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Research Article

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Formulation Development and Characterization of Ointments containing *Bambusa arundinacea* Extract and Chlorophytum borivilianum Extract

Ritu Nandal

R. S. M. College of Pharmacy, Lakhu Buana, Tehsil Israna, Panipat 132145, Haryana, India.

ABSTRACT

The goal of the current study was to investigate potential applications for extracts of *Bambusa arundinacea* (resin) and *Chlorophytum borivilianum* (rhizome) used in ointment formulations. The pharmaceutical properties of the formulations, such as pH, the skin irritancy test, viscosity, appearance, extrudability, spreadability, washability, and swelling index, were evaluated. The skin irritation test inquiry found that no particular edema or erythema symptoms appeared after therapy for a continuous seven days. pH measurements of the formulations were 6.3 (F1) and 6.7 (F2). While F2 showed edema of 1.29%, F1 showed swelling of 1.42%. The two ointment compositions' respective spreadabilities were 6.5 g.cm/sec and 6.0 g.cm/sec. The formulae for F1 and F2 were found to be +++ and +++, respectively, extrudable from the collapsible tubes. In light of the formulations' rheological characteristics, the viscosity was found to be 5300 cps (F1) and 6200 cps (F2). The washability of the formulations was found to be +++ for Formulation-1 and +++ for Formulation-2. By making this finding, which also revived the ideas of ethnopharmacology in connection to modern medicine, the uses of polyherbal formulations in conventional medicine were made clear.

Keywords: Extract, Ointment, Formulation, Characterization, *Bambusa arundinacea*, *Chlorophytum borivilianum*

INTRODUCTION

Both traditional and alternative medicine frequently use herbal remedies in underdeveloped and developed countries. The use of traditional medicines has been promoted by the World Health Organization (WHO) and India because they are more economical, widely available, and well-liked by populations in developing countries. Common, traditional herbs, according to published studies, can aid in the healing of wounds as well as a number of skin-related conditions. The popularity of using herbal-based active extracts or phytoconstituents is attributed to the belief that these substances are dependable, secure, and less likely to cause side effects. Recent research has examined a number of herbal-based formulations for treating skin conditions, including creams, ointments, emulsions, gels, liquids, suspensions, jellies, sprays, wet dressing, carbogel, and lipogels[1].

Bambusa arundinacea Linn is the bamboo plant, and it produces both fresh leaves and dried fruits. Grasses like maize, sugar cane, and bamboo belong to the Graminae (Poaceae) family. Bamboos are unique among grasses in that their nodes develop into branches. In most species of bamboo, the culm is made up of hollow internodes and solid nodes that hold the plant together. There is a bud (or many buds, in some species) at each node, from which new shoots grow. In order to treat ringworm, bleeding gums, and sore joints, the root (burnt root) is used topically. The seeds have been traditionally used to treat strangury and urinary discharges due to their pungent and laxative properties. Eruptions of the skin may be treated with bark. The leaf may be used for a number of medical purposes, including as an emmenagogue, an antileprotic, a febrifuge, a bechic, and in the treatment of haemoptysis[2].

Chlorophytum borivilianum of the family Liliaceae is an economically viable medicinal plant. Starting in the 11th Century A.D., writers on traditional Indian medicine recognized the therapeutic potential of safed musli tubers. The tubers' saponin content confers a variety of health benefits, including aphrodisiac, adaptogenic, antiaging, restorative, and boosting effects on the body. Today, the plant is mostly grown on a microscale in a few of Indian states. In all, over 300 species may be found in tropical and subtropical regions. Africa's tropical and subtropical regions are strong

Corresponding Author:
Ritu Nandal, Assistant Professor, R. S. M. College of Pharmacy, Lakhu, Buana, Panipat 132145, Haryana, India.
Email: nandalritu27@gmail.com

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candidates for the genus's original habitat. Seventeen different *Chlorophytum* species has been documented in India. All have different healing capabilities, but owing to a lack of accurate information, they're all referred to as safed musli. Though it is mostly used as an aesthetic plant outside of India, where it is prized for its therapeutic properties[3].

The goal of the current study was to investigate potential applications for extracts of *B. arundinacea* (resin) and *C. borivilianum* (rhizome) used in ointment formulations. The pharmaceutical properties of the formulations, such as pH, the skin irritancy test, viscosity, appearance, extrudability, spreadability, washability, and swelling index, were evaluated.

MATERIALS AND METHODS

Chemicals

We bought analytical-grade chemicals from SD Fine Chem Ltd. in India, including white wax, white petroleum, and other compounds. From HiMedia Chemicals Ltd. in India, we purchased PEG 300, cetostearyl alcohol, and chloroform. The suppliers of propyl paraben and methyl paraben were Sigma Aldrich Ltd. in Germany. From Dabur India Ltd. in India, we purchased honey that was 99.98% pure. The double distillation process was carried out using Borosil® distilled water equipment.

Instrumentation

A Shimadzu® electronic balance was used for all measurements (Model AUW220D, Japan). The pH was observed using a digital pH meter by VSI® (model VSI-1B). A Brookfield Digital DV-II+ (USA) Viscometer was used to determine the viscosity (using spindle 6). A stability chamber was used to conduct accelerated stability testing (Bio-Technics, India).

Extracts

Standardized *B. arundinacea* resin extract (50%-60% Silica) and standardized *C. borivilianum* rhizome extract (20%-40% Saponins) were purchased from S.A. Herbal Bioactives Ltd., Mumbai, India.

Formulation development

Preparation of ointment base

The ointment base was made by melting white wax on a heated skillet between 70-75°C. When the wax was entirely melted, white petroleum was added, and the mixture was kept on the hot plate until it liquefied. The substance was heated, allowed to liquefy, then removed from the heat, and then allowed to congeal. The liquid was stirred until it began to harden (**Table 1**)[4].

Table 1: Composition of ointment base.

INGREDIENTS	QUANTITY (in gram)
White wax	1.5
White petroleum	1.5
Cetosteary alcohol	1.5
PEG 300	2.5
Methyl paraben	0.025
Propyl paraben	0.025

Preparation of polyherbal formulation

The extracts were used to make ointment after being semi-dried. The polyherbal formulations (F1 and F2) were developed on the basis of the ointment. The typical trituration method was used, which required melting and mixing solid fats. After that, the 40°C melted base was appropriately combined with the required quantity of the ointment base. Up until a uniform dispersion was reached, the mixture was softly and continuously stirred (**Table 2**)[5].

Table 2: Composition of polyherbal ointments.

INGREDIENTS	FORMULATION-1 (F_1) QUANTITY (g)	FORMULATION-2 (F_2) QUANTITY (g)
Bambusa arundinacea	6	3
Chlorophytum borivilianum	3	6
Honey	1	1
Ointment base	10	10

Evaluation of polyherbal formulations

The formulations were characterized as per the protocols given by Shivhare et al., 2018 [6].

Physical Evaluation

The color, general appearance, and application-related feel of the developed compositions were noted, and the results are analyzed.

pH

The pH of the ointment formulations (F1 and F2) was measured using a digital pH meter that had been calibrated, and it had also been further calibrated using buffered solutions at pH-4 and pH-7 before each usage. To ascertain the formulations' pH values, the reference electrode and glass electrode were entirely submerged in the ointment.

Spreadability

The spreadability of the formulae was measured using a novel apparatus composed of a flat wooden block supported by a pulley at one end. The formulations were evaluated for

drag and slip by releasing 2 g of the polyherbal product onto a ground slide. The apparatus was supported by a hook, and the formulation was sandwiched between two slides of the same dimensions. To let the formulae' trapped air out and make a consistent film between the two slides, a unit kilogram weight was put over the slide. The excess formulation that was sticking out of the borders was removed. With the use of the hook, it was determined how long it would take the top slide to move 7.5 cm after 50 g of weight had been linked to it to provide a pulling force. The following formula was used to determine the formulation's spreadability:

$$\textbf{Spreadibility} = \frac{M \times L}{T}$$

where, M = weight tied to the upper slide (50 g); L = length of glass slide (6 cm); T = time taken (sec) to separate the glide slides from each other.

Washability

The washability of the goods was assessed by applying the ointments to the skin and personally watching how quickly the polyherbal compositions could be cleaned with distilled water.

Skin irritancy test

Over a 6 cm^2 area of skin, 0.5 g of the formulation was applied, then a piece of gauze that was loosely kept in place by a dressing (semi-occlusive) for an hour. After removing the gauze for an hour, the remaining content was removed without altering the other conditions. A thorough analysis was performed about sensitivity features and additional rash or reaction signs. Evaluations were finished after the program was followed for seven days in a row.

Viscosity

Using a Brookfield viscometer with spindle number 6 at 50 rpm at room temperature, the manufacturer's recommended operating procedure was followed to evaluate the apparent viscosity values of the ointment compositions.

Extrudability

A collapsible aluminum tube containing the polyherbal ointment compositions was sealed with an ordinary plastic cap before being crimped shut using ointment sealing equipment. The tubes were placed between the two slides and then secured in place. When a weight of 500 g was placed over the slides, the top came off with no delay. The mixture was extruded in a ribbon-like shape in ten seconds. The length of the extruded ribbon was measured.

Swelling index

The swelling index of the ointment was determined by dissolving 2 grams of the material in distilled water because it contains hydrophilic ingredients (10 mL). A Petri plate was used to hold the mixture after it had been in the beaker for an hr. The amount of swelling was calculated using the following method after the content was weighed:

$$\text{Swelling index} = \frac{w_t \times w_o}{w_o} \times 100 \times 100$$

where, Wt = weight of swollen after 1 hr; Wo = original weight of ointment at zero hr.

Accelerated Stability Studies

A 90-day investigation on the stability of F1 and F2 was conducted in accelerated humidity and temperature conditions (40°C ± 2°C / 75% ± 5% RH). The formulations were placed in a foil-wrapped PVC container. The formulations underwent additional testing for medical properties such appearance, pH, spreadability, viscosity, washability, and extrudability after being withdrawn from the stability chamber for 90 days.

RESULTS AND DISCUSSION

Organoleptic properties

There are no such defects in either ointment's composition, which is fairly exquisite, wonderfully colored, incredibly soft to the touch, grit-free, and non-irritating. Formulation-1 looks yellow and smells strongly of herbs, in contrast to Formulation-2, which is brown in appearance. Formulation-2 seemed more tasteful than Formulation-1.

Skin irritation test

According to the analysis of the skin irritation test, no particular edema or erythema signs were noticed after treatment for a continuous seven days. The Formulation-2 was far less irritating than the Formulation-1, as was easily discernible from observation. Contrarily, polyherbal preparations demonstrated improved human use compatibility with no local irritability. Many synthetic cosmetics on the market now contain novel synthetic excipients that irritate the skin in sensitive populations when usage compatibility is examined.

Viscosity

When analyzing the rheological characteristics of the formulations, the viscosity was found to be 5300 cps (Formulation-1) and 6200 cps (Formulation-2). It's been presumpted that when torque increases, shear stress raises as well, causing viscosity to decrease. The honey addition, which hampered the Brookfield viscometer spindle, is responsible for Formulation-2's increased viscosity. Since it is generally known that increasing emulsifier concentration results in a decrease in viscosity, the absence of a high emulsifier concentration may also be to blame. Because of the

high viscosity, the substance was additionally concentrated to stay on the skin's surface for a longer time and to continue exerting its action.

pH

The pH values for the formulations were found to be 6.3 (Formulation-1) and 6.7 (Formulation-2). Because the pH of the mixture closely equals the pH of the skin, this suggests compatibility for dermal application (5.4-6.0).

Swelling index

The swelling indices were minimal for both formulations. Formulation-1 showed a swelling of 1.42%, whereas Formulation-2 showed a swelling of 1.29%. The ointment contains hydrophilic excipients, however because there is a sizable quantity of extract component in the formulation, which inhibits swelling, there was hardly any swelling even though the ointment contains these excipients. It is necessary for dermal applications to have some degree of occlusive swelling, even though swelling can have both positive and negative effects.

Spreadability

The two ointment formulations (F1 and F2) were found to have spreadabilities of 6.5 g.cm/sec and 6.0 g.cm/sec, respectively. As the viscosity decreases, the spreadability of the formed formulation increases. Formulation 2 has a low spreadability due to its high viscosity. Since Formulation-2 is less spreadable and more likely to adhere to the wounded area, a concentrated concentration of the substance in the intended site, it may have a stronger activity.

Extrudability

The extrudability of Formulation-1 and Formulation-2 from the collapsible tubes was found to be +++ and +++, respectively. Formulation-2's reduced extrusion compared to Formulation-1 may be due to Formulation-2's higher viscosity, which hindered free extrusion from the collapsible tube.

Washability

It was established that the formulations' washability was +++ for Formulation-1 and +++ for Formulation-2. Because of its higher viscosity, better retention power, and enhanced stickiness, Formulation-2 had less washability (**Table 3**).

Table 3: Evaluation parameters.

PARAMETERS	FORMULATION-1	FORMULATION-2
Appearance	Yellow, characteristic odor	Brown colored, characteristic odor
Spreadability (g.cm/sec)	6.5	6.0
Extrudability	+++	+++
Skin irritancy test	Non-irritant	Non-irritant
pH	6.3	6.7
Viscosity (cps)	5300	6200
Washability	+++	+++
Swelling index (%)	1.42	1.29

Short-term accelerated stability conditions

Under the accelerated stability conditions (40°C ± 2°C and 75% ± 5% RH for 90 days), the polyherbal wound healing formulations (F1 and F2) did not exhibit any appreciable changes in terms of washability, physical appearance, spreadability, viscosity, or extrudability. The pH reduction in Formulation-1 may have been caused by the increased production of a few small fragmented acidic components. In contrast, it was found that Formulation-2 was more pH and viscosity robust (**Table 4**). The most likely explanation is that the product contained honey, which prevented the chemicals from rapidly degrading. It was discovered as a result that the ointment compositions were rather stable.

Table 4: Accelerated stability studies.

PARAMETERS	FORMULATION-1	FORMULATION-2
Appearance	No change	No change
Spreadability (g.cm/sec)	6.2	5.9
Extrudability	+++	+++
pH	6.2	6.5
Viscosity (cps)	5100	5900
Washability	++	++

CONCLUSION

In a good way, this research has opened up new possibilities for treating various ailments. The created polyherbal formulations, which contain extracts of *B. arundinacea* (resin) and *C. borivilianum* (rhizome), have potential use in the future. By making this finding, which also revived the ideas of ethnopharmacology in connection to modern medicine, the uses of polyherbal formulations in conventional medicine were made clear.

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CONFLICT OF INTEREST

Authors state that there is no conflict of interest regarding the publication of this manuscript.

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