

การพัฒนาผลิตภัณฑ์ยาสมุนไพรเมนทอลกลืนตัวยำและการออกแบบบรรจุภัณฑ์:**การประเมินการสร้างมูลค่าทางเศรษฐกิจและสังคมสำหรับวิสาหกิจชุมชน****DEVELOPMENT OF A TOM YUM MENTHOL HERBAL INHALER AND PACKAGING DESIGN:
A PROJECTED ECONOMIC AND SOCIAL VALUE CREATION FOR A COMMUNITY ENTERPRISE**ทรัพย์ อมรปิญโญ^{*1} กฤษดา คำเจริญ¹ ณัฐ อมรปิญโญ² และ พีชยา สุริยวงศ์^{**3}¹คณะสหวิทยาการ มหาวิทยาลัยขอนแก่น วิทยาเขตหนองคาย²คณะวิทยาการจัดการ มหาวิทยาลัยราชภัฏอุดรธานี³ศูนย์ภาษา มหาวิทยาลัยราชภัฏอุดรธานีSup Amornpinyo¹ Kritsda Khajareem¹ Nath Amornpinyo² and Peechaya Suriyawong³¹Faculty of Interdisciplinary Studies, Khon Kaen University, Nong Khai Campus²Faculty of Management Science, Udon Thani Rajabhat University³Language Center, Udon Thani Rajabhat University

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บทคัดย่อ

ชุมชนเกษตรกรรมในจังหวัดหนองคายมีทรัพยากรสมุนไพรพื้นบ้านที่ยังไม่ได้รับการพัฒนาเป็นผลิตภัณฑ์เชิงพาณิชย์มูลค่าสูง การศึกษาครั้งนี้มีวัตถุประสงค์เพื่อพัฒนาผลิตภัณฑ์ยาสมุนไพรเมนทอลกลืนตัวยำนวัตกรรมที่ผสมผสานสมุนไพรไทยอัตลักษณ์จากเครื่องต้มยำ ได้แก่ ข่า ตะไคร้ มะกรูด พริก และหอมแดง เข้ากับเมนทอลเพื่อสรรพคุณทางยา ควบคู่กับการออกแบบบรรจุภัณฑ์ที่สื่อสารอัตลักษณ์ทางวัฒนธรรม เพื่อยกระดับรายได้เกษตรกรในพื้นที่ภายใต้กรอบโครงการหนองคายโมเดล การวิจัยใช้การออกแบบแบบผสมผสานเชิงลำดับ ประกอบด้วย 3 ระยะหลัก ได้แก่ 1. การปรับสูตรผลิตภัณฑ์ให้เหมาะสมที่สุดโดยใช้ระเบียบวิธีพื้นผิวดตอบสนอง (RSM) 2. การประเมินทางประสาทสัมผัสและความพึงพอใจของผู้บริโภค (n=100) และ 3. การประเมินบรรจุภัณฑ์โดยการวิเคราะห์คอนจอยต์สูตรยาที่ได้รับปรับปรุงให้เหมาะสมที่สุดประกอบด้วยเมนทอลความเข้มข้น 18.2% (น้ำหนักต่อน้ำหนัก) ผสมกับน้ำมันหอมระเหยสมุนไพรต้มยำในสัดส่วนที่สมดุล (ข่า:ตะไคร้:มะกรูด:พริก:หอมแดง = 2:3:2:1:2) บรรจุในกระปุกขนาด 8 กรัม โมเดลกำลังสองที่สร้างจาก RSM มีนัยสำคัญสูง ($R^2 = 0.9318$, $p < 0.0001$) โดยสูตรที่ปรับให้เหมาะสมให้คะแนนความยอมรับโดยรวม 8.31 ± 0.29 บนมาตราส่วนเฮโดนิค 9 คะแนน การประเมินความพึงพอใจของผู้บริโภคต่อการออกแบบบรรจุภัณฑ์ใช้มาตราส่วนลิเคิร์ต 5 ระดับ โดยความพึงพอใจต่อบรรจุภัณฑ์ที่ได้รับการประเมินในระดับสูงสุด (ค่าเฉลี่ยโดยรวม 4.63 ± 0.89) และด้านการตลาดได้คะแนนเฉลี่ยสูงสุด (4.66 ± 0.90) การวิเคราะห์คอนจอยต์ระบุว่าบรรจุภัณฑ์แบบเล่าเรื่อง (P3) สามารถตั้งราคาพรีเมียมได้สูงกว่าการออกแบบมินิมอล 31.2% ผลิตภัณฑ์สามารถเพิ่มราคาจำหน่ายที่เสนอขายได้ถึงร้อยละ 82.5 จากราคาเดิม 120 บาท เป็น 219 บาท ต่อกล่อง (6 กระปุก) นอกจากนี้ ผลการประเมินผลตอบแทนทางสังคมจากการลงทุน (SROI) ที่คาดการณ์ไว้ภายใต้สมมติฐานการดำเนินงาน 1 ปี มีค่าเท่ากับ 3.30 ซึ่งหมายความว่าทุก 1 บาทที่ลงทุนจะได้รับผลตอบแทนทางสังคม 3.30 บาท แสดงให้เห็นถึงศักยภาพอย่างมีนัยสำคัญในการสร้างมูลค่าทางเศรษฐกิจและสังคมอย่างยั่งยืน การศึกษาครั้งนี้จึงถือเป็นแบบจำลองที่สามารถนำไปปฏิบัติซ้ำได้สำหรับการเปลี่ยนทรัพยากรสมุนไพรพื้นบ้านให้เป็นผลิตภัณฑ์นวัตกรรมมูลค่าสูงภายในกรอบวิสาหกิจชุมชน เพื่อการพัฒนาเศรษฐกิจชนบทอย่างยั่งยืนต่อไป

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ABSTRACT

Agricultural communities in Nong Khai Province possess abundant indigenous herbal resources that have yet to be effectively transformed into high-value commercial products. This study aimed to develop an innovative Tom Yum menthol inhaler by integrating signature Thai herbs commonly used in Tom Yum—namely galangal, lemongrass, kaffir lime, chili, and shallots—with menthol for therapeutic functionality, alongside culturally expressive packaging design intended to strengthen the local identity and enhance farmers' income under the Nong Khai Model framework. A sequential mixed-methods research design was employed in three phases: 1. formulation optimization using response surface methodology (RSM), 2. sensory and consumer satisfaction evaluation ($n = 100$), and 3. packaging assessment through conjoint analysis. The optimized inhaler formulation consisted of 18.2% menthol (w/w) combined with a balanced blend of Tom Yum herbal essential oils in a 2:3:2:1:2 ratio (galangal: lemongrass: kaffir lime: chili: shallots), packaged in 8-gram containers. The resulting quadratic RSM model was highly significant ($R^2 = 0.9318$, $p < 0.0001$), and the optimized formula achieved an overall acceptability score of 8.31 ± 0.29 on a 9-point hedonic scale. Consumer satisfaction with packaging design was assessed using a 5-point Likert scale, with packaging satisfaction rated at the highest level (overall mean score of 4.63 ± 0.89). The marketing dimension received the highest average score (4.66 ± 0.90). Conjoint analysis further revealed that the storytelling-based packaging design (P3) generated a 31.2% price premium compared with a minimalist alternative. The developed product had an 82.5% increase in market value, from THB 120 to THB 219 per box (6 units). Furthermore, the projected Social Return on Investment (SROI) under a 1-year operational assumption yielded a ratio of 3.30, indicating that every THB 1 invested generated THB 3.30 in social value. This highlights a significant potential for sustainable economic and social value creation within the community enterprise. Ultimately, the findings demonstrate a replicable model for converting local herbal resources into high-value innovative products, with significant implications for sustainable rural economic development.

Keywords: Product Innovation, Packaging Design, Community Enterprise

INTRODUCTION

The global Thai herbal products market has been steadily growing. In 2023, the global market for herbal medicine and wellness products was valued at USD 150 billion, and it is expected to continue growing at a compound annual growth rate (CAGR) of 7.4% to 2030 (Bhattacharjee et al., 2024). In this context, Thai herbal inhalers are unique products that represent Thai cultural identity and have received attention in the international markets, especially in China and ASEAN countries. Consumers from these countries are interested in Thai herbal inhalers and balms (Rakkitathammo, 2024).

Additionally, Thailand is an important herb-growing area, with over 186,000 rai (29,760 hectares) of land dedicated to economic herbs across the country. Herbs commonly used as ingredients in Tom Yum dishes, such as galangal, lemongrass, kaffir lime, chili, and shallots, are widely grown in Nong Khai Province and nearby areas. However, these herbs are often sold as low-value raw materials without any value-added processing (Office of Agricultural Economics, 2023). This situation represents a significant opportunity cost, as these herbs have chemical constituents with pharmacological activities reported in earlier studies (Nopparat & Siree, 2009; Avoseh et al., 2015).

Khon Kaen University, in collaboration with the Committee on Science, Technology, Research and Innovation of the House of Representatives and Nong Khai Province, has been supporting the implementation of the Nong Khai Model. The core of the model focuses on enhancing the quality of life and income levels of target farmers through science, technology, and innovation. The concept of developing a Tom Yum menthol herbal inhaler emerged from the integration of knowledge accessed in two key dimensions: Thai food culture, in which Tom Yum is a popular Thai dish known all over the world, and Thai traditional medicine, where herbs found in Tom Yum are traditionally believed to provide relief to people with respiratory symptoms that benefit from herbal inhalers. Building upon this conceptual foundation, this study introduces innovation at three distinct levels: (1) Product Innovation by integrating the unique Tom Yum aromatic identity into a menthol inhaler, (2) Packaging Innovation through storytelling design to enhance market value, and (3) Community Innovation by employing participatory processes to upgrade low-value agricultural raw materials into high-value commercial products.

RESEARCH OBJECTIVES

The objectives of this study were to:

1. Develop and optimize the formulation of a Tom Yum menthol herbal inhaler based on response surface methodology (RSM). The herbal raw materials were provided by the Community Enterprise of Ban Khok Pa Fang Phatthana Agricultural Housewife Group in Nong Khai Province.
2. Study the product's sensory qualities and evaluate the consumers' acceptance of the Tom Yum menthol herbal inhaler among different target market groups, including community members, general consumers, and international tourists.
3. Design and assess the effectiveness of packaging that conveys cultural identity using conjoint analysis to examine consumers' perceived values and their willingness to purchase.
4. Analyze the economic value and social return on investment (SROI) of product innovation within the context of community enterprise operations.

RESEARCH METHODOLOGY

A sequential mixed- methods design was employed in this study, combining participatory action research (PAR) with advanced statistical techniques to achieve comprehensive product development and assess socio-economic impacts. This approach ensured that both technical optimization and stakeholder perspectives were integrated throughout the research process.

1. Population and Sample

The research participants were strategically divided into two distinct groups to address different aspects of the product development and evaluation phases. **Group 1: Technical Development Group**

The technical development group comprised 20 members from the Community Enterprise of Ban Khok Pa Fang Phatthana Agricultural Housewife Group, located in Pa Kho Subdistrict, Mueang District, Nong Khai Province. This group was instrumental in providing raw materials and actively participating in the formulation development process from the initial stages through product trials. The group was selected according to participatory action research principles, which prioritizes community ownership and facilitates knowledge transfer among participants, thereby strengthening local capacity and ensuring the long-term sustainability of the enterprise.

2. Product Formulation Optimization Using Response Surface Methodology

Optimization of the herbal inhaler formulation was conducted using response surface methodology (RSM) with a central composite design (CCD), employing Design-Expert software (version 13.0, Stat-Ease Inc., Minneapolis, MN, USA) for experimental design, statistical analysis, and model optimization. The independent variables consisted of menthol concentration (ranging from 15 to 22% w/w) and proportional ratios of essential oils derived from Thai herbs including galangal, lemongrass, kaffir lime, chili, and shallots. The dependent variables measured in this optimization phase were odor intensity (assessed on a standardized intensity scale from 0 to 10) and overall sensory acceptance (measured on a nine-point hedonic scale ranging from "extremely dislike" to "extremely like"). The ranges of independent variables were systematically determined based on preliminary trials conducted with the technical development group to ensure practical feasibility and market viability. The adequacy of the quadratic model was rigorously evaluated using analysis of variance (ANOVA), which assessed the statistical significance of model coefficients and the overall fit of the model to the experimental data. Model validation was performed through prediction accuracy testing,

ensuring that the predicted optimal formulation possessed sufficient reliability for subsequent sensory evaluation and consumer assessment phases.

Group 2: Evaluation Sample

A total of 100 participants were selected to conduct sensory evaluation and consumer satisfaction assessments. To ensure comprehensive market representation, these participants were stratified into three distinct groups based on geographical location and consumer behavior patterns. The local stakeholder group comprised 40 members consisting of community enterprise members and residents from the surrounding area. The tourist segment included 30 visitors to Nong Khai Province and border areas, representing potential customers from outside the immediate community. The urban consumer group consisted of 30 participants from Khon Kaen Province, representing a broader geographical market.

For packaging design assessment using conjoint analysis, a subsample of 80 participants was selected from the initial 100 evaluators based on demonstrated high purchase intention. This focused sample group enabled effective evaluation of trade-offs and preferences among various packaging attributes, providing insights into optimal design configurations from a consumer perspective.

3. Research Instruments

The study employed multiple data collection instruments tailored to address each research objective and correspond with the relevant participant groups.

Qualitative research: The researchers developed a semi-structured interview guide containing open-ended questions for the technical development group. This instrument enabled exploration of participants' perspectives, experiences, and insights regarding formulation preferences, ingredient sourcing, production challenges, and perceived value of the product. The qualitative approach facilitated in-depth understanding of community enterprise members' knowledge and practical considerations throughout the product development process.

Quantitative Research—Sensory Evaluation: The researchers developed a closed-ended questionnaire designed to assess sensory attributes and consumer satisfaction among the broader evaluation sample. This instrument measured respondents' perceptions of odor intensity, aroma characteristics, and overall product acceptability using standardized rating scales, enabling statistical comparison across the three consumer segments (local stakeholders, tourists, and urban consumers).

Quantitative Research—Conjoint Analysis: For the conjoint analysis component, the researchers employed a Choice-Based Conjoint (CBC) approach. A specialized conjoint questionnaire was developed, presenting respondents with multiple product profiles that systematically varied packaging attributes, including design concepts (P1, P2, P3), material, size,

price point, and sustainability features. Respondents were instructed to evaluate these hypothetical product combinations and indicate their preferences by selecting their most preferred options among multi-option scenarios. This methodology enabled the research team to decompose overall product preferences into the relative importance (utility scores) of individual packaging attributes, determine the price premium, and identify optimal packaging configurations perfectly aligned with consumer willingness to purchase.

Valuation Assessment: The researchers employed a structured questionnaire to collect data necessary for calculating and evaluating the social return on investment (SROI). This instrument gathered information on economic outcomes, social benefits, and environmental impacts attributed to the community enterprise, enabling quantification and monetization of the project's broader socio-economic value.

4. Data Collection

Data collection was conducted in four stages as follows:

Stage 1: The formulation was developed to produce a prototype of the product.

Stage 2: Sensory evaluation was conducted to identify the most appropriate optimal formulation.

Stage 3: Packaging concepts were assessed and developed into a prototype package.

Stage 4: The analysis of social income creation was conducted to assess the social return on investment (SROI).

5. Data Analysis

Data analysis was done in four steps.

1. Formulation optimization: The response variables obtained from the experiments were analyzed using a quadratic regression model to generate response surface plots and determine the statistically optimal point.

2. Consumer group comparison: A one-way ANOVA, followed by Tukey's Honest Significant Difference (HSD) test, was used to compare acceptance and satisfaction scores among the three consumer groups: local stakeholders, tourists, and urban consumers.

3. Packaging Assessment: Conjoint analysis was used to estimate the utility scores of each packaging attribute. This analysis was also used to quantify the willingness to purchase the most preferred model.

4. Impact analysis: A benefit-cost (B/C) ratio was calculated, and the social return on investment (SROI) was analyzed. This process involved assessing increased value of community productivity, projected health-care cost savings, and local job creation to convert social outcomes into clear monetary values for funding.

6. Research Results

The research findings are categorized by the study objectives as follows:

1. Optimization of the Tom Yum menthol inhaler formulation using RSM

The response surface methodology analysis demonstrated that the quadratic model was statistically significant and adequately fitted the experimental data ($p < 0.0001$). The regression model yielded high predictive accuracy, with an R^2 of 0.9318 specifically for overall sensory acceptance. This indicates that the model robustly explains 93.18% of the variability in consumer preference for the formulation, confirming the model's reliability in predicting optimal sensory outcomes. Furthermore, the model coefficients revealed that menthol concentration exhibited a positive linear effect on odor intensity, while the ratios of certain essential oils (specifically lemongrass and galangal) demonstrated significant interactive effects on overall sensory acceptance. The analysis identified the optimal formulation parameters that simultaneously maximized odor intensity within acceptable ranges while achieving the highest predicted sensory acceptance score among the technical development group. The optimization process utilizing response surface methodology and numerical optimization analysis resulted in the identification of an optimal formulation for the Tom Yum menthol inhaler. This formulation achieved the highest consumer acceptance scores while demonstrating chemical stability in full compliance with pharmacopeia standards, as shown in Table 1.

Table 1 Optimal Formulation Composition of the Tom Yum Menthol Inhaler with Corresponding Component Proportions and Carrier Medium

Component	Optimal Proportion
Menthol (% w/w)	18.2±0.3%
Ratio of herbal essential oils (galangal: lemongrass: kaffir lime: chili: shallots)	2:3:2:1:2
Carrier solvent	Virgin coconut oil

The menthol concentration, 18.2±0.3% by weight, was established as the optimal level, representing a balance between achieving sufficient odor intensity for perceived refreshing and aromatic qualities and maintaining consumer acceptability across all demographic segments evaluated in the study. The herbal essential oil ratio incorporating galangal, lemongrass, kaffir lime, chili, and shallots in a 2:3:2:1:2 proportion was selected to enhance the authentic Thai flavor profile characteristic of Tom Yum cuisine while preserving

the traditional medicinal properties associated with these botanicals. Virgin coconut oil was chosen as the carrier solvent based on its superior stability profile, compatibility with the active ingredients, and alignment with consumer preferences for natural and sustainable formulations. This optimal formulation subsequently underwent sensory evaluation and consumer satisfaction assessment to validate its market viability and acceptability across the three target consumer segments.



Figure 1 Physical appearance of the optimized Tom Yum menthol herbal inhaler, showing the arrangement of herbal ingredients infused in virgin coconut oil.

2. Sensory Evaluation and Consumer Satisfaction

A sensory quality evaluation was conducted using a nine-point hedonic scale, which is a standardized psychometric instrument that measures consumer preferences and acceptance levels for food and consumer products. On this scale, scores range from 1 (dislike extremely) to 9 (like extremely), with a midpoint of 5 representing a neutral response. A sample of 100 participants was stratified into three consumer groups as previously described to ensure representative assessment across diverse market segments. All sensory evaluations were conducted with informed consent from the participants, ensuring no history of allergy to menthol or the specified essential oils. Each participant independently evaluated the optimal

Tom Yum menthol inhaler formulation using the nine-point hedonic scale to assess four key attributes: odor intensity characteristic of Tom Yum cuisine, menthol odor intensity, product novelty, and overall acceptance. Quantitative data were recorded and subsequently analyzed using analysis of variance (ANOVA) to identify statistically significant differences in sensory preferences among the three consumer groups. Statistical significance was established at $p < 0.05$, and significant differences were noted in the results where applicable, as presented in Table 2.

Table 2 Mean Sensory Satisfaction Scores by Consumer Groups for Key Product Attributes on the Nine-Point Hedonic Scale

Evaluated Attribute	Local Stakeholders (n=40)	Tourists (n=30)	Urban Consumers (n=30)	Overall (n=100)
1. Tom Yum odor intensity	8.25 $\pm$ 0.35	8.55 $\pm$ 0.28*	8.35 $\pm$ 0.30	8.38 $\pm$ 0.32
2. Menthol odor intensity	8.10 $\pm$ 0.40	8.00 $\pm$ 0.45	8.05 $\pm$ 0.35	8.05 $\pm$ 0.40
3. Product novelty	8.05 $\pm$ 0.50	8.51 $\pm$ 0.35*	8.40 $\pm$ 0.40	8.30 $\pm$ 0.45
4. Overall acceptance	8.20 $\pm$ 0.30	8.42 $\pm$ 0.25	8.35 $\pm$ 0.30	8.31 $\pm$ 0.29

Note: indicates statistically significant differences at the $p < 0.05$ level when compared to the local stakeholders group using analysis of variance. All scores are presented as mean $\pm$ standard deviation.

The sensory evaluation results demonstrated that the optimized Tom Yum menthol inhaler formulation achieved consistently high acceptance across all consumer segments. The product achieved an overall mean acceptance score of 8.31 ± 0.29 on the nine-point hedonic scale, indicating that consumers rated the product between "like very much" and "like extremely." This uniform acceptance across diverse demographic groups suggests strong commercial viability and broad market appeal.

The analysis revealed two statistically significant differences among consumer segments. The tourist group exhibited notably higher preference for Tom Yum odor intensity (8.55 ± 0.28) compared to the local stakeholders group (8.25 ± 0.35 , $p < 0.05$), suggesting that visitors to Nong Khai Province particularly appreciated the pronounced Thai flavor profile characteristic. Similarly, tourists demonstrated significantly higher ratings for product novelty (8.51 ± 0.35) relative to local stakeholders (8.05 ± 0.50 , $p < 0.05$), indicating that the combination of traditional Thai cuisine with menthol inhalation was perceived as a distinctive and innovative offering by this market segment.

The menthol odor intensity ratings remained consistently high across all three consumer groups (ranging from 8.00 to 8.10), demonstrating that the formulation achieved appropriate balance in this critical attribute. The absence of significant differences in menthol perception among groups suggests that the 18.2% menthol concentration selected through response surface methodology optimization was effective and acceptable across diverse consumer preferences. These findings collectively validate the technical optimization process and support the commercial advancement of this formulation to subsequent market assessment phases.

3. Packaging Design Concepts and Conjoint Analysis Methodology

Three distinct packaging design concepts were collaboratively developed with the technical development group and design professionals to represent varying approaches to visual communication and market positioning. The first concept, designated as Minimal Graphic Design (P1 - General), employed a minimalist aesthetic featuring basic product information, ingredient listings, and usage instructions presented in standard typography on a neutral background. This design served as the baseline comparator, representing a conventional pharmaceutical-style packaging approach. The second concept, designated as Industrial Graphic Design (P2), incorporated geometric patterns, contemporary color schemes, and modernist visual elements to project a technologically advanced and professional product image. This design emphasized product efficacy and scientific legitimacy through visual language commonly associated with industrial and pharmaceutical sectors.

The third concept, designated as the Storytelling Graphic Design (P3 - Community Identity), was developed to visually communicate the product's origins, traditional knowledge systems, and community heritage. This design incorporated narrative elements including visual representations of the herbs used in the formulation, illustrations depicting traditional Thai medicinal practices, imagery of the Ban Khok Pa Fang Phatthana community, and text narratives explaining the connection between Tom Yum cuisine and herbal wellness. This design approach emphasized cultural authenticity, community pride, and the integration of traditional knowledge with contemporary product innovation.

To evaluate consumer preferences among these three packaging concepts, a conjoint analysis was conducted with 80 participants. A purposive sampling approach was utilized, focusing on participants with an initial interest in herbal products to evaluate specific packaging preferences among potential target buyers, rather than the general population. Conjoint analysis is a quantitative methodology that systematically presents respondents with multiple product profiles representing different combinations of predefined attributes and levels. In this study, participants were presented with visual mockups of the three packaging designs and asked to evaluate and rank their preferences among the presented options. This methodology

enabled decomposition of overall packaging preference into utility scores for individual design concepts, estimation of the relative importance of design attributes in driving consumer choice, and quantification of consumer willingness to accept price premiums for preferred design characteristics. Following the conjoint analysis exercise, participants completed a satisfaction evaluation using a five-point Likert scale (ranging from 1 = strongly dissatisfied to 5 = strongly satisfied) to assess three dimensions of the selected optimal packaging design: structural and functional aspects, aesthetic qualities, and effectiveness in communicating marketing and community identity messages, as detailed in Tables 3 and 4.

Table 3 Utility Scores and Price Premium Implications Derived from Conjoint Analysis of Three Packaging Design Concepts

Packaging Design Concepts	Utility Score	Price Premium Compared with Minimal
1. Minimal graphic design (P1 - General)	0.95	Baseline (0%)
2. Industrial graphic design (P2)	0.51	-15.5% (Decrease)
3. Storytelling graphic design (P3 – Community Identity)	1.42	+31.2% (Increase)

Note: Utility scores represent the relative preference strength for each packaging design concept derived from conjoint analysis. Positive price premiums indicate consumers' willingness to pay higher prices for preferred design concepts compared to the minimal baseline design.

The conjoint analysis results demonstrated decisive consumer preference for the storytelling-focused packaging design concept (P3 - Community Identity). This design achieved a utility score of 1.42, substantially outperforming both the minimal graphic design baseline (utility score 0.95) and the industrial graphic design alternative (utility score 0.51). The superiority of the storytelling design was further evidenced through price premium analysis, which revealed that consumers demonstrated willingness to accept a price increase of 31.2% for the community identity-focused packaging compared to the minimal design baseline. Conversely, the industrial graphic design received negative valuation, with consumers indicating acceptance of only a 15.5% price reduction relative to the minimal design, suggesting that this modernist aesthetic approach was perceived as less aligned with consumer preferences and product positioning within the target market.

Table 4 Consumer Satisfaction Dimensions for the Storytelling Packaging Design (P3) Measured on a Five-Point Likert Scale

Packaging Evaluation Dimension	Mean	Standard Deviation (SD)	Satisfaction Level
1. Structural and functional aspect	4.58	0.85	Strongly Satisfied
2. Aesthetic aspect	4.65	0.88	Strongly Satisfied
3. Marketing and identity communication aspect	4.66	0.90	Strongly Satisfied
Overall Packaging Satisfaction	4.63	0.89	Strongly Satisfied

Note: All satisfaction dimensions are measured on a five-point Likert scale where 1 = strongly dissatisfied and 5 = strongly satisfied. Satisfaction levels are interpreted as follows: 4.50–5.00 = Strongly Satisfied, 3.50–4.49 = Satisfied, 2.50–3.49 = Neutral, 1.50–2.49 = Dissatisfied, 1.00–1.49 = Strongly Dissatisfied.



Figure 2 Tom Yum menthol herbal inhaler and its value-added packaging.

Following identification of the storytelling packaging design as the optimal concept through conjoint analysis, the selected design underwent detailed satisfaction evaluation across three consumer-relevant dimensions. Results indicated exceptionally high and consistent satisfaction across all assessed aspects. The structural and functional aspect dimension, evaluating the packaging's practical utility, durability, and ease of use, achieved a

mean score of 4.58 ± 0.85 . The aesthetic aspect dimension, measuring visual appeal and design quality, attained a mean score of 4.65 ± 0.88 . The marketing and identity communication aspect dimension, assessing effectiveness in communicating product differentiation and community heritage, achieved the highest rating, 4.66 ± 0.90 . The overall packaging satisfaction rating across all dimensions was 4.63 ± 0.89 , indicating strong consumer approval and confidence that the selected packaging design effectively serves multiple functional, aesthetic, and communicative purposes.

These packaging assessment findings demonstrated that consumers strongly value authentic cultural narrative and community identity representation in product packaging. The substantial price premium associated with the storytelling design, combined with exceptionally high satisfaction ratings, indicates significant commercial viability and suggests that investment in culturally meaningful packaging design can serve as both a market differentiation strategy and a mechanism for amplifying the social value proposition inherent in community-based enterprises.

4. Economic and Social Return Analysis

Commercial comparison illustrated an increase in product value following the product development phase, as shown in Table 5.

Table 5 Product Value Enhancement and Economic Indicators Comparing Pre- and Post-Development Stages

Economic Indicator	Pre-Development (Raw Material/Basic Inhaler)	Post-Development (Innovative Product)
Selling price per box (6 units) (THB)	120	219
Product value enhancement	-	82.5%
Daily added income per member (THB/person/day)	Approximately 50 (From raw material sales)	Approximately 91 (from processing)
Benefit-Cost Ratio (B/C Ratio)	-	2.25

Note: THB denotes Thai Baht, the official currency of Thailand. All economic values are presented in nominal Thai Baht without adjustment for inflation. Daily added income represents the average incremental income generated per community enterprise member from product-related activities.

Commercial comparison analysis demonstrated substantial economic value creation through the product development initiative. The selling price per unit increased significantly from 120 THB per box of six units in the pre-development stage to 219 THB in the post-development stage, representing an overall product value enhancement of 82.5%. This price increase reflects the cumulative value-addition resulting from optimized formulation, professional packaging design, and enhanced market positioning achieved through the development process.

Daily income analysis revealed corresponding improvements in individual livelihood outcomes for community enterprise members engaged in product processing and marketing activities. Pre-development income derived primarily from raw material sales averaged approximately 50 THB per person per day. Following product development and commercialization, the daily added income from processing and value-addition activities increased to approximately 91 THB per person per day, representing a net income increase of approximately 82% and demonstrating meaningful economic benefit accrual at the individual household level.

The benefit-cost ratio calculated for the overall initiative was 2.25, indicating that for every one THB of investment in research and development, product commercialization, and capacity building activities, the community enterprise generated 2.25 THB in measurable economic returns. This positive ratio demonstrates favorable economic viability and suggests sustainable long-term financial performance for the community enterprise.

Social Return on Investment Analysis

The social return on investment (SROI) analysis complemented the conventional economic assessment by quantifying the broader societal benefits generated through the development initiative. The SROI methodology incorporates multiple dimensions of social value creation, including employment generation, community pride and social cohesion, promotion of sustainable agricultural practices, and enhancement of local cultural identity and knowledge systems. These social outcomes are typically intangible or difficult to monetize through conventional market mechanisms; therefore, the SROI approach employs financial proxy values derived from social science literature, precedent case studies, and stakeholder valuation to translate social benefits into monetary equivalents.

In this study, the SROI analysis resulted in a ratio of 3.30, indicating that the community enterprise initiative generated social value equivalent to 3.30 THB for every Thai baht invested by community organizations and government agencies in research and development activities, product formulation optimization, packaging design, and capacity building. This SROI ratio encompasses quantified benefits from employment creation among community members, strengthened community identity through product association with Ban

Khok Pa Fang Phatthana village heritage, demonstrated commitment to organic and sustainable agricultural production systems, and enhanced social cohesion resulting from collaborative enterprise participation. The systematic breakdown of these financial proxies, projected over a simulated one-year operational period, is detailed in Table 6.

Table 6 Projected Social Return on Investment (SROI) for the Tom Yum Menthol Herbal Inhaler (1-Year Simulation)

Category	Impact Outcome/Indicator	Financial Proxy	Value (THB)
1. Investment (Inputs)	R&D and Product Formulation Optimization	Direct project expenses	30,000
	Packaging Design & Consumer Research	Direct project expenses	40,000
	Initial Production (Equipment & Materials)	Capital expenditure	50,000
	Community Training & Capacity Building	Cost of workshops and experts	30,000
	Total Investment (A)		150,000
2. Outcomes (Impacts)	Economic: Increased Revenue Margin	Price premium (+99 THB/unit) x Estimated 2,000 units sold	198,000
	Economic/Environmental: Sustainable Agricultural Production (Local Supply Chain)	Purchase value of local organic herbs (galangal, lemongrass, kaffir lime)	77,000
	Social: Employment Generation	Additional household wages for community members	120,000
	Cultural/Social: Community Pride & Identity	Estimated brand equity derived from local storytelling	100,000
	Total Impact Value (B)		495,000
3. SROI Ratio	SROI = Total Impact Value (B) / Total Investment (A)	495,000 / 150,000	3.30

Note: The SROI ratio of 3.30 is a 1-year projection based on simulated operational capacity. It represents potential social value creation, not observed historical profits.

The Social Return on Investment (SROI) was calculated at 3.30, which is notably higher than the financial B/C ratio of 2.25. This difference highlights the substantial non-financial value generated by the project. While the B/C ratio of 2.25 confirms strong financial profitability (indicating a return of 2.25 THB for every 1 THB invested), the SROI of 3.30 demonstrates that when social and environmental proxies are monetized—such as enhanced community pride, local skill development, empowerment of the elderly, and the sustainable utilization of local agricultural resources—the overall value delivered to the community is significantly amplified. This validates the effectiveness of integrating community identity into product development, as it yields returns that extend far beyond mere financial metrics.

These combined economic and social return findings demonstrate the substantial value creation potential of the Nong Khai Model in promoting sustainable rural development. Integration of community enterprise development with rigorous product optimization, culturally meaningful branding, and authentic storytelling packaging design creates a replicable framework for transforming traditional knowledge and local agricultural resources into commercially viable products that simultaneously generate greater household income and strengthen community social cohesion and cultural identity.

DISCUSSION

The study's findings are discussed in the context of related concepts, theories, and previous research. They are connected to the research objectives and experimental results for each aspect, as follows.

1. For formulation optimization of the Tom Yum herbal inhaler using RSM, the study results showed that the optimal formulation contained 18.2% menthol combined with essential herbal oils. Using virgin coconut oil as a carrier provided the highest stability and aroma intensity. These findings agree with Montgomery (2019), who indicated that response surface methodology (RSM) effectively reduced experimental errors in optimizing pharmaceutical extract proportions much better than a traditional one-factor-at-a-time approach.

2. For sensory evaluation and consumer satisfaction, the results illustrated that the tourist group rated novelty and overall acceptance (hedonic score) significantly higher than the local group. Similarly, Sthapit (2017) explored tourists' memorable food experiences (novelty seeking) associated with local identity.

3. According to packaging assessment using conjoint analysis, the results indicated that customers ascribed the highest utility to storytelling packaging, demonstrating a willingness to pay a premium price that was up to 31.2% higher. This finding revealed the effectiveness of packaging in communicating value. This was also supported by Amornpinyo (2021), who observed that integrating community identity and local narratives into packaging enhanced

perceived value and could elevate low-priced goods to premium products. Similarly, Rundh (2016) reported that narrative illustrations on packaging directly influence purchase decisions at the point of sale and decrease price sensitivity among contemporary consumers.

4. Economic and social return analysis

The social return on investment (SROI) was 3.30, while the local value-added reached 82.5%. These numbers demonstrate the efficiency of technology transfer to the community through social return on investment analysis. Moreover, these results aligned with Suwankesorn et al. (2024) in their investigation of the social impact of an agricultural processing community enterprise. Their study revealed that utilizing innovative products made from 100% local resources generated a multiplier effect in the grassroots economy. Furthermore, these results aligned with Ashton et al. (2024) on the issue of the social impact assessment framework. It indicated that the investment of research and development on local community product packaging provided both financial returns and social value, such as occupational pride, job creation, and preservation of local herbs. These are important for the sustainable development of the creative economy under the framework of a Bio Circular Green (BCG) Economy model.

LIMITATIONS AND FUTURE RESEARCH

While this study provides a foundational framework for community product development, several limitations should be acknowledged. First, the SROI and economic impact assessments are based on a 1-year projection rather than observed historical financial data. Future longitudinal studies are required to validate actual income enhancements and profit margins. Second, the sensory evaluation focused on consumer preferences and aromatic qualities; it does not confirm clinical therapeutic efficacy. Finally, the purposive sampling used in the conjoint analysis may not fully represent the broader national market. Future research should involve larger, cross-regional sample sizes and actual market-testing phases.

CONCLUSIONS AND RECOMMENDATIONS

This study addressed four primary research questions designed to guide the development of a community-based herbal inhalation product that integrates traditional Thai culinary and medicinal knowledge with contemporary product innovation and market-oriented business practices. The research questions encompassed the following objectives: (1) What optimized formulation of menthol and Thai herbal essential oils would achieve superior sensory characteristics and consumer acceptance? (2) What sensory and consumer satisfaction levels could be achieved for the optimized product across diverse market segments? (3) What packaging design approach would most effectively communicate community identity while maximizing consumer appeal and market value perception? and (4) What economic and social

value would be generated through the product development process for community enterprise stakeholders?

The findings of this comprehensive investigation provide definitive answers to each research question. First, response surface methodology optimization identified an optimal formulation containing menthol at $18.2 \pm 0.3\%$ by weight combined with herbal essential oils in a 2:3:2:1:2 ratio of galangal, lemongrass, kaffir lime, chili, and shallots, with virgin coconut oil as the carrier. This formulation achieved superior performance across both dependent variables examined, with an R^2 value of 0.9318, indicating that the model explained 93.18% of the variance in both odor intensity and overall sensory acceptance.

Second, sensory evaluation across three distinct consumer segments—local stakeholders, tourists, and urban consumers—revealed consistently high acceptance with an overall mean score of 8.31 ± 0.29 on a nine-point hedonic scale. Tourist consumers demonstrated significantly higher appreciation of both the Tom Yum odor intensity and product novelty attributes compared to local stakeholders, indicating strong market appeal for this distinctive product positioning.

Third, conjoint analysis demonstrated that a storytelling-focused packaging design emphasizing community identity and cultural heritage substantially outperformed both minimal and industrial design alternatives. The storytelling design achieved a utility score of 1.42, compared to 0.95 for the minimal baseline and 0.51 for the industrial design. It generated a consumer willingness to accept a price premium of 31.2%, representing substantial commercial value differentiation.

Fourth, economic and social return analysis demonstrated that the product development initiative generated measurable value at both household and community levels. The selling price increased from 120 to 219 THB per box, representing an 82.5% product value enhancement. Daily income for individual community members engaged in processing and marketing increased from approximately 50 to approximately 91 THB per person per day. The benefit-cost ratio of 2.25 indicated that every Thai baht invested in the initiative generated 2.25 THB in economic returns, while the complementary SROI analysis demonstrated equivalent social value generation through employment creation, enhanced community pride, and promotion of sustainable agricultural practices.

Through this investigation, several important insights emerged that advance understanding in the fields of product development for community enterprises, consumer behavior research in emerging markets, and sustainable rural development frameworks. First, this study demonstrates that systematic application of contemporary optimization methodologies—particularly response surface methodology and conjoint analysis—can effectively bridge traditional knowledge systems with modern product development practices. The successful integration of Thai culinary and medicinal traditions with evidence-based

formulation and design optimization validates the potential for traditional knowledge to serve as a foundation for commercially viable innovation rather than representing merely historical or cultural artifacts.

Second, this research provides empirical evidence that consumers in developing market contexts exhibit substantial willingness to pay price premiums when products authentically communicate community identity, cultural heritage, and social-value narratives. The 31.2% price premium associated with storytelling packaging design, combined with exceptionally high satisfaction ratings across all packaging evaluation dimensions, challenges conventional assumptions that consumers in emerging markets prioritize only functional attributes and lowest-cost options. This finding suggests that market segmentation strategies emphasizing cultural authenticity and community connection may represent effective differentiation approaches for small and medium enterprises in developing regions.

Third, the study demonstrates the viability of the Nong Khai Model as a replicable framework for community enterprise development that simultaneously achieves economic sustainability and social value generation. The integration of rigorous research methodology, culturally meaningful product positioning, and authentic community narrative in both product formulation and packaging design created measurable positive outcomes across economic indicators and social cohesion measures. This framework may serve as a template for government agencies and development organizations supporting agricultural product upgrading and community enterprise development in other regional contexts.

Fourth, the research reveals important market segmentation insights regarding tourist consumer preferences versus local stakeholder preferences. The significant preference differential observed among tourist consumers for product novelty and Thai flavor intensity characteristics indicates that tourism-oriented marketing channels and positioning strategies may warrant differentiated product attributes or communication approaches compared to locally focused distribution. This finding suggests opportunities for market-specific product variations or packaging adaptations that preserve core product quality while addressing segment-specific preference profiles.

The broader significance of this research extends beyond the specific product developed or the particular community enterprise context studied. This work demonstrates the potential for systematically designed research and development initiatives to support livelihood improvements and economic advancement in resource-constrained community contexts while simultaneously strengthening cultural identity and social cohesion. The successful application of advanced statistical methodologies, consumer preference analysis, and social return measurement frameworks to community enterprise development challenges suggests possibilities for scaling such approaches to other agricultural products, regions, and development contexts throughout Thailand and comparable developing markets.

RECOMMENDATIONS FOR IMPLEMENTATION AND PRACTICE

Quality Control and Operational Excellence: The community enterprise should establish a formal quality assurance program grounded in the optimized formulation identified through this research. Development of a comprehensive standard operating procedure manual detailing the 18.2% menthol specification, the precise 2:3:2:1:2 herbal essential oil ratio, carrier selection, and manufacturing process protocols will ensure consistency and reproducibility across all production batches. This operational systematization is essential for maintaining the sensory characteristics and consumer acceptance levels demonstrated through this study and for establishing a foundation for official product registration and certification.

Premium Market Positioning and Distribution Strategy: Recognition of the substantial consumer willingness to pay premium prices for the storytelling packaging design warrants deliberate market positioning strategy focused on premium and experiential retail channels. The community enterprise should prioritize distribution through cultural tourism sites, including temples, heritage centers, and cultural attractions that draw both domestic and international visitors. Placement within specialized souvenir shops targeting foreign tourists and provincial OTOP (One Tambon One Product) retail locations would align with the product's distinctive positioning and target consumer demographics. This channel strategy leverages the premium packaging design effectiveness demonstrated through conjoint analysis and capitalizes on the tourist consumer segment's demonstrated higher appreciation for product novelty and cultural authenticity.

Policy Framework and Government Support: Government agencies, including the Community Development Department and the Ministry of Commerce, should consider formal adoption of the Nong Khai Model as an evidence-based best practice framework for supporting research and development investments in community enterprise product innovation. The demonstrated social return on investment ratio, 3.30, combined with the model's successful integration of optimization methodologies, culturally meaningful positioning, and rigorous consumer evaluation, provides a replicable template for scaling similar initiatives across other regions and agricultural product categories. Institutional adoption of this framework would enable systematic upgrading of agricultural products, application of advanced statistical and design methodologies, and consistent measurements of both economic and social value generation across government-supported development initiatives.

RECOMMENDATIONS FOR FURTHER RESEARCH

Clinical and Efficacy Validation: Future research should prioritize physiological and clinical investigation of the therapeutic properties claimed or implied for the Tom Yum herbal inhaler formulation. Specifically, controlled clinical trials should be conducted to determine whether the essential oil aroma combination effectively relieves nasal congestion, alleviates

dizziness symptoms, or enhances alertness and cognitive performance. Such clinical evidence is essential for official product registration with health authorities and for substantiation of health-related claims in marketing communications. Rigorous clinical validation would strengthen the product's credibility, expand potential distribution channels including pharmacy and health retail sectors, and support premium pricing strategies grounded in demonstrated efficacy rather than aesthetic or cultural appeal alone.

Product Line Extension and Portfolio Development: Research and development efforts should explore formulation and commercialization of herbal inhalers featuring essential oil combinations representing other iconic Thai culinary traditions, including mango sticky rice, green curry, and Thai tea. This portfolio expansion would create a more comprehensive souvenir collection with broader appeal to diverse tourist segments and would enhance the product's positioning within gift and tourism retail environments. Additionally, product line extension would strengthen the brand identity and community enterprise market presence while utilizing similar optimization and evaluation methodologies established through the current study.

International Market Assessment and Cross-Cultural Consumer Research: Given the evident appeal of the product to international tourists and the potential for export commercialization, further research should systematically evaluate consumer acceptance and satisfaction profiles in priority foreign markets, including China and Western Europe. Cross-cultural consumer behavior research in these markets would identify culturally specific preferences, communication approaches, and packaging adaptations required for effective market entry. Such research must be integrated with comprehensive assessment of applicable legal regulations, food safety standards, labeling requirements, and packaging specifications mandated in targeted foreign markets. This combination of consumer research and regulatory analysis would substantially reduce market entry risk and inform strategic decisions regarding product adaptation versus standardization for international commercialization.

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