The Effect Of Adsorbtion And Drying Of Natural Color Of Red Spinach (*Amaranthus tricolor)* On The Manufacturing Of Soybean Flour On Antioxidant Value

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ABSTRACT

Increasing the content of food and beverage products cannot be separated from food innovations that can increase the added value of becoming superfood products. One of them is soybeans, which can be processed into products in the form of vegetable flour that comply with SNI standards. Superfood is for various products, whether in the form of processed food, drinks or additional ingredients in making cakes, bread, noodles and others. A new innovation by utilizing natural dye extracts from plants in the environment which contain many *flavonoid* compounds which are very beneficial for health for both toddlers and adults. Soybeans are a source of protein, fat, vitamins and minerals such as K, Fe, Zn and P. The protein content ranges from 20% - 25%, while in soybeans it reaches 40%, which, compared to other legume plants, is the protein in soybeans. the tallest. The protein content in processed products with soybean ingredients varies. For example, in soy flour the protein content reaches 50%, in soy protein concentrate it reaches 70%, and in soy protein isolate it reaches 90% [9]. To increase the product content of White Soybeans, a natural adsorption process was carried out using red spinach extract (*Amaratunthus Tricolor) with* a variable treatment of soaking at room temperature, soaking at a temperature of 4.4 ^{0}C and heating for 60 minutes at a temperature of 70 ^{0}C. The rack was dried at a temperature of 70oC for 5 hours. The length of time and temperature when adding the extract to soybean flour affects the color and antioxidant content produced. Soybean flour A5 and A1 respectively have an antioxidant content of 27.89% and 16.37%, sample B5 has Antioxidant content of 18.41% and sample C5 as much as 18.76%, while soybean flour that has not been treated has Antioxidant 16.12%.

Keywords: White soybeans, Vegetable Flour, Adsorption, Drying, Red spinach,

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1. Introduction

Source can be processed into various forms of processed products, such as tempeh, tofu, soy sauce and tofu, soy oil, soy flour, soy milk and so on. Soybeans are a source of protein, fat, vitamins and minerals such as K, Fe, Zn and P. The protein content from 20% - 25%, while in soybeans it reaches 40%, which, compared to other legume plants, is the protein in soybeans. the tallest. The protein content in processed products with soybean ingredients varies. For example, in soy flour the protein content reaches 50%, in soy protein concentrate it reaches 70%, and in soy protein isolate it reaches 90% [9]. Soybeans that can be made into semi-finished products are soybean flour. Soy flour has many uses. Soybean flour can be used as composite flour as well as an ingredient that can enrich nutrition in food in the form of high protein**.** Red Spinach (*Amaranthus trocolor).* Spinach is a highly nutritious vegetable because it contains protein, Vitamins A, B and C and contains mineral salts needed by the body and anthocyanin compounds which are useful in curing anemia. The red color of red spinach indicates the presence of pigment content which can be used as a natural coloring agent [5]. Adding color to the manufacture of soy flour with red spinach extract (*Amarantuntrus tricolor*) as a natural coloring. Apart from adding color, red spinach coloring can also increase the antioxidant levels in soybean flour, making it a superfood product. To obtain naturally colored soybean flour from red spinach, it is necessary to carry out an adsophic process, drying under conditions that do not damage the nutritional content and antioxidant compounds in red spinach.

Figure 1. soybeans and red spinach

1.1. Basically Adsorption

Process is divided into 2 processes, namely:

1. Physical Adsorption
2. Chemical Adsorption

Factors Affecting Adsorption

Tabel 1.1 Comparison of Adsorption Properties

Physical Adsorption	Chemical Adsorption

Molecules are bound to the adsorbent by Vander Walls forces	Molecules are bound to the adsorbent by chemical bonds
Has a reaction enthalpy -4 to -40 kJ/mol Has a reaction enthalpy	Has a reaction enthalpy -4 to -40 kJ/mol Has a reaction enthalpy of -40 to 800 kJ/mol
Adsorpsi hanya terjadi padasuhu dibawah titikdidih adsorbat	Adsorpsi dapat terjadi padasuhu tinggi
Adsorption only occurs at temperatures below the boiling point adsorbate	Adsorption can occur at high temperatures
Does not involve activation energy certain Involves activation energy certain	certain Involves activation energy certain
Non-specific Very specific	specific Very specific

1.2. Factors Affecting Adsorption

Factors influence the process adsorbate that can be adsorbed, including:

1. Adsorbent Characteristics
   The adsorbent characteristics that influence adsorbent, adsorption rate, while larger greater the number of adsorbate particles absorbed.
2. Agitation
   The agitation referred to is a turbulent state or what could be called turbulent
3. Adsorbent Pore Size
   Pore size is an important factor in the adsorption process, because the adsorbent particles must enter the adsorbent pores. The adsorption process will run smoothly if the pore size of the adsorbent is large enough to allow the adsorbate to enter the adsorbent pores. Most wastewater contains varying sizes of adsorbate particles.
4. pH
   pH has a big influence on the level of the adsorption process. This is because hydrogen ions absorb strongly; besides that, pH can also affect ionization.
5. Adsorbate Solubility
   The adsorption process occurs when the adsorbate is separated from the solution and sticks to the surface of the adsorbent. Dissolved adsorbate particles have a strong affinity.
6. Contact Time
7. Temperature
   Contact time affects the amount of adsorbate absorbed.

1.3. Drying

Drying is the process of separating relatively small amounts of water from materials using heat energy. The result of the drying process is a dry material that has a water content equivalent to the normal air balance water content or equivalent to a water activity value that is safe from microbiological, enzymatic, and chemical damage. Drying is a food processing process that has long been known. The aim of the drying process is to reduce the water content of the material so that it becomes more durable, reduce the volume of the material to make it easier, and save costs on transportation, packaging, and storage. However, there are losses incurred during drying, namely changes in the physical and chemical properties of the material and a decrease in the quality of the material [2].

This type of dryer consists of several components as follows:

a. The drying tank has holes in the floor and separates the drying tank from the room where the hot air is distributed (plenum chamber).
b. The fan is used to push drying air from the source to the plenum chamber and past the pile of material above it.
c. The heating unit is used to heat the drying air so that the relative humidity of the drying air decreases while the temperature rises.

The advantages of this type of dryer are as follows:

a. Faster drying rate
b. The possibility of over drying is smaller
c. The low pressure of the drying air can pass through the layers of the material being dried.

1.4. Antioxidant

Antioxidants are substances that can prevent or slow down cell damage caused by free radicals. Sources of antioxidants can be divided into two categories: natural antioxidants and synthetic antioxidants. Natural antioxidants are antioxidant compounds that occur naturally in the body as a normal body defense mechanism or come from intake outside the body.

In general, there are three types of antioxidants that can be found in nature, namely

1. Enzymes are a type of antioxidant composed of protein and various minerals. When in the body, enzymes synthesize. And for enzymes to function optimally, they need partners in the form of minerals such as iron, copper, selenium, magnesium and zinc. Another thing that is no less important to know is that the quality of the enzymes obtained by the body also really depends on the quality of the food source of protein that we consume.
2. Vitamins cannot be produced by the body itself, so you need to get them from outside, namely through food or supplements.
3. Phytochemicals Phytochemicals are a type of antioxidant used by plants to protect

themselves from damage caused by free radicals. As a result of various research studies, we can enjoy this protection when consuming plant-based food sources. According to [4], the level of antioxidant power in the DPPH method can be seen in Table 1.2.

Table 1.2. Levels of Antioxidant Activity in the DPPH Method

Value	**Tiers**
IC50 < 50 µg/mL	Very strong
IC50 50-100 µg/mL	strong
IC50 101-150 µg/mL	moderate
IC50 > 150 µg/mL	Weak

DPPH has the advantage that the analytical method is simple, fast, easy, can be used on small samples, is sensitive to samples with small concentrations, and the DPPH radical compound used is relatively stable compared to other methods. DPPH also has the disadvantage that it can only be dissolved in organic solvents, so it is rather difficult to analyze hydrophilic compounds [3].

2. Material and Method

In this research, food coloring extract was carried out using the maceration method. Then the resulting coloring extract will be used as a variable in the innovation of making soy flour. This research was conducted to find out which treatment is appropriate to produce good color and increase antioxidant levels in soy flour so that it meets soy flour standards according to SNI 3751:2009 standards [6].

Specifications for Quality Requirements for Soybean Flour SNI 01-3751-2009.

Test Type	Unit Condition	Condition
Condition:		
a. Form	-	Powder/Dust
b. Scent	-	Normal (Free from foreign odor)
c. Colour	-	Normal
Subtlety, slip trought the sieve212 µm (mesh NO. 70) (b/b)	-	Min. 99

PH	-	6,5 – 7,0
Protein Level	%	Min 2,0
Fat Level	%	Min 1,0
Water Content	%	Maks 14,5
Ash Content	%	Maks 1,5

Table of Variation in Composition of soaking treatment using red shallot extract

Treatment	Soaking time (hour)	Extract color (ml)	soybean weight (gr)	drying time (hour)	drying temperature (°C)
	3	**100**	**100**	**5**	**70**
	6	100	100	5	70
	9	100	100	5	70
Room temperature	12	100	100	5	70
(A)	**15**	**100**	**100**	**5**	**70**
	3	100	100	5	70
	6	100	100	5	70
Temperature	9	100	100	5	70
<4,4°C	12	100	100	5	70
(B)	**15**	**100**	**100**	**5**	**70**
Warm up during 1 hour	60	100	100	5	70
	65	100	100	5	70
(C)	70	100	100	5	70
	75	100	100	5	70
	80	**100**	**100**	**5**	**70**

2.1. Observation

This research was conducted to find out which treatment is appropriate to produce good color and increase antioxidant levels in soybean flour so that it meets the standards for soybean flour according to SNI 3651:2009 standards.

1. Ash Content Analysis (AOAC 2005) [1]
2. Water Content Analysis (AOAC 2005) [1]
3. Antioxidant Activity Analysis
4. Anthocyanin Analysis

3. Research and Procedure

3.1. Making color extract

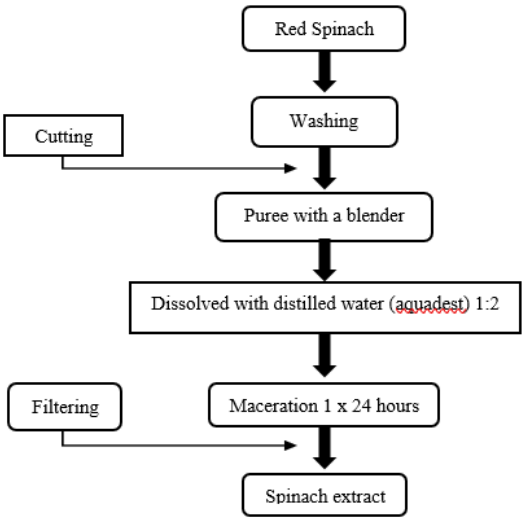


Fig. 2. Procedure Making extract color

3.2. Making Soybean Flour Manufacturing Stage

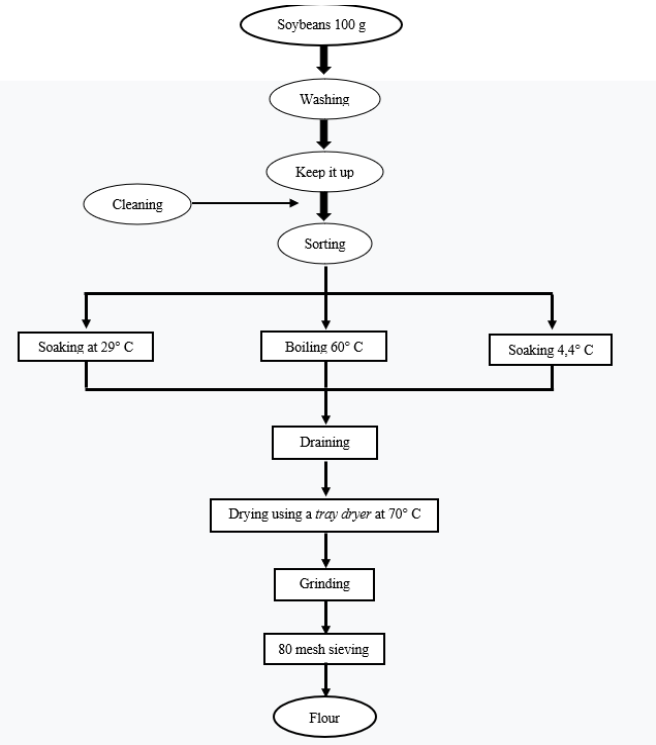


Fig. 3. Stage making Flour soybean

3.3. Stages of the process of making soy flour with red spinach color extract and colored flour products into ice cream sticks

Soybean, extract, immersion at 27^0 C drained

Drying results, Colored soy flour, Stick ice cream products red spinach extract

3.4. Water content

Water content is a test method used to measure the water content a material

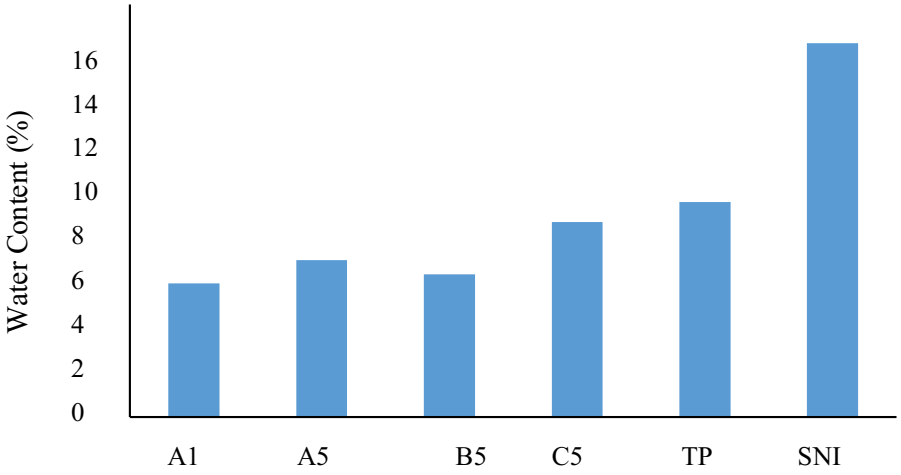


Figure 4. Graph of the percentage of moisture content of soybean flour

Information:

A1 = Soy flour 3 hours at room temperature, A5 = Soy flour 15 hours at room temperature, B5 = Soy flour 80°C heating C5 = Soy flour 15 hours at temperature >4.4°C, TP = No treatment.

The TP sample contains more water, namely 8.35%, then C5 is 7.58% and the lowest is B5 at 5.54%. The water content of all samples is in accordance with SNI 3751:2009 standards, namely a maximum of 14,5%.

3.5. Ash Content Analysis

Water content is a test method used to measure the ash content a material

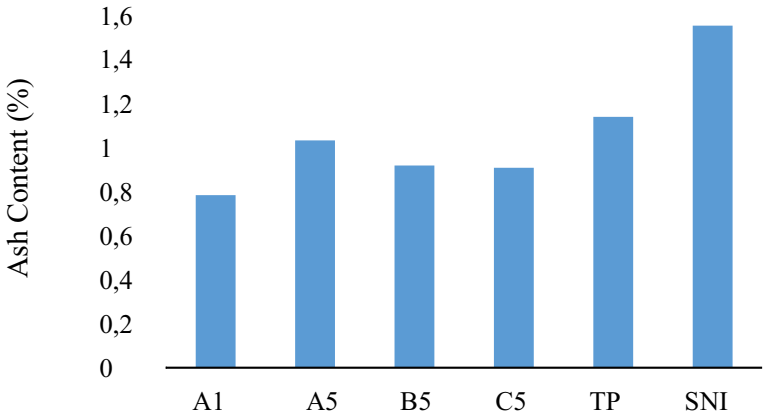


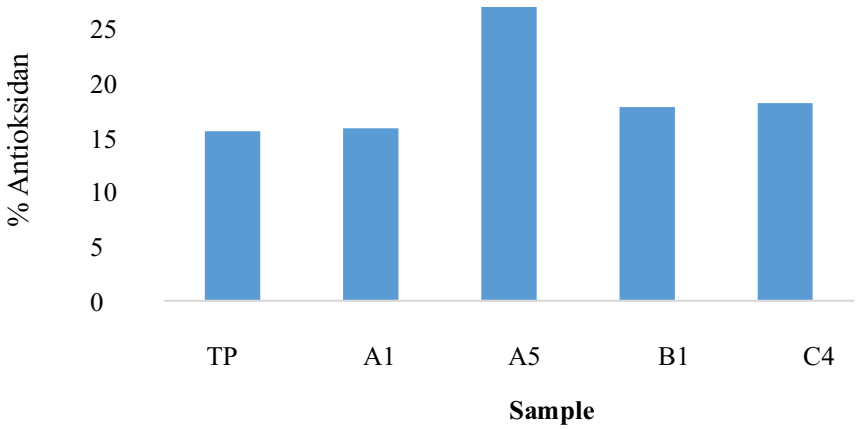
Figure 5 Graph of the percentage of Ash Content of Soybean Flour

Information:
A1 = Soy flour 3 hours at room temperature, A5 = Soy flour 15 hours at room temperature, B5 = Soy flour 80℃ heating C5 = Soy flour 15 hours at temperature >4.4℃, TP = No treatment.

The TP sample contained more ash, namely 1.1%, then A5 at 0.995% and the lowest was at A1 at 0.755%. The water content of all samples was in accordance with the SNI 3751:2009 standard, namely a maximum of 1.5%.

3.6. Antioxidants

The antioxidant test on soybean tempeh TP, A1, A5, B5 and C5 aims to determine how much antioxidant activity it contains. The results of the antioxidant test can be seen in the following image:



Information
A1 = Soy flour 3 hours at room temperature, A5 = Soy flour 15 hours at room temperature, B5 = Soy flour 80°C heating C5 = Soy flour 15 hours at temperature >4.4°C, TP = No treatment.

The antioxidant test on soybean tempeh TP, A1, A5, B5 and C5 aims to determine how much antioxidant activity it contains. This antioxidant activity test uses the DPPH method by monitoring absorbance at a wavelength of 517 nm using a Uv-Vis spectrophotometer.

3.7. Anthocyanin

Anthocyanins are bioactive components of the flavonoid group which can provide red, purple, blue colors to flowers, tubers, fruit and vegetables [8].

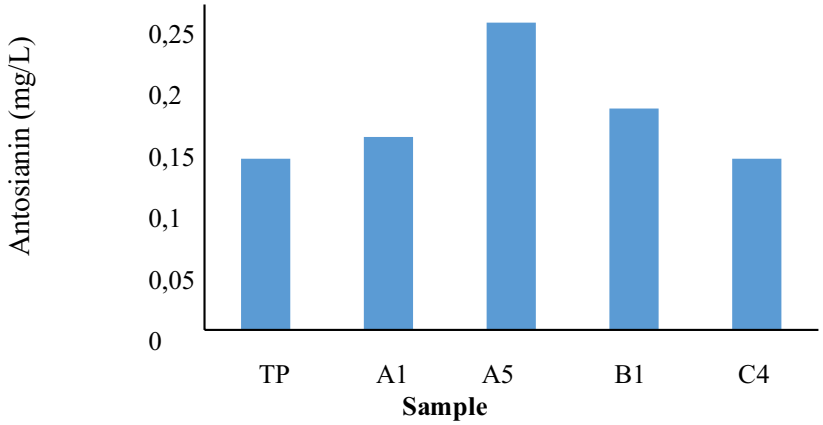


Figure 6 Anthocyanin Activity Graph

Information:
A1 = Soy flour 3 hours at room temperature, A5 = Soy flour 15 hours at room temperature, B5 = Soy flour 80°C heating, C5 = Soy flour 15 hours at temperature >4.4°C, TP = No treatment.

The percentage of anthocyanin activity in soybean tempeh is found in sample A5, namely 0.23597 ppm, and the smallest is found in sample Tp, namely 0.13167 ppm.The amount of anthocyanin color pigment not only plays a role in providing color, but also has an effect in increasing the amount of antioxidant content in it. This happens because the anthocyanin contained in Red Spinach extract belongs to the flavonoid group, which is an antioxidant [7].

4. Conclusion

The difference in time and temperature when adding extracts to soybean flour also affects the color and antioxidant content produced. A5 and A1 soybean flour respectively have an antioxidant content of 27.89% and 16.37%, sample B5 has as much antioxidant content as 18.41% and the C5 sample was 18.76%, while untreated soybean flour had an antioxidant content of 16.2%.Soy flour with additional coloring is in accordance with SNI 3751:2009 standards in terms of water content and ash content, which does not exceed the quality requirements for soy flour.The best soy flour with red spinach extract in terms of the quantity of color added is soy flour with sample A5. The sample produces color**.**

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