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The Ethnochemistry Dimensions of *Lemeng* in Malingping: Producer and Seller Narratives

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Abstract
Lemeng is a traditional food from Malingping, Lebak Regency, Banten Province, Indonesia. It is prepared from glutinous rice cooked inside bamboo segments through direct-fire roasting. This study examined the ethnochemical concepts embedded in the production process of *lemeng* and compares the perspectives of producers and sellers using a qualitative ethnographic approach. Data were collected in May 2026 through in-depth interviews (lasting approximately 35 minutes each) and direct, non-participant observations (totaling 325 minutes) with six purposively selected respondents: three producers and three sellers from the Lebak region, aged 38 to 80 years, with over five years of experience. The findings indicate that the production process of *lemeng* involves several chemistry concepts inferred from traditional practices and supported by published literature—such as starch gelatinization, coconut milk emulsification, heat transfer (conduction and radiation), release of volatile compounds, and the Maillard reaction—rather than empirically established through chemical assays in this study. Patterned thematic differences in perspectives emerged from the informants' narratives: producers prioritized cultural preservation and the transmission of tradition, whereas sellers emphasized product consistency and market demand. These findings suggest that *lemeng* embodies both cultural and historical significance while incorporating scientific chemical principles, highlighting its potential as a contextual foundation for the future development of ethnochemistry-based chemistry education at secondary and tertiary levels.

Keywords: Contextual Chemistry Learning; Ethnochemistry; Lemeng; Local Wisdom; Starch Gelatinization

INTRODUCTION

Indonesia has a diverse traditional culinary heritage, with regions offering distinctive culinary practices. One notable example is lemeng, a traditional food associated with Malingping, Lebak Regency, Banten Province. This food is prepared from glutinous rice cooked inside bamboo segments using a direct-fire roasting technique. Beyond its role as a regional culinary identity, *lemeng* has cultural significance; based on local community accounts, it is traditionally served during communal gatherings and religious festivities in Malingping, acting as a medium for social cohesion and intergenerational knowledge transfer. For instance, preliminary interviews with local elders reveal that the night-long communal roasting process requires a coordinated division of labor, naturally embedding the transmission of intricate fire-tending skills and recipes to younger family members (Gardjito, 2018; Sukenti et al., 2016). Ethnochemistry provides a framework to examine such practices by distinguishing between three analytical layers: the community's own linguistic and empirical explanations of their practices, the observable physical food-processing techniques, and the externally applied scientific interpretation of the underlying molecular and thermodynamic phenomena (Junaidi et al., 2025). Through this multi-layered lens, the preparation of *lemeng* can be examined systematically.

A literature search conducted using Google Scholar, covering the publication period from

2021 to 2026, utilized keywords such as "lemeng", "lemang", "bamboo-cooked glutinous rice", and "ethnochemistry". The initial search yielded approximately 10 articles. After screening titles and abstracts to exclude purely agronomic or unrelated studies, the screened literature suggests that existing research predominantly concentrates on socio-cultural preservation or economic mapping (Wijaya, 2019). Key recent studies examining similar traditional dishes, such as *lemang*, frequently detail cultural symbolism or market viability but omit systematic chemical analyses. Consequently, specific chemical mechanisms—such as the *in-situ* starch gelatinization dynamics and bamboo-mediated heat transfer—have received limited discussion in the reviewed sources. Ethnochemistry bridges indigenous knowledge with formal chemical principles, offering a culturally responsive framework that empowers students' scientific identity (Rahmawati et al., 2019).

The novelty of this study lies in its qualitative mapping of traditional practices, literature-based scientific interpretations, and occupational narratives. By contrasting the empirical knowledge of producers and sellers, this study reveals how distinct occupational orientations—namely, cultural preservation versus market adaptation—shape how the observed practices that can be interpreted using chemistry concepts are managed, standardized, and valued by different practitioners.

To address these gaps, this study is guided by the following research questions: (1) What are the ethnochemical concepts associated with the preparation of lemeng in Malingping, as identified through observable practices and scientific literature comparison? (2) How do the empirical knowledge and value orientations regarding these processes differ between producers and sellers, based on thematic narrative analysis? and (3) How can these documented ethnochemical concepts be contextually mapped onto specific secondary and tertiary chemistry curricular topics (such as colloids, thermochemistry, and macromolecules) to serve as a prospective foundation for educational materials?

METHODS

Study Design and Research Context

This study employed a qualitative approach using a focused ethnographic, exploratory case study design (Yin, 2018) to explore the ethnochemical dimensions of lemeng, reflecting the targeted and time-bound nature of the field engagement. The research team conducted field observations on May 15 and May 30, 2026, adopting a direct, non-participant observer role within the local community. Fieldwork focused on the primary production sites and retail market environments. The research was conducted at two main locations: Malingping and Rangkasbitung traditional market. Malingping was specifically selected because it is officially recognized by the Banten Provincial Tourism Office (2023) as the historical and commercial hub of traditional *lemeng* production, where the dish serves as a regional culinary icon. Furthermore, while Malingping serves as the cultural center, informants based outside Malingping (such as those from Rangkasbitung, Cikotok, and Cikadu) were purposefully included in the study; these practitioners represent the broader regional diffusion of this culinary heritage across Lebak Regency and actively employ or interact with the authentic Malingping production techniques.

The ethnographic context of *lemeng* is deeply rooted in local socio-cultural practices. Local cultural archives and media publications (Perpustakaan Digital Budaya Indonesia, 2022; Turisian, 2023) indicates that *lemeng* is prominently prepared during specific communal occasions, notably throughout the holy month of Ramadan for *iftar* (breaking the fast) and during Eid al-Fitr celebrations, where it culturally serves as a substitute for *ketupat* (woven palm leaf rice cakes). Alongside these archival accounts, interviews with the six informants indicated that the production process is guided by indigenous knowledge embedded in local Sundanese terminologies. During the interviews, informants systematically utilized emic terms such as *beasna diisikan* (washing the rice), *diasak* (the cooking process), *dibeuleum* (direct-fire roasting), and *asak* (the fully cooked state). These vernacular terms illustrate links among language, empirical experience, and inherited food-processing practices maintained by the culinary

practitioners.

Participant Selection and Ethical Considerations

Participants were recruited using purposive sampling to provide rich, contextualized data from a specific group without aiming for broad population generalizability (Creswell & Poth, 2018). To account for overlapping tasks observed in the field, the occupational categories were operationally separated based on their primary position in the supply chain: "Producers" are defined as individuals who manufacture *lemeng* entirely from raw ingredients, whereas "Sellers" are those who primarily focus on retail and customer interaction, even if they perform secondary or final roasting at their stalls to maintain product warmth and crust quality. The selection criteria included continuous involvement in their respective roles for at least five years, ensuring established empirical knowledge, and the willingness to provide observational access. Prior to data collection, verbal informed consent was obtained from all participants. The consent process documented their agreement to be interviewed, audio-recorded, and photographed without disrupting their livelihoods (Figure 2). To protect confidentiality, participant identities were anonymized using alphanumeric codes (P1–P3 for producers and S1–S3 for sellers), and explicit permission was secured for the academic publication of any field photographs where participants or their stall locations might be identifiable.

Although this study is culturally anchored in the *lemeng* tradition of Malingping, it intentionally investigates a wider regional production-distribution network across Lebak Regency rather than being restricted to a single locality. Accordingly, informants located outside Malingping—such as those in Rangkasbitung, Cikotok, and Cikadu—were purposively selected because they actively employ the authentic Malingping processing techniques or participate directly in its retail supply chain. The demographic profiles of the six anonymized informants (P1–P3 for producers; S1–S3 for sellers) who represent this broader network are detailed in Table 1.

Table 1. Participant Demographics

Code	Role	Age	Origin/Location	Experience
P1	Producer	55	Rangkasbitung	> 5 years
P2	Producer	57	Rangkasbitung (Lewiranji)	> 5 years
P3	Producer	40	Cikotok	> 5 years
S1	Seller	40	Malingping	> 5 years
S2	Seller	38	Cikadu	> 5 years
S3	Seller	80	Malingping	> 5 years

Data Collection and Instruments

Data were collected through in-depth interviews, non-participant observations, and document analysis.

1. In-depth Interviews: A semi-structured interview guide was used, covering principal domains such as the functional purpose of each ingredient, fire management techniques, sensory indicators of doneness, and the intergenerational transmission of culinary knowledge. The guide was reviewed by chemistry education faculty and piloted with a local elder prior to formal data collection. Each of the six participants engaged in one primary interview session lasting approximately 35 minutes, supplemented by brief follow-up clarifications during the observation periods. Interviews were conducted primarily in Indonesian and the local Sundanese dialect to accommodate the informants' comfort and accurately capture emic expressions. To avoid imposing scientific categories, the interviews elicited indigenous explanations first; for example, rather than asking about starch gelatinization, the researcher asked an emic question such as, "Why must the rice be soaked before roasting?" (*"Kunaon beasna kedah dikeueum heula saacan dibeuleum?"*). All interview sessions were audio-recorded and transcribed verbatim into Indonesian while meticulously preserving key Sundanese terminology, providing the

traceable evidentiary basis for all direct quotations and subsequent chemical inferences.

2. Direct Observation: The researcher conducted two non-participant observation sessions—lasting 230 minutes and 95 minutes, respectively (totaling 325 minutes). These sessions took place specifically at the sites of S1-S3 in Rangkasbitung and P1-P3 in Malingping. A complete, uninterrupted cooking cycle—from the initial preparation of ingredients and bamboo stuffing to the final roasting phase—was witnessed at both sites. To maintain the natural workflow of the informants, the researcher did not physically intervene in the cooking process but documented the activities visually and chronologically. The observation guide utilized a structured field-note format accompanied by a digital chronometer to accurately log process changes. Heating durations and bamboo rotation frequencies were recorded in real-time as timed field observations (e.g., logging exact rotation intervals every 10–15 minutes). These chronological logs were distinguished from the generalized time estimates verbally reported by respondents during the interviews. These timed metrics, alongside visual-tactile changes in product texture (such as steam emission and crust formation), formed the empirical basis for the subsequent chemical inferences.
3. Document Analysis: Local documents were analyzed by reviewing specific digital cultural archives and regional media publications, notably *Perpustakaan Digital Budaya Indonesia* (2022), *Turisian* (2023), and *Jagad Tani* (2026). The inclusion criteria for these documents required that they explicitly detail the socio-cultural context or historical significance of *lemeng* in Lebak Regency, originate from recognized cultural repositories or established regional journalistic platforms, and were published within the last five years to ensure contemporary relevance. To improve transparency and traceability, claims extracted from these secondary documents—such as the specific use of *lemeng* during Ramadan and Eid al-Fitr—were methodically triangulated. Specifically, archival claims were cross-checked against the primary empirical data by verifying them during the informant interviews to confirm their ongoing practical reality, ensuring that media narratives matched the lived experiences of the culinary practitioners.



Figure 1. The physical appearance of lemeng inside charred bamboo segments after the direct-fire roasting process (*dibeuleum*)



Figure 2. In-depth interview session with a *lemeng* seller at the local market

Data Analysis

All audio-recorded interviews were transcribed verbatim into Indonesian, carefully preserving local Sundanese expressions. To maintain a clear translation audit trail and preserve cultural nuances, the English translations of these emic terms were peer-reviewed by bilingual members of the research team. Data were then analyzed using a thematic analysis framework (Braun & Clarke, 2006). To ensure methodological rigor and trustworthiness (Lincoln & Guba, 1985), the coding process involved six researchers who initially double-coded a subset of the transcripts (e.g., the first two interviews) to develop a shared codebook. The remaining transcripts were then divided equally among three pairs of coders for independent open coding.

The researchers then used axial coding to group local practices into broader categories (Braun & Clarke, 2019). Discrepant codes between paired researchers were resolved through joint analysis meetings, where the coders returned to the raw audio and transcripts to debate interpretations until a negotiated consensus was achieved. These agreed-upon categories were ultimately abstracted into final overarching themes. For example, a raw interview extract from a producer stating, "Bambu diputer ambeh asakna rata" (The bamboo is rotated so it cooks evenly), was initially assigned the open code "manual heat distribution," which was subsequently grouped via axial coding into the final theme of "Sensory-based fire and rotation control". To identify ethnochemical concepts, an explicit evidence matrix was constructed to systematically separate and align four analytical dimensions: (1) participant wording (emic terminology), (2) direct field observations, (3) the researcher's scientific hypothesis, and (4) supporting scientific literature. Importantly, the chemical mechanisms reported in the findings are literature-based hypotheses inferred from observed field conditions; no instrumental chemical measurements were performed in this study. Consequently, alignment with the literature is utilized to provide plausible theoretical explanations rather than serving as an empirical validation of the chemical mechanisms. Finally, the differences between producers and sellers were analyzed using a qualitative comparative matrix (Miles, Huberman, & Saldaña, 2014), aligning coded data across predetermined categories to construct contrasting typologies.

RESULT AND DISCUSSION

Ingredients for Lemeng Preparation and Their Chemistry Concepts

Based on interviews with all six informants, similar descriptions were obtained regarding the primary ingredients used in *lemeng*. The interviews also indicated that sellers possess firsthand preparation knowledge rather than merely relaying information from producers; S1 and S3 routinely perform the final roasting phases at their retail stalls to manage crust quality,

while S2 prepares independent, modified batches. An informant-by-ingredient cross-check revealed unanimous agreement across all six participants (P1–P3; S1–S3) that glutinous rice, coconut milk, bamboo, and banana leaves were regarded as essential ingredients (synthesized in Table 2). The three producers reported no variations in the basic recipe, who strictly adhere to the traditional composition, though seller S2 reported experimenting with additions such as peanuts to diversify texture. The informants recognize the role of each ingredient through empirical, functional observations. To illustrate this consistency across roles, producer P1 noted that glutinous rice is essential because it "binds together and doesn't fall apart" (*"rapet, teu acak-acakan"*). This functional requirement was independently corroborated by seller S3, who stated the rice must "stick perfectly to the crust" (*"kedah nempel kana kerak"*). These emic observations are consistent with the expected textural effects of the high amylopectin content of the starch.

Table 2. Ingredients, Emic Functions, and Hypothesized Chemistry Concepts

Ingredient	Participant-Reported Function (Emic)	Observed Material Role (Field Observation)	Chemical Components (Literature- Derived)	Associated Chemistry Concepts (Literature-Derived)
Glutinous rice	"Binds together and doesn't fall apart"; creates a sticky, cohesive texture.	Primary filler and structural base of the food matrix.	Amylopectin (98–100% of the starch fraction) (Teng et al., 2025)	Starch gelatinization; amylopectin leaching
Coconut milk	Provides savory flavor; prevents the rice from drying out during roasting.	Liquid hydration medium that boils inside the vessel.	Native coconut proteins; lipids (17–20% wet weight) (Codex Alimentarius, 2003).	Emulsion stabilization; lipid oxidation
Bamboo segments	Container to hold the rice and protect the food from direct fire.	Rigid cooking vessel and thermal boundary layer.	Cellulose, lignin, and internal moisture content (Aicher et al., 2014).	Heat transfer medium (conduction/insulation); superficial pyrolysis.
Banana leaves	Cover/plug to trap heat and impart a fragrant green aroma.	Physical plug sealing the bamboo opening.	Terpenes, esters (Zommari et al., 2017).	Release and migration of volatile compounds.

As detailed in Table 2, the chemical characteristics are literature-derived estimates rather than analytical measurements of the specific *lemeng* samples. Based on the cited literature, general glutinous rice varieties are characterized by an amylopectin-rich starch fraction (typically estimated at 98–100% of the total starch content). Using this literature-based description differentiates its highly cohesive textural behavior from high-amylose rice, without attributing a measured chemical percentage for the local Malingping harvest. Similarly, coconut milk acts as a natural oil-in-water emulsion. Bamboo is not a heat source, but rather a crucial cooking vessel and heat-transfer medium that regulates the thermal environment of the rice.

Ethnochemistry Concepts in the Preparation of Lemeng

To ensure an auditable ethnochemistry mapping, the following subsections systematically present the empirical field evidence—comprising direct observation descriptions and short verbatim interview excerpts—before introducing the corresponding chemical interpretations. Through this evidence-first alignment, several ethnochemistry concepts were identified. These chemical mechanisms are proposed as plausible explanations supported by literature for the observed phenomena, supported by source-specific citations, rather than empirically assayed measurements from this fieldwork.

Starch Gelatinization and Swelling

During field observations at the production sites of P1 and P2, the researcher documented

that glutinous rice was fully submerged in water for 1–2 hours prior to roasting. When asked about this practice, P2 provided a functional emic explanation: *"Kudu dikeueum heula ameh beasna hipu, jadi asakna rata di jero awi"* (It must be soaked first to soften the grains, so they cook evenly inside the bamboo). From a scientific perspective, soaking hydrates the rice and prepares the starch for gelatinization during subsequent heating. Soaking allows water penetration and the initial swelling of the starch granules. During the subsequent heating phase, literature indicates that the gelatinization of glutinous rice starch typically occurs within a range of approximately 70–75°C, though this parameter is highly dependent on the specific rice variety, water content, and laboratory test conditions (Damodaran, Parkin, & Fennema, 2017; Teng et al., 2025). Because no internal process temperatures were empirically recorded during this fieldwork, this temperature range is presented strictly as a theoretical reference rather than a confirmed field measurement. Because glutinous rice starch is rich in amylopectin and contains relatively little amylose (Tester, Karkalas, & Qi, 2004), the literature suggests the process is characterized by granule swelling and partial disruption, and the leaching of amylopectin into the interstitial water (Biliaderis, 2009), which plausibly explains the highly cohesive and chewy texture prized by the Malingping community.

Emulsion Stabilization and Lipid Oxidation

During field observations, the producers were observed incorporating freshly pressed coconut milk into the soaked glutinous rice. Highlighting its functional importance, P3 explicitly stated, *"Santen teh wajib dicampurkeun ameh rasana gurih tur beasna teu garing nalika dibeuleum"* (Coconut milk is mandatory to make the taste savory and prevent the rice from drying out during roasting). From a food chemistry perspective, coconut milk is a natural oil-in-water emulsion, stabilized by native coconut proteins that lower the interfacial tension between the aqueous and lipid phases (McClements, 2015). Contemporary food chemistry literature confirms this structural function and stability during thermal processing (Damodaran, Parkin, & Fennema, 2017; Zheng et al., 2021). Separately from this established emulsion function, the specific effects of prolonged roasting on the lipid profile of *lemeng* were not analytically measured in this study. However, to explain the development of the final product's complex aroma, it is hypothesized that the thermal conditions may induce lipid oxidation and the thermal degradation of fatty acids (such as lauric acid). If these reactions occur in the food matrix, these theoretical lipid degradation pathways—distinct from amino-carbonyl Maillard reactions—would plausibly contribute to the rich, savory aroma prized by consumers.

Complex Heat Transfer Mechanisms

During field observations, the observations showed that the bamboo tubes were arranged over an open wood fire and continuously manually rotated. As the cooking progressed, steam was clearly visible escaping from the banana leaf plugs. Explaining the function of the bamboo during this process, P1 provided a practical emic perspective: *"Awi teh tameng seuneu, panasna lalaunan asup ka jero ngagolakkeun santen, matak kudu diputer ambeh rata"* (The bamboo is a fire shield; the heat slowly enters inside to boil the coconut milk, which is why it must be rotated so it cooks evenly). While no heat fluxes or internal temperatures were instrumentally assessed during this fieldwork, these empirical observations can be conceptually explained through mechanisms of heat transfer. Theoretically, radiation from the direct fire heats the exterior bamboo walls. The bamboo itself acts simultaneously as a conductive medium and a thermal insulator; contemporary studies specific to bamboo indicate a thermal conductivity of κ approximately 0.12–0.23 W/m·K, depending on the exact species and internal moisture content (Shah et al., 2016). Internally, as the conductive heat penetrates the vessel, steam-mediated convection may occur as the moist rice-coconut milk mixture reaches boiling temperatures typical for such biological emulsions (Tansakul & Chaisawang, 2006), which aids in the uniform cooking described by the producers.

Based on the real-time digital chronometer logs documented during the two prolonged

field observation sessions, producers attempted to distribute heating more evenly by manually rotating the bamboo segments approximately every 10–15 minutes. The observed heating duration for a single bamboo batch ranged between 30–45 minutes, which varied with the bamboo's diameter and the intensity of the wood fire. To reconcile this localized batch time with the "night-long communal roasting process" noted in the cultural context, the accounts distinguish the overarching communal event involves the continuous, sequential roasting of dozens of individual bamboo segments throughout the evening; however, the thermal exposure for any single *lemeng* unit is strictly limited to this 30–45-minute window. Furthermore, the endpoint of this duration was not dictated by a strict clock schedule, but was judged by producers using empirical sensory cues: visually (the emission of thick steam from the banana leaf plug) and aurally (the subsiding sound of boiling liquid inside the bamboo cavity).

Volatilization and Aromatic Transfer

During field observations, the producers used folded banana leaves to tightly seal the bamboo openings prior to roasting. Emphasizing the sensory importance of this practice, S2 provided a practical emic explanation: *"Mun ditutupan ku daun cau, seungitna leuwih kaluar"* (If covered with banana leaves, the fragrance comes out more). Despite these consistent informant claims, it must be explicitly stated that no gas chromatography-mass spectrometry (GC-MS) or controlled sensory analyses were undertaken during this study. Therefore, the product's aroma cannot be attributed conclusively to the banana leaves, the charred bamboo, or lipid breakdown. Instead, a theoretical explanation is proposed based on existing literature. According to established food science literature, natural botanical wrappers such as banana leaves contain diverse volatile organic compounds—including specific terpenes and aldehydes—which are thermally released into the food matrix during heating (Belitz, Grosch, & Schieberle, 2009; Nugrahani & Parela, 2022). Furthermore, the superficial pyrolysis (charring) of the bamboo exterior is theoretically known to generate woody aromatic compounds. Rather than serving as a confirmed chemical mechanism, it is hypothesized that the migration of these specific leaf and wood volatiles into the food matrix might synergize with theoretical lipid oxidation products to influence the final sensory profile.

The Maillard Reaction on the Crust (Kerak)

During field observations, the researcher observed that a golden-brown crust formed on the rice directly touching the inner bamboo walls. Informants widely appreciated this localized crust, locally known as *kerak*. Highlighting its culinary value, S1 provided an emic perspective: *"Kerakna ieu nu paling raos, garing tur seungit"* (This crust is the most delicious part, crispy and fragrant). Scientifically, this surface browning may be partly explained by the Maillard reaction—a condensation between amino groups and reducing sugars. However, because crust temperature, reducing-sugar availability, and amino-reactant concentrations were not analytically measured in this study, this mechanism is proposed strictly as a chemically plausible hypothesis. Literature indicates that while the internal wet rice mixture remains at boiling temperatures (~100°C), the localized micro-environment at the dry interface of the rice and the heated bamboo wall could approach the literature-reported range of 140–165°C under some conditions, potentially favoring melanoidin formation (Martins, Jongen, & Van Boekel, 2000; Starowicz & Zieliński, 2019). Importantly, this 140–165°C condition is presented solely as an illustrative literature range, not a measured local interface temperature. Furthermore, without chemical assays, alternative or co-occurring thermal browning pathways—such as the caramelization of available sugars or the dextrinization of starches under high localized heat—must also be considered as plausible contributors to the roasted, nutty flavor notes concentrated on the crust (Belitz, Grosch, & Schieberle, 2009; Van Boekel, 2006).

Comparison of Perspectives between Lemeng Producers and Sellers

Analysis of interview transcripts revealed differences in recurring themes in how producers and sellers frame their practices. However, because this research relies on a small purposive sample of only six individuals (three producers and three sellers), these thematic findings describe only this group of informants rather than establishing generalized, group-level occupational characteristics. Furthermore, these two groups are not strictly homogeneous, and variations or exceptions were systematically documented within the sample. For instance, while sellers generally focused on retail and marketability, an exception was observed with S1 and S3, who actively managed the final roasting phases (a traditional producer task), and S2, who uniquely engaged in product modification by adding peanuts. These specific documented exceptions highlight the fluid, overlapping interests within this small local network rather than rigid, absolute occupational boundaries.

Table 3. Thematic Comparison of Perspectives between Producers (P1-P3) and Sellers (S1-S3)

Aspect	Producer Accounts (Emphasis on Craft/Tradition)	Seller Accounts (Emphasis on Market/Consistency)
Primary Orientation	Intergenerational transmission and process fidelity	Retail consistency and customer satisfaction
Technical Emphasis	Sensory-based fire and rotation control	Standardized final texture and crust formation
Innovation	Maintaining the original recipe (deviant case: P3 open to new packaging)	Active diversification (e.g., S2 adding peanuts)
Explanatory Framework	Rooted in tactile, visual, and ancestral vocabulary	Receptive to standardized or practical quality metrics

Within this specific sample, the three producers primarily described their practices based on empirical sensory experience. For example, rather than treating his age (55 years old) or seniority as inherent evidence of skill, observations of P1 documented specific fire-management practices—such as manually adjusting the bamboo's distance from the embers and executing rotations based on the visual thickness of the escaping steam. When asked about heat control, P2 explicitly preferred the specific local term for "roasting" (*dibeuleum*) over generic burning, stating, *"Kudu dibeuleum lalaunan ameh awina teu beulah"* (It must be roasted slowly so the bamboo doesn't split). This linguistic distinction reflects a nuanced procedural understanding of the slow heat transfer required to preserve the vessel. Furthermore, while P1 and P2 focused on cultural preservation, variations within this small group were systematically noted; for instance, P3 expressed an interest in operational efficiency to meet higher holiday demands.

Conversely, the three sellers (S1–S3) within this sample evaluated the product predominantly through a commercial lens. Based strictly on their anecdotal retail experience and customer feedback rather than formal product testing, S1 and S3 stated that a pronounced crust (*kerak*) is valued by some customers and is locally believed to extend the product's shelf-life. Consequently, S3 reported explicitly requesting a slightly longer heating duration from producers to ensure a drier, more durable crust. Furthermore, it must be methodologically acknowledged that discussions regarding the systematic mechanisms of shelf-life extension were initially introduced by the interviewer as prompts. Therefore, the sellers' subsequent openness to these scientific concepts should be interpreted as responses to the interviewer's prompts, rather than being represented as spontaneous indigenous ethnochemical knowledge.

Based on a tentative interpretation of these six accounts, the contrasting yet complementary perspectives suggest that the ethnochemical practices of *lemeng* production are shaped by two distinct priorities within this small network. The producers' focus on cultural preservation directly informs their attention to observed heat-management practices, such as their meticulous manual fire management and sensory-based heat control. Conversely, the sellers' retail concerns relate directly to the practical standardization of the product's physical traits, such as requesting specific roasting durations to achieve a durable crust (*kerak*) for market

requirements. Ultimately, rather than representing universal occupational forces, these specific accounts illustrate how traditional culinary heritage is pragmatically negotiated between authentic craftsmanship and commercial viability within this localized sample.

15 To build upon the theoretical framework established in this study, future research could proceed in two phases. Phase one should focus on controlled chemical measurements to experimentally test the proposed mechanisms; this could involve instrumental analyses—such as gas chromatography-mass spectrometry (GC-MS) for volatile profiling and precise thermodynamic sensors—to transition these ethnochemical hypotheses into verified empirical data. Subsequently, phase two should involve an independently designed classroom study to assess the actual instructional value of this ethnochemical context. Rather than presuming an inherent pedagogical benefit from cultural integration, this future educational phase must rigorously evaluate *lemeng*-based learning modules against specific instructional indicators, such as measurable improvements in students' conceptual mastery of applied chemistry (Fasasi, 2017), pre-and-post assessments of scientific engagement (Abungu, Okere, & Wachanga, 2014), and their ability to bridge indigenous knowledge with formal scientific principles to enhance scientific literacy (Gilbert, 2006; Holbrook & Rannikmae, 2007). Additionally, parallel longitudinal studies on the transmission of this traditional knowledge could further mitigate the risks of local knowledge erosion.

CONCLUSION

This ethnochemistry study of *lemeng* production in Malingping documented traditional preparation practices and proposed literature-supported explanations for these cultural techniques. Because no thermal, compositional, or volatile-compound assays were conducted during this fieldwork, this study does not claim to have analytically verified these chemical processes. Instead, the directly observed field activities—such as soaking the glutinous rice, incorporating coconut milk, managing the open fire, utilizing banana leaf plugs, and achieving localized surface browning—are conceptually aligned with five hypothesized chemical explanations derived from existing scientific literature: (1) starch gelatinization as the theoretical basis for the cohesive texture; (2) natural emulsification by coconut milk proteins; (3) complex heat transfer regulating the internal cooking environment; (4) the theoretical volatilization of aromatic compounds from the botanical materials; and (5) localized Maillard reactions and alternative co-occurring pathways contributing to the crust's distinct profile.

The research also revealed meaningful differences in perspective between *lemeng* producers and sellers. The producers in this sample emphasized cultural preservation, the transmission of tradition to future generations, and the integrity of the original recipe, with a strong emphasis on sensory-based fire control. In contrast, the sellers in this sample emphasized on product consistency, market satisfaction, and adaptation to consumer demand, showing openness to product innovation and systematic explanations of the production process. These perspectives are not contradictory but complementary, potentially contributing to the sustainability of lemeng as a dynamic local culinary heritage.

6 The practical implication of this study is that *lemeng* has cultural and historical value while embodying indigenous practices that are consistent with scientific chemical principles, which could be rigorously investigated experimentally in future laboratory studies. Furthermore, these findings offer a contextual foundation for developing ethnochemistry-based learning materials. For example, educators could design a contextual lesson on thermochemistry or macromolecules using *lemeng* as a case study. An instructional sequence could begin with a guiding question: "How does the low thermal conductivity of a bamboo vessel regulate the gelatinization process of glutinous rice compared to a metal pot?" This could be followed by an activity in which students compare the insulating properties of wood versus metal, and conclude with an assessment requiring students to construct a thermodynamic model explaining the formation of the *kerak* (crust). Rather than claiming educational improvement without classroom testing, this study posits that such a prospective framework provides a culturally

situated starting point to make chemistry concepts more tangible for students.

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