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Exploration of Ethnomathematics in Traditional Lebaran Food in Labuhanbatu

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ABSTRACT

This study aims to explore the potential of ethnomathematics in the concept of solid geometry contained in traditional Lebaran foods in Labuhanbatu. The research was conducted using a qualitative approach with data collection techniques including observation, interviews, and documentation. The results show that traditional Lebaran foods in Labuhanbatu contain various solid geometry concepts, such as cylinders, rhombic prisms, spheres, and blocks. These solid geometry concepts are closely related to the process of making traditional Lebaran foods, both in the form of the ingredients used and in the manufacturing process. Additionally, traditional Lebaran foods also contain ethnomathematical values reflected in the patterns, motifs, and shapes found in these foods. Based on this research, it can be concluded that traditional Lebaran foods in Labuhanbatu can be a potential learning resource for teaching solid geometry concepts in mathematics education. Exploring ethnomathematics in traditional Lebaran foods can help students understand solid geometry concepts contextually, thus increasing students' interest and motivation in learning. Therefore, it is hoped that the results of this research can contribute to the development of contextual and culturally-based mathematics education in Indonesia.

To cite this article:

INTRODUCTION

Indonesia is one of the countries that has a wide variety of ethnicities, languages, cultures, and customs. These differences create a unique character for each region. Regarding culture and customs, many people, almost every individual, practice traditions that have been passed down from their ancestors to the present day. Therefore, to ensure that a tradition does not disappear, Indonesians continuously engage in these activities according to the established time.

Speaking of traditions, in Indonesia, some communities still preserve cultural practices, especially those with religious significance. This is evident in traditions leading up to the fasting month of Ramadan (each region has its own way of welcoming it), and even during the major Muslim holidays of Eid al-Fitr and Eid al-Adha, commonly referred to as 'Lebaran' by Muslims. Regarding Lebaran, Indonesia has many interesting traditions both in anticipation and during the celebration. These practices are a form of joy and happiness in observing and celebrating the occasion. Therefore, Lebaran is a much-anticipated major holiday for Muslims. For example, during Eid al-Fitr.

Eid al-Fitr comes from two words in Arabic: 'id,' which means return, and 'fithr,' which means purity. Based on this meaning, Eid al-Fitr is a holiday where humans return to their pure nature, constantly doing

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good deeds. Eid al-Fitr is also often referred to as the day of victory, which signifies the successful completion of fasting and the triumph over one's desires. During fasting, one not only abstains from food and drink but also refrains from bad deeds, thus achieving happiness and returning to purity on Eid al-Fitr (Diniyati et al., 2022). Lebaran is a highly anticipated moment for family gatherings because usually, each individual is busy with their own activities and work. Therefore, Lebaran becomes a very special day.

Food or cuisine is an identity or reflects the culture of a nation. Indonesia is famous for its variety of traditional foods that are enjoyed not only by local tourists who are Indonesians but also by tourists from abroad. Each region throughout the archipelago has its own specialty foods.

Specifically for the city of Labuhanbatu, there are traditional foods such as Lontong, Ketupat, and Nastar unique to Labuhanbatu, which are sold in areas with diverse ethnic populations. The most distinctive foods from Labuhanbatu are Lontong, Ketupat, and Nastar, which are usually served during the fasting month and the Eid al-Fitr holiday

Mathematics is a general science that contributes to the development of various other sciences and technologies. This is in accordance with (Ngalim Purwanto (1990:84), n.d.)'s opinion that the nature of mathematics itself is very prevalent and we often encounter and use it in everyday life. According to Carl Friedrich Gauss (Yohanes, n.d.), mathematics is the 'Queen of Sciences' because it is the foundation and source frequently used in other sciences. Ilmiyah and colleagues suggest that mathematics is also present in various activities and places commonly engaged in by humans, making it an easy subject for students to understand. However, in reality, mathematics is still often considered a difficult and daunting subject. This happens because educators teach in a monotonous way without relating it to the surrounding context, making it difficult for students and causing confusion in applying the mathematical concepts learned at school in everyday life. Educators teach material in a boring manner without involving the surrounding environment, making it difficult and confusing for students to apply the mathematical concepts learned at school to their surroundings. Therefore, educators can integrate the learning process with the surrounding environment, for example, by combining education with culture.

Education and culture grow naturally within the human environment and have interconnections with each other in terms of knowledge (Yohanes, n.d.). Due to the cultural diversity in Indonesia and its varied applications, education and culture play an important role in fostering and developing the ancestral values of the nation, which are useful for shaping students' character and building the national identity in the global community. Mathematics is closely related to cultural development towards civilization because mathematics is a part of cultural development. The close relationship between mathematics and culture is known as ethnomathematics.

Ethnomathematics originates from the term 'ethnomathematics,' which was introduced by D'Ambrosio from Brazil in 1977. 'Ethno' refers to various cultural amalgamations within a society, while 'mathema' refers to the understanding, explanation, and management of real phenomena using calculation, measurement, ordering, grouping, and pattern modeling that emerge within an environment. Ambrosio also stated that ethnomathematics is a subject at the intersection of the history of mathematics and cultural anthropology (Sumayani et al., 2020). Ethnomathematics is a useful approach to recognizing and understanding the connection between culture and mathematics. Local wisdom-based mathematics education is a tangible form of character education for students in preserving local culture. Students can develop their potential through the integration of local wisdom, enabling them to use the acquired knowledge to address issues encountered in life. One example of the application of ethnomathematics is in traditional Lebaran foods in Labuhanbatu.

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In this study, the researcher will explore the ethnomathematics of solid geometry in traditional Lebaran foods in Labuhanbatu. These traditional Lebaran foods have unique and interesting shapes, formed by the use of specific ingredients and distinctive preparation methods. Therefore, it will be interesting to study these shapes from a mathematical perspective.

In addition, this study aims to educate the community, particularly in enriching their knowledge of mathematics. Through this research, we hope to inspire the community to pay more attention to the connection between mathematics and culture, and to provide new insights for educators on how to integrate ethnomathematics into the educational curriculum. Overall, this study can provide benefits in various fields, such as education, culinary arts, and culture. Therefore, this research is highly relevant and important to conduct, especially in Indonesia, which has a rich diversity of cultures and traditional foods.

This research aims to explore the geometric shapes in traditional Lebaran foods in Labuhanbatu, such as lontong, ketupat, and nastar. We will analyze these shapes in terms of size, dimensions, and proportions, and try to identify specific patterns related to geometry in the preparation of these traditional Lebaran foods. It is hoped that this research can contribute to strengthening the connection between culture and mathematics, as well as enhancing our understanding of traditional Lebaran foods, which are an important part of Indonesian culture.

Several studies are relevant to this research. First, the study titled 'Lebaran Traditions in Kemang Village, Musi Banyuasin Regency, South Sumatra,' written by (Siregar, 2024), discusses a Lebaran tradition. The difference from this journal is the object of study. Next, there is a mini-research titled 'Javanese Ethnic Leadership Values and Their Relevance to Future Development.' This mini-research, written by Khalishah and colleagues, shares a similarity with this journal in that it also discusses a tradition. Then, there is the research titled 'Ethnic-Math Hots on Homemade Eid Al-Fitr Cookies 1443 Hijri,' which discusses the use of Lebaran cookies as a medium for applying mathematics. Another relevant study is by Indah Amanah Diniyati and colleagues in 2022, titled 'Ethnomathematics: Mathematical Concepts in Lebaran Cookies.' The results show that Lebaran cookies contain elements of ethnomathematical geometry. According to Husnul Hotima in 2020, 'in the process of making ketupat bawang and Javanese ketupat in Alasmalang Village, Singojuruh District, Banyuwangi, there are concepts of the position of two lines, special angle concepts, two-dimensional geometry concepts, volume determination concepts, and three-dimensional geometry concepts.

RESEARCH METHOD

This Ethnomathematical Exploration Study on Spatial Structures in Traditional Lebaran Foods in Labuhanbatu uses a qualitative approach with data collection techniques through interviews and direct observations of traditional Lebaran food makers in Labuhanbatu.

In data collection, the researcher will use purposive sampling technique to select informants considered competent and experienced in making traditional Lebaran foods. Subsequently, the

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researcher will conduct structured interviews with informants to gather data on the process of making traditional Lebaran foods, the ingredients used, and the sizes and proportions employed in their preparation

In addition to interviews, the researcher will also conduct direct observations of the making of traditional Lebaran foods to obtain data on their shapes and dimensions. During the observations, the researcher will record all shapes and sizes of the observed traditional Lebaran foods. Subsequently, the data obtained from interviews and observations will be analyzed using qualitative descriptive techniques. This analysis will include measuring the dimensions and proportions of the observed traditional Lebaran foods, as well as identifying shapes and patterns related to spatial structures. Furthermore, the results of the analysis will be interpreted to identify the connection between culture and mathematics in the making of traditional Lebaran foods in Labuhanbatu.

Therefore, this research employs qualitative data collection methods and qualitative descriptive analysis to address the predefined research objectives. This data collection technique was chosen because it can provide a deep understanding of the observed phenomena and allow researchers to discover complex relationships between culture and mathematics in the making of traditional Lebaran foods in Labuhanbatu.

RESULTS AND DISCUSSION

Kabupaten Labuhanbatu is located on the east coast of Sumatra Island. It lies on the eastern route of Sumatra, which is a crucial part of Sumatra's land transportation network. To the north, it borders Labuhanbatu Utara Regency, to the south it borders Labuhanbatu Selatan Regency, to the west it borders Toba Samosir and Tapanuli Utara Regencies, and to the east it borders the Malacca Strait (Doni et al., 2023). Born on October 17, 1945, Kabupaten Labuhanbatu cannot be considered a new regency, as it was established just two months after the proclamation of Indonesian independence. Though not as well-known as Deli Serdang to the north or Siak to the south, Kabupaten Labuhanbatu has been a part of the Republic of Indonesia long before its independence.

Labuhanbatu is an area characterized by heterogeneous culture, where various ethnic groups and languages are inherent to its diverse communities. The diversity of ethnic groups gives rise to various distinctive cuisines that accompany a variety of dishes served. The community's habit of preparing various types of dishes for daily needs or special occasions is a common practice. This culinary tradition, passed down through generations, includes dishes such as gulai, anyang ayam, holat, and other prepared foods. We will explore this cultural fusion in Labuhanbatu through a written work (journal) to serve as a benchmark or simply as reading material and reference in assessing the food ingredients used to prepare various types of foods for daily needs or during festive seasons like Lebaran. As summarized in this researcher's journal, the content primarily focuses on common foods widely recognized throughout Indonesia, such as lontong, ketupat, and nastar. These three types of food are typically found on the dining table to be enjoyed together with family members.

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A. Lontong

Lontong is a typical Indonesian food made from white rice packed in banana leaves, then boiled until cooked. Lontong is usually served with various types of broth such as chicken opor, sayur lodeh, or satay. This food is very popular in Indonesia, including Labuhanbatu, and is a favorite dish at various events like Lebaran. Ethnomathematics can study the relationship between lontong and the cylinder shape, because in the process of making lontong, volume calculations and the cylindrical shape are used as containers for boiling lontong.

In the process of making lontong, white rice that has been washed and soaked is then measured for its volume and mixed with water. The mixture of rice and water is then placed into a cylindrical tube made of banana leaves. The volume and shape of the cylinder must correspond to the amount of rice and water used, so that the lontong can cook properly and evenly..

Furthermore, in the process of boiling lontong, the tube containing glutinous rice and water is placed in a larger container filled with water and heated over a flame. This heating process also involves calculating the necessary time and water temperature, ensuring that the lontong cooks perfectly without being too soft or too firm

Picture 1. Lontong

From an ethnomathematics perspective, the making of lontong using a cylinder can also be seen as an example of the application of geometry in everyday life. This is because the cylinder has a distinct geometric shape, which is a cylinder, with specific mathematical properties such as volume and surface area. Therefore, making lontong using a cylinder also involves understanding concepts of geometry and mathematics related to the shape of the cylinder.

B. Ketupat

The concept of spatial geometry in ketupat is actually very simple and consists of several basic elements. Ketupat is typically cubic or tetrahedral in shape, made from woven coconut leaves or other materials tied and then boiled. In this case, ketupat can be considered as a three-dimensional spatial structure with volume. Additionally, ketupat also has square-shaped sides or surfaces, each of which can be considered as a flat plane. These surfaces can be seen from the outside of the ketupat and also from the inside after the ketupat is opened.

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In addition to its shape and volume, the concept of spatial geometry in ketupat is also related to the arrangement and pattern of woven coconut leaves or other materials used. These weaves can form specific geometric patterns, such as squares or octagons, which can also be considered as spatial structures or flat planes. Overall, ketupat can be seen as a simple spatial structure but with many variations in terms of size, patterns, and materials used. The concept of spatial geometry in ketupat can provide a deeper understanding of the structure and form of this traditional food.

Picture 2. Ketupat

Mathematics can be applied to various aspects of life, including food like ketupat. Some mathematical concepts related to ketupat include:

a. Geometry – Ketupat shape

Ketupat has a distinctive shape, which is a rhombus with equal sides and angles of 45 degrees. Therefore, ketupat can be considered as a flat geometric figure with specific properties such as area, perimeter, diagonal, and others..

b. Rasio – Ketupat weight

In making ketupat, the ratio between rice and water is crucial. If this ratio is not correct, the ketupat will not form properly. Additionally, the ratio of rice to ketupat weight needs attention to ensure the ketupat is neither too dense nor too soft.

c. Statistics – Number of ketupat

During specific occasions such as Eid al-Fitr or Eid al-Adha, people usually buy ketupat in large quantities. To determine how many ketupat to buy, statistical analysis can be conducted based on the number of family members or guests expected..

d. Trigonometry – Ketupat inclination

In making ketupat, precision is needed in measuring the inclination of the triangles that form the ketupat. Trigonometry can be used to calculate these inclinations to ensure the ketupat has a symmetrical and proportional shape..

e. Arithmetic – Ketupat portions

Typically, ketupat servings in one meal are around 1 or 2 ketupat. However, the number of portions can be calculated arithmetically based on the amount of rice used and the grams of rice required to make one ketupat.

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C. Nastar

In Indonesian culture, one of the traditions that indirectly uses mathematics is the making of a traditional Eid cake called round nastar. Several mathematical concepts are used in making this cake, especially in geometric forms. First, when making round nastar, there is a geometric concept used in the dough shaping stage. The dough must be formed into small balls of the same size so that the resulting cakes are uniform in size. This includes the concept of geometry in the form of a sphere. A sphere is a three-dimensional shape that has properties such as a spherical shape, equal surface area on all sides, and a center point at every point.

When shaping the dough into balls, the use of hands plays a crucial role. Hands are the most natural and flexible tools for shaping the dough into small balls of the same size. In this regard, hands have better capabilities compared to other human-made tools.

Picture 3. Nastar

However, behind these exceptional manual skills lies hidden mathematical principles that are unconsciously but naturally applied in their use. One of them is the concept of comparison and proportion. When making dough balls, having the same size between two balls is crucial. The comparison and relationship between the dough used and the size of the resulting balls must be accurate so that the balls produced are of the same size. For example, if you want to make a ball that is 2 cm in size, you must use the same amount of dough and of the same size to ensure the result is exactly 2 cm..

In addition, there is another mathematical concept related to making dough balls, namely the concepts of volume and surface area of a sphere. The volume of a sphere measures how much space the sphere occupies, while the surface area of a sphere indicates how much space the sphere covers around it. When making dough balls, it is important to consider the volume and surface area of the sphere to create balls of the same size.

Besides geometry concepts, there are other mathematical concepts involved in making round nastar cookies, such as the concept of measurement. When making the dough, precise ratios among the ingredients are crucial to ensure the quality of the cookies produced. Using correct units during

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measurement is also important for accuracy. For instance, when measuring flour, grams or measuring spoons are typically used..

Another aspect is the measurement during the dough-making stage. When forming dough balls, the size of the resulting balls must match the desired size. Therefore, measuring the dough ball is also important when making round nastar cookies. Here, there is the concept of measurement in terms of the diameter of the ball. The diameter of a ball is the longest distance between two points on the ball passing through its center. When making dough balls, measuring the diameter ensures that the resulting balls are of the correct size.

There are also other mathematical concepts related to making round nastar cookies, such as the concept of probability. Probability is the science that studies the likelihood of an event occurring. When making round nastar cookies, the concept of probability can be applied when filling the dough with pineapple jam. The success or failure of filling the dough with pineapple jam depends greatly on the technique and skill of the baker. However, there are other factors that can affect this success, such as the texture of the dough, oven temperature, and humidity. In this case, bakers can use the concept of probability to estimate the likelihood of success or failure in making round nastar cookies..

Round nastar cookies are not just treats; they are also part of Indonesian culture. These cookies are part of the celebration of Eid al-Fitr, demonstrating how mathematics is integrated into Indonesian culture. The integration of mathematics and culture is contextual and realistic. Mathematics becomes a part of culture, applied and used to analyze innovative aspects.

Tabel 1. Ethnomathematics in Traditional Lebaran Food

Mathematical Aspects	**Explanation**

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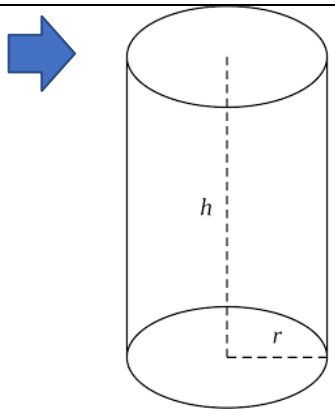
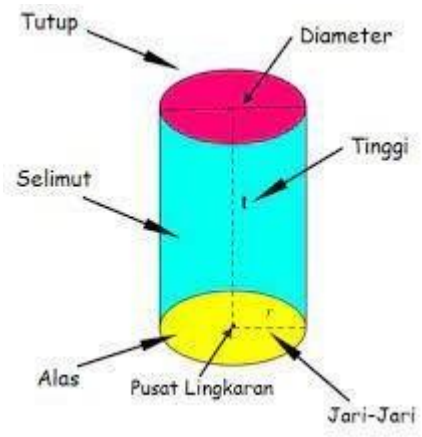
The shape of lontong has aspects of a cylindrical or tubular spatial structure.	  Lontong has elements of diameter and height, which can also be seen in the structure of a cylinder.  Thus, its volume can be found using the formula:: $V = \pi r^2 t$ π = 3,14 or $\frac{22}{7}$ $r = radius$ t = high Its surface area can also be found using the formula for the surface area of a cylinder L surface area of the cylinder = $2\pi r(r + t)$

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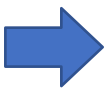
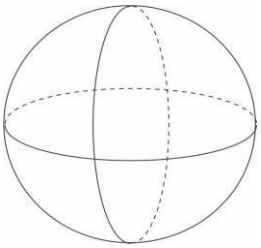
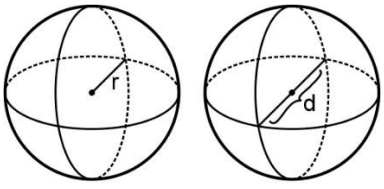
The shape of a diamond which has aspects of a three-dimensional solid.	 $V = s^3$ and $L = 6s^2$ **Keterangan:** V = Volume s = length of the side of the diamond L = Area
The shape of pineapple tart cookies which has aspects of a three-dimensional sphere	   The round pineapple tart has a diameter, which is an element found in the sphere.  Gambar Bola Thus, its volume and surface area can be calculated using the formula: the formula for a sphere is as follows: • Volume of a sphere = (4/3) x π x r^3 surface area of a sphere = 4 x π x r^2 r = radius of the sphere π = pi (mathematical constant with a value approximately 3.14)

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D. Question on the application of eid special foods in labuhanbatu

1. Last Eid in 2024, I tried making lontong by myself in Labuhanbatu. The lontong has a diameter of 5 cm and a height of 25 cm. The lontong will be completely wrapped in banana leaves, how many square centimeters of banana leaves are needed to wrap the lontong? π =3,14

Solution :

Given :

$\pi = 3{,}14$

$t = 25\ cm$

d = 5 cm

$r = \frac{1}{2}d = \frac{1}{2} * 5 = 2{,}5\ cm$

Asked :

Area of banana leaf ?

Answered :

Surface area of lontong (cylinder) = $2(r + t)$

Surface area of lontong (cylinder) = 2 × 3,14 × 2,5 (2,5 + 25)

Surface area of lontong (cylinder) = 431,75 cm^2

So the required area of banana leaf to wrap the lontong is approximately 431,75 .

cm^2

2. One day, my grandfather was making ketupat for the Eid al-Fitr celebration. He used woven coconut leaves shaped like an octagon to make the ketupat. Each side of the ketupat measures 8 cm. What is the volume of the ketupat that my grandfather successfully made?

Solution:

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To calculate the volume of the ketupat, we need to use the formula $V = s^3$, where s is the length of the side of the ketupat. In this case, the length of the side of the ketupat is 8 cm, so the formula becomes:

V = 8^3

V = 512 cm^3

So, the volume of the ketupat successfully made by my grandfather is 512 cm^3

3. Hendri plans to produce 1,000 toy balls with a diameter of 30 cm each. If the cost of materials per m² is Rp 20,000, how much money does the entrepreneur need to spend to produce the balls?

Solution :

$$r = \frac{d}{2} = \frac{30}{2} = 15cm$$

$$L_{1000\ bola} = 1000x4x\pi x r^2$$

$$L_{1000\ bola} = 1000x4x3{,}14x15^2$$

$$L_{1000\ bola} = 1000x4x3{,}14x225$$

$$L_{1000\ bola} = 2.826000cm^2 = 282{,}6m^2$$

$$Cost\ of\ 1000\ ball = L_{1000Bola}\ x\ cost\ per\ m^2$$

$$Cost\ of\ 1000\ ball = 282{,}6\ x20000$$

$$Cost\ of\ 1000\ ball = Rp5.652.000$$

So, the entrepreneur needs to spend a total of

$$Rp5.652.000$$

.

CONCLUSION

Summary

Labuhanbatu Regency, located between North Labuhanbatu Regency, South Labuhanbatu Regency, and North Padang Lawas Regency, certainly boasts unique culinary cultures specific to each of these regions. Based on the findings of the Ethnomathematical Exploration on Spatial Structures of Eid al-Fitr Special Foods in Labuhanbatu, it is concluded that there is a close relationship between culture and mathematics in the preparation of Eid al-Fitr special foods in Labuhanbatu.

In the making of Eid al-Fitr special foods in Labuhanbatu, food artisans apply principles of spatial structures. They blend ingredients skillfully, drawing on habits, expertise, and experience to create harmonious spatial structures within their foods. Additionally, it was found that food artisans in Labuhanbatu exhibit strong mathematical reasoning and logical abilities in selecting and proportioning ingredients for their culinary creations. They rely on simple measurement techniques such as counting, dividing, and multiplying to achieve desired outcomes.

In this regard, this research adds value by enhancing our understanding of how mathematics permeates everyday life, particularly in the context of creating Eid al-Fitr special foods in Labuhanbatu. This study also offers educational insights for the public and educators on the importance of recognizing the connection between mathematics and culture, while inspiring food artisans to enhance the quality of their products.

Recommendations

The traditional Eid al-Fitr foods in Labuhanbatu can be an alternative idea for mathematics education based on ethnomathematics. An educator can introduce Labuhanbatu's traditional Eid al-Fitr foods to students and apply the concepts derived from these foods to facilitate understanding of mathematical lessons. This research also aims to benefit the field of education, particularly mathematics education. It is hoped that this research will also enhance students' appreciation for the traditional Eid al-Fitr foods in Labuhanbatu.

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