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Original Research

Effect of shallot peel extract in tofu to detect the presence of formaldehyde

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Abstract

Background: The prohibition of the addition of formalin in food is carried out because it is dangerous to health. People generally find it challenging to carry out formalin checks on food, which are usually carried out in laboratories because they use chemicals. Another way to test formalin can use natural ingredients that contain anthocyanins. Anthocyanins are a group of pigments, namely flavonoids. These flavonoids are commonly found in plant parts such as fruits and flowers and other parts such as the skin of shallots.
Objective: This study aimed to determine the formalin test with shallots peel extract.
Methods: An experimental research design was used in this study using colorimetric, which took anthocyanin extract from the skin of the shallots, and the extract was tested again on formalin tofu to see the color change.
Results: Shallots peel extract was tested with an Ultraviolet Visible spectrophotometer instrument, and the results showed the presence of anthocyanins in the extract.
Conclusion: Formalin testing with shallots peel extract can be done, but we must pay attention to the extraction process so that maximum results can be obtained.

Keywords: shallots; formalin; tofu; formaldehyde

Background

Formalin is often used as an ingredient in the manufacture of urea fertilizer, perfume products, preservative cosmetic products, nail hardeners, and materials for foam insulation. Formalin can also be used as corrosion prevention for oil wells. In the wood industry, formalin is used as an ingredient adhesive for plywood products (Moznuzzaman, Islam, & Khan, 2021; Rochyani & Akbar, 2018).

Formalin is a substance that should not be used in food ingredients because of its harmful side effects on health. However, it is still often misused by food manufacturers because the price is cheaper than the food preservative itself. Misusing this formaldehyde in foodstuffs can cause poisoning because formaldehyde quickly reacts with the mucous lining of the digestive and respiratory tract (Hasan, Pervin, Kobir, Sagor, & Karim, 2021; Nasution & Ervina, 2019). People who consume foods that contain formalin just a few times will not feel the consequences. But the effects of formalin foods can be felt after a few years. Formalin exposure to humans can be hazardous to health, such as eye and respiratory tract irritation, and increase the risk

of cancer (Hasegawa et al., 2022; Nurhayati, Widiyanto, & Yuniarno, 2019).

Formalin causes pain accompanied by mucous membrane necrosis, ulceration, and inflammation when it enters the digestive tract. The use of formalin in food causes poisoning in humans, namely abdominal pain accompanied by vomiting, headaches, seizures, and unconsciousness to coma, and it also can cause damage to the central nervous system and kidneys (Ayuchecaria, Sari, & Fatmawati, 2017; Mustafa et al., 2021). Research conducted by Ayuchecaria et al. (2017), Qualitative Analysis of Formalin on Chickens sold in the Old Market, Banjarmasin Region, showed that 7 out of 10 samples of chicken pieces were positive for formalin. A study by Saptarini, Wardati, and Supriatna (2011) on the formalin test, also in tofu samples from the traditional market of Purwakarta, reported the presence of 44.44% formalin content in tofu samples where the levels were 5.59-12.86 ppm. Research by Dewi (2019) aims to identify formaldehyde in formalin-containing foods found in several traditional markets in Samarinda by using extracts of natural ingredients, namely dragon fruit peel extract. The results showed that six samples were positive for formalin.
Formalin analysis can be done in several ways, namely qualitative and quantitative analysis methods. Qualitative examination methods include using 0.1 N KMnO4 (Khaira, 2016), Tollens reagent, Chromatofat Acid powder, visible light method, Schiff reagent, and test with Ferric. The quantitative examination can use reflectometry, titrimetry, colorimetry, and visible spectrophotometry (Hariyanti, 2012).

Shallots are root vegetables that can be used as a cooking spice and food seasoning. Shallots contain essential oils, flavonoids, diallyl sulphide, propantiol-S-oxide, prostaglandin a-1, diphenylamine cycloalin, methylene didroaliin, kaenpherol, phloroglucinol, s-allyl-lcysteine-sulpoxide or aliin (Nurhayati et al., 2019).

Anthocyanins compounds are polar. It can be extracted with polar solvents such as water, ethanol, and methanol. Anthocyanins are often extracted with ethanol. However, it is most effective if using methanol. The colors of the anthocyanin pigments are red, blue, and violet. Anthocyanins can usually be found in fruits, skin and flesh, flowers, and vegetables. This pigment turns red at an acidic pH and turns violet, and then turns blue at an alkaline pH. So, it can also be used as an acid indicator and also an alkaline indicator. Anthocyanins can be used to detect the presence of chemical compounds such as formalin. The acidic nature of formalin is due to the presence of formic acid due to the oxidation of formaldehyde, and if it is mixed with strong acid, anthocyanins will easily react (Bekhit, Giteru, Holman, & Hopkins, 2021; Dewi, 2019). Several studies that have succeeded in extracting anthocyanins from natural ingredients include Mangosteen Peel Waste (Farida & Nisa, 2015; Plaza, Domínguez-Rodríguez, Sahelices, & Marina, 2021), Banana Bract (*Musa paradisiaca* L) (Lestario, Yoga, & Kristijanto, 2014), Kastuba (*Euphorbia pulcherrima*) (Maulid, 2015).

The researcher considers it necessary to conduct a study on the effect of adding shallot skin extract to detect the presence of formalin in tofu. This study is expected to determine whether the anthocyanin content in the skin of shallots can be used to detect the presence of formalin. The research is also expected to be used as an alternative for independent formalin testing for the community.

Methods

Study Design

This research used an experimental study design to determine whether the anthocyanin content in the skin of shallots can be used to detect the presence of formalin. This study was conducted in 2022 at Kupang City Health Laboratory Technical Implementation Unit, East Nusa Tenggara, Indonesia.

Samples and Instruments

The materials needed in this research are white tofu, ethanol, shallots peel, formalin solution, aquades, and label paper. The tools and instruments used are a dropper, hot plate, mortal, evaporator, stirring rod, UV spectrophotometer, spray bottle, bulb, and glassware commonly used in chemistry laboratories.

The manufacture of 1% formalin, as much as 100 mL, is done by diluting 37% formalin using distilled water. Meanwhile, for the manufacture of formalin tofu preparations, 50 grams of tofu that has been weighed, and soaked in a 1% concentration of formalin, is for 1 hour. Then the soaked tofu is

pounded in a mortar, aquades are added to a volume of 100 ml, then filtered. The manufacture of shallots peel extract is by extracting it with ethanol and then taking the extract.

Data Analysis

Quantitative descriptive analysis was only used to present the data.

Ethical Consideration

This study did not involve humans or animals as samples. Therefore, this study did not require any ethical approval.

Results

The results of the extraction of 250 grams of shallots skin samples obtained a thick extract from the skin of shallots of as much as 6.0805 grams. The yield of the ethanolic extract of the shallots skin obtained was 2.4322%.

Figure 1 Test of Shallots Peel Extract on HCl and NaOH

The color of anthocyanins is affected by acid and alkaline conditions. The color of anthocyanins becomes red if it is in an acidic environment. In contrast, it becomes bluish-green if it is in an alkaline environment, as shown in **Figure 1** and **Table 1**.

Table 1 Test of Shallots Peel Extract on HCl and NaOH

Solvent	Color Result
HCl	Red
NaOH	Turning into green-blueish and finally fade

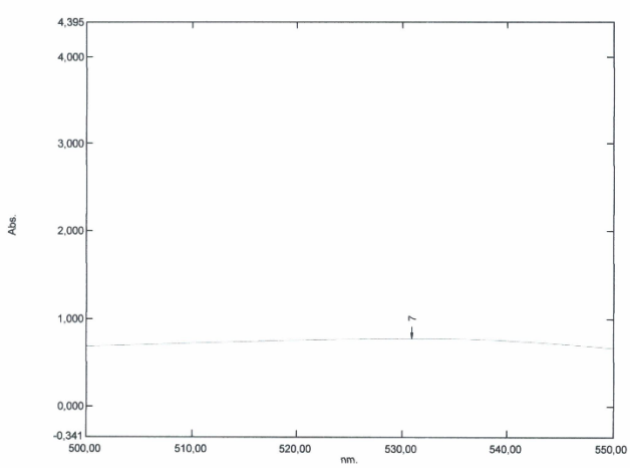

Figure 2 Characterization of shallots peel extract on UV-Spectrophotometer

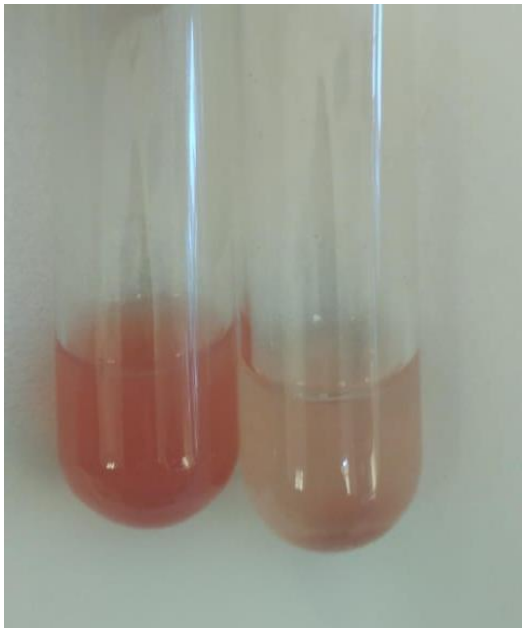

Figure 3 Formalin test on tofu with shallots peel extract

Discussion

The color of purple sweet potato anthocyanin extract changed from red, purple red, blue, green, and yellow as the pH increased from 1 to 14 (Mahmudatussaadah, Fardiaz, Andarwulan, & Kusnandar, 2014). Anthocyanins react with acidic formalin to produce a dark red color which is indicated that the tofu contains formalin, but if the resulting color is pink or leaves no color, the tofu does not have formalin (Nasution & Ervina, 2019).

Anthocyanin compounds are indicated in the obtained wavelengths. Although there are differences in the sources of anthocyanins and

differences in the findings used, the wavelengths obtained are also different. The anthocyanin compound from the ethanolic extract of the shallots' skin is thought to be a type of cyanidin. The typical absorption given from the characteristics of anthocyanins is at a wavelength of 240 - 282 nm and a wavelength of 516 - 520 nm. Other studies also found absorption at a wavelength of 547 nm and a wavelength of 536.4 nm.

Determining the type of anthocyanin contained in the ethanolic extract of the shallots' skin is rather difficult. Because the form of the extract from the sample obtained is still very thick, the resulting spectrum is not suitable because many compounds provide absorption. The difference may be due to differences in the type of shallot sample and the type of acid used in the extraction process, while previous studies used acetic acid. In addition, environmental factors for the growth of sample plants, such as altitude, air temperature, soil fertility, and light, may also be the cause of the differences obtained. The higher the position above sea level, the lower the air temperature and the greater the intensity of light in that place, which will cause the rate of anthocyanin biosynthesis to be greater.

Formalin has an aldehyde element that easily reacts with proteins; therefore, when poured on tofu, formalin will bind to protein, starting from the surface of the tofu to the inside, causing the protein to die. Because the protein in tofu has bound to formalin, the tofu protein will not react with anthocyanin pigments. This resulted in the stability of anthocyanins. Anthocyanins do not change color, and no precipitate or vapor is formed when mixed with tofu samples containing formalin (Khaira, 2016).

Conclusion

Shallots peel extract containing anthocyanin substances can be used for formalin testing. Formalin testing with shallots peel extract can be carried out, taking into account the extraction process in order to obtain maximum results.

Declaration of Conflicting Interest

The authors declare that there is no conflict of interest.

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Author Contribution

AR contributed to the planning, searching of the literature, data collection, and manuscript writing. WLORB contributed in supervised the conduct of the study. MT contributed to the review of the draft and supervision. NMS contributed in revised the manuscript and supervised the conduct of the study.

Author Biography

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