Membrane separation process (MSP) for the purification of biopesticides to control *Euschistus heros* (Fabricius, [1798]) (Hemiptera: Pentatomidae)

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ABSTRACT

A fundamental element of contemporary agricultural practices to ensure food security and improve crop yields is the control of pests that cause serious damage to plants. Nevertheless, there are difficulties in terms of purification and formulation for the production of effective pest control agents such as biopesticides. The purpose of this study was to perform the membrane separation process (MSP) on 40 fermented broths of bioagents obtained by bioscreening to evaluate the potential control of *Euschistus heros*. The collected biomaterials were superficially sterilized, placed in Petri dishes with Potato Dextrose Agar (PDA), and were directed to a submerged fermentation process at 28 ºC and 120 rpm for seven days. Subsequently, the broth was centrifuged at 4000 rpm and 10 ºC for 10 min and filtered using a vacuum pump. Finally, the assays were conducted to MSP with a 0.45 µm nylon membrane. The control rate varied up to 100% in broths after MSP for *E. heros*. Appropriately, the MSP indicated promising results as an accepted technology for the biopesticides formulation process, based on optimizing and improving the control potential of agricultural pests.

Keywords: Bioscreening. Fermented broth. Food security. Pest management. Purification.

1 INTRODUCTION

Biopesticides play an essential role in pest control, providing an alternative to conventional chemical pesticides that is more sustainable and ecological (AYILARA et al., 2023). Its relevance comes from its ability to efficiently combat agricultural pests, in addition to minimizing their adverse impacts on human health, the environment, and biodiversity. In contrast to chemical pesticides, biological pesticides are made from living organisms such as bacteria, fungi, viruses, or plant extracts that target specific organisms like pests without negatively affecting non-target organisms including beneficial insects (ŠUNJKA & MECHORA, 2022).

Furthermore, the presence of impurities or contaminants that can impact the quality and safety of final products can make the purification of biopesticides challenging. Toxic substances formed during the extraction or purification process, secondary metabolites produced by producing organisms, and culture medium residues can be considered as impurities. To ensure that biopesticides meet regulatory safety and efficacy standards, it is vital to implement appropriate quality control measures and ensure purity. Scaling purification processes for large-scale production is another significant challenge. Time, cost, and production capacity constraints can lead to a shift in the scalability of efficient purification methods in the laboratory to industrial production (CHAVES NETO et al., 2021).

Therefore, research and development of economically viable purification technologies are required to meet the growing necessity for safe and effective biopesticides for pest management in agriculture. Consequently, the concentration of biomolecules is an attractive strategy to preserve the potential of the formulation as a biopesticide. Contextually, the membrane separation process (MSP) has emerged as an interesting approach to increasing the concentration of desired metabolites and improving the potential action of these biocompounds (SANTOS et al., 2023). Suitably, the purpose of this study was to concentrate the fermented broth of 40 bioagents isolated by bioscreening, using MSP and, subsequently, formulate bioproducts with high biopesticide potential to indicate a potential phytotoxic effect in the control of *Euschistus heros*.

2 MATERIAL & METHODS

Figure 1 provided a schematic representation of the techniques used during the actual execution of the work, providing a better comprehension of the phases (A–G) applied to the production of this study.

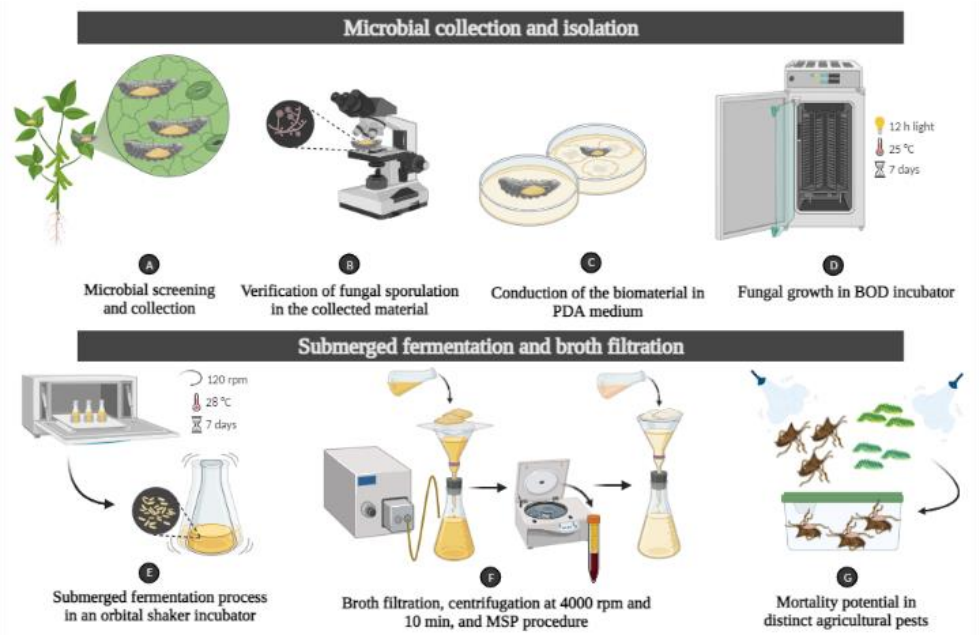
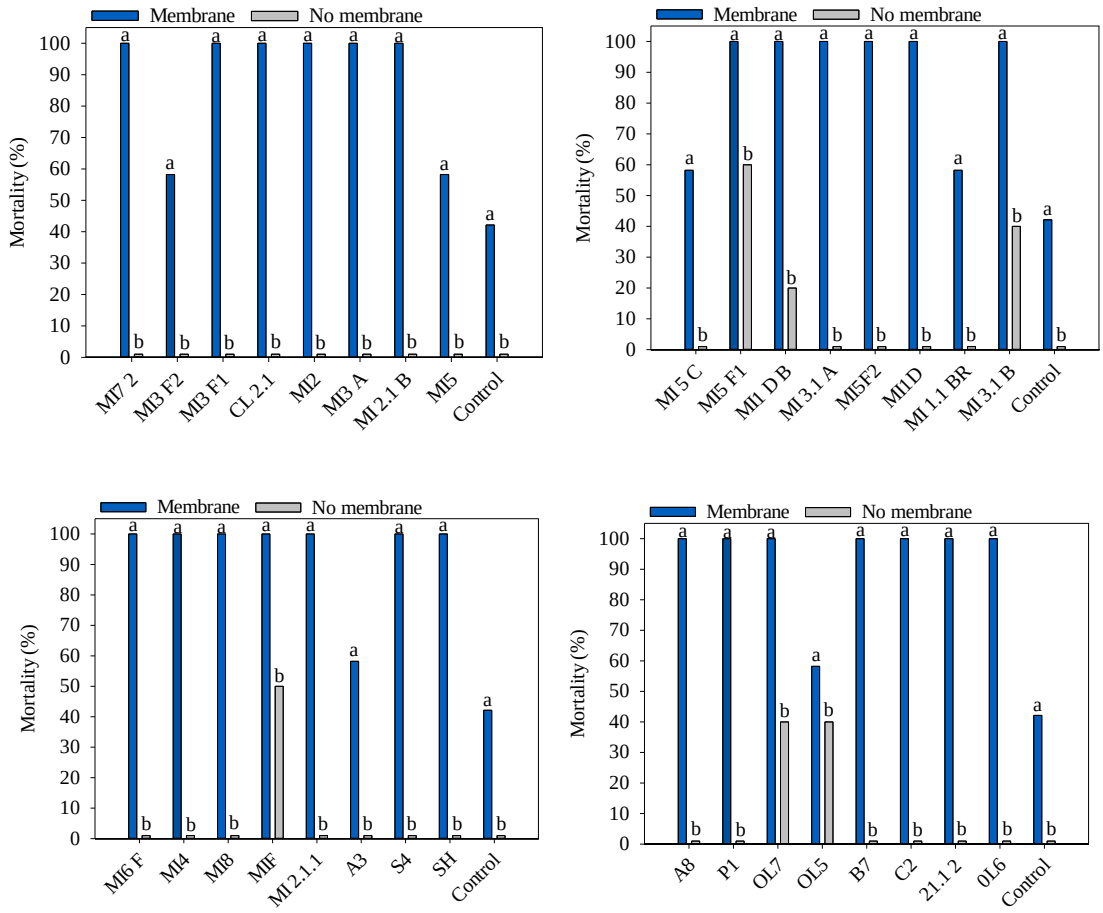


Figure 1 Diagram showing the many stages used in this investigation.

3 RESULTS & DISCUSSION

Based on a preliminary investigation of the microbial agents collected for this study, 40 microorganisms were isolated from dead insects. Furthermore, the scenario selected for *E. heros* was indicated in Figure 2. For *E. heros*, 31 isolated microorganisms reported 100% mortality effects (Figure 2). Furthermore, all microorganisms indicated a statistical difference between MSP and the control treatment, which presented the strategy as an alternative for *E. heros* control actions. Control treatments were 42.1% and 0% for MSP and no membrane, respectively. Considering this species, only 10 bioagents reported greater mortality effects than the control in the membrane-free condition. MI5F1, MI1D B, MI3.1 B, MIF, OL7, and OL5 presented mortality rates of 60%, 20%, 40%, 50%, 40%, and 40% for the control treatment, respectively. These microorganisms expressed 100% control potential. Also, there were no treatments with higher mortality in the control compared to the MSP, indicating that the results expressed in this study were superior for the control of *E. heros*. The alternative was extremely appropriate for MSP and fermented broths that promoted a higher mortality rate than the control, even for treatments without membranes.



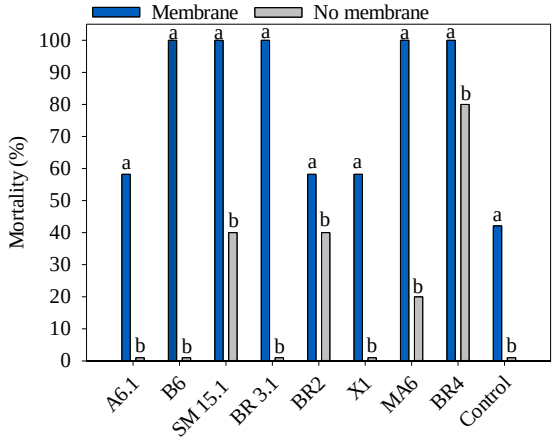


Figure 2 Abbott mortality rate (%) of 40 bioagents isolated from bioscreening for the potential control of *Euschistus heros* (Fabricius, [1798]) (Hemiptera: Pentatomidae). *Averages followed by the same letter in the bars do not differ statistically from each other using the Tukey test at 5% probability.

According to this study, MSP was an effective alternative for controlling *E. heros*, based on the significant increase in the mortality rate after the procedure. One of the main approaches reports MSP as an interesting strategy for separating cell materials from fermented broth. Furthermore, after MSP, the fermented broth indicates a higher concentration of secondary metabolites (SMs), small compounds that are not retained in the filtration and purification processes. SMs are biocompounds originating from metabolic processes of pathways and primary metabolites, with acyl-CoA fueling the synthesis of MSs from polyketides, terpenes and amino acids. SMs are not essential mechanisms that regulate the growth of microorganisms, but they promote the intensification of interactions with other organisms, since these compounds are synthesized to defend the fungi habitat, inhibiting the growth of competing organisms. Basically, these substances express the potential to control another phytopathogenic organism or fungus in the environment (KELLER, 2019).

4 CONCLUSION

This study reported the application of 40 microbial agents to control *Euschistus heros*. The 40 isolated bioagents indicated phytotoxic effects, with 31 microorganisms showing effects of up to 100% mortality. The control rate ranged from 80% to 100% for *E. heros*. Finally, this study indicated a high control of *E. heros* through the isolated bioagents. This scenario indicates that the purity and concentration of isolated microbial agents affected the control of pests harmful to agriculture.

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