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Ethnomathematics Study of Minangkabau Traditional Food: Case Study in Lamang, Basung Cake, Onde-Onde, and Mangkuak Cake

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Abstract: This study addresses the limited exploration of mathematical concepts embedded in Minangkabau traditional food practices, despite their potential to support culturally relevant mathematics learning. The research aims to identify and describe the ethnomathematical elements found in the preparation of four traditional foods: lamang, basung cake, onde-onde, and mangkuak cake. A qualitative approach was employed using ethnographic and case study methods. Data were collected through participant observation, in-depth interviews with traditional food makers, visual documentation, and supporting literature. The data were analyzed using thematic analysis combined with mathematical and geometric identification techniques to uncover measurement, proportional reasoning, and geometric structures. The findings reveal that traditional food preparation integrates various mathematical concepts, including ratios, volume and weight measurement, symmetry, cylindrical and conical geometry, and time estimation. These concepts appear in ingredient measurement, shaping techniques, folding patterns, and cooking management, although practitioners apply them intuitively without formal notation. The study concludes that Minangkabau culinary practices represent rich sources of ethnomathematical knowledge that can be integrated into mathematics education. This integration has the potential to enhance meaningful learning, connect mathematics with students' cultural experiences, and support the preservation of local heritage.

Keywords: Culture; Ethnomathematics; Mathematics Education; Minangkabau; Traditional Food

Introduction

Mathematics is often perceived as an abstract and universal discipline, disconnected from the realities of everyday life. This perception stems from the way mathematics is traditionally taught through decontextualized symbols, formulas, and standardized procedures that seem detached from social and cultural environments. However, in truth, mathematics is embedded deeply within human activities, including cultural practices, daily routines, and indigenous knowledge systems (Kusuma et al., 2024; Thomas & Jacob, 2021). The field of ethnomathematics, introduced by D'Ambrosio & Rosa (2017) challenges the notion of a singular, culture-free mathematics. Instead, it proposes that different cultural groups—ranging from indigenous communities and professional guilds to age-specific cohorts, develop and use mathematical ideas that are contextually situated, socially meaningful, and functionally relevant within their environments (Umbara et al., 2025).

Ethnomathematics serves as a bridge between formal mathematical knowledge and the diverse ways in which mathematics is manifested in cultural practices (Andriono, 2021; Gusti et al., 2024). It acknowledges that mathematical thinking can emerge organically through activities such as weaving, architecture, navigation, agriculture, and culinary traditions. As highlighted by

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D'Ambrosio & Rosa (2017), ethnomathematics refers to the way that members of various cultural groups mathematize their own reality, examining how both mathematical ideas and practices are processed and used in daily activities. By rooting mathematical learning in cultural practices, students are better able to internalize and apply mathematical concepts in ways that are both meaningful and empowering (Abdullah, 2016). This approach not only enhances students' engagement and understanding but also validates their cultural identity and local wisdom (Putri et al., 2024).

Despite its transformative potential, the integration of ethnomathematics into formal education systems remains limited. Mainstream curricula tend to prioritize Western mathematical conventions, often marginalizing or ignoring culturally embedded mathematical knowledge (Meaney et al., 2021; Pais, 2011). This disconnection creates a critical gap between students' lived experiences and their classroom learning, particularly for students from traditional or indigenous backgrounds. In this context, the failure to recognize and incorporate local mathematical practices may contribute to alienation, decreased motivation, and underachievement in mathematics. Addressing this gap requires deliberate efforts to explore and validate the presence of mathematics in everyday cultural contexts, including one of the most accessible and meaningful domains: food.

Traditional food practices offer a rich yet underexplored avenue for studying ethnomathematics (Setiadi, 2025). Food preparation involves a wide range of mathematical concepts, including measurement, proportion, geometry, estimation, time management, and spatial reasoning (Della et al., 2024; Putra & Ramdhani, 2025). These elements are often transmitted informally from one generation to the next through hands-on experience, observation, and cultural rituals. Yet, few academic studies have systematically analyzed the mathematical knowledge embedded in culinary traditions, especially within specific cultural contexts such as that of the Minangkabau community in West Sumatra, Indonesia (Jasmani et al., 2024).

The Minangkabau people are known for their matrilineal social structure and rich cultural heritage, which includes intricate culinary traditions (Enmufida et al., 2021; Rurisman et al., 2023). Among the many traditional foods prepared by the Minangkabau community are lamang (glutinous rice cooked in bamboo), basung cake (a steamed rice cake in a cone-shaped banana leaf), onde-onde (sweet glutinous rice balls), and mangkuak cake (a dessert made from rice flour and coconut milk). These dishes are not only central to cultural celebrations and daily life but also reflect deep-seated mathematical thinking (Della et al., 2024; Ja'faruddin & Haw, 2024).

For instance, the preparation of lamang involves precise measurements of rice and coconut milk to fit within the confined volume of bamboo tubes. The timing of the cooking process, the balance of moisture, and the even distribution of heat all require accurate estimation and proportional reasoning. Similarly, the making of onde-onde involves creating uniformly shaped, symmetrical balls a task that draws upon concepts of geometry, spatial awareness, and symmetry. The basung cake requires folding banana leaves into geometric cones, which not only preserves the food but also highlights a practical use of angles, surface area, and volume. The preparation of mangkuak cake involves careful measurements of ingredients and equal distribution of dough, echoing the principles of arithmetic operations and ratios.

These examples illustrate how traditional food-making is not merely a cultural or culinary act, but also a mathematical one. Ethnomathematics research on Indonesian traditional foods confirms that such culinary practices embed mathematical ideas like plane and spatial geometry, social arithmetic, and measurement, which can be effectively integrated into mathematics education to enhance contextual learning and student engagement (Busrah & Pathuddin, 2021; Hasibuan & Irvan, 2025; Rahmaniyah et al., 2025). Unfortunately, the mathematical dimensions of such practices are often overlooked or undervalued, both in academic research and in educational contexts. This neglect not only obscures the richness of cultural heritage but also represents a missed opportunity to make mathematics education more inclusive, relevant, and grounded in real-life experiences.

Given the global push for education systems to become more culturally responsive and contextually relevant, especially in the face of globalization and cultural homogenization, the integration of ethnomathematics into teaching practices has become increasingly urgent. Exploring how mathematical concepts are embedded in traditional food practices can foster both cultural preservation and innovation in educational methods (Azurah & Maysarah, 2024; Musodiqoh & Purwokerto, 2025). Moreover, such research can contribute to a broader understanding of how indigenous knowledge systems function as sophisticated bodies of knowledge, deserving of equal recognition alongside formal scientific disciplines. Druker-Ibáñez & Cáceres-Jensen (2022) emphasize that integrating Indigenous and local knowledge into sustainability education enhances students' identity and learning outcomes, promoting epistemological justice. Similarly, Handayani et al. (2018) argue that incorporating indigenous knowledge into science curricula fosters cultural sustainability and bridges the

gap between students' lived experiences and formal education

Although previous studies have explored ethnomathematics in various cultural products such as batik patterns, temple architecture, and several regional foods, no research has provided a systematic and comparative analysis of mathematical concepts embedded simultaneously in four key Minangkabau traditional foods, namely lamang, basung cake, onde-onde, and mangkuak cake. The novelty of this study lies in mapping how measurement, proportion, geometry, and time estimation naturally emerge within the preparation of these foods through an integrated ethnographic and mathematical analysis. This approach offers a more comprehensive framework compared to earlier studies that focused on only one type of food or one mathematical aspect. The urgency of this research is strengthened by the current need to develop culturally responsive mathematics education that connects students' learning experiences with local knowledge systems. Therefore, this study aims to systematically identify the ethnomathematical elements within Minangkabau culinary practices and highlight their potential contribution to curriculum development and meaningful mathematics learning.

Therefore, this study aims to explore and identify the application of mathematical concepts in the preparation of traditional Minangkabau foods—particularly lamang, basung cake, onde-onde, and mangkuak cake—through an ethnomathematical lens. The research seeks to answer the following overarching questions: How are mathematical ideas of form, size, proportion, measurement, and geometry applied in these culinary processes? What elements of traditional knowledge reflect mathematical reasoning, and how can these be incorporated into educational practice? Ultimately, this research aspires not only to enrich the field of mathematics education but also to strengthen cultural identity and appreciation of local wisdom amid ongoing socio-cultural changes.

Method

This study employs a qualitative research approach using a combination of ethnographic and case study methods to investigate the application of mathematical concepts within the traditional food-making practices of the Minangkabau community. A qualitative approach is particularly appropriate for exploring the rich, context-dependent, and culturally embedded nature of ethnomathematical practices (Creswell & Poth, 2016). This method enables the researcher to interpret meanings, patterns, and practices related to mathematical thinking as they naturally occur within the social and cultural context of the Minangkabau people.

The ethnographic method is selected to allow for deep immersion in the community, offering insights into the cultural knowledge systems through direct engagement with traditional food makers. Ethnography is suitable for understanding how individuals within a particular cultural group conceptualize and enact mathematics in everyday life. It involves observing participants in their natural environment and interpreting the meanings behind their actions, which is essential in identifying how mathematical reasoning is embedded in culinary traditions. For instance, Marsigit & Rusli (2021) employed an ethnographic approach to explore mathematical concepts in Riau Malay traditional foods, highlighting the integration of geometry and measurement in culinary practices.

Simultaneously, the case study method is employed to focus specifically on four traditional Minangkabau foods: lamang, basung cake, onde-onde, and mangkuak cake. Case study methodology allows for an in-depth examination of each food as a distinct unit of analysis, helping to uncover unique mathematical elements, techniques, and knowledge embedded in each food-making process (Yin, 2017). This dual methodological strategy ensures a comprehensive exploration of both general cultural patterns and specific practices related to the application of mathematics.

Data Collection Techniques

Data will be gathered through several qualitative techniques:

Participant Observation

Researchers will engage directly with the Minangkabau community and observe the process of making the four selected traditional foods. Observations will be conducted in natural settings such as home kitchens, local markets, and ceremonial gatherings. As described by Maxwell (2018), participant observation allows the researcher to witness practices first-hand and document subtle mathematical behaviors, such as measurement estimation, symmetry in food presentation, and time calculation during cooking.

In-depth Interviews

Interviews will be conducted with individuals who are directly involved in traditional food preparation. These include experienced food makers, community elders, culinary experts, and cultural leaders. Both structured and semi-structured interview techniques will be used to allow for a combination of consistent data gathering and open-ended exploration. According to Kallio et al. (2016), a systematic approach to developing semi-structured interview guides enhances the reliability and depth of qualitative data collection. The goal is to uncover both explicit and implicit

understandings of mathematical concepts in the culinary practices.

Visual materials such as photographs and videos will be collected to support the analysis. These will capture spatial arrangements, geometric patterns, proportions, and procedural steps in food preparation. According to Pink (2020), visual ethnography enhances traditional data collection by providing rich visual contexts that are essential for interpreting embodied knowledge and practices.

After field data collection, visual and descriptive data will be analyzed to identify mathematical elements such as measurements (e.g., quantities of ingredients), geometric shapes (e.g., cone-shaped banana leaves for basung), patterns, ratios, and proportions. This stage seeks to make visible the mathematical reasoning and skills inherent in traditional food-making processes (D'Ambrosio & Rosa, 2017)

In addition to primary data, researchers will consult relevant literature, cultural texts, cookbooks, and ethnographic records to support and contextualize findings. This step ensures data triangulation and enriches the analysis with historical and theoretical insights.

Research Procedure

The research process is divided into three main stages:

The preparation stage began with identifying the research problems and formulating the objectives to establish a clear direction for the study. This was followed by an extensive literature review on ethnomathematics and Minangkabau cultural practices to build a strong theoretical foundation. The researchers then developed the necessary research instruments, including interview guidelines and observation protocols, to ensure systematic data collection. Finally, the preparation stage included selecting appropriate research sites and participants who could provide rich and relevant information for the investigation.

The implementation stage involved conducting direct participant observation during the preparation of traditional foods, allowing the researchers to closely examine each step of the process. All activities were documented through detailed field notes and visual recordings to capture both procedural and contextual information. Throughout the observations, the researchers identified mathematical practices that were implicitly embedded in the tasks performed by the food makers. To deepen the understanding of these practices, in-depth interviews were carried out with participants, focusing on their knowledge and reasoning related to measurement, proportion, and geometry. The field data were then supplemented with textual and visual secondary sources to strengthen interpretation and ensure comprehensive analysis.

The final stage focused on conducting a thematic analysis of the qualitative data to identify recurring patterns within the traditional food-making practices. This was followed by mathematical and geometric analysis based on observational notes and visual documentation to reveal the underlying concepts embedded in each process. To enhance the validity and reliability of the findings, data triangulation was applied by comparing information from observations, interviews, and secondary sources. The stage concluded with drawing comprehensive conclusions regarding the integration of ethnomathematics within Minangkabau culinary traditions and its potential implications for mathematics education.

This multi-method strategy ensures a comprehensive understanding of how mathematics is practiced and conceptualized within a cultural framework. It contributes to the broader discourse on culturally responsive mathematics education and highlights the potential of local knowledge systems in enriching formal mathematical instruction.

Result and Discussion

Research Finding

Based on direct observations conducted at various locations and the sale of traditional foods such as lamang, basung cake, onde-onde, and mangkuak cake, it is known that these foods are traditional to Payakumbuh, each with its own unique characteristics. In Payakumbuh, people of all ages are familiar with and enjoy these traditional delicacies.

The interview results were presented by two research subjects, namely producers and traders of traditional foods such as lamang, basung cake, and onde-onde. The first interview used in this research data collection was with Mrs. Cuna, who works at Balai Nan Duo and makes traditional dishes such as lamang, basung cake, and onde-onde. Based on the interview findings with Mrs. Cuna, the traditional dishes lamang, basung cake, and onde-onde are recognized as one of the favorite dishes of the Payakumbuh community. One of the pieces of evidence is the high number of orders she receives, especially during certain events, both formal and non-formal.

Mrs. Cuna explained that several ingredients are needed to prepare this dish. For lamang, ingredients such as glutinous rice, coconut milk, grated coconut, banana leaves, and palm sugar are required. The process of making lamang begins with soaking the glutinous rice for approximately 8 hours. While waiting for the glutinous rice to soak, the filling is prepared by mixing

grated coconut with pieces of palm sugar until well blended. Then, the glutinous rice is steamed for about 30 minutes over boiling water. After steaming, the glutinous rice is transferred to a container and mixed with coconut milk that has been stirred with a teaspoon of coarse salt. Next, the glutinous rice is placed on banana leaves in a rectangular shape, then filled with the grated coconut mixture on top and rolled into a tube shape. Finally, the food is steamed again over boiling water for approximately 15 minutes until cooked and ready to be served.

For basung cake, the required ingredients are rice flour, palm sugar, coconut milk, and banana leaves. The process of making basung cake begins with preparing the banana leaves, which are cut into approximately 10 cm pieces and then shaped into cones. Then, palm sugar and water are cooked until dissolved and thickened, and allowed to cool until warm. In a bowl, add three-fifths of the roasted rice flour, half a teaspoon of salt, and the palm sugar solution, then mix well. The remaining rice flour is mixed with coconut milk and half a teaspoon of salt. Fill the cone molds with about a quarter of the palm sugar mixture and steam for 15 minutes, then top with the coconut milk mixture and steam for another 10 minutes until cooked and ready to be served.

For onde-onde, glutinous rice flour, pandan, food coloring, palm sugar, and coconut milk are needed. The process of making onde-onde begins by mixing grated coconut with salt and then steaming for about 15 minutes to prevent it from spoiling quickly. Mix glutinous rice flour, rice flour, sugar, and salt, then add oil and food coloring gradually until the dough reaches the right texture for shaping into balls. Boil water, take a small amount of dough, flatten it, and fill it with palm sugar, then shape it into balls and place them into the boiling water until all the dough is used. Once the balls float to the surface, remove them and roll them in the grated coconut until coated, and they are ready to be served.

The second interview data for this research is sourced from an interview with Mr. Eka, a traditional snack trader specializing in Mangkuak cake. Mr. Eka stated that he has been selling Mangkuak cake for over 10 years and is still trusted by the local community for making this cake, even being featured on television stations. For Mangkuak cake, ingredients such as rice flour, wheat flour, cassava tape, palm sugar, instant yeast, and coconut milk are needed. The process begins by cooking water with palm sugar and then cooling it. After that, mix rice flour, wheat flour, and instant yeast evenly. Then add the cassava tape and mix well. Gradually add the palm sugar mixture to avoid clumping and mix evenly. For the second dough, mix coconut milk, rice flour, and salt until well combined. Steam the first dough mixture, and once cooked, add the second mixture until ready to be served.

Based on the interview findings, the seller was unaware that during the processing and preparation, mathematical concepts of ratios and curved surface areas were found in the ingredients. According to the current curriculum, it explains how to calculate surface area and volume of spaces (prisms, cylinders, spheres, pyramids, and cones) and solve problems using ratios (size, proportion, and rate of change).

Here are the documentation results gathered during direct observations at the locations where traditional snacks such as lamang, basung cake, onde-onde, and mangkuak cake are made and sold.

Figure 1. Lamang

figure 2. Basung Cake

Figure 3. Onde – Onde

Figure 4. Mangkuak Cake

Discussion of Research Findings

The relationship between ethnomathematics and traditional foods such as lamang, basung cake, onde-onde, and mangkuak cake is evident in the geometric shapes of each of these dishes, as determined by researchers based on their findings. Thus, there is a link between classroom mathematics learning and ethnomathematics. Ethnomathematics, or culturally nuanced mathematics, significantly enhances students' understanding of mathematics (Choeriyah & Nusantara, 2020). Similarly, fundamental mathematical ideas influence how real-world problems are solved, so even though it may not always be apparent, mathematics plays a crucial role in human civilization (Dalimunthe et al., 2022).

Similar to Minangkabau cuisine, the primary purpose of culinary traditions is to fulfill basic human needs and they have deeply rooted within the culture. Every celebration, whether cultural or religious, is always accompanied by a variety of culinary delights to entertain the attendees.

Food is anything that can be consumed, including staple foods like rice and other foods, as well as side dishes, fruits, vegetables, pastries, snacks, and various

types of drinks. There are three culinary categories in Minangkabau society: side dishes, complementary or substitute foods, and main meals. Eating rice is the main dish. Bread is one of the additional foods in the second category. On the other hand, side dishes are foods that are rarely eaten. Most people eat white rice for lunch and dinner along with side dishes known as "samba" by the Minangkabau people.

Many common foods contain mathematical ideas that are very useful in learning mathematics, especially in teaching geometry to students. Examples of these foods include lamang, basung cake, onde-onde, and mangkuak cake.

Several steps in the preparation of traditional dishes such as mangkuak cake, basung cake, onde-onde, and lamang can enhance problem-solving techniques using curved surface structures. Table 1 below presents the findings from the examination of mathematical ideas used in the preparation of traditional dishes including lamang, basung cake, onde-onde, and mangkuak cake.

Table 1. Ethnomathematics in the Making of Lamang, Basung cake, Onde-Onde, and Mangkuak cake

Traditional Food	Mathematics concept	Ethnomathematics
Lamang	Selection and Preparation of Ingredients In the preparation process, measuring glutinous rice and coconut milk is crucial to achieve consistent taste and texture. This involves mathematical concepts in measuring volume and proportions.	In Minangkabau tradition, the measurement of ingredients does not always rely on modern tools. The community often uses traditional tools commonly found in the kitchen. This indicates the presence of mathematical concepts in the form of ratios and measurements using traditional tools.
	Shape and Structure The formation of lamang involves geometric learning related to the shape of a cylinder. The length of the initial rectangular shape will influence the diameter and height of the cylinder. Additionally, the amount or weight of the glutinous rice will affect the volume of the cylinder in the lamang.	The community usually does not use formal mathematical formulas but has an intuitive understanding of the appropriate measurements. This is an example of how geometric concepts are applied in local culture.
	Cooking time management The cooking process requires precise time management to ensure that the glutinous rice is perfectly cooked. Time measurement is also a part of mathematics, where the proportion of cooking time can be influenced by the amount of ingredients	In traditional practices, fire management is done based on experience, such as observing the color of the flame or listening for specific sounds during the burning process. Cooking time is also determined traditionally, like counting how long bamboo is kept over the fire without using a modern timer.
	Distribution and Allocation of Lamang Once lamang is cooked, its distribution at traditional events involves concepts of division and allocation. If there are a certain number of guests present, lamang is divided proportionally. This division can be seen as an application of number concepts and arithmetic operations.	In Minangkabau culture, the distribution of lamang often follows traditional customs. For example, during traditional ceremonies or certain celebrations, lamang is divided in ways that involve symbolic meaning and social hierarchy. These rules are a form of applying mathematics within a socio-cultural context.
Basung Cake	Selection and Measurement of Ingredients The use of basic ingredients such as rice flour, palm sugar, and coconut milk requires precise ratios. Usually, the measurement of these ingredients follows specific proportions to maintain the ideal texture and taste of the cakes. For example, the ratio between rice flour and coconut milk is crucial to ensure that the cakes are neither too hard nor too soft.	In Minangkabau tradition, the measurement of ingredients is often done using local measuring tools such as bowls or coconut shells. This demonstrates the concept of proportion and measurement in traditional culture, even without using modern measuring tools like scales or measuring cups.
	Dough Formation and Volume After measuring the ingredients, the dough is formed and placed into banana leaf wrappers. The volume of dough placed into the wrappers can be calculated using simple volume formulas based on the shape of the wrapper. Since the wrappers are usually cone-shaped or cylindrical, the volume concepts of these geometric shapes can be used to determine how much dough to fill.	In traditional communities, intuition and experience are typically used to determine the right amount of dough in the wrappers. Generations of knowledge and practice dictate how much dough to use to ensure the cakes cook perfectly and have an appealing shape.

Traditional Food	Mathematics concept	Ethnomathematics
	Geometric Shapes of Banana Leaf Wrappers The wrappers for basung cake are typically shaped like triangles or cones using banana leaves. This is an application of geometric concepts, specifically in the rolling of the leaves, which involves geometric shapes such as triangles and cones.	The technique of wrapping with banana leaves is passed down from generation to generation. Although the community might not use formal geometric formulas, they have an intuitive understanding of how to fold banana leaves to create uniform and attractive cone shapes. This demonstrates an inherent understanding of geometric shapes within the tradition.
	Measurement of Steaming Time and Temperature The time required to steam basung cake depends on the amount of dough in the wrapper and the heat of the steam. Scientifically, there is a relationship between the volume of dough, temperature, and cooking time. The larger the amount of dough, the longer it takes to steam it until it is fully cooked.	In traditional culture, the steaming time for basung cake is not always measured by a clock. Usually, indicators such as the change in the color of the banana leaves or the aroma of the cake serve as signs that the cake is cooked. This demonstrates a good understanding of the concepts of time and temperature combined with experience.
	Proportion and Distribution of Cakes In traditional ceremonies or celebrations, basung cake is often distributed to guests or family members. This distribution involves the concepts of proportion and fair division. For instance, if there are a certain number of guests, basung cake is shared equally according to the number of guests.	In Minangkabau society, there are specific social rules regarding the distribution of food during traditional ceremonies. This is an application of mathematical concepts in social life, where the distribution of cakes is carried out according to the agreed-upon norms and rules.
	Symmetry and Aesthetics of Cakes Basung cake wrapped in banana leaves often displays a regular symmetry, especially in the folding of the wrappers. This symmetry can be seen as a form of applying geometry in everyday life, where the cakes need to have a uniform shape to make them more visually appealing.	Aesthetically, the Minangkabau people value beauty and order in cake making. The folds of the banana leaves and the uniform shape of the cakes are part of cultural values that also reflect harmony and balance, even though they do not explicitly use formal mathematical symmetry concepts.
Onde-Onde	Measurement of Ingredients and Proportions Making onde-onde involves measuring ingredients such as glutinous rice flour, water, sugar, and filling (e.g., palm sugar). The proportions of these ingredients must be carefully adjusted to ensure that the dough has the right consistency and the onde-onde has the desired taste. For example, the ratio between glutinous rice flour and water affects the texture of the dough.	Traditionally, ingredient measurement can be done with simple tools like cups or spoons, without using modern scales or measuring cups. Experience and habit in measuring ingredients based on the "feel" or "appearance" of the dough are examples of applying mathematical concepts based on traditional knowledge.
	Forming onde-onde balls The process of forming onde-onde balls from dough involves concepts of volume and geometric shapes. Onde-onde balls usually have a spherical shape with a uniform diameter. If we want to make onde-onde of a specific size, we can calculate the volume of the ball using the formula $v = \frac{4}{3}\Pi R^3$ Where r is the radius of the ball.	The community usually uses hands or simple tools to form onde-onde balls. Although they do not use formal measuring tools, they have the intuition and experience to create balls with consistent and uniform sizes.
	Filling and Wrapping The process of adding filling to the onde-onde balls involves measuring the volume of the filling and the dough. The filling needs to be enough to provide flavor but not too much so that the dough can still close properly. The concept of proportion between the filling and the dough is crucial to ensure balance.	Traditionally, the use of filling is based on experience and visual judgment. Using simple tools like a spoon to scoop and place the filling reflects a practical understanding of volume and proportion.
	Coating with Grated Coconut After forming the onde-onde balls, they are coated with grated coconut. This process involves regulating how much grated coconut adheres to each ball. The amount of grated coconut can be roughly calculated based on the size of the ball.	The coating of onde-onde with grated coconut is often done manually and based on experience. This tradition shows how repetition and simple techniques can influence the final result, even without using formal mathematical methods.

Traditional Food	Mathematics concept	Ethnomathematics
	Distribution and Presentation of Onde-Onde After being coated with grated coconut, onde-onde is usually divided for serving. This distribution involves the concept of proportion, especially when onde-onde is shared among guests or family members in a fair amount.	The distribution of onde-onde at traditional ceremonies or celebrations follows specific social rules. This is often done manually and based on simple calculations according to the number of guests, demonstrating the application of mathematics in a socio-cultural context.
Mangkuak Cake	Selection of Ingredients and Proportions In the process of making mangkuak cake, the use of ingredients such as flour, sugar, and coconut milk involves calculating proportions. For example, if the amount of flour exceeds the standard, the texture of the cake can change.	Traditionally, the measurement of ingredients is often done using natural measures like "glasses" or "spoons," which are actually forms of measurement concepts in traditional mathematics.
	Measuring dough volume The dough volume must be measured to ensure each mangkuak cake has a uniform size. If the container used is cylindrical (like a cake mold), the volume of the dough can be calculated based on the height and diameter of the container.	Traditionally, the community might use certain measuring tools made from natural materials, such as coconut shells, which may not always have a perfect geometric shape but still uphold the concept of volume measurement.
	Temperature and Cooking Time Regulation The regulation of temperature and cooking duration can be precisely calculated using a thermometer and timer. However, in some traditional settings, this is done based on experience.	In traditional kitchens, cooking time is often measured based on experience or natural signs, such as changes in aroma or the color of the cakes.
	Symmetry and Shape of Cakes The shape of mangkuak cake is generally symmetrical, typically round or hemispherical. This symmetry can be analyzed in geometry. The mold used influences the shape, and this can be calculated using basic geometric principles.	In Minangkabau tradition, the use of molds and decorations on cakes also reflects cultural aesthetics that contain elements of symmetry or specific patterns.
	Distribution of Cakes at Traditional Events The distribution of mangkuak cake at a traditional event can involve the concepts of numbers and division. For example, the cakes might be distributed to guests based on the hierarchy of the adat (customary law) or the number of guests present.	This distribution system often has its own set of rules that are passed down from generation to generation, representing a form of social mathematics in Minangkabau culture.

Based on previous research findings and discussions, it is clear that meaningful learning can help students overcome challenges in learning mathematics that stem from inconsistencies in teachers' instruction and the gap between formal mathematical concepts and their real-life applications. One effective way to implement meaningful learning is by utilizing ethnomathematics to connect traditional foods and other cultural practices with mathematical instruction. This relevance-based approach is supported by studies demonstrating that integrating traditional games such as Congklak and real-world activities like brick-making into mathematics learning enhances students' problem-solving abilities, conceptual understanding, and overall motivation (Magdalena et al., 2023; Rodríguez-Nieto et al., 2025).

Ausubel's theory of meaningful learning aligns with the use of ethnomathematics in mathematics education to provide a meaningful learning environment (Agra et al., 2019; Nurhasanah et al., 2020). Recent studies emphasize that students' prior knowledge significantly influences how effectively they acquire new information. Students undergo two types of learning processes: meaningful learning and rote learning. Meaningful learning occurs when new information is integrated with existing knowledge structures, resulting in deeper understanding (Agra et al., 2019). This is consistent with the use of ethnomathematics, which stems from the students' cultural context and is recognized by them. By bringing information closer to students' everyday lives, it is highly possible for them to understand topics in mathematics class. This makes sense because the closest environment is what is most familiar to them. Objects that are nearest to children often have profound positive meanings for them (Zulaekhoh & Hakim, 2021).

Numerous related papers have further evaluated and supported the relationship between learning

mathematics and ethnomathematics. Among these related studies is the one conducted by Sukestiyarno et al. (2023) titled Learning Trajectory of Non-Euclidean Geometry through Ethnomathematics Learning Approaches to Improve Spatial Ability, which showed an improvement in spatial ability in non-Euclidean geometry after learning through ethnomathematics approaches.

Additionally, Haji & Yumiati (2018) identified ethnomathematics in the batik besurek of Bengkulu concerning the concepts of congruence and similarity. Meanwhile, Hidayat et al. (2021) explored ethnomathematics at Muara Takus Temple in XIII Koto Kampar district, Riau.

Conclusion

The findings of this study show that the preparation of Minangkabau traditional foods such as lamang, basung cake, onde-onde, and mangkuak cake contains clear and identifiable mathematical concepts that emerge naturally through cultural cooking practices. These concepts include ratios in ingredient mixing, measurement of volume and weight, geometric structures such as cylinders and cones, symmetry in shaping and wrapping, and intuitive time estimation. Although traditional food makers do not use formal mathematical terminology, their practices demonstrate consistent forms of proportional reasoning, spatial understanding, and geometric manipulation.

More broadly, the results indicate that culinary traditions serve as meaningful contexts where intuitive mathematical thinking develops and is transmitted across generations. This suggests that traditional food-making can be a valuable source of ethnomathematical knowledge not only within the Minangkabau community but also across other cultural groups with similar culinary practices. The generalization of these findings highlights that everyday cultural activities often contain embedded mathematical reasoning that can enrich mathematics education when properly identified and integrated.

Practically, this research provides a foundation for developing culturally responsive mathematics learning materials that connect classroom content with students' lived experiences. The integration of local culinary practices into teaching has the potential to strengthen meaningful learning, increase student engagement, and support the preservation of cultural heritage. These findings underscore the importance of incorporating ethnomathematical insights into curriculum development and instructional design to make mathematics more relevant, contextual, and culturally grounded.

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Author Contributions

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Conflicts of Interest

The author deaclares that he has no conflict of interest.

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