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ETHNOSCIENCE STUDY OF REED PLANTS (IMPERATA CYLINDRICA (L.)) IN THE UME KBUBU OF THE TIMOR TRIBE

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ABSTRACT

The alang-alang plant is believed to be a good thermal insulation, but unfortunately, it is starting to be abandoned. The purpose of this study was to investigate the use of reed plants *(Imperata cylindrica (L.))* as a basic material in the manufacture of *ume kbubu* of the Timorese tribe. This research was conducted in the South Middle Timor District, East Nusa Tenggara Province. The method used in this research is the triangulation method, which analyzes primary data in the form of observation data, interview data, and literature studies. The results showed that alang-alang *(Imperata cylindrica (L.))* is used by Timorese people as an *ume kbubu* roof due to several factors such as its abundant availability, cheap, strong, durable, and cheap. Through scientific studies, it can be explained that alang-alang *(Imperata cylindrica (L.))* has a strong structure, contains high lignin and cellulose, is hydrophobic, and has anti-microbial and antioxidant properties that can help protect plants from pests and diseases. In addition, the influence of the shape of the roof construction using alang-alang which has a hollow structure makes the *ume kbubu* roof a good thermal insulator. The study of community science and scientific science on using reeds (Imperata cylindrica (L.)) as a basic material for making *ume kbubu* of the Timorese tribe can be integrated into science learning in schools and universities.

Keywords: Imperata cylindrica (L.); Reeds; Science Learning; Timorese; Ume Kbubu

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1. INTRODUCTION

Indonesia is a country rich in local traditions and cultures. The richness of tradition and culture includes language, traditional clothing, traditional houses, traditional weapons, food, traditional ceremonies, beliefs, and other community traditions. Based on data from the population census conducted by the Central Statistics Agency (BPS) in 2010, 1340 tribes constitute ethnic and cultural groups of the community and live together in the territory of Indonesia which stretches from Sabang to Merauke, from Miangas island to Rote island (Peter & Simatupang, 2022).

In addition, Indonesia is also rich in flora and fauna spread throughout the archipelago. This diverse flora is a source of food, medicine, spices, building materials, and various other sources (Mallangi, 2017 in Danong, et al., 2021) The utilization of plants for people's lives in Indonesia is strongly influenced by culture or habits in each region. This is because Indonesia is rich in ethnic diversity and has a variety of knowledge in the use of plants that have been passed down from generation to generation (Danong, et al., 2021). One of the traditions or habits of the community is the use of surrounding plants is as a material for the construction of traditional houses or traditional houses.

One of the cultural treasures of the archipelago passed down from generation to generation is "Ume Kbubu". *Ume kbubu* is a round-shaped dwelling and a house where *Atoin Meto* (a term for Timorese people) lives. *Ume kbubu* is one of the traditional buildings that has been recorded into the Intangible Cultural Heritage by the Ministry of Education and Culture of the Republic of Indonesia. The shape of the *ume kbubu* can be seen in Figure 1.

Figure 1. Physical form of Ume Kbubu
Source: *https://shorturl.at/hyQ46*

The term *ume kbubu* consists of two words, namely *"Ume"* which means house, and *"Kbubu"* which means round so that *ume kbubu* can be interpreted as a roundhouse but is commonly known as a roundhouse (Kana, et. al., 1986). However, *ume kbubu* (roundhouse) is not really round but has a conical or almost conical shape. The base of the cone is the base of the roundhouse which is characterized by a circle-like arrangement of stones that serves as the foundation of the roundhouse building itself. At the same time, the roof is a cone blanket made of reeds that have been clenched per bundle. Then the reeds are tied to a frame that has been made as strong and as tight as possible from top to bottom, even the walls of the roundhouse are covered by reeds. At the same time, the top point of the cone is the ridge on the roundhouse. The shape is like clenching hair, some use one head and

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some use two heads because on the ridge, the meeting of the *usuk (suaf)* and the support pole *(pauf)* must be wrapped or clenched as well as possible.

Ume kbubu (roundhouse) has four main pillars as the main support and several supporting pillars that are circular following the foundation of the building. The four main pillars not only support the house but also the attic. The walls follow the supporting pillars, made as tight as possible. There is only one door, as high as an adult's stomach, no windows, and no ventilation.

One of the unique and interesting things is the use of *alang-alang* (reeds) as the basic material for making *ume kbubu*. The use of *alang-alang* as a traditional building roof for the Timorese is a tradition that has been passed down from generation to generation since time immemorial. The use of *alang-alang* as a building roof is interesting to study because it can be used as a reference in the development of environmentally friendly building materials. In addition, this scientific study can also be implemented in science learning to support contextualized learning. Therefore, this research was conducted to analyze the use of reeds *(Imperata cylindrica (L.))* as a basic material for *ume kbubu* in terms of the local wisdom of the Timorese people and scientific knowledge studies.

2. RESEARCH METHODS

This research uses descriptive quantitative and qualitative data analysis research with the triangulation method to determine the use of reed plants *(Imperata cylindrica (L.))* as a basic material for making *ume kbubu* of the Timorese tribe. Triangulation is done by examining evidence from data sources from interviews/focus groups, observations, documentation, and literature studies.

The research was conducted from February to April 2024, starting with field observations in the local community. This research occurred in the South Middle Timor District, East Nusa Tenggara Province, Indonesia. The data used in this research are primary in the form of observation, interviews, and literature studies. Observations were made in the form of observations of the tradition of making *ume kbubu* both through video documentation and direct observation in the field. The research was then continued with interviews with local communities or traditional leaders regarding reeds (Imperata cylindrica (L.)) use in making *ume kbubu*. Interviews were conducted with 5 participants who are Timorese and have experience in making ume kbubu. The last data collection was by conducting a literature study. The data obtained were then analyzed using triangulation to obtain conclusions (Denzin, 2014).

3. RESULTS AND DISCUSSION

The *ume kbubu* building structure has several main elements, namely (Wikipedia, 2024; Dima, et. al., 2013; Timbulong, et. al., 2023): 1) Roof: Consists of various shapes, ranging from high conical roofs like wasp nests to elliptical dome-shaped roof structures, and hemispherical shapes; 2) Walls: Made from natural materials such as bamboo, stone, clay, and shale; 3) Support poles: Used to support the roof and walls; 4) Interior spaces: Includes beds, stoves, and other furniture; 5) Cooking area: Located at the back of the room; 6) Rest area: A place to rest; 7) Columns and roof trusses: Forms a continuous roof structure down to the ground; 8) Attic (Kaenbaun village): Wooden frames placed longitudinally and

transversely on the inside of the building that functions to strengthen the roof structure and as a place to hang crops; and 9) additional semicircle at the front (Boti village): Used as an access point. The shape and construction of the *ume kbubu* can be seen in Figure 2.

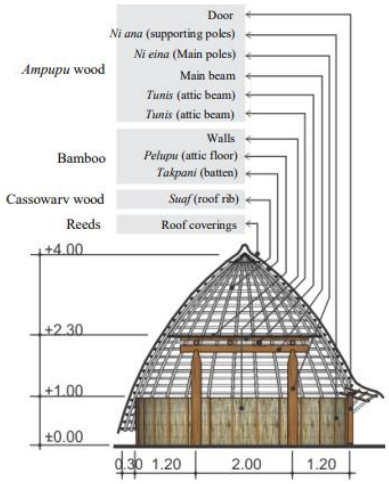

Figure 2. *Ume Kbubu* building construction
Resource: Boli, et. al. (2021)

Differences in the form and structure of *ume kbubu* between regions located on the island of Timor are caused by the surrounding natural resources, the difference in the location of the village from the city, the customs, and the nature of the local community (Timbulong, et. al., 2023). *Ume kbubu* is usually used as a kitchen and warehouse, while *Ume Naek* is used as a house of worship and a place to hold events (Dima, et. al., 2013). The materials used in *ume kbubu* are flexible, strong, and lightweight but still malleable to be dynamic and can respond to climate change that occurs.

In this study, the main focus of the research lies in the use of *alang-alang* plants as a basic material in the construction of *ume kbubu*. The *ume kbubu* roof is usually covered with reeds. The *ume kbubu* roof has an important role because of its prominent shape. The roof is formed by 9 elements. The elements are (Dima, et. al., 2013):

1. *Suaf* (usuk). *Suaf* has a function to support or support the roof covering. Generally made of wood plugs and even in number.
2. *Lael* (nok), *Lael* is the wood that is attached to the *ni enaf* branch (the main pole). The wood has the function of supporting the *suaf*.
3. *Nono*, which functions as a binder and keeps the suaf arrangement in a round shape. *Nono* itself is located on the inside of the house. The *Nono* has been divided into four types. First, *nono ni ana* which functions to help support the suaf. Second, *nono lote* which functions as a form of *maun nine* (terrace) and a place to hang corn and rahan bones sacrificed during traditional ceremonies. Third, *nono tetu* which functions to maintain the shape of the suaf structure which is located above the *nono late*. Fourth, *nono lael* which functions as a support for the *suaf.*
4. *Lote*, functions as a tritisan forming the terrace of the house *(maun nine)*. This part has a number of four and is made of wood plugs.
5. *Tanpani* or *takpani*, which serves as a place to shorten the reeds. Usually made of split bamboo.
6. *Tfa*, serves as an element that strengthens the roof structure and a place to hang the corn harvest. Tfa is also made of wooden plugs and the number must be even.

7. Roof coverings, generally made of *hun* or *alang-alang*. The reeds are bound together by forest pineapple leaf fibers.
8. *Nete bifo*, meaning rat's path. This element is usually made of bis wood and is located above the *lael*.
9. *Tobes*, serves to cover the top of the *ume kbubu* roof. The purpose of making it is so that rainwater does not seep into the house.

The comprehensive design form of *ume kbubu* can be modeled as shown in Figure 3.

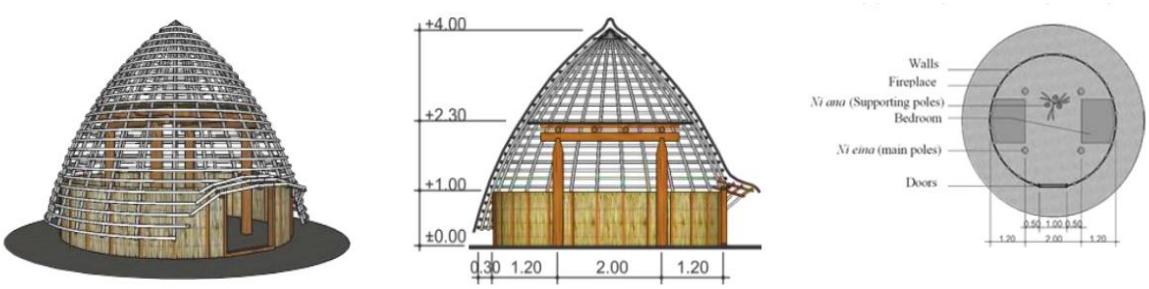

Figure 3. Ume Kbubu construction design
Source: Boli, et. al., (2021)

Community Science & Scientific Science Study on the Utilization of Alang-Alang Plant *(Imperata cylindrica (L.))* As a Basic Material for Making *Ume Kbubu* Timorese Tribe

In the *ume kbubu* structure, alang-alang is used as roofing material. The type of alang-alang used is the *Imperata cylindrica (L.)* species as shown in Figure 4. This species of alang-alang thrives almost throughout the mainland of Timor Island. It is often found in places that receive more than 1000 mm of rainfall, or in the range of 500-5000 mm. In some countries, this species grows at altitudes from sea level to 2000 m and has been recorded at altitudes up to 2700 m asl in Indonesia. It is found in a wide range of habitats including dry sand hills off the coast and deserts, as well as swamps and river banks in valleys. It grows in grasslands, agricultural areas, and plantations. It is also found in areas of bare forest (Yuwono, 2015).

The geographical condition of Timor Island is mostly highland or mountainous. Some areas such as the districts of South Middle Timor, North Central Timor, and parts of Kupang Regency, Malaka Regency, and Belu Regency are at an altitude above 500 meters above sea level. For example, approximately 51% of South Middle Timor has an altitude above 500 meters above sea level (ttskab.go.id, 2024). In addition, the average monthly rainfall that occurs on Timor Island ranges from 300 mm - 500 mm in December - March. While for the dry months (April - November) the monthly rainfall rate ranges from 30 mm to 60 mm. So if calculated, the annual average rainfall is around 1500 mm - 2000 mm (Krisnayanti & Bunganaen, 2018).

Taxonomy of the reed plant (*Imperata cylindrica (L.)*

Kingdom	:	Plantae
Division	:	Magnoliophyta
Class	:	Liliopsida
Ordo	:	Poales
Family	:	Poaceae
Genus	:	Imperata
Species	:	*Imperata cylindrica (L.)*

Figure 4. Reed plants (Imperata cylindrica (L.))
Resource: https://shorturl.at/afzGM

Based on the results of interviews and literature review, data were obtained about the knowledge (science) of the community about the reasons for using reeds as *ume kbubu* roofs. This indigenous knowledge was then reconstructed and scientifically studied based on credible literature sources. The results of this study are then integrated with science learning in schools and universities. Thus, this comprehensive study can increase knowledge and be used in more meaningful learning. The following is the result of a study on the utilization of alang-alang *(Imperata cylindrica (L.))* in making ume kbubu based on process, community science, scientific science, and its implementation in science learning.

1. The process of selecting reed species

The reeds used are a particular type of reeds that grow abundantly on the mainland of Timor Island. In Timorese, the reeds are called *"hun"*. The reeds used are reeds with a minimum length of ±1.5 m.

Table 1. The process of selecting reed species

Science Society	Scientific Science	Implementation in science learning
The reeds are strong, durable, easy to obtain, and cheap.	1. The reeds used were *Imperata cylindrica (L.)* reeds. This type of alang-alang is the most common type of alang-alang used as a basic building material. 2. Physical & chemical properties of reeds include: • Water content: The water content of reeds is 93.76% (Sutiya, et. al., 2012). • Water absorption: The value of water absorption in reeds is 24.61% (Dalle, 2017). 3. The high lignin content of alang (leaves: 18.12%, stems: 31.29%) causes the structure of alang-alang to be strong (Jalaluddin, et. al., 2014). This is because, chemically, lignin is difficult to break down naturally (by water). The content of cellulose (and lignin) forms a sturdy plant (alang-alang) structure. The longer the cellulose chain, the more tightly arranged the reed fibers are and the stronger the structure (Sutiya, et. al., 2012).	1. Classification of Living Things & Biodiversity (Class X Biology) 2. Organic Chemistry (S1)

2. The process of collecting reeds from the field

The parts of the reeds used are the leaves and stems. The uprooting process is carried out carefully so that the reed stems are not disconnected from the leaves. The uprooted reeds are then collected and tied in large enough bundles and transported to the drying place. Reeds collected in the forest are usually transported manually using human labor (shouldered).

Table 2. The collecting reeds from the field

Science Society	Scientific Science	Implementation in science learning
If the leaves and stems of the reeds are cut off, the reeds cannot be used as a roof.	1. Reed stems and leaves are inseparable in the making of *ume kbubu* (as a roof). 2. The length of the reed stems is ± 20-30 cm, while the length of the leaves is ± 12-80 cm (Damaru, 2011). 3. The process of deterioration of the alang-alang structure starts from the leaves and then to the stems due to the construction of the roof. Extreme weather such as sunlight, rain, strong winds, and high humidity can affect the cellulose and lignin content in reed leaves, which in turn can cause the leaves to become more brittle and easily damaged. When reed leaves are excessively exposed to sunlight, the cellulose and lignin in their cell walls can degrade due to oxidative damage caused by UV radiation (Derbyshire & Miller, 1998; Evans, et. al., 1993).	1. Kingdom plantae and its role in life (Plant morphology) (Biology class X. 2. Organic chemistry (S1)
Large bundles will speed up the process of moving the reeds to the drying area. In addition, the use of human labor is easier and less costly.	Difficult terrain conditions (mountain and forest areas) do not allow reeds to be transported using motorized vehicles. In addition, in the concept of physics, humans are easier to manage their motion equilibrium because of their ability to adapt to the surrounding environment. Humans have a higher ability to regulate their motion equilibrium compared to other creatures. This is due to the higher power of the human mind, which allows humans to more easily understand and regulate their motion equilibrium (Sujalu, et. al., 2021).	1. Point of gravity and equilibrium of a rigid body (Physics class XI) 2. Basic Natural Science (S1)

3. Drying process of reeds

The uprooted reeds are then collected and tied in large bundles and transported to the drying site. Reeds collected in the forest are usually transported manually using human labor (shouldered).

Table 3. Drying process of reeds

Science Society	Scientific Science	Implementation in science learning
The reeds are dried to make them durable and not easily damaged.	1. The drying process causes the water content of the reeds to decrease (Martha, et. al., 2016). Thus, the small water content in the reeds will cause the natural decay process to run slower. Wet leaves decay faster due to the high water content in them. The high water content in wet leaves provides an ideal environment for decomposing microorganisms, such as bacteria and fungi, to multiply rapidly (Wardhani, et. al., 2020). The decay process in wet leaves is accelerated because these microorganisms utilize the high moisture to decompose the organic matter in the leaves, so the leaves will decay faster compared to dry leaves which have a lower water content.	1. Plant growth and development (Biology class XII) 2. Organic chemistry (S1)

Science Society	Scientific Science	Implementation in science learning
	2. In addition, the lignin content in reeds will also support the slowing of decay by preventing pests. Lignin can prevent pests in plants because it has properties that make it useful for pest control (Suwasdi, 2021). Lignin, which is a major component in plant cell walls, has anti-microbial and antioxidant properties that can help protect plants from pests and diseases. In addition, lignin can also play a role in increasing plant resistance to pest attacks due to its strong structure and difficulty in being digested by pathogenic microorganisms (Taiz & Zeiger, 2004). Therefore, lignin can be one of the important factors in the natural defense of plants against pests and diseases. 3. Cellulose, hemicellulose, and lignin content are all hydrophobic, making it difficult to bind with water (Steffen, 2003).	

4. The process of assembling reeds as *ume kbubu* roofs

The reeds are tied in small bundles about the size of a human fist. These assembled reeds will be tied to the *ume kbubu* frame.

Table 4. The process of assembling reeds as ume kbubu roofs

Science Society	Scientific Science	Implementation in science learning
The reeds are tied in small bundles to facilitate the installation of the *ume kbubu* frame.	The alang-alang bundles are small and relatively the same, in addition to facilitating the installation process on the frame, they also function in maintaining the balance of the ume kbubu. The even distribution of the weight of the reeds will make the *ume kbubu* sturdier as it follows the symmetrical shape of the frame.	Point of weight and equilibrium of a rigid body (Physics class XI)

The construction of the alang-alang installation as the *ume kbubu* roof can be illustrated in Figure 6.

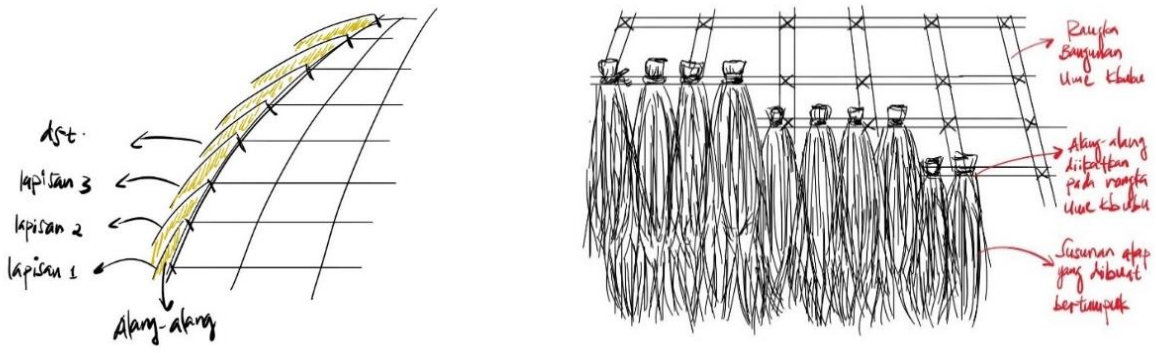

Figure 6. Construction of the reeds on the *ume kbubu* frame

5. The process of installing reeds into *ume kbubu* roofs

The reeds that have been assembled in smaller bundles are then attached (tied) to the *ume kbubu* frame. The installation process is done from bottom to top.

Table 5. The process of installing reeds into *ume kbubu* roofs

Science Society	Scientific Science	Implementation in science learning
Installation of reeds in order from bottom to top aims to facilitate the tying process.	The process of installing a roof from the ground up not only makes installation easier but there are some scientific reasons behind it: 1. Placing the reeds from bottom to top will make the location of the center of gravity move slowly from bottom to top. Therefore, the *ume kbubu* will be sturdier and not easily shaken. 2. The order of installation from bottom to top will allow workers to control the symmetry of the ume kbubu. 3. Philosophically, the bottom-up installation also means that achieving something must be a gradual, progressive, and painstaking process.	Point of weight and equilibrium of a rigid body (Physics class XI)

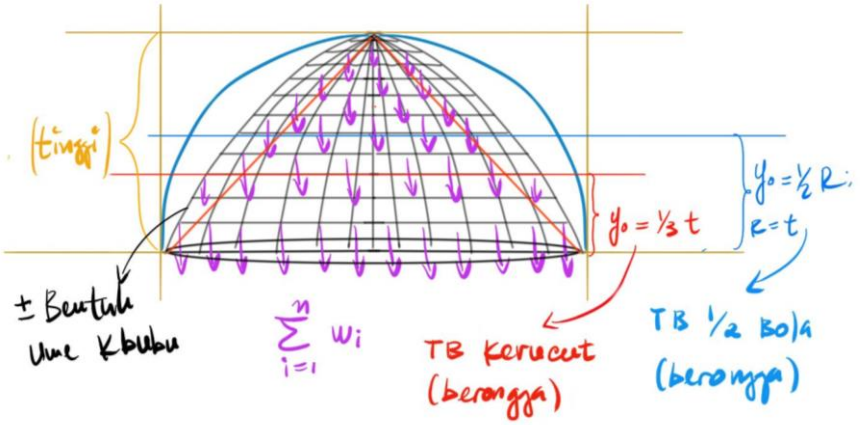

Figure 7. Analysis of *ume kbubu's* heavy point with hollow cone and hollow sphere shape modeling

To integrate it into science learning (Physics), the *ume kbubu* form can be made into a building model so that it is easy to analyze and study as shown in Figure 8:

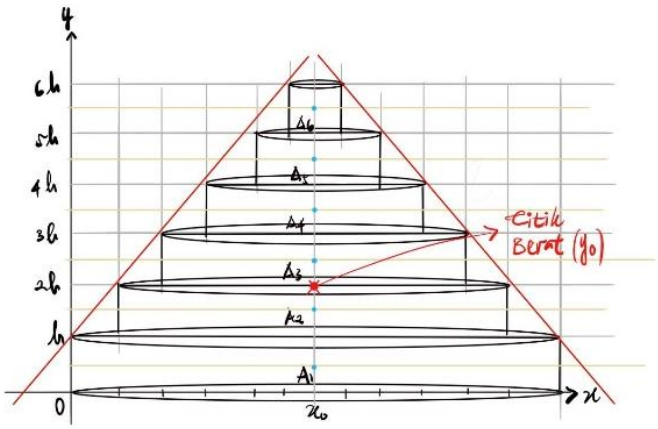

Figure 8. Modeling of *ume kbubu* to mathematically study the position of the weight point

By modeling the base and height of *ume kbubu* in the form of a cone, it is obtained:
A_1 = 20 $m^{2;}$ A_2 = 16 $m^{2;}$ A_3 = 12 $m^{2;}$ A_4 = 8 $m^{2;}$ A_5 = 4 $m^{2;}$ A_6 = 2 m^2

So, the location of y_0:

$$y_0 = \frac{V_1y_1+V_2y_2+V_3y_3+V_4y_4+V_5y_5+V_6y_6}{V_1+V_2+V_3+V_4+V_5+V_6}$$

$$y_0 = \frac{A_1hy_1+A_2hy_2+A_3hy_3+A_4hy_4+A_5hy_5+A_6hy_6}{A_1h+A_2h+A_3h+A_4h+A_5h+A_6h}$$

$$y_0 = \frac{20h\left(\frac{1}{2}h\right)+16h\left(\frac{3}{2}h\right)+12h\left(\frac{5}{2}h\right)+8h\left(\frac{7}{2}h\right)+4h\left(\frac{9}{2}h\right)+2h\left(\frac{11}{2}h\right)}{20h+16h+12h+8h+4h+2h}$$

$$y_0 = \frac{h(121h)}{62h}$$
$$y_0 = \frac{121h}{62}$$
$$y_0 = 1{,}95\ h$$
$$y_0 = \pm 2h$$

6. Another reason people use reeds as roofing *ume kbubu*

The reeds make the temperature inside the *ume kbubu* more stable; cool in summer and warm in winter. In addition, the *ume kbubu* is a good heat trap.

Table 6. The reason people use reeds as roofing ume kbubu

Science Society	Scientific Science	Implementation in science learning
Reeds make a good plant for a good heat insulator and the resources are abundant.	1. Thickness development: The thickness development value of reeds is 13.80% (Dalle, 2017). 2. Internal adhesive strength: The internal bond strength of reeds was 16.49 Kg/cm² (Dalle, 2017). Internal bond strength is the tensile strength perpendicular to the surface that describes the strength of the bond between particles. Reeds have a strong enough	1. Elasticity & Hooke's Law (Physics class XI) 2. Temperature & Heat, Thermodynamics

	adhesive strength that the bond between their leaves causes the roof density to increase. 3. Coupler holding strength: The screw-holding strength of reeds was 40.38 Kg (Dalle, 2017). Screw-holding strength is one of the particle mechanics properties that shows the strength of the material to hold the screw against external tensile forces. With a screw-holding strength value of 40.38 kg, the reeds have great strength so that they do not break easily. 4. Research shows that reeds have good thermal insulation power compared to uninsulated. Reeds have the ability to store heat better than some other materials, making it suitable for use as a thermal insulation material (Pratiwi, et. al., 2017). 5. However, reed fibers have a fibrous and hollow structure (Sembodo, 2010). This structure creates air spaces between the fibers, which function as air traps. Air has low thermal conductivity, so these air spaces help inhibit heat transfer through conduction.	(Physics grade XI) 3.

The findings of community science and scientific science in the results of interviews with the community about the reasons for using reeds *(Imperata cylindrica (L.))* in making *ume kbubu* obtained information that the reason people use reeds is that they are strong, durable, and cheap. It turns out that the chemical content influences the strong and long-lasting nature of the reeds in the reeds. The chemical content is lignin and cellulose. In addition, the lignin content in reeds will also support the slowing of decay by preventing pests. Lignin can prevent pests in plants because it has properties that make it useful for pest control. Lignin, a major component in plant cell walls, has anti-microbial and antioxidant properties that can help protect plants from pests and diseases. In addition, lignin can also increase plant resistance to pest attacks due to its strong structure and difficulty in being digested by pathogenic microorganisms. In addition, reed fibers have a fibrous and hollow structure. This structure creates air spaces between the fibers, acting as air traps. Thus reeds have good thermal insulation properties.

4. CONCLUSION

Based on the study of community science and scientific science on the use of reeds *(Imperata cylindrica (L.))* in making *ume kbubu* of the Timorese tribe, it can be concluded that local community knowledge can be studied and integrated into science learning. Thus, the knowledge that is mostly based on beliefs and experiences can be explained scientifically so that it adds to the repertoire of knowledge of students, students, and the community. This study can also be used as a reference basis for developing further research. In addition, by studying the knowledge of this community, it is hoped that it can be a means to preserve the culture that exists in the Timorese tribe.

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