

POTENTIAL OF HUD OF *EUPHORBIA TIRUCALLI* AS A BIOINDICATOR IN RESEARCH FOR ENVIRONMENTAL TECHNOLOGY

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ABSTRACT

Background: *Euphorbia tirucalli* is an African species with a cosmopolitan distribution. In highly saline soils, it produces aromatic diterpene esters, which induce oxidative stress and are corrosive at room temperature and locally. Natural products that cause local oxidative stress are important as degraders of persistent materials in nature. Thermoplastic polymers become flexible when heated and return to a solid state when cooled, making them remouldable, making them advantageous for reuse, similar to the process used in the manufacture of PET bottles. Polypropylene (PP) is a crystalline resin with high chemical resistance, tensile strength, acid-base attack, and heat deformation. It can burn without flame, is transparent, has a short drying time, and its shrinkage varies between 1.5 and 3.0%. We know that films, bottles, and hospital materials persist in nature, causing problems such as solid waste.

Objective: To qualitatively evaluate the bioprocess of the bioproduct obtained during the pharmacotechnical process of ultradilution and succussion of *E. tirucalli* mother tincture - HUD 15CH (elicitor agent) on PP at room temperature.

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Methodology: It was applied 0.2 mL to a PP surface (30 units with three repetitions), and a time and retractile activity curve was established. For the qualitative evaluation of the physicochemical effect of the bioproduct on PP, scales adjusted for this material were adopted, in accordance with the literature: Regarding speed: immediate, as well as mediate term: short (<2 hours), medium (2 to 3 hours), and long term (>3 hours). Regarding the intensity of contraction: Low (<2.5%), Medium (2.5%), High (>3.0%).

Results: There was little shrinkage, low intensity contraction (<2.5%) in the long term, with no apparent degradation or damage to the surface.

Discussion: These preliminary results will possibly favor reuse. The continuous thermal conductivity of the materials likely influenced the long cooling time, leading to shrinkage and twisting. Therefore, the pharmacotechnical process employed as a bioproduct in the Plant Biotechnology trial suggests potential application in the bioeconomy, initiating the degradation of polypropylene plastic, facilitating its reuse and perhaps decontamination, potentially making it sustainable.

Conclusion: Preliminary results are promisors. The research methodology will be refined to repeat this trial, establishing a high-dilution and digestive activity curve.

Keywords: Environmental Technology. Propylene. High Ultradiluted and Dynamized Solution. *Euphorbia tirucalli*. Potential Bioindicator of Digestore Action.

POTENCIAL DO HUD DE *EUPHORBIA TIRUCALLI* COMO BIOINDICADOR EM PESQUISAS DE TECNOLOGIA AMBIENTAL

RESUMO

Introdução: *Euphorbia tirucalli* é uma espécie africana, que ganhou distribuição cosmopolita. Em solos de alta salinidade, produz ésteres diterpênicos de cadeias aromáticas, indutores de estresse oxidativo, corrosivos à temperatura ambiente e a nível local. Produtos naturais que provocam estresse oxidativo local têm relevância como degradadores de materiais persistentes na natureza. Os polímeros termoplásticos quando aquecidos, tomam-se flexíveis e retomam ao estado sólido quando resfriados, tornando-se remoldáveis, sendo vantajoso para o reuso, semelhante ao processo feito na fabricação de garrafas PET. O polipropileno (PP) é resina cristalina de elevada resistência química, à tração, a ataques ácido-base, à deformação pelo calor, pode arder sem chama, é transparente, possui pouco tempo de secagem e a sua contração varia entre 1,5 a 3,0%. Sabemos que filmes, garrafas materiais hospitalares persistem na natureza, causando transtornos como resíduos sólidos.

Objetivo: Avaliar qualitativamente o bioprocesso, do bioproduto obtido durante o processo farmacotécnico de ultradiluição e sucussão de tintura-mãe de *E. tirucalli* – SUD 15CH (agente elicitor) sobre PP à temperatura ambiente.

Metodologia: Aplicou-se 0,2mL em uma superfície de PP (30 unidades com três repetições), e uma curva de tempo e de atividade retrátil foi estabelecida. Para avaliação qualitativa do efeito físico-químico do bioproduto sobre o PP escalas ajustadas para este material foram adotadas, em acordo com a literatura: Quanto à velocidade: imediata, além de mediata de prazo: curto (< 2 horas), médio (2 a 3 horas) e longo prazo (> 3 horas). Quanto à intensidade de contração: Baixa (< 2,5%), Média (2,5%), Alta (> 3,0%).

Resultados: Ocorreu pouca retração, contração de baixa intensidade ($< 2,5\%$) a longo prazo, sem aparente degradação nem dano à superfície.

Discussão: Estes resultados preliminares possivelmente favorecerão o reuso. Possivelmente ocorreu condutibilidade térmica contínua dos materiais influiu no tempo longo de resfriamento, propiciando encolhimento e retorção. Portanto, o processo farmacotécnico empregado como bioproduto em ensaio de Biotecnologia Vegetal, sugere ter possível aplicação em bioeconomia, dando o início à degradação de plástico feito com polipropileno, facilitando seu reuso, e talvez, descontaminação, com probabilidade de torná-lo sustentável.

Conclusão: Os resultados preliminares são promissores. A metodologia de pesquisa será refinada para repetição deste ensaio estabelecendo-se curva de altas diluições e de atividade digestora.

Palavras-chave: Tecnologia Ambiental. Propileno. Solução Ultradiluída e Dinamizada. *Euphorbia tirucalli*. Potencial Bioindicador de Ação Digestora.

POTENCIAL DEL HUD DE EUPHORBIA TIRUCALLI COMO BIOINDICADOR EN LA INVESTIGACIÓN DE TECNOLOGÍA AMBIENTAL

RESUMEN

Antecedentes: *Euphorbia tirucalli* es una especie africana con una distribución cosmopolita. En suelos altamente salinos, produce ésteres diterpénicos aromáticos, que inducen estrés oxidativo y son corrosivos a temperatura ambiente y localmente. Los productos naturales que causan estrés oxidativo local son importantes como degradadores de materiales persistentes en la naturaleza. Los polímeros termoplásticos se vuelven flexibles al calentarse y vuelven a su estado sólido al enfriarse, lo que los hace remodelables y, por lo tanto, ventajosos para su reutilización, similar al proceso utilizado en la fabricación de botellas de PET. El polipropileno (PP) es una resina cristalina con alta resistencia química, resistencia a la tracción, ataque ácido-base y deformación térmica. Puede arder sin llama, es transparente, tiene un tiempo de secado corto y su contracción varía entre el 1,5 y el 3,0 %. Sabemos que las películas, las botellas y los materiales hospitalarios persisten en la naturaleza, causando problemas como los residuos sólidos.

Objetivo: Evaluar cualitativamente el bioproceso del bioproducto obtenido durante el proceso farmacotécnico de ultradilución y sucusión de tintura madre de *E. tirucalli* - HUD 15CH (agente elicitor) sobre PP a temperatura ambiente.

Metodología: Se aplicaron 0,2 mL a una superficie de PP (30 unidades con tres repeticiones) y se estableció una curva de actividad retráctil y de tiempo. Para la evaluación cualitativa del efecto fisicoquímico del bioproducto sobre PP, se adoptaron escalas ajustadas para este material, de acuerdo con la literatura: en cuanto a velocidad: inmediata, y a mediano plazo: corto (< 2 horas), medio (2 a 3 horas) y largo (> 3 horas). En cuanto a la intensidad de contracción: baja ($< 2,5\%$), media (2,5%), alta ($> 3,0\%$).

Resultados: Se observó poca contracción, contracción de baja intensidad ($< 2,5\%$) a largo plazo, sin degradación ni daño aparente en la superficie.

Discusión: Estos resultados preliminares posiblemente favorezcan la reutilización. La conductividad térmica continua de los materiales probablemente influyó en el largo tiempo de enfriamiento, lo que provocó contracción y torsión. Por lo tanto, el proceso farmacotécnico empleado como bioproducto en

el ensayo de biotecnología vegetal sugiere una posible aplicación en la bioeconomía, iniciando la degradación del plástico de polipropileno, facilitando su reutilización y posiblemente su descontaminación, lo que podría hacerlo sostenible.

Conclusión: Los resultados preliminares son prometedores. Se perfeccionará la metodología de investigación para repetir este ensayo, estableciendo una curva de alta dilución y actividad digestiva.

Palabras clave: Tecnología Ambiental. Propileno. Solución Ultradiluida y Dinamizada. *Euphorbia tirucalli*. Posible Bioindicador de la Acción Digestiva.

1 INTRODUCTION

The economic and eco-socio-environmental use of natural products is a perspective in plant biotechnology with favorable results applied to contemporary society, especially applicable to peripheral communities, indigenous peoples, ethnic groups, as well as refugees, environmentally displaced people and those in war-torn regions (Wasim et al., 2020; 2022).

In this sense, *Euphorbia tirucalli*, a xerophilic and halophytic species, whose family and genus have existed on the planet since Pangea and is adaptable to inhospitable conditions, including dry soil poor in nitrogen (Valle, 1999 In Delaunay de Souza et al., 2025; 2025a).

After the development of laboratory investigations upon the antifungal effects of *E. tirucalli* (Gaspar et al., 2023), a cycle of studies were initiated about the phytoremediation potential of this species in periods of climatic uncertainty, besides possible mechanisms involved, resulting to date in the possible use as an indicator marker of variations (Varricchio et al., 2020; 2020a) and environmental contamination of water (Kathar et al., 2023; Gaspar et al., 2023a), soil (Varricchio et al., 2025; Delaunay de Souza et al., 2025a), and also air in domestic environments (Rebelo et al., 2025), remembering the statistical importance of diagnoses of environmental diseases (WHO, 2022).

Considering the literature's description of its irritant and caustic properties, as well as the use of High Ultradiluted and Dynamized Solutions (HUDS) or High Dilutions Succussions (HDS) in agricultural sciences (Gaspar et al., 2025), while basic researchers are investigating the mechanisms of the pharmacotechnical process, the potential mitigation of these harmful effects of the HDS plant was considered. The question arose whether the ultradilution and dynamization process could contribute in some way to this mitigation, as a novel chapter in research.

The objective of this brief communication is to show the possibility of inserting HUDS into research methodologies already known and widespread, such as those for the reuse of plastic, whose accumulations are so harmful to nature and human health, due to its widespread use, polypropylene (PP-5) (Freire Souza Silva et al., 2023), as yet another resource with innovative potential that can be closely and rationally monitored in a simple, perhaps safe, way of handling to provide circular economy.

2 METHODOLOGY

Polypropylene (PP - 5) was cut into 1.5 x 1.5 cm segments organized into groups of 3, arranged in quadruplicates (N = 12) per solution, totaling 120 segments arranged in three aluminum trays. Then, 0.2 mL of control solution (no. 1) and test solutions (2 to 10) was applied to each cut PP surface. Next, a time and activity curve was established (Freire Souza Silva et al., 2023).

HUD 15CH was prepared from the mother tincture of *Euphorbia tirucalli* collected at 9:00 a.m. from the garden in Seropedica, Rio de Janeiro, using the Hahnemannian multiple vial process. This tincture was obtained for this experiment only, in a teaching pharmacy. 0.2 mL of this SUD 15CH was applied to a PP surface (30 units with three repetitions, and a time and retractile activity curve was established.

For the qualitative evaluation of the physicochemical effect of the test solution on PP, scales adjusted for this material were adopted, in accordance with the literature: Regarding speed: immediate, in addition to mediate term: short (< 2 hours), medium (2 to 3 hours) and long term (> 3 hours). Regarding the contraction intensity: Low (< 2.5%), Medium (2.5%), High (> 3.0%)(Freire Souza Silva et al., 2023).

3 RESULTS

No corrosive effect was observed within 24 hours. After 1 week in the solution, there was little shrinkage, low-intensity contraction (<2.5%) in the long term, with no apparent degradation or surface damage. The materials' continued thermal conductivity influenced the long cooling time, as it led to slight shrinkage and warping.

Unlike the activity of *E. tirucalli* bioproducts used in contaminated disposable waste for bioremediation (Delaunay et al., 2023), they became resinous after 24 hours. The ultradilution and succussion process in dehydrated latex likely intensified their gum and potent adhesive action (Wendling da Silva et al., 2019).

The tested solutions (HUD) were not immediately corrosive to plastics, meaning they did not act within the first 24 hours. However, their actions were persistent, with the chemical interaction continuing for a week, demonstrating a growing "ironing" action similar to that observed of the bioproduct obtained from the fermentation of *E. tirucalli latex*, a parchment-like substance with potential for paper recovery for reuse, a potential that favors environmental preservation. It also exhibited a slight plastic-digesting action, similar to that reported by Delaunay de Souza et al. (2023, 2023a).

Therefore, despite the extreme dilution, activity was maintained. Furthermore, the ultradilution and succussion process also suggested it could reduce toxicity and erosivity, favoring the enzymatic lysis of isopropylene plastic 5 (IPP-5) digestion process, our research model, which is currently being refined.

4 DISCUSSION

Thermoplastic polymers become flexible when heated and return to a solid state when cooled, making them remouldable, making them advantageous for reuse, similar to the process used in the manufacture of PET bottles. Polypropylene (PP) is a crystalline resin with high chemical resistance, tensile strength, acid-base resistance, and heat deformation. It can burn without flame, is transparent, has a short drying time, and its shrinkage varies between 1.5 and 3.0%. It is known that films, bottles, and hospital materials persist in nature, causing problems such as solid waste.

Since the high ultradilution and succussion process did not erode the plastic, so it could act as a bioproduct and allows human handling of this waste with the use of gloves, enabling reuse by vulnerable groups with less access to recycling, such as those living along the African coast, who frequently receive containers arriving by sea containing disposable plastic materials (whose may contain IPP5), contaminated as they are hospital waste. These people handle and reuse this material due to their extreme poverty.

At the same time, there is a recurring outbreak of lethal viruses and bacteria, as well as the development of malignancies, from these exposed geographic regions, highlighting the need for awareness-raising efforts on environmental bioethics in both rich and poor countries, since such infectious diseases tend to spread to other countries if the outbreak is not contained.

Furthermore, the pressing need to include health professionals in this type of discussion about the existence of methodological practices and educational practices in Environmental Technology (BR/MS, 2022) is evident, due to the direct repercussion and consequence of (misunderstanding about) environmental health on global well-being, and our group has committed to this achievement.

So, in addition to research into immunomodulation with natural plant products used as functional foods through traditional crops from Eastern countries (Wasim, 2019; Wendling da Silva et al., 2019; Wasim et al., 2020; 2022), crops with HUD have been developed for medicinal purposes (Varricchio et al., 2006), as well as cooperation for temporary restriction of germination so that seeds arrive viable in distant locations (Gaspar et al., 2025).

Without healthy people (and lack of healthy practices) there is lower chance to reach a well-developed, self-sustainable, environment (Freire Souza Silva et al., 2023; Hansel-Martins et al., 2023; Cruz Filho et al., 2023, 2025; Delaunay de Souza et al., 2023, a; Bentes Lopes et al., 2024), an understanding based on the principle of One Health (Gomes et al., 2024; Hobaica et al., 2025).

5 LIMIT

Test with a single potency of a single pharmacotechnical preparation of an high ultradiluted and dynamized solution. Future tests with at least three different potencies, also from different pharmacotechnical preparations, are expected to establish a curve to stablish correlation between high ultradilution sucussions and biological digestive retractile activity.

6 CONTRIBUTION

This study contributed to the research group's perception that high ultra-diluted and dynamized solutions can be methodologically investigated, regarding their action on apparently inert materials but with potential reuse, aiming at local solutions for environmental health in a circular economy through novel processes.

7 CONCLUSION

A specific protocol will be developed in Plant Biotechnology, as this use of a high ultra-diluted and dynamized solution for small tasks in the collection and reuse of solid waste has the possibility of being applied to small solid waste recyclers, due to its viability confirmed by the retraction effect on polypropylene (IPP-5), as well as the reduction of risks to those who handle it, in addition to the ease of obtaining these HUD through pharmacotechnical processing.

The trial aimed to promote autonomy for ethnic groups in urban settings living in the outskirts and, ultimately, aims to promote environmental sustainability.

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