

## The Role of Anthocyanin Substances from Dragon Fruit Skin Extract in Formalin Content Testing in White Tofu

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### Abstract

*One of the high-quality processed vegetable food ingredients is tofu. Tofu is made from processed soy milk with a thick texture and molded according to the right nutritional amount. White tofu is the most popular of the various forms of tofu available. Most of the tofu production centers provide additional ingredients in the form of preservatives such as formalin to reduce losses from damage to the tofu they produce. The presence or absence of formalin in food can be detected using a unique component found in dragon fruit peel called anthocyanins. The method used is purposive sampling selected based on established criteria. The sample used in this study as many as 10 white tofu traded in the traditional market of Banten region with the criteria of tofu tends to be chewy, odorless and not easily destroyed. The aim of the research is to identify formalin in white tofu discovered in numerous traditional markets in Banten using natural component extracts, including dragon fruit peel extract. The results showed that dragon fruit skin extract can be used as an alternative natural indicator on formalin examination in tofu. From the results of formalin testing using dragon fruit skin extract, found 2 positive samples containing formalin and eight negative samples, the presence of formalin in tofu was indicated by a red color on the tissue. Sellers or customers can detect formalin simply by utilizing dragon fruit, allowing them to avoid formalin which is harmful to health, with a simple and low-cost method.*

*Keywords : white tofu, Banten, anthocyanin, formalin, dragon fruit peel extract.*

### 1. Introduction

The rise of cases related to food quality on long-term health is important attention to the future in choosing a safe source of food is also worth consuming. Generally, food ingredients can be obtained from plant and animal sources. One of the high-quality processed vegetable food ingredients is tofu. Tofu is made from processed soy milk with a thick texture and molded according to the right nutritional amount [1]. Nutrition content at 100 gr tofu covering 1.6 gr of carbohydrates, 7.8 gr protein, 4.6 gr of fat, 68 gr calories, 124 gr of calcium, 63 mg phosphor, 0.8 mg of iron, 0.06 mg vitamin B, and 84.8 gr of water [2], while the composition contained in tofu is 70 - 90% of water, 5-15% protein, 4-8% fat, and 2-5% carbohydrates [1].

Basically, every food ingredient has limited time to the shelf life of consumption suitability. Some types of tofu are produced and have a high number of enthusiasts one of which is white tofu. White tofu is a food that can only survive for 1 day without the provision of additives or preservatives. White tofu has a nutrient rich in protein, and has a high enough water content to create a good environment for the growth of decaying microorganisms that can affect the shelf life of the know for long-term consumption feasibility [3]. Tofu that has suffered damage is characterized by the appearance of mucus and unpleasant aromas. Today, tofu producers have taken manipulative actions

to anticipate production losses by including preservatives in the mix of ingredients used to make tofu. Most of the tofu production centers provide additional ingredients in the form of preservatives such as formalin to reduce losses from damage to the tofu they produce. Food additives are ingredients that are added to food in limited amount to improve texture, taste, and shelf life. According to Yulisa *et al.* (2014) in [4,] the usage of additional substances in the form of formalin might induce esophageal irritation, chest pain, and kidney failure when consumed in the long term. This is because formalin is not a food preservative, but rather a chemical used to preserve corpses and is also used as an antiseptic in the medical field [5]. The use of formalin in food can result in food poisoning, which includes immediate abdominal pain accompanied by vomiting, the onset of nervous system depression, or circulatory failure [6].

Tofu is a food consumed so that it requires safety and wakefulness from dangerous elements, therefore it takes protective action against food security itself. The presence or absence of formalin in the composition of tofu can be tested using chemicals in the form of anthocyanins [7]. Anthocyanin is a natural pigment from the flavonoid group with three carbon atoms that find an oxygen atom to connect two benzene aromatic rings ( $C_6H_6$ ) and can detect formalin, which is a polyphenol derivative compound [8] and natural dyes from the flavonoid group with three carbon atoms that find an oxygen atom to connect two benzene aromatic rings ( $C_6H_6$ ) [9]. Compounds of the flavonoid group have the general characteristic of having a carbonyl group ( $-C=O$ ) [10]. Anthocyanins are natural antioxidants. Anthocyanins will change color along with changes in pH value. At high pH or alkaline anthocyanins tend to be blue or colorless, while for low pH or acid anthocyanins are red. Anthocyanins produce a purplish red color at a pH of less than 4. Dragon fruit skin contains anthocyanins which can detect formalin. This is because the nature of formalin and anthocyanins both have acidic properties so that they still stabilize the color of the anthocyanins of dragon fruit skin. Anthocyanins have a pH of about 2-3, almost the same as the pH of formalin [21] One of the factors that affect the color of anthocyanins remains stable when reacting with formalin because formalin is acidic and at high pH changes to violet and then to blue [11]. Anthocyanins can be found in some companies that produce plant extracts with a fairly high selling price, which is around Rp. 6,000,000 so that a simple method is needed at an economical cost to find out the content of formalin contained in the food consumed.

.A simple way to detect formalin in food is to use a natural indicator, namely red dragon fruit peel extract. The nutrients contained in the skin of the red dragon fruit (*Hylocereus polyrhizus*) include carbohydrates, fats, proteins, and dietary fiber. Anthocyanins are a unique component of dragon fruit peel that may detect the presence or absence of formalin in food items [7]. Anthocyanins contained in dragon fruit peel can be used as a natural pigment, antioxidant, and can also be used to detect the presence of chemicals (preservatives) such formalin and borax [12; 13]. Anthocyanins are water-soluble flavonoids. Formalin testing can use anthocyanins because formalin contains formic acid as a result of formaldehyde oxidation, which makes it easier for anthocyanins to react with strong acids [14]. The stability of the dragon fruit peel extract remained constant after 30 days of storage in a closed bottle in the refrigerator, and it performed well as an indicator of acid-base titration, with the titration results found to be accurate and cost-effective, attracting the public to conduct formalin tests using a simple method [15]. In addition to the above, dragon fruit peel waste is also easy to find and cost efficient so that it can attract the public to conduct formalin testing with a simple method. Based on the above, research into the presence of dangerous compounds in food, such as formalin, is required. As a result, the aim of the research is to see if anthocyanins found in red dragon fruit peel can be used as an alternative natural indicator for detecting formalin in tofu sold in traditional markets.

## 2. Material and Methods

This research is a qualitative research method in which a simple experimental procedure was used to determine formalin content using a natural indicator, dragon fruit peel extract. The method used is purposive sampling selected based on established criteria, to collect primary data in the form of testing food samples taken. The sample used in this study as many as 10 white tofu traded in the traditional market of Banten region with the criteria of tofu tends to be chewy, odorless and not easily destroyed.

This research uses instruments such as a blender, tissue, knife, chopping board, spoon, and bowl. While the materials utilized are water, dragon fruit skin, and white tofu. The working procedure for testing the formalin content in white tofu is as follows:

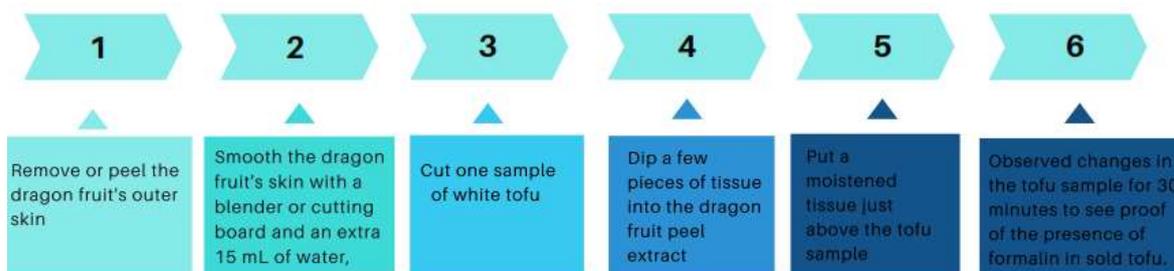


Figure 1. The working procedure for testing the formalin content in white tofu

## 3. Results and Discussion

### Testing Formalin with the Dragon Fruit Skin Indicator

The research used a simple method of extraction from dragon fruit peel to detect the formalin content. The skin of the dragon fruit contains anthocyanins, which easily react with the acidic formalin to produce a red color. As a result, the color change in white tofu was the parameter noted in the formalin examination this time. Table 1 shows the results of formalin testing on 10 samples of white tofu obtained from a traditional market in the Banten region using dragon fruit peel extract:

Table 1.

Results of Formalin Test Using Anthocyanins from Dragon Fruit Skin (*Hylocereus costaricensis*)

Food Sample	Result	Explanation
Tofu 1	(-)	did not contained formalin
Tofu 2	(+)	formalin contained
Tofu 3	(-)	did not contain fomalin
Tofu 4	(-)	did not contain fomalin
Tofu 5	(-)	did not contain fomalin
Tofu 6	(-)	did not contain fomalin
Tofu 7	(-)	did not contain fomalin
Tofu 8	(-)	did not contain fomalin
Tofu 9	(-)	did not contain fomalin
Tofu 10	(+)	formalin contained

When viewed from the results of Table 1. above, it shows that of the 10 samples of white tofu that were tested, there were 2 samples which were stated (+) positive to contain formalin and 8 other samples were stated (-) negative to contain formalin. Tofu which was declared positive to contain formalin was seen in tofu samples 2 and tofu 10. Meanwhile, tofu which was declared negative to contain formalin could be seen in samples of tofu 1, tofu 3, tofu 4, tofu 5, tofu 6, tofu 7, tofu 8 and tofu 9. According to Muchtadi in [16], tofu containing formalin solution has a shelf life of 4-5 days at room temperature. While the effect of anthocyanins in dragon fruit peel extract can prove the presence or absence of formalin content in tofu samples in this test, storage treatment for 30 minutes can prove the effect of anthocyanins in dragon fruit peel extract can prove the presence or absence

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of formalin content in tofu samples. This is confirmed by the statement that formalin easily reacts with proteins, causing the tofu proteins to die quickly and the tofu to last a long time [17]. A natural indicator of dragon fruit peel was utilized in this experiment because dragon fruit contains anthocyanin compounds that react well with acids and bases. According to [18], when anthocyanins are exposed to formalin, they do not change color and stay dark red. Figure 2 shows that when the sample was left to stand for 30 minutes after being mixed with dragon fruit peel extract, the color change in the tofu that did not contain formalin and the tofu that did contain formalin did not change color or remained dark red.



Figure 1. Initial conditions of ten tofu samples that were tested



Figure 2. Tofu sample inspection process at  $\pm$  30 minutes

The same thing was also proven [19] that tofu that had been dripped with dragon fruit peel extract for 30 minutes did not change color or color to dark red, while for samples that did not contain formalin the color changed to brown or white. The anthocyanin content in the fruit can be used as a test to detect the presence of chemical compounds such as formalin. Anthocyanins will react easily if mixed with strong acid, the resulting color will be more concentrated when combined with acid [20] Anthocyanins have a pH of about 2-3, almost the same as the pH of formalin. One of the factors that affect the color of anthocyanins remains stable when reacting with formalin because formalin is acidic [21].

## **Formalin Compounds and Dragon Fruit Peel**

Formalin has an acidic aldehyde element because it contains formic acid due to formaldehyde oxidation. The aldehyde element easily reacts with protein, when poured on formalin tofu it will bind to the protein from the surface of the tofu to the inside, causing the protein to be denatured or damaged. The binding of protein by the chemical elements of formalin causes the tofu when pressed feels more chewy. In addition, the protein that has been bound and damaged will not be attacked by spoilage bacteria that produce acidic compounds, so the tofu will be more durable [22]. Some white tofu containing formalin has characteristics that can be distinguished from tofu that does not contain formalin, tofu containing formalin has characteristics such as chewy when pressed, not easily crushed, not easily damaged or rotten, and can last longer [23]. The nature of formalin tends to evaporate at high temperature but the boiling process does not remove all the formalin content in food samples [21]. The formalin binds to proteins and other compounds and the remainder remains in the form of free formalin which will then be absorbed into the food ingredients, so that it will be protected from outside air and consequently evaporation is very slow, so that formalin is still detected in the evaporation sample [24]. Formalin belongs to the group of strong disinfectants, can eradicate various types of spoilage bacteria, diseases, fungi or molds. Formalin is easily soluble in water to levels of 55%, very reactive in alkaline conditions, and is a strong reducing agent, volatile because of its low boiling point, namely  $-21^{\circ}\text{C}$  [25].

Anthocyanins are water-soluble pigments that belong to the flavonoids group. Anthocyanin pigment colors are red, blue, and violet and are commonly found in flowers, fruits, and vegetables. Purple sweet potatoes, strawberries, dragon fruit, and grapes are examples of natural fruit extracts containing anthocyanins. The anthocyanin concentration of some of these natural fruits varies. Anthocyanin content in purple sweet potatoes is 519 mg, strawberry anthocyanin is 69 mg, dragon fruit anthocyanin is 104.58 mg, and grape anthocyanin is 6 mg. Purple sweet potato has the highest anthocyanin content, followed by dragon fruit, strawberries, and grapes [20]. The amount of pigment, the location and number of substituted hydroxyl and methoxyl groups, and different environmental effects such as pH all influence the nature and color of anthocyanins in plant tissues [26].

## **4. Conclusion**

The results of the experiment indicate that dragon fruit peel extract can be used as an alternative natural indicator in testing the presence or absence of formalin in food ingredients. From 10 tofu samples, 2 samples of tofu containing formalin were found in the Banten traditional market by a simple test using anthocyanins contained in dragon fruit peel. Therefore, people should be careful in choosing the type of food to be consumed and pay attention to the composition as well as the nutritional value contained in it.

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