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MAKING COOLBOX USING A JUNE SACK WITH RICE HUSK (*Oryza sativa*) INSULATION AND CORN COB (*Zea mays*)

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ABSTRACT

Fish quality is very important to determine the selling price of fish in the market; therefore, it is necessary to have special handling in storage so that the quality of fish does not decrease. Fishermen usually use styrofoam-insulated coolboxes to maintain fish quality. This study aims to determine the lowest temperature and temperature stability. This research was conducted in April-June 2022 at the Integrated Fisheries Laboratory, Faculty of Fisheries and Marine Science, Teuku Umar University. The method used is a quantitative experimental method using a completely randomized design (CRD) with 1 control, 2 treatments, and 3 replicates. Tests were carried out by measuring the temperature of the coolbox room filled with 3 kg of bulk ice and looking at temperature changes within 9 hours. The lowest temperature test results contained in the rice husk coolbox were 17.4°C, the corn cob coolbox had the lowest temperature of 19.3°C, and in the styrofoam coolbox (control), the lowest temperature obtained was 13.6°C. The temperature comparison between the styrofoam coolbox, rice husk insulation coolbox, and corn cob insulation coolbox shows that, in terms of the lowest temperature point, the styrofoam coolbox is still better than the rice husk and corn cob coolbox, while the rice husk coolbox is still lower in temperature than the corn cob coolbox.

Keywords: Coolbox, Insulation, Rice Husks, Corn Cobs

1. INTRODUCTION

Fish is one of the sources of protein and high nutrition that helps the development of every individual who eats it, therefore extra handling is needed so that the quality of the fish is maintained and the nutritional content of the fish is not reduced. Fish obtained by traditional fishermen will be stored in a coolbox. A decrease in fish quality is a problem that often occurs, especially in fish that have been caught for a long time. The damage that occurs in fish is generally the state of the surface of the fish body that is deformed or an unpleasant odour that comes out of the fish, consequently reducing the actual selling value of the fish[1].

The means used by fishermen to overcome this is by utilising wet ice or bulk ice. Cooling using bulk ice is not very effective because the ice melts quickly and can reduce the fish load, but fishermen not only use bulk ice as a cooling medium but also add salt to the ice which serves to keep the temperature cold for a longer time, but this technique can change the taste of fish consumed to be more salty[2].

Arbintarso and Wibowo[3], another alternative way that can be done is by utilising rice husk insulation, rice husk is currently not optimally utilised. Rice husk

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as an inhibitor of the rate of heat transfer has advantages, one of which is to keep the ice from melting easily against room temperature and inhibit temperature transfer. Manikandan et al.[4], rice husk is one type of natural fibre (reinforcement) that grows and is abundant in Indonesia. Rice husk consists of two hard layers covering the caryopsis called lemma and palea which are interconnected. Therefore, it is not only rice husk insulation that can maintain room temperature in a cooler box, but corn cobs can also be used as insulation material.

Corn is a very useful plant and contains carbohydrates that can be a substitute for rice. Tangenjaya and Wina[5] corn cob is a part of corn that serves as a place for the attachment of corn kernels. Corn has residue in the form of corn husks (10%), leaves (20%), cobs (20%) and corn stalks (50%) of the total production of by-products. Pinto[6], currently, the use of corn is not only limited as a food source, but corn plants, especially corn cobs, have advantages as insulators and can be one of the materials for making insulation.

One solution to the use of agricultural waste is to make rice husks and corn cobs as a substitute for cooling system insulators because they are easily available and reduce costs for traditional fishermen, to strengthen the structure, jute sack fibre is added as a wall to the modified natural fibre coolbox. The purpose of this study is to determine the optimal cooling system with the effect of rice husk and corn cob insulation on temperature and cooling time in the fish storage room. Knowing whether the cooling device with insulation using rice husk and corn cob can maintain the temperature in the cool box in unit time

2. RESEARCH METHOD

Time and Place

This research was conducted in April-June 2022, at the Integrated Fisheries Laboratory of the Faculty of Fisheries and Marine Science, Teuku Umar University.

Method

The method used is the experimental method, namely an experiment by making an equipment system and then experimenting and testing the tools that have been made. This research is quantitative, which clearly describes the results of several test objects, and then the data is analysed using a completely randomised design (CRD) with 1 control, 2 treatments and 3 repetitions. The treatment used is:

P0: Styrofoam coolbox
P1: Rice husk coolbox
P2: Corn cob coolbox

Procedure

Coolbox Dimensions and Components

The standard dimensions of making coolboxes are equated with coolboxes on the market with a length of 42.8 cm, a width of 26.8 cm, a height of 23.3 cm and a thickness of 2 cm. The coolbox design has 3 layers including the outer layer which functions as a protector this study uses jute sacks and fibre so that it is possible to withstand impact and exposure to sunlight. The insulation layer uses rice husks and corn cobs so that it is not easy for temperature transfer between outside and inside the coolbox. The inner layer functions as a protector in this study using fibre and jute sacks, so that it does not leak when the ice water melts. The dimensions of the size and components of the coolbox can be seen in Figure 1 and Figure 2.

Temperature Testing

The test will be carried out in the form of testing the room temperature in the coolbox, and the ambient temperature. Data collection is carried out regarding the results of previous research stating that fish can only last 6-7 hours, so this test will see how long the temperature changes in the coolbox of rice husks and corn cobs with 1 control, 2 treatments 3 times repetition. Tests were carried out after the coolbox was completed and tested indoors. Experiments in this study were carried out by comparing

the lowest temperature in the rice husk coolbox, corn cob and Styrofoam. The following is the testing process:

a) Prepare tools and materials, Provide 3kg of bulk ice, b) prepare a hygrometer on each coolbox and make sure the hygrometer is working properly, c) furthermore, the installation of a hygrometer whose temperature detection position depends on and is not directly touched by the ice in the coolbox or water from the melting of bulk ice, therefore, the hygrometer can read the room temperature in the coolbox, d) record the temperature change indicated by the hygrometer as well as the time. The experiment was conducted for 9 hours, and e) analyse the data obtained from the experiment

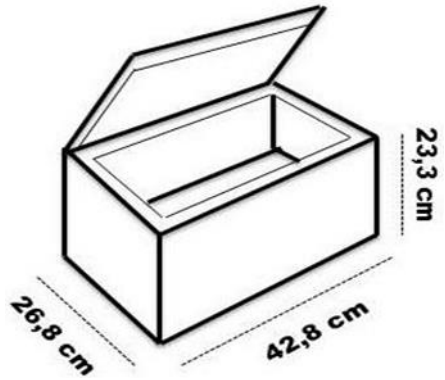

Figure 1. Coolbox Size Dimensions

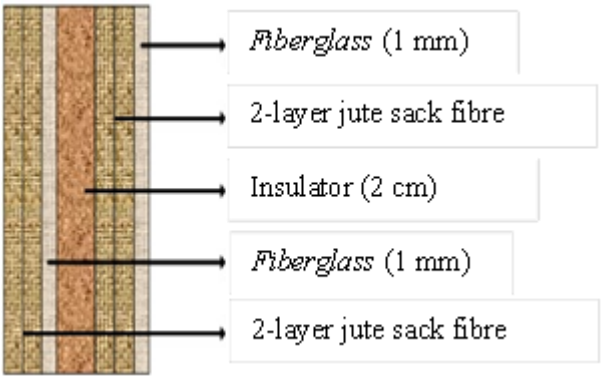

Figure 2. Components of a Coolbox Setup

Data Analysis

The test data used the Completely Randomised Design (CRD) method and was analysed using the SPSS 25.0 application to see significant differences in each treatment. If the normality test value shows that the data is normally distributed, the data will continue to be analysed using Analysis of Variance (ANOVA). ANOVA is one of the multivariate analysis methods whose role is to distinguish the averages of more than 2 groups of information by equalising the variance. Analysis of variance is listed in the type of parametric statistics. As a parametric statistical equipment, to be able to use the ANOVA formula, it is mandatory to first try the assumption test including normality, heteroscedasticity and random sampling[7].

3. RESULT AND DISCUSSION

Coolbox Testing

The lowest temperature comparison data from the average of each replication between styrofoam coolboxes, rice husk insulation coolboxes and corn cobs that show the lowest temperature, can be seen in the graph in Figure 3.

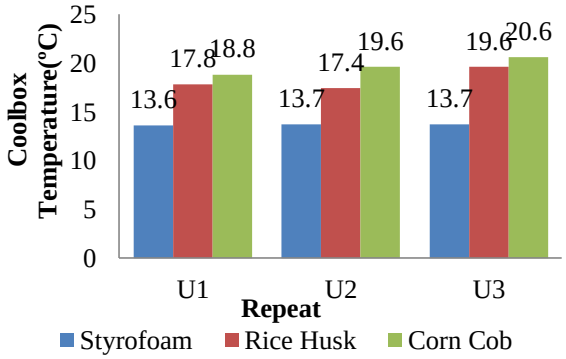

Figure 3. Temperature Comparison Chart of Coolbox

Figure 3 shows that the rice husk coolbox shows the lowest average temperature is 17.4℃ from minutes 80-310 with the lowest temperature stability reaching 3 hours 50 minutes, while in the corn cob coolbox, the lowest average temperature is 19.3℃ from minutes 70-300 with the lowest temperature stability reaching 3 hours 50 minutes and for the styrofoam coolbox (control) the lowest average temperature obtained is 13.6℃ with the lowest temperature stability reaching 2 hours 10 minutes. The data results can be concluded that the coolbox insulated with rice husk and corn cob has

not been able to resemble the lowest temperature of the styrofoam coolbox but can still maintain its lowest temperature for a longer time.

Comparison of Coolbox Lowest Temperature Stability

The results of the lowest temperature stability comparison between styrofoam coolboxes, rice husk coolboxes and corn cobs that show the lowest temperature stability can be seen in the graph in Figure 4.

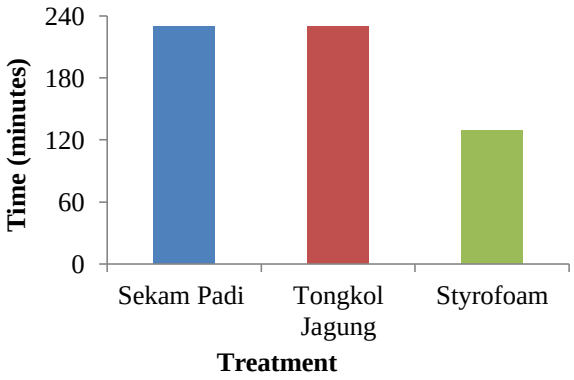

Figure 4. Comparison Chart of Lowest Temperature Stability

In Figure 4, it can be seen that the lowest time stability obtained by the rice husk coolbox can maintain its temperature for 230 minutes, as well as the corn cob coolbox can maintain its lowest temperature for 230 minutes, which is where there is a similarity in time (minutes) between the rice husk coolbox and corn cob to maintain its lowest temperature, while in the Styrofoam coolbox the time to maintain its lowest temperature is 130 minutes. The conclusion can be drawn that the rice husk and corn cob coolbox are better than the styrofoam coolbox when viewed in terms of maintaining the temperature.

The results of the analysis can be known coolbox temperature test data and cooling time for 9 hours that has been done that when viewed from the lowest temperature point in the styrofoam coolbox is better than the coolbox insulated rice husk and corn cob fibre when viewed in terms of the rate of temperature change or the lowest temperature stability coolbox insulation rice husk and corn cob longer than the styrofoam coolbox in maintaining the temperature inside the coolbox.

Another study using rice husk insulators in a coolbox with a cooling method in the form of wet ice as much as 3 kg, in a cooling time of 24 hours produced the lowest temperature of 13.5°C in the 70th minute (1 hour 10 minutes). Temperature stability in the coolbox occurs at the 350th minute (5 hours 50 minutes) to the 970th minute (16 hours 10 minutes) ranging from 21.1°C[2], while the results of research using corn cob insulators get the lowest temperature of 23.4℃ at 270th minute (4.5 hours) the temperature can last until the 300th minute (5 hours) in a cooling time of 24 hours[1].

The cause of the high thermal conductivity value that causes the high temperature of the results of the coolbox experiment of rice husk and corn cob is a mixture of insulators, as it is known that the smaller the thermal conductivity value, the longer the heat transfer process and the better the cooling process. Another factor is that no water content testing was carried out so it can be hypothesised that there will be water content trapped in the rice husk and corn cob insulation so that the pores containing water can conduct heat well and make the thermal conductivity value of the insulator higher and cause high test results on the coolbox, the requirement as a good cooling insulator is to have a low thermal conductivity value[8].

Insulator properties can be affected by the density of the particles that make up the insulator, the fine size of the husk can be arranged more tightly in the rice husk insulation so that it is impossible to form cavities in the insulator. The cavities created in the insulation will affect the insulating properties of the coolbox because it causes a convection process inside the coolbox insulation. For conductor materials, this will lead to reduced conductor behaviour of the coolbox insulation, while for insulator materials, the

cavities will reduce the insulating properties of the material[9].

Low thermal conductivity in insulating materials is in line with the air content in the material, therefore, if a porous object is filled with water, it will affect the thermal conductivity value[10]. In the natural fibre insulation coolbox, the difference in mesh size affects the air in and out process, the small mesh size creates a rough surface and the bond between particles is weak so there are pores between particles and not all particles bind well with the matrix. Small particle sizes create a smooth surface and good inter-particle bonding, as the matrix bonds well with the particles[11].

4. CONCLUSION

The coolbox made from rice husk insulation has the lowest achievable temperature of 17.4°C. The lowest temperature was reached after the 80th minute after the experiment started. While the corn cob insulation material was only able to reach the lowest temperature of 19.3℃ which was reached within 70 minutes after the experiment began. The best application of natural fibre coolbox insulation material between the two aspects is rice husk insulation.

REFERENCES

1. Pratama, M.D. *Modifikasi Kotak Pendingin Ikan pada Kapal Ikan Tradisional Menggunakan Insulasi Menggunakan Tongkol Jagung*. Doctoral dissertation: Institut Teknologi Sepuluh Nopember. 2018.
2. Abidin, M. *Desain Sistem Pendingin Ruang Muat Kapal Ikan Tradisional Menggunakan Insulasi dari Sekam Padi*. Doctoral dissertation: Institut Teknologi Sepuluh Nopember. 2017.
3. Arbintarso, E.S., Wibowo, H. Modulus Elastisitas dan Modulus Pecah Papan Partikel Sekam Padi. *Jurnal Teknologi Technoscientia*, 2008; 23-28.
4. Manikandan, N., Al Azad, S., Deb, H., Rumi, T.M., Ahmed, M.R. Effect of Alkalization on Fabrication and Mechanical Properties of Jute Fiber Reinforced Jute-Polyester Resin Hybrid Epoxy Composite. *American Journal of Current Chemistry*, 2017; 3(1): 1-10.
5. Tangendjaja, B., Wina, E. *Limbah Tanaman dan Produk Samping Industri Jagung untuk Pakan*. Balai Penelitian Ternak: Bogor. 2006.
6. Pinto, J.A.B. Possible applications of corncob as a raw insulation. *Insulation Materials in Context of Sustainability*, 2009; 26-43.
7. Ghozali, I. *Analisis Multivariate Lanjutan dengan Program SPSS*. Semarang: Badan Penerbit Universitas Diponegoro. 2006.
8. Lubis, S., Arif, S. *Penggunaan Komposit Sekam Padi sebagai Pengganti Dinding Box Pendingin Ikan* (Doctoral dissertation). 2021.
9. Handani, S. Sifat Isolator Panas Papan Sekam Padi dengan Variasi Resin dan Ukuran Partikel. *Jurnal Ilmu Fisika Universitas Andalas*, 2010; *2*(2): 68-73.
10. Pratama, N. Pengaruh Variasi Ukuran Partikel terhadap Nilai Konduktivitas Termal Papan Partikel Tongkol Jagung. *Pillar of Physics*, 2016; 7(1).
11. Pan, Z., Zheng, Y., Zhang, R., Jenkins, B.M. Physical Properties of Thin Particleboard Made from Saline Eucalyptus. *Industrial Crops and products*, 2007; *26*(2): 185-194