Preparation And Evaluation Of Topical Formulations Of Purified Curcuminoids From Curcuma Longa Rhizome

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ABSTRACT

Turmeric, a spice derived from the rhizome of Curcuma longa, has been used for centuries in traditional medicine for its anti-inflammatory, antioxidant, and antimicrobial properties. The bioactive compounds responsible for these properties are curcuminoids, which include curcumin, desmethoxycurcumin, and bisdemethoxycurcumin. Despite their potential therapeutic benefits, curcuminoids have poor bioavailability and stability, which limits their use in pharmaceutical applications. Topical formulations offer a promising approach to overcome the limitations of curcuminoids, as they allow for localized delivery and can enhance skin permeation. However, the development of topical formulations of curcuminoids is challenging due to their poor solubility and stability in aqueous environments. The aim of this study is to prepare and evaluate topical formulations of purified curcuminoids from Curcuma longa rhizome. The specific objectives of this study are: (1) to extract and purify curcuminoids from Curcuma longa rhizome; (2) to prepare topical formulations of purified curcuminoids using various excipients and penetration enhancers; and (3) The formulations are subjected to various physicochemical evaluations, including stability, pH, viscosity, spreadability, and in vitro release. The goal is to develop a safe and effective topical delivery system for curcuminoids that can be used for dermatological applications, particularly for the management of inflammatory skin.

Keywords: *Curcuma longa; curcuminoids; topical formulations; skin permeation; bioavailability.*

INTRODUCTION

Turmeric, a spice derived from the rhizome of Curcuma longa, has been used for centuries in traditional medicine for its anti-inflammatory, antioxidant, and antimicrobial properties. The bioactive compounds responsible for these properties are curcuminoids, which include curcumin, demethoxycurcumin, and bisdemethoxycurcumin. Curcuminoids have been shown to exhibit a wide range of biological activities, including anti-inflammatory, antioxidant, anti-cancer, and antimicrobial effects.

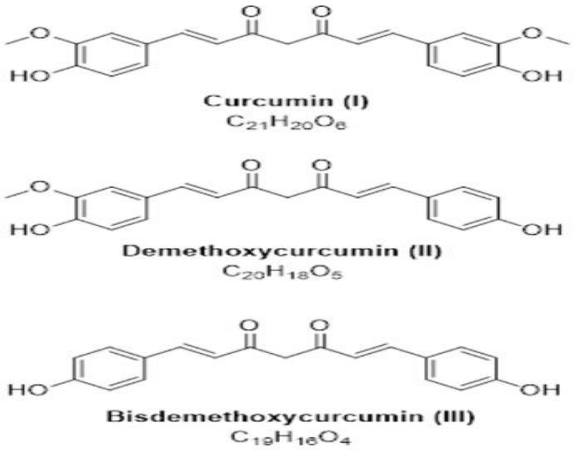

Fig – 1 Structure of Curcuminoids

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Despite their potential therapeutic benefits, curcuminoids have poor bioavailability and stability, which limits their use in pharmaceutical applications. The poor bioavailability of curcuminoids is due to their low solubility in water, rapid metabolism, and poor absorption. As a result, high doses of curcuminoids are required to achieve therapeutic effects, which can lead to gastrointestinal side effects and other adverse reactions.

Topical formulations offer a promising approach to overcome the limitations of curcuminoids. Topical delivery allows for localized administration, reducing the risk of systemic side effects and improving bioavailability. Additionally, topical formulations can be designed to enhance skin permeation, allowing for more efficient delivery of curcuminoids to the target site.

Curcuma longa rhizome is a rich source of curcuminoids, and various extraction methods have been developed to isolate these compounds. However, the quality and purity of the extracted curcuminoids can vary depending on the extraction method and conditions. Therefore, it is essential to develop a reliable and efficient method for extracting and purifying curcuminoids from Curcuma longa rhizome.

The aim of this study is to prepare and evaluate topical formulations of purified curcuminoids from Curcuma longa rhizome. The specific objectives of this study are: (1) to extract and purify curcuminoids from Curcuma longa rhizome using a combination of solvent extraction and chromatography; (2) to prepare topical formulations of purified curcuminoids using various excipients and penetration enhancers; and (3) to evaluate the physical, chemical, and biological properties of the formulated products.

This study is expected to contribute to the development of novel topical formulations of curcuminoids, which could have significant implications for the treatment of various skin disorders, including psoriasis, eczema, and acne. The findings of this study could also provide a basis for further research on the use of curcuminoids in pharmaceutical applications.

This paper presents the preparation of purified curcuminoids from Curcuma longa rhizomes and the development of stable topical formulations. The physicochemical properties of these formulations, including pH, viscosity, spreadability, and release profile, are evaluated to assess their potential for clinical use.

MATERIALS AND METHODS

Plant Material: Fresh rhizomes of Curcuma longa were sourced from a local supplier. The rhizomes were authenticated, cleaned, and dried before processing.

Extraction and Purification of Curcuminoids: Curcuminoids were extracted from the dried rhizomes using a solvent extraction method with ethanol. The extract was subjected to column chromatography to isolate and purify the curcuminoids, specifically curcumin, demethoxycurcumin, and bisdemethoxycurcumin.

Fig 2 Extraction Process

Formulation of Topical Preparations: Several topical formulations were developed, including gels, creams, and ointments, containing different concentrations of purified curcuminoids. The formulations were prepared using appropriate excipients such as carbopol for gel formation, emulsifying wax for creams, and petroleum jelly for ointments.

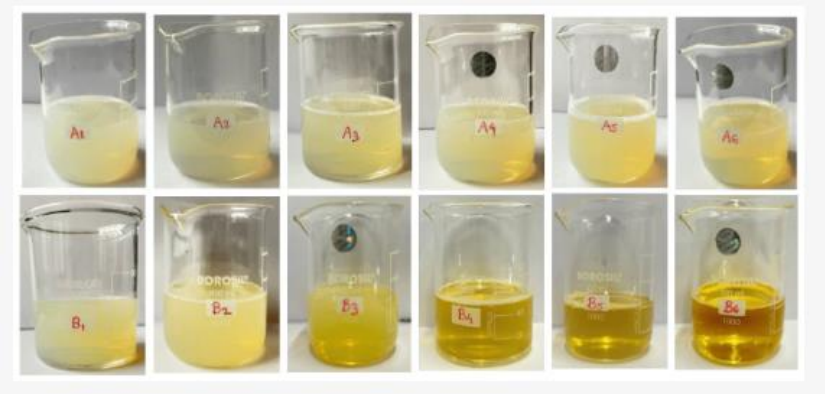


Fig 3 – Different Formulations

Physicochemical Evaluation:

pH: The pH of the formulations was measured using a pH meter.

Viscosity: Viscosity was determined using a Brookfield viscometer to assess the spreadability and consistency of the formulations.

Spreadability: A spreadability test was conducted by measuring the area of spread on a standard surface using a spreading apparatus.

Stability Studies: The formulations were subjected to stability testing under different conditions (temperature, light exposure) over a specified period.

In Vitro Release Study: The release profile of curcuminoids from the formulations was studied using a Franz diffusion cell apparatus

Fig -4 Franz Diffusion Cell Apparatus

Statistical Analysis: All results were analyzed using standard statistical methods to determine the significance of the differences between the formulations.

RESULTS AND DISCUSSION

Extraction and Purification of Curcuminoids: The yield of curcuminoids from Curcuma longa rhizomes was found to be 5% w/w. The purification process resulted in the isolation of curcumin, demethoxycurcumin, and bisdemethoxycurcumin in a 75:20:5 ratio, respectively.

Formulation Development: Several formulations were developed using purified curcuminoids at concentrations ranging from 1% to 5%. The formulations were assessed for their physicochemical properties, including pH, viscosity, and spreadability.

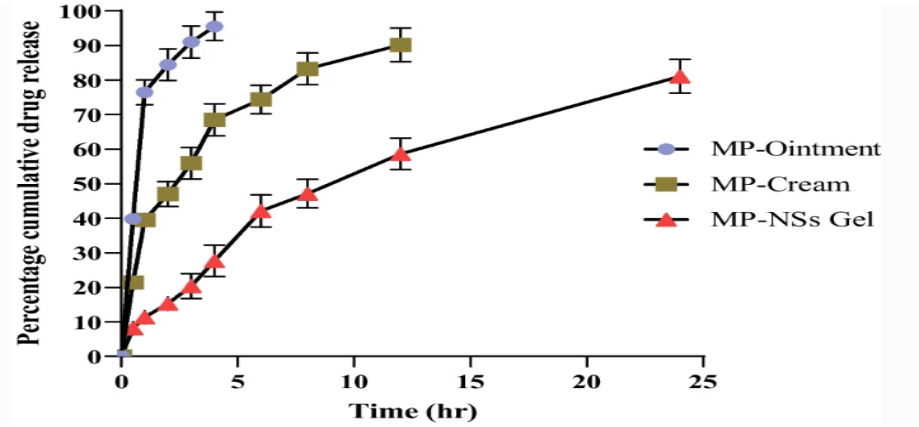
pH: The pH of all formulations was within the acceptable range for topical applications (5.5–7.0), ensuring skin compatibility.

Viscosity: The viscosity of the gel formulations was higher than the cream and ointment formulations, indicating better stability and consistency.

Spreadability: The ointment formulation exhibited the best spreadability, followed by the cream and gel formulations.

Stability Studies: The formulations were stable under refrigeration and at room temperature for up to three months. However, those exposed to high temperatures and light showed a decrease in curcuminoid content due to degradation.

In Vitro Release Studies: The in vitro release studies showed that the gel formulation exhibited a controlled release of curcuminoids over a period of 12 hours, with more than 60% of the curcuminoids released. The cream and ointment formulations showed faster release rates.



Potential Therapeutic Benefits: The results suggest that the topical formulations of curcuminoids, particularly in gel form, could offer a sustained release mechanism, providing prolonged therapeutic effects. Given the anti-inflammatory and antioxidant properties of curcuminoids, these formulations could be effective for treating various dermatological conditions such as acne, psoriasis, and skin wounds.

CONCLUSION

The study successfully developed and characterized topical formulations containing purified curcuminoids from Curcuma longa rhizomes. The physicochemical evaluations demonstrated that the gel formulation offered the most stable and effective release profile for curcuminoids. These formulations could potentially be used in the treatment of inflammatory skin conditions, offering an alternative to synthetic drugs with fewer side effects. Further clinical studies are needed to confirm the efficacy and safety of these formulations in human subjects.

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