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CHARACTERISTICS OF ANTI-TERMITE PARTICLE BOARD FROM BINTARO FRUIT FIBER WITH BINTARO FRUIT SEED EXTRACT COATING USING SPRAY COATING METHOD

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Abstract. Termites are pests that damage wooden furniture. Termite attacks on wooden furniture are getting higher and broader, so the value of losses due to termite attacks on furniture is increasing from year to year. This research has succeeded in making particle boards from bintaro fruit fibers as fillers and urea formaldehyde resin (UF) as a matrix with a composition of filler mass fractions: the matrix of the particle board to be made is 30:70. The particle board that has been made is then coated using bintaro seed extract and UF resin using the spray coating method. The extract mass fractions of bintaro seeds and UF resins in this study were sample 1 (90:10), sample 2 (80:20), sample 3 (70:30), sample 4 (60:40) and sample 5 (50:50). The physical characterization of particleboard includes density, water absorption, and moisture content. The mechanical characterization of particle boards is the bending strength and characterization of particle boards to resistance to termite attacks. The results of this study show that particle boards with optimum values are sample particle boards 1 with a density value of 0.864 gr / cm^3, water absorption of 4.28%, which has met SNI 03-2105-2006 and the results of testing the resistance to termites 3.45% have met SNI 01-7207-2006. Because the structure influences the manufacture of particle boards and the physical shape of the raw materials used.

Keywords: *Bintaro Fruit, Natural Fiber, Extract, UF Resin, Biocomposite*
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INTRODUCTION

Termites are pests that damage wooden furniture. Termite attacks on wooden parapets are getting higher and broader, so the value of losses due to termite attacks on furniture increases yearly [1]. Economic losses due to termite attacks on residential furniture in Indonesia have reached 1.67 trillion rupiah. Damage to residential furniture is caused by the disruption of the natural habitat of termites on agricultural land, plantations, and forests that turn into residential areas [2].

Furniture is usually made of several materials, one of which is particle board. Particle board is in great demand by consumers because it is made of environmentally friendly natural fibers. Particle board consists of fiber as a filler and matrix as a binder. The filler material for manufacturing particle boards is a natural fiber with lignin and

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cellulose [3]. Many studies on natural fibers have been carried out including areca nut fiber, empty palm oil bunches, coconut fiber, and water hyacinth [2];[4];[5];[6].

Many studies on furniture damage have been carried out, including [7] regarding adding a matrix of citric acid to particle boards. The resistance to termite attack by dry wood was 57-78%. [8] produced research that ironwood extract as a matrix on particle boards increased the number of dead termites by 4−6%. The next method is particle board coating, which uses spray coating. The spray coating method can protect the particle board surface against scratches, stains, and weather resistance and give a glossy and satin effect [9]. Research [10] also used the spray coating method to see the differences between single and two layers. The two-layer coating is better than a single layer.

Research [11] says that bintaro fruit contains cellulose (56.76%) and lignin (28.30%), so bintaro fruit fiber can be used as fiber for particle board. Bintaro plants in Riau Province are usually used as ornamental plants on the side of the road and as shade plants. Bintaro has strong roots to prevent erosion when it rains, while the fruit can be used as a rat repellent. Research [12] states that bintaro fruit seeds contain saponins and pephenol compounds which are toxic and can be used as termite exterminators.

Bintaro's enormous potential from both fiber and seeds can be utilized for the furniture industry, one of which is as particle board. In this study bintaro fiber as fiber and urea formaldehyde as matrix. This study used a coating on particle board by utilizing Bintaro fruit seed extract using the spray coating method . The particle board to be made will be tested for physical, mechanical and termite resistance based on SNI 03-2105-2006 standards.

RESEARCH METHOD

Research Tools and Materials

The tools used in this study are mixers , calipers , digital balances, material containers, Sieve 100 mesh , Beaker glass , Steel mold size (21 x 21 x 2) cm , Cold press , Oven , Greending Machine , Grinding Machine and Aluminum Foil . The materials used in this research were bintaro fruit fiber , bintaro fruit seeds , urea formadehid resin , water and ethanol .

Preparation of Bintaro Fruit Fiber

Bintaro fruit that has been collected is dried in the sun to dry . Bintaro fruit that has been dried in half . then separated between the fiber and the shell of the Bintaro seeds . Bintaro fruit fiber that has been separated from the shell is ground using a greending machine until smooth. Bintaro fruit fiber that has been refined is filtered using a 50 mesh sieve [13].

Particle board manufacturing process

The materials used for the manufacture of particle board are bintaro fruit fiber as a filler (fiber) and urea formaldehyde (UF) resin as an adhesive (matrix) in the manufacture of particle board with a ratio (35% water : 35% UF resin : 30% bintaro fruit fiber) . Prepare UF resin and water in a container then stir until combined. The crushed Bintaro fruit fiber and UF resin are mixed with stirring using a mixer for 10 minutes so that they are evenly mixed. The mixed Bintaro fruit fiber and resin are put into a particle board mold

measuring (21 x 21 x 3) cm and covered with aluminum foil . The fiber and UF resin that has been put into the mold are leveled so that there are no parts of the mold that are not filled and then compressed using a cold press with a pressure of 5 bar for 2 hours [13] , so that 2 cm is obtained for the thickness of the particle board. Lift the felt cover and gently pick up the printed particle board . Particle board that has been taken from the mold is left for up to 5 days to dry completely [14].

Preparation of Bintaro Fruit Seeds

Bintaro seeds that have been separated from their shells are sun-dried for 1 week and baked for 1 hour at 40°C [15]. The dried Bintaro seeds were crushed using a grinding machine with a fineness of 50 mesh [13] .

The Process of Making Bintaro Fruit Seed Extract

Bintaro seeds that have been refined soaked in 96% ethanol solution with ratio (1:3), so to produce 3 liters of extract, 1 kg of bintaro seeds and 3 liters of ethanol are needed, soaked for 3 x 24 hours, then filtered using a buchiner funnel covered with coarse filter paper . Bintaro seed extract is stored in the refrigerator (≤40 C) before use [15].

Particle Board Coating Process Using Bintaro Seed Extract

Bintaro seed extract and UF resin were mixed in the ratio as shown in Table 1. The particle board was made in 5 variations , each variation containing 3 samples. The mixture of UF extract and resin was sprayed onto the particle board using a double layer spray gun , at a distance of 30 cm from the surface of the particle board. The drying process was carried out at 21°C for 48 hours based on research [10].

Table 1. Comparison of Bintaro Seed Extract and Urea Formaldehyde Resin

Variation	Made Samples	Bintaro Fruit Seed Extract (%)	Urea Formaldehyde Resin (%)
Variation 1	3 pieces	90	10
Variation 2	3 pieces	80	20
Variation 3	3 pieces	70	30
Variation 4	3 pieces	60	40
Variation 5	3 pieces	50	50

Testing Process

Density Test

The density or compactness of a particle in a sheet depends on the density of the fiber and the amount of pressure exerted during the particleboard manufacturing process. Density is calculated based on the weight and dry volume of the air sample. Test sample measuring 10 cm x 10 cm according to SNI 03-2105-2006 The amount of density can be calculated by Equation (1) [16] .

$$\rho = \frac{B}{V} \quad (1)$$

Note: ρ= Density (gr/cm^3) ; B= Weight of test sample (g) ; V= Volume of test sample (cm3)

Water Absorption Test

The water absorption test is intended to determine the ability of the composite to absorb water to the maximum extent. Testing the board's water absorption is calculated by measuring the difference in weight before and after soaking for 24 hours. The test sample measuring 5 cm x 5 cm x 2 cm according to SNI 03-2105-2006 . The value of water absorption is calculated by Equation (2) [16] .

$$\text{DSA}\ (\%) = \frac{\text{B1} - \text{B0}}{\text{B0}} \text{x}\ 100\% \qquad (2)$$

Information: DSA = Water absorption (%) ; B0 = Weight of sample before immersion (g) ; B1 = weight of sample after immersion (g) .

Water Content Test

The water content test is intended to determine the weight of water contained in the particle board expressed in percent (%) of the dry weight of the particle board. Testing the board's moisture content is calculated by measuring the difference in weight before and after being in the oven. Test sample measuring 10 cm x 10 cm x 2 cm according to SNI 03-2105-2006 The value of water absorption is calculated by Equation (3) [16].

$$\text{kadar air}\ (\%) = \frac{\text{Ba} - \text{Bk}}{\text{Bk}} \text{x}\ 100\% \qquad (3)$$

Information: Ba= weight of sample before oven (g) ; Bk = Weight of the test sample after being in the oven (g)

Strength Test

Flexural strength is the ability of a material to withstand a bending force applied in a direction perpendicular to the sample cross section. Usually the flexural strength of the test sample measuring 20 cm x 1.27 cm x 1.27 cm with reference to the SNI 03-2105-2006 standard, the flexural strength value can be calculated using Equation (4) [16] .

$$\sigma\text{b} = \frac{3\text{PL}}{2\text{bd}^2} \qquad (4)$$

Information : σ: bending strength (Kgf/cm ^{2}); d: applied load (Kgf) ; b : sample thickness (cm) ; P : support distance (cm) ; L: specification width (cm)

Termite Resistance Test

To determine the success of research on anti-termite particleboard, calculations are needed about the effect of particleboard on termites, so calculations are needed when the test sample loses its weight at the end of exposure after observation. Testing for termite attack uses the SNI 01-2707-2006 standard using Equation (5) [17].

$$\text{P} = \frac{\text{w1} - \text{w2}}{\text{w2}} \text{x}\ 100 \qquad (5)$$

Information : Q : Weight loss; W1 : wood weight before testing (grams); W2 : weight of wood after testing (grams).

RESULTS AND DISCUSSION

Density

Density testing was carried out to see the effect of the density value produced by the particle board. This sample was calculated using the SNI 03-2105-2006 testing

standard. The results of the density test can be seen in Figure 1 which shows the relationship between the density value and the coating composition of the Bintaro fruit seed extract used. The sample that has the highest density value is sample 1 (extract 90: UF 10 resin) with a density value of 0.864 gr/cm^3. The lowest density value was found in sample 5 (extract 50: UF 50 resin) of 0.541 gr/cm^3. The addition of Bintaro fruit seed extract coating on the composition of particle board affects the density value. The results of the particle board density test decreased in each sample, this is because the less extract used, the density value also decreased. Research [18] states that the density depends on the constituent materials which can cause absorption or entry of more extracts into the pores of the particle board, the higher the resulting density value. Research on the density value of particle board has been carried out [19] stating that the density of particle board is affected by the structure of the physical form of the particle raw material used. The results of the regression equation analysis show that the addition of fiber composition results in a lower density value.

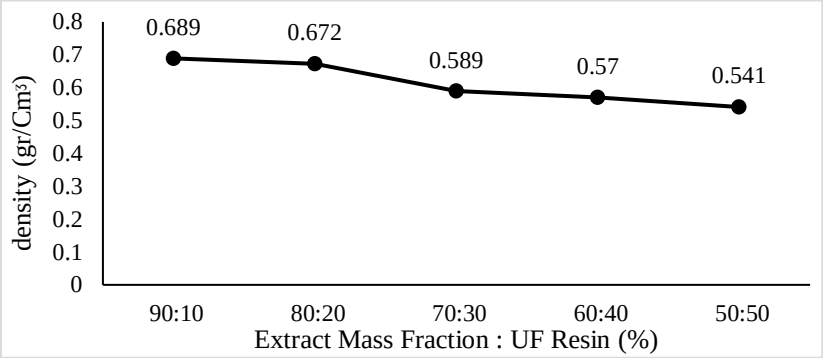

Figure 1. Results of Termite Particle Board Density Test

Water Absorbency

The water absorption test aims to determine the ability of particle board to absorb water during immersion in water for 24 hours. The water absorption test refers to research [20]. The test graph can be seen in Figure 2 which shows the relationship between the value of water absorption and the coating composition of the Bintaro fruit seed extract used. The sample that has the highest water absorption value is sample 5 (extract 50: UF 50 resin) with an absorption value of 53.64% . The lowest density value was found in sample 1 (extract 90: UF 10 resin) of 34.49%. The addition of Bintaro fruit seed extract coating to the composition for making particle board affects the value of water absorption. The results of the water absorption test are higher for each sample, this is because the more UF resin used, the more water absorption capacity will be produced. UF resin has binding properties that cause water to enter the composite [21]. Research [22] states that the high value of water absorption is due to the hygroscopic nature of particle board because it contains lignin and cellulose, and all materials containing lignin and cellulose are very easy to absorb and release water.

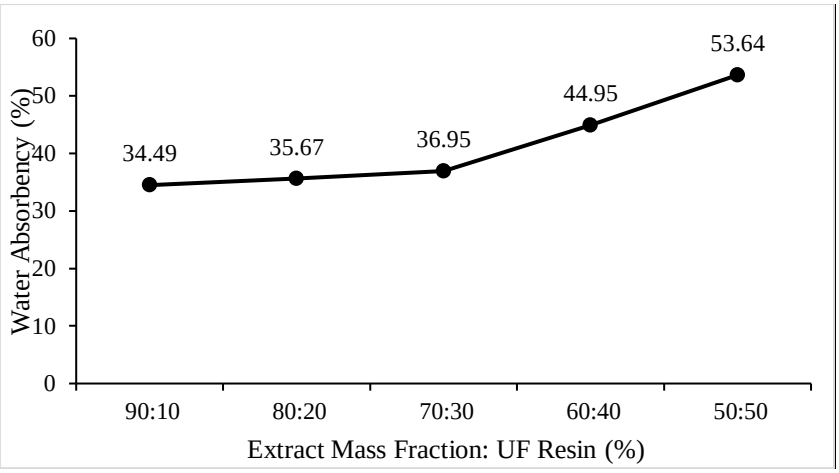

Figure 2. Test Results of Termite Particle Board Water Absorbency

Water Content Test

Testing the water content aims to determine the water content contained in the particle board. This test refers to the SNI 03-2105-2006 standard. The results of testing the water content test values can be seen in Figure 3 which shows the effect of the composition of the Bintaro fruit seed extract and UF resin on the water content values on particle board. The highest water content value was in sample 5 (50 extract: UF 50 resin) with a water content value of 6.75%. The lowest water content value was in sample 1 (extract 90: UF 10 resin) with a water content value of 4.28%. The addition of Bintaro fruit seed extract coating to the composition for making particle board affects the value of the water content. The sample has a higher water absorption value for each sample, this is because the more extracts used, the lower the water content value. The extract used contains water and alcohol which, if heated at 100°C, will evaporate, thus affecting the water content in the test object [23]. [24] stated that during conditioning, particle board composed of sawdust wood particles still has hygroscopic properties, meaning it can absorb or release water from its environment.

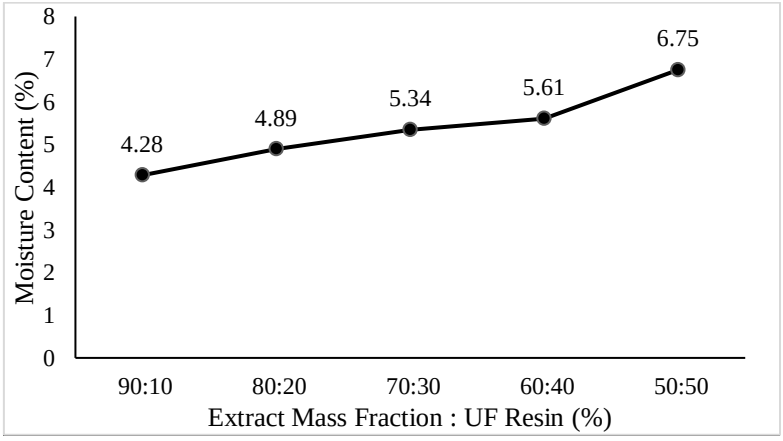

Figure 3. Moisture Test Results for Anti-Termite Particle Boards

Flexural Strength Test

The flexural strength test was carried out to determine the elasticity of the sample by applying a bending load slowly until the sample breaks. Flexural strength testing is carried out with reference to the SNI 03-2105-2006 standard. The test results can be seen

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in Figure 4 which shows the relationship between the value of the flexural strength of particle board and the extract of bintaro fruit seeds as a coating. The particle board sample that had the highest flexural strength value was sample 5 (extract 50: UF 50 resin) with a flexural strength value of 25.18Mpa. The lowest flexural strength value is sample 1 (extract 90: UF 10 resin) with a flexural strength value of 15.09 Mpa. The addition of Bintaro fruit seed extract coating to the composition for making particle board affects the value of flexural strength. The value of flexural strength is higher in each sample because the more resin is used, the more flexural strength will be produced, UF resin has binding and hardness properties, this makes the test object increase in the value of flexibility on particle board [25]. classification results which means that particle board with coating gives good and optimal results can cover the surface of the board so that no particle board bond is released on the surface and what is released is only the paint material [26].

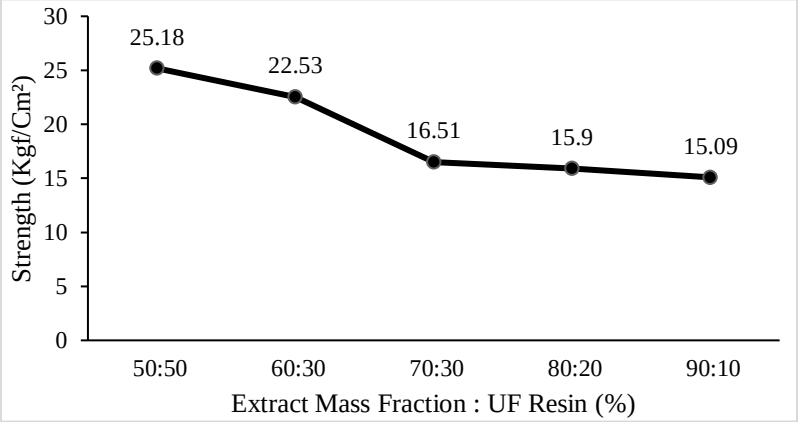

Figure 4. Flexural Strength Test Results for Anti-Termite Particle Boards

Termite Resistance

Termite resistance testing aims to determine the effect of Bintaro fruit seed extract contained in the particle board layer. This test refers to the SNI 01-7207-2006 standard. the effect of the composition of bintaro fruit seed extract and UF resin the resistance value of particle board to termites can be seen in Figure 5 which shows the relationship between the value of termite resistance on particle board with bintaro fruit seed extract as a coating. The particle board sample that had the highest termite resistance value was sample 5 (extract 50: UF 50 resin) with a termite resistance value of 0.86%. The lowest termite resistance value was sample 1 (extract 90: UF 10 resin) with a termite resistance value of 0.41%. The addition of Bintaro fruit seed extract coating to the composition of particle board manufacture affects the value of termite resistance. The value of termite resistance is higher for each sample, this is because the Bintaro fruit seed extract contains polyphenols and saponins which are toxic which function as termite exterminators , the more extracts used, the higher the resistance to termites [12] . Efforts to increase the resistance of particle board to termite attack are also carried out by providing a coating material on the surface of the particle board, besides aiming to improve the surface appearance of the board it also aims to protect this board from changes in humidity and attack by destructive organisms. According to [26].

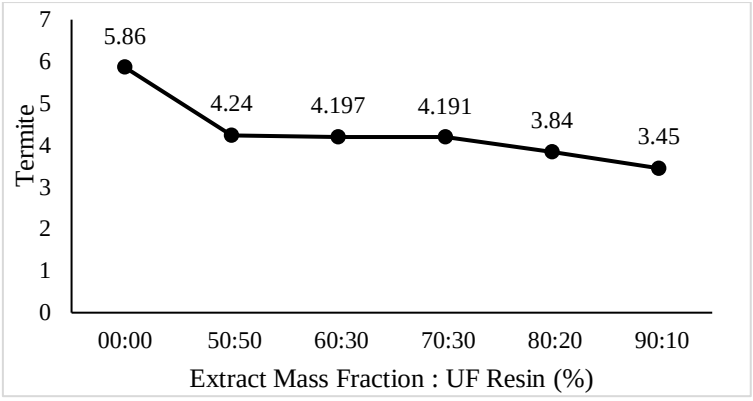

Figure 5. Test Results for Termite Resistance to Termite Particle Boards

CONCLUSION

Based on the research that has been done regarding the manufacture of particle board made from bintaro fruit fiber, UF resin and bintaro fruit seed extract as a particle board coating, it can be concluded that the effect of coating variations on bintaro fruit seed extract and UF resin on particle board on the physical properties test of density and water content complies with SNI 03-2105-2006 standards with a density value of 0.40% - 0.90% gr/cm^3 and the value of water content is not more than 14%. The effect of coating variations on bintaro fruit seed extract and UF resin on particle board on the mechanical properties test for flexural strength did not meet the SNI 03-2105-2006 standard with a flexural strength value of 82 Kgf/cm^2. Effect of coating variations on bintaro fruit seed extract and UF resin on particle board on termite resistance testing according to SNI 01-7207-2006 standards which are class 1 resistant category with a value of 2.0% -4.4%.

SUGGESTION

The flexural strength in the research that has been carried out does not meet the SNI 03-2105-2006 standard because the more extracts used in the coating, the lower the flexibility of the particle board. It is possible that adding more UF resin will add flexural strength to the particle board, because the resin UF has binding and hardness properties.

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