
- Turmeric is used for cuts and burns as it is believed to have antiseptic effects and promotes healing.
- Curcumin also has an anti-inflammatory effect by reducing histamine (hormone) levels.
- The flouride present in turmeric is essential for teeth.
- Turmeric also has a protective effect on the liver and also in atherosclerosis.

B. Food Additive

- Turmeric is a mild aromatic stimulant used in the manufacture of curry powders.
- Turmeric is used in products that are packaged to protect them from sunlight.
- The oleoresin component of turmeric is used for oil-containing products.
- The curcumin solution or curcumin powder dissolved in alcohol is used for water containing products.
- Sometimes in pickles and mustard, turmeric is used to compensate for fading.
- Turmeric is also used for coloring cheeses, salad dressings, margarine, yoghurts, cakes, biscuits, popcorn, cereals, sauces, etc.

- Turmeric also forms a substitute for mustard in the cattle feed.

Fig. 9 Turmeric- In Beatification

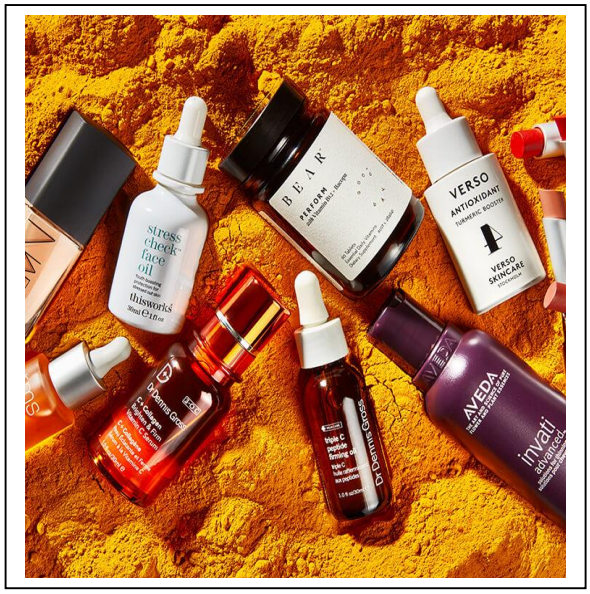

Fig. 10 Turmeric-In Cosmetic Industry

C. Cosmetics

- The juice of raw turmeric is applied to the skin as a paste, kept for around thirty minutes and then washed off. It adds glow to the skin.
- It is an essential ingredient of the traditional bathing ritual of Indian marriages where it is applied along with sandal wood paste before the bath.
- It is believed that regular bathing in water containing turmeric reduces growth of body hair.
- Regular turmeric use is said to make the skin fair, soft and smooth.
- Turmeric is used for spots caused due to pigmentation or blotches and also for diseases like eczema.

Miscellaneous Uses

- Ayurveda states that turmeric is poisonous for crocodiles. So anyone swimming in crocodile infested waters should apply turmeric paste to protect himself.
- Turmeric is also believed to ward off snakes and the presence of turmeric plants around the house acts as a barrier for them.
- The turmeric paste is used in Indian medicine for snakebites.
- The leaves of turmeric are said to act as mosquito repellents.
- Turmeric is used as a coloring agent for filter paper used in scientific tests.

- It has been recently discovered that in water cooled type of radiators, a spoonful of turmeric added to the water, plugs any leaks.

Fig. 11 Turmeric-In Dental cleaning

Fig. 12 Turmeric-Remove Dental Plaque

IX. Application of turmeric in dental problem

A. Dental problems

Turmeric can be used in following ways offer relief from dental problems:

- Rinsing the mouth with turmeric water (boil 5 g of turmeric powder, two cloves, and two dried leaves of guava in 200 g water) gives instant relief.
- Massaging the aching teeth with roasted, ground turmeric eliminates pain and swelling.
- Applying the powder of burnt turmeric pieces and bishop's weed seed on teeth and cleaning them makes the gums and teeth strong.
- Applying a paste made from 1 tsp of turmeric with ½ tsp of salt and ½ tsp of mustard oil provides relief from gingivitis and periodontitis. Rub the teeth and gums with this paste twice daily.

B. Pit and fissure sealant

It has been found that tinted pit and fissure sealant is useful for applying to tooth surfaces for the prevention or reduction of dental caries. This sealant can be produced from a composition comprising a polymerizable resin system containing acrylic monomer and at least one colorant selected from the group consisting of Annatto extract, turmeric extract, and β-Apo-8'-Carotenal.

C. Dental-plaque detection system

Caries or periodontal diseases are thought to be infectious diseases caused by bacteria present in dental plaques and it is known that the removal of dental plaques is highly important for the health of oral cavities. However, dental plaques are not easy to identify by the naked eye and it is difficult to confirm their attachment site and extent precisely. Accordingly, dental plaques are generally stained with dental-plaque staining agents, which contain dyes, to reveal their locations in order to uncover the attached dental plaques. The dental-plaque

detection system includes a dental-plaque staining agent, which contains at least one selected from the yellow pigment of beni-koji, turmeric extracts, and curcumin; and a light-emitting apparatus, which outputs light having a wavelength within a range of 250 to 500 nm to an object in the oral cavity where the dental-plaque staining agent is attached. A yellow pigment of beni-koji and turmeric are known as staining agents also used for other purposes.

D. Side Effects of Turmeric

The use of herbs is a time-honored approach to strengthening the body and treating disease. Herbs, however, contain active substances that can trigger side effects and interact with other herbs, supplements, or medications. For these reasons, herbs should be taken with care, under the supervision of a practitioner knowledgeable in the field of botanical medicine. While pregnant women needn't avoid foods containing turmeric, its use as a medicinal herb is not recommended during pregnancy because the effects are not fully known.

E. Dosage of Turmeric

Turmeric extracts standardized at 90 to 95% curcumin can be taken in the amount of 250 to 500 mg three times per day. Tincture, 0.5-1.5 ml three times per day, is sometimes recommended.

X. Turmeric and Modern Research

Continuing research on the health and medical benefits of turmeric show its healing properties are more far-reaching than researchers first thought. Scientists discovered that turmeric has natural phenolic compounds which provide a multitude of antioxidant properties. These antioxidant properties are called curcuminoids. Beginning in the mid1970s and continuing to this day, the medical use of curcuminoid compounds is being studied in clinical and laboratory research. The results of these studies show the importance of the rhizome, or fleshy rootstock, of the turmeric plant and its current and possible future effect on modern medicine. Turmeric is the root (or rhizome) of the Asian plant, *Curcuma longa* or C. *domestica*. When the roots are ground up, they yield a yellowish powder that resembles saffron; it is sometimes referred to as Indian saffron. Turmeric is used as a curry component and as a spice in Indian cooking, and can be used as a dye. Turmeric and its major component, curcumin, are both used as phyto medicines.

Clinical trials in Turmeric

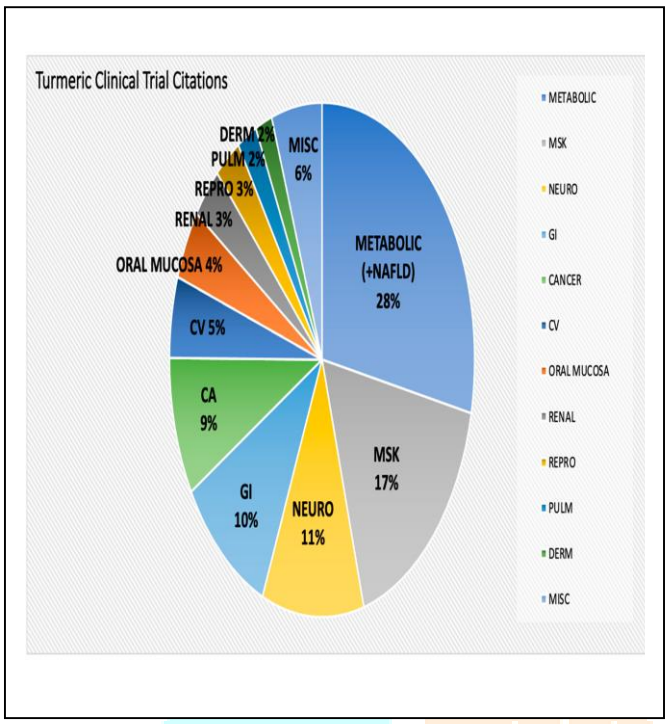

Fig. 13 Turmeric-In clinical Trials

Fig. 14 Curcumin and Crushine

Clinical trials have been primarily published in local journals from Asian countries. There have been no clinical studies on turmeric or curcumin from Europe or North America. Inflammation and Arthritis-In a randomized, double-blind, crossover trial from India, of 6-month duration and conducted on 42 patients with osteoarthrits, Articulin-F, an herbal mixture containing turmeric (plus ashwagandha, frankincense, and zinc) improved pain and disability scores compared to placebo. Although the results were statistically significant, the individual effect of turmeric was not evaluated and the dose of turmeric (300 mg/day) was relatively small. A "preliminary" double-blind RCT on 18 patients with rheumatoid arthritis suggested curcumin 400 mg ti.d. was as effective as phenyl-butazone 100 mg t.i.d.; however, upon analyses of the results, phenyl-butazone appeared more effective, and there was no adequate placebo control. Other Indications-An open study on patients with chronic anterior uveitis evaluated 53 patients, with 21 lost to follow-up. Eighteen patients with a weak reaction to purified protein derivative (PPD) received 375 mg t.i.d. of turmeric alone for 12 weeks, versus 12 patients with a strong PPD reaction who received turmeric combined with Anti Tubercular drugs for 1 year. The 18 patients receiving turmeric alone all improved within the initial 12 weeks, compared to 86% of the combined treatment group. After 3 years of follow-up, there was a higher recurrence rate in the turmeric group (55%) than the combination treatment group (36%), with similar rates of vision loss. The authors suggest that turmeric may be beneficial in treating chronic anterior uveitis, but the results of this non-blinded and poorly controlled study are difficult to interpret Small uncontrolled studies in India and China have reported potential effects of turmeric or curcumin in lowering serum cholesterol In an open study of 45 patients that assessed cholesterol as a secondary endpoint over 4 weeks, triglycerides were reduced, but total cholesterol was unaffected. An uncontrolled pilot study in India involving 814 patients reported that a paste of turmeric combined with neem was beneficial to treat scabies.

Adverse Effects of Turmeric

Encapsulated turmeric or curcumin administered in the clinical trials was well tolerated; side effects were generally similar to placebo. In one trial of patients with duodenal ulcers, a burning sensation was reported twice as often in turmeric group than in the placebo group (13% and 7%, respectively). There are rare cases of allergic contact dermatitis reported.

Side Effects and Interactions of Turmeric

Turmeric has anti platelet effects *in vitro*, which could have an additive effect with anticoagulants or antiplatelet drugs. However, antiplatelet effects have not been demonstrated in *vivo*, and no adverse effects or interactions have been reported in the clinical trials or from individual cases.

Preparations & Doses of Turmeric:

Turmeric is used in foods, and is readily available as powders or capsules. Various extracts containing curcumin are available in liquid form or in proprietary mixtures. In the clinical trials, turmeric root or powder preparations were administered in a dose of 1-6 g/day, typically divided three times daily, whereas doses of about 400 mg t.i.d. of curcumin were used. Quality turmeric products are allegedly standardized to contain not less than 3% curcumin, and not less than 3% volatile oils. Much larger amounts of curcumin can be administered than turmeric; the usual dose of 1200 mg/day of curcumin is equal to about 40 g/day of turmeric (containing 3% curcumin). A heaping teaspoon of powdered turmeric is about 4 g.

Turmeric and Curcumin as coloring agent:

Turmeric is an aromatic spice obtained from the dried ground rhizomes of *Curcuma longa* L., a perennial shrub. *Curcuma longa* L has bright green leaves, conical yellow flowers, and reaches maturity after 7 to 10 months, when rhizomes are harvested. The dried ground rhizomes yield a bright yellow powder also known as yellow ginger or Indian saffron. It has the special property of imparting both color and flavor.

The main compounds involved in color are curcumin, de-methoxy curcumin, and bis de-methoxy curcumin. The three commercial forms based on *Curcuma longa* L. are turmeric powder, turmeric oleoresin, and curcumin powder. Commercially available products called curcumins contain curcumin (1, 7-bis (4-hydroxy-methoxyphenyl)-1, 6-heptadiene-3,5-dione) as the major component (~ 77% of total curcuminoids). Turmeric and curcumin are insoluble in water but soluble in alkalis, alcohols, and glacial acetic acid, and are used mainly as food color and secondarily as a spice. All turmeric pigments have good heat stability, but they are light sensitive.

Turmeric is used mainly as a spice, to give specific flavor and color, but also as an additive for maintaining freshness and improving the palatability and shelf lives of perishable foods. Turmeric powder is obtained from dried rhizomes. The turmeric powder standardized with maltodextrin contains 8 to 9% curcumin.

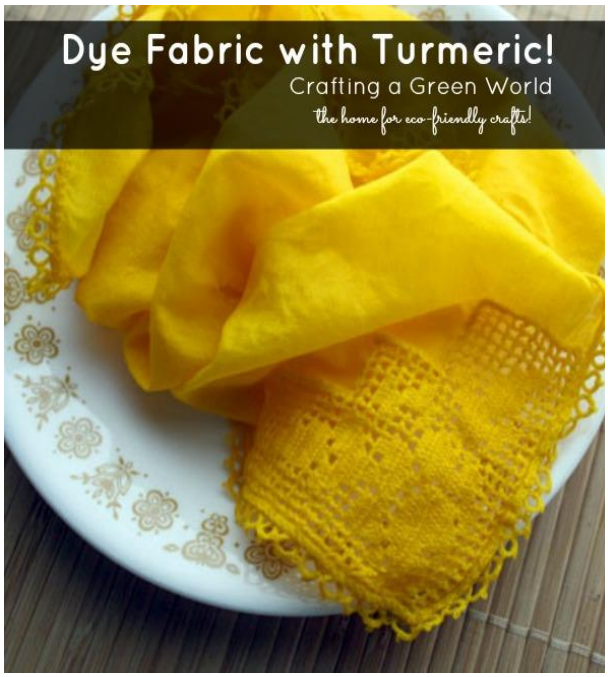

Fig. 15 Dye Fabrics with Turmeric

Fig. 16 Fiber dying shade with Turmeric

The stability of turmeric under light and alkaline conditions have been increased by the addition of acids (gallic, citric, gentisic) as stabilizers. The oleoresin is obtained from turmeric powder by solvent extraction; the solvents used are ethyl acetate, acetone, carbon dioxide, dichloromethane, n-butanol, methanol, ethanol, and hexane and their mixtures; isopropanol and trichloroethylene is also one good mixture. After filtration the solvents must be completely removed from the oleoresin. Turmeric powder and turmeric oleoresin contain pigments, flavor compounds (volatile oils), resins, and fats. Both can be used as spices and as food colorants. Curcumin powder (E 100) is obtained from the turmeric oleoresin by crystallization. It appears as an orange-yellow crystalline powder with a melting point at 179 to 182ºC. It is soluble in ethanol, propylene glycol, and acetone and insoluble in water. Curcumin powder must contain minimum of 90% pigment. Generally turmeric powder is used in mustard paste and curry powder as a colorant and for aroma. Oleoresin is added to mayonnaise, to breading of fish and potato croquettes, and to nonalcoholic beverages. However, curcumin (E 100) is added to products where turmeric is incompatible, such as cheese, butter, ice cream, and some beverages.

Other applications are coloring mustard, pickles, mayonnaise, salad dressings, oils, and cauliflower. In the European Union (EU), curcumin is permitted in alcoholic beverages (*quantum satis*), jam, jellies, marmalades (100 mg/kg), sausages, pâtés (20 mg/kg), dried potato granules and flakes, non-alcoholic drinks, and confectionery. The FDA approved turmeric powder (CI 73600) and turmeric oleoresin (CI 73615) but not curcumin powder for general use in foods. Turmeric powder is used in the 0.2 to 60 ppm range and the oleoresin

in the 2 to 640 ppm range. According to Joint Expert Committee on Food Additives (JECFA), the acceptable daily intake (ADI) was established at 0 to 3 mg kg/body weight. Curcumin is a potent candidate to replace the synthetic tartrazine pigment.

Conclusion

Turmeric has been traditionally recognized in India as a flavorful, colorful condiment, and as an Ayurvedic medicine to improve appetite, act as a carminative, and treat gallstones and other biliary problems, as well as dyspepsia. It is a traditional remedy in India, China, and other Southeast Asian countries to treat asthma and colds, and is applied as an ointment, paste, or poultice for scabies, boils, bruises, insect bites, and other skin lesions. Turmeric is given orally for many other conditions, including menstrual problems, pain, epilepsy, respiratory tract infections, bleeding, diarrhea, jaundice, and rheumatic disorders. More recently, it has gained a reputation as an anti-inflammatory agent, a treatment for hypercholesterolemia, an antioxidant, and a cancer preventative, and is claimed to prevent cardiovascular and other degenerative changes of aging. Claims also are made for its value in allergy, AIDS, cataracts, and other diseases. Curcumin is added to foods such as butter and margarine to prevent oxidation and to improve the color. Turmeric is a valued spicy condiment that has been traditionally used to improve digestion and to treat dyspepsia and inflammatory disorders. Turmeric and its major component, curcumin, are also promoted as antioxidants; cancer, HIV, and hypercholesterolemia treatments; and cardiovascular disease preventatives. However, controlled clinical trials are either lacking for these indications or have not shown convincingly positive results. A clinical benefit has not been demonstrated for peptic ulcer disease, and one study was inconclusive for dyspepsia. Controlled trials for arthritis and inflammation also do not adequately demonstrate beneficial effects. Other uses have not been evaluated in controlled clinical trials.

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