



Ethnoscience and Ethnomathematics Analysis of Kupatan Tradition in Durenan Trenggalek East Java

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Abstract. Kupatan tradition in Durenan District, Trenggalek Regency is celebrated on the 8th day of Shawwal in Hijri year. This tradition has conditions with positive values, including strengthening the relationship, realizing tolerance, preserving the teachings of charity, and honoring guests. This kupatan tradition can be used as an object of ethnoscience and ethnomathematics, that it can be used as an effort to preserve the nation's culture. This study aims to describe the elements of ethnoscience and ethnomathematics in the Kupatan Tradition in Durenan Trenggalek. This research was a qualitative research with an ethnographic approach. The results showed that in the Kupatan Durenan tradition, ketupat is always available, which is a special food during Eid that is wrapped in coconut leaves and filled with rice, then cooked and served with other dishes. In addition, this tradition is celebrated with slametans in mosques or prayer rooms, bringing a procession of gunungan kupat, pilgrimages to the grave of Mbah Mesir, visiting kyai, and open houses. Ethnobiological elements in the Kupatan Durenan tradition are found in scientific classification, biodiversity, and locomotion systems, while ethnochemistry elements are found in carbohydrates, proteins, lipids, food additives, colloids, and chemical elements. Elements of ethnophysics in the kupatan tradition are in magnitude and unit, motion, and heat transfer. Studies of Ethnomathematics in the kupatan tradition are found in the plane and solid geometry, the concept of permutations and cyclical permutations of the number of guest sitting positions, as well as the concept of the combination of the number of handshakes.

Keywords: ethnoscience, ethnomathematics, kupatan tradition, durenan.

1 Introduction

Eid al-Fitr is a Muslim holiday which is celebrated on the 1st of Shawwal in the Hijri year. Eid al-Fitr has meaning as a day of victory for Muslims after fasting in the month of Ramadan. The command to fast in the month of Ramadan is an obligation for those who believe as stated in the QS. Al-Baqarah verse 183 which means "O believers! Fasting is prescribed for you as it was for those before you, so perhaps you will become mindful of Allah". [1] Fasting is interpreted not only to refrain from eating and drinking from sunrise to sunset, but also to refrain from lust. Therefore, after fasting Ramadan, Muslims celebrate the victory of Eid al-Fitr. Eid al-Fitr is a momentum to forgive each other, stay in touch with relatives, have an attitude of tolerance to build religious moderation, and teach charity.

Celebrating Kupatan for the community in Durenan District, Trenggalek Regency, East Java, is a tradition that is inseparable from the celebration of Eid al-Fitr. From this, it is clear that Kupatan is held after Eid al-Fitr. Kupatan holiday in Durenan has become a tradition that is carried out from generation to generation so that it becomes a culture. Culture is the development of the plural form of "cultivation" which means power and reason, the power of reason. So culture is the whole of what has been produced by humans because of their thoughts and works [2]. Kupatan tradition is a culture in the form of social activities that involve the whole community in a joint effort to obtain safety and peace together, which is usually done in the month of Shawwal [3].

The history of the Kupatan Tradition in Durenan District, Trenggalek Regency began in ancient times from the legacy of Mbah Mesir ancestors whose real name was KH Abdul Mahsyir, as the founder of the Babul Ulum Islamic Boarding School around 1671. Now continued by his sons and descendants, at that time Mbah KH Abdul Mahsyir is one of the figures as well as an elder named Mbah Mesir who is always eager to perform the sunnah fast of Shawwal or commonly called "nyawal" for six days [4]. It was only on the eighth day of the month of Shawwal that the Kupatan celebration was held and received guests and served ketupat food. Philosophically in the Kupatan tradition, ketupat/kupat is always available, which is a special Eid food wrapped in coconut leaves "janur" and filled with rice, then cooked and served with other dishes. "Kupat" means "ngaku lepat" (admit mistake), "janur" means "jatining nur" (conscience). When the ketupat is split open, it looks like white rice, which symbolizes the purity of the heart. Besides that, there have been values of religious moder-

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The uniqueness of Kupatan Durenan Eid is the main Eid in the tradition of the Durenan District community because of the peak of the crowd and mutual stay in touch on that day. There are several sequences of events in the kupatan tradition in Durenan Trenggalek, namely the first start, the preparation stage which begins with deliberation to determine the day, prepare somethings, and work together to make *gunungan* ketupat. Second, the implementation stage is making offerings in the form of ketupat or *kupat* food, vegetables, side dishes, and drinks. Then there was a slametan at the mushala or mosque, a giant *gunungan* kupat carnival, and a pilgrimage to the tomb of Mbah Mesir[4]. The third stage, carried out friendship with the descendants of Mbah Mesir, visiting the kyai, and also visiting to the relatives. What's special about this ketupat Eid is that almost every resident's house provides Durenan ketupat food and holds an open house.

Cultural studies on the kupatan tradition have been discussed by several previous researchers, that the kupatan tradition makes a positive contribution to efforts to strengthen the identity and personality of the people in Bantul, Yogyakarta[5]. The implementation of the mutual cooperation values contained in the kupatan celebration in Durenan Trenggalek[6]. From the study of living hadith, it was found that the Kupatan tradition in Durenan Trenggalek is a form of local community practice on the teachings of the Prophet Muhammad SAW related to alms, strengthening ties of friendship, and glorifying guests so that life becomes more blessed[3]. In addition to the socio-cultural context, the existence of mathematical and scientific concepts in the form of components or materials in making ketupat as well as human activities contained in the kupatan tradition is an interesting thing to identify, which can then become the basis for learning science and technology, culture-based contextual mathematics. Therefore, the kupatan tradition also has the potential to be used as a source and object of ethnosience and ethnomathematics learning.

A learning approach that makes culture the object of study in science is called ethnosience. Ethnosience is the activity of transforming primary knowledge into scientific knowledge. True scientific knowledge consists of all knowledge relating to the facts of society. This knowledge comes from beliefs that are passed down from generation to generation[7]. Ethnosience-based learning is an innovation in education that combines culture and science. Through cultural philosophical values studied in ethnosience, it is hoped that it can encourage students to do commendable actions (akhlakul karimah) in everyday life[8]. Ethnomathematics can be said to be mathematics that grows and develops in a certain culture[9]. The presence of ethnosience and ethnomathematics can make students learn contextually from the surrounding culture and associate with culture with the concepts of science and mathematics so that learning is more meaningful.

New innovations in education to minimize the erosion of local cultural values by globalization can be pursued through ethnosience-based learning[10]. However, in reality, learning science and mathematics is still rarely associated with local culture. Sumarni explains that some teachers tend to focus on delivering the material contained in the syllabus but have not thought about science learning that is linked to indigenous knowledge/culture that develops in society[11]. In ethnomathematics, students are not only invited to develop mathematical abilities but students are also introduced to the culture which is the original character of their nation[12]. This study aims to describe the kupatan tradition in Durenan Trenggalek related to the concepts of science and mathematics or what is called ethnosience and ethnomathematics.

2 Method

This research is a descriptive study with an ethnographic approach, namely describing and analyzing cultural heritage through literature study. Ethnographic studies focus on the cultural aspects of society, which are classified as qualitative research. The data collection technique in this study is the collection of library data obtained from literature studies such as books, journals, and other literature sources. From the results of this literature study, notes were made, and further analysis was carried out. Data analysis in this study includes domain and taxonomy analysis.

Domain analysis was carried out in order to obtain a general and comprehensive picture of the research object along with determining the domain and grouping the data according to the domain. In this study, data related to mathematical concepts are grouped in the ethnomathematical domain, especially geometry, permutations, and combinations, while data related to science/natural science concepts are grouped in the ethnosience domain, especially biology, chemistry, and physics. Furthermore, taxonomic analysis is carried out by describing the selected domains in more detail.

3 Results and Discussion

The term kupatan was first coined by Sunan Kalijaga as a form of holiday for people who fast for six days of Shawwal. The Kupatan tradition contains special philosophical values. Kupatan has the meaning of "*ngaku lepat*", which is admitting mistakes. Every human being must have mistakes and the best of them are those who admit their mistakes and apologize, so that they forgive each other. In addition, in terms of the materials used in making ketupat, they also contain philosophical values. Janur, according to Javanese philosophy,

comes from the word "*jatining nur*" which symbolizes all humans being in a clean and holy condition after fasting. Kupat has a rectangular shape that describes the four types of worldly desires, namely *al amarah*, namely emotional lust; *al lawwamah* or lust to satisfy hunger; *supiah* i.e. lust for something beautiful; and *mutmainah* is the desire to control oneself. And the person who eats kupat describes that he is able to control the four passions after fasting. Furthermore, the content of the ketupat is rice, as a form of hope that human life will be filled with prosperity. In addition, when the kupat has been cooked and split, it will appear white, meaning that after forgiving each other, humans return to pure white like the contents of a ketupat. When eating ketupat, coconut milk is usually added. Santen means *pangapunten*, which is to apologize for mistakes[13].

The Kupatan Durenan tradition is one of the original cultures in Durenan District which is still preserved today and has become a typical icon of Trenggalek Regency. The tradition of Kupatan Durenan is preserved by Kyai Abdul Masyir or commonly called Mbah Mesir. He is the caretaker of the Babul Ulum Islamic boarding school. The chronology of the Hari Raya Kupatan was created because Mbah Mesir at that time saw the people of Durenan who after celebrating Eidul Fitri did not do the Sunnah fasting of the month of Shawwal. Even though fasting in the month of Shawwal has many rewards and can erase the sins of the past year and the future. Seeing social problems like that, Mbah Mesir finally came up with a new idea by combining culture and shari'a, namely fasting the month of Shawwal for 6 days and followed by slametan kupat (tasyakuran ketupat) at his Islamic boarding school which then spread to mosques and mosques. Then the tradition spread to the villages around Durenan[14]. This tradition begins with several processions ranging from the preparation of ubarampe, the procession of *gunungan ketupat*, pilgrimage to the tomb of Mbah Mesir, gathering with clerics and elders, to an open house. This tradition serves kupat menu as the main menu for guests. The kupat dish is usually accompanied by vegetables so it is known as vegetable kupat, and is added with side dishes such as chicken *opor*, peanut brittle, and others.

The results of the study of the Kupatan Durenan tradition show the potential for ethnoscience that can be used as a learning resource that includes elements of ethnobiology, ethnochemistry, and ethno physics. Ethnoscience studies in the Kupatan Durenan tradition include materials used in making ketupat or kupat, such as janur (young coconut leaves), rice, vegetables, and cooking spices that can be used as objects of ethnobiology and ethnochemistry studies, while movements during sungkeman, movements when moving from one house to another, and the movement during the Gunungan Kupat procession can be used as an object of ethno physics study. Ketupat served with vegetables *lodeh* jackfruit and long beans, chicken *opor*, and others are shown as shown in Figure 1.



Fig. 1. Serving Ketupat (authors' documentation)

The ethnobiological elements contained in the Kupatan Durenan tradition are shown in Table 1. The ethnomathematics studies in the Kupatan tradition are found in the plane and solid geometry, the permutations, and combinations of sitting positions and the number of handshakes.

Table 1. Elements of Ethnobiology in the Kupatan Durenan Tradition

No	Components	Indigenous knowledge	Biology Concepts
1.	Janur	Young coconut leaves are yellow which is used as a material for wrapping kupat	<ul style="list-style-type: none"> - Scientific classification of Kingdom plantae - Biodiversity - Monocotyl - Name of species : <i>Cocos nucifera L.</i>
2	Rice	Used for filling ketupat	<ul style="list-style-type: none"> - Scientific classification of Kingdom plantae - Biodiversity - Monocotyl - Name of species: <i>Oryza sativa</i>
3	Vegetable - Long beans - Jackfruit - Lotho beans - Papaya	Vegetable <i>lodeh</i> with coconut milk as a snack with ketupat	<ul style="list-style-type: none"> - Scientific classification of Kingdom plantae - Biodiversity
4	Rempeyek - Peanuts - Soybean	Side dishes	<ul style="list-style-type: none"> - Scientific classification of Kingdom plantae - Biodiversity - Dicotyl - Peanut species name: <i>Arachis hypogaea</i> - Soybean species name : <i>Glycine soja / Glycine max Merr.</i>
5	Coconut milk	Ingredients for making vegetable gravy	<ul style="list-style-type: none"> - Scientific classification of Kingdom plantae - Biodiversity - Monocotyl - Name of species : <i>Cocos nucifera L.</i>
6	chicken (chicken <i>opor</i>)	A coconut milk soup with chicken meat and certain spices added	<ul style="list-style-type: none"> - Scientific classification of Kingdom Animalia, Class : Aves - Biodiversity - Name of species : <i>Gallus domesticus</i>

Apart from the ingredients for making ketupat, ethnobiology elements in the Kupatan Durenan tradition are also present during the sungkeman (Figure 2), which is an expression of the process of forgiving each other by younger people to older people. Sungkeman is done by means of a younger person kneeling in front of an older person and kissing his hand while saying sorry and asking for prayer. Movement when kneeling at the time of sungkeman involves the movement system or the musculoskeletal system in humans. The motion system consists of two types of locomotion, namely active locomotion (muscles) and passive locomotion (bones)[15].

**Fig. 2.** Sungkeman Procession (authors' documentation)

The ethnochemistry elements contained in the Kupatan Durenan tradition are found in the materials used in the manufacture of ketupat/kupat which are described in detail in Table 2.

Table 2. Elements of Ethnochemistry in the Kupatan Durenan Tradition

No.	Components	Chemistry Concepts
1.	Rice	<ul style="list-style-type: none"> - Polymers (Carbohydrates) <p>The rice used for filling ketupat is a carbohydrate polymer. Types of starch include polysaccharides containing amylose and amylopectin (Figure 3).</p> <ul style="list-style-type: none"> - Condensation polymerization reaction <p>Composed of glucose monomers linked to one another by glycosidic bonds and releasing small molecules of H₂O to form polysaccharides (starch)</p>
2.	Vegetables	<ul style="list-style-type: none"> - Protein <p>Nuts are a source of protein that contains amino acids needed by the body</p> <ul style="list-style-type: none"> - Vegetable oil <p>Nuts are a source of vegetable oil that contains unsaturated fatty acids that are good for the body. For example, soybeans contain linoleic acid (omega-6) and linolenic acid (omega-3).</p> <ul style="list-style-type: none"> - Vitamins <p>Nuts also contain vitamins, such as soybeans containing vitamins A, B complex and E.</p>
3.	Coconut milk	<ul style="list-style-type: none"> - Colloid <p>Coconut milk is a colloidal system in the form of an emulsion, where the dispersed phase is liquid and the dispersion medium is also liquid</p>
4.	Seasoning	<ul style="list-style-type: none"> - Food additives <p>Certain ingredients are added to dishes/foods to enhance the taste. There are natural and artificial food additives. Natural additives such as salt and sugar serve to enhance taste, turmeric is a natural colorant while flavoring agents such as monosodium glutamate/MSG are artificial/synthetic additives.</p> <ul style="list-style-type: none"> - Elemental chemistry <ul style="list-style-type: none"> - Table salt (NaCl) is composed of the elements sodium (Na) and chlorine (Cl); - Sugar has the chemical formula C₁₂H₂₂O₁₁ composed of elements C, H, and O; - Flavoring / Monosodium Glutamate (MSG) has the chemical formula C₅H₈NO₄Na composed of the elements C, H, N, O, and Na.

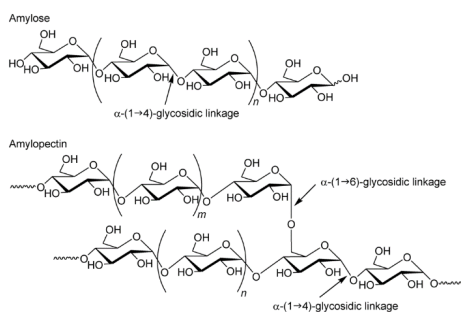


Fig. 3. Structure of Amylose and Amylopectin

Furthermore, the ethnophysics elements in the Kupatan Durenan tradition are contained in the concept of magnitude and unit, the concept of motion during the procession of the ketupat mountains (Figure 4), and the concept of heat transfer when boiling the ketupats. The filling of the rice into the ketupat is adjusted to the size of the ketupat so that the cooked rice in the kupat has the right texture, not too soft or not too hard. The filling of rice is estimated to be only half of the contents in the ketupat skin. The measurement of mass of rice stuffed into the ketupat can be measured in terms of mass and grams. Next, the strength of carrying the kupat mountain cannot be separated from the theory of lifting a heavy load. In physics, this theory can be studied in the matter of force. Force is an interaction that can cause an object with mass to change its motion, position, or change shape of the object. This is similar to the findings which identified elements of ethnoscience in the

Gunungan Tradition in the Yogyakarta Palace[16]. In addition to these two concepts, when the process of boiling water and boiling kupa in boiling water also involves the concept of heat transfer, namely the occurrence of convection events. Convection is the transfer of heat from one place to another along with the motion of the particles of the object.



Fig. 4. Procession of Gunungan Kupa Durenan (authors' documentation)

The ethnomathematical elements contained in the Kupa Durenan tradition are found in the materials used in making kupa/kupa as well as the interactions made by people during the Kupa tradition which are detailed in Table 3.

Table 3. Elements of Ethnomathematics in the Kupa Durenan Tradition

No.	Components	Description	Mathematics Concepts
1.	Ketupa/ Kupa	- Kupa made in the Kupa Trenggalek tradition, there are three kinds of forms, namely kupa gunung, kupa sinto, and kupa luwar (Figure 5).	- Plane and Solid Geometry - A rhombus is a plane geometry formed by four congruent right-angled triangles. It has diagonal lines that are perpendicular The geometry other and opposite angles are equal. - Solid Geometry of kupa in the form of a three-dimensional shape of a rectangular prism (Kupa Sinto)
2.	Sitting position when visiting - Sitting side by side	- The sitting position that occurs if there are as many as n people (guests) and provided as many as n chairs arranged side by side	- Permutations The number of possible sitting positions if as many as n chairs are arranged side by side $P(n, n) = n!$
3.	Sitting position when visiting - Sit in a circle (around a round table)	- The sitting position that occurs if there are n people (guests) and provided as many as n chairs arranged in a circle (around a round table)	- Permutations (cyclical permutations) Number of possible sitting positions if n chairs are arranged around a round table $P(n) = (n-1)!$
4.	Number of handshakes	- The handshake incident involves (r = 2) people, where the position of the two people shaking hands is not in question, meaning that the handshake of person A and person B is the same as the handshake of person B and person A. So many handshakes occur between n people can be viewed as a problem of combining (r = 2) elements from the available n elements.	- Combination The number of handshakes $n C r = \frac{n!}{r!(n-r)!}$ $n C 2 = \frac{n!}{2!(n-2)!}$

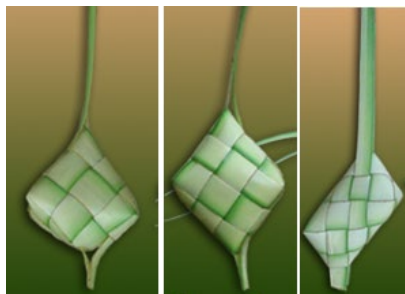


Fig. 5. Shapes of Ketupat (Kupat Gunung (left) , Kupat Sinto (middle), and Kupat Luwar (right) (authors' documentation)

Previous research conducted by Heriyati succeeded in explaining the surface area of the ketupat, and the concept of volume in filling the Betawi Ketupat as an Ethnomathematics-Based Learning Media[17]. Similarly, to previous research explained that Javanese ketupats in the Ketupat ethnomathematics study of Alasmalang Village Banyuwangi contain the concepts of relationships between lines, angles, plane and solid geometry, tiles, volumes of shapes in non-standard units, and fractions[18]. The results of this study discuss the concept of permutations related to determining the number of possibilities of sitting when visiting and the concept of combinations relating to the number of handshakes that occur during the open house hospitality procession.

4 Conclusion

Kupatan tradition in Durenan District, Trenggalek Regency began in ancient times from the legacy of Mbah Mesir's ancestors and has been preserved until now. In this tradition, ketupat is always available, which is a special food during Eid which is wrapped with coconut leaves inside, filled with rice, then cooked and served with other dishes. In addition, this tradition is celebrated with slametans in mosques or prayer rooms, bringing a procession of gunung kupat, pilgrimages to the tombs of Mesirian Grandmothers and clerics, and open houses. Ethnoscience studies in the kupatan tradition include ethnobiology, ethnochemistry, ethnophysics, and ethnomathematics. Ethnobiological elements in the Kupatan Durenan tradition are found in scientific classification, biodiversity, and locomotion systems, while ethnochemistry elements are found in carbohydrates, proteins, lipids, food additives, colloids, and chemical elements. Elements of ethnophysics in the kupatan tradition are magnitude and unit, motion, and heat transfer. Ethnomathematical studies in the kupatan tradition are found in the plane and solid geometry, the concept of permutations and cyclical permutations of the number of guest sitting positions, and the concept of combinations of the number of handshakes.

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