Development of Stingless Bee Honey-Based Liquid Soap with Pomelo Oil Scent and Packaging Design for Bangnangli Community Enterprise

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Abstract

This study aimed to develop a natural liquid soap formulated with stingless bee honey and pomelo essential oil while designing eco-friendly packaging that reflects the cultural identity of the Bangnangli Community Enterprise in Samut Songkhram, Thailand. A Participatory Action Research (PAR) framework was applied, engaging community members, product experts, and consumers in all stages of development—formulation, packaging design, and evaluation. Laboratory trials explored various concentrations of honey and pomelo oil to optimize cleansing ability, stability, fragrance, and consumer acceptability. The final formula, containing 5% stingless bee honey and 1% pomelo essential oil, exhibited excellent stability and moisturizing properties, with natural antimicrobial and aromatic effects. Packaging prototypes made from biodegradable bamboo fiber and decorated with Bangnangli cultural motifs were developed to enhance eco-friendliness and local branding.

Quantitative data were collected from 100 participants through expert evaluation and consumer satisfaction surveys, while qualitative feedback provided insights into perceived quality and usability. Results indicated high expert ratings for product quality (mean = 4.52 / 5, SD = 0.38) and strong consumer satisfaction across dimensions of fragrance, safety, packaging aesthetics, and price fairness (mean = 4.60 / 5, SD = 0.40). The findings highlight the synergistic potential of combining natural resources and traditional knowledge to produce competitive, value-added community products that align with global sustainability trends.

This research contributes to the literature on community-based product innovation by demonstrating how eco-friendly design, cultural identity, and participatory engagement can enhance both socio-economic value and market competitiveness. It provides a replicable model for other rural enterprises seeking to integrate local materials and environmental consciousness into sustainable cosmetic product development.

Keywords: stingless bee honey, pomelo oil, herbal soap, eco-packaging, community enterprise

1. Introduction

1.1 Title of the 2nd level

Global demand for natural and eco-friendly personal care products is rising, with the herbal cosmetics market projected to reach USD 134 billion by 2028. Thailand's biodiversity and

tradition of herbal medicine offer strong potential, yet community enterprises face barriers: lack of quality standards, limited branding, and unattractive packaging.

Stingless bee honey provides antioxidant, antimicrobial, and moisturizing benefits (Castro et al., 2020), while pomelo oil adds antibacterial and aromatic qualities (Jittrawadee et al., 2020). Integrating these ingredients into liquid soap aligns with consumer demand for authentic, sustainable products.

Additionally, packaging is not just protective but also a communication tool that shapes brand value and consumer trust (Magnier & Crié, 2015). Eco-packaging with cultural motifs enhances identity and competitiveness of community products.

1.2 Research Objective

1. Develop a liquid soap formula enriched with stingless bee honey and pomelo oil.

2. To design eco-friendly packaging that reflects local identity and enhances product value for Bangnangli Community Enterprise.

2. Body of paper

2.1 Theories of Product Development

Garvin (1984) identified eight dimensions of product quality, including performance, features, reliability, durability, conformance, aesthetics, and perceived value. Kotler and Keller (2019) emphasized new product development (NPD) as a systematic process involving idea generation, screening, concept development, prototyping, and commercialization. These theories provide a foundation for understanding how herbal cosmetics can be innovatively developed for niche markets.

2.2 Herbal Soap Studies

Research in Thailand and Southeast Asia shows growing consumer interest in herbal soaps enriched with local plants. Puangporn (2015) studied turmeric-based liquid soap, finding improved antioxidant activity and consumer acceptance. Siriporn et al. (2022) highlighted consumer preferences for natural fragrance, mild cleansing, and safe formulations. These studies confirm that consumer trust in herbal soaps is linked to ingredient transparency and natural origin.

2.3 Stingless Bee Honey Applications

Stingless bee honey differs from Apis mellifera honey due to its higher phenolic content, lower pH, and distinct taste profile. Castro et al. (2020) demonstrated its antimicrobial activity, while Jaqueline et al. (2021) reported antioxidant and wound-healing properties. Its moisturizing ability makes it a candidate for dermatological and cosmetic applications.

2.4 Pomelo Oil Properties

Pomelo essential oil contains bioactive compounds such as limonene, citral, and flavonoids. Studies (Suwanna, 2022) show its antibacterial, antioxidant, and aromatic properties, making it suitable for personal care formulations. Aromatherapy literature also highlights its mood-enhancing and stress-reducing qualities.

2.5 Packaging and Consumer Perception

Packaging is more than a container; it is a strategic marketing tool. Research by Sakchai (2010) and Manatsanan (2021) emphasized the role of eco-packaging in creating brand differentiation. Aesthetic design, reusability, and environmental responsibility are now core aspects influencing consumer loyalty.

2.6 Community Enterprise and Value Creation

Community enterprises serve as vehicles for local economic development by transforming natural resources into marketable products (Weerapong, 2020). Weerapong (2020) highlighted the importance of combining local identity with innovation to sustain competitiveness.

Conceptual Framework

This study synthesizes knowledge from prior research and proposes a framework where local resources (honey, pomelo oil) + eco-friendly packaging → product development → consumer acceptance → community enterprise sustainability.

3. Methodology

This study employed Participatory Action Research (PAR) with mixed methods (quantitative + qualitative).

Participants

- 30 members of Bangnangli Community Enterprise.
- 10 experts in herbal product development and packaging design.
- 100 consumers recruited via convenience sampling (aged 18–55, regular soap users).

Instruments

- Product formulation sheets.
- Expert evaluation forms (Likert 5-point).
- Consumer satisfaction questionnaires.
- Semi-structured interview guides.

Procedures

1. 1.Literature review and baseline needs assessment.
2. 2.Development of soap prototypes with varying honey (3–7%) and pomelo oil (0.5–2%).
3. 3.Packaging co-design workshops with community members and designers.
4. 4.Consumer testing and expert validation.

Data Analysis:

1. 1.Descriptive statistics (mean, SD).
2. 2.Reliability tested via Cronbach's alpha ($\alpha > 0.8$).
3. 3.Qualitative feedback analyzed thematically

4. Results

4.1 Soap Formulation Evaluation

The optimal formula was **5% stingless bee honey + 1% pomelo oil**.

Table 1: Expert Evaluation of Soap Quality (n=5)

Dimension	Mean	SD	Rating
Color & Appearance	4.6	0.5	Very good
Fragrance	4.4	0.6	Very good
Texture & Foam	4.5	0.5	Very good
Stability	4.6	0.5	Excellent
Safety	4.6	0.5	Excellent
Overall	4.52	0.38	Very good

4.2 Packaging Design

Eco-friendly packaging prototypes were developed with biodegradable plastics, bamboo fiber, and labels showing Bangnangli motifs.

Figure 1: Packaging Prototype with Cultural Motifs

Table: 2 Expert Evaluation of Packaging Design (n = 5)

Criteria	Description	Mean ($\bar{x}$)	SD	Interpretation
Aesthetics	Visual appeal, cultural motifs, and overall attractiveness	4.6	0.55	Very High
Usability	Ease of handling, opening/closing, and dispensing function	4.4	0.63	High
Eco-friendliness	Use of biodegradable materials and environmental safety	4.4	0.58	High
Material Innovation	Novelty of using bamboo fiber or biodegradable composites	4.5	0.60	Very High
Cultural Identity	Representation of Bangnangli local motifs and community value	4.7	0.50	Very High
Overall Mean		4.52	—	Very High

Consumers expressed high satisfaction across all six dimensions**.** The highest mean score was found for fragrance freshness **(**4**.**40**)** and product quality **(**4**.**35**)**, indicating strong approval of the product**'**s sensory appeal and performance**.** Satisfaction with safety, packaging, and price**-**value ratio was also high, confirming that the liquid soap met consumer expectations in

terms of quality, usability, and affordability**.** The overall satisfaction score **(**M = 4**.**32**)** reflects a positive consumer response and supports the potential for commercial scaling of the product**.**

5. Conclusion

The study revealed that the optimal formulation containing 5% stingless bee honey and 1% pomelo essential oil produced excellent product characteristics smooth texture, pleasant natural fragrance, and high stability while maintaining user safety and satisfaction. These results support the functional potential of combining bioactive natural ingredients to achieve both cosmetic efficacy and consumer acceptance.

The finding corresponds with Kakatum et al. (2021), who developed an innovative gel sunscreen using Momordica cochinchinensis (Gac fruit) extract with high antioxidant activity (IC_{50} = 0.72 mg/mL) and low cytotoxicity. Both studies highlight that plant-derived antioxidants improve product stability, safety, and market value. The integration of natural extracts in cosmetic formulations thus represents a sustainable alternative to synthetic chemicals, aligning with the global trend toward green innovation.

In addition, the eco-friendly packaging designed from bamboo fiber and biodegradable plastics with Bangnangli cultural motifs reflects an effective combination of scientific innovation and local identity. This supports Weerapong (2020), who emphasized that community enterprises can enhance competitiveness by merging local wisdom with creative product design.

Overall, this study confirms that the use of natural bioactive ingredients, coupled with sustainable packaging and community participation, forms a viable model for local enterprise development. The results echo Kakatum et al. (2021) in demonstrating that integrating scientific research with local resources can yield safe, eco-friendly, and marketable herbal products that promote both economic and environmental sustainability.

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