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Polyphenol content and antioxidant activity of beverage from dragon fruit peel powder and soy powder

N M Rosiana*¹, A L Suryana¹, Z Olivia¹

¹Clinical Nutrition Study Program, Health Department, Politeknik Negeri Jember
Jalan Mastrip Kotak Pos 164 Jember 68101, Indonesia

*E-mail : nita.maria.r@polije.ac.id

Abstract. Excessive oxidation reactions in body cells caused by dietary changes. This causes a chain reaction that damages the body cells. Excess oxidation reactions can be prevented by antioxidants. Polyphenol groups such as flavonoids, anthocyanins, and phenolics are the most active natural antioxidants. Soya powder and dragon fruit peel powder are a source of natural antioxidants. This research aims to analyse the antioxidant compounds on the mix of dragon fruit peel powder and soy powder as a source of antioxidant beverage. The research design used one factorial that is the ratio of soy powder and dragon fruit peel powder (0%:100%; 25%:75%; 50%:50%; 75%:25%; 100%:0%). The result showed that the antioxidant compound from this mixture was flavonoid, anthocyanin, and phenol. The range pH of the beverage are 5,25-6,83, range of water content are 4,81-6,29%, range of phenol content are 250,33-908,00 mg/100g, range of flavonoid are 250,33-908,00 mg/100g, range of anthocyanin are 8,00-387,83 mg/100g and the IC50 of the beverage are 17,61-18,60.

1. Introduction

The lifestyle that mostly changes is a diet that tends to be unhealthy so the body is exposed to harmful substances including free radicals. It can lead to degenerative diseases. The onset of the disease is due to an excessive oxidation reaction in the body's cells. In general, oxidation is a process to change chemical substances that produce reactive free radicals. It causes a chain reaction that can damage cells resulting in various diseases included heart disease, liver disease, cancer, neurodegenerative diseases, and aging ¹.

The antioxidant can prevent oxidation reactions. Polyphenol groups such as phenolic acids, flavonoids, anthocyanins, and phenolics are the most active natural antioxidant groups. The antioxidant activity act as reducing agents or hydrogen/electron donors that related to the redox properties. As a result, antioxidants can bind radical chain, free radicals and metals as well ². The antioxidant compounds mentioned above are found in dragon fruit and soybeans ³. Phenol content of white dragon fruit peels reaches 48.15mg GAE / 100g with antioxidant activity reaching 97.42%. Another study showed that the total phenol in dragon fruit peel powder was 0.1 g GAE / 100g, total flavonoids 0.31 g QE / 100 g with antioxidant activity measured by the DPPH Trolox method of 0.16 mM / 100 g³. 1 mg/ml of red dragon fruit peel can prevent 83.48 ± 1.02% free radicals ⁴. Meanwhile, soybean flour extract has an antioxidant activity of 155mg AEAC / 100 g. Vitamin E (α-tocopherol) and phenolic (isoflavones) are phytochemical compounds in soybeans that have biological activity ⁵. However, the weakness of soybeans is an unpleasant taste. Therefore we need a red dragon fruit substitution.



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30% substitution of red dragon fruit affects on pH, antioxidant activity, taste, colour, preferences ⁶. The addition of dragon fruit peel extract take effect on the levels of pH, antioxidants, protein, taste, and color of soy milk ⁷. There are no studies related to the bioactive compounds and antioxidant activity of drinks from dragon fruit peel powder and soy. Therefore, this research needs to be done to test the proper formulation as a novelty.

2. Materials and methods

2.1. Materials

Soy powder used Melilea soy powder. Dragon fruit harvested from Rembangan plantation at Rembangan, Jember. Dragon fruit has maturity and similar age, same on size, colour, and has no defects. The fruits were delivered immediately to the laboratory. Dragon fruit were cut, peel, cut again into small piece, dried, crush it into powder and sieve with 80 mesh sieve. Dragon fruit peel powder and soy powder were mixed according to the treatments.

2.2. Analysis

The samples were analysed for pH, water content, phenolic, flavonoid, anthocyanin, and antioxidant activity. All analyses were performed in duplicate.

2.3. Statistics analysis

All experiment used complete random design. The results were showed as mean values with standard deviations of triplicate. Statistical analysis used ANOVA with significance level $\alpha = 0,05$. If there was any significant difference, continued with post hoc test : Duncan test.

3. Result and discussion

Antioxidants are essential for humans since they have a role in signalling mechanisms and complex metabolic. They protect human cells by reducing free radicals, which is a chemical structure that has at least one unpaired electron. This free radical has highly reactive state that cause damage in cellular and genetic. Phenol is one of the active compounds in plants that has antioxidant activity. Table 1 below shows the types of phenol in the beverages made from the dragon fruit peel and soybean powder.

Table 1. Phytochemicals characteristics in the beverages from the dragon fruit peel and soybean powder

Parameter	Ratio of soya powder : dragon fruit peel powder (%)				
	0 : 100	25 : 75	50 : 50	75 : 25	100 : 0
pH	5,25±0,08 ^a	5,32±0,02 ^a	5,56±0,06 ^b	5,98±0,07 ^c	6,83±0,12 ^d
Water content (%)	6,29±0,28 ^b	6,19±2,93 ^b	4,81±0,94 ^a	4,99±0,02 ^a	5,02±0,26 ^a
Phenol (mg/100g)	908,00±4,00 ^c	745,33±3,79 ^d	571,67±2,52 ^c	412,33±2,89 ^b	250,33±4,04 ^a
Flavonoids (mg/100g)	656,33±4,51 ^c	611,67±2,89 ^d	562,00±4,00 ^c	520,33±4,5 ^b	476,67±4,04 ^a
Anthocyanin (mg/100g)	387,833±5,30 ^c	294,33±2,52 ^d	194,67±2,08 ^c	105,67±1,53 ^b	8,00±1,00 ^a
Antioxidant activity (IC ₅₀)	17,67±0,69	18,24±1,49	18,03±0,74	17,61±0,73	18,60±1,35

The same lowercase notation in the same line showed no significant difference at the 95% (Duncan test, $p < 0,05$)

The types of phenols in the mixture of this powder are flavonoids and anthocyanin. Table 1 shows that dragon fruit peel powder gives lower pH, higher water content, higher phenols, higher flavonoids, and higher anthocyanin but has no difference in antioxidant activity. The range of pH are 5,25-6,83. Higher anthocyanin in beverage gives in lower pH. At low pH, anthocyanins are more stable. Anthocyanins become less unchanged when exposed to heat, leading to discolour and becomes

browning. pH gives big effect to the colour of anthocyanins, the colours of anthocyanins are blue in alkaline pH, violet or purple in neutral solutions and red in acid solutions⁸. The range of water content of beverage is from 5,02-6,29%. Higher dragon fruit peel powder gives higher water content. Fresh dragon fruit peel has high water content. It has 91,19% of water content⁹.

Antioxidants for use in food must be safe, cheap, easy to incorporate stable and capable in holding on during processing, no odor, taste or colour of their own, effective at low concentrations, and have a good solubility¹⁰. Phenols are one of the antioxidant compounds that capable to use in food system because it stable in thermal processing. This is proven by phenol content on beverage that is from 250-908 mg/100g. The other research show that total phenolic content in dragon fruit peel is 0,1 mg/100 g³ equivalent with 1000 mg/100 g. So there are no many differences of total phenolic content of fresh dragon fruit peel and dry dragon fruit peel. The thermal process increase the total phenolic of oat bran by 25,84% and wheat bran by 22,49%,. After the thermal processing, the total phenolic content showed a significant percentage improve¹¹.

Flavonoids are known as a good potential source of antioxidants. Total flavonoids content in the mixture of these two powders varied from 476,67-656,33 mg/100 g. Dragon fruit peel gives higher flavonoids content than soybean. In others research show that dragon fruit peel has 0,31 g/100 g of flavonoids equivalent with 310 mg/100 g². It is lower than flavonoids content in dragon fruit peel powder in this research. Generally, the capability of flavonoids to be effective antioxidants hangs on three factors: (i) The composition of carbonyl and hydroxyls group around the molecule induces the strong of potential of metal-chelating, (ii) the existence of hydrogen-/electron-donating substituents able to lower free radicals, and (iii) the capability of the flavonoid to remove the unpaired electron result to the structure of a stable phenoxy radical. Both known ways of the antioxidant performance, i.e., inhibit mechanism and chain-breaking mechanism, are proved to be responsible for the high activity of flavonoids¹².

Dragon fruit peel contains anthocyanin which can be used as a potential natural colorant and source of natural antioxidants. The anthocyanins content in the mixture of these two powders varied from 8,00-387,833 mg/100 g. Dragon fruit peel contains higher anthocyanin than soybean shown by the red color of the peel. This dragon fruit peel has high anthocyanin than other dragon fruit peel from the other place. The dragon fruit peel from Mexico has only 45,15 mg/100 g anthocyanin¹³. While the anthocyanin content from dragon fruit peel obtained from Solo Regency up to 104,58 mg/kg¹⁴. These variations may be in consequence of the solvents used or to the methodology used to extract the compound. Red dragon fruits peel extract contains types of anthocyanin that are 3,5 O diglucoside, pelargonidin 3,5 O-di glucoside and cyanidin 3 O-glucoside¹³. The potential health benefits of anthocyanins are antimicrobial, antioxidative effects, anti-obesity, neuroprotection, antiangiogenetic, prevention of CVD, anticancer, antidiabetic, and improved visual health¹⁵.

The higher phenol content, flavonoids content, and anthocyanin content don't give higher antioxidant activity on the mixture of these two powder. The range of antioxidant activity (IC₅₀) from 17,61-18,60. Although soybean have low in phenol content, flavonoids content, and anthocyanin content, but there are has antioxidant activity same with the dragon fruit peel powder. The antioxidant activity at this mixture powder is lower than antioxidant activity at catechin pure and gallic acid pure. Catechin pure have 13,53 of antioxidant activity (IC₅₀), while gallic acid pure have 10,30 of antioxidant activity (IC₅₀).

4. Conclusion

The mixture powder of dragon fruit peel and soybean result in higher phenol content, flavonoids content, and anthocyanin content at sample with high dragon fruit peel powder. Although soybean have low in phenol content, flavonoids content, and anthocyanin content, but there are has antioxidant activity same with the dragon fruit peel powder. This mixture powder have good potential to be source of antioxidant beverage.

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