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Cracking Culture: Exploration of Bugis Salted Eggs as a Chemistry Learning Resource

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Abstract
The traditional production of salted eggs in Soppeng Regency, South Sulawesi, reflects scientific principles relevant to chemistry education. This study explores this local practice through an ethnoscience perspective and assesses its potential as a contextual chemistry learning resource. A qualitative descriptive design with an ethnographic approach was used. Data were collected through observation, interviews, and documentation involving key informants (senior artisans), main informants (active producers), and supporting informants (community members). Data analysis applied source triangulation and inductive reasoning to ensure validity and allow themes to emerge. The findings reveal that the salted egg-making process incorporates various chemical concepts, including diffusion, osmosis, protein denaturation, physical and chemical changes, solution chemistry, and colligative properties. Artisans demonstrate empirical knowledge through consistent techniques, even without using formal scientific terms. The novelty of this study lies in its systematic integration of traditional salted egg production with core chemical concepts, positioning it as a culturally grounded and pedagogically valuable learning resource aligned with the Merdeka Curriculum. The practice embodies local values such as diligence, cooperation, and sustainability, making it suitable for character education and the Profil Pelajar Pancasila. Integrating this ethnoscientific knowledge into classroom instruction can help students grasp abstract chemistry concepts through real-life, culturally relevant contexts. Overall, this study supports the use of local wisdom as a means to enrich science education and preserve cultural heritage.

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INTRODUCTION

Chemistry education in schools is often perceived as difficult by students due to the dominance of abstract concepts that are challenging to relate to real-life experiences (Masayu, 2017) (Munandar et al., 2024). These abstract ideas such as molecular interactions, reaction mechanisms, and thermodynamic principles often feel disconnected from students' daily realities and making them difficult to comprehend. This perception contributes to students' low motivation and interest in learning chemistry. In fact, chemistry is a discipline that is closely intertwined with daily life and plays a vital role in explaining various phenomena in our surroundings. Therefore, there is a need for pedagogical approaches that bridge the gap between chemical concepts and the social-cultural realities of students.

One relevant approach to contextualizing chemistry education is ethnoscience. Ethnoscience refers to the body of knowledge and practices that emerge from a specific cultural community, rooted in local experiences, traditions, and customs (Laksono et al., 2023) (Rista Ayuni et al., 2021) (Azizah & Premono, 2021). It encompasses diverse aspects of community life, including cuisine, agriculture, traditional medicine, and environmental conservation (Firdaus et al.,

2021). By integrating ethnoscience into chemistry instruction, students can develop the understanding that science is not exclusive to academic institutions but is also embedded in their own cultural heritage (Yusaerah et al., 2023) (Imranah et al., 2024).

The traditional production of salted eggs is a prominent example of ethnoscientific practice found in various regions of Indonesia, including Soppeng Regency, South Sulawesi. This technique has been transmitted across generations as a natural method of egg preservation and flavor enhancement. Beyond its cultural significance, the salting process reflects fundamental chemical principles, such as the diffusion of salt ions through the eggshell, osmosis-driven water movement, and the denaturation of proteins during preservation. Although seemingly simple, the process involves multiple chemical principles (Junita & Yuliani, 2022) (Pratiwi & Bakti, 2024). These chemical changes provide a concrete context for students to engage with abstract scientific concepts.

By analyzing the physical and chemical transformations during the salting process, students are able to connect textbook knowledge with tangible phenomena they observe directly. This hands-on exploration fosters critical thinking, analytical skills, and deeper conceptual understanding of chemistry topics. Thus, this local practice offers more than cultural enrichment that it provides a scientifically valid, accessible, and relatable medium for learning chemistry (Utami & Ana, 2024). The use of learning resources derived from local wisdom, such as salted egg processing, also supports culturally responsive teaching. This pedagogical approach encourages students to value their own culture while simultaneously enhancing their self-confidence in learning (Whatoni et al., 2024). By recognizing local cultural practices as part of science, learners become aware that they possess a valuable intellectual heritage that remains relevant to modern scientific discourse (Sumardi et al., 2020).

Furthermore, the integration of ethnoscience in chemistry education aligns with the goals of the Merdeka Curriculum (Yani & Yerimadesi, 2023), which emphasizes project-based learning and the development of the *Profil Pelajar Pancasila* (Jumriati & Allo, 2024). In this context, the salted egg-making process can serve as an interdisciplinary project encompassing cultural exploration, scientific experimentation, and reflection on local values. This approach promotes learning experiences that are enjoyable, meaningful, and contextually grounded. Implementing ethnoscience in education also plays a strategic role in the preservation of local culture (Arrozaqu & Setiawan, 2022) (Arrozaqu & Setiawan, 2022). By integrating traditional practices into science instruction, younger generations are encouraged to recognize, understand, and preserve their cultural heritage. This is crucial in preventing the gradual loss of traditional knowledge, which is often passed down orally. On the other hand, the education sector benefits from a richer and more contextual pool of learning resources, strengthening character education and environmental awareness (Rahmawati et al., 2017) (Hidayatussani et al., 2020) (Wahyudiati, 2021).

However, research specifically exploring and developing salted egg production as a chemistry learning resource within the context of formal education remains limited. The application of ethnoscience in school-based chemistry education is still underutilized (Nufus et al., 2023). Many educators have yet to incorporate local knowledge into their teaching practices due to a lack of references, limited time, or insufficient training on this approach. This underutilization is unfortunate, given the scientific richness and pedagogical potential embedded in culturally relevant practices such as salted egg making.

Based on the discussion above, this study aims to explore the scientific processes involved in the traditional Bugis salted egg-making technique and analyze its potential as a contextual chemistry learning resource. Furthermore, this research is expected to contribute to the development of culturally integrated science education that supports conceptual understanding, fosters local cultural appreciation, and aligns with the goals of the national curriculum.

METHOD

This research employs a descriptive qualitative approach with ethnographic methods. The ethnographic method was chosen because it enables an in-depth exploration of local practices through direct interaction and cultural immersion, making it especially suitable for uncovering the scientific (chemical) values embedded in traditional activities such as salted egg production. The research was conducted in Soppeng Regency, South Sulawesi, specifically in Bulue Village, Marioriawa District, where traditional salted egg-making practices are still actively preserved. The site was purposively selected based on the continuity of cultural practices and the availability of community knowledge related to the salting process.

The research subjects included local salted egg artisans and community elders who have in-depth knowledge of the practice and the cultural meaning behind it. Informants were selected using purposive sampling, with specific criteria: (1) having at least five years of experience in traditional salted egg-making, (2) being recognized by the local community as a knowledge holder or practitioner, and (3) being willing to participate in interviews and observations. These individuals provided relevant insights regarding the traditional salted egg process and the associated chemical principles.

Data were collected through three main techniques: (1) participant observation, (2) semi-structured interviews, and (3) documentation (Creswell & Clark, 2017). Participant observation allowed the researcher to engage directly in the salted egg-making activities, observe materials used (e.g., type of salt, soil, or ash), and identify visible chemical changes such as osmosis, diffusion, and changes in egg texture. Semi-structured interviews were conducted with key informants using open-ended guiding questions, allowing flexibility to probe deeper into chemical understandings and cultural explanations.

Documentation involved written field notes, photographs, video recordings of the process, and collection of physical materials for further analysis. The data analysis was conducted inductively using the Miles and Huberman model, which includes data reduction, data display, and conclusion drawing/verification. To ensure data validity, triangulation of techniques (observation, interviews, documentation) and sources (various informants from different roles) was applied (Puspasari et al., 2021).

RESULTS AND DISCUSSION

The traditional method of salted egg production in Soppeng Regency continues to be preserved and passed down through generations. This process is carried out manually by immersing eggs, typically duck eggs, either in a saline solution or by encasing them in a mixture of clay, wood ash, and salt for a duration of 10 to 14 days.

Figure 1. Duck eggs to be processed into salted eggs

The eggs are mixed thoroughly into a paste made from clay, wood ash and salt to ensure that the salting ingredients adhere well to the shell and allow the flavors to penetrate during the curing period.

Figure 2. Main raw materials for egg salting

The technique is performed without modern measuring tools, relying solely on empirical knowledge and organoleptic observations, such as changes in color, texture, and aroma of the eggs. For example, an artisan in Bulue Village mentioned, "we add one handful of salt for every five eggs and leave them for two weeks to ensure even salting."

Figure 3. The process of mixing duck eggs in the salting mixture

Interviews with artisans reveal a high level of practical understanding of preservation techniques, even though they do not use scientific terminology. For instance, they understand that adding more salt speeds up the process and extends shelf life. They are also aware that ambient temperature affects the final outcome, which relates to the concept of reaction kinetics. One artisan explained, "when the weather is hot, the eggs cure faster. But if it keeps raining, sometimes we need to add more days for the eggs to become perfectly salted." Additionally, artisans assess the doneness of salted eggs based on shell texture and aroma, as stated: "if the aroma is strong and the shell feels hard, it's time to boil them".

Figure 4. The egg salting process takes 10 to 14 days.

The process reflects various chemical principles such as diffusion (movement of salt particles through the eggshell pores), osmosis (movement of water from inside the egg to the external medium), and protein denaturation (occurring when salted eggs are boiled). Furthermore, the saline solution functions as an electrolyte, related to concepts of solution properties and ionization. The process illustrates both physical and chemical changes, such as structural transformations in proteins that cause the egg whites to firm and yolks to become oilier.

The salting mixture's high ionic content (from Na^+ and Cl^-) plays a central role in creating a hypertonic environment around the eggs (Li et al., 2022). This facilitates osmosis, drawing water from within the egg while allowing salt ions to diffuse inward, modifying the protein structure of the egg white and yolk. Protein denaturation, which becomes more pronounced after boiling, results in firmer egg whites and oilier yolks, evidence of structural transformations in biomolecules caused by salting and heat. Additionally, heating may trigger non-enzymatic browning reactions, such as the Maillard reaction, further altering flavor and appearance.

The use of wood ash contributes not only texture but also an alkaline environment, rich in potassium carbonate (K_2CO_3) and other basic salts , which may affect the pH and further influence the denaturation process (Wang et al., 2024). This links the practice to acid-base chemistry and ionic equilibrium, enriching the scope of learning.

From a periodic table perspective, several elements are directly involved:

1. Sodium (Na) and chlorine (Cl) (Groups 1 and 17): in salt, critical to osmosis and ionic strength.
2. Carbon (C) and potassium (K): found in wood ash, relevant in pH and buffering reactions.
3. Oxygen (O), hydrogen (H), and nitrogen (N): present in proteins and water molecules, crucial to structural and molecular changes

Table 1. Chemical Concepts in the Salted Egg Production Process

No	Stage/Process	Scientific Principle Involved	Related Chemistry Concept	Concrete Example from the Field
1	Soaking eggs in salt solution	Diffusion (Xiao et al., 2023)	Movement of salt particles from the solution into the egg	Artisans soak eggs in solution for 10–14 days
2	Water absorption by salt	Osmosis (Xiao et al., 2023)	Movement of water from inside the egg to outside through a semi-permeable membrane	Eggs are soaked until the surface shows slight wrinkling
3	Change in egg white texture	Protein denaturation (Evanuarini et al., 2025)	Structural changes in proteins caused by salt and heating	After boiling, egg whites become firmer and more elastic
4	Formation of salty taste	Solution concentration (Xu et al., 2017)	Relationship between salt concentration and taste intensity	Artisans add one handful of salt for five egg
5	Change in egg yolk color	Maillard reaction (during heating) (Li et al., 2022)	Reaction between amino acids and sugars when the egg is heated	Yolk appears darker after heating
6	Adding salt to clay medium	Colligative properties of solutions (Xiao et al., 2023)	Relationship between solute amount and freezing/boiling point of solution	Clay and ash mixture is salted to improve preservation
7	Boiling salted eggs	Physical and chemical changes	Changes in state and chemical reactions during heating	Eggs are boiled for 30 minutes until evenly cooked

No	Stage/Process	Scientific Principle Involved	Related Chemistry Concept	Concrete Example from the Field
		(Mai Dang et al., 2014)		
8	Storage process	Natural preservation (Surya & Nugroho, 2025)	Salt inhibits microbial growth through osmotic pressure	Eggs stored in sealed containers to extend shelf life
9	Reactions during storage	Slow enzymatic and non-enzymatic reactions (Wang et al., 2024)	Slow reactions causing changes in color or odor of the eggs	Eggs change color and aroma after several days of storage
10	Evaluation of salted egg doneness	Organoleptic indicator (Xiao et al., 2023)	Visual, smell, and texture observations as indicators of chemical reactions	Artisans check eggs by smelling and feeling their surface

From an ethnoscientific perspective, salted egg production reflects a body of empirical knowledge that has been independently developed by local communities through processes of adaptation and repeated experimentation. This knowledge functions not only as an economic practice but also as a form of cultural heritage, embodying local values such as diligence, cooperation, and sustainability. These values align closely with character education and the *Profil Pelajar Pancasila* (Indonesian Student Profile), particularly in fostering appreciation for local wisdom and the development of critical thinking skills.

By incorporating cultural practices into educational media, students are not only learning chemistry but also gaining awareness of, appreciation for, and commitment to preserving their regional cultural identity (Asmaningrum et al., 2018). This approach is essential within an educational paradigm that emphasizes cognitive, affective, and psychomotor domains. Ethnoscience-based learning contributes to strengthening local identity while simultaneously promoting a deeper and more meaningful scientific understanding.

Overall, this study demonstrates that the traditional production of salted eggs in Soppeng Regency possesses strong potential as an ethnoscience-based chemistry learning resource. Through appropriate pedagogical integration, this local practice can be introduced into formal education to create a more contextual, engaging, and relevant learning experience for students. This approach represents not only an innovative model in science education but also a strategic effort in cultural preservation and community empowerment through education.

CONCLUSION

The traditional production of Bugis salted eggs in Soppeng Regency holds scientific values closely related to chemical concepts such as diffusion, osmosis, protein denaturation, physical and chemical changes, and colligative properties of solutions. This study reveals that the local community has empirically applied scientific knowledge in the practice of making salted eggs, even without formally using scientific terminology. These ethnoscientific findings can serve as contextual and relevant chemistry learning resources, particularly in supporting the implementation of the Merdeka Curriculum. he novelty of this study lies in its systematic identification and alignment of indigenous salted egg-making practices with core chemistry concepts, offering an innovative approach to integrate ethnoscience into formal education. Integrating this cultural practice into chemistry education not only enhances students' understanding of abstract concepts but also helps preserve local wisdom as part of science education rooted in regional culture.

RECOMMENDATIONS

Further deepen the understanding and improve the production of salted eggs by considering the following aspects in future research. For future research, it is recommended to explore the effects of varying salting durations and ingredient ratios on the nutritional value and sensory qualities of salted eggs. Additionally, investigating sustainable methods for waste management in the production process could contribute to environmental preservation. Integrating modern technology with traditional practices may also enhance product consistency and scalability.

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