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Innovation and evaluation of Vi-Ca herbal soap from Lagundi (*vitex negundo*) and Papaya (*carica papaya*): antibacterial efficacy, sensory acceptability and cost efficiency

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Abstract: The demand for natural, skin-friendly, and cost-effective alternatives to commercial skincare products is steadily increasing due to growing consumer awareness of synthetic chemical risks. However, limited research remains on using Lagundi (Vitex negundo) and Papaya (Carica papaya) in developing antibacterial herbal soap. This study aimed to innovate and develop Vi-Ca Soap, a herbal soap formulated from Lagundi and Papaya. It assessed its antibacterial properties, chemical composition, cost-efficiency, and acceptability among different user groups. Utilizing an experimental research design, the soap was produced in two treatments: scented and unscented. It was evaluated by 60 respondents categorized as teenagers, adults, and beauty experts. Sensory evaluation considered nine criteria, including appearance, cleansing, hardness, lathering, texture, foaming, solubility, moisturizing, and fragrance. Findings showed both variants were rated "Excellent," particularly in lathering, foaming, and cleansing, though appearance received relatively lower scores, especially from beauty experts. ANOVA revealed significant differences in acceptability across groups for specific attributes such as cleansing, texture, and hardness. Antimicrobial analysis confirmed strong activity of Vi-Ca soap against Staphylococcus aureus but limited effect on Escherichia coli, indicating its primary effectiveness against skin bacteria. The total development cost was ₱7,556.00, mainly spent on raw materials and laboratory testing. The study concludes that Vi-Ca Soap is a promising, highly acceptable, and cost-efficient product. Recommendations include improving the soap's appearance, texture, and antibacterial strength at lower concentrations, and making it effective against more types of bacteria to boost market appeal and user satisfaction.

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Keywords: Herbal soap, Lagundi (Vitex negundo), Papaya (Carica papaya), Antibacterial properties, Sensory evaluation, Cost-efficiency

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INTRODUCTION

In recent years, people around the world have become more concerned about the harmful effects of synthetic chemicals in personal care products like soap (Khalid & Abdollahi, 2021). Chemicals such as parabens, sulfates, and triclosan, often found in commercial soaps, have been linked to allergies, hormone problems, and harm to the environment (Wirtu, 2024). Because of this, many consumers now prefer natural and herbal alternatives that are seen as safer and more eco-friendly (Bent, 2008; Ramirez et al., 2022).

Herbal soaps, made from plant-based ingredients, are becoming more popular because they are gentle on the skin, help with healing, and are better for the environment (Majumdar et

al., 2023; Sharma Verma, 2023). These soaps combine traditional knowledge of medicinal plants with modern cosmetic science to provide antibacterial, antifungal, and anti-inflammatory benefits (Kumar et al., 2023). In the Philippines, many people still use native plants like Lagundi (Vitex negundo) and Papaya (Carica papaya) for healing purposes (Cordero et al., 2020).

Lagundi is a well-known medicinal plant in the Philippines. It is used for its antibacterial, pain-relieving, and anti-inflammatory effects. The Department of Health recommends it for treating colds and minor infections (Maramba-Lizarte, 2024). Research shows that Lagundi extracts can kill different types of bacteria (Amin et al., 2021). On the other hand, Papaya has an enzyme called papain that helps remove dead skin and improve skin texture. It also contains vitamins A, C, and E, which help nourish and brighten the skin (Veersain et al., 2023). Papaya's antimicrobial and antioxidant properties make it useful in skincare.

Even though Lagundi and Papaya are both effective on their own, there are very few local soaps that combine them in one product with proven antibacterial power, consumer satisfaction, and cost-effectiveness. Many herbal soaps sold in the Philippines rely on imported ingredients or do not meet customer expectations for quality, scent, or texture (Leevisitpattana & Srisopa, 2020). Also, little focus has been given to whether these products are affordable and appealing to buyers.

This study aims to fill that gap by creating Vi-Ca Herbal Soap, which combines Lagundi and Papaya extracts. The soap will be tested for its antibacterial ability, appeal to consumers, and cost. The goal is to offer a skin-friendly, eco-conscious, and affordable alternative while making good use of local resources.

Research objectives

This study aimed to develop an innovative herbal soap named Vi-Ca soap using locally available Lagundi (Vitex negundo) and Papaya (Carica papaya). Specifically, it sought to determine and document the processes involved in the development and formulation of the Vi-Ca herbal soap. It also aimed to assess the antibacterial and antimicrobial properties of the soap, including its chemical composition. Furthermore, the study intended to evaluate the level of sensory acceptability of the developed soap in terms of appearance, cleansing ability, hardness, lathering, scent or fragrance, texture, foaming, solubility, and moisturizing effect. Another objective was to determine the overall level of acceptability of the Vi-Ca soap as evaluated by three groups of respondents: teenagers, adults, and experts. Additionally, the study aimed to identify whether there were significant differences in the general level of acceptability of the Vi-Ca soap among the different groups of respondents. It was also intended to find out whether there were significant differences between the two treatments of the Vi-Ca soap based on the mentioned sensory characteristics. Lastly, the study aimed to determine the total cost involved in the development of the Vi-Ca herbal soap, providing insights into its economic feasibility and cost-efficiency.

METHODOLOGY

Research design

The study examined the association between teachers' perceptions and students' scholastic development during the implementation of Catch-Up Friday in Tupi South District, a descriptive correlational research design proved to be appropriate. This design allows the assessment of the The study utilized an experimental research design. Experimental research is a systematic and

scientific approach in which the researcher manipulates one or more independent variables and observes their effects on a dependent variable while controlling for extraneous variables. This method allows for the establishment of cause-and-effect relationships between variables.

Respondents and locale of the study

The respondents of the study were categorized into three groups: (1) teenagers aged 13–19 years, (2) adults aged 20–60 years, and (3) beauty experts. After permission was granted, the testing of the three samples on the respondents for effectiveness was carried out, followed by the administration of the questionnaires.

Research instrument

The instrument for data gathering was a score sheet using a quantitative analysis method to determine the acceptability of the products. The responses as to the level of acceptability of the Vi-Ca soap in terms of appearance, cleansing, hardness, lathering, texture, foaming, solubility, moisturizing, and fragrance were determined with the use of a Five-point Likert scale.

Data analyses procedure

The variables were analyzed and interpreted using the Statistical Package for the Social Sciences (SPSS). The statistical tools used are as follows:

Mean (M). This was utilized to determine the level of acceptability of Vi-Ca soap with the two treatments in the formulation of soap by age groups.

Standard Deviation (SD). This was used to determine the homogeneity or the average distance of the acceptability scores from the computed mean.

One-Way Between-Groups Analysis of Variance (ANOVA). This was used to determine whether there is a significant difference in the level of acceptability of the Vi-Ca soap with the two treatments across age groups. Additionally, it was revealed whether the responses from the age groups are different or the same.

DISCUSSION OF FINDINGS

Product development

The Vi-Ca Soap underwent several stages of development: selection, washing, chopping, extraction, mixing, curing, and packaging. Fresh Lagundi leaves and ripe Papaya were prepared, and their juices were extracted. Lye was made by dissolving caustic soda in water and cooling it for 24 hours. The cooled lye was mixed with the extracts and coconut oil until the mixture thickened. It was then poured into molds and left to harden for 24 hours. The soap bars were cured for 20–30 days to complete saponification and improve quality. Finally, the fully cured Vi-Ca Soap was packaged for testing and evaluation.

Antimicrobial and chemical analysis of Vi-Ca soap

The antimicrobial and chemical analysis of Vi-Ca soap was conducted at the Quirino State University-Diffun Research Facility. Results showed that at 1 ppm concentration, the soap exhibited strong antibacterial activity against Staphylococcus aureus (28 mm inhibition zone), surpassing the commercial control (17 mm). At 0.5 ppm, it remained moderately active, but was

inactive at lower concentrations. Against E. coli, Vi-Ca soap showed weak activity (12 mm at 1 ppm), similar to commercial soap. Phytochemical tests revealed that both scented and unscented variants contain essential oils, phenolics, tannins, phenols, and flavonoids, compounds known for their antibacterial and skin-healing properties. The unscented version had a higher essential oil content, making it potentially more effective for sensitive skin. Both variants lacked triterpenes. These findings indicate that Vi-Ca soap, particularly at higher concentrations, is highly effective against common skin bacteria and suitable for antibacterial skin care, with the unscented version offering an ideal option for fragrance-sensitive users.

Level of acceptability of the unscented Vi-Ca soap

The Unscented Vi-Ca Soap received a high level of acceptability, with all criteria rated as "Strongly Agree." Lathering (4.78) and foaming (4.77) were the most highly rated attributes, while appearance (4.28) received the lowest score but remained favorable. The overall mean score of 4.59 indicates consistent and positive feedback, confirming the soap's excellent quality and effectiveness.

Level of acceptability of the scented Vi-Ca soap

The Scented Vi-Ca Soap received a "Strongly Agree" rating in all acceptability criteria, with an overall mean of 4.56. Its foaming ability (mean: 4.70) was most highly praised, while appearance scored the lowest (mean: 4.32), with the most varied responses. Despite this, all aspects were positively received, confirming the soap's excellent quality, especially in terms of foaming, cleansing, and moisturizing.

General level of acceptability of the developed Vi-Ca soap as evaluated by the different groups of respondents (unscented)

The Developed Unscented Vi-Ca Soap received high acceptability ratings from teenagers, adults, and experts. Teenagers gave the highest overall mean of 4.79, with "Lathering" as the most favored criterion. Adults also rated "Lathering" highest, with an overall mean of 4.63. Experts, though slightly more critical, rated the soap 4.36 overall, with "Foaming" as the top feature. Across all groups, "Appearance" consistently received the lowest scores, particularly among experts, indicating it may require improvement. Overall, the soap is well-received, especially by younger users, with consistently strong performance in lathering and foaming properties.

General level of acceptability of the developed Vi-Ca soap as evaluated by the different groups of respondents (scented)

The general acceptability of the scented Vi-Ca Soap was evaluated by teenagers, adults, and experts. Teenagers gave the highest overall rating (mean = 4.78), with strong approval for foaming and cleansing properties. Adults also rated the soap positively (mean = 4.66), although they identified hardness as a concern. Experts provided the lowest mean score (4.26), expressing reservations about the soap's appearance. Despite varying perspectives, all groups strongly agreed on the soap's effectiveness in foaming, lathering, and cleansing. The findings suggest

overall high acceptability, with suggested improvements in appearance and firmness for greater appeal across all respondent groups.

Comparison on the general level of acceptability of unscented Vi-Ca soap as evaluated by the different groups of respondents

The comparison of acceptability of the Unscented Vi-Ca Soap among Teenagers, Adults, and Experts revealed significant differences in Cleansing ($p = 0.0428$), Lathering ($p = 0.0044$), and Texture ($p = 0.0008$). Experts rated these aspects more critically than Teenagers and Adults. No significant differences were found in Appearance, Hardness, Foaming, Solubility, and Moisturizing, indicating consistent perceptions across groups. The findings suggest that while the soap is generally well-received, expert evaluators tend to have higher standards. These results highlight the need for refinement in cleansing effectiveness, lathering ability, and texture to improve acceptability among more critical users.

Comparison on the general level of acceptability of scented Vi-Ca soap as evaluated by the different groups of respondents

The comparison of the general level of acceptability of the Developed Scented Vi-Ca Soap revealed significant differences in several attributes across Teenagers, Adults, and Experts. Experts rated the soap more critically in terms of Appearance, Hardness, Lathering, Texture, Foaming, Moisturizing, and Scent/Fragrance, while Teenagers gave higher ratings, especially for Lathering, Foaming, and Scent. Adults had moderate ratings. Cleansing and Solubility did not show significant differences. The findings suggest that while the soap is well-received by general consumers, further refinement is needed to meet expert expectations and enhance appeal for a more discerning market.

Post hoc analyses of the general level of acceptability of the developed unscented and scented Vi-Ca soap

The post hoc analysis of the general level of acceptability of the Vi-Ca Soap, both scented and unscented, reveals significant differences in perceptions between beauty experts and other groups (teenagers and adults). Experts rated both versions of the soap lower across various criteria such as cleansing, lathering, texture, and scent/fragrance, indicating more critical evaluations based on their professional standards. In contrast, teenagers and adults had similar and more favorable ratings, particularly in lathering, texture, and scent, suggesting general satisfaction with the product. These findings imply that while the soaps meet the expectations of everyday users, improvements may be necessary to meet the more rigorous standards of beauty experts, especially in areas like appearance, hardness, and foaming.

Total cost of developing Vi-Ca soap

The total cost of developing Vi-Ca Soap is ₱7,556.00, which includes: raw materials (₱2,653.00), production costs (₱1,248.00), packaging costs (₱855.00), and miscellaneous costs (₱2,800.00). No labor costs were included as the work was done by the researcher. The overall breakdown reflects essential components in soap production.

CONCLUSIONS AND RECOMMENDATIONS

The development of Vi-Ca Soap has significant implications for its marketability and production. While it shows strong antibacterial properties and high acceptability among general consumers, there is a need to refine certain attributes, such as appearance, texture, and firmness, to meet the higher standards of beauty experts. These improvements could enhance its appeal across all consumer groups. Additionally, the cost structure, with no labor costs involved, suggests that the soap is affordable to produce, offering a competitive edge in the market. Focusing on these refinements will increase its potential for wider market adoption and consumer satisfaction.

In view of the findings and conclusions of the study, several recommendations are proposed to guide the future development and promotion of Vi-Ca Soap. The researcher is encouraged to explore further improvements in the soap's appearance, texture, and firmness to meet the expectations of more critical users, particularly beauty experts, thereby ensuring broader market acceptance. Manufacturers are also advised to focus on enhancing the unscented version of Vi-Ca Soap, as its higher essential oil content makes it more suitable for sensitive skin, potentially attracting a wider customer base. Additionally, the developer should continue refining the soap's formulation to improve its antibacterial performance against a broader range of bacteria, further establishing its effectiveness in the market.

For future product developments, it is important for the researcher or developer to take into account the feedback provided by expert evaluators. This feedback can help strike a balance between general consumer preferences and professional standards, especially in terms of scent, texture, and foaming ability. Moreover, it is recommended that the developer pursue patenting of the Vi-Ca Soap to secure intellectual property rights and safeguard its unique formulation and properties, which can provide a significant competitive edge in the industry. Finally, marketing teams should emphasize the soap's strong points, such as its antibacterial properties and positive reception among both teenagers and adults. At the same time, they should also address the identified areas for improvement to create a more compelling and well-rounded promotional strategy.

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