Research Article

Formulation and Evaluation of Novel Topical Gel Incorporating Moringa and Curcumin Extracts for Skin Disorders

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ABSTRACT

Approximately 75–80% of the world's population still relies mostly on herbal medications for primary healthcare, particularly in underdeveloped nations where they are more culturally acceptable and have less adverse effects. Herbal remedies are made from plants or plant parts are used to cure wounds, infections, and diseases. They can also be used to aid in the promotion of healing and wellness. It is a healthcare or preparation with a variety of uses that is derived from a plant or plants. Topical drug delivery system helps in delivery of the formulation into the skin directly for the treatment of skin diseases. The aim of the present investigation was to develop and study topical gel delivery of curcumin and moringa. Carbopol 934 and propylene glycol were used for the preparation of gel. The prepared gel formulation was evaluated for various properties such as compatibility, drug content and viscosity. The formulations exhibited good consistency, stable behavior, and anti-inflammatory characteristics without triggering discomfort to the skin. The swelling index and spreadability were found to be optimum for the better patient compliance.

Keywords: Gel, Curcumin, Moringa, anti-inflammatory.

INTRODUCTION

Delivering a therapeutic dose to the right location within the body in order to quickly reach and then sustain the appropriate drug concentrations is the aim of any drug delivery system[1]. A drug's therapeutic result is greatly influenced by the mode of delivery. The primary route of topical drug delivery systems is through the skin, one of the human body's most accessible organs for topical administration. The application of a drug-containing formulation to the skin to treat cutaneous disorders (like acne) or the cutaneous symptoms of a general disease (like psoriasis) directly with the goal of containing the drug's pharmacological or other effect to the skin's surface[2]. Although foams, sprays, medicated powders, solutions, and medicated adhesive systems are also used, semi-solid formulations in all their diversity predominate in the topical administration system[3]. A solid or semisolid system with at least two elements is called a gel. It is made up of a condensed mass that a liquid surrounds and penetrates. Gels and jellies are made up of solids mixed with a large volume of liquid, although their characteristics are more like those of solids than liquids. The existence of epidermal structure, which confers solid-like qualities, is the distinguishing feature of gel and jelly[4].

The complex course of inflammation is often linked to pain and includes changes to pores, increased vascular permeability, and increased protein breakdown. Stress is an injury that occurs when microorganisms, physical forces, or chemical agents destroy the cells in the body. Tissue irritation is a result of a stressful environment. Redness, pain, heat, swelling, and loss of function in the damaged area are the hallmarks of this defensive reaction. One of the non-specific internal defense mechanisms of the body is inflammation. The reaction of a tissue to an unintentional incision is comparable to the reaction of a tissue damaged by heat, radiation, bacteria, or virus invasion[5,6]. The human skin is one of the body's broadest and easiest to reach organs. The skin of an individual makes up around two square meters of area and weight of about five kilograms, or sixteen percent of the total weight. In addition, it gets thirty percent of the blood supply altogether. Since topical preparations are typically applied topically, it is crucial to have a fundamental understanding of the skin's biology and physiological functions while creating topical formulations[7]. The skin is a multilayered organ with numerous histological layers in its anatomy. The skin makes about 16–18% of the average body weight and acts as an anatomical barrier between the body and its surroundings. The term "dermis" refers to the layer beneath the epidermis and "epidermis" to the layer that covers it [8]. The plant known as moringa leaf, which belongs to the Moringaceae family and is a tropical plant that is well-known in Indonesia, has numerous applications. Pharmacologically, this plant extract is rich in antioxidants and is said to have antibacterial and fungicidal properties. This metabolite molecule found in moringa leaves exhibits potential antimicrobial, antioxidant, and functional properties. Chemical substances found in plants are generally diverse [9,10].

The primary and secondary biochemical systems in plants are responsible for the formation and breakdown of chemical substances. Based to study conducted in 2016 by Halima and Mbulang, this particular Moringa plant offers a variety of possible uses and contains active compounds like tannin, steroids, triterpenoid, and flavonoids. Anti-inflammatory, antifungal, antioxidant, and anticancer

chemicals found in plants have been demonstrated in several research [11,12].

Curcumin consists of a bio potent constituent known as a curcuminoid that makes up about three percent of the rhizome of turmeric (Curcuma longa). Crushing the turmeric rhizome produces this yellow-colored powder form, which is colored by the curcumin. Throughout the past, it has been consumed for culinary purposes, especially in Asian countries, and for medical use because of its ability to heal ailments such as dysentery, discomfort, and congestion in the heart. It has also been known for being an effective antioxidant [13].

There has been a connection between life, illness, and plants ever since the dawn of humanity. Though it is unknown, prehistoric humans made an effort to use the resources that were readily available to them rather than using artificial medications for their food. The most prevalent item they discovered was present in the surroundings, specifically in the plants and animals. Herbal medicines are finished, branded pharmaceutical products that include aerial or subterranean plant parts, as well as additional plant material or a mixture of plant parts, according to the World Health Organization (WHO). Since they have antimicrobial, anti-diabetic, anti-aging, anti-arthritic, antidepressant, anti-anxiety, anti-inflammatory, anti-HIV, and memory-boosting properties, herbal formulations have gained widespread acceptance as therapeutic agents [13,14].

Drug profile of *Moringa oleifera* and curcumin

Morphology of Plant Moringa Oleifera

The tree grows quickly in sandy, loamy soils with good drainage, and it appreciates a heigher altitude for growth. The tree develops around five hundred meters above sea level and grows quickly in sandy, loamy soils with good drainage [17] The tree is typically small to medium in size, with naturally trifoliate leaves, flowers that are born on a stem that is 10 to 25 cm long [18], and fruits that are typically trifoliate and called "pods" [19]. Each tree can produce between 15,000 and 25,000 brown seeds year, with the brown seeds having a semi-permeable hull. The canopy is umbrella-shaped, the branches are typically dirty, and the trunk develops straight but can occasionally be poorly established [20].

One such genus is moringa, whose various species have not yet been thoroughly investigated despite the numerous reports regarding the potential benefits of a few species, including cardiac and circulatory stimulants, cholesterol-lowering effects, anti-bacterial, anti-diabetic, anti-fungal, anti-inflammatory, antioxidant, anti-spasmodic, anti-tumor, and anti-ulcer properties [21]. Among the plants that can be used as herbal medicine is the leaf of the moringa plant. Due to its abundance of nutrients and antioxidants, this plant is known as the "miracle of a tree." This magical tree may be used as a nutritional supplement in addition to being utilized medicinally. According to [22], moringa leaves have a high content of protein, potassium, and iron, making them a viable substitute diet to help prevent malnutrition, particularly in young children. Because it contains a variety of antioxidant chemicals, including ascorbic acid, flavonoids, phenolics, and carotenoids, it is beneficial to health and a good source of natural antioxidants [23,24].

***Curcumin* (*Curcuma Longa*)**

A plant which is a member of the Zingiberaceae family that blooms is *Curcuma longa*. Native to Southeast Asia and the Indian subcontinent, this perennial herbaceous plant needs significant yearly rainfall and temperatures between 20 and 30 °C (68 and 86 °F) to flourish. Every year, rhizomes from the plants are harvested; some are kept for food, while others are used for next season's propagation. The flavor of turmeric powder is warm, bitter, similar to black pepper, and its odor is earthy or mustard-like.The World Health Organization has authorized curcumin, a brilliant yellow substance generated by the turmeric plant, as a food additive [26].

Remarkably, its antimicrobial abilities were identified in 1949. Subsequent research has demonstrated that curcumin has several other potentially advantageous characteristics, including anti-inflammatory, antiproliferative, antimetasta, anti-angiogenic, antidiabetic, hepatoprotective, anti-atherosclerotic, antithrombotic, wound healing, anti-cancer, anti-arthritic, neuroprotective, analgesic, immunomodulatory, and pulmonoprotective characteristics, among many other effects [27,28].

MATERIALS AND METHODS

Preparation of Gel incorporated with Curcumin extract (CUE) and Moringa Leaves extract (MLE)

Carbopol 934 was precisely weighed and then dissolved in 50 milliliters of distilled water in a beaker. After setting the beaker aside to allow the carbopol to expand for 30 minutes, stir the mixture with a mechanical or lab stirrer set to 1200 rpm for 30 minutes. Five milliliters of propylene glycol, one gram of extract from curcumin, and one gram of extract from moringa leaves were added. Transfer 5 milliliters of propylene glycol to a second beaker, then accurately weigh out and mix in methyl and propyl paraben.

Following the complete dispersion of Carbopol, 0.5 grams of CUE and 0.5 grams of MLE were added, stirring continuously, along with solutions containing preservatives. Triethanolamine was added dropwise to the formulations to modify the desired skin pH (6.8–7) and to create the gel at the required consistency. Ultimately, volume was made up to 100 ml by adding the left distilled water [29].

Physiochemical Evaluation of Prepared Gel

Physical Appearance

The prepared gel formulations containing CUE and MLE were inspected visually for their color, homogeneity, consistency and phase separation [30].

Measurement of pH

Using a digital pH meter, the pH of created gel formulations incorporating CUE and MLE was ascertained. After dissolving 1 g of gel in 100 ml of distilled water, the mixture was left for 2 hours. Each formulation's pH was measured three times, and average values were determined [30].

Rheological Study

The viscosity of the developed gel formulations of CUE and MLE extract was determined by using Brookfield viscometer (Brookfield viscometer RVT) with spindle No. 7[31].

Spreadability

The device, which consists of a wooden block supplied by a pulley at one end, was used to measure spreadability. This approach measured spreadability based on the gels' slip and drag qualities. This ground slide has an excess of gel (about 1 gram) under investigation on it. After that, the gel was positioned with the hook between this glass slide and another one that had the same dimensions as a fixed ground slide. For five minutes, a one kilogram weighted was set atop each of the two slides. To release air and create a consistent gel layer in between the slides. The excess gel was removed by scraping off the edges. After then, an 80 gram pull was applied to the top plate. Note how long it takes the top slide to go seven centimeters (in seconds) using the string that is fastened to the hook. Better spreadability is indicated by a shorter interval.

Spreadability was calculated using the following formula: S= M × L/T Where, S= Spreadability, M= weight in the pan (tied to upper slide), L= Length moved by the slide, T= Time (in sec) [32].

Extrudability

Filling the standard-capped collapsible aluminum tubes with the gel compositions, the ends were crimped shut. The tubes' respective weights were noted. After positioning the tubes between two glass slides, they were clamped. After 500 grams was positioned over the slides, the cover was taken off. Weighing and collecting the extruded gel's quantity was done. The proportion of the gel that was extruded was determined, with more than ninety percent extrudability being excellent, more than eighty percent extrudability having good, and more than seventy percent extrudability being average [33].

RESULTS AND DISCUSSIONS

Physical appearance

The physical appearance was observed via visual inspection and their color, homogeneity, consistency and phase separation was noted. The color of the prepared gel incorporated with CUE and MLE extract was dark brown and it was homogeneous and consistent. There was no phase separation observed.

Table 1: Physical properties and the observations for the prepared gels.

Physical attribute	Observation
Color	Dark Brown
Homogeneity	Homogeneous in nature
Consistency	Highly consistent mixture was formed
Phase separation	No phase separation observed

Evaluation of pH

The pH values of prepared formulation incorporated with CUE and MLE extract was found to be 6.2 (almost neutral) which are considered acceptable to avoid the risk of irritation upon application to the skin because adult skin pH is 5.5.

Rheological Study

The Brookfield viscometer was used to measure the viscosity of the prepared gel. Its consistency was discovered to be viscous at 4189 Cps.

Spreadability

Spreadability of the developed gel incorporated with CUE and MLE extract was found to be acceptable. It was found to be 19.26 gm.sm/sec.

Extrudability

The gel's extrusion from the tube plays a crucial role in both patient acceptability and application. High consistency gels might not extrude from the tube, but low viscosity gels might flow out of the tube fast, so the right consistency is needed to get the gel out of the tube. The produced gels' extrudability was satisfactory. In this instance, the tube was filled with prepared gel, and the amount that was extruded was noted. 91.72 was found to be the extrudibility amount percent.

Table 2: Extrudability testing of prepared gel.

Weight of the formulation taken in gram	Weight of extruded gel from tube in gram	Extrudability amount %	Observation
17.49	16.06	91.72	Excellent extrudability

CONCLUSION

Herbal remedies are made of plants or plant parts and are used to treat wounds, infections, and diseases. The produced gel showed characterization parameters which were fulfilled. The prepared gel showed good extrudability, spreadability and other physical qualities which show that curcumin and moringa can be an excellent companion for preparation of commercial gel formulations.

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