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Physical characteristics of water paint with the addition of bintaro extract additives

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ABSTRACT

The addition of additives to paint aims to improve the quality and usability of paint. Natural additives, such as bintaro seed extract, have potential as anti-bacterial and anti-fungal agents. This study aims to investigate the physical properties of commercial paints added with bintaro seed extract. The physical properties tested were changes in density and adhesion. While the chemical content was characterized using HPLC and FTIR. The extraction process includes drying to grinding the bintaro seeds into powder, followed by extraction using a ratio of bintaro powder and 96% (m/v) ethanol 1:3. Bitaro extract obtained was added to commercial watercolors (100 ml) with variations of 5, 10 and 15 ml. The paint is applied to the surface of the multiplex wood evenly by pre-heating it at 40°C. The adhesion analysis was carried out using the help of ImageJ software to determine the ratio of the gray value of the image before and after the adhesion test using the cross-cut technique. It was observed that the increase in bintaro seed extract caused a decrease in paint adhesion.

Keywords: Adhesive; bintaro seed extract; density; paint

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INTRODUCTION

Paint is generally defined as a colloidal dispersion of pigments in solvents [1]. So the properties of paint are highly dependent on the particle size and surface of the pigment. Paint dispersion is the process of wetting and releasing the main pigment particles to spread them into the application media [2].

Bintaro fruit has the Latin name *Cerbera manghas* which has secondary metabolite compounds such as alkaloids, saponins, flavonoids, and tannins [3]. Alkaloid compounds in the form of berberine are found in almost all parts of the bintaro plant which play a role in the mortality of bintaro insects which play a role in insect mortality [4].

The way cerberin works is by disrupting the function of calcium ion channels in the heart of insects and eventually causing death [5]. Bintaro fruit extract has been proven to have the potential as a botanical insecticide. The level of cerberin depends on the level of ripeness of the bintaro fruit. Fruit whose skin color is more than 50% red has a high cerberin content, while unripe fruit contains low cerberine. When the ripeness of the bintaro fruit is even, the antibacterial content is at its maximum [6].

Bintaro fruit consists of 14% shell and 86% seed flesh. Bintaro seeds contain oil between 35% – 50%. The drier the bintaro seeds, the more oil they contain. This oil is a type of non-edible oil. Bintaro plants have many benefits even though Bintaro plants have dangerous cerberin poison [7]. The purpose of this study was to fabricate paint that can prevent termite attacks. Physical testing includes density testing and reactive power testing. High pressure liquid chromatography (HPLC) testing to quantitatively identify the chemical compound content in bintaro seed extract. Fourier transform infrared spectroscopy (FTIR) testing is used to identify functional compound groups contained in a compound [8].

LITERATURE REVIEW

Paint is defined as a liquid used to coat the surface of a material with the aim of beautifying, strengthening, or protecting the material. After being coated on the surface and drying, the paint will form a thin layer that adheres firmly to the surface [1].

Bintaro has various secondary metabolite contents that function as self-defense against pests and insects. Almost all parts of the bintaro plant contain a poison called "cerberin", a poison that can inhibit human calcium ion channels, thereby disrupting the heartbeat and can cause death. In addition, smoke from burning wood can cause poisoning [4].

Bintaro is known as one of the perennial plants that is widely used for greening, city decoration, organic pesticides and also as a raw material for dried flower crafts. All parts of the bintaro plant are poisonous because they contain alkaloid compounds that are repellent and antefeedant. Bintaro contains the poison cerberin which is very deadly. The leaves, fruit, and bark of the bintaro plant contain saponins, the leaves and fruit contain polyphenols which are known to be very toxic to insects and can inhibit pest feeding activities, and the bark contains tannins. Behind its poison, the bintaro tree can be used for human benefit, such as eradicating rats, raw materials for candles, bio-insecticides, wound medicine, deodorants and potentially as biodiesel [16]. The bintaro tree is 4 to 20 meters tall. This plant grows abundantly in the lowlands to the coast and is very suitable for sandy areas. Bintaro leaves are oval-shaped, elongated, symmetrical, and stacked at the ends, shiny dark green in color with varying lengths averaging 27 cm with a spiral leaf arrangement and collected at the end of the rosette.

RESEARCH METHODS

Seed Sample Preparation

The type of bintaro used is *Cerbera manghas*. Bintaro was collected from several parks in Pekanbaru City. The seeds used are from the bintaro fruit. Seed preparation includes several stages as follows: Separating the seeds from their shells, After the seeds are separated, the shells are washed and dried in the sun for ± 7 days. The dried seeds are then ground using a blender. The bintaro seed powder is sieved using a T100 mesh sieve.

The Process of Making Bintaro Seed Extract

The extract is made by macerating the bintaro seeds that have been ground using a blender then weighed as much as 100 grams and mixed with 300 ml of distilled water, left for ± 24 hours and a closed container to remove the substances in the bintaro seed powder [9]. The soaked powder is heated using a temperature of 60°C for ± 1 hour after being filtered using filter paper and then centrifuged for 20 minutes [10].

Extract and Paint Mixing Process

Watercolor mixing is done by first measuring the paint and bintaro seed extract using a measuring cup. Put the paint and bintaro seed extract into one container then stir using a stirring rod until both are mixed. This study uses 2 variables, the independent variable of bintaro seed extract and the dependent variable of paint. Bintaro seed extract as much as 5, 10, and 15 ml were mixed each in 100 ml of paint as summarized in Table 1.

Table 1. Variation of paint and extract mixtures.

Sample	Extract (ml)	Paint (ml)	Description
CEB-0	0	100	Control
CEB-1	5	100	Constant
CEB-2	10	100	Constant
CEB-3	15	100	Mixture

Characterization and Testing

HPLC Test

HPLC testing was carried out in the chemistry laboratory of Riau University by

sending a sample of 10 ml. HPLC testing quantitatively identifies the content of alkaloids, saponins, flavonoids, and tannins [11].

FTIR Test

FTIR testing was carried out in the chemistry laboratory of Riau University by sending samples to identify functional compound groups contained in a compound. Testing was carried out with the ASTM E1252 standard 2013.

Density

Density (or density, is the mass (m) per unit volume (V). Things that affect the density measurement of a sample are temperature and pressure. Mathematically, density measurement can be found using Equation (1) [12].

$$\rho = \frac{m}{V} \tag{1}$$

Adhesion Test

Adhesion is measured using a cross cut system. This test is relatively simple by making a number of (6 – 11 lines) cross line boxes to the surface of the paint according to the ASTM D3359 standard. Furthermore, the tape is attached to the prepared paint surface and pulled quickly to the side [13]. Image capture using a smartphone camera with 16MP+5MP autofocus camera specifications and f/1.7 Aperture with a distance between the camera and sample of ~28 cm. The image capture scheme can be seen in Figure 1.

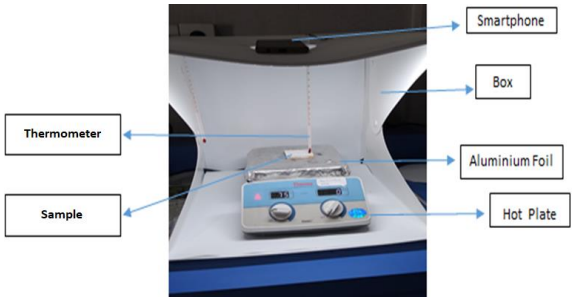


Figure 1. Image capture scheme.

Image analysis is carried out with the help of ImageJ software to obtain adhesion data. The ratio of the gray value of the image before and after the adhesion test using tape is represented as paint adhesion.

RESULTS AND DISCUSSION

Results

The maceration process is a fairly simple extraction process or method without a heating system or known as cold extraction [14]. So in this process the sample and solvent do not undergo a heating process so that they can be used on compounds that are not heat resistant. The disadvantage of this method is that it takes quite a long time. The maceration process on bintaro seeds is carried out by soaking approximately 1 gram of powdered sample in aquades solvent for 24 hours at room temperature [10]. Previously, the dry and cut seeds will be ovened for 6 hours to make it easier during the blending process to produce powder [7]. In the soaking process, plant samples will experience the breakdown of cell walls and membranes due to the difference in pressure between inside and outside the cell. Furthermore, maceration is carried out using heating at a temperature of 60°C because excessive heating can damage the chemicals contained in the powder [10].

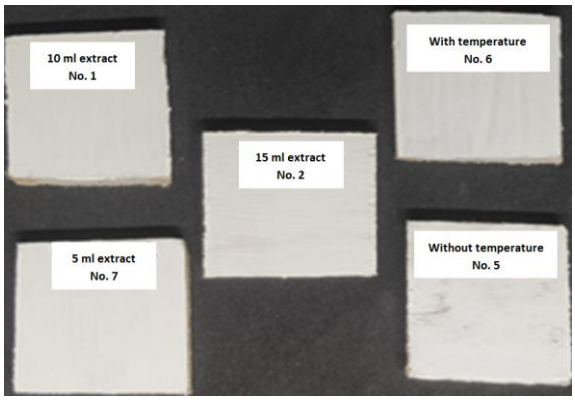


Figure 2. Multiplex sample image.

The filtering process is carried out using ordinary filter paper and Whatman paper to separate the extract from the dregs of bintaro

seed powder [15]. Filtration was carried out for 2 days so that the extract was completely separated from the dregs of the bintaro seed extract powder after the extract was obtained, then centrifuged for 20 minutes [10]. The extract obtained was then mixed with commercial paint and then painted on the surface of the plywood sample (see Figure 2).

HPLC Testing

The results of the bintaro seed powder data obtained after analysis using the HPLC tool in the form of chromatograms, retention time and peak area of the compound [11]. The time data is used to determine the type of compound contained in the sample, this occurs because the price or value for each compound between the sample and the standard is the same. If the retention time of the resulting sample is the same as the time produced, then the retention of one of the standard standards contains the compound used as the standard. From 12 data taken from different concentrations and times, data was obtained. The data produced only one substance that is very dominant in the bintaro seed powder is at 3.037, area 46301227 and 283253 ppm. Then from the graph above, a control chart graph is made to see whether the data obtained is only one substance that is very prominent in the bintaro seed powder, which can be seen in Figure 3.

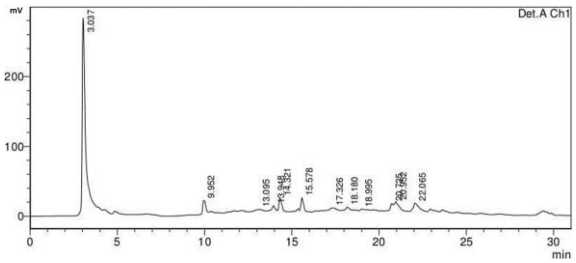


Figure 3. Spectrum p-control chart of bintaro seed powder

FTIR Test

FTIR testing aims to determine the functional groups of compounds contained in bintaro seeds and paint. The test is carried out by grinding bintaro seeds and then adjusting them to the existing spectrum, the paint used is commercial paint available in stores used for trees. The FTIR spectrum is recorded using a spectrophotometer at room temperature, the data obtained is in the form of a spectrum image between wave numbers and transmittance so that the functional groups contained in the bintaro seed powder and paint can be known. The results of the analysis of bioplastic functional groups with FTIR can be seen in Figure 4 and 5.

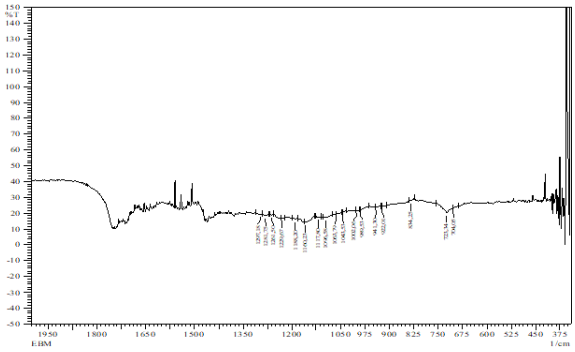


Figure 4. FTIR spectrogram of bintaro seeds.

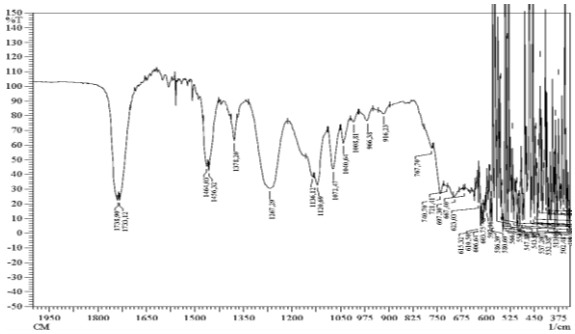


Figure 5. FTIR spectrogram of commercial paint

A wide absorption band with weak intensity at a wavelength of 1950 – 1350 cm^{-1} contains a typical alkaloid peak, where in this absorption area there is also an HN–O stretching group. Wavelength 675 – 450 cm^{-1} contains the C–Br functional group. The commercial paint graph group band has a wavelength of 4600 – 3600 cm^{-1} contains O-H (Alcohol).

Density Testing

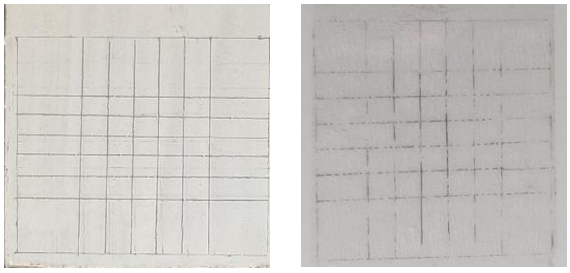
The results of the density test for each sample are presented in Table 2. There appears to be a tendency for an increase in density when the amount of extract is increased.

Table 2. Density of liquid extract of bintaro seeds.

Sample	ρ (g/cm^3)
CEB-1	1.04
CEB-2	1.07
CEB-3	1.11

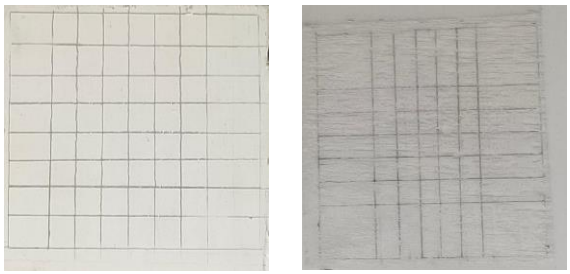
Adhesion

The results of the adhesion test (cross cut) were carried out by scratching the surface layer with a pencil, then tape was attached to the layer that had been drawn in the form of lines forming small boxes of 1 cm, then the attached tape was pulled or removed again until the results were obtained. This adhesion test (cross cut) was carried out on all test specimens as shown in Figure 6, 7, and 8.



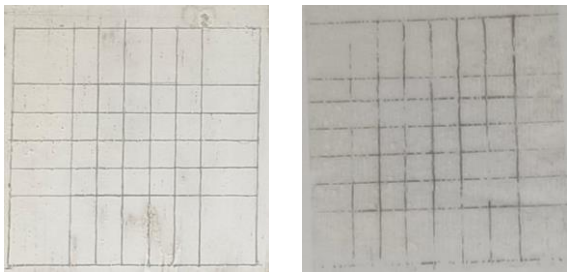
(a) (b)

Figure 6. Surface image of paint before (a) and after (b) adhesion test for sample CEB-1.



(a) (b)

Figure 7. Surface image of paint before (a) and after (b) adhesion test for sample CEB-2.



(a) (b)

Figure 8. Surface images of paint before (a) and after (b) adhesion test for CEB-3 sample.

Table 3. Adhesion test results.

Sample	Peeled in (%)	
	Image result	Visual result
CEB-1	5.62	5
CEB-2	15.18	15
CEB-3	29.42	35

The results of the adhesion test (cross cut) above show the level of adhesion of paint to the multiplex wood surface [1]. The results of visual observation and ImageJ analysis showed that shows consistent results. The large percentage of peeled ca on CEB-2 and CEB-3 samples indicates a decrease in paint adhesion due to increased concentration of bintaro seed extract. Therefore, further study is needed to determine the maximum dose of bintaro extract as a paint additive.

CONCLUSION

The content in the bintaro seed extract is proven to have alkaloid content as in the FITR test data. The density of the extract has an average value of 1.067 g/cm^2, 1.108 g/cm^2 from the data obtained means that the density of an extract reaches its maximum density value. The addition of bintaro extract concentration causes a decrease in paint adhesion.

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REFERENCES

1. Cahyadi, D. & Puspita, D. F. (2019). Pengembangan Formulasi Cat Tembok Emulsi Berbahan Acrylic untuk Meningkatkan Daya Saing IKM. *Jurnal Teknologi Bahan dan Barang Teknik*, **4**(1),

1–6.
2. Khan, M. A. & Hadromi, H. (2020). Pengaruh Inhibitor Natrium Kromat Terhadap Laju Korosi Pada Komponen Radiator Sistem Pendingin Mobil. *Automotive Science and Education Journal*, **9**(1), 18–24.
3. Wulandari, K. & Ahyanti, M. (2018). Efektivitas ekstrak biji bintaro (Cerbera manghas) sebagai larvasida hayati pada larva Aedes aegypti Instar III. *Jurnal Kesehatan*, **9**(2), 218–224.
4. Gokok, S. (2017). *Uji Toksisitas bioinsektisida ekstrak metanol buah bintaro (Cerbera odollam L.) terhadap mortalitas ulat grayak (Spodoptera litura) pada pakan daun tomat*. Universitas Sanata Dharma, Indonesia.
5. Jannah, S. R., Ika Trisharyanti, D. K., & Farm, M. (2013). Aktivitas ekstrak etanol daun bintaro (*Cerbera odollam Gaertn.*) *terhadap bakteri Shigella sonnei dan Staphylococcus saprophyticus*. Doctoral dissertation, Universitas Muhammadiyah Surakarta, Indonesia.
6. Rizal, S. & Dewi, H. (2015). Pengaruh jenis pelarut terhadap aktivitas antibakteri ekstrak daging dan biji buah bintaro (*Cerbera manghas L.*). *Jurnal Teknologi Industri & Hasil Pertanian*, **20**(1), 51–64.
7. Amelia, H. (2022). *Pengaruh ekstrak daun bintaro (Cerbera odollam) terhadap pengendalian hama ordo Lepidoptera Pada Tanaman Kubis (Brassica oleracea)*. Universitas Islam Negeri Sunan Ampel, Indonesia.
8. Nandiyanto, A. B. D., Oktiani, R., & Ragadhita, R. (2019). How to read and interpret FTIR spectroscope of organic material. *Indonesian Journal of Science and Technology*, **4**(1), 97–118.
9. Suastuti, N. A., Dewi, I. P., & Ariati, N. K. Pemberian ekstrak daun sirsak (*Annona muricata*) untuk memperbaiki kerusakan sel beta pankreas melalui penurunan kadar glukosa darah. *Jurnal Kimia*, **9**(2), 289–295.
10. Lateef, A., Azeez, M. A., Asafa, T. B., Yekeen, T. A., Akinboro, A., Oladipo, I. C., Azeez, L., Ajibade, S. E., Ojo, S. A., Gueguim-Kana, E. B., & Beukes, L. S. (2016). Biogenic synthesis of silver nanoparticles using a pod extract of Cola nitida: Antibacterial and antioxidant activities and application as a paint additive. *Journal of Taibah University for Science*, **10**(4), 551–562.
11. Saputra, S. A. & Arfi, F. (2019). Analisis residu kloramfenikol pada udang windu (*Penaeus monodon*) menggunakan high performance liquid cromatography (HPLC). *Amina*, **1**(3), 126–131.
12. Widiyatun, F., Selvia, N., & Dwitiyanti, N. (2019). Analisis viskositas, massa jenis, dan kekeruhan minyak goreng curah bekas pakai. *STRING (Satuan Tulisan Riset Dan Inovasi Teknologi)*, **4**(1), 25–30.
13. ASTM Standard D3359-09. (2010). Test methods for measuring adhesion by tape test. *ASTM D3359-09*.
14. Badaring, D. R., Sari, S. P. M., Nurhabiba, S., Wulan, W., & Lembang, S. A. R. (2020). Uji ekstrak daun maja (*Aegle marmelos L.*) terhadap pertumbuhan bakteri Escherichia coli dan Staphylococcus aureus. *Indonesian Journal of Fundamental Sciences*, **6**(1), 16.
15. Putri, V. D. & Dyna, F. (2019). Standarisasi Ganyong (Canna edulis ker) sebagai pangan alternatif pasien diabetes mellitus. *Jurnal katalisator*, **4**(2), 111–118.
16. Kartimi, K. (2015). Pemanfaatan buah bintaro sebagai biopestisida dalam penanggulangan hama pada tanaman padi di kawasan pesisir Desa Bandengan Kabupaten Cirebon. *Prosiding Seminar Nasional Pendidikan Biologi 2015*, 101–111.