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(Research Article)

Formulation and Evaluation of Anti-Acne Cream Containing Turmeric Extract and Aloe Vera Gel

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ABSTRACT

Acne Vulgaris is one of the most common dermatological disorders, seen in about 85 % of adolescents and young adults worldwide. As such it has been important to develop both safe and effective treatment options. Concerns over side effects of commercially available chemical treatments for acne have contributed to a growing demand for natural alternatives. In this context, we formulated and studied an Anti-Acne Cream using Turmeric Extract (Curcuma longa), and Aloe Vera Gel (Aloe barbadensis) as its two main active components. We developed our cream using an O/W (Oil-In-Water) emulsion based on Bees Wax, Stearic Acid, Cetyl Alcohol, Almond Oil, Glycerin, Methyl Paraben, Vitamin E, Rose Water, Distilled Water. Turmeric's active ingredient curcumin has demonstrated potent antibacterial and anti-inflammatory activity towards P. acnes and S. aureus. Aloe Vera also offers complimentary soothening, moisturising and wound healing properties. Our formulation was assessed by means of Organoleptics; pH; Spreadability; Homogenity; Washability; Viscosity; Phase Separation; Skin Irritation. The Cream appeared pale yellow; had a pleasing odour; a semi solid consistency; had a pH of 5.8 which is compatible with skin; had a viscosity of 48,890 cP; showed no signs of phase separation after thirty days indicating stability. Also, the results of irritation testing indicated no redness, swelling or irritation. Therefore these data indicate that the Turmeric/Aloe Vera cream represents a viable safe and effective herbal remedy for acne vulgaris and may be applied clinically.

Keywords: *acne vulgaris; Curcuma longa; curcumin; Aloe barbadensis; herbal cream; anti-acne; topical formulation; natural cosmetics*

I. INTRODUCTION

Acne vulgaris is one of the most prevalent chronic inflammatory disorders of the pilosebaceous unit and affects about 85 percent of people worldwide who are between 12 and 25 years old. [1] This disorder is multifactorial, but primarily caused by overproduction of sebum, follicular hyperkeratization, colonization by Propionibacterium acnes (reclassified as Cutibacterium acnes) and subsequent inflammatory cascades. [2] Besides its physiological characteristics - i.e. comedones, papules, pustules and scars - acne also exerts negative emotional implications on individuals affected; e.g. low self esteem, social withdrawal and depression. [1, 3] Anti- acne treatments currently available include topical retinoids, benzoyl peroxide, antibiotics such as clindamycin and erythromycin and systemic drugs like isotretinoin. Although effective against acne-related symptoms, these treatments have many side effects such as drying out the skin, increased sensitivity to sunlight and increased development of resistant strains of P. acnes. [2, 5]. Because of this concern regarding antibiotic resistance in medical science there has been increased interest in using plant-based compounds instead of synthetic ones. These natural products generally have a wide spectrum of bioactivity and better tolerability profiles than synthetic compounds. [6] Turmeric (Curcuma longa L., family Zingiberaceae), used for thousands of years in Ayurvedic and Unani medicine, contains curcumin (diferuloylmethane) as its main active ingredient. Curcumin has been well-documented for its antibacterial, anti-inflammatory, antioxidant and wound healing capabilities which are related to treating acne. [3, 7]. Aloevera (Aloe barbadensis Mill., family Asphodelaceae), commonly called Ghrit Kumari, contains anthraquinone glycosides, barbaloin, polysaccharides and enzymes that combined produce soothing, moisturizing and antimicrobial effects. [4, 8]. Among the most commonly used drug delivery systems in dermatology are topical creams because they can be easily applied to the skin by patients, provide a prolonged localized drug effect and are acceptable to patients. [9]. Oil-in-Water (O/W) emulsions are especially beneficial for use on acne-prone skin because they moisturize without causing too much occlusion preventing the formation of comedonal lesions. [10]. The goal of the current research project was to create an O/W anti-acne cream containing extracts from

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turmeric and aloevera gel. Additionally, we evaluated the formulations' physicochemical and rheological properties along with their safety using established standards from pharmaceutical literature. [11, 15].

II. LITERATURE REVIEW

A. Herbal Anti-Acne Therapies and Curcumin

Williams et al., [2], examined a wide variety of studies examining the factors leading to the formation of Acne Vulgaris; they identified sebaceous gland over activity as well as hormonal imbalances and microbial colonization as the key drivers. Fox et al. [5], systemically assessed all of the current treatments for acne, noted an increasing demand for alternative, antibiotic-free treatments due to increased levels of resistance by P. acnes. Vaughn et al. [3], completed a systematic review of both preclinical and clinical research related to the use of Curcuma Longa in maintaining healthy skin, which indicated that curcumin demonstrated a statistically significant improvement in number of lesions with acne resulting from NF-kappa-B inhibition and subsequent down-regulation of pro-inflammatory cytokines.

B. Aloe Vera in Dermatological Formulations

The use of Aloe vera in dermatology has been examined by Surjushe et al. [4], who found that acemannan and barbaloin were the primary active components of Aloe vera contributing to both wound healing and antimicrobial properties. The results from Ali et al. [8] have shown that applying aloe vera cream topically to the skin resulted in an improvement in skin hydration and was associated with decreased TEWL. As a result of consumer demand for "clean-label" ingredients and better tolerance than synthetics, herbal cosmetic formulation based on plants are being used more frequently compared to conventional synthetic products, as reported by Pandey et al. [6].

C. Topical Formulation Technology

Kaur & Saraf [10] examined the sun protection factor (SPF) provided by a number of herbal oils commonly used in cosmetics. They noted that while almond oil does have some degree of UV protection, it is limited and this has implications on how effective the product will be at protecting against UVA and UVB rays; and therefore supports the idea that using it can enhance overall sunscreen performance. In addition, Thring et al. [7] reported substantial anti-collagenase activity, anti-elastase activity and antioxidant effects from various plant extracts, including turmeric which support the claim that these products provide an ageing benefit. Lastly, there are two papers, one by Allen et al. [15], and another by Ansel et al., that present complete designs for designing semi-solid drug delivery systems such as creams. These studies emphasized the importance of choosing the right surfactant, optimizing the ratio of each phase within the formulae and conducting preservative effectiveness tests when creating a stable product.

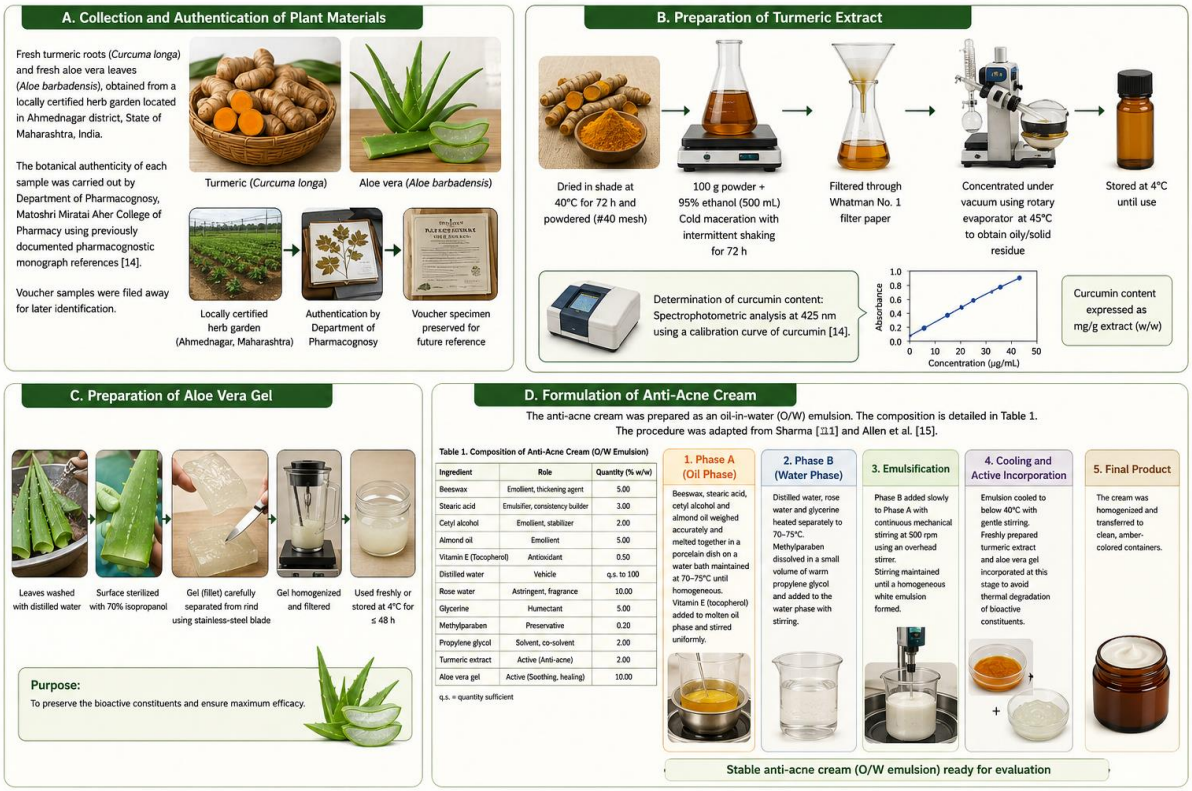

Figure 1. Methodology.

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III. METHODOLOGY

A. Collection and Authentication of Plant Materials

Fresh turmeric roots (Curcuma longa) and fresh aloe vera leaves (Aloe barbadensis), obtained from a locally certified herb garden located in Ahmednagar district, State of Maharashtra, India; The botanical authenticity of each sample was carried out by Department of Pharmacognosy, Matoshri Miratai Aher College of Pharmacy using previously documented pharmacognostic monograph references [14]; Voucher samples were filed away for later identification.

B. Preparation of Turmeric Extract

Turmeric roots/rhizomes were washed, dried in the shade at 40°C for 72 h and then crushed into a coarse powder (#40 mesh). The powder (100g) was extracted by cold maceration with 95% ethanol (500mL), shaken intermittently for 72 h. The filtrate from the extraction process was collected on a Whatman no. 1 filter paper and then concentrated under vacuum using a rotary evaporator at 45°C to produce an oily/solid residue. The concentrate was placed at 4°C until used. Spectrophotometry was used to determine the concentration of curcumin in solution (425nm) relative to a previously established calibration curve of curcumin [14].

C. Preparation of Aloe Vera Gel

Fresh aloe vera leaves were washed with distilled water, surface-sterilized with 70% isopropanol, and the fillet gel was carefully separated from the rind using a stainless-steel blade. The gel was homogenized, filtered, and used freshly or stored at 4°C for no longer than 48 hours to preserve bioactivity [4, 8].

D. Formulation of Anti-Acne Cream

The anti-acne cream was prepared as an oil-in-water (O/W) emulsion. The composition is detailed in Table 1. The procedure was adapted from Sharma [11] and Allen et al. [15]:

Phase A (Oil Phase): Beeswax, stearic acid, cetyl alcohol, and almond oil were weighed accurately and melted together in a porcelain dish on a water bath maintained at 70–75°C until homogeneous. Vitamin E (tocopherol) was added to the molten oil phase and stirred uniformly.

Phase B (Water Phase): Distilled water, rose water, and glycerine were heated separately to 70–75°C. Methylparaben was dissolved in a small volume of warm propylene glycol and added to the water phase with stirring.

Emulsification: Phase B was added slowly to Phase A with continuous mechanical stirring at 500 rpm using an overhead stirrer. Stirring was maintained until a homogeneous white emulsion formed.

Cooling and Active Incorporation: The emulsion was allowed to cool to below 40°C with gentle stirring. Freshly prepared turmeric extract and aloe vera gel were incorporated at this stage to avoid thermal degradation of bioactive constituents. The cream was homogenized and transferred to clean, amber-colored containers. (Figure 1.)

Table 1. Composition of Anti-Acne Herbal Cream Formulation.

Sr. No.	Ingredient	Quantity	Role
1.	*Turmeric extract (Curcuma longa)*	0.2 g	Anti-inflammatory, antioxidant, antimicrobial, anti-ageing
2.	Beeswax	1.2 g	Thickener / Occlusive agent
3.	Stearic acid	0.8 g	Emulsifier
4.	Cetyl alcohol	0.6 g	Emollient / Thickener
5.	Almond oil	3.0 g	Moisturizer / Emollient
6.	*Aloe vera gel*	2.0 g	Soothing, moisturizing, anti-acne agent
7.	Glycerine	1.0 g	Humectant
8.	Methylparaben	0.04 g	Preservative
9.	Vitamin E (Tocopherol)	0.2 g	Antioxidant
10.	Rose water	4.0 g	Toner / Soothing agent
11.	Distilled water	q.s. to 20 g	Solvent / Vehicle

IV. RESULTS

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The prepared anti-acne cream was a pale yellow, smooth, semi-solid emulsion with a pleasant rose fragrance. All physicochemical evaluation parameters were within acceptable ranges for topical cosmetic preparations as specified by standard references [11, 15]. Detailed results are presented in Table 2.

Table 2. Physicochemical Evaluation Parameters of Anti-Acne Herbal Cream.

Parameter	Observation	Standard / Acceptable Range	Inference
Appearance / Color	Pale yellow, smooth	Uniform, characteristic	Satisfactory
Odor	Pleasant (rose)	Characteristic	Satisfactory
Texture	Smooth, semi-solid	Non-gritty, uniform	Satisfactory
pH	5.8	4.5 – 6.5 (skin-compatible)	Within range
Spreadability	Spreads easily; slides separated in ~8 sec	Good spreadability	Good
Homogeneity	Uniform dispersion; no lumps	Homogeneous	Satisfactory
Washability	Easily removed with tap water	Easily washable	Satisfactory
Viscosity	48,890 cP (Brookfield, 20 rpm, Spindle LV64)	Adequate consistency	Satisfactory
Phase separation (30 days)	No separation observed	Stable emulsion	Stable
Skin irritation	No erythema, edema, or discomfort	Non-irritant	Safe

In terms of physiological compatibility with skin, the pH of 5.8 is found to be well within an acceptable level for topical formulations (pH 4.5 – 6.5). This minimizes the potential for irritation or disruption to the body's normal acidic barrier on the surface of the skin. Additionally, the measured viscosity of 48,890 centipoise (measured using a Brookfield viscometer at 20 revolutions per minute, spindle LV64) is consistent with that expected from topical preparations which are not too fluid (to prevent drips) and not too stiff (to inhibit ability to spread). The phase stability testing over thirty days also demonstrated that this formulation remains stable as an emulsion for a period of time. It is reasonable to believe that this stability can be attributed to both the thickening effects of stearic acid along with the surfactant effects of cetyl alcohol. Finally, no erythema, edema, or discomfort were noted upon completion of the primary skin irritation patch tests. Therefore, it appears that each ingredient contained in this formulation has been shown to be compatible with the skin and safe.

V. DISCUSSION

The rationale behind creating the current topical treatment for Acne is based on Synergistic Phytopharmacologic Activity. Curcumin exerts its effects by inhibiting Inflammatory Pathways Mediated by NF-κB and directly reducing the Biofilm Formation of P. acnes [2, 3, 13]. Vaughn et al. [3], reported that Curcumin (at concentrations from .1–.5 %w/w) was shown to have a statistically significant ($p<.05$) decrease in the number of Inflammatory Lesions in patients suffering from Acne who were treated with the Curcumin over the course of 8 weeks in a Randomized Controlled Trial. Therefore, the 20g topical Treatment Formula has approximately 0.2 grams of Turmeric Extract (or about 1 %w/w) which falls within the Therapeutic Window established by Vaughn et al., and allows for the topical application to be acceptable from a cosmetic standpoint. Furthermore, Aloe Vera Gel (at 10%w/w) offers several beneficial properties to the Dermatological Condition being addressed. Specifically, the Muco-Laginous Polysaccharide components of Aloe Vera Gel; primarily Acemannan provide a Semi-Occlusive Barrier Film that will reduce Transepithelial Water Loss (TEWL). As a result, the desquamation and drying commonly found when using conventional Anti-Acne treatments can be alleviated [4, 8]. Furthermore, Aloe Vera's ability to buffer pH will aid in establishing the Final Formulation pH of 5.8 which is well-within the Skin Compatible Range [4, 8]. Surjushe et al. [4] and Ali et al. [8] jointly support the utilization of Aloe Vera at concentrations ranging from 5–15% for Optimal Moisturizing and Anti-Inflammatory Effects. In addition to providing optimal Moisturizing and Anti-Inflammatory Properties, the Oil-in-Water (O/W) Emulsion Base utilized in the creation of this topical treatment is especially suitable for individuals whose skin is prone to acne, or those with Seborrheic skin. This is due to the fact that O/W Systems are Non-Greasy, Cosmetically Elegant and will be less likely to exacerbate Comedone Formation than their counterpart W/O Bases [9, 10]. Beeswax and Cetyl Alcohol both contribute structural integrity and emolliency to the Topical Treatment formula, whereas Stearic Acid acts as an Anionic Emulsifier and pH-Sensitive Thickening Agent [11, 15]. Methylparaben at 0.04

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grams (.2%w/w) is consistent with the Concentration Range Recommended by the International Cosmetic Ingredient Review Board (.01–.3%) for Preserving Creams Containing Aqueous Solutions [12]. As a result, the Stability Profile exhibited by this topical treatment — including no Phase Separation, Creaming or Syneresis over the course of 30 Days at Ambient Conditions (25°C) — suggests that the formulation has sufficient Robustness. However, it should be noted that further Testing of Accelerated Stability (40°C / 75% RH for 6 Months; ICH Q1A Guidelines) and Long-Term Preservative Efficacy (USP <51>) will be necessary prior to Scale-Up or Clinical Deployment [15].

VI. CONCLUSION

The primary objective of this research was to formulate and evaluate an oil-in-water anti-acne cream using turmeric extract (containing curcumin) and aloevera gel as active ingredients. A successful formulation of the cream was achieved as evidenced by the physicochemical characteristics of the cream which included a pH of 5.8, a viscosity of 48,890 centipoise, good spreadability, and uniformity; all of these are in compliance with regulatory requirements for dermatologically applied creams. These results were further supported by primary skin irritation studies confirming that the cream is not irritating to the skin and has a high degree of biocompatibility. The combination of curcumin's antibacterial activity and inflammation reduction capabilities with aloe vera's moisturizing/skin-soothing capabilities presents a scientific basis for a multi-modal treatment approach for the prevention/treatment of acne. As there continues to be an increase in antibiotic resistant strains of bacteria responsible for causing acne along with consumers' desire to have their cosmetic products made from natural/cosmeceutical sources, herbal-based formulations may provide a viable alternative to traditional synthetic anti-acne products. Further research can include in vitro antimicrobial studies; quantitative determination of curcumin via HPLC; accelerated stability testing according to ICH standards; and randomized clinical trials to definitively assess the effectiveness of the cream. Additional research can also investigate new methods of delivering curcumin through the skin such as nano-emulsion technology or transfersome technology.

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