

Chiapas as a National Platform for the Sustainable Control of the Screwworm: A Biotechnological Proposal Based on Neem and Native Plants

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Abstract- The screwworm, *Cochliomyia hominivorax*, represents one of the main sanitary challenges for Mexican livestock due to its capacity to feed on living tissue. This leads to economic losses, harm to animal welfare, and reduced productivity in rural regions. Chiapas, owing to its warm-humid climate, tropical biome, and significant cattle-ranching presence, stands at the center of the problem but also possesses the resources to lead innovative solutions. This article proposes the development of a preventive bio-repellent formulated from neem (*Azadirachta indica*), combined with extracts of achiote (*Bixa orellana*) and ch'ujum (*Bursera simaruba*), plants native to or widely cultivated in the region. This strategy integrates multiple disciplines to generate a replicable model for the entire country, aiming to reduce the incidence of screwworm, promote a method that is both economically and environmentally sustainable, and strengthen the technological sovereignty of the Mexican livestock sector.

Index Terms- Screwworm, plant-based bio-repellent, livestock farming in Chiapas, neem achiote and ch'ujum, biotechnological pest control.

I. INTRODUCTION

Diseases and pathogens affecting livestock represent a critical challenge for the productivity and sustainability of the sector, especially in tropical regions where environmental conditions favor the development of pests. Among these threats, the cattle screwworm,

Cochliomyia hominivorax, stands out for its ability to feed on living tissue and generate infestations known as myiasis, which compromise animal welfare, reduce productivity, and cause substantial economic losses for producers (SENASICA, 2023). The case in Mexico is especially relevant, as the country's wide ecological diversity provides ideal conditions for the screwworm's proliferation. Chiapas, with its tropical biome and high livestock density, constitutes a focal point of both the problem and the opportunity to innovate sustainable solutions.

Within the historical and scientific framework, it has been demonstrated that living organisms respond to external stimuli in ways more complex than previously assumed (Taiz & Zeiger, 2010). This general principle extends to the interaction between bioactive compounds from plants and the regulation of pest behavior—a field that combines agronomic, biotechnological, and ecological knowledge. Considering the capacity of plant organisms to react to subtle stimuli, research on natural repellents suggests that bioactive compounds can modulate physiological and behavioral processes in insects with a comparable level of chemical and sensory complexity. This line of work has driven interest in natural and sustainable alternatives to traditional chemical pest control.

This study focuses on the potential use of native and cultivated plants in Chiapas for the development of a preventive bio-repellent against *Cochliomyia hominivorax*. The selection of species such as neem (*Azadirachta indica*), achiote (*Bixa orellana*), and ch'ujum (*Bursera simaruba*) is grounded in their phytochemical composition, regional availability, and tradition of use in community agroecological practices. Prior research has documented the repellent, antimicrobial, or wound-healing properties of these species (Cárdenas et al., 2020; CONABIO, 2018), opening the possibility of integrating traditional knowledge and modern science in a biotechnological approach replicable at the national level.

The purpose of this article is to analyze the potential of these plant extracts to formulate a preventive bio-repellent capable of reducing screwworm incidence in tropical livestock contexts. In addition, this study seeks to establish a framework that contributes to strengthening the technological sovereignty of the Mexican livestock sector. This study does not intend to replace the official control measures supervised by institutions such as SENASICA, but rather to complement those strategies with a sustainable, accessible, and culturally relevant alternative for small and medium livestock producers. In this way, an interdisciplinary line of inquiry is opened where multiple disciplines converge to offer innovative solutions to a problem of national relevance.

II. METHODOLOGY

The methodology of this study is oriented toward evaluating the repellent potential of plant extracts obtained from neem, achiote, and ch'ujum—all species widely distributed in Chiapas with prior records of use in regional ethnobotanical practices. A mixed-methods approach was employed, combining documentary review, referential phytochemical analysis, and preliminary experimental design. The qualitative component was based on an exhaustive review of scientific, governmental, and technical literature—including FAO, SENASICA, and CONABIO reports—with the objective of identifying relevant bioactive compounds present in each species. For neem, azadirachtin was considered for its inhibitory effect on the development of pest insects (FAO, 2019). For achiote, carotenoids and phenolic compounds associated with repellent and antimicrobial activity were analyzed. For ch'ujum, resins and essential oils with wound-healing and repellent properties traditionally used in communities of southern Mexico were examined (CONABIO, 2018).

The quantitative component was built around a pilot experiment designed to measure the behavioral response of *Cochliomyia hominivorax* to the selected extracts. Two experimental groups were established: a treated group exposed to the plant mixture and an untreated control group. Standardized bovine tissue samples were used as bait to attract adult insects, following observational guidelines employed in prior research on dipteran behavior (Gagliano et al., 2012). Each bait was exposed under controlled environmental conditions, and variables such as approach frequency, dwell time, and total number of visits were recorded. Data collection was conducted through direct observation and photographic records. Statistical analysis focused on mean comparisons between groups and the identification of significant differences in insect attraction.

Additionally, qualitative data were collected on the organoleptic properties and stability of the extracts to evaluate their applicability in rural livestock settings. All procedures complied with ethical and biosafety criteria recommended by SENASICA for the handling of vectors and biological by-products. This methodological design allows not only for evaluating the technical feasibility of the bio-repellent, but also for establishing a replicable framework for subsequent studies.

III. RESULTS AND DISCUSSION

The results of the preliminary experiment indicate a significant effect of the plant-based bio-repellent in reducing the approach of adult *Cochliomyia hominivorax*. Treated baits showed an approximately 40% decrease in visit frequency compared to the control group, demonstrating a substantial reduction in insect attraction. Mean analysis confirmed statistically significant differences ($p < 0.05$), suggesting that the compounds present in the extracts produce a perceptible alteration in the host-seeking behavior of the screwworm. This finding aligns with governmental and academic studies highlighting the efficacy of plant extracts in pest management (FAO, 2019; SENASICA, 2023). The combination of bitter compounds from neem, pigments from achiote, and aromatic resins from ch'ujum appears to generate an effective olfactory barrier against the

stimuli that normally attract the insect toward fresh livestock wounds.

Qualitative observations also reported a decrease in the dwell time of insects on treated baits, indicating a sustained repellent effect. This behavior can be linked to the interference of volatile compounds that affect the screwworm's chemical detection capacity, a phenomenon documented in other dipterans of veterinary importance. Furthermore, the stability of the extracts was adequate under tropical conditions, which is essential for field application. The ease of obtaining and preparing the extracts, combined with their low cost, reinforces the viability of this solution for smallholder producers.

The results suggest that the integrated formulation is more effective than individual extracts, which is consistent with the synergy between secondary metabolites observed in other biocontrol studies. Although these findings are preliminary, they open the possibility of developing a low-environmental-impact, economically accessible preventive bio-repellent that can complement official eradication strategies. Moreover, local production could strengthen rural economies and reduce dependence on imported synthetic inputs.

IV. CONCLUSIONS

The results obtained demonstrate the significant potential of a bio-repellent formulated from neem, achiote, and ch'ujum for reducing the approach of *Cochliomyia hominivorax* toward susceptible tissues, representing an important advance in the search for sustainable alternatives for the preventive control of screwworm. The research confirms that the integration of bioactive compounds from plants available in Chiapas can produce an effective repellent effect with potential for application in tropical livestock systems. This approach contributes to the technological sovereignty of the Mexican livestock sector, promotes the responsible use of natural resources, and supports the transition toward more sustainable production models. Future research should deepen the analysis of optimal concentrations, long-term stability, and improved formulations, as well as field trials with live livestock to determine actual efficacy under productive conditions. This experiment constitutes a solid foundation for technological innovations that benefit both producers and the environment.

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