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DEVELOPMENT AND PHYSICOCHEMICAL ANALYSIS OF THE *Cyrtocymura scorpioides* (Lam.) H. Rob EXTRACT AND ITS IN VITRO ANTIMICROBIAL EVALUATION

DESARROLLO Y ANÁLISIS FISICOQUÍMICO DEL EXTRACTO DE Cyrtocymura scorpioides (Lam.) H. Rob Y SU EVALUACIÓN ANTIMICROBIANA IN VITRO

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ABSTRACT

Background: Species of the Asteraceae family are being extensively investigated as prolific sources of bioactive compounds for dermatological applications, given the rising global demand for natural ingredients with a reduced environmental impact. **Aim**: The present study aimed to obtain and characterise the hydroalcoholic extract of *Cyrtocymura scorpioides* (known locally as Piracá) and to evaluate its antimicrobial activity against *Staphylococcus aureus*, *Escherichia coli*, *Candida albicans*, *Aspergillus niger* and *Trichophyton interdigitale*. **Methods:** Leaves and stems were collected and processed. The resulting extract

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was characterised in terms of pH, density, viscosity, and colour, following the ANVISA guidelines, and subsequently tested using an agar-based microbiological screening assay and a 96-well plate microdilution assay to determine the Minimum Inhibitory Concentration (MIC) and the Minimum Bactericidal/Fungicidal Concentrations (MBC/MFC). **Results:** The product exhibited a slightly acidic pH and physicochemical properties which were deemed compatible with cosmetic formulations. A bactericidal effect was observed against *S. aureus*, alongside partial growth inhibition of *E. coli*. For the fungi, fungistatic activity was confirmed against *C. albicans* and A. *niger*, with a fungicidal effect achieved against *T. interdigitale*. **Conclusions:** These findings indicate the presence of compounds possessing antimicrobial potential, thereby suggesting the feasibility of the *C. scorpioides* extract as a functional ingredient in topical cosmetic products.

Keywords: Botanical Extract; Piracá; Antimicrobial Agent; Topical Cosmetic Product.

RESUMEN

Introducción: *Las especies de la familia Asteraceae están siendo investigadas exhaustivamente como fuentes prolíficas de compuestos bioactivos para aplicaciones dermatológicas, dada la creciente demanda global de ingredientes naturales con un impacto ambiental reducido.* ***Objetivo:*** *El presente estudio tuvo como objetivo obtener y caracterizar el extracto hidroalcohólico de Cyrtocymura scorpioides (conocido localmente como Piracá) y evaluar su actividad antimicrobiana frente a Staphylococcus aureus, Escherichia coli, Candida albicans, Aspergillus niger y Trichophyton interdigitale.* ***Métodos:*** *Se recolectaron y procesaron hojas y tallos. El extracto resultante se caracterizó en* términos de pH, *densidad, viscosidad y color, siguiendo las directrices de ANVISA, y posteriormente se probó mediante un ensayo de cribado microbiológico en agar y un ensayo de microdilución en placa de 96 pocillos para determinar la Concentración* Mínima *Inhibitoria (CMI) y las Concentraciones* Mínimas Bactericida/Fungicida (CMB/CMF). ***Resultados:*** *El producto exhibió un pH ligeramente ácido y propiedades fisicoquímicas que se consideraron compatibles con formulaciones cosméticas. Se observó un efecto bactericida contra S. aureus, junto con una inhibición parcial del crecimiento de E. coli. Para los hongos, se confirmó la actividad fungistática contra C. albicans y A. niger, lográndose un efecto fungicida contra T. interdigitale.* ***Conclusiones:*** *Estos hallazgos indican la presencia de compuestos con potencial antimicrobiano, sugiriendo así la viabilidad del extracto de C. scorpioides como ingrediente funcional en productos cosméticos tópicos.*

Palabras Clave*: Extracto Botánico; Piracá; Agente Antimicrobiano; Producto Cosmético Tópico.*

INTRODUCTION

Industrialised cosmetic products have generated considerable environmental impacts over the past few decades (ALNUQAYDAN, 2024; YILMAZ, 2025), primarily due to the incorporation of synthetic substances and compounds that do not readily degrade in the environment (AMIRALIAN; FERNANDES, 2018; SOARES, 2020; ZUCCO; DE SOUSA; ROMEIRO, 2020; ALNUQAYDAN, 2024). Considering this scenario of environmental degradation and rising health concerns, an alternative has emerged and gained prominence: the consumption of natural cosmetics (KUCHARSKA, 2026). According to Euromonitor International (2019), the “natural” beauty trend has prompted an increase in the production of cosmetics formulated with naturally derived ingredients, aiming to minimise health risks and mitigate environmental impacts. Scientific advancements have revitalised research interest in the utilisation of medicinal plants, particularly as they represent accessible and low-cost alternatives. Numerous plant species have already demonstrated significant potential for cosmetic and therapeutic applications, exhibiting properties such as nourishing, conditioning, moisturising, anti-inflammatory, anti-acne, natural repellent, and after-sun effects, among others dedicated to skin and hair care (PIRES *et al*., 2017; MINTO *et al*., 2021; PIRES *et al*., 2021; OLIVEIRA *et al*., 2022; FERREIRA *et al*., 2024; PÉREZ-FLORES *et al*., 2025; KUCHARSKA, 2026). Despite these promising phytochemical profiles, the commercial application of this specific plant remains largely unexplored, highlighting the novelty of investigating its leaves and stems for new biotechnological applications.

The species *Cyrtocymura scorpioides* (Lam.) H. Rob. (syn. *Vernonia scorpioides* (Lam.) Pers.), which belongs to the Asteraceae family, is a medicinal plant indigenous to South America, more commonly known as "Piracá". This species has been extensively utilised in traditional medicine for the treatment of a variety of conditions, owing to its well-documented therapeutic properties. Notably, its antifungal potential is highlighted, including efficacy against different *Candida* species, in addition to its antibacterial activity against *Staphylococcus aureus*. This pharmacological profile positions "Piracá" as a promising candidate for scalp cleansing and the treatment of other dermal affections (DREUX *et al*., 2004; TOIGO *et al*., 2004; CAMARGO, 2020). Rauh *et al*. (2008), report that its phytochemical composition includes sesquiterpene lactones and flavonoids, which are constituents that have demonstrated anti-inflammatory activity in other studies. The incorporation of this botanical extract into cosmetic formulations can yield significant benefits for the health of the skin and its appendages. Furthermore, it offers a natural and effective alternative to conventional products, which frequently contain synthetic compounds associated with potential adverse effects (DREUX *et al*., 2004; PIRES *et al*., 2017; EUROMONITOR INTERNATIONAL, 2019; KUCHARSKA, 2026).

In this context, considering the established antimicrobial potential and anti-inflammatory activity of this plant (RAUH *et al*., 2008), the primary objective of this research was to extract the bioactive compounds present in the leaves and stems of *Cyrtocymura scorpioides*. Consequently, we sought to evaluate the in vitro microbiological activity of the isolated hydroalcoholic extract against a broad spectrum of microorganisms, including *Staphylococcus aureus*, *Escherichia coli*, *Candida albicans*, *Aspergillus niger*, and *Trichophyton interdigitale*, providing foundational data regarding its future potential for incorporation into cosmetic formulations. This investigation aims not only to explore the therapeutic potential of the C. *scorpioides* extract but also to contribute to the development of more natural and effective cosmetics, thereby aligning with the increasing market demand for products derived from plant-based active ingredients.

MATERIALS AND METHODS

PLANT MATERIAL AND EXTRACTION

Collection and Preparation

The plant material utilised in this study was identified by Prof. Dr. Rosangela Simão Bianchini, and a voucher specimen is deposited at the Herbarium of the Botanical Garden/Botanical Institute (IBOT-SP) under Voucher Number: SP 452867.

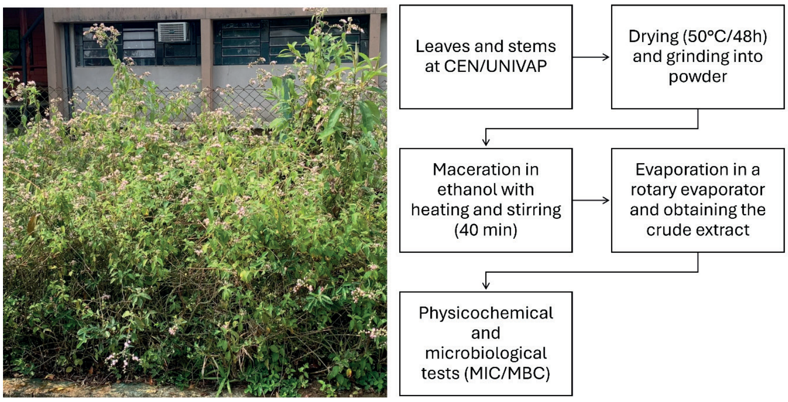
The initial project stage involved the collection of Piracá (Figure 1), which was carried out at the medicinal plant nursery of the Centre for Nature Studies at the University of Vale do Paraíba (CEN/UNIVAP). Leaves and stems were harvested manually and placed into paper bags for transportation. In the laboratory, the fresh material was separated by plant part and weighed, totalling 248.64 g of fresh material, comprising 60.29 g of stem and 188.35 g of leaves. Subsequently, the material was subjected to drying in an oven at 50°C for 48 hours, yielding 17.20 g of dried stem and 49.60 g of dried leaves. Following the drying process, the samples were macerated until a fine powder was obtained, ready for the extraction process.

Hydroalcoholic Extraction

To obtain the hydroalcoholic extract, 10 g of each dried plant part were macerated in ethanol with controlled heating and constant stirring for 40 minutes. The mixture was then filtered, and the concentrated extract was transferred to round-bottom flasks and subjected to hot extraction in a Buchi R-114 rotary evaporator (rotavapor) for solvent removal. The resulting crude extract was stored in amber vials under refrigeration until the microbiological analyses.

A subsample (aliquot) of the crude extract was transferred for drying in an oven, subsequently scraped, and aseptically packaged in sterile microtubes for use in the microbiological assays. For the microbiological tests, the extract was further dried in an oven at 40°C. The dried material was scraped using a sterile metal spatula and transferred to sterilised microtubes. The detailed stages of the plant collection at the CEN/UNIVAP nursery and the subsequent hydroalcoholic extraction procedures are visually summarized in Figure 1.

Figure 1 - Graphical representation of the study. Left: Specimen of *Cyrtocymura scorpioides* at the CEN/UNIVAP medicinal nursery. Right: Flowchart of the hydroalcoholic extraction process and subsequent microbiological evaluation.



Source: Authors, 2025.

Physicochemical Analysis

Following the extraction process of the compounds from the leaves and stems of *Cyrtocymura scorpioides*, physicochemical analyses of the obtained extract, including pH, density, viscosity, and colour, were performed. These analyses strictly followed the guidelines of the ANVISA Cosmetic Product Quality Control Guide (2008). Prior to measurements, the electrode was sanitised, and the Quimis brand pH meter was calibrated with buffer solutions according to Minto *et al.* (2021) and Pires *et al.* (2021). The material was kept stored in an amber bottle at a temperature of 7.5°C until the moment of analysis.

Qualitative Microbiological Evaluation (Agar Diffusion Method)

All materials utilised were pre-sterilised, and the experiments were conducted within a laminar flow cabinet. Three strains were selected for the initial screening: a Gram-positive bacterium (*Staphylococcus aureus* ATCC 6538), a Gram-negative bacterium (*Escherichia coli* ATCC 25922), a yeast *Candida albicans* (ATCC 10231), and the molds *Aspergillus niger* (ATCC 6275) and *Trichophyton interdigitale* (ATCC 9533). The agar diffusion technique, based on the work of Holder and Boyce (1994) with minor adaptations regarding inoculum standardisation and the precise volume pipetted into the agar wells, was employed. Inocula were prepared from isolated colonies, established by subculturing the bacteria on Tryptic Soy Agar (TSA) and the yeast on Sabouraud Dextrose Agar (SDA). Incubation times were 24 and 48 hours, respectively, in a Fanem A-lt oven at 36°C (± 1). The inocula of bacteria and yeast were standardised to the 0.5 McFarland scale 1.5 x 10^8 cells/mL in sterile 0.9% NaCl. Inocula of the filamentous fungi were prepared by pipetting 10 mL of sterile deionised water onto plates previously incubated for 7 days. Spore recovery was achieved by gently scraping the colonies with a sterile 10 µL loop. The resulting spore suspension was collected, filtered through sterile gauze, and quantified using a haemocytometer, establishing a final concentration between 8.0 x 10^5 e 1.20 x 10^6 spores/mL. Spore inoculation onto the agar was performed using the pour-plate method: 1.5 mL of the spore suspension was transferred to 50 mL of SDA maintained at 46°C ± 1°C, followed by homogenisation and subsequent transfer to 120 x 15mm Petri dishes until complete solidification.

Subsequently, the standardised inocula of the different microorganisms were uniformly spread onto the surface of plates containing Mueller-Hinton Agar (MHA) using a sterile swab. Four wells, approximately 5 mm in diameter, were created in each plate using a sterile straw. These wells were designated for the following groups: the negative control (sterile distilled water), the positive control (2.5% sodium hypochlorite or miconazole nitrate 20 mg/mL), the leaf extract, and the stem extract. Both extracts were tested at a concentration of 200 mg/mL, a value justified and established by preliminary trials regarding the maximum solubility limit of the dried extract in the chosen solvents. For the assay, 50 µL of the respective solutions were pipetted into their corresponding wells. Following complete diffusion of the solutions, the plates were incubated in a Fanem A-lt oven at 36°C (± 1) for 24 hours (for bacteria), 48 hours (for the yeast) or 7 days (for the filamentous fungi).

Determination of Minimum Inhibitory and Minimum Bactericidal/Fungicidal Concentrations (MIC/MBC/MFC)

For the quantitative determination of the hydroalcoholic extract's antimicrobial activity, adapted protocols from the Clinical and Laboratory Standards Institute (CLSI) 2018 guidelines (HUMPHRIES *et al.*, 2018) were utilised. Two independent assays were conducted in duplicate for each tested bacterial strain (*Staphylococcus aureus* ATCC 6538 and *Escherichia coli* ATCC 25922). The tests were performed in distinct weeks to counter the limited yield of the botanical extraction while ensuring the temporal reproducibility of the results. This decision to proceed only with the leaf extract and bacterial strains was made because the leaf extract demonstrated the best yield and superior antimicrobial action in the preliminary screening tests, allowing the focus to remain on the same category of microorganisms. Initially, the strains were subcultured in their respective culture media under the conditions previously mentioned. The bacterial inoculum was then prepared: an isolated colony of each microorganism was inoculated into 10 mL of Mueller-Hinton Broth (MHB) using a disposable loop and incubated for 18 hours at 36°C (± 1).

For the preparation of the extract at a concentration of 400 mg/mL, 400 mg of the dried leaf extract were weighed into sterile microtubes. To this, 950 µL of MHB and 50 µL (5%) of Dimethyl Sulfoxide (DMSO) were added. DMSO served as the solvent to promote dissolution of the extract, and the mixture was homogenised using a vortex mixer. The microdilution assay was conducted in 96-well plates. The first column received 100 µL of the dissolved extract, while the subsequent columns were filled with 50 µL of MHB. A serial dilution was then performed by transferring 50 µL sequentially across the plate, achieving an experimental range from 400 mg/mL to 0.78 mg/mL. Subsequently, 2.5 µL of the standardised inoculum were added to all wells. The final columns were reserved for the positive control (2.5% sodium hypochlorite or miconazole nitrate 20 mg/mL) and the negative control (culture medium plus inoculum and 5% DMSO). The inclusion of DMSO in the negative control confirmed that the solvent exerted no isolated antimicrobial activity. The plate was incubated at 36°C (± 1) for 16 to 20 hours.

To determine the Minimum Inhibitory Concentration (MIC) and Minimum Bactericidal Concentration (MBC) of the extract against the tested strains, a 3 µL aliquot from the wells was plated onto MHA (for bacteria) or SDA (for yeast), employing the spot plate method (or drop method). The plates were then incubated at 36°C (± 1) for 24 hours to verify the complete, partial, or absence of microbial growth for the final determination of MBC/MIC.

RESULTS

The physicochemical analysis performed on the extracts obtained from the stem and leaves of *Cyrtocymura scorpioides* revealed differences in the evaluated properties (Table 1). The pH values exhibited a slightly acidic range for both extracts, registering 5.46 for the stem extract and 5.62 for the leaf extract. The colouration varied from light-green (stem) to yellowish-green (leaves), and both extracts remained in the liquid state at ambient temperature. The viscosity was determined to be 0.9019 mPa.s for the stem extract and 1.5068 mPa.s for the foliar extract. Concurrently, the density values were 0.74 g/mL and 0.84 g/mL, respectively.

Table 1 - Physicochemical parameters of the *Cyrtocymura scorpioides* stem and leaf extracts.

Parameter	Stem Extract	Leaf Extract
pH	5.46	5.62
Colouration	Light-green	Yellowish-green
Physical state	Liquid	Liquid
Viscosity (mPa.s)	0.9019	1.5068
Density (g/mL)	0.74	0.84

Source: Authors (2025).

In the qualitative microbiological evaluation, the extract was observed to exhibit antimicrobial activity against all three bacterial and yeast microorganisms studied. Total inhibition zones (characterised by the complete absence of microcolonies) were observed against *Staphylococcus aureus*, while partial inhibition zones (indicating the presence of microcolonies) were recorded for both *Escherichia coli* and *Candida albicans*. Additionally, against the filamentous fungus *Trichophyton interdigitale*, the formation of a total zone of inhibition was observed, which is indicative of a fungicidal effect. For *Aspergillus niger*, the formation of a partial inhibition zone was obtained, noting the absence of aerial mycelium development and fruiting bodies, which characterises a fungistatic effect. The measured diameters of these zones of inhibition are presented in Table 2.

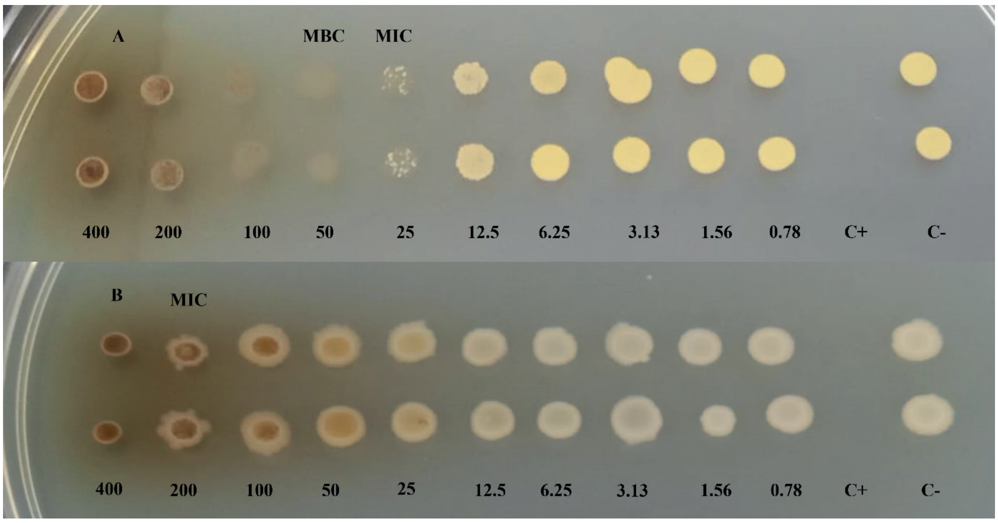
Table 2 - Diameters of the inhibition zones (in millimetres) of the *Cyrtocymura scorpioides* hydroalcoholic stem and leaf extracts.

Microorganism	2.5% Sodium Hypochlorite or Miconazole nitrate 20 mg/mL (Positive Control)	Leaf Extract	Stem Extract
Staphylococcus aureus ATCC 6538	27.00	18.00	15.00
Escherichia coli ATCC 25922	28.00	10.00	08.00
Trichophyton interdigitale ATCC 9533	30.00	15.00	0.00
Aspergillus niger ATCC 6275	14.00	20.00	0.00
Candida albicans ATCC 10231	35.00	21.00	09.00

Source: Authors (2025).

The quantitative microdilution assays facilitated the determination of the Minimum Inhibitory Concentrations (MIC) and Minimum Bactericidal Concentrations (MBC) for the bacterial strains tested (Figure 2). For *S. aureus*, the MBC was observed at a concentration of 50 μL/mL, and the MIC was determined at 25 μL/mL. Conversely, for *E. coli*, an MBC was not achieved, with the MIC being determined at 200 μL/mL. These findings unequivocally confirm the antimicrobial activity of the extract, particularly against the Gram-positive strain, and indicate the presence of bioactive compounds with significant potential for application in cosmetic formulations designed for antimicrobial action.

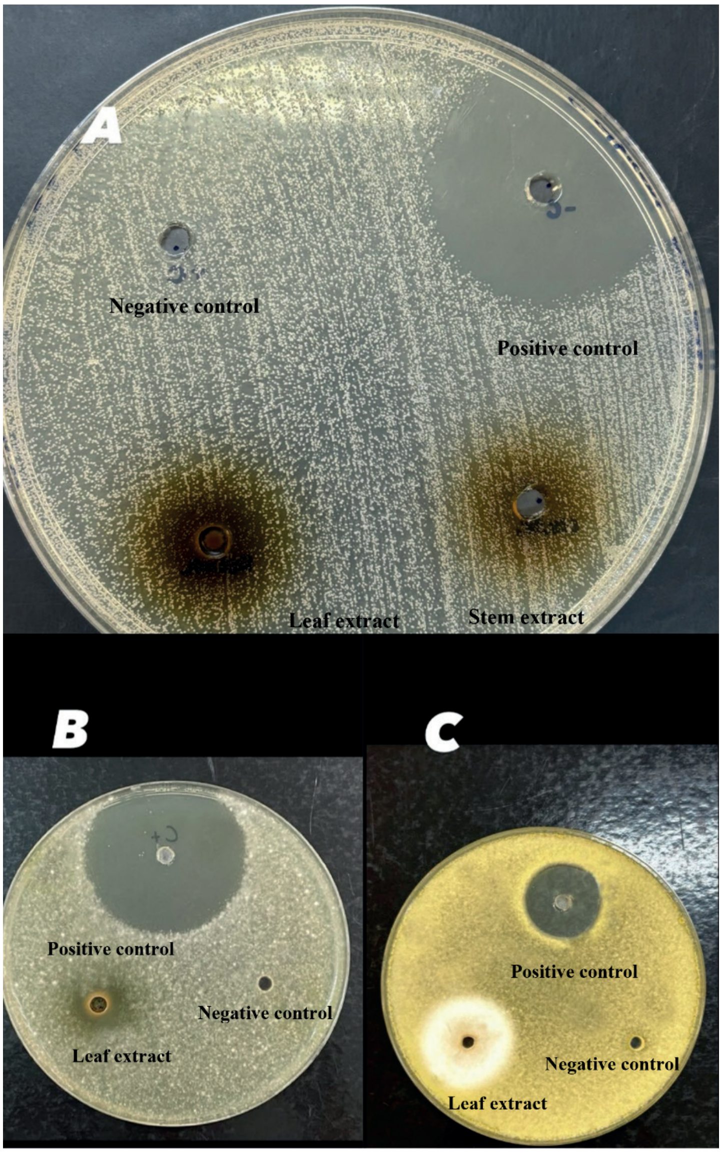
Figure 2 - Subculture results of the microorganisms challenged with *the Cyrtocymura scorpioides* hydroalcoholic extract, illustrating the determination of MIC and MBC. **A**: *Staphylococcus aureus*. **B**: *Escherichia coli*.



Source: Authors, 2025; **Extract Concentration Range**: (400 - 0,78) mg/mL; **C+** (Positive Control): 2.5% Sodium Hypochlorite; **C-** (Negative Control): Mueller-Hinton Broth with a 16 to 20-hour culture of the tested bacteria; **MBC**: Minimum Bactericidal Concentration; **MIC**: Minimum Inhibitory Concentration.

Given that the leaf extract demonstrated superior antimicrobial efficacy, it was selected for the subsequent evaluation against the filamentous fungi. In the qualitative evaluation, the extract exhibited a fungistatic effect against the yeast *Candida albicans* (Figure 3A), characterised by partial growth inhibition. Against the filamentous fungus *Trichophyton interdigitale* (Figure 3B), the formation of a total zone of inhibition was achieved, which is indicative of a fungicidal effect. For *Aspergillus niger* (Figure 3C), a partial inhibition zone was obtained, with the notable absence of aerial mycelium development and fruiting bodies, which characterises a fungistatic effect.

Figure 3 - Qualitative evaluation of the extracts. A: *Candida albicans* ATCC 10231 showing partial inhibition (fungistatic); B: *Trichophyton interdigitale* ATCC 9533 showing a total zone of inhibition (fungicidal); C: *Aspergillus niger* ATCC 6275 exhibiting absence of aerial mycelium. Positive Control (C+): Miconazole nitrate; Negative Control (C-): sterile distilled water with DMSO 5%.



Source: Authors, 2025; Positive Control: Miconazole nitrate 20 mg/mL; Negative Control: sterile distilled water with DMSO 5%. In the wells created in A, B, and C, the formed zone of inhibition for the leaf extract can be clearly observed, contrasting with the stem extract well, in A which demonstrated lower antimicrobial efficacy.

DISCUSSION

The physicochemical analysis of the extract in the present investigation demonstrated characteristics compatible with cosmetic formulations, specifically exhibiting an appropriate viscosity and density. The slightly acidic pH obtained is consistent with the profile commonly reported for extracts of the Asteraceae family, often attributed to the natural presence of organic acids (AMIRALIAN; FERNANDES, 2018; SOARES, 2020; ASTUTI *et al*., 2021; KUCHARSKA, 2026). Silva *et al.* (2022) conducted a systematic review concerning the evaluation of chemical risks associated with the irrational use of dermatological formulations containing acids. They highlighted that acidic compounds are common in cosmetic formulations but may potentially cause irritation, excessive drying, stinging, photosensitivity, and burning, sometimes leading to dermal lesions resulting from unrecommended or misuse of such products. This context underscores the critical importance of the slightly acidic pH obtained in the present study. Notwithstanding, longer-term physicochemical evaluation periods for the developed Piracá extract are suggested. Crucially, the organoleptic and physicochemical parameters determined for the developed product were entirely consistent with the guidelines stipulated in the National Health Surveillance Agency (ANVISA) Cosmetic Product Quality Control Guide (ANVISA, 2008).

The antimicrobial performance of *Cyrtocymura scorpioides* observed in this study can be attributed to the presence of sesquiterpene lactones, flavonoids, and tannins. These classes of secondary metabolites are well-recognised for their ability to inhibit cell wall synthesis and interfere with the quorum sensing communication of dermal pathogens, and they are commonly occurring substances within the Asteraceae family (KOH *et al*., 2013; SOKOVIC *et al*., 2017; PÉREZ-FLORES *et al*., 2025). This phytochemical profile brings “Piracá” close to other species of the Asteraceae family, such as *Baccharis dracunculifolia* and *Vernonia polyanthes*, which are traditionally used in herbal preparations for antiseptic, anti-inflammatory, and wound-healing purposes (TEMPONI *et al*., 2012; DE SOUZA *et al*., 2017; ARMSTRONG *et al*., 2024). The compositional similarity suggests that the extract’s microbicidal mechanism of action may involve both the disruption of microbial membranes and the precipitation of proteins, thereby justifying the greater susceptibility observed in Gram-positive strains, such as S. *aureus* (KOH *et al*., 2013; PÉREZ-FLORES *et al*., 2025).

Camargo (2020) also cites that the bioactive metabolites commonly found in species of the genus *Cyrtocymura* belong to the classes of sesquiterpene lactones, polyacetylenes, flavonoids, triterpenoids, and steroids. Through dereplication of active extracts, their study reported specific efficacy against *Candida spp.* and *Trichomonas vaginalis*, thereby corroborating our findings regarding the plant’s robust microbiological potential. The scarcity of further advanced clinical studies concerning *C. scorpioides* emphasizes the pioneering nature of the present evaluation. Another relevant point is the anti-inflammatory potential of Piracá, which has been documented in experimental models by Dreux *et al.* (2004). They described a significant reduction in oedema and cellular infiltrate in tissues subjected to extracts of *Vernonia scorpioides*. This activity suggests that, beyond the antimicrobial effect, the inclusion of the extract in cosmetic formulations could mitigate mild inflammatory processes, such as erythema or post-procedure irritations, consequently increasing its applicability in multifunctional products. The synergy between antimicrobial action and inflammatory modulation reinforces the feasibility of its use in topical preparations aimed at the management of acne-prone skin and the prevention of secondary infections. Finally, when considering market trends and the demand for natural products, Piracá presents competitive advantages related to sustainability and the valorisation of native species. Controlled cultivation and the standardisation of extracts enable the obtaining of ingredients with a reduced environmental impact and full traceability, thus aligning with Good Manufacturing Practice guidelines and the principles of "green cosmetics" (VILA FRANCA; UENO, 2020).

The current study has demonstrated that the Piracá extract exhibited a significant bactericidal effect against *Staphylococcus aureus*, a Gram-positive microorganism frequently associated with cutaneous infections. Toigo *et al.* (2004) investigated the fluid extract of *Vernonia scorpioides* (Lam.) Pers. and confirmed its microbicidal efficacy against S. *aureus*, *Escherichia coli* and *Candida albicans*, observing inhibition zones proportional to the volumes of the tested extract. This observation is highly consistent with the results of the present study and indicates that compounds present in species of this family play an important role in both antimicrobial and fungicidal activities. Moreover, in our studies, antimicrobial action of Piracá was also observed against *Trichophyton interdigitale* and *Aspergillus niger*.

Furthermore, studies reinforce the relevance of applying botanical extracts with antimicrobial activity in cosmetic research (MINTO *et al*., 2021; PIRES *et al*., 2021). For instance, Ferreira *et al.* (2024) developed a liquid soap based on cannabidiol essential oil and demonstrated its efficacy against standard ATCC bacterial strains, analogous to the methodological scope proposed by the present study. Similarly, Oliveira *et al.* (2022) formulated soaps with *Bidens pilosa* extract specifically for neonatal care, thereby evidencing the safety and functionality of plant compounds in skin products. This evidence supports the antimicrobial potential of the Piracá extract as an active ingredient.

The data observed in the present study, in conjunction with the theoretical underpinning derived from scientific literature, collectively reinforce the significance of investigating and valorising plant extracts possessing antimicrobial potential. Crucially, this work establishes Piracá as a promising natural active ingredient for future applications in antimicrobial cosmetic formulations, highlighting the relevance of medicinal plant research for the development of sustainable and effective solutions in both the health and cosmetological fields. While further studies concerning dermal toxicity, safety, and photostability are strictly necessary to advance the development of commercial prototypes, the findings of this investigation consolidate the Piracá extract as a promising candidate possessing high market appeal for antimicrobial formulations.

CONCLUSION

The hydroalcoholic extract of *Cyrtocymura scorpioides* demonstrated physicochemical parameters compatible with cosmetic products for topical application and exhibited measurable antimicrobial activity. The extract showed superior efficacy against the Gram-positive bacterium *Staphylococcus aureus* and achieved a fungicidal effect against *Trichophyton interdigitale*, while also showing activity against *Candida albicans* and *Aspergillus niger*. These results confirm the presence of bioactive compounds possessing an antimicrobial effect, thereby evidencing its potential for utilisation as a functional ingredient in cosmetic formulations with an antiseptic function. The utilisation of native species from the Asteraceae family in dermatological products reinforces the relevance of phytochemical investigations aimed at developing natural alternatives with a reduced environmental impact. Complementary studies focusing on toxicity, stability, and extract standardisation are necessary to fully establish safety and efficacy parameters prior to incorporation into commercial prototypes.

REFERENCES

AGÊNCIA NACIONAL DE VIGILÂNCIA SANITÁRIA (ANVISA). **Guia de controle de qualidade de produtos cosméticos / Agência Nacional de Vigilância Sanitária**. 2ª edição, revista - Brasília: Anvisa, 2008.

ALNUQAYDAN A.M. The dark side of beauty: an in-depth analysis of the health hazards and toxicological impact of synthetic cosmetics and personal care products. **Front Public Health**. 2024 Aug 26;12:1439027. doi: 10.3389/fpubh.2024.1439027. PMID: 39253281; PMCID: PMC11381309.

AMIRALIAN, L.; FERNANDES, C. R. Fundamentos da Cosmetologia. **Cosmetics & Toiletries, Osasco, SP**, v. 30, 2018.

ARMSTRONG, L. *et al. Baccharis dracunculifolia* DC. A Review of Research Advances From 2004 to 2024, With New Micromorphology and Essential Oil Investigations. **Journal of Herbal Medicine**, v. 48, p. 100952, 2024.

ASTUTI, E.; RAHAYU, A.; SULISTIAWATI, E. *et al.* Effect of Time and Reaction Speed on Making Liquid Soap in Terms of Viscosity and Density Values. **CHEMICA Jurnal Teknik Kimia**. 8(1):39, 2021.

VILA FRANCA, C. C.; UENO, H. M. Green cosmetics: perspectives and challenges in the context of green chemistry. **Desenvolvimento e Meio Ambiente**, v. 53, n. ja/ju 2020, p. 133-150, 2020.

CAMARGO, J.G.S. **Desreplicação dos extratos ativos de *Cyrtocymura scorpioides* (Asteraceae) contra *Candida* spp. e *Trichomonas vaginalis***. 2020. Mestrado - Universidade Estadual Paulista, São José do Rio Preto, 2020. Disponível em: https://repositorio.unesp.br/entities/publication/d714a-318-a83c-4d68-b21a-4657cd3995fe

DE SOUZA, P. V. R. *et al. Vernonia polyanthes* (Spreng.) Less.: uma visão geral da sua utilização como planta medicinal, composição química e atividades farmacológicas. **Revista Fitos**, v. 11, p. 105-115, 2017.

DREUX, E. C.; JUNIOR, A. C. P.; ÁLVARO, R. B. *et al.* **Avaliação do efeito anti-inflamatório do extrato hidroalcoólico de** *Vernonia scorpioides* (lam) Persons **em edema de pata em ratos**. VII Encontro Latino-Americano de Iniciação Científica e IV Encontro Americano de Pós-Graduação - Universidade do Vale do Paraíba, 2004.

EUROMONITOR INTERNATIONAL. **Natural and Organic Beauty: A Price Segmentation Analysis**. Londres, Reino Unido. Disponível em: https://www.euromonitor.com/article/natural-vs-organic-beauty-a-price-segmentation-analysis, 2019.

FERREIRA *et al.* **Desenvolvimento do sabonete líquido a base de óleo essencial de canabidiol e avaliação in vitro do óleo em cepa ATCC**. XXVIII Encontro Latino-Americano de Iniciação Científica. São José dos Campos, 2024.

HUMPHRIES, R. M. *et al.* CLSI methods development and standardization working group best practices for evaluation of antimicrobial susceptibility tests. **Journal of clinical microbiology**, v. 56, n. 4, p. 10.1128/jcm. 01934-17, 2018.

HOLDER I.A.; BOYCE S.T. Agar well diffusion assay testing of bacterial susceptibility to various antimicrobials in concentrations non-toxic for human cells in culture. **Burns**. vol. 20, n.5, p.426-429, 1994.

KOH, CHONG-LEK *et al.* Plant-derived natural products as sources of anti-quorum sensing compounds. **Sensors**, v. 13, n. 5, p. 6217-6228, 2013.

KUCHARSKA, E. Recent Progress in Fermentation of *Asteraceae* Botanicals: Sustainable Approaches to Functional Cosmetic Ingredients. **Appl. Sci**. *16*, 283. 2026. https://doi.org/10.3390/app16010283

MINTO, L. F. *et al.* Desenvolvimento de Sabonete Líquido Antisséptico à Base de Óleos Essenciais de *Melaleuca alternifolia*, *Schinus terebenthifolius* e *Rosmarinus officinalis*. **Cadernos Camilliani** e-ISSN: 2594-9640, v. 17, n. 4, p. 2338-2354, 2021.

OLIVEIRA, A. A. *et al.* Sabonete líquido com extrato de picão (*Bidens pilosa linn*) para o cuidado de recém-natos com icterícia neonatal. **Revista Científica FACS**, v. 22, n. 2, p. 18-29, 2022.

PÉREZ-FLORES, J. G. *et al.* Plant antimicrobial compounds and their mechanisms of action on spoilage and pathogenic bacteria: A bibliometric study and literature review. **Applied Sciences**, v. 15, n. 7, p. 3516, 2025.

PIRES, V. R. *et al.* Desenvolvimento de um sabonete líquido a partir do extrato da casca do fruto da pitomba (*Talisia esculenta*). **Research, Society and Development**, v. 10, n. 15, p. e325101522791-e325101522791, 2021.

PIRES, L. K. S.; GRISOTTO, M. G.; GRISOTTO, R. F. O uso de plantas da Amazônia na produção de bioprodutos para tratamentos de pele. **Revista de Investigação Biomédica**, v. 9, n. 1, p. 78-88, 2017.

RAUH, L. K.; OTUKI, M. F.; CABRINI, D. A. **Avaliação da atividade anti-inflamatória tópica da** *Vernonia scorpioides* (Lam) Persons **em modelos de inflamação cutânea em camundongos**. Dissertação desenvolvida no Departamento de Farmacologia do Setor de Ciências Biológicas da Universidade Federal do Paraná durante o Curso de Pós-graduação em Farmacologia, como requisito parcial para a obtenção do título de Mestre em Farmacologia, 2008.

SILVA, B. I. O. F.; OLIVEIRA, M. E. V.; MESQUITA, A. C. T. **Avaliação dos riscos químicos ao uso irracional de formulações dermatológicas contendo ácidos: revisão sistemática**. Trabalho de Conclusão de Curso (Farmácia) - Faculdade Pernambucana de Saúde, Recife, 2022.

SOARES, V. **Cosméticos naturais e orgânicos: uma opção de inovação sustentável**. Trabalho de Conclusão de Curso apresentado ao Curso de Engenharia Química do campus I da Universidade Federal da Paraíba. João Pessoa, 2020.

SOKOVIC, M. *et al.* Biological activities of sesquiterpene lactones isolated from the genus *Centaurea* L. (Asteraceae). **Current Pharmaceutical Design**, v. 23, n. 19, p. 2767-2786, 2017.

TEMPONI, V. S. *et al.* Antinociceptive and anti-inflammatory effects of ethanol extract from *Vernonia polyanthes* leaves in rodents. **International Journal of Molecular Sciences**, v. 13, n. 3, p. 3887-3899, 2012.

TOIGO, L.; OLIVEIRA, R. F.; OLIVEIRA, F.; MARQUES, M. O. M. Caracterização farmacobotânica, estudo do óleo essencial e atividade antimicrobiana da erva de São Simão *Vernonia scorpioides* (Lam.) Pers. **Revista Brasileira de Farmácia**, v. 85, n. 2, p. 49-55, 2004.

YILMAZ, D. Sustainability in the Cosmetics Industry: Environmental Impacts, Statistics, and Solutions. In **Current Approaches in Applied Statistics** I; TAHTALI, Y., DEMIR, İ., BAYYURT, L., EDS.; ÖZGÜR YAYINLARI: ISTANBUL, Turkey, 2025. ISBN 9786255646941. DOI: 10.58830/ozgur.pub862.c3490.

ZUCCO, A.; DE SOUSA, F. S.; ROMEIRO, M.C. Cosméticos naturais: uma opção de inovação sustentável nas empresas. **Brazilian Journal of Business**, v. 2, n. 3, p. 2684-2701, 2020.