# IJoRCE Cek Akhir ID 98

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**Submission date:** 29-Aug-2024 02:17PM (UTC+0700)
**Submission ID:** 2450846929
**File name:** 03_b_Klepon_Edited_48-55.docx (6.84M)
**Word count:** 3849
**Character count:** 22413

*International Journal of Research and Community Empowerment*
*e-ISSN: 2985-6175*

***Vol 02, No 02, 48-55***
*https://doi.org/10.58706/ijorce*
*ijorce.mep@gmail.com*

# Ethnophysics of *Klepon*: Exploring Physics Concepts in Traditional Pasuruan Snack

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***Abstract***

*Local wisdom plays a crucial role in preserving cultural heritage and embedding scientific knowledge within traditional practices. This study explores the physics concepts inherent in the traditional process of making Klepon, a local snack from Pasuruan, and examines the community's response to this cultural practice. Using a qualitative descriptive research method, the study gathered in-depth data to uncover the underlying physical principles and societal perceptions. The findings reveal that making traditional Klepon involves key physics concepts such as pressure, phase changes, temperature, heat, and Archimedes' principle. Additionally, the research indicates the positive reception of these traditional snacks by the local community and consumers. The study concludes that the preparation of Klepon embodies significant physics concepts and that there is strong community support for the preservation and continued development of this cultural heritage.*

**Keywords:** *Klepon*, Physics Concepts, Community Responds

**Manuscript History**
Received: 30 June 2024 Revised: 8 August 2024 Accepted: 28 August 2024

**How to cite:**
Sari, I.J., et al. (2024). Ethnophysics: Exploring Physics Concepts in Traditional Pasuruan *Klepon* Snack. *International Journal of Research and Community Empowerment*, **2**(2), 48-55. DOI: https://doi.org/10.58706/ijorce.v2n2.p48-55.

## INTRODUCTION

Indonesia is a nation rich in culture, spanning from Sabang to Merauke, with a vast array of unique cultural expressions, including language, dwellings, clothing, traditions, religions, and cuisine. Every corner of Indonesia is imbued with cultures that possess charisma, and the knowledge and socialization of these cultures passed down through generations, are crucial for fostering pride in local culture and a love for the nation (Nugroho et al., 2021). As a country with a rich diversity of cultures, Indonesia not only has a variety of local cultures but is also abundant with local wisdom that is preserved and continuously enriched. This local wisdom in Indonesia encompasses knowledge, practices, and values embedded within communities across different regions.

Local wisdom is a unique and valuable cultural heritage, as it reflects a community's identity and plays a critical role in maintaining the cultural diversity of Indonesia. One form of local wisdom is traditional snacks. These conventional snacks include various foods and beverages passed down from generation to generation and have become an integral part of the local culture. In the context of traditional snacks, local wisdom includes knowledge about the ingredients, the preparation process, and the food's social significance. In the context of Indonesian culture, traditional snacks refer to foods or snacks that originate from the traditions and customs of Indonesian society, usually presented and using local ingredients. These conventional snacks often hold high cultural value and are an integral part of the identity of Indonesian society (Faturrahman et al., 2023).

Each traditional snack has its unique recipe and technique that has been learned and preserved through generations. They often carry deep cultural meanings and symbolism, such as in conventional celebrations or ceremonies. Traditional snacks are crucial in preserving cultural identity and fostering pride in the local

community (Hidayat et al., 2019). They preserve conventional snacks as cultural heritage, essential for enhancing local tourism and supporting the local economy (Utami, 2020). Traditional snacks include *kue putu, onde-onde, cenil, ronde*, and *Klepon*.

*Klepon* is one of the most well-known traditional snacks in Indonesia. It is typically made from glutinous rice, formed into small balls filled with liquid palm sugar, and then coated with grated coconut. *Klepon* has a unique flavor, a characteristic chewy texture, and a fragrant coconut aroma. This snack is consumed as a daily treat and often forms an inseparable part of traditional celebrations or customary events in various regions of Indonesia (Wulandari et al., 2020).

Although traditional snacks like *Klepon* have cultural value and rich historical significance, studying the physics concepts behind them provides a deeper understanding. Understanding the physics concepts in traditional snacks can reveal several phenomena that occur during the preparation process, texture changes, or flavor transformations. Through a physical analysis, we can comprehend principles such as phase transitions, heat transfer, and mass transfer.

Based on the abovementioned issues, the process of making *Klepon* is based on physics concepts and presents intriguing physical phenomena worthy of study and contextualization. *Klepon* is a traditional snack that contains underlying physics phenomena that have yet to be underexplored. Therefore, this study aims to identify the physics concepts related to the local wisdom involved in making traditional *Klepon* and to understand the community's responses to the local wisdom of this traditional snack.

## METHOD

This study used a descriptive qualitative approach, which is anticipated to comprehensively depict the subject under investigation and yield more detailed results (Miles & Huberman, 1994). Qualitative research is a type where the findings are not derived through statistical procedures or other calculation forms (Creswell, 2007). Data for this study were collected through observation, interviews, and documentation. The data analysis technique is based on data triangulation (Miles & Huberman, 1994), which involves (1) Data Reduction, (2) Data Presentation, and (3) Conclusion Drawing or Verification. This research uses descriptive qualitative analysis to identify the physics concepts related to the local wisdom in making traditional Pasuruan *Klepon* snacks. The following research flow diagram can be seen in Figure 1.

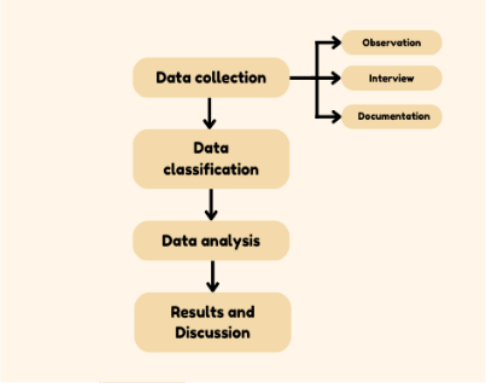


**Figure 1.** Research Flowchart

### Data Collection Techniques

The data collection techniques in this qualitative research include observation, interviews, and literature studies. The observation conducted in this study involved non-participant observation of Pasuruan *Klepon* vendors (producers). Interviews were carried out to obtain accurate data from experts in their respective fields. In this study, the author interviewed six informants, all of whom were highly knowledgeable and experienced, consisting of three local residents and three Pasuruan *Klepon* vendors (producers). The literature study in this research was necessary to review and analyze prior research on the production of traditional Pasuruan *Klepon* snacks.

**Research Informants**

The author used purposive sampling to determine the informants in this study. Purposive sampling involves selecting informants based on specific criteria and research needs. The selected informants included residents of varying age groups and *Klepon* business owners:

1. DW, a resident in their teenage years
2. CH, a resident in their adult years
3. HJ, a resident in their senior years
4. ML, the owner of Mama Luluk *Klepon*
5. W, the owner of Wahyu *Klepon*
6. RF, the owner of Rafi *Klepon*

## RESULTS AND DISCUSSION

In this research study, the findings and discussion focus on the observations, interview results, and survey analysis. The research was conducted in Pasuruan, Indonesia, by selecting informants who met the predefined criteria. The study took place on May 15, 2024, beginning with data collection by observing *Klepon*-making process at three different *Klepon* shops in Pasuruan. Following the observation, interviews and documentation were conducted with *Klepon*makers and sellers to gain insights into the techniques and necessary steps involved in *Klepon*-making process, as in Figure 2.

**Figure 2.** The Process of Making *Klepon*

Based on the observations and interviews, several physics concepts can be summarized in Table 1. The following sections elaborate on these findings.

**Table 1.** Analysis of Physics Concepts in *Klepon*

| **Physics Concepts** | ***Klepon* Production Process** |
|---|---|
| Pressure | Kneading *Klepon* dough before it undergoes the maturation process. |
| Phase Change | The raw *Klepon* dough becomes chewy after the maturation process, and the filling inside *Klepon* melts. |
| Temperature and Heat | During the maturation process, heat is transferred from the stove to the water, and from *Klepon* dough to the grated coconut. |
| Archimedes' Principle | Throughout the maturation process, *Klepon* will float at various positions, indicating the degree of doneness. |

Based on Table 1, several physics concepts are observed in making traditional *Klepon* snacks. Based on data analysis from observations and interviews, the following explores the physics concepts involved in traditional *Klepon* snack production as a manifestation of local wisdom.

**Pressure**

During the preparation of *Klepon* dough, the concept of pressure is applied. Serway & Jewett (2018) and Halliday et al (2013). define pressure as the force per unit area, where the force acts perpendicular to the surface of an object. The force per unit area on the surface where the force is applied explains the concept of pressure (Hendri, 2021), as illustrated by Equation 1.

$$P = \frac{F}{A} \quad (1)$$

Notation:
$P$ = Pressure (Pa)
$F$ = Force (N)
$A$ = Area ($m^2$)

The elasticity experienced when consuming *Klepon* is was influenced by the type of flour used and the technique employed in kneading the dough. Proper kneading involves mixing and pressing the dough with sufficient force to achieve the desired consistency. During this process, the hands force the dough, resulting in pressure. The greater the force exerted, the higher the pressure experienced by the dough. This pressure causes *Klepon* dough to consolidate and bond, ensuring an even mixture of ingredients and resulting in a more elastic texture, as in Figure 3. This concept of pressure continues to apply when the dough is shaped into *Klepon* balls.

**Figure 3.** Process of Forming *Klepon* Balls

**Phase Changes**

After the dough is formed into balls, the next step is preparing *Klepon* filling. The filling consists of sweet palm sugar, which must be melted before use. Melting the palm sugar facilitates its incorporation into *Klepon* dough. Palm sugar melts or liquefies when heated, as the applied thermal energy causes the molecules in the sugar to move more rapidly. This thermal energy breaks the bonds between sugar molecules, causing the crystalline structure of the palm sugar to become more disordered. At a specific boiling point, the thermal energy is sufficient to overcome the intermolecular forces, causing the crystalline structure of the palm sugar to collapse and transition into a liquid form (Atkins & de Paula, 2014).

Once the sugar filling is incorporated into the dough, as in Figure 4, the dough is placed in boiling water for cooking. The phase changes during the cooking process involve physical changes in state and texture. According to Tipler and Mosca (2008), phase change is the process in which one or more properties of a material are altered. These changes can be physical, such as changes in state, or chemical, such as forming new compounds. Raw *Klepon* is is in a solid phase with a firm structure. Upon heating, a phase transition occurs from solid to semi-solid or semi-liquid. This phase transition changes mechanical properties, with the initially solid dough becoming soft and pliable.


**Figure 4.** *Klepon* Filling Process

**Temperature and Heat Transfer**

During the preparation of *Klepon*, convective and conductive heat transfer processes occur. Convective heat transfer involves the movement of heat between a solid surface and the surrounding fluid (liquid or gas), accompanied by the movement of the fluid itself. When *Klepon* is immersed in boiling water, as in Figure 5, convective heat transfer occurs from the hot water to *Klepon*. Heat transfers from the high-temperature water to the lower-temperature *Klepon*, leading to uniform cooking from the outer layer to the interior.

Conversely, conductive heat transfer occurs due to temperature differences within a stationary medium (solid or stationary fluid) without material movement. This type of heat transfer happens when *Klepon*, after being cooked, is rolled over grated coconut. The still-hot *Klepon* transfers some of its heat to the grated coconut, warming it in the process. The temperature of *Klepon* influences the principles of heat transfer, the surface contact between *Klepon* and the grated coconut, and the thermal properties of the materials involved (Lavine, A.S., 2007).

**Figure 5.** Water Heating Process

**Archimedes' Principle**

The subsequent process involves the maturation of *Klepon* balls. During this maturation stage, *Klepon* is immersed in boiling water, which was previously heated. *Klepon* initially sinks, indicating that the density of the dough is greater than that of the boiling water. After cooking, *Klepon* floats to the surface. This maturation process exemplifies Archimedes' Principle. Archimedes' Principle states that any object partially or wholly immersed in a fluid (liquid or gas) experiences an upward buoyant force equal to the weight of the fluid displaced by the object. The buoyant force is expressed as the resultant force on the object due to hydrostatic pressure in the fluid. According to this Principle, the buoyant force's magnitude equals the displaced fluid's weight, resulting in a vertical upward movement (Munson et al., 2004). The relevant equation is:

$$\begin{aligned} P &= \rho.g.h \\ F_a &= P.A \\ F_a &= \rho.g.h.A \\ F_a &= \rho.g.V \end{aligned} \qquad (2)$$

Notation:
$P$ = Pressure (Pa)
$F_a$ = Buoyant Force (N)
$A$ = Area ($m^2$)
$\rho$ = Density of Fluids (kg / $m^3$)
$g$ = Gravitational Acceleration ($m/s^2$)
$h$ = Height (m)
$V$ = Volume ($m^3$)

When Klepon is placed into boiling water, it experiences a buoyant force. This buoyant force arises because *Klepon* displaces a volume of water, resulting in an upward push from the water. Buoyant force helps keep *Klepon* submerged during the maturation process. The maturity of *Klepon* is indicated by its floating behavior as in Figure 6, which occurs because the density of *Klepon* becomes lighter than that of the water, allowing *Klepon* to experience a sufficient buoyant force to rise to the surface (Serway& Jewett, 2018).

**Figure 6.** The Maturation Process of *Klepon*

After doing the experiment to proving the article gained new knowledge as when the *Klepon* cake is cooked it does not affect the mass of the *Klepon* cake. The mass of *Klepon* cake when raw, when cooked, and when cold is fixed. kue *Klepon* floats because when the kue *Klepon* is boiled, the size of the kue *Klepon* increases so that affects the density of the cake (Maryono, 2021).

Based on interviews conducted with local community members in Pasuruan, the study offers valuable insights into the perception of the traditional snack, *Klepon*. The findings highlight the community's deep connection to *Klepon* as a symbol of local heritage. One respondent, DW, a local teenager, shared that *Klepon* not only represents the cultural wisdom of Pasuruan but also provides a unique culinary experience for visitors unfamiliar with the region's traditional foods. However, DW also emphasized the need for innovation to maintain *Klepon*'s relevance in today's fast-changing food market. He suggested introducing new flavor variations and modernizing the presentation could make *Klepon* more attractive to younger generations, ensuring it competes effectively with contemporary snacks. This flavor, in turn, would help preserve the tradition while broadening its appeal across different age groups, from children to the elderly. DW's detailed statement reflects these points:

> "*Klepon* is very important for Indonesian traditional cuisine. It has a distinctive and delicious taste and carries cultural values and a sense of togetherness. Preserving *Klepon* means maintaining a rich cultural heritage, promoting national identity, and supporting the local economy. Its natural ingredients also make *Klepon* a healthier food choice. However, due to the limited variety of fillings, there is a need for innovation in *Klepon* fillings to make it more attractive and enjoyable for various groups and to compete with other modern snacks."

From DW's statement, it is evident that DW is a young person who follows various trending food content on social media platforms. This interest is reflected in DW's observation of food innovations that are popular online. DW's interest in viral culinary innovations on social media highlights the younger generation's desire to keep up with trends and explore the culinary world, as well as their awareness of the importance of participating in conversations about trending foods.

In addition to DW, another informant, CH, an adult resident, shared a similar view about *Klepon*. CH firmly stated that *Klepon* is not merely an ordinary traditional food but a culinary icon of Pasuruan and its surrounding areas, characterized by its unique and authentic flavor that is hard to find elsewhere. The following is CH's complete statement:

> "I believe *Klepon* can become a global icon of Indonesian cuisine. With its unique and original taste, *Klepon* truly reflects our rich cultural heritage. Furthermore, *Klepon* has become popular on social media and various events, making its appeal global. Introducing *Klepon* to the international stage will strengthen Indonesia's culinary identity and provide economic opportunities for our local vendors".

Local wisdom found in some indigenous groups/societies in Indonesia holds the noble value of the nation's culture of the nation so that it can be used as identity or character of the community. Will But often the value of local wisdom is ignored, because it is considered not in accordance with (Priyatna, 2016). Sari and Nurizzati (2018) stated that traditional snacks are a form of local wisdom that reflects the natural potential of each region. This snack can be used in maintaining relationships between people.

The statement reinforces the response from the first informant. *Klepon* is recognized as a traditional snack and local wisdom in Pasuruan, and preserving *Klepon* means maintaining cultural heritage and supporting the

local economy. Both informants agree that *Klepon* can continue to be local wisdom and can be expanded by increasing product innovation without diminishing the snack's traditional values.

In contrast to the opinions of the previous informants, HJ, an elderly resident, has provided a deeper perspective on *Klepon*. According to HJ, *Klepon* is not just a food but a cultural heritage with values passed down through generations. From HJ's viewpoint, the distinctive taste of *Klepon* is not merely a culinary aspect but a characteristic feature representing local wisdom and Indonesia's cultural diversity. For HJ, the authenticity of the recipe and the techniques used in making *Klepon* are crucial, as they ensure that *Klepon* maintains its traditional taste and authenticity. By preserving the local wisdom of *Klepon*, HJ believes that we are not only safeguarding cultural heritage but also honoring and upholding ancestral values and passing them to future generations. According from HJ, *Klepon* is more than a snack; it symbolizes Indonesia's culinary diversity that must be earnestly preserved.

> "In my opinion, *Klepon* should be preserved. It is not just food but an important part of our culture. Maintaining *Klepon* means preserving traditions from generation to generation."

ML, a *Klepon* vendor in Pasuruan, further supports HJ's statement. ML asserts that *Klepon* has a distinctive taste differentiates it from other traditional snacks. With years of experience making *Klepon*, ML emphasizes that each ingredient, such as palm sugar, grated coconut, and rice flour, imparts unique characteristics that are difficult to replicate in other traditional treats. For ML, *Klepon* is not just a simple snack but a cultural heritage worth preserving. With its proven uniqueness passed down through generations, *Klepon* not only tantalizes the taste buds but also strengthens Indonesia's diverse culinary identity. As a dedicated *Klepon* vendor, ML hopes that through each bite of *Klepon* enjoyed by the public, more people will appreciate and understand Indonesia's rich and historical culinary diversity.

Research results the results of this study are relevant to research related to the integration of local wisdom as a learning resources. Integration of local wisdom can help students to understand learning material and create physics learning becomes more fun and meaningful in line with research conducted by Misbah and Fuad (2019), Novitasari et al (2017), and Midroro et al (2021).

## CONCLUSION

Based on interviews and observations conducted with the people of Pasuruan, it can be concluded that the process of making the traditional snack, *Klepon*, involves several underlying physics concepts. This finding indicates that physics concepts are inherent in everyday life and not limited to formal education settings such as schools and universities. *Klepon*, often regarded as merely a local culinary tradition, contains physics principles that can be uncovered through detailed and in-depth analysis. Thus, *Klepon* should not be viewed as an ordinary traditional food but rather as a form of local wisdom and cultural heritage that must be preserved. Despite its widespread popularity and global appeal, *Klepon* must continue to evolve with flavor variations and presentation innovations to remain appealing to younger generations and competitive with modern products. By preserving the authenticity of its recipe and traditional preparation techniques, *Klepon* symbolizes the rich diversity of Indonesian cuisine and preserves the values passed down through generations, linking the present with ancestral traditions. Through efforts to preserve *Klepon*, the people of Pasuruan collectively safeguard their cultural heritage, strengthen Indonesia's culinary identity, and support the local economy.

## DECLARATION OF COMPETING INTEREST

The authors declare that they have no known competing financial interests or personal relationships that could have appeared to influence the work reported in this paper.

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