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A Review On Curcumin : "A Comprehensive Review On Curcumins Pharmacological Properties And Therapeutics Application"

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Abstract :- Curcumin, a key medicinal compound from the Zingiberaceae family, is the principal bioactive component of turmeric widely used in India. It exhibits notable biological properties, especially strong antioxidant potential, and epidemiological studies suggest turmeric consumption may reduce the risk of various cancers. Curcuma longa, a commonly used rhizomatous plant, contains three major curcuminoids—curcumin, demethoxycurcumin (DMC), and bisdemethoxycurcumin (BDMC), also known collectively as diferuloyl methane. Curcumin demonstrates diverse therapeutic activities including anti-inflammatory, antiviral, antibacterial, anticancer, anti-asthmatic, anti-obesity, wound-healing, anti-venom, and antidiabetic effects. Clinical investigations further support these pharmacological roles. The compound exhibits tautomerism, forming a keto structure in water and an enolic form in organic solvents. This review summarizes curcumin's varied activities and its significance in medicinal applications.

Keywords:- Zingiberaceae, Curcuma longa, Curcuminoids, Anti-asthmatic, Curcumin, Cancer applications in pharmacology, Antioxidant, antidiabetic, and anticancer

Introduction :- Curcumin, the main active compound in turmeric, has gained significant attention due to its antibacterial, antioxidant, and anti-inflammatory properties, which support its use in topical formulations such as creams for skin disorders. Although turmeric has therapeutic potential, its clinical application is limited by poor solubility and stability; however, incorporating curcumin into lipid-based creams enhances skin penetration and bioavailability. Curcumin has long been used medicinally for antimicrobial, antimutagenic, and antioxidant benefits, and bioavailability can be further increased with agents like piperine. Traditionally, turmeric has been applied for rheumatoid arthritis, chronic skin conditions, conjunctivitis, uveitis, infections, wound healing, digestive issues, and general wellness. Studies also show curcumin's protective effects in conditions such as osteopenia, osteoarthritis, gingivitis, and periodontitis, helping reduce inflammation, bone loss, and oral discomfort.

History of Curcumin

1. Curcumin has been used for thousands of years in Ayurveda and Traditional Chinese Medicine for treating inflammation and skin disorders.
2. Turmeric served both as a medicinal agent and a culinary spice in ancient cultures.
3. Scientific interest increased in the mid-20th century when studies confirmed curcumin's antioxidant and anti-inflammatory properties.
4. This led to exploration of curcumin in pharmaceutical and topical applications.
5. By the late 20th century, curcumin creams and topical dosage forms began to emerge.
6. Researchers focused on overcoming curcumin's poor solubility and bioavailability using lipid-based formulations.
7. In the early 2000s, advancements such as liposomes, ethosomes, and nanotechnology enhanced topical effectiveness.
8. Clinical studies showed benefits in conditions like acne, psoriasis, and photoaging.
9. Recent research incorporates polymers, emulsifiers, and natural oils to improve stability, permeability, and efficacy.
10. Due to increasing demand for safe herbal skincare, curcumin is now considered a strong candidate for future dermatological and medicinal formulations.

Phytochemistry:

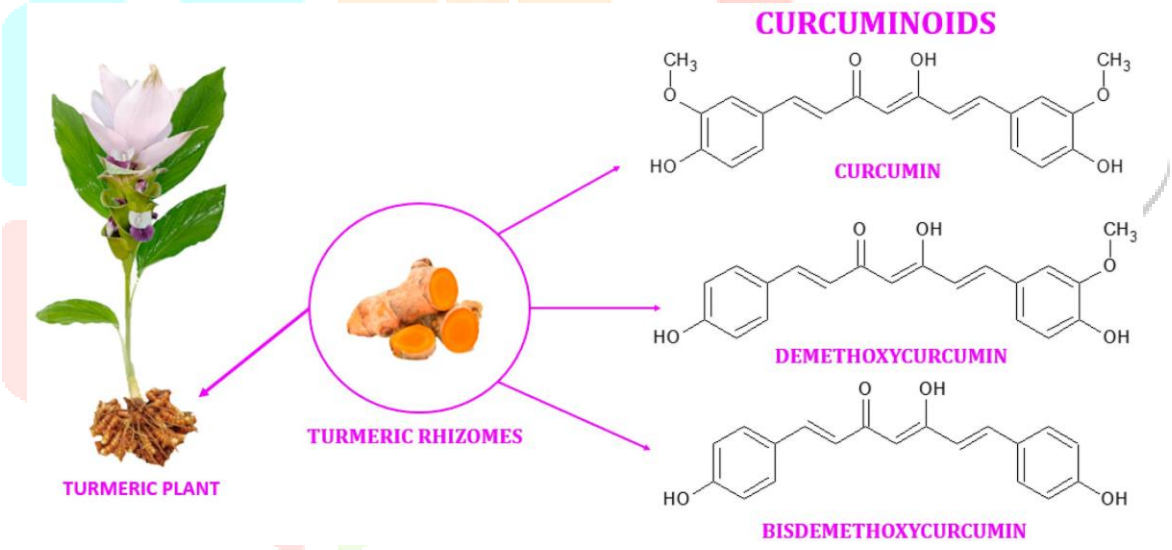

Fig.1 . Chemical structure of curcuminoids

Benefits

1.Help in healing acute kidney injuries
2) increasing antioxidant
3) Improve skin brightness and tone
4) skin is moisture and hydrated
5. Promotes healthy digestion

Synonyms:

Turmeric is frequently called "haldi" in northern India, a term derived from the Sanskrit word "haridra," and "manjal" in southern India.
word that was widely used in Tamil literature in the past. Huang jiang (Mandarin Chinese), curcuma (French, German, Italian), kurkum (Arabic & Hebrew, Spanish), as well as Hindi haldi.

Family
Zingiberaceae

Biological source
The dehydrated rhizome of the herbaceous perennial plant Curcuma longa is the biological source of turmeric.

Pharmacological Activity :-

1. Antidiabetic Activity
Shows antidiabetic potential due to antioxidant properties
Reduces oxidative stress and cell damage
Enhances HO-1 and other cytoprotective enzymes
Improves endothelial dysfunction in diabetes
Useful in topical creams for diabetic skin issues

2. Wound Healing Activity
Accelerates granulation, remodeling, and tissue repair
Reduces reactive oxygen and enhances collagen formation
Promotes reepithelialization and neovascularization
Increases migration of macrophages, fibroblasts, and myofibroblasts

3. Anti-Arthritis Activity
Reduces inflammation, joint pain, and oxidative damage
Supports cartilage protection and mobility
Topical forms give localized relief
Helps reduce synovial hyperplasia in rheumatoid arthritis

4. Anti-Alzheimer Activity
Reduces neuroinflammation and oxidative stress
Prevents amyloid-beta aggregation and plaque formation
Enhances cognitive support in topical delivery
Research ongoing; oral clinical trials show limited effect

5. Anti-Parkinson Activity
Provides neuroprotection through antioxidant action
Reduces alpha-synuclein toxicity
Helps dopaminergic neuron survival
Topical application may improve absorption

6. Anti-Inflammatory Activity
Inhibits COX-2, LOX, cytokines, and inflammatory mediators
Reduces redness, swelling, and inflammatory skin issues
Acts as free-radical scavenger
Useful for arthritis and dermatological inflammation

7. Anti-Venom Activity
Reduces venom-induced inflammation and tissue damage
Inhibits PLA2 and other venom enzymes
Supports faster recovery at bite sites

8. Anti-Angiogenesis Activity
Suppresses VEGF and NF-κB pathways
Prevents abnormal blood vessel formation
Useful in controlling angiogenesis-related conditions

9. Antioxidant Activity
Enhances endogenous antioxidant enzymes
Reduces ROS and oxidative skin damage
Prevents premature aging and promotes healing

10. Anti-Bacterial Activity
Disrupts bacterial membranes and inhibits growth
Prevents biofilm formation
Reduces redness, swelling, and infection symptoms
Shows activity against S. aureus, P. gingivalis, S. gordonii

11. Anti-Fungal Activity
Effective against Candida albicans and Aspergillus niger
Inhibits fungal membrane synthesis and biofilms
Reduces irritation and inflammation in fungal infections
Low toxicity and suitable for topical application

12. Anti-Viral Activity
Inhibits viral replication and cell entry
Shows action against HSV-1, HPV, influenza, RSV, and others
Topical delivery enhances localized antiviral effect

13. Anti-Cancer Activity
Induces apoptosis and reduces tumor cell proliferation
Modulates oncogenes and tumor suppressor pathways
Effective against breast, prostate, and colorectal cancers
Topical use minimizes systemic effects

14. Anti-Fibrotic Activity
Reduces collagen accumulation and fibroblast activation
Modulates TGF-β and Wnt/β-catenin pathways
Helps resolve fibrosis and improve tissue structure

15. Hepatoprotective Activity
Reduces oxidative liver damage and inflammation
Supports hepatocyte survival and regeneration
Helps in detoxification, metabolism, and bile secretion

Pharmacokinetic

1.Absorption :- Low bioavailability is caused by curcumin's poor absorption in the gastrointestinal tract. Although it can penetrate the skin and reach local tissues when applied topically, systemic absorption is still limited.

2. **Distribution :-** When applied topically, curcumin can penetrate both the dermis and the epidermis. Due to its Because of its lipophilic qualities, it can pierce lipid-rich epidermal layers.

3. **Metabolism :-** The degree of first-pass metabolism may be reduced by topical treatment, but curcumin is mostly processed in the liver, making it possible for more active ingredients to get to the intended tissues.

4. **Excretion :-** Metabolites are primarily expelled through the urine and feces. In contrast to oral preparations, topical application of curcumin reduces the likelihood of serious systemic excretion [35]

Pharmacodynamics

Mechanism of Action

Curcumin has antioxidant and antibacterial properties. Of the signaling channels, it
NF-kB and Nrf2 have effects linked to oxidative stress responses and inflammation.

Medical Benefits

Research has examined the effectiveness of topical curcumin in treating psoriasis, acne, and wounds. Its anti-inflammatory properties can help reduce redness and swelling.

Safety Profile

Though some people may experience allergic reactions, it is generally thought to be safe for topical application.
reactions or irritation of the skin.

Formulation Considerations

To improve absorption, curcumin creams can be made with liposomes or nanoemulsions, or they can contain penetration enhancers. [36]

Importance of Skincare Formulations :- The goal of skincare formulations is to preserve the general health, hydration, and elasticity of the skin while tackling typical skin issues like hyperpigmentation, acne, aging, and dryness. A good skincare product ought to: 1.Effectively deliver the active ingredients.

2. For extended use, maintain stability and safety.

3. Be free of dangerous chemicals while maintaining the effectiveness of the product**.**

4.Because of their inherent healing qualities and rising consumer awareness of the advantages of herbal skincare, turmeric-based formulations are especially significant in the current market.

Role of Herbal Ingredients in Cosmetics :- Plant-based extracts, essential oils, and bioactive compounds are used in the formulation of herbal cosmetics to benefit the skin without the use of harsh chemicals. Herbal formulations, as opposed to synthetic ones, are:

1.Gentler on the skin and less likely to cause irritation.

2. Environmentally friendly due to biodegradable ingredient

3.Antioxidants that prevent premature aging are abundant.

4.When mixed with other natural oils, butters, and botanical extracts, turmeric creates a potent base for herbal face creams that offer both medicinal and aesthetic advantages.

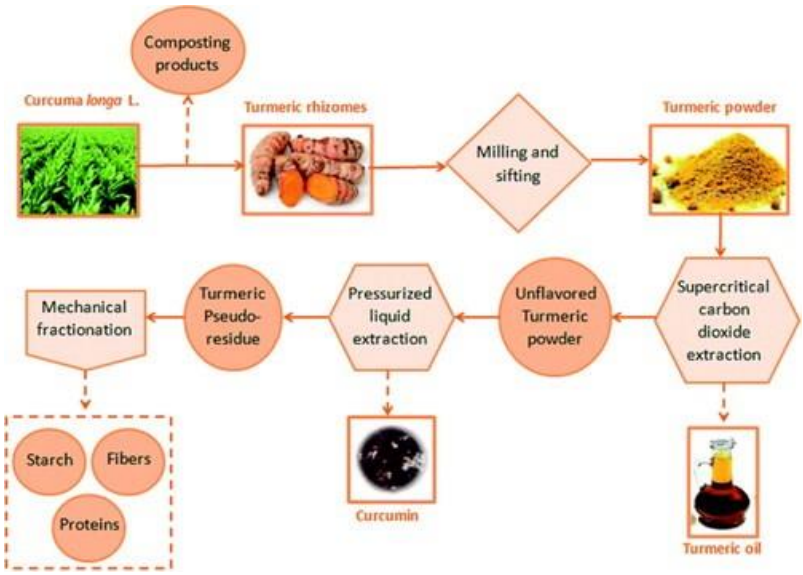

Fig 4 : preparation of curcumin extract

Preparation of curcumin extract:

Making the herbal cream:

The rhizomes of turmeric (Curcuma longa) were collected, cleaned, and Given two days to dry in the sun. then forced through a suitable sieve plate after being ground with a mortar into a fine powder. such as sieve #60 to eliminate bigger fragments. The collected powder was macerated in an iodine flask with 70% ethanol for seven days in order to extract the curcumin, or solute, that was found in the turmeric powder. In order to produce a transparent liquid, filter paper was used to decolorize the extract using charcoal and filter it.

Taxanomical classification

Kingdom	Plant
Subkingdom	Tracheobionta
Division	Magnoliophyta
Superdivision	Spermatophyta
Subclass	Zingiberidae
Family	Zingiberaceae
Order	Zingiberales
Genus	Curcuma
Species	Longa

Name in science	Curcuma Longa

Applications of Cream

1.Reduce the likelihood of getting sunburned
2. Encourage the skin to retain moisture.
3. Make the skin softer.
4. Reducing skin roughness is crucial.
5. Reduce the number of wrinkles
6. Take care of skin conditions like acne and scars.

Ingredients of Curcumin Cream:

1. Turmeric Powder or Extract
2. Coconut Oil or Almond Oil
3. Beeswax or Emulsifying Wax
4. Vitamin E Oil
5. Essential Oil

Preparation Method

Oil Phase Preparation :- In a water bath that has been heated to 70 to 75°C, dissolve the oils and emulsifiers. Stir. the curcumin until it is well combined with the oil phase.

Water Phase Preparation :- To guarantee that the thickening agents dissolve entirely, heat each water phase component independently.

Emulsification :- Add the water phase to the oil phase gradually while stirring constantly. Use a mixer with high shear.to accomplish full emulsification.

Cooling and Additive :- Allow the mixture to cool, then stir in the preservatives and pH adjusters.Adjust the pH to 5.5 to 6.5 if necessary. [39]

Evaluation Parameter The following criteria were used to assess curcumin cream

- **Organoleptic Properties :-** Notable organoleptic properties included color and fragrance. Curcumin cream's distinct organoleptic properties increase user satisfaction. It typically has a bright yellow-orange hue that signifies its efficacy because of curcumin.It's easy to use because of its creamy and smooth texture. to put on the skin. Its generally earthy, mildly spicy scent adds to its inherent charm.reminds me of turmeric . When applied, the cream may feel cool or soothing, providing a pleasant tactile perception.When applied, the cream may have a pleasant tactile sensation and feel cool or soothing. Because it absorbs fairly quickly and leaves a non-greasy finish, it is also appropriate for a range of skin types. These characteristics work together to create a topical composition that is powerful and alluring.
- **Determination of pH :-** Prior to taking a pH reading, make sure the curcumin cream is at room temperature. For Use a calibrated pH meter or pH strips for measurement**.** Distilled water can be used to dilute a small amount. of the viscous cream. To determine pH, dip a pH meter's electrode into a cream or diluted example. Using pH strips, measure the pH by dipping the strip into the cream and comparing the color change to the specified scale.Take note of the displayed or corresponding pH value. To guarantee accuracy, take Several measurements show that the optimal pH range for skin compatibility and stability is typically from four to seven.
- **Determination of Homogenecity :-** The herbal preparation's homogeneity was assessed both visually and tactilely. To evaluate the homogeneity of curcumin cream, visually inspect the

sample to make sure the color and texture are consistent. You can conduct a physical examination by applying the cream to a level surface and checking for any separation or clumping. A test for rheology can additionally assess the cream's viscosity and flow properties, proving its homogeneity. A well- Uniformity in these properties suggests a mixed formulation, but significant variations could draw attention to issues that need to be fixed with the preparation process. [40]

- **Determination of Spreadability :-** When applied to the skin, a topical application's "spreadability" describes the area it covers. impacted area of skin. The herbal mixture's effectiveness as medicine is influenced by its spreading range as well. Therefore, it is essential to ascertain the spreadability of the generated formulation. To produce a uniformly thin layer, three grams of cream were compressed and positioned between the two glass slides. A thousand-gram weight was used to apply the required pressure to the top slide for five minutes.Next, using a thread attached to the pan, the top slide was raised.after adding roughly 10 grams of weight.
- **Washability :-** Curcumin cream's washability refers to how easily it can be removed from surfaces or skin after application. In general, a good curcumin cream should be washed off with water and gentle soap so that no visible stains or residue remain. On a tiny area, apply the cream. After a brief period of sitting, rinse it off with lukewarm water and a gentle cleanser to Assess washability. Analyze the staining's removal ease and any residual effects. Because it is washable, the cream is more appealing for daily use without causing discomfort or skin irritation, ensuring user satisfaction and convenience.
- **Spreadability :-** The ease of application and Spreadability is the term used to describe how well curcumin cream distributes on the skin.A cream with a smooth texture and good spreadability is easy to apply and doesn't clump. This quality improves the user experience by guaranteeing uniform coverage and efficient absorption for the maximum potential benefits.
- **Stability Studies :-** Placing the formulations in a glass or plastic container allowed researchers to examine their physical stability container, then heating them in a humidity chamber to 45°C. Throughout the day, their look and Physical stability was assessed. [41]

CONCLUSION :- Various therapies are being developed to try to improve curcumin's bioavailability.looked into. These include altering the curcumin's structural composition, blocking metabolic pathways by taking it with other medications, and changing the way and medium in which it is administered.However, there are also some innovative delivery techniques, like the ones listed Liposomes, nanoparticles, and phospholipid complexes that help enhance the medication's bioavailability, therapeutic potential, and application of this fascinating natural material. In conclusion, the creation and evaluation of curcumin-containing creams provide a practical way to of applying the therapeutic benefits of curcumin to a variety of illnesses.

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