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A Comprehensive Critique and Complete Investigation of Curcumin's Pharmacological Capabilities

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Abstract

Curcumin root, also known as Curcuma longa Linn, grows in moderate and subtropical environments. Around the world. Curcumin is very nutrient-dense. According to extensive study conducted over the last 50 years, curcumin has been accountable for almost every one of turmeric's advantages. Turmeric contains antimicrobial agents, anti-inflammatory properties components, activities that reduce coagulation and lower blood sugar levels, antimicrobial properties, stimulates wound healing, and impacts on fertility, arthritis, Alzheimer's, Parkinson's, cancer, HIV, and angiogenesis. It is useful for diabetics. Turmeric powder is often used to colour and taste meals, but it is also employed in traditional Indian medicine to treat a number of health issues. Turmeric appears to be on its way to supplying much more than just a vibrant colour for Indian dishes. It helps with diabetes. Turmeric powder is often used to colour and taste meals, but it is also employed in traditional Indian medicine to treat a number of health issues. Turmeric appears to be on its way to supplying much more than just a yellow tint for Indian curries, thanks to its chemical constituents, curcumin and curcuminoids. Curcumin extract was widely employed in mediaeval Indian medicine to treat a number of ailments as well as to give colour and flavour to food.

Keywords*:* anti-mutagenic, food preserving agent, 2-hydroxymethyl anthraquinone, curcumin, Zingiberaceae,

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Introduction

Curcuma longa, which is also known as turmeric, is a spice o r annual plant from the ginger family.The roots are utilised in food preparation.The rhizome of the turmeric plant is freque ntly cleaned, roasted, and dried to create a yellow powder use d in medicine.Turmeric, obtained from dried Curcuma longa, is responsible for the yellow colour of curry powder.Turmeri c has been utilised for its taste and colour in cuisine, as well a s in Traditional Chinese and Ayurvedic therapeutic technique s (Fuloria *et al.*, 2022). Turmeric is commonly utilized in Ayurvedic healing practices to strengthen and warm the body. India has an extensive background in medicinal use of plant of turmeric. Turmeric is rich in curcumin, a substance known for its anti-inflammation and antioxidation properties as well as anti-mutagenic and antibacterial effects. The everlasting floral plant, native to south Asia and Indian subcontinent, thrives at degrees ranging from 20 to 30degree celcius (ranging from 68 to 86 degree farenhiet) with significant yearly precipitation (Ahmad *et al.*, 2020).

In India, turmeric, or Curcuma longa, is widely utilized as spices, food preserving agent, and colouring agent. Turmeric, also known as the 'KITCHEN STAR', is a popular spice among Indians, including homemakers and Himalayan hermits alike (Abd *et al.*, 2021). Extended period usage to turmeric, Tulsi, and trifala resembles a brief Pancha Karma therapy. Curcumin has antioxidant attributes and safeguards towards free radical destruction. Curcumin additionally has non-cancerous effects as well as prevents cancer. It suppresses an enzyme called as topoisomerase, which is crucial for cancer (Akaberi *et al.*, 2021).

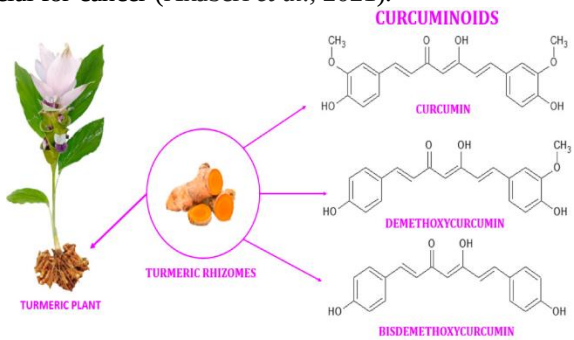


Fig. 1

Turmeric's History:

Turmeric has been used as a culinary component and a religi ous symbol in India's Vedic civilisation for around 6000 year s (Razavi *etal.*,2021).Curcumin, according to Marco Polo (12 80 AD), is Indian ginger used to colour clothing.Turmeric ha s been used in India for thousands of years for medicinal, cos metic, and culinary purposes, as well as colouring.It is menti oned in the ArtharvaVeda of India.For almost 2000 years, Bu ddhist monks have used turmeric to dye their robes.For thous ands of years, turmeric has been used medicinally, especially for the bowels, belly, and liver.. It is used for stimulation and purification, as well as anti-biotic, antiviral, and analgesic properties (Zhu *et al.*,2022). This natural remedy is beneficial for females as it strengthens the reproductive system and relieves menstruation blockage (Chumroenphat *et al.*, 2021). In the mid-1870s, researchers observed that bases caused curcumin root powder to become reddish brown. The identification resulted in the creation of curcumin paper for testing basicity (Gupta *et al.*, 2020).

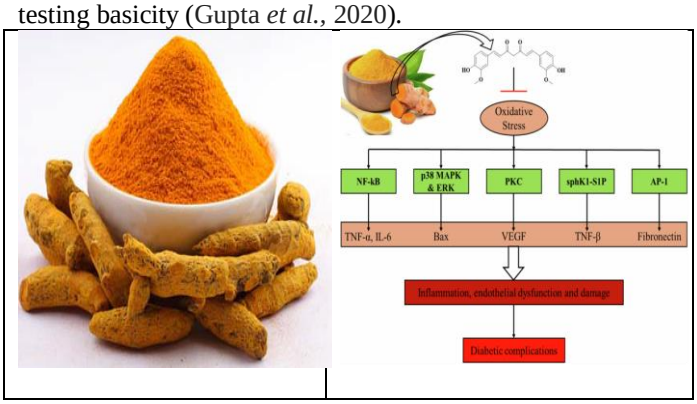


Fig. 2 Turmeric leaves, powder rhizome and oxidative stress

Table. 1 Various names of turmeric in different language

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

Cultivation

Soil: Turmeric production's soil should be fertile and porous. Soil that has a somewhat greater sandy concentration seem ideal. turmeric grows in different types of soil, such as dark and light ones. This plant prospers in watered and areas dependent on rainfall of horizons ranging from a dark, and reddish to rigid clayey soils. Turmeric may be cultivated in a variety of tropical settings, from below the surface level to 1500 millimetres above sea level, alongside temperatures varying between 20 and 35 degrees Celsius and yearly precipitation of 1500 mm or more, either rain-fed or watered (Jyotirmayee *et al.*, 2022).

Climate: Turmeric thrives in degrees ranging from 20°C to 30°C and requires high precipitation throughout the year. Every plant reach to a height of one meter and are tall lengthy, rectangular leaflets. Turmeric, being a tropical plant, grows across both tropical and subtropical regions. Turmeric, being a tropical plant, grows across both tropical and subtropical regions (Kadam *et al.*, 2020).

Irrigation: Turmeric's irrigation frequency varies according on soil and climate conditions. Watering is recommended for moderate soil based on rainfall (Nandhini *et al.*, 2023).

Storage: Turmeric's rhizomes for germination are frequently stored in shaded areas and adequately conditioned shelters, wrapped in curcumin leaf. Seeds, roots can also be preserved in holes with soot (Harisha *et al.*, 2023).

Harvesting: According to the type, yield is available for harvesting seven to nine month following sowing in the first three months. Earlier types develop in seven to eight month a period of time middle kinds in eight to nine months, while latter variants take nine months to mature as detail shown in cultivation of turmeric is shown is the Fig. 3 (Sontsa *et al.*, 2021).

Fig. 3 cultivation of turmeric

International Scenario: Turmeric is grown at global areas like China, Cambodia, Malaysia, Indonesia, Madagascar, Nepal, Viet Nam and Philippines (Tripathi *et al.*, 2018).

Indian Scenario:

Our Nation (India) grows almost each among the globe's curcumin crops as well as consuming eighty percent of them. Considering its intrinsic properties and a significant amount of the key pharmacological component turmeric, Indian curcumin is regarded as among the finest in entire globe. Turmeric is mainly grown in states like Orissa, Andhra Pradesh, West Bengal, Gujarat, Maharashtra, Meghalaya, Tamil Nadu etc. in which AP (Andhra Pradesh) comprises of 35 percent of land area and 47 percent of productive yield (Temteme *et al.*, 2020).

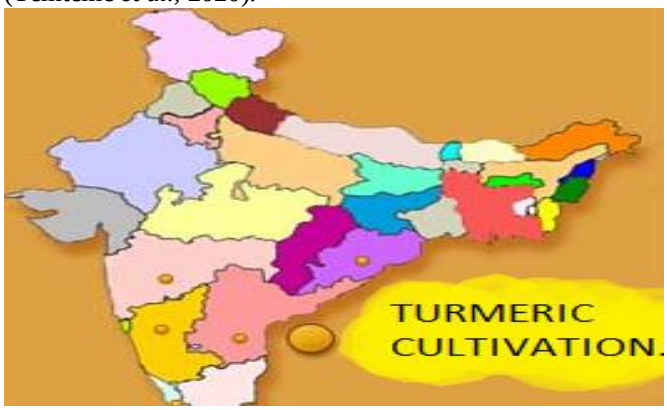
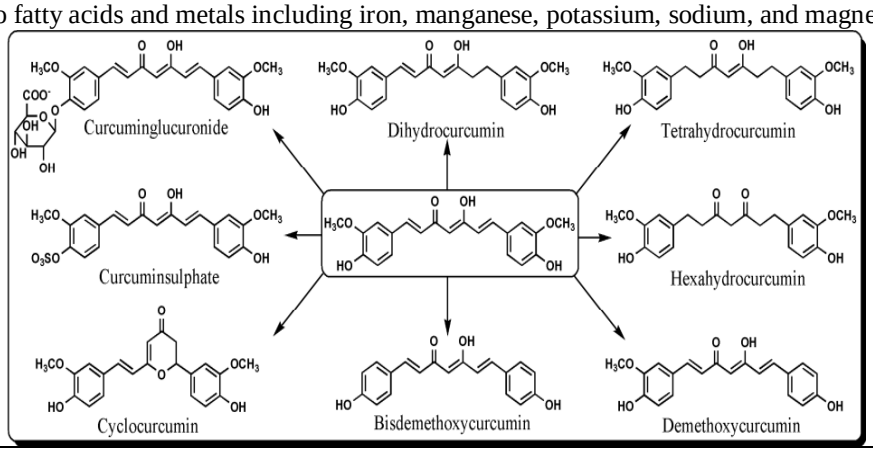


Fig. 4 Geographical distribution in India.

Table. 3 Phytoconstituents [Plant-based constituents] (Prajapati *et al.*,2021, Singh *et al.*, 2014 and Singh *et al.*, 2019)

Sr. No.	Phytoconstituents of turmeric
1.	1,8-cineole, 4-hydroxybisabola-2, 2-bornanol, and 2-hydroxymethyl anthraquinone
2.	α-atlantone, α-pinene, α terpineol, Aromatic-turmerone & Arabinose constitute the molecules that make up

	(10-diene-9-one, 4-methoxy-5-hydroxybiosabola) and 4-(hydroxy-cinnamoyl-(Feruloyl)-methane).
3.	chromium, cineole,7innamic acid, cuminyl alcohol, calcium, carbrylic acid, caryophyllene, (curcumene, curcumenol, curcumin, curdione, cobalt), and Cu. Borneol, boron, bis-desmethoxycurcumin, bisabolene, and caffeic acid.
4.	Residue, azulene, β-carotene, β-pinene, bis-(p-hydroxycinnamoyl)-CH_4, ascorbic acid, and beta-sesquiphellandrene.
5.	Phosphorus, Protocatechuic acid, Procurcumadiol, (L-β-curcumene) Limonene, Mn, Niacin, Ni, norbixin, P-coumaric acid, P-methoxycinnamic acid, Pcymene, Ptolymethylcarbinol, and Monodesmethoxycurcumin.
6.	Guaiacol, Isoborneol, L-alphacurcumene, Eugenol, Epiprocurcumenol, Eucalyptol, Germacrone, Germacrone13-al, and alpha-atlantone
7.	The polysaccharides A, B, C, and D are acidic.
8.	Highly volatile oil (4.2%) is made up of ar-curcumene, germacrone, curcumene, arturmerone, and turmerone.
9.	Further substances: Turmeric contain 6.3% of protein, 5.1% of fats, 3.5% of mineral, 69.4% carbohydrates, and 13.1% of humidity Curcumin (diferuloylmethane), a phenolic di-ketone consisting of 94% curcumene I , 6% of curcumin II and 0.3% curcumin III , is responsible for the yellowish color.
10.	Further chemical components include magnesium, beta sitosterol, campesterol, cholesterol, and copper/zinc. There are also fatty acids and metals including iron, manganese, potassium, sodium, and magnesium.



Approaches of Curcumin Separation

Curcumin initially isolated by Vogel and Pelletierin who first described the rhizomes of C. longa in 1815. Vogel Jr. refined it in 1842. After decades of research, Curcumin's framework was reported by Milobedeska et al. in 1910 (Jyotirmayee *et al.,* 2024). Curcumin was successfully synthesised by Lampe and Milobedeska in 1913. It was chromatographically separated and quantified by Srinvansen in 1953. An essential step in removing the biologically active substance from the matrix of the plant extracting the curcumin. Inaccessible chemicals are left behind throughout the extraction procedure when particular mixtures were utilised through the line with predefined process (Kaur S *et al.,* 2024). It is possible to extract curcumin by both traditional and cutting-edge methods. Many researchers have used novel techniques for extraction like ultrasonography to aid in the extracting procedure, extraction using a microwave, extraction using enzymes, extraction using supercritical fluid, and pressurised the removal of liquids in place of traditional methods for extraction like extraction of solvent and extraction of Soxhlet because they need less period of time, Energy, cooling water, and organic solvents (Kanglom *et al.,* 2024). Curcuma glob longa's curcuminoids extracted including omega-3 fatty acids oxidise when exposed to elevated temperatures or sunlight. Warming may be easily controlled utilising Historically established methods for recovering the ingredient curcumin and omega-3 fatty acids. Percolation, steam, and hydro distillation is a boiler and reflux temperature process used for eliminating carotenoids as well as additional physiologically enduring elements after curcuminoid separation.

Table. 3 Techniques, approaches, and circumstances regarding obtaining the ingredient curcumin omega-3 fatty acids (Pawar *et al.,* 2024 and Prajapati *et al.*, 2021).

Approaches / Methods	Circumstances along with Concepts	Source of Extraction
S.A.S. stands for Antisolvent agent Supercritical Fluid.	CO_2 becomes supercritical.	Dehydrated root systems to both China and India, as well as readily accessible saffron liquefied extraction
Vortex-aided deep eutectic solvent (D.E.S.)	Liquid-liquid micro-extraction using emulsification	Commercially available liquid extract of turmeric
Liquid-liquid microextraction	Liquid-liquid extraction in aqueous solutions utilizing imidazolium as well as ultrasound.	Dried rhizomes obtained from the market and power obtained economically
Ionic liquid assisted by ultrasound dispersion	Liquid micro-extraction	A commercial mixture of curcuminoids
*Environment-responsive long-chain	Supramolecular extraction	Power available commercially

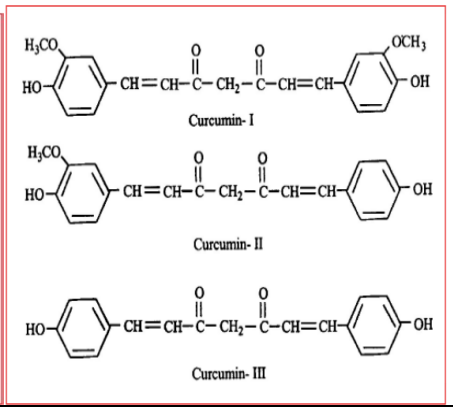
acid (C7-C14)		
Microwave-assisted extraction	Microwave energy for analyte partitioning	Power obtained commercially
Microwave-assisted extraction	Microwave energy for analyte partitioning	

Fig.5 Extraction process

Fig. 6 Extract

Table. 4 Various Tests of turmeric (Prajapati *et al.,* 2021, Lavudya *et al.,* 2024, Roney *et al.,* 2024 and Hasan *et al.,* 2024).

Alkaloid's Test: Three milliliters of diluted Hcl were added to the extraction, and it is thereafter carefully filtered. The following procedure was used to carefully examine the filtrate that was obtained.	
Test of Mayer	Filtrate (1ml or 2ml) + A small amount of reagent of mayer is put to the side of the test tube. Alkaloids presence was revealed being milky residue.
Test of Wagner	Filtrate (1ml or 2ml) were treatment with reagent of wagner. Development of brownish, rusty precipitation shows that the Alkaloids are working.
Test of Dragendroff.	Filtrate (1ml or 2ml) of reagent of Dragendorff. After the addition, a noticeable yellowish ppt. formed, signifying the existence of drugs.
Glycosides's Test: Equal amounts (Fehling's solutions A + B 2 ml sample fluid) heated, the glycoside result was positive. There was a reddish ppt.	
Test of Legal	Test solution (1ml or 2ml), two chemicals (Sodium nitroprusside as well as pyridine) were introduced, and the appearance of a red or pink color signifies the presence of glycosides.
Test of Keller-Killani	When two milliliters of CH_3COOH (glacial acetic acid) with A single drop of FeCl3 is mixed with the extract, resulting in a brown ring, signifying the the existence of glycoside.
Borntrager's Examination	Chloroform added to the filtrate when the extract had been heated with dilute sulfuric acid and well mixed. Once the organic layer had been isolated, ammonia was slowly introduced. The ammoniacal layer's transition from pink to red suggests a successful outcome.
Flavonoids Examination	
Examine of Shinoda	Drop by drop + Sulphuric acid two ml Solution for testing + some pieces of magnesium ribbon. output is possibly pink scarlet or crimson red..
Test of Alkaline Reagent	NaOH solution + test solution, producing it a red to yellowish hue.
Test of Zn	After diluting 2 mL with zinc dust extract and conc. Hcl acid, crimson color was observed a few minutes later that indicates the existence of flavonoids.
Tannins Test	



Test of $FeCl_2$ (Ferric Chloride).	Drops of $FeCl_2$ + extract solution. Gallic tannins were found to be blue, while catecholic tannins were found to be green-black in color.
Test of Gelatin	2 ml of testing solution and 1% gelatin solution + 10% NaCl+white precipitate.
Saponins Test	
Test of Foam	The following is how researchers attempt to determine whether saponins are present: After shaking 5 ml of extract + 20 ml of dist. H_2O, the mixtures were brought to a boil. Frothing indicates that saponins are present.
Triterpenoids Test	
	Salkowski Test: 2 ml(chloroform) + 3 ml (concentrated H_2SO_4) were additional to the test solution, and it was thoroughly shaken. Drugs(steroids) were identified by production of a red color to the lower coating, while drugs(triterpenoids) are specified to the yellow colour
Phenol test:	
Test of Ferric Chloride	Test extract + 4 drops of (alcoholic) FeCl3 solution. Phenol presence is showed by a blue – black appearance
Fats and Fixed Oils Test:	
Test of Stain	A small A particular quantity of the extraction was squeezed across the 2 Sheets (filter) and the stain (filter paper) show that there are static oil present.
Tests of Saponification	Few drops of 0.5 KOH(alcoholic) was mixed with little quantity (extract solution) + a drop of phenolphthalein, and the mixture is heated in a water bath for one or two hours. The findings demonstrate the existence of fats and fixed oils by either partially neutralizing the alkali or forming soap.
Test of proteins and amino acids	
Test of Millon's	When Millon's reagent is applied to 2 ml of test solution, a white precipitate forms that turns crimson when heate d.
Test of Ninhydrin	Ninhydrin solution was treated and then boiled to create a 2 ml test solution. The presence of amino acids is shown by the formation of a blue color. Once again, 2 ml of the test solution, 0.2% ninhydrin solution, was treated with proteins and amino acids before b oiling to reveal a violet hue.
Carbohydrates Tests: After dissolving the extracts in five to ten ml of dist. H_2O, the filtrate was passed through Whatmann number (filter paper) and used for the subsequent carbohydrate test.	
Molish Test	Few drops Molish Reagent were applied + (test tube) containing two ml of solution. Two ml of conc. HCl were additionally from the test tube's sides. In (test tubes) a purple was seen. Carbohydrates occur when a purple ring is formed at the junction of the 2 liquids.
Test of Fehling	The existence of decreasing sugars can be seen by production of a pink ppt. after diluted hydrogen chloride was hydrolyse + two ml of extract, neutralized with alkali + heat provided + add Fehling's solutions A and B.
Benedict's Test	After gently heating the filtrate and treating it with Benedict's reagent, occurrence of dropping sugars are shown with the formation of red ppt.
Test of Iodine	When two ml of extract are added to five drops of iodine solution, the resultant blue color indicates a positive test .

Chemistry of Curcumin

Differentiuloylmethane, another name for curcumin, is a poly phenol related to the diarylheptanoids group and has the IUP AC name (1E,6E).4-hydroxy-3-methoxyphenyl-1,7-bis-1,6 heptadiene3,5dione, the chemical equation$C_{21}H_{20}O_6$ and a m olecular weight of 368.39 g/mol(Bharadwaj*etal*.,2024).The st ructure of this symmetrical molecule shows two phenyl rings that have been replacedby(OH) in the p position aswell as me thoxy group in the ortho position.It is simultaneously a polyp henol and a polyketie because the two aromatic rings are connected by a 7 C- chain that contains an diketone with an alpha-beta unsaturation component(Sarah R *et al.*,2024). Ketoenol tautomerism is exhibited by the Diketo group, whic h existed 100% in the enol form in the solid state and predom inated as an enol in basic aqueous solutions. In contrast, the keto form predominates in solution with acidic pH and neutral with 7 pH solutions, with enol accounting with roughly 30% of all curcumin is found in the latter. As seen in Fig. 9 (Kholif *et al.*, 2024).

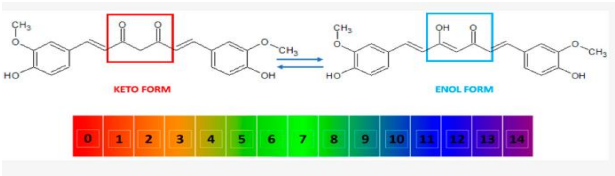


Fig. 7

Natural source

The tubers of Turmeric (curcuma domestic valeton), a the Zingiberaceae family, are used to produce saffron.

Technique for Processing

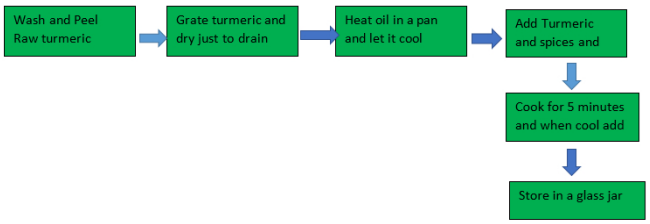


Fig. 8

Table. 5 The Vitamin Content of Turmeric (Allabaksh *et al.*, 2024, Dey *et al* 2024, Abara *et al.*, 2021, Ikpeama *et al.*, 2014, Enemor *et al.*,2020, Parhak *et al.*, 2024)

Ingredients	**Value (per table spoon) (14g)**
Water	1.6g
Calories	47.8g
Cholesterol	0mg
Protein	3.0g
Fat	11.2
Carbohydrates	33.6g
MINERALS	
Calcium	24.8mg
Phosphorus	36.2mg
Iron	5.6mg
Zinc	0.6mg
Magnesium	26.0mg
Potassium	340mg
Sodium	5.2mgss
Vitamins	
Thiamine	0.0mg
Riboflavin	0.0mg
Vitamin C	3.4mg
Vitamin A	0.0IU
Folate	5.2mcg
Choline	6.6mg

Table. 6 The nutrients in each 100g of (turmeric) saffron (Freitas *et al.*, 2022, Behera *et al.*, 2024, Chattopadhyay *et al.*, 2004, Pathak *et al.*,2024 and Stanić *et al.*, 2017).

Calories 354kcal	Dietary Fiber 21g	Vitamin C 25.9mg	Vit. B2 (Riboflavin) 0.233mg
Energy Value 1481kj	Sugars 3g	Iron 41.42mg	Vitamin E 3.1mg
Total Fat 9.88mg	Sodium 38mg	Calcium 183mg	Vit. B3 (Niacin) 5.14mg
Protein 8g	Potassium 2525mg	Copper 0.603mg	Vitamin B6 1.8mg
Carbohydrates 65g	Zinc 4.35mg	Magnesium 193mg	Vit. B1 (Thiamine) 0.152mg

Curcumin, Turmeric, & Wellness: Curcumin has a broad spectrum of natural actions as shown in Fig.11 and has many medicinal uses. (Urošević *et al.*, 2022, Witkin. *et al.*, 2013, Pathak *et al.*, 2024).

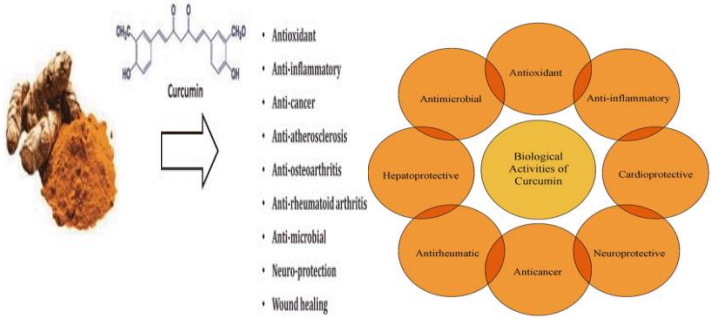
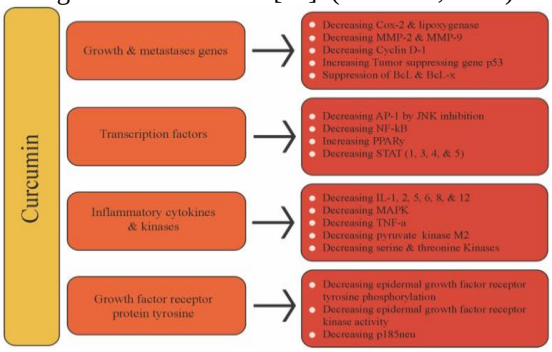
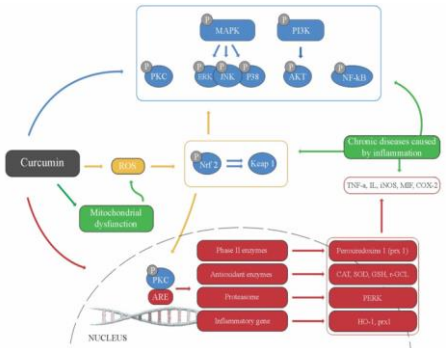
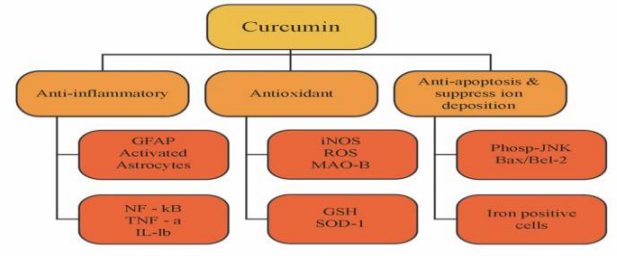


Fig. 9

Using turmeric to treat dental issues	• **Curcumin water**, it is a fast remedy for sore lips which is prepared by boiling two dried guava leaves, turmeric powder upto five grams, and two cloves two hundred grams water. (Shome *et al.*, 2016). • To reduce pain and suffering, crushed and roasted curcumin is applied to aching teeth . (Adamczak *et al.*,2020) • The gums and tooth enamel get stronger when roasted curcumin pieces and bishop's weed seed powder is applied & cleaned. • Using a paste consisting of one teaspoon turmeric, one tablespoon sodium chloride, along with one teaspoon mustard oil frequently relieves periodontitis and gingivitis. Twice daily, apply this paste to your gums and teeth .
Using Turmeric for Cosmetics	• Cosmetology uses curcumin extensively. On their wedding night, Indian ladies and grooms alike are covered with turmeric. It smooths, reduces inflammation, treats, and prevents skin conditions including pimples, acne, blackheads, and blemishes. (Sharifi-Rad *et al.*, 2020) • all while giving the skin a gorgeous golden shine. • Turmeric is a component in a wide variety of creams, lotions, pace packs, and other products. • Also use for beautification.
Using Turmeric which lowers stomach acid GIT effect	• The use of turmeric may cause some medications to work differently, producing more stomach acid. (Panda *et al.*, 2017). • Esomeprazole (Nexium) • Lansoprazole (Prev acid)

	• Ranitidine (Zantac) • Cimetidine (Tagamet) • Researchers showed that curcumin helped lessen inflammation in models of rat of induced pancreatitis and decreased mucosal damage in mice with experimentally induced colitis. In an unrestricted phase II trial, A total of 25 individuals suffering from stomach ulcers. identified by endoscopy were given take 600 milligrammes of turmeric powder 5 times each day. • Findings revealed that 48% of patients had fully recovered. • Components of Curcuma longa that include P-tolymethylcarbinol and sodium curcuminate have a number of beneficial actions on the digestive system. Curcumin sodium demonstrates the traits of inhibition of p-tolymethylcarbinol and intestinal spasm, raises the levels of bicarbonate, secretin, gastrin, and secretion of pancreatic enzymes. Since turmeric has Further proof to prevent ulcers formation brought on by alcohol, stress, reserpine, indomethacin, and pyloric ligation, significantly raising the mucus on the stomach wall in rats exposed to these digestive injuries [44].. (Anand *et al.,* 2008).
Using Turmeric as antiviral agent	• As an antiviral agent, curcumin is also very essential. It inhibits the transcription of the BamH fragment z left frame 1 protein, which is a major activator of the Epstein-Barr virus in RajiDRLUC cells. • • It additionally hinders the expression of the HIV gene, which is triggered by UV lig ht (Fuloria *et al.,* 2022). • Plants are of scientific interest because they were in abundant supply. • of phytochemicals as a variety of physiological functions, include antivirals qualities. • Antiviral medication resistance is on the rise, most viral illnesses lack effective medicines, and many antiviral therapies are expensive. Therefore, the search for novel, effective antiviral chemicals is necessary [45].
Using Turmeric as Anticancer Agent	• One alternative cancer treatment that is being advocated is turmeric. Curcumin has a compound called turmeric, that may be able to kill cancer cell to some types of cancer. However, more research is required. Many Asian nations grow turmeric as a spice. • Curcumin's protein targets in tumour cells [46]. (Dai *et al.,* 2022).  Fig. 10
Using Turmeric as Anti-fungal agent	• The regulating fungal aspect of turmeric and curcumin associated fungi and spoiling agents. Curcumin Intensity is an important component in preventing fungi growth. • Turmeric is used in plant tissue culture as powder at concentrations of 0.8 and 1.0 g/L has demonstrated strong inhibits fungal infections. Antifungal properties towards Candida albicans as well as Cryptococcus neoformans had shown by the turmeric methanol extract, with minimum inhibitory concentrations (MIC) The concentrations were 128 and 256 microgram per millilitre, accordingly.
Using as Anti-inflammatory agents	• The combination of curcumin and the aromatic oils in the turmeric plant results in powerful anti-inflammatory benefits. • Half of curcumin can be used to treat chronic inflammation when taken orally. demonstrated to be equally effective in treating the acute inflammatory response as c ortisone or phenylbutazone (Verma *et al.,* 2018). • Turmeric is known for its potent spicy flavor and anti-inflammatory properties because of its special capacity to inhibit lipoxygenase and COX-2. • Rheumatic symptoms are often associated with inflammatory changes in the joints. It addresses the fundamental causes of inflammation as well as its pathological changes.

	• It works just as well as cortisone and phenylbutazone at comparable dosages. • Once more, rats' paw oedema and inflammation were reduced by a lower dosage of 2 0–80 mg/kg.Curcumin reduced formaldehyde- induced arthritis in rats at 40 mg/kg, and no acute toxicity was observed at dosages as high as 2 g/kg/day. • In both animals examined in rheumatoid arthritis, which is brought on by streptococcal cell walls, joint inflammation was avoided four days prior to the onset of arthritis by administering an intraperitoneal injection of turmeric extract containing 4 mg total curcuminoids/kg/day. • The following effects of curcumin have been demonstrated: • Pro-inflammatory transcription factors (AP-1 and NF-κB) are inhibited. • Lower pro-inflammatory cytokines (TNFα, MIP-1a, MCP-1, CRP, PGE2, IL-1b, IL-2, IL-6, IL-8, and IL-2). • Reduce the activity of certain enzymes, such as COX-2, 5-lipoxygenase, and -5 • Block the production of nitric oxide synthase (NOS) enzymes by inhibiting pathways and mitogen-activated protein kinases (MAPK) [51-54]. (Nasri *et al.*, 2014).  **Fig. 11 Mechanisms of action of curcumin on inflammation**
Using as Hepatoprotective agent	• The main causes of turmeric's hepatoprotective and reno-protective effects, which are similar to those of silymarin, are its antioxidant characteristics and ability to inhibit the synthesis of pro-inflammatory cytokines (3)–5. • Turmeric's hepatoprotective qualities have been shown in animal studies against a number of hepatotoxic insults, including carbon tetrachloride (TCE), Aspergillus aflatoxin, galactosamine, and acetaminophen (paracetamol). (Wanninger *et al.*, 2015). • In rats with acute and subacute liver injury brought on by $CCl4$, it has been demonstrated that giving curcumin considerably decreased liver damage in test animals as compared to controls. • Turmeric extract is very which, when tested on ducklings, reduces the generation of fungal aflatoxin by 90% harbouring an Aspergillus parasitises infection. • It is feasible to prevent and cure cholelithiasis because of the curcumin salt sodium curcuminate, furthermore has choleretic effects via raising [55].
Using as Immunity booster	• Additionally, freshly extracted turmeric juice has blood purifying properties. • Turmeric's main ingredient, curcumin, has antioxidant properties and is typically employed in complementary and alternative treatment. • According to custom myth, turmeric is mostly used for burns and wounds for wounds have antibacterial qualities that encourage recuperation. Additionally, curcumin has anti-inflammatory properties. via lowering histamine levels. • Thus, turmeric may be a strong immune system booster, when taken at the recommended dosage for the SARS-CoV-2 corrective action. • (desmethoxycurcumin), Benzodiazepine Dimethyl Carbamate (BDMC) and several volatile chemical compounds such as tumerone, atlantone, and zingiberene used as immunity booster. (Fazel *et al.*, 2015). • 80 mg of curcumin was administered daily as a 400 mg powder. We collected saliva and blood both before and after the four weeks. Triglyceride levels were dramatically reduced by curcumin, but neither total cholesterol, LDL, or HDL levels were. Both nitrous oxide (NO) and the atherosclerosis-related molecule soluble intercellular adhesion molecule 1 (sICAM) significantly increased. • Myeloperoxidase levels indicated an increase in inflammation-related neutrophil activity, but not in c-reactive protein or ceruloplasmin. Salivary radical scavenging

	abilities and plasma antioxidant enzyme catalase increased, but not super oxide dismutase or glutathione peroxidase. (Labban *et al.*, 2014). • Salivary amylase activity decreased, which might be a sign of stress. Furthermore, beta amyloid plaque, a sign of brain damage, decreased. • Ageing of the brain and changes in the liver damage biomarker plasma alanine amino transferase activity. It also suggests that those without medical diagnoses may benefit from a comparatively modest dosage of curcumin [56].  Fig. 12
	• A disorder that falls under this category is called Metabolic Syndrome (MetS), and it is characterised by a number of symptoms such as insulin resistance, hyperglycaemias, hypertension, low HDL-C, raised LDL-C, elevated triglyceride levels, and obesity, particularly visceral obesity. • By enhancing the responsiveness to insulin, inhibiting fatty tissue development, and lowering high blood pressure, curcumin has been demonstrated to mitigate a number of characteristics of metabolic syndrome. • Furthermore, studies have shown that curcuminoids alter gene expression and the activity of lipoprotein metabolism-related enzymes, which lowers plasma triglyceride and cholesterol levels and raises HDL-C levels. Chronic low-grade inflammation is associated with both obesity and overweight.
Turmeric to provide Nutrition along with Biomedical Techniques	• Curcumin encounters a long tradition as an aromatic spice and dietary mutually beneficial, and nowadays it is frequently employed to improve the palatability and preservation longevity of foods because because of its distinct yellow colour, flavour, and potential for antioxidants. (Saras T. *et al.*, 2023). • The study of the turmeric's extract rhizomes' organoleptic makeup found that they are golden in colour, with a fragrant odour as well as a somewhat unpleasant flavour. • Turmeric has a bright yellowish-orange colour which is nearly impermeable in water and has been approved as a component of food by the European Union. (Paleker *et al.*, 2023) • Alternative designations include CI 75300, Mother Nature Yellow 3, perhaps diferuloylmethane, in addition to E symbol E100. Turmeric longevity in water-based solutions appears pH-responsiveness, offering an optimal the threshold value that stretches from pH 1 to 6. • Curcumin's colour transforms to red when electrified (pH level < 1 or pH > 7), and being exposed to sunshine enhances breakdown (Pathak *et al.*, 2024).

Conclusion

A detailed review of the scientific literature indicates that Curcuma longa, a herbal remedy with a wide range of pharmacological properties, is considered a panacea. (Zeng L *et al.*, 2022) As a result of its diverse chemical composition, this plant is considered a multipurpose medicinal herb. Therefore, it is clear that in order to combat the ailments, a great deal of research is required to ascertain their potential for cure.

Reference

Fuloria, S., Mehta, J., Chandel, A., Sekar, M., Rani, N. N. I. M., Begum, M. Y., ... & Fuloria, N. K. (2022). A comprehensive review on the therapeutic potential of Curcuma longa Linn. in relation to its major active constituent curcumin. Frontiers in Pharmacology, 13, 820806.

Ahmad, R. S., Hussain, M. B., Sultan, M. T., Arshad, M. S., Waheed, M., Shariati, M. A., ... & Hashempur, M. H. (2020). Biochemistry, safety, pharmacological activities, and clinical applications of turmeric: a mechanistic review. Evidence-Based Complementary and Alternative Medicine, 2020(1), 7656919.

Abd El-Hack, M. E., El-Saadony, M. T., Swelum, A. A., Arif, M., Abo Ghanima, M. M., Shukry, M., ... & El-Tarabily, K. A. (2021). Curcumin, the active substance of turmeric: its effects on health and ways to improve its bioavailability. Journal of the Science of Food and Agriculture, 101(14), 5747-5762.

Akaberi, M., Sahebkar, A., & Emami, S. A. (2021). Turmeric and curcumin: from traditional to modern medicine. Studies on Biomarkers and New Targets in Aging

Research in Iran: Focus on Turmeric and Curcumin, 15-39.

Orellana-Paucar, A. M., & Machado-Orellana, M. G. (2022). Pharmacological profile, bioactivities, and safety of turmeric oil. Molecules, 27(16), 5055.

Razavi, B. M., Ghasemzadeh Rahbardar, M., & Hosseinzadeh, H. (2021). A review of therapeutic potentials of turmeric (Curcuma longa) and its active constituent, curcumin, on inflammatory disorders, pain, and their related patents. Phytotherapy Research, 35(12), 6489-6513.

Zhu, Z., Chen, J., Chen, Y., Ma, Y., Yang, Q., Fan, Y., ... & Liao, W. (2022). Extraction, structural characterization and antioxidant activity of turmeric polysaccharides. Lwt, 154, 112805.

Chumroenphat, T., Somboonwatthanakul, I., Saensouk, S., & Siriamornpun, S. (2021). Changes in curcuminoids and chemical components of turmeric (Curcuma longa L.) under freeze-drying and low-temperature drying methods. Food Chemistry, 339, 128121.

Gupta, H., Gupta, M., & Bhargava, S. (2020). Potential use of turmeric in COVID-19. Clinical and experimental Dermatology, 45(7), 902-903.

Jyotirmayee, B., & Mahalik, G. (2022). A review on selected pharmacological activities of Curcuma longa L. International Journal of Food Properties, 25(1), 1377-1398.

Kadam, J. H., & Kamble, B. M. (2020). Effect of organic manures on growth, yield and quality of turmeric (Curcuma longa L). Journal of Applied and Natural Science, 12(2), 91-97.

Udhaya Nandhini, D., Janaki, P., Venkatesan, S., Senthilraja, K., Somasundaram, E., & Meena, S. (2023). Assessing changes in soil quality indicators, turmeric (Curcuma longa L.) yield, and monetary returns under different years of organic nutrient management. Organic Agriculture, 13(3), 443-460.

Harisha, C. B., Meena, K. K., Rane, J., Halli, H. M., Manjanna, B. K., Patil, B. S., ... & Sorty, A. M. (2023). Bacterial derived biopolymer to alleviate nutrient stress and yield enhancement in turmeric (Curcuma longa L.) by mediating physiology and rhizosphere microbes on poor soils of semi-arid tropics. Archives of Agronomy and Soil Science, 69(13), 2645-2662.

Sontsa-Donhoung, A. M., Bahdjolbe, M., Nekou, G. N., Tadjouo, I. K., & Nwaga, D. (2021). Growing Curcuma longa for rhizome production on diverse arable soil types in Cameroon: agronomic and microbial parameters. Agricultural Sciences, 12(5), 464-480.

Tripathi, S. K., Sharma, B., Ray, R., Raha, P., & Denis, A. F. (2018). Performance of turmeric and soil moisture depletion pattern under different water regimes and nutrient sources at New Alluvial Zone of Indo-Gangetic Plains, India. Communications in Soil Science and Plant Analysis, 49(9), 995-1008.

Temteme, S., GutaAmente, M. W., & Yaziz, B. (2020). Establishment of Stability Indices and Rates of Compost Application for Turmeric (Curcuma domestica) on Nitisols of Yeki District, Southwest of Ethiopia. Results of Natural Resources Management Research.

Prajapati, S. K., Mishra, G., Malaiya, A., Jain, A., Mody, N., & Raichur, A. M. (2021). Antimicrobial application potential of phytoconstituents from turmeric and garlic. Bioactive natural products for pharmaceutical applications, 409-435.

Singh, S., Sahoo, S., Dash, S., & Nayak, S. (2014). Association of growth and yield parameters with bioactive phytoconstituents in selection of promising turmeric genotypes. Industrial Crops and Products, 62, 373-379.

Singh, I., & Madan, V. K. (2019). Effect of moisture levels on various phytoconstituents of turmeric (Curcuma longa L.). Journal of Pharmacognosy and Phytochemistry, 8(1), 1427-1432.

Jyotirmayee B, Nayak SS, Mohapatra N, Sahoo S, Mishra M, Mahalik G. (2024). Bioactive compounds and biological activities of turmeric (Curcuma longa L.). InBioactive Compounds in the Storage Organs of Plants (3) 31 (pp. 395-423).

Kaur, S., Chauhan, P. N., Hamid, J. U., Kaur, S., & Sharma, Y. (2024). Phyto pharmaceutical advances on black turmeric as a functional herb. Current Nutrition & Food Science, 20(2), 131-142.

Kanglom, C., Singh, Y. A., & Singh, S. H. (2024). Evaluation of Phytochemical Constituent, Antioxidant Activity and Anti-Bacterial Activity of Black Turmeric (Curcuma caesia Roxb.). Environment and Ecology, 42(2B), 821-827.

Pawar, H. A., & Dhingra, B. S. (2024). Phytochemistry, Applications and Patents of Curcuma Longa (Turmeric): A Comprehensive Review. Journal of Advancement in Pharmacognosy, 4(1).

Prajapati, S. K., Mishra, G., Malaiya, A., Jain, A., Mody, N., & Raichur, A. M. (2021). Antimicrobial application potential of phytoconstituents from turmeric and garlic. Bioactive natural products for pharmaceutical applications, 409-435.

Lavudya, S., Patel, M. P., Kumar, S., Singh, A., Sakure, A. A., & Pandya, M. (2024). Identification of elite genotypes through morpho-biochemical and molecular characterization of turmeric (Curcuma longa L.). South African Journal of Botany, 166, 161-168.

Roney, M., Huq, A. M., Rullah, K., Zamri, N. B., & Mohd Aluwi, M. F. F. (2024). Curcumin, a bioactive compound of Turmeric (Curcuma longa) and its derivatives as α-amylase and α-glucosidase inhibitors. Cell Biochemistry and Biophysics, 1-19.

Hasan Mujahid, M., Upadhyay, T. K., Upadhye, V., Sharangi, A. B., & Saeed, M. (2024). Phytocompound identification of aqueous Zingiber officinale rhizome (ZOME) extract reveals antiproliferative and reactive oxygen species mediated apoptotic induction within cervical cancer cells: an in vitro and in silico approach. Journal of Biomolecular Structure and Dynamics, 42(17), 8733-8760.

Sarah, R., Idrees, N., & Tabassum, B. (2024). Phytoconstituents and their Therapeutic Potential in Precision Medicine. Precision Medicine and Human Health, 394.

Kholif, A. E., Olafadehan, O. A., Gouda, G. A., Fahmy, M., Morsy, T. A., Ammar, H., ... & Chahine, M. (2024). Turmeric rhizomes reduced in vitro methane production and improved gas production and nutrient degradability. Animal Biotechnology, 35(1), 2371519.

Allabaksh, S., & Senthilraj, R. (2024). A Quantitative Hplc Analysis of Phytoconstituents and Assessment of Antioxidant Properties of The Rhizome of Curcuma

angustifolia ROXB. Rasayan Journal of Chemistry, 17(2).

Dey, A., Sharma, P. K., Pathak, A., Yadav, S. K., Singh, J., & Ghosh, S. (2024). Revolutionizing Infection Control: Harnessing the Power of Stem Cells for Precision Antimicrobial Therapy. In Emerging Paradigms for Antibiotic-Resistant Infections: Beyond the Pill (pp. 197-209). Singapore: Springer Nature Singapore.

Abara, P. N., Adjeroh, L. A., Nwachukwu, M. O., & Osinomumu, I. D. (2021). Differentiation between two spices: Zingiber officinale (ginger) and Curcuma longa (tumeric); their proximate, mineral and vitamin contents. Journal of Scientific Research, 7(1), 17-24.

Ikpeama, A., Onwuka, G. I., & Nwankwo, C. (2014). Nutritional composition of Tumeric (Curcuma longa) and its antimicrobial properties. International Journal of Scientific and Engineering Research, 5(10), 1085-1089.

Enemor, V. H. A., Ogbodo, U. C., Nworji, O. F., Ezeigwe, O. C., Okpala, C. O., & Iheonunekwu, G. C. (2020). Evaluation of the nutritional status and phytomedicinal properties of dried rhizomes of turmeric (Curcuma longa). Journal of biosciences and medicines, 8(8), 163-179.

Sivakumar, P., Monisha, S., Selvaraj, K. V., Chitra, M., Prabha, T., Santhakumar, M., ... & Velayutham, A. (2022). Nutritional value, phytochemistry, pharmacological and in vitro regeneration of turmeric (Curcuma longa L.): An updated review. Annals of Phytomedicine, 11(1), 236-246.

Behera, R., Sharma, S. S., Praveena, J., Rymbai, B., & Behera, L. (2023). Indian Saffron Use as a Source of Drugs and Therapeutics. In Nano-Biofortification for Human and Environmental Health (pp. 179-186). Cham: Springer International Publishing.

Chattopadhyay, I., Biswas, K., Bandyopadhyay, U., & Banerjee, R. K. (2004). Turmeric and curcumin: Biological actions and medicinal applications. Current science, 44-53.

Stanić, Z. (2017). Curcumin, a compound from natural sources, a true scientific challenge–a review. Plant Foods for Human Nutrition, 72, 1-12.

Urošević, M., Nikolić, L., Gajić, I., Nikolić, V., Dinić, A., & Miljković, V. (2022). Curcumin: Biological activities and modern pharmaceutical forms. Antibiotics, 11(2), 135.

Witkin, J. M., & Li, X. (2013). Curcumin, an active constiuent of the ancient medicinal herb Curcuma longa L.: some uses and the establishment and biological basis of medical efficacy. CNS & Neurological Disorders-Drug Targets (Formerly Current Drug Targets-CNS & Neurological Disorders), 12(4), 487-497.

Shome, S., Talukdar, A. D., Choudhury, M. D., Bhattacharya, M. K., & Upadhyaya, H. (2016). Curcumin as potential therapeutic natural product: a nanobiotechnological perspective. Journal of Pharmacy and Pharmacology, 68(12), 1481-1500.

Adamczak, A., Ożarowski, M., & Karpiński, T. M. (2020). Curcumin, a natural antimicrobial agent with strain-specific activity. Pharmaceuticals, 13(7), 153.

Sharifi-Rad, J., Rayess, Y. E., Rizk, A. A., Sadaka, C., Zgheib, R., Zam, W., ... & Martins, N. (2020). Turmeric and its major compound curcumin on health: bioactive effects and safety profiles for food, pharmaceutical, biotechnological and medicinal applications. Frontiers in pharmacology, 11, 550909.

Panda, A. K., Chakraborty, D., Sarkar, I., Khan, T., & Sa, G. (2017). New insights into therapeutic activity and anticancer properties of curcumin. Journal of experimental pharmacology, 31-45.

Anand, P., Thomas, S. G., Kunnumakkara, A. B., Sundaram, C., Harikumar, K. B., Sung, B., ... & Aggarwal, B. B. (2008). Biological activities of curcumin and its analogues (Congeners) made by man and Mother Nature. Biochemical pharmacology, 76(11), 1590-1611.

Dai C, Lin J, Li H, Shen Z, Wang Y, Velkov T, Shen J. The natural product curcumin as an antibacterial agent: Current achievements and problems. Antioxidants. 2022 Feb 25;11(3):459.

Fuloria, S., Mehta, J., Chandel, A., Sekar, M., Rani, N. N. I. M., Begum, M. Y., ... & Fuloria, N. K. (2022). A comprehensive review on the therapeutic potential of Curcuma longa Linn. in relation to its major active constituent curcumin. Frontiers in Pharmacology, 13, 820806.

Pathak, A., Yadav, S.K., Singh, J., Ghosh, S. (2024). Revolutionizing Infection Control: Harnessing the Power of Stem Cells for Precision Antimicrobial Therapy. In: Gangwar, M., Nath, G. (eds) Emerging Paradigms for Antibiotic-Resistant Infections: Beyond the Pill. Springer, Singapore First Online: 19 November 2024 Chapter First Online: 19 November 2024 pp 197–209 (Online ISBN978-981-97-5272-0) https://doi.org/10.1007/978-981-97-5272-0_9

Fu, Y. S., Chen, T. H., Weng, L., Huang, L., Lai, D., & Weng, C. F. (2021). Pharmacological properties and underlying mechanisms of curcumin and prospects in medicinal potential. Biomedicine & Pharmacotherapy, 141, 111888.

Verma, R. K., Kumari, P., Maurya, R. K., Kumar, V., Verma, R. B., & Singh, R. K. (2018). Medicinal properties of turmeric (Curcuma longa L.): A review. Int. J. Chem. Stud, 6(4), 1354-1357.

Ashutosh Pathak, Pavan Kumar, Kritika Shukla, Riya Vissen, Khushi Verma, Sanskar, Yash Giri, Ayush Tiwari, Aabhash shukla, Anuj Yadav, (2024) An Overview of Zingiber officinale as an Essence of Life and Therapeutic Applications, Journal of Science Innovations and Nature of Earth Vol.4,Issue, 4, Page 01-07, SSN (Online) 2583-2093. DOI: https://doi.org/10.59436/jsiane.267.2583-2093

Nasri, H., Sahinfard, N., Rafieian, M., Rafieian, S., Shirzad, M., & Rafieian-Kopaei, M. (2014). Turmeric: A spice with multifunctional medicinal properties. Journal of HerbMed Pharmacology, 3(1), 5-8.

Wanninger, S., Lorenz, V., Subhan, A., & Edelmann, F. T. (2015). Metal complexes of curcumin–synthetic strategies, structures and medicinal applications. Chemical Society Reviews, 44(15), 4986-5002.

Fazel Nabavi S, Thiagarajan R, Rastrelli L, Daglia M, Sobarzo-Sanchez E, Alinezhad H, Mohammad Nabavi S. Curcumin: a natural product for diabetes and its complications. Current topics in medicinal chemistry. 2015 Dec 1;15(23):2445-55.

Saras T. Turmeric Unveiled: Exploring the Golden Spice's Health Benefits and Culinary Marvels. Tiram Media; 2023 Aug 14.

Labban L. Medicinal and pharmacological properties of Turmeric (Curcuma longa): A review. Int J Pharm Biomed Sci. 2014;5(1):17-23.

Paleker, G. (2023). Rhizome networks: Turmeric's global journey from haldi doodh to turmeric latte. Agenda, 37(1), 19-26.

Park J, Do S, Lee M, Ha S, Lee KG. Preparation of turmeric powder with various extraction and drying methods. Chemical and Biological Technologies in Agriculture. 2022 Jun 16;9(1):39.

Boscariol, R., Paulino, T. H., Oliveira Jr, J. M., Balcão, V. M., & Vila, M. M. (2022). Characterization of Commercially Available Turmeric for Use in Pharmaceutical Products and Food Supplements. Journal of the Brazilian Chemical Society, 33(12), 1392-1401.

Pathak A, Soni N, Panday AR. A short review of the incredible therapeutic plant, Aloe vera. J Pharm Adv Res, 2024; 7(7): 2283-2291.

Pathak, A., Soni, N., Mishra, B., Pandey, D. D., Kumar, P., Verma, P., ... & Verma, D (2024) Environmental Epigenomics and New Trends in the Developmental Causes of Diabetes Mellitus.

Pathak, A., Soni, N., Pandey, D. D., & Verma, D. (2023). Recent Advances, Future Challenges, Sar And Antimicrobial Activities Of Isatin: A Breaf Review. Journal of Pharmaceutical Negative Results, 7285-7307.

Pathak, A., Neetu, S., Singh, R., Kumar, S., Kushwaha, S., Rana, P., ... & Gupta, A. (2023). A Short Review of Current Trends, Impending Obstacles, Modern Synthetic Approach, Structure Activity Relationship And Numerous Biological Activities Of Benzimidazole. Latin American Journal of Pharmacy, 42(3), 1089-1104.

Zeng, L., Yu, G., Hao, W., Yang, K., & Chen, H. (2021). The efficacy and safety of Curcuma longa extract and curcumin supplements on osteoarthritis: a systematic review and meta-analysis. Bioscience reports, 41(6), BSR20210817.

Yeung AW, Horbańczuk M, Tzvetkov NT, Mocan A, Carradori S, Maggi F, Marchewka J, Sut S, Dall'Acqua S, Gan RY, Tancheva LP. Curcumin: total-scale analysis of the scientific literature. Molecules. 2019 Apr 9;24(7):1393.

Ashutosh Pathak, Pavan Kumar, Kritika Shukla, Riya Vissen, Khushi Verma, Sanskar, Yash Giri, Ayush Tiwari, Aabhash shukla, Anuj Yadav, An Overview of Zingiber officinale as an Essence of Life and Therapeutic Applications, Journal of Science Innovations and Nature of Earth Vol.4, Issue4,2024, Page 01-07, DOI: https://doi.org/10.59436/jsiane.267.2583-2093.

Pathak, A., Soni, N., Pandey, D. D., & Verma, D. (2023). Recent Advances, Future Challenges, Sar And Antimicrobial Activities Of Isatin: A Breaf Review. Journal of Pharmaceutical Negative Results, 7285-7307.