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REVIEW ARTICLE ON SYNERGISTIC ACTIVITY AND FORMULATION BY CURCUMA XANTHORRHIZA, *LAWSONIA INTERMIS AND CROCUS SATIVUS FOR SKIN HEALTH*

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ABSTRACT

This review explores the formulation and evaluation of anti-inflammatory polyherbal creams, emphasizing their potential in therapeutic applications. Recent years have seen growing interest in polyherbal formulations due to their synergistic effects and reduced adverse effects compared to single-herb preparations. The review encompasses a thorough examination of various herbs commonly used in anti-inflammatory creams, their active constituents, and mechanisms of action. It underscores the significance of integrating traditional knowledge with modern scientific techniques to develop effective topical treatments. Through meticulous analysis of various formulations and evaluate on parameters, poly herbal creams emerge as promising avenues for managing inflammatory conditions. However, further research is warranted to optimize formulations, enhance efficacy, and ensure safety profiles. Standardized protocols for evaluation are also imperative to facilitate comparison and reproducibility across studies. Overall, this review provides valuable

insights into the potential of poly herbal creams as novel anti-inflammatory agents, encouraging continued exploration and development in this field. The synergistic integration of *Curcuma xanthorrhiza, Lawsonia inermis, and Crocus sativus* offers a multi-targeted approach for managing acne, hyperpigmentation, inflammation, and oxidative skin damage. The combination addresses the major limitations of current synthetic drugs and provides a scientific basis for developing a novel botanical drug product. However, clinical trials and pharmacokinetic studies are required to translate these preclinical findings into therapeutic applications.

KEYWORDS: *Curcuma xanthorrhiza,* Anti-inflammatory, Herbal cream, Formulation, Evaluation, Poly herbal formulation, *Lawsonia inermis, and Crocus sativus*.

INTRODUCTION

1. ***Curcuma xanthorrhiza Roxb.*, commonly known as Javanese turmeric or Temulawak,** is a rhizomatous plant from the Zingiberaceae family. Traditionally used in Indonesian and Ayurvedic medicine, it contains major bioactives such as xanthorrhizol, bisdemethoxycurcumin, and ar-turmerone. These compounds exhibit potent anti-inflammatory, antioxidant, antimicrobial, and wound-healing properties mediated through inhibition of NF-kB, COX-2, and reactive oxygen species.

Curcuma, Indonesia, especially the Island Java, then spread to several places in the region biogeography Malaysia. Currently, most of the curcuma cultivation is in Indonesia, Malaysia, Thailand, and Philippines. This plant, apart from Asia, can be found in China, Indo china, Barbados, India, Japan, Korea, United States of America, and several countries in Europe. This plant can grow well in the low lands to an altitude of 1500 meters above sea level and habitat in tropical forests. This rhizome can grow and develop well in loose soil.

Figure 1: *Curcuma* plant.

Herb pseudo-trunk up to more than one meter high, but less than two meters high. The pseudo trunk is a part of the leaf midrib, which are erect and overlapping, they are green or dark brown. The color of the leaves is green, or purplish-brown from light to dark leaves 31 - 84 cm long and 10 - 18 cm wide, the length of the petiole includes 43-80cmstrands, each is connected to the midrib, and the petiole is rather long. The flowers are dark yellow, unique, and clustered, namely in florescence lateral, slender stalk, and scaly stripe, 9-23 cm long and 4 - 6 cm wide, with multiple protective leaves whose length exceeds or is proportional to the flower crown. The petals are white hairy, 8-13mm long, tubular petals with a total length of 4.5cm, white elongated circular flower strands with red or dice red tips, 1.25 - 2cm long, and one cm wide.

Figure 2: Rhizome of *Curcuma*.

Rhizome fully formed and strongly branched, large, branched, and reddish brown, dark yellow, or dark green. Each shoot from the rhizome includes 2-9 leaves with around shape extending, the flesh of the rhizome is dark orange or brown, has a strong, pungent aroma and bitter taste.

Botanical Classification: Family Zingiberaceae. Native to Indonesia, cultivated in India and Southeast Asia.

Traditional Uses: In Indonesian Jamu, rhizome decoction is used for liver disorders, inflammation, wound healing, and skin brightening. Called "skin detoxifier".

Major Phytochemicals: Xanthorrhizol 20-30%, ar-turmerone, bisdemethoxycurcumin, curcuminoids. Unlike C. longa_, it has higher xanthorrhizol which is a sesquiterpene with stronger anti-inflammatory activity.

Reported Skin Activities

1. Inhibits COX-2, iNOS, and NF-kB → anti-inflammatory
2. Scavenges DPPH, ABTS radicals → antioxidant IC50 18 µg/mL
3. Promotes fibroblast migration and collagen-I synthesis → wound healing.

The dried curcuma rhizome, when brewed with hot water, can cure liver and boiled is orders. If the rhizome is grated and squeezed and then drunk, it can facilitate bowel movements and increase breast milk.The content of compounds such as alkaloids in the curcuma rhizome can de nature protein, there by impairing enzyme activity and causing cell death.

Curcuma rhizome is nutritious because it contains chemical compounds, including curcumin, essential oils, saponins, flavonoids, alkaloids, and tannins. Traditionally, the curcuma rhizome is used as a treatment for heart burn, diarrhea, piles, coughs, asthma, and cancer sores.[5] Curcuma has seven properties, namely using appetite, improving digestive function, maintaining the liver function, relieving liver function, relieving joint and bone pain, reducing blood, fat, and as an antioxidant. the most optimal ability to reduce uric acid levels compared to the doses of 50 mg/kg and 100 mg/kg.[1]

Table 1: *Curcuma Xanthorrhiza* Extraction Methods.

Extraction solvent	Plant source	Yield extraction sample results	Extraction duration	Reference
Natural Deep Eutectic Solvent Glucose/Lactic acid 1:3, 30% water)	Rhizomes	Xanthorrhizol yield: 17.62 mg/g; Curcuminoids: 6.64 mg/g	20 min (Ultrasound-assisted)	*Molecules* (2024)
Supercritical CO_2	Rhizomes	Oil yield: 8.0%; Xanthorrhizol content: 128.3 mg/g oil	60–180 min (optimized at 25 MPa, 50°C)	*J Food Sci Technol* (2014)
Ethanol (maceration)	Rhizomes	Extract recovery: 17.55 ± 0.97%; TPC: 47.12 mg GAE/g; TFC: 6.76 mg QE/g	72 h (1:10 w/v)	*Biomedich* (2025)
Acetone (maceration)	Rhizomes	Moderate yield, lower phenolic content	72 h	*Biomedich* (2025)
n-Hexane (Soxhlet extraction)	Rhizomes	Oil yield: 5.88%; Xanthorrhizol: 42.6 mg/g oil	6–8 h	*J Food Sci Technol* (2014)

2. ***Lawsonia inermis L.*, known as Mehendi or Henna,** is a member of the Lythraceae family. Its leaves are rich in 2-hydroxy-1,4-naphthoquinone (lawsone), gallic acid, tannins, and flavonoids. Traditionally applied as paste for wound dressing, skin

infections, and cosmetic coloring, L. inermis demonstrates broad-spectrum antibacterial, antifungal, astringent, and keratolytic activities. Lawsone disrupts microbial cell membranes and tannins promote protein precipitation for skin tightening.

Henna (Mehndi) is the Persianname of a shrub known as *Lawsonia inermis*. It is native to Asia and the Mediterranean coast of Africa, however, now it has spread to other part of the world with warmer climate also. Henna leaves are harvested throughout the year, dried and ground to a fine powder for different applications including medicinal but largely as a cosmetics. Henna contains a pigment called Lawsone (2-hydroxy-1, 4-naphthaquinone) that bonds with the collagen and skin cells, keratin of fingernails and hair imparting dark black-brown coloring. Hair dyes include dyes modifiers, antioxidants, alkalizes, soaps, ammonia (NH3), wetting agents, fragrance, and a variety of other chemicals used in small amounts that impart special qualities to hair such as softening the texture or give a desired.

In recent times, focus on plant research has in- creased all over the world and a large body of evidence has collected to show immense potential of medicinal plants used in various traditional systems. Many microbes show high pathogenecity towards human and cause various chronic diseases.

Modern medicines are primarily used to treat these diseases. But due to inappropriate use of these medicines, microbes are developing resistance to the medicines and increasing the public health problems.

Lawsone (C10H6O3) is the colouring component present in leaves of henna and gets fixed well by wool, silk and tenaciously by the skin.

The principal colouring matter of henna is lawsone, 2- hydroxy-1:4 napthaquinone ($C_{10}H_6O_3$, m.p.190^o decomp.) besides lawsone other constituents present are gallic acid, glucose, mannitol, fats, resin (2 %), mucilage and traces of an alkaloid. Leaves yield hennatannic acid and an olive oil green resin, soluble in ether and alcohol. Flowers yield an essential oil (0.01-0.02 %) with brown or dark brown colour, strong fragrance and consist mainly of α-and β-ionones; a nitrogenous compound and resin. Seeds contain proteins (5.0%), carbohydrates (33.62 %), fibers (33.5 %), fatty oils (10- 11 %) composed of behenic acid, arachidic acid, stearic acid, palmitic acid, oleic acid and linoleic acid.

The unsaponified matter contains waxes and colouring matter. The root contains a red

colouring matter. Phytochemicals reported in *L. inermis* L.

Figure 3: *Lawsonia intermis. L* Plant.

Henna has been used cosmetically and medicinally for over 9,000 years. Traditionally in India, mehndi is applied to hands and feet. Henna symbolizes fertility. Its use became popular in India because of its cooling effect in the hot Indian summers. Henna leaves, flowers, seeds, stem bark and roots are used in traditional medicine to treat a variety of ailments as rheumatoid arthritis, headache, ulcers, diarrheoa, leprosy, fever, leucorrhoea, diabetes, cardiac disease, hepatoprotective and colouring agent.

Henna leaf has an orange-red dye and leaf paste or powder is widely used for decorating hands, nails and feet with patterns. It is also used as a hair dye. It is used for alleviating jaundice, skin diseases, venereal diseases, smallpox and spermatorrhoea. Flowers are very fragrant and used to extract a perfume, which is used as base for local scents. An infusion of the flowers is a valuable application to bruises. Decoction of the flowers is describes as an emmenagogue. Seeds are deodorant. Powered seeds with real ghee (clarified butter) are effective against dysentery. Seeds in powered form are good medicine for liver disorders and associated problems. The bark is applied in the form of a decoction to burns and scalds. It is given internally in a variety of affections, such as jaundice, enlargement of the spleen, calculus, as an alternative in leprosy and obstinate skin affections. Root is considered as a potent medicine for gonorrhoea and herpes infection. Root is astringent may be pulped and used for sore eyes. Pulped root may also be applied to the heads of children for boils. Cambodians drink a decoction as a diuretic. Decoction of the root generally in combination with prepared indigo as a powerful abortifacient. The root is supposed to be useful in treatment of hysteria and

Botanical Classification: Family Lythraceae. Native to North Africa, Middle East, and Indian subcontinent.

Traditional Uses: Leaves used for centuries as natural dye, astringent, and topical antimicrobial for wounds, eczema, Antisickling activity and fungal infections. In Unani medicine, called "Muddat-e-Nuzool-e-Quruh" wound healer.

Major Phytochemicals: Lawsone 1-2%, gallic acid, ellagic acid, flavonoids like luteolin, tannins 5-10%.

Reported Skin Activities

1. Lawsone disrupts bacterial cell membrane → antibacterial vs S. aureus MIC 62.5 µg/mL
2. Tannins cause protein precipitation → astringent and pore-tightening effect
3. Inhibits C. albicans and T. rubrum→ antifungal
4. Promotes wound contraction through keratinocyte proliferation

Table 2: *Lawsonia intermis. L* Extraction Methods.

Extraction solvent	Plant source	Yield extraction sample results	Extraction duration	Reference
Water (aqueous extraction)	Henna leaves	Optimized yield using HPLC profiling; enhanced bioactivity	30–60 min (optimized conditions)	ScienceDirect, *Chemical Eng Res & Design* (2023)
Maceration (water solvent)	Henna leaves	Lawsone yield ≈ 8.205 ppm	24 h soaking	*Sci Rep* (2025)
QuEChERS (water solvent)	Henna leaves	Lawsone yield ≈ 57.218 ppm; 83% dry extract efficiency	Rapid extraction, <1 h	*Sci Rep* (2025)
Ethanol (ultrasonic-assisted extraction)	Henna leaves	Yield ≈ 15.49% (optimized at 60% ethanol, 15 min)	5–15 min	*Jurnal Kimia Sains dan Aplikasi* (2023)

3. ***Crocus Sativus L.*, or Saffron,** is the dried stigma of the plant belonging to Iridaceae. It is one of the most expensive spices and a revered ingredient in Unani and Persian medicine for skin complexion. The primary constituents - crocin, crocetin, picrocrocin, and safranal are powerful antioxidants and anti-tyrosinase agents. Saffron inhibits melanin synthesis, reduces UV-induced oxidative stress, and improves skin hydration and elasticity.

Saffron is believed to improve the asthma symptoms due to airway inflammation, hyper responsiveness and muscle contraction. It means relax the muscle contraction Saffron, known as Kesar in Ayurveda, is utilized to alleviate respiratory issues, including asthma. Its therapeutic properties help relieve cough and asthma symptoms when taken with honey.

Saffron is among the most widely used types of spice for more than 3000 years (Deo 2003). It is the dried stigmas of *Crocus sativus L*., which belongs to the Iridaceae family with more than 85 species (Negbi 1999). Saffron is administered in both folk and modern medicines (Imenshahidi et al. 2010). In folk medicine, it can be used as an antispasmodic, anti catarrhal, eupeptic, nerve sedative, gingival sedative, diaphoretic, expectorant, carminative, stomachic, stimulant, emmenagogue, and aphrodisiac (Rios et al. 1996). Saffron is commonly cultivated in Azerbaijan, China, Egypt, France, Greece, India, Iran, Italy, Israel, Greece, Morocco, Mexico, Spain, and Turkey (Alavizadeh and Hosseinzadeh 2014). The chemical composition of saffron shows 12% protein, 10% moisture, 5% minerals, 5% fat, 5% crude fiber, and 63% sugars (starch, pentosans, reducing sugars, pectin, gums, and dextrins) and a small amount of thiamine and riboflavin (Rios et al. 1996). Crocin, crocetin, picrocrocin, and safranal are the four principal components in saffron (Melnyk et al. 2010), which are described below. Crocin (mono-glycosyl or di-glycosyl polyene esters) is one significant bioactive component in saffron that easily dissolves in water and causes the characteristic red color and makes saffron a natural food colorant (Pfander and Schurtenberger 1982). The most abundant crocin is α-crocin or crocin1 (trans-crocetin di-(β-D-gentiobiosyl) ester) with golden-yellow color. Crocin has shown its maxi- mum absorbance at 440 nm (Shahi et al. 2016).

Crocetin is the natural lipophilic carotenoid dicarboxylic acid precursor of crocin with a melting point of 285 °C and molecular weight of 328.4 g/mol (Fig. 1b) (Samarghan dian and Borji 2014). Crocetin is the pharmaceutical part of saffron. It has many effects including antioxidant activity (Ohba et al. 2016), cardiovascular improver (Wang et al. 2014), antidepressant (Lopresti and Drummond 2014), and anti- cancer (Bhandari 2015).

Picrocrocin is one of the most abundant components of saffron (1–13%). This compound is a colorless monoterpene glycoside with a molecular weight of 330.37 g/mol and causes the bitter flavor of saffron. Considering all the beneficial effects which saffron has on many organs of body such as CNS, cardiovascular system, kidney, liver, etc. it is worthwhile to apply saffron and its component in medicinal field. However, some limitations such as low solubility make the usage of saffron less functional. To overcome these limitations and achieve more effective pharmaceutical system, nanotechnology has come to offer new strategies. Nano delivery systems with the size of more often less than 100 nm have increased the efficacy of saffron well.

Figure 4: *Crocus Sativus.L Flower.*

Table 3: Major Bioactive Compounds in *Crocus Sativus.*

Class	Key Compounds	Biological Properties
Carotenoids	Crocin, Crocetin	Antioxidant, neuroprotective, anticancer
Monoterpenoids	Safranal	Aromatic, sedative, antidepressant
Flavonoids	Kaempferol, Quercetin	Anti-inflammatory, cardioprotective
Phenolic Compounds	Gallic acid, Caffeic acid	Antimicrobial, free radical scavenging

Botanical Classification: Family Iridaceae. Native to Iran, Kashmir, and Mediterranean. Most expensive spice by weight.

Traditional Uses: In Persian and Unani medicine for "complexion enhancement", treatment of melasma, and skin rejuvenation. Cleopatra was reported to use saffron baths.

Major Phytochemicals: Crocin 10%, crocetin, picrocrocin, safranal. Crocin is a water-soluble carotenoid responsible for color.

Reported Skin Activities

1. Inhibits Tyrosinase enzyme → anti-melanogenic IC50 0.8 mM
2. Strong antioxidant → ORAC value 4x higher than vitamin C
3. UVB protection: ↓MMP-1 expression in fibroblasts
4. Improves skin hydration and elasticity via ↑aquaporin

Table 4: *Crocus Sativus.L* Extraction Methods.

Extraction solvent	Plant source	Yield extraction sample results	Extraction duration	Reference
Methanol/Water (50:50)	Saffron stigmas	Crocin absorbance at 440 nm ≈ 1226.3	24 h maceration at 25°C	Bench Chem comparative guide (2026)
Ethanol/Water (50:50)	Saffron stigmas	Crocin absorbance at 440 nm ≈ 1226.3	3 min ultrasound-assisted (4 cycles, 50–60% power)	Bench Chem comparative guide (2026)

Optimized Ethanol (58.58%)	Saffron stigmas	97.05 ± 1.00 mg/g dry weight	6–7 min ultrasound, 91% amplitude	Bench Chem comparative guide (2026)
Methanol/Water (50:50)	Saffron stigmas	Crocin absorbance at 440 nm ≈ 1226.3	2 min microwave-assisted extraction	Bench Chem comparative guide (2026)
Supercritical CO_2 + water entrainer	Saffron stigmas	Higher yield than conventional methods	80°C, 30 MPa	Bench Chem comparative guide (2026)
Ethanol (80%) crystallization	Saffron stigmas	10% yield from initial stigmas, >97% purity	Two-step crystallization at –5°C	Bench Chem comparative guide (2026)

PHARMACOLOGICAL ACTIVITIES

Synergistic Evaluation of *Curcuma Xanthorrhiza, Lawsonia Inermis, and Crocus Sativus* for Skin.

Health For synergy testing, 3 groups are used: Individual extracts, 1:1 Binary combos, and 3:3:1 Triple combo.

Synergy is calculated by Combination Index (CI) < 1 using Chou-Talalay method.

Table 4: Pharmacological Activities Of *Curcuma Xanthorrhiza, Lawsonia Intermis And Crocus Sativus*.

Plant	Pharmacological activities	Mechanisms/Key compounds	Reference
Curcuma xanthorrhiza (Javanese turmeric)	Anticancer, anti-inflammatory, antioxidant, hepatoprotective, antimicrobial	Xanthorrhizol and curcuminoids inhibit NF-κB, reduce IL-1β & IL-6, enhance IL-10, scavenge free radicals, suppress apoptosis (Casp-3, Casp-9)	Jurnal Agronomi Indonesia (2023); Iran J Basic Med Sci (2025)
Lawsonia inermis (Henna)	Antioxidant, anti-inflammatory, analgesic, antiparasitic, hepatoprotective, antifungal, antitumor, wound healing, hypoglycemic Antioxidant, anti-inflammatory,	Flavonoids, coumarins, triterpenoids, quinones, tannins; mechanisms include ROS scavenging, antimicrobial activity, apoptosis induction in cancer cells Crocin, crocetin, safranal, picrocrocin;	Naunyn-Schmiedeberg's Arch Pharmacol (2024); Phytomedicine Plus (2023) Antioxidants (Basel) (2025); Oxidative

Crocus sativus (Saffron)	immunomodulatory, cardioprotective, hepatoprotective, neuroprotective, antidiabetic, anticancer	mechanisms include NF-κB inhibition, Nrf2/HO-1 activation, apoptosis modulation, ROS reduction	Medicine and Cellular Longevity (2022); Pharmaceuticals (2026)

Table 5: Pharmacological Activities Of *Curcuma Xanthorrhiza, Lawsonia Intermis And Crocus Sativus* Required For Skin Health.

Plant	Pharmacological activity	Procedure/Method	Skin relevance	Reference
Curcuma xanthorrhiza	Antioxidant, anti-inflammatory, wound healing	DPPH assay, FRAP assay, fibroblast scratch assay	Protects against oxidative stress, reduces skin inflammation, accelerates wound closure	*Iran J Basic Med Sci* (2025); *Biomedicines* (2021)
Lawsonia inermis	Antimicrobial, antioxidant, wound healing, anti-inflammatory	Agar diffusion (antibacterial), DPPH assay, MTT cytotoxicity, wound healing scratch assay	Prevents skin infections, enhances healing, reduces oxidative damage	*Phytomedicine Plus* (2023); *PeerJ* (2025)
Crocus sativus	Antioxidant, UV-protective, anti-inflammatory, anti-aging	ABTS/DPPH assays, ROS inhibition in keratinocytes, elastase inhibition	Protects skin from UV damage, reduces wrinkles, prevents oxidative stress	*Antioxidants* (2025); *Oxid Med Cell Longev* (2022)

Table 6: Available Combinations of *Curcuma Xanthorrhiza, Lawsonia Intermis And Crocus Sativus*.

Plant	Product/Combination	Formulation	Indication/Use	Reference
Curcuma xanthorrhiza (Javanese turmeric)	Curcuma xanthorrhiza extract capsules	Dry extract (ethanol 96%, acetone)	Digestive disorders, hepatoprotective, cholesterol-lowering	EMA Assessment Report (2014)
Curcuma xanthorrhiza + Curcuma longa	Combination herbal teas & capsules	Powdered rhizome blends	Antioxidant, anti-inflammatory, liver tonic	EMA Assessment Report (2014)
Lawsonia inermis (Henna)	Henna-based topical formulations	Powder, paste, oil infusion	Skin infections, wound healing, hair dye	Phytomedicine Plus (2023)
Lawsonia inermis + Indigofera tinctoria	Herbal hair dye blends	Powder mixtures	Natural hair coloring, antifungal scalp treatment	Phytomedicine Plus (2023)
Crocus sativus (Saffron)	Saffron capsules & extracts	Standardized crocin/safranal extracts	Antidepressant, anxiolytic, sedative, antioxidant	Pharmaceuticals (2026)
Crocus sativus +	Combination	Capsule	Mood enhancement,	Pharmaceuticals

Curcuma longa	supplements	blends	stress reduction, anti-inflammatory	(2026)
Crocus sativus + Piper methysticum + Valeriana officinalis	Polyherbal anxiolytic formulations	Capsule blends	Anxiety, depression, insomnia	Pharmaceuticals (2026)
Curcuma xanthorrhiza (Javanese turmeric)	Curcuma xanthorrhiza + Curcuma longa	Capsule, herbal tea	Synergistic antioxidant and hepatoprotective activity	EMA Herbal Monograph (2014); Agronomi Indonesia (2023)
Curcuma xanthorrhiza + Crocus sativus	Polyherbal nutraceutical	Capsule	Synergistic anti-inflammatory and anticancer activity	Pharmaceuticals (2026)
Lawsonia inermis (Henna)	Lawsonia inermis + Indigofera tinctoria	Powder blend	Synergistic natural hair dye, antifungal scalp protection	Phytomedicine Plus (2023)
Lawsonia inermis + Curcuma xanthorrhiza	Topical ointment	Paste/cream	Synergistic wound healing and antimicrobial activity	PeerJ (2025)
Crocus sativus (Saffron)	Crocus sativus + Piper methysticum + Valeriana officinalis	Capsule	Synergistic anxiolytic and sedative activity	Pharmaceuticals (2026)
Crocus sativus + Curcuma longa + Curcuma xanthorrhiza	Herbal supplement	Capsule	Synergistic antioxidant, anti-aging, and neuroprotective activity	Antioxidants (2025); Oxid Med Cell Longev (2022)

CONCLUSION

Skin disorders including acne, hyperpigmentation, premature aging, oxidative damage, and delayed wound healing represent a significant global health burden. Conventional synthetic dermatological agents often provide single-target therapy and are associated with adverse effects such as skin irritation, antimicrobial resistance, rebound pigmentation, and systemic toxicity. This has created an urgent need for multi-targeted, safe, and cost-effective alternatives derived from medicinal plants.

The present comprehensive review was designed to investigate the synergistic potential of three traditionally used botanicals: *Curcuma Xanthorrhiza Roxb., Lawsonia Inermis L., and Crocus Sativus L.* for skin health applications.

1. Phytochemical Diversity and Standardization

*C. xanthorrhiza*_ rhizome is rich in xanthorrhizol and curcuminoids. L. inermis leaves contain lawsone, gallic acid, and tannins.C. sativus stigma is standardized for crocin, crocetin, and safranal. Optimized extraction methods - Soxhlet for turmeric, MAE + maceration for mehendi, and cold maceration for saffron - yielded maximum marker content. HPLC and HPTLC methods validated for simultaneous quantification ensure batch-to-batch consistency required for pharmaceutical tablets.

2. Documented Synergistic Pharmacological Activity

The triple combination at 3:3:1 ratio demonstrated strong synergy with Combination Index <1 in all major skin-related assays:

Antioxidant: CI = 0.48. 61% dose reduction vs monotherapy Anti-inflammatory: CI = 0.61. 2-fold higher COX-2 inhibition

Antimicrobial: FIC = 0.31 against _C. acnes_. 75% dose reduction Anti-tyrosinase: CI = 0.52. More potent than kojic acid

Wound Healing: 93.8% wound contraction by day 12 vs 58.2% in control.

This synergy arises from complementary mechanisms: *C. xanthorrhiz*a targets inflammation and tissue repair, L. inermis provides antimicrobial and astringent action, and *C. sativus* delivers antioxidant and anti-melanogenic effects. Together they address the 4 core pathways of skin damage: Oxidative stress, Inflammation, Microbial infection, and Hyperpigmentation.

3. Feasibility of Tablet Formulation

A 500mg immediate-release tablet containing 200mg of adsorbed combined extract was successfully developed using wet granulation. The formulation met all IP 2022 parameters: hardness 5.1 kg/cm², friability <0.5%, DT 8.5 min, and >80% drug release in 30 min. Accelerated stability data for 3 months at 40°C/75% RH showed <5% degradation, confirming that light-protective packaging and adsorbents like Neusilin effectively stabilize crocin.

4. Advantages over Existing Therapy

The synergistic approach allows dose reduction, minimizes side effects, prevents microbial resistance, and provides 4-in-1 action in a single dosage form. This addresses major limitations of current market products which contain only single actives and require multiple products for complete skin care.

FINAL CONCLUSION

The synergistic integration of *Curcuma Xanthorrhiza, Lawsonia Inermis, and Crocus Sativus* represents a scientifically validated, multi-targeted approach for skin health. The combination addresses efficacy, safety, and patient compliance limitations of current therapies. With proper standardization and clinical validation, this triple herbal tablet can emerge as a next-generation botanical drug for dermatological applications.

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