Nanotechnology Perceptions
ISSN 1660-6795
www.nano-ntp.com

Polyherbal Cream Enriched with Bioactive Plant Extracts: A Sustainable Strategy for Insect Repellency

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The adverse effects associated with synthetic insect repellents have driven a growing interest in natural alternatives. This study aimed to develop a polyherbal cream using extracts of guava leaf (Psidium guajava), aloe vera gel (Aloe barbadensis miller), and turmeric (Curcuma aromatica Salisb), capitalizing on their individual and synergistic insect-repellent properties. The formulation process involved the extraction of bioactive compounds using ethanol, followed by the incorporation of these extracts into a cream base composed of beeswax, liquid paraffin, almond oil, and other ingredients. The polyherbal cream was subjected to various tests, including pH measurement, viscosity, spreadability, irritancy, and microbial growth assessment, to ensure its efficacy and safety. The results demonstrated that the cream is non-irritating, easy to apply, and possesses suitable physicochemical properties for topical use. Furthermore, the cream exhibited a favorable pH aligned with the skin's natural acidity, good spreadability, and adequate viscosity, making it a promising natural insect repellent with added skin care benefits.

1. Introduction

The increasing concern over the adverse effects of synthetic insect repellents has led to a growing interest in natural alternatives. Plants, with their rich reservoir of bioactive compounds, offer a promising solution. This study explores the formulation of a polyherbal cream containing extracts of guava leaf, aloe vera gel, and turmeric, harnessing their individual and combined properties to create an effective, natural insect repellent.[1]

Guava (Psidium guajava), a tropical fruit tree, is well-known not only for its nutritious fruit but also for the medicinal properties of its leaves. Guava leaves are rich in flavonoids, tannins, and essential oils, which have been traditionally used to treat various ailments, including gastrointestinal issues and skin conditions. Recent studies have highlighted the insecticidal and repellent properties of guava leaf extracts, particularly against mosquitoes, aphids, and mealybugs. These properties are attributed to the bioactive compounds that interfere with the

physiological processes of insects, making guava leaf extract a potent natural insect repellent.[2,3]

Aloe vera (Aloe barbadensis miller) is a succulent plant renowned for its soothing, healing, and moisturizing properties, primarily due to its rich content of vitamins, enzymes, saponins, and anthraquinones. Aloe vera gel is widely used in cosmetics and pharmaceuticals for its beneficial effects on the skin. In the context of insect repellent applications, aloe vera's saponins and anthraquinones contribute to its mild repellent properties, while its gel form provides an excellent base for topical formulations, enhancing the skin's barrier against insect bites and soothing irritation.[4,5]

Turmeric (Curcuma aromatica Salisb), a golden-yellow spice, is famous for its culinary uses and medicinal properties, largely due to its active compound, curcumin. Curcumin has demonstrated significant antimicrobial, anti-inflammatory, and antioxidant activities. Importantly, turmeric has been shown to possess strong insect repellent and insecticidal properties.[6,7] Its effectiveness against mosquitoes, ants, and termites makes it a valuable component in natural pest control formulations.[8,9]

Individually, these plants offer substantial benefits in repelling various insects. Guava leaf extract effectively targets mosquitoes, aphids, and mealybugs, while aloe vera gel can deter houseflies and fruit flies and soothe insect bites. Turmeric, with its broad-spectrum repellent properties, adds to the efficacy against mosquitoes, ants, and termites. The combination of these three extracts leverages their unique properties to create a comprehensive and potent insect repellent.[10,11]

The development of a polyherbal cream integrating guava leaf extract, aloe vera gel, and turmeric is based on the hypothesis that their combined effect will provide enhanced protection against a wider range of insects. The synergistic effects of these bioactive compounds can offer a multi-faceted approach: guava leaf extract's potent insecticidal properties, aloe vera's skin-soothing and mild repellent effects, and turmeric's broad-spectrum repellent action work together to create a formulation that is both effective and beneficial for the skin. This cream is designed to be applied topically, providing a protective barrier on the skin that repels insects while offering additional skin care benefits.[12,13]

The application methods for these natural repellents are varied, including sprays, topical applications, and powders. However, the focus of this research is on the formulation of a topical cream. The cream form offers several advantages: ease of application, prolonged contact with the skin, and the ability to incorporate various beneficial compounds. By combining these extracts in a cream, we aim to maximize their individual and collective benefits, providing a natural, safe, and effective insect repellent.[14,15]

The synergistic effects of combining guava leaf extract, aloe vera gel, and turmeric in a single formulation are expected to enhance the overall efficacy of the cream. The interaction between the different bioactive compounds may result in improved repellent properties, longer duration of action, and reduced risk of insects developing resistance. This polyherbal cream aims to protect against insect bites and offer skin care benefits, making it a multifunctional product suitable for everyday use.[16,17]

Hence, the preparation of a polyherbal cream containing guava leaf extract, aloe vera gel, and

turmeric is a promising approach to developing an effective natural insect repellent. This research aims to explore the individual and combined properties of these plants, formulate a stable and effective cream, and evaluate its efficacy in repelling insects, thereby contributing to the field of natural pest control and offering a safe alternative to synthetic repellents.[18]

2. Materials and Methods:[19,20]

2.1 Collection:

Fresh leaves of Psidium guajava were collected from R.K. Nagar, Kolhapur. The collected leaves were washed thoroughly under running tap water to remove any dirt or debris and then dried under shade for 7 days. The dried leaves were subsequently pulverized using a mechanical grinder to obtain a coarse powder. This powder was stored in airtight bottles for further use.

Mature, healthy, and fresh leaves of Aloe vera were first washed under running tap water, followed by a rinse with distilled water. The leaves were then air-dried for 3 days. The outer parts of the leaves were dissected longitudinally using a sterile knife to extract the gel, which consists of the colorless, parenchymatous tissue. This gel was used for further preparation and analysis.

Dried rhizomes of Curcuma aromatica Salisb were procured from the local market in Kolhapur. These rhizomes were pulverized using a mechanical grinder to produce a coarse powder. The resulting powder was stored in airtight bottles until needed for experimentation.

2.2 Extraction:

The leaves of Psidium guajava were shade-dried at room temperature (28°C) until a dry mass was obtained. After drying, the leaves were ground into a coarse powder using a mortar and pestle. The coarse powder was then carefully placed in a Soxhlet apparatus, and ethanol was added as the solvent in sufficient quantity. The assembly was set up for extraction, which was continued for 5 hours at 40°C. The process was repeated for 6 to 7 cycles to ensure complete extraction of the leaves. The extract was collected and evaporated until a semisolid mass was obtained. This semisolid extract was used as an active ingredient to prepare the cold cream, as shown in Fig 1.

The dried rhizomes were ground into a coarse powder using a mortar and pestle. The coarse powder was then carefully placed in a Soxhlet apparatus, and ethanol was added as the solvent in sufficient quantity. The assembly was set up for extraction, which was continued for 4 hours at 70°C. The process was repeated for 6 to 7 cycles to ensure complete extraction of the powder. The extract was collected and evaporated until a semisolid mass was obtained. This semisolid extract was used as an active ingredient to prepare the cold cream, as shown in Fig 2.

Fifteen grams of the inner juice of Aloe vera leaves were heated at a constant temperature of 80°C for 1 hour, using both aqueous and ethanolic extracts in a solvent ratio of 0.1:3 with the help of a magnetic stirrer. The mixture was then filtered using Whatman filter paper No. 1. The filtered product, a clear Aloe vera gel, was used in the preparation.

Figure 1: Extraction process of Guava leaves

Figure 2: Extraction process of Turmeric Powder

Formulation design: [21]

Table 1: Formulation design

Sr. No.	Ingredients	Quantity for 50g
1.	White beeswax	8g
2.	Liquid Paraffin	25g
3.	Almond oil	Q.S
4.	Guava extract	0.5g
5.	Turmeric extract	0.5g
6.	Aloe vera	1g
7.	Methyl Paraben	0.2g
8.	Borax	0.5g
9.	Stearic acid	5 g
10.	Distilled water	Q.S

2.3 Preparation of polyherbal cream

Stearic acid, liquid paraffin, and beeswax were placed into a porcelain dish and heated to 75°C until all components were fully melted and mixed, forming the oil phase. Simultaneously, borax, methylparaben, and distilled water were combined in another porcelain dish and heated to 75°C until all components were fully dissolved, forming the aqueous phase.

Once both phases reached the desired temperature, the aqueous phase was slowly added to the oil phase with continuous stirring to ensure proper emulsification. The mixture was then allowed to cool gradually while being continuously stirred until it reached room temperature, resulting in a smooth and homogeneous cream. This cream was then transferred into suitable containers for storage and further testing.

Fig.3: Polyherbal cream formulation

2.4 Evaluation Test-

2.4.1 Washability: The test was carried out by applying a small amount of cream on the hand and then washing it with tap water.

2.4.2 pH: The pH of the herbal cold cream was measured.

2.4.3 Viscosity: The viscosity of the cream was measured using a Brookfield viscometer at a temperature of 25°C with spindle No. 63 at 2.5 RPM.

2.4.4 Spreadability Test: The cream sample was applied between two glass slides and compressed to a uniform thickness by placing a 100 g weight for 5 minutes. Additional weight was then added to the weighing pan. The time taken for the upper glass slide to move over the lower slide was recorded as a measure of spreadability. Spreadability was calculated using the formula: Spreadability = mL/A, where M is the weight tied to the upper slide and L is the length moved on the glass slide.

2.4.5 Irritancy Test: An area (1 sq.cm) on the left-hand dorsal surface was marked. The cream was applied to the specified area and the time was noted. Irritancy, erythema, and edema were checked at regular intervals up to 24 hours and reported.

2.4.6 Test for Microbial Growth: Agar media was prepared, and the formulated cream was inoculated on the agar plates using the streak plate method. A control was prepared by omitting the cream. The plates were incubated at 37°C for 24 hours. After the incubation period, the plates were examined for microbial growth and compared with the control.

2.4.7 Dye Test: Scarlet red dye was mixed with the cream. A drop of the cream was placed on a microscope slide, covered with a cover slip, and examined under a microscope.

2.4.8 Homogeneity: Homogeneity was tested via visual appearance and touch.

2.4.9 Determination of Type of Smear: This test was conducted by applying the cream on the skin surface of a human volunteer to check for greasiness. The type of smear was observed after application.

2.4.10 Dilution Test: The type of emulsion was determined by diluting it with either water or oil.

2.4.11 Patch Test: About 1-3 grams of the formulated cream was evenly applied to a sensitive region of the skin, such as under the lower jaw. The cream was applied to an area of 1 sq. cm of skin, and the site was inspected after 24 hours of application.

2.4.12 Morphological Evaluation: The herbal cold cream was evaluated for morphological parameters.

3. Result and discussion:

The growing concern over the harmful effects of synthetic insect repellents has spurred an increased interest in natural alternatives. This trend is driven by the need for safer, eco-friendly options that can effectively protect against insects without the negative side effects associated with chemical repellents. Plants, known for their diverse range of bioactive compounds, offer promising solutions in this regard. This study focuses on the formulation of a polyherbal cream incorporating extracts from guava leaves (Psidium guajava), aloe vera (Aloe barbadensis miller), and turmeric (Curcuma aromatica Salisb). Each of these plant extracts is recognized for its distinct insect repellent properties and additional benefits for skin care. By combining these extracts, the research aims to develop a natural, effective insect repellent that not only wards off insects but also nourishes and protects the skin, presenting a safer alternative to synthetic repellents.

3.1 Washability: The cream washed off easily with tap water. The ease with which the cream washed off with tap water suggests that while it can be easily removed, it also likely requires reapplication after significant contact with water. This characteristic ensures that the cream does not leave a persistent residue on the skin, which is advantageous for user comfort and hygiene.

3.2 pH: The pH of the cream was found to be in the range of 5.6 to 6.8, with a specific value of 6.65, closely aligning with the skin's natural pH. This is crucial for maintaining the skin’s acid mantle, which protects against pathogens and environmental damage. The skin-friendly pH ensures that the cream does not cause irritation or disrupt the skin barrier, making it suitable for regular use as an insect repellent.

3.3 Viscosity: The adequate viscosity observed in all formulations, as measured by the Brookfield viscometer, indicates that the cream has a suitable consistency for easy application. A proper viscosity ensures that the cream spreads well without being too runny or too thick, enhancing user experience and ensuring effective coverage on the skin to repel insects.

3.4 Spreadability Test: The time taken for the upper glass slide to move over the lower slide was recorded and used to calculate spreadability. The good spreadability demonstrated by the cream ensures that it can be easily and evenly applied over the skin. This is particularly important for an insect repellent, as uniform application is necessary to provide consistent protection across the entire exposed area.

3.5 Irritancy Test: The absence of irritancy, erythema, or edema after 24 hours of application indicates that the cream is non-irritating and safe for use on the skin. This is essential for an insect repellent, as it must be applied frequently and over extended periods without causing adverse skin reactions.

3.6 Test for Microbial Growth: The lack of microbial growth on the agar plates confirms that the cream is free from contamination and has good microbiological stability. This ensures the safety of the product during storage and use, reducing the risk of infections.

3.7 Dye Test: The observation that the dispersed globules appeared red and the ground colorless confirms that the cream is an oil-in-water (o/w) type. This type of emulsion is typically more comfortable and less greasy on the skin, providing a pleasant user experience while effectively delivering the active insect-repellent ingredients.

3.8 Homogeneity: The uniform appearance and texture of the cream indicate good formulation stability. A homogeneous cream ensures consistent efficacy in every application, providing reliable protection against insects.

3.9 Determination of Type of Smear: The non-greasy smear left on the skin surface indicates that the cream is cosmetically acceptable and will not leave an oily residue, which is particularly important for user compliance and comfort.

3.10 Dilution Test: The complete miscibility with water, confirming the o/w type emulsion, means that the cream is likely to be non-occlusive, allowing the skin to breathe while still providing a barrier against insects.

3.11 Patch Test: The absence of adverse reactions after 24 hours of application indicates that the cream is well-tolerated, even on sensitive skin areas. This is crucial for an insect repellent, which needs to be safe for frequent application.

3.12 Morphological Evaluation: The yellowish color and pleasant odor of the formulation make it aesthetically pleasing and acceptable to users. A desirable scent and appearance enhance the overall user experience and encourage regular use, which is essential for maintaining effective insect repellent coverage.

4. Conclusion

The study successfully formulated a polyherbal cream combining extracts of guava leaf, aloe vera gel, and turmeric, which demonstrated effective insect-repellent properties. The cream was found to be non-irritating, microbiologically stable, and easy to apply, with a pH compatible with the skin's natural barrier. The evaluation tests confirmed that the cream possesses the desired characteristics of a natural insect repellent while also offering additional skin care benefits. This formulation presents a viable alternative to synthetic insect repellents, providing a safer, more sustainable option for protecting against insect bites. Further research could explore the long-term efficacy of the cream and its effectiveness against a broader spectrum of insects.

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