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Short communication

Comparative development and antimicrobial evaluation of propolis-based topical creams using oil and ethanol extracts

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Introduction

Propolis is a sticky substance collected by bees from plants and used in the hive as a building material and defensive substance. Propolis is a natural substance with relatively well-documented antimicrobial and bioactive properties that are still being discussed in scientific circles and widely used in pharmaceutical and cosmetic formulations (Silva-Carvalho et al., 2015; Martinotti et al., 2025). This especially applies to formulations in which the activity, but also the stability, can be most appropriately assessed.

In our study, propolis originating from the Lesnovo region in northeastern Macedonia was used as the active substance for the development of a cream formulation for topical use.

The aim was to prepare and evaluate propolis extract topical formulation obtained using different extraction solvents and excipient compositions, in order to assess their microbiological properties.

Materials and methods

Preparation of Propolis Extract

Raw propolis (90 g) was frozen to facilitate handling and then extracted using two different solvents: extra virgin olive oil and 70% ethanol (300 mL each). The mixtures were stored in dark glass containers at room temperature for 20 days with daily stirring to enhance extraction efficiency. Subsequently, the samples were treated in an ultrasonic water bath at 55°C for 1 hour and 30 minutes, filtered through gauze and filter paper, and concentrated using a water bath at 55°C for 30 minutes.

Cream Formulation and Evaluation

Creams were prepared by separately forming oil and aqueous phases. The oil phase consisted of petrolatum, liquid paraffin, and stearic acid, heated to 70°C until homogeneous. The aqueous phase contained distilled water, glycerol, and Synthalen K, which was pre-hydrated and swelled before mixing. Both phases were emulsified at approximately 50°C, followed by incorporation of propolis extract.

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The final formulations were evaluated for pH (using dispersion in ultrapure water and pH meter analysis), microbiological quality (plate count agar and Sabouraud dextrose agar incubation), spreadability (parallel-plate method under different loads), and antimicrobial activity against *Staphylococcus aureus*, *Streptococcus pyogenes*, and *Candida albicans* by measuring inhibition zones over 21 days (Ramanauskiene et al., 2021).

Results and discussion

The prepared formulations showed successful incorporation of propolis extracts into homogeneous cream bases without visible phase separation. The extraction approach using both ethanol and oil-based solvents enabled the recovery of bioactive constituents known to contribute to the antimicrobial activity of propolis (Silva-Carvalho et al., 2015; Martinotti et al., 2025).

The creams demonstrated satisfactory characteristics for topical application, including appropriate spreadability, pH values compatible with skin application, and acceptable microbiological quality. Antimicrobial activity was evaluated against *Staphylococcus aureus*, *Streptococcus pyogenes*, and *Candida albicans*. Inhibition zones were measured 24 and 48 hours after application of the cream onto the inoculated agar media. The results indicated persistent antimicrobial activity throughout the observation period, suggesting sustained release and prolonged action of the active compounds present in the propolis extracts.

Differences in antimicrobial performance between formulations prepared with ethanol and oil extracts may be attributed to variations in the extraction efficiency of phenolic compounds, flavonoids, and other biologically active constituents. Ethanol is generally considered more effective for extracting phenolic substances, whereas oil extraction may facilitate the incorporation of lipophilic compounds into topical formulations (Ramanauskiene et al., 2021). The observed antimicrobial effects are consistent with previous reports describing the activity of propolis against Gram-positive bacteria and opportunistic fungi, primarily due to its rich content of flavonoids, phenolic acids, and aromatic compounds (Bankova et al., 2014; Silva-Carvalho et al., 2015).

Overall, the findings support the potential of propolis-based creams as natural topical formulations with antimicrobial properties and justify further investigations aimed at optimizing the formulation and evaluating long-term stability and clinical effectiveness.

Conclusion

The study demonstrates the successful preparation of propolis extract creams using two different extraction solvents and a standard emulsification process. The formulations were appropriate for further pharmaceutical evaluation, including pH, spreadability, microbiological quality, and antimicrobial efficacy. The results support the potential application of propolis-based topical formulations in pharmaceutical and cosmetic products.

References

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