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Research Article

Formulation and Evaluation of Emulgel from *Carica papaya* Seeds Extract

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ABSTRACT

Background: Carica papaya L. seeds are a plant-derived material reported to contain several bioactive constituents and to exhibit antimicrobial, antifungal and anthelmintic activities. Emulgel combines an emulsion with a gel base and is widely described as a useful topical dosage form, particularly for incorporating poorly water-soluble or lipophilic substances. Objective: The present work aimed to formulate and evaluate an emulgel containing Carica papaya seed extract, using Carbopol 940 as the gelling polymer. Methods: Papaya seeds were cleaned, dried, powdered and subjected to Soxhlet extraction with different solvents, including aqueous, acetone, chloroform and ethanol. Phytochemical screening was performed, followed by preparation of a Carbopol 940 gel and incorporation of an emulsion containing papaya seed extract. The emulgel was intended to be evaluated for appearance, consistency, homogeneity, pH, spread-ability, swelling index, rheological behavior, in-vitro release and stability. Results: The source document reports the presence of carbohydrates, proteins, vitamin C, alkaloids, flavonoids, tannins, steroids, phenolic compounds and saponins, together with physic-ochemical values for powdered seeds. It describes the formulation composition and evaluation procedures. However, numerical results for the finished emulgel—including pH, spreadability, viscosity, swelling index, drug/marker content, release profile and stability—are not reported in the supplied document. Conclusion: The supplied work supports the feasibility of developing a Carica papaya seed-based emulgel and identifies a need for complete quantitative formulation and biological evaluation before thera-peutic claims can be established.

INTRODUCTION

Topical drug delivery offers the possibility of deliver-ing an active substance directly to the skin and the intended site of action while potentially avoiding gas-trointestinal exposure and first-pass metabolism. The skin, however, is an effective biological barrier. The stratum corneum is the principal barrier to permeation

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and is commonly described as a brick-and-mortar structure of corneocytes embedded in a lipid matrix. The supplied document notes that drug movement across skin is influenced by concentration gradient, diffusion coefficient, formulation excipients, hydration, skin condition and physicochemical properties of the active substance.

Emulgel is a semisolid topical system formed by incorporating an emulsion into a gel base. According to the supplied study, this approach can combine characteristics of emulsions and gels, including ease of application, spreadability, acceptable cosmetic properties and potential for incorporating hydrophobic substances. The document describes both oil-in-water and water-in-oil emulsion systems and emphasizes the potential advantages of emulgel over conventional topical systems.

Carica papaya L. (family Caricaceae) is a tropical plant with recognized nutritional and traditional medicinal uses. The seeds, commonly treated as a by-product of the fruit, contain fixed oils and other phytoconstituents. The supplied document reports that ethanolic seed extracts have yielded 2,3,4-trihydroxytoluene and a glyceryl trihydroxybenzoyl dioleate derivative, along with several glycerides and other constituents. Earlier work cited in the document has also described antifungal activity of papaya seed preparations.

The rationale for the present formulation is therefore to combine the reported bioactive potential of papaya seeds with an emulgel vehicle suitable for topical application. The work is primarily a formulation-development study; the supplied document does not contain sufficient quantitative biological data to establish clinical efficacy.

2. Aim and Objectives

Aim: To formulate and evaluate an emulgel containing Carica papaya seed extract.

Objectives:

- To prepare Carica papaya seed material and obtain extracts using Soxhlet extraction.
- To perform preliminary phytochemical screening of the seed extracts.
- To prepare a Carbopol 940 gel base.
- To formulate an emulsion containing papaya seed extract and incorporate it into the gel base.
- To evaluate the prepared emulgel using appropriate physicochemical, rheological, release and stability tests.

MATERIALS AND METHODS

3.1 Plant material

Carica papaya seeds were collected from the local area around Patas, Taluka Daund, District Pune. The seeds were rinsed with sterile water to remove surface contaminants, dried in a dark place at room temperature for several days, and powdered using an electric chopper.

3.2 Materials

The formulation work used Carbopol 940, triethanolamine, petroleum ether, ethanol, propylene glycol and other formulation materials. The source document states that chemicals were obtained from a nearby market.

3.3 Extraction procedure

Powdered papaya seeds were subjected to Soxhlet extraction. The document describes extraction using distilled water, acetone, chloroform and ethanol. For each solvent, 5 g of dried powdered seed was placed in a thimble and extracted with 60 mL solvent for three hours. After solvent evaporation, the extracts were weighed and preserved at room temperature. The document also provides a general Soxhlet procedure using dried seed powder, a 1:10 plant-material-to-solvent ratio, repeated extraction, filtration and concentration of the filtrate.

3.4 Preliminary phytochemical screening

Freshly prepared crude seed extracts were subjected to qualitative phytochemical screening according to literature methods. The classes specifically described in the study include tannins, alkaloids, fixed oils, reducing sugars/glycosides and saponins. The results section additionally identifies flavonoids, steroids and phenolic compounds among the reported constituents.

3.5 Preparation of Carbopol 940 gel

Carbopol 940 (1% w/w) was dispersed uniformly in 150 mL water without forming lumps. A 0.5 N NaOH solution was added dropwise until gel formation occurred. The gel was then weighed and stored in an airtight container.

3.6 Preparation of papaya seed emulgel

For the oil phase, 0.5 mL Span 20 and 0.01 g powdered Carica papaya seed extract were incorporated into 4.5 mL liquid paraffin. For the aqueous phase, 0.5 mL Tween 20 was taken in purified water. Both phases were heated to 60–70 °C. The oily phase was added to the aqueous phase with continuous stirring to form the emulsion. The resulting emulsion was incorporated into the gel in a 1:1 weight ratio. Additional 0.5 N NaOH was used for consistency adjustment.

3.7 Evaluation of emulgel

The supplied protocol describes visual assessment of color, consistency and homogeneity; pH measurement after dispersing 1 g formulation in distilled water and allowing it to stand for two hours; and spreadability testing using a glass-slide method. Spreadability was expressed using $S = M \times L/T$, where S is spreadability, M is the weight tied to the upper slide, L is slide length and T is the time needed for separation.

Swelling index was determined by placing 1 g gel on porous aluminium foil in 10 mL of 0.1 N NaOH and reweighing samples at different time intervals. The equation reported in the document is: Swelling index (%) = $[(Wt - Wo)/Wo] \times 100$, where Wt is the swollen weight at time t and Wo is the initial weight.

In-vitro release was proposed using a Franz diffusion cell with an effective diffusion area of 3.14 cm^2 and a cell volume of 15.5 mL. A 200 mg sample was placed on an egg membrane separating donor and receptor chambers. The receptor compartment contained phosphate buffer at pH 5.5 and was stirred. Samples were withdrawn at suitable intervals and analyzed by UV-visible spectrophotometry after dilution.

Rheological evaluation was described at 25 °C using a cone-and-plate viscometer. Stability testing was planned in 5-g aluminium collapsible tubes at 5 °C, 25 °C/60% RH, 30 °C/65% RH and 40 °C/75% RH for three months, with 15-day sampling intervals. The planned stability attributes included physical appearance, pH, rheological properties, drug content and release profile.

RESULTS

4.1 Pharmacognostic/physicochemical observations of powdered seeds

Parameter	Reported observation
Colour	Green to black
Odour	Odourless
Apex	Acuminate to blunt
Shape	Big oval or pea-shaped
Surface	Smooth
Ash value	5.2%
Moisture loss	6% (also reported as 10% in a separate row)
Acid-insoluble value	0.65%
Water-soluble extractive value	0.7%

4.2 Reported phytochemical constituents

Constituent/class	Reported status
Carbohydrates	Present
Proteins	Present
Vitamin C	Present
Alkaloids	Present
Flavonoids	Present
Tannins	Present
Steroids	Present
Phenolic compounds	Present
Saponins	Present

4.3 Formulation composition reported in the source

Component	Amount/condition reported
Carbopol 940	1% w/w in 150 mL water for gel preparation
NaOH	0.5 N; added for gel formation and consistency adjustment
Span 20	0.5 mL
Papaya seed extract	0.01 g
Liquid paraffin	4.5 mL
Tween 20	0.5 mL
Phase temperature	60–70 °C
Emulsion : gel	1:1 w/w

4.4 Evaluation outcomes: reporting limitation

The supplied PDF describes the analytical methods for pH, spreadability, swelling index, in-vitro release, rheology and stability, but it does not provide the corresponding numerical datasets or comparative formulation results. Consequently, numerical values for these parameters have not been invented or extrapolated in this article. This distinction is important if the manuscript is intended for submission to a scientific journal.

DISCUSSION

The study provides a logical formulation-development rationale: a plant material with reported antimicrobial and antifungal potential is combined with an emulgel vehicle intended for topical use. The choice of Carbopol 940 provides a structured gel base, while Span 20 and Tween 20 are used to construct the emulsion phase. Incorporation of the emulsion into the gel is expected to produce a semisolid system with the handling characteristics associated with topical emulgels.

The preliminary phytochemical profile reported in the source is consistent with a chemically complex plant extract rather than a single defined active pharmaceutical ingredient. This has important implications for quality control. A reproducible herbal topical product should ideally be standardized to one or more chemical markers, with extractive yield, chromatographic fingerprinting and assay methods established. The present document does not report such quantitative standardization.

The source also cites studies reporting inhibition of Candida albicans by papaya seed extract and describes possible mechanistic observations involving reactive oxygen species and mitochondrial membrane potential. These findings provide a scientific rationale for antifungal investigation, but they should not be interpreted as proof that the formulated emulgel is clinically effective. The supplied work itself identifies antifungal testing against Candida albicans, in-vivo testing and toxicological evaluation as future requirements.

A further limitation is that the manuscript uses the terms 'drug release' and 'drug content' even though the active botanical material is an extract and no validated marker assay is reported. For a journal-quality study, the analytical target should be clearly defined—for example, a validated chemical marker or total phenolic content—followed by method validation for specificity, precision, accuracy and linearity.

The stability design described in the source is useful as a framework, but actual stability conclusions cannot be made without the three-month observations. Similarly, claims of enhanced skin permeation or controlled release require quantitative diffusion/release data and appropriate controls.

6. Strengths and Limitations

6.1 Strengths

- Uses a plant-derived material with a documented traditional and experimental pharmacological background.
- Provides a practical Soxhlet extraction and emulgel preparation procedure.
- Includes multiple physicochemical and performance evaluation methods.
- Identifies the need for antifungal, in-vivo and toxicological investigations.

6.2 Limitations

- Numerical results for the finished emulgel are not reported in the supplied PDF.
- No clear formulation-code comparison or optimization study is presented.
- No quantitative extract yield or validated chemical-marker assay is reported.
- No experimental antifungal zone-of-inhibition, MIC/MFC or Candida albicans data for the final emulgel are reported.
- No in-vivo efficacy, skin-irritation/sensitization or toxicological data are reported.
- The document contains an internal inconsistency in the reported moisture-loss values (6% and 10%).

CONCLUSION

Carica papaya seed extract represents a promising botanical material for exploration in topical formulation development because the supplied literature

review and preliminary screening report multiple phytochemical classes and previously described antimicrobial and antifungal activity. The study successfully establishes a formulation concept in which papaya seed extract is incorporated into an emulsion and subsequently dispersed in a Carbopol 940 gel base. The reported formulation uses Span 20, Tween 20 and liquid paraffin, with the emulsion incorporated into the gel at a 1:1 weight ratio.

However, based strictly on the supplied PDF, the work should be regarded as a preliminary formulation study rather than definitive evidence of therapeutic efficacy. Complete quantitative evaluation of the optimized formulation, validated chemical standardization, antifungal testing, skin permeation studies, irritation/toxicity assessment and in-vivo confirmation are required before therapeutic claims can be made.

8. Future Research

- Determine extractive yield and establish a validated chemical fingerprint/marker assay.
- Optimize extract concentration and polymer/surfactant levels using a defined experimental design.
- Compare multiple formulations and identify an optimized formulation using predefined quality attributes.
- Evaluate antifungal activity of the final emulgel against Candida albicans using validated microbiological methods.
- Perform ex-vivo skin permeation and retention studies using an appropriate biological membrane.
- Conduct skin irritation/sensitization and systemic toxicology studies as appropriate.
- Generate complete accelerated and long-term stability datasets.
- Conduct in-vivo efficacy studies before considering clinical translation.

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