

Physicochemical Characteristics and Antioxidant Activity of Gluten Free Cookies with the Addition of Red Dragon Fruit Peel Paste (*Hylocereus Polyrhizus*)

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Abstract Antioxidant activity test on cookies with the addition of red dragon fruit peel paste was carried out to find out how much antioxidant activity was in these cookies. This study aims to determine the physicochemical characteristics and antioxidant activity of spritz cookies that have been added with red dragon fruit peel paste. Physical analysis includes color analysis, chemical analysis includes pH test. Antioxidant activity analysis was carried out using the DPPH UV-Vis Spectrophotometric measurement method. Data analysis of color, pH and analysis of antioxidant activity are presented descriptively. The results showed that making red dragon fruit peel paste increased redness with an b^* value 10.7 ± 4.7 . pH of red dragon fruit peel paste after drying in oven decreased to 3.39 in acidic conditions. The addition of lemon juice had no significant effect on increasing the antioxidant activity of spritz cookies added with red dragon fruit peel paste. In conclusion, the antioxidant activity of spritz cookies that have been added to red dragon fruit peel paste can be identified before adding lemon juice or after adding lemon juice to dragon fruit peel paste, as well as during the processing into spritz cookies the antioxidant activity is maintained.

Keywords: Antioxidant, IC_{50} , Cookies, Red dragon fruit peel

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1. Introduction

Dragon fruit is an exotic fruit because the fruit is unique and attractive, the skin is red and green with frayed scales, has a fragrant aroma, tastes sweet. In addition to eating dragon fruit, its thick skin can be used so that dragon fruit can be a "zero waste" fruit. Utilization of dragon fruit skin is an alternative solution to reducing food waste because it is known that around 30-35% of the weight of the fruit is dragon fruit skin [1]. The antioxidant activity in dragon fruit skin is greater than the antioxidant activity in the fruit flesh [2,3]. The amount of anthocyanin content as a natural dye from dragon fruit peel, in fact each has different anthocyanin content. The factors that affect the stability of non-enzymatic anthocyanins are the influence of pH, temperature, and also light [4].

Dragon fruit skin that is good for natural dyes is red dragon fruit skin, this is in line with the research by Joseph [5] which concluded that the antioxidant pigment anthocyanin in red meat dragon fruit skin produces higher levels of anthocyanin, i.e. 22.59335 ppm of the

anthocyanin content in dragon fruit skin, white flesh, which is 16.73593 ppm, which means it belongs to the strong category. This is because the skin of dragon fruit with red flesh has anthocyanin pigment which gives it a brighter color than the skin of dragon fruit with white flesh [6].

Red dragon fruit skin is used as a natural dye with various processing methods apart from extraction, it can be made into porridge/paste and flour [7]. Dragon fruit peel paste is obtained from the red dragon fruit skin refinement process, the boiling process until thickening occurs. The process of making red dragon fruit peel paste is simpler than making extracts or flour [1].

Utilization as a natural dye can be optimized properly if it is treated properly when making natural dyes from red dragon fruit peels [8]. Phenol compounds are found in dragon fruit peels which have properties that are easily oxidized and sensitive to heat, heating temperatures higher than 60° C after 4 minutes can damage the phenol, drying in the oven can prevent damage because drying is more closed, the temperature can be set not to exceed 60°C. Optimization of dragon fruit skin as a natural dye in Harjanti's research [9], was carried out by making dragon fruit skin acidic conditions with an evaporation

temperature of 50°C, acidification of the solvent serves to maintain the stability of the anthocyanin. Anthocyanins will be stable at pH 1-3, the water content contained in the dragon fruit skin must be low, the lower the water content, the higher the use of dragon fruit skin so that the anthocyanin level is higher [10].

Making spritz cookies is considered easier, then these cookies can be a light snack, cakes that last a long shelf life, can be used as products for gifts, souvenirs or for holiday events. It is hoped that the addition of red dragon fruit peel paste will add to its attractiveness and also increase the antioxidant content in it.

2. Materials and Methods

The samples used for the antioxidant activity test included samples without additional treatment (T0), then samples with the addition of 2 grams of lemon juice (T1), and the addition of 4 grams of lemon juice (T2). After that, the roasting process is carried out in the oven using a temperature of 135°C. Repeat 1 time so that there are 6 samples.

2.1. Making Red Dragon Fruit Peel Paste

There are several stages in the process of making red dragon fruit peel paste. The first stage is the process of sorting, washing and draining. The sorting process starts from the beginning of selecting the dragon fruit skin by choosing ripe dragon fruit skin which is characterized by thin skin, dark color, because anthocyanins will increase many fold in ripe fruit [7]. The sorting process continues by removing the dried petals, so that the smoothing results are perfect so that a paste with a soft and smooth texture is produced. The next treatment that is carried out is the washing process, the aim is to clean the skin from adhering dirt, to maintain the sanitary hygiene of the paste produced. After cleaning, it must be drained so that the water content attached to the surface of the skin is reduced.

The second stage is the process of cutting 100 grams of red dragon fruit skin, cutting into dice with a size of approximately 1 x 1 cm, the purpose of cutting is to make it easier during the process of smoothing and absorbing lemon juice so that it is evenly distributed.

The third stage is the soaking process with lemon water, carried out for 30 minutes to get the maximum absorption of the acid in the lemon water. Solvent acidification serves to maintain the stability of the anthocyanins, the red dragon fruit skin becomes soft so that the refining process becomes easier with smooth, even results [9].

The fourth stage is to drain again with the aim of removing the remaining liquid that is not absorbed into the red dragon fruit skin. The slicing treatment is part of an effort to reduce the water content in the red dragon fruit skin so that the resulting pasta contains as little water content as possible and the roasting process will produce pasta with a very low water content.

The fifth stage is smoothing the red dragon fruit skin using a blender, mashed until completely smooth. The sixth stage is to carry out the heating process to evaporate the water in the red dragon fruit skin.

2.2. Color Physical Characteristics and pH Test on Red Dragon Fruit Peel Paste

The physical characteristic test of color was carried out using the Color Grab application by looking at the indicators L* (brightness), a* (reddish), b* (yellowish). The Ph test is carried out using a digital Ph meter. This test was carried out to find out the level of stability of anthocyanins, it is known that the pH level will affect the stability of anthocyanins and will affect the color they cause. According to Pedro [11] and Sitepu [12] said that in the presence of the right combination of polar solvents and organic acids it can produce very acidic pH conditions (pH 1-2) to stabilize anthocyanins in the form of red flavium cations, if the combination of solvents with weak acids (pH 3) then the anthocyanin will turn red to fade, at pH 4 it becomes purplish red, at pH 5-6 it becomes purple and at pH 7 it becomes blue purple.

2.3. Making Spritz Cookies Gluten Free

The recipe formula for making spritz cookies is 48% tapioca flour, 11% margarine, 11% butter, 22% powdered sugar, 4% egg yolks, 1% liquid coconut milk, 3% coconut milk powder, 17% red dragon fruit skin paste. dough weight. Provision of a good paste on texture results in a position of 17% of the dough. The use of tapioca flour makes these spritz cookies a gluten free product because tapioca flour is included in the gluten free material group.

2.4. Antioxidant Activity Test on Spritz Cookies with the DPPH Method

Measurement of antioxidant activity was carried out quantitatively using the DPPH method. The principle of the DPPH method is that there is a change in the intensity of the purple color in DPPH which is proportional to the concentration of the DPPH solution. DPPH free radicals that have unpaired electrons will give a purple color to the solution. The color will change to yellow when the electrons are paired. This change in color intensity occurs due to the attenuation of free radicals resulting from the reaction of DPPH molecules with hydrogen atoms released by molecules of sample compounds to form diphenylpicryl hydrazine compounds and cause a color change in DPPH from purple to yellow. This color change from purple to yellow will give a change in absorbance at the maximum wavelength of DPPH using a UV-Vis spectrophotometer so that the value of free radical scavenging activity will be known which is expressed by the IC₅₀ (Inhibitory concentration) value. The IC₅₀ value is defined as the concentration of the test compound which can reduce free radicals by 50%. The smaller the value of IC₅₀, the higher the value of free radical scavenging activity.

3. Results and Discussion

3.1. Physical Characteristics of Color and pH Value

Changes in the pH value and color during the process of

making red dragon fruit peel paste can be seen in Table 1. At the washing stage, a pH value of 4.19 was obtained for the red dragon fruit peel, which means that the condition is alkaline, the color produced is included in the signal violet color type, with $L^*37.8\pm6.7$ means that it is close to the middle position of the brightness ring. The value $a^*54.2\pm10.8$ indicates a position in the vicinity of red approaching green and $b^*-16.0\pm 4.3$ a minus position indicating that it is in a yellow position approaching blue. The change occurred in the pH after the process of soaking the red dragon fruit skin with lemon water, the acidity of the lemon caused the pH to decrease to acid, which was 2.02 so that in color there was also a color change that could increase the color intensity, the data showed an increase in intensity of 2.9 ie from $L^*37.8\pm6.7$ to 40.5 ± 5.0 but the brightness decreased to $L^*36.3\pm1.7$. After a long heating process during the process from pulp to paste. Data from the measurement results on the pH after it became indigo paste the pH rose to 3.09. Anthocyanins are more stable at low pH (9). The increase in pH occurs due to a long heating process so that the solubility of carbon dioxide will decrease so that the pH will increase. An increase in the pH value indicates that the anthocyanin color fades because the red flavium cation undergoes hydration to become a colorless carbinol. This is because anthocyanins break down quickly under high pH conditions [9].

It is said that anthocyanins at concentrated concentrations are red, if ordinary concentrations are purple [13]. There are fluctuating changes in color due to factors that affect the stability of non-enzymatic anthocyanins, namely the influence of pH, temperature, and also light [4]. The lack of concentrated color produced from dragon fruit peel paste shows that the concentration

of the paste is close to normal, meaning that the water content is still quite a lot [14]. The process of evaporating the water content by roasting using an oven is only 2 hours and not continued any longer, because the expected color of dragon fruit peel paste requires a slightly purple color, to get optimization results dragon fruit peel paste when applied in cookies as a dye will produce pink.

3.2. Antioxidant Activity in Spritz Cookies

Antioxidant activity test on cookies with the addition of red dragon fruit peel paste was carried out to find out how much antioxidant activity was in these cookies. Determination of antioxidant activity first by measuring the maximum wavelength of DPPH. DPPH (Diphenylpicril hydrazil) is a free radical compound that acts as an oxidizing agent when it reacts with an antioxidant. Testing antioxidant activity with the DPPH method is a simple procedure to find out if a compound functions as an antioxidant.

Measurement of antioxidant activity was carried out by reacting the sample solution with DPPH. The sample solution containing a compound that can function as an antioxidant when reacted with DPPH, the DPPH solution which was originally purple in color changes to a yellow color, this indicates that DPPH has been reduced so that DPPH changes to DPPH-H (Diphenylpicryl hydrazine). The results of the antioxidant activity test on cookies with the addition of red dragon fruit peel paste using the DPPH method by looking at the IC_{50} (Inhibitory concentration) value. The smaller the value of IC_{50} , the higher the value of free radical scavenging activity. The IC_{50} value of spritz cookies can be observed in Table 2.

Table 1. pH value and color of red dragon fruit peel paste

Stages	pH Value	Color	Colors Value			Color Description
			L*	a*	b*	
Washing the red dragon fruit peel	5.3±0.9		37.8±6.7	54.2±10.8	-16.0± 4.3	Signal violet
Red dragon fruit peel smoothing after soaking using lemon	3.2±1.1		40.5±5.0	60.4±8.4	-14.2±9.1	Telemagenta
After drying (oven) and become a paste	3.8±1.1		36.3±1.7	56.1±2.8	10.7±4.7	Red violet

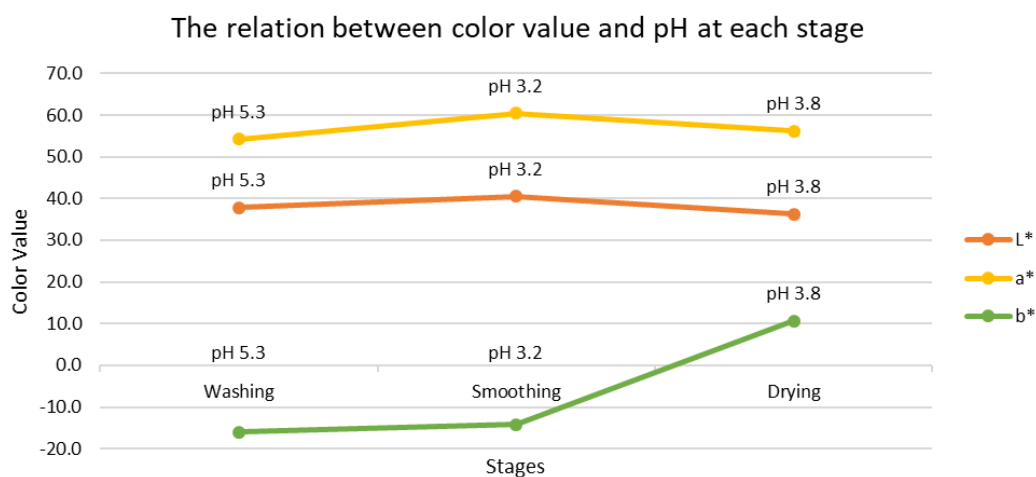
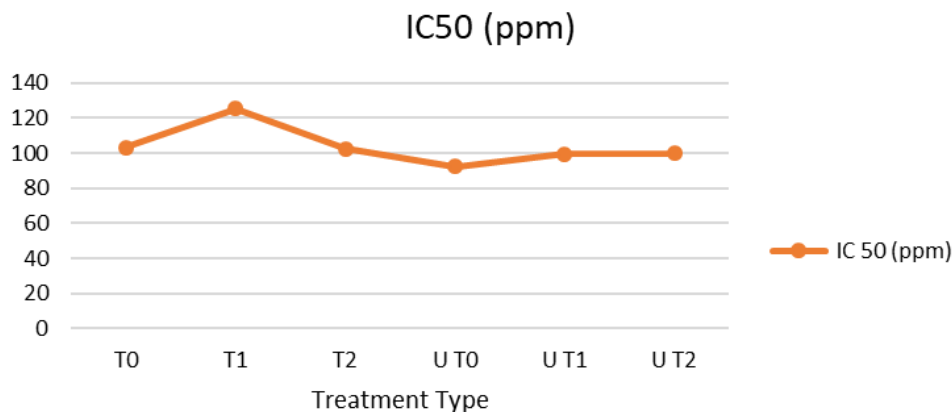


Figure 1. Graph of $L^*a^*b^*$ value with pH at each stage of making dragon fruit peel paste

Table 2. Antioxidant Activity Test Results on Spritz Cookies with the addition of red dragon fruit peel paste

Treatment Type	IC ₅₀ (ppm)
Without additional treatment (T0)	103.39 ± 0.00
addition of 2 grams of lemon juice (T1)	125.39 ± 0.19
addition of 4 grams of lemon juice (T2)	102.71 ± 0.05
Repetition T0	92.40 ± 0.00
Repetition T1	99.36 ± 0.01
Repetition T2	99.81 ± 0.00

Figure 2. Graph of Effect of Treatment on IC₅₀

Based on the antioxidant activity test using the DPPH method, the IC₅₀ results of the cookies sample were in the strong category (50-100 ppm) for repetitions T0, T1, T2 and medium category (101-150 ppm) T0, T1, T2. Based on the treatment carried out, the antioxidant activity with the addition of acid from lemon juice had a higher IC₅₀ value than without adding lemon juice. Treatment sample T1 with the addition of 2 grams of lemon juice had a higher IC₅₀ value than T2 with the addition of 4 grams of lemon juice. Red dragon fruit skin is known to contain flavonoid compounds, namely anthocyanins [15]. The anthocyanin test was also carried out for the same sample, but the results were not detected. It is possible that the anthocyanins were damaged during the processing of dragon fruit peels into paste. In addition to anthocyanins, other antioxidant metabolites found in the skin of red dragon fruit are betalains which are classified into betacyanin and betaxanthin [16]. The betacyanin content in red dragon fruit skin is relatively high [17]. Around 65.2% of dietary fiber in dragon fruit peel paste contains phenolic compounds, betacyanins and antioxidant activity [18,19].

Figure 2 shows that in the T2 treatment with the addition of 4 grams of lemon juice, there was a decrease in the IC₅₀ value indicating an increase in antioxidant activity. This is in accordance with research that one way to increase antioxidant activity is by adjusting the pH. Adjusting the pH can be done by adding various organic acids such as juice or lemon juice which contains citric acid [20]. Lemon juice tended to increase the IC₅₀ value in the T1 samples and for repeat samples T0, T1, T2 an increase in the IC₅₀ value indicated that there was a decrease in antioxidant activity. This is in line with Nizori's research [8] that the addition of citric acid did not significantly affect the antioxidant activity of the resulting red dragon fruit peel extract because antioxidants are electron-donating or reductant compounds. Antioxidants are compounds that can inhibit oxidation reactions by binding to free radicals and highly reactive molecules.

In addition to testing the antioxidant activity, anthocyanin levels were also measured for these spritz cookies, but laboratory results could not be detected. the stability of anthocyanins makes the anthocyanin content lower [8]. This is in accordance with research conducted that the Ph level of spritz cookies is included in the acidic category, 3.39.

4. Conclusion

Based on the results of this study it was concluded that the process of making red dragon fruit peel paste can increase its redness with a value of $b * 10.7 \pm 4.7$. The pH test performed on dragon fruit paste after drying in an oven was 3.39, which was under acidic conditions. This is in line with the undetectable anthocyanins in spritz cookies because acidic conditions can cause the hydrolysis of the anthocyanin glycosidic bonds which result in less stability of the anthocyanins resulting in a lower anthocyanin content. The antioxidant activity of spritz cookies can be identified, the addition of lemon juice has no significant effect on the antioxidant activity of spritz cookies because antioxidants are electron donor compounds or reductants.

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Conflict of Interest

The authors declare that there is no conflict of interest regarding the publication of this article.

Declaration of Authorship

The author(s) declare that this manuscript is our own original work, which has not been previously published, and is not currently submitted for publication elsewhere. All external sources and materials have been properly acknowledged and referenced. We confirm that the manuscript reflects our own research and analysis in its entirety.

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