Production and characteristic of natural coloring and flavoring preparations from pandan leaves (*Pandanus amaryllifolius*)

N A Arshimny¹,² and K Syamsu²
¹ Bachelor of Agroindustrial Technology
²Agroindustrial Technology Department, IPB University, Bogor, Indonesia
E-mail: nabila.arshimny@apps.ipb.ac.id, khaswars@yahoo.com

Abstract. *Pandanus amaryllifolius* or pandan is widely used as a source of natural seasoning such as food coloring and flavoring. The objective of this research is to study maltodextrin concentration’s effect on physical and chemical properties of pandan preparations, to substitute the use of synthetic coloring and flavoring in its application to pandan cake. Pandan leaves are extracted by distilled water with destruction method using a blender, then added with maltodextrin (w/v) as filler, as well as binder and stabilizer. The extract is converted to powder using vacuum dryer at ±60 °C, then sifted with an 80 mesh sieve. The total yield test showed that 35% maltodextrin (w/v) addition had the largest amount of yield. While in the organoleptic test, the most liked color of pandan preparations was 20% maltodextrin (w/v) addition. In its application to pandan cake, the most liked color and flavor was 35% maltodextrin (w/v) addition. The comparison with synthetic coloring and flavoring showed that color has a significant effect while flavor does not. From all parameters, the best treatment of pandan preparations was the addition of 35% maltodextrin (w/v). It can be concluded that pandan preparations in powder form can be used as a substitute of synthetic coloring and flavoring.

1. Introduction
Food coloring is important for producing colors in foods aimed to increase attractiveness to consumers [1]. Food coloring can be produced from plants, animals, and synthetic chemicals. In general, natural food coloring has some weaknesses, that are the color is not homogeneous, less stable, and the price is relatively expensive. While synthetic food coloring has the advantage of being relatively more homogeneous and stable. In its use in food, synthetic food coloring can cause a health risk if it is consumed in excessive amounts. Therefore, the provisions are regulated by Food and Drug Supervisory Agency (BPOM) in the Regulation of the Head of Republic Indonesia Drug and Food Supervisory Agency No. 37 in year 2013 about "Limits on the Use of Food Coloring Foodstuffs Boundaries". In the making of synthetic food coloring sulfuric acid or nitric acid is usually used which is often contaminated by arsenic or other heavy metals that contain toxins [2]. Therefore, the use of natural food coloring continues to increase along with the trend of "back to nature" which encourages the use of materials that are safe and environmentally friendly [3].

Pandan (*Pandanus amaryllifolius*) is one of the plants which are widely used as a source of natural seasoning in various parts of Asia including India, Thailand, Indonesia, and Malaysia [4]. Paryanto and Mastuti (2011) conducted research on the manufacture of natural food coloring from pandan leaves and kesumba seeds as coloring agents [2]. Their research did not use pandan leaves as a flavoring agent. In
this research, pandan leaves are not only used as a coloring agent, but also used as a flavoring agent. Tama et al. (2014) [5] conducted research on making natural coloring powder from suji leaves. Suji leaves only have coloring agent so they cannot be used as a flavoring agent. While pandan leaves have coloring and flavoring substance that can be used as well as coloring and flavoring agent. In addition, the previous research used maltodextrin as a filler and MgCO$_3$ as a stabilizer. In this research only maltodextrin used as a filler as well as a stabilizer because maltodextrin has a strong binding power. The use of maltodextrin as a filler as well as a stabilizer makes the expenses more effective.

Maltodextrin is best used as a filler to increase volume in the food system. One of the uses of maltodextrin is as a dry powder mixture because it has several properties, namely rapid solubility dispersion process, low hygroscopic properties, high solubility, low browning properties, able to form films, able to form a body, able to inhibit crystallization, and has a strong connective power. DE value (the degree of breakdown of starch into glucose) of maltodextrin ranges from 3 - 20 [6]. Therefore, it is necessary to determine the right concentration of maltodextrin to produce safe and healthy natural coloring and flavoring preparations from pandan leaves that have the best physical, chemical, and organoleptic quality. This study aims to determine the effect of maltodextrin concentration on the physical and chemical properties of pandan preparations, determine the concentration of maltodextrin as the best coloring and flavoring stabilizer in pandan preparations and determine the best concentration of maltodextrin that can substitute the use of synthetic coloring and flavoring in its application to pandan cake.

2. Materials and methods

2.1. Materials

Material used are old and fresh pandan leaves (age around 2-3 months), aquadest, maltodextrin, and acetone 80%.

2.2. Tools

Tools used for producing pandan preparations are digital scales (ACIS), blender (HR 2115 Philips), mori cloth, beaker glass, stopwatch, stirring glass rod, magnetic stirrer (SCILLOGEX MS7-H550-Pro), aluminum foil, vacuum dryer (OSK 6513),80 mesh siever, bottle glass.

Tools used for analysis are digital scales (ACIS), oven (BINDER), aluminum cup, stainless steel tweezers, desiccators, petri dish, colorimeter (NR60CP), test tube, test tube rack, drop pipette, refractometer (MASTER-500), paper filter Whatman No. 41 and 42, vacuum filter (MEDI-PUMP 1132E), sample bottle, spatula, measuring cup, volumetric pipette 10 ml, bulb, glass funnel, and spectrophotometer (Hach).

2.3. Preparing materials

Pandan leaves and maltodextrin were purchased from traditional market. The criteria of pandan leaves used are old and fresh one. Distilled water used was obtained from the Department of Biology, Bogor Agricultural University while the acetone was obtained from the Department of Agroindustrial Technology, Bogor Agricultural University.

2.4. Pandan leaves extraction

The method used is an extraction method with the use of destruction method using a blender with the distilled water solvent. First, the old and fresh pandan leaves are sorted. Pandan leaves are cleaned and washed with water until clean, then cut into small pieces using scissors or knives. Small cutting objectives are necessary for making the process of smoothing and faster, and the content of chlorophyll in pandan leaves are easy to obtain [7]. Pandan leaves are weighed and added with distilled water, with a comparison of pandan leaves: distilled water at the ratio of 1:3 (w/v) [5]. Next, pandan leaves and aquadest are blended with a blender until well blended. Filtrate are separated from the pulp using mori
cloth. Before the process of vacuum drying, filtrate was added by maltodextrin with a concentration of 5%, 10%, 15%, 20%, 25%, 30% and 35% (w/v) [5].

2.5. Vacuum drying
Pandan filtrate that has been added by maltodextrin then converted to solid (powder) using vacuum dryer at temperature of ± 60 °C. Vacuum dryer used in this study has the ability to turn 500 ml of the filtrate into powder within 45 minutes. Furthermore, pandan powder is milled and sifted with 80 mesh sieve. The powder that has been sifted then referred to as pandan preparations.

2.6. Testing of physical, chemical, and organoleptic of pandan preparations
Pandan preparations are analyzed and selected for the best treatment. The tests used are yield, color intensity, moisture content, solubility in water, total dissolved solids, chlorophyll stability, and organoleptic [5][8]. The parameters are used to determine the concentration of maltodextrin which gives the best physical, chemical, and organoleptic properties in pandan preparations.

2.7. Data analysis
Data obtained from the test result of yield, moisture content, color intensity, water solubility, total dissolved solids, chlorophyll stability, and organoleptic are presented in graphical form. The calculation of organoleptic test is done by normality test (Shapiro-Wilk) and followed by ANOVA test and advanced test using Duncan method. Of all the treatments, it is determined which concentration of maltodextrin gives the best physical, chemical, and organoleptic properties in pandan preparation and determine the best concentration of maltodextrin that can substitute the use of synthetic coloring and flavoring in its application to pandan cake. The main parameters are yield and organoleptic. Data are retrieved three times in one loop (triple) and repeated twice. It is shown to generate accuracy in research. Furthermore, data analysis uses comparisons with the study of literature on national and international journals.

3. Results and discussions

3.1. Yield
Graph of the relationship between the addition of maltodextrin and yield can be seen in Figure 1. Results show that the increasing use of maltodextrin into pandan preparations produces higher yield. This is caused by the use of maltodextrin which has function to enlarge the volume and increase the material total solids, so it will get the higher yield [9]. The results of various analyses show that the differences of maltodextrin concentration have a real impact on the yield, and each treatment is significantly different with each other. The highest yield (98.75%) was obtained from the treatment of 35% maltodextrin (w/v) addition.
3.2. Color intensity

The graph shows the effect of maltodextrin to the color intensity of the brightness level (Figure 2) and the green level (Figure 3) on pandan preparations. The ‘L’ notation states the reflected light that results in a chromatic color of white, gray, and black. The higher the ‘L’ value is, then the higher the brightness level of pandan preparations. The ‘a’ notation shows the color of the achromatic mixture between red-green color with a value +‘a’ (positive) from 0 to 80 for the red color with a value −‘a’ (negative) from 0 to (−80) for the green color. The more negative value ‘a’ is, the higher the greenness level of pandan preparations [10]. The color intensity graph at the brightness level indicates the brightness level increases along with the addition of maltodextrin. While, the color intensity chart at the greenness level indicates the greenness level decreases along with the increasing of the use of maltodextrin into pandan preparations. Maltodextrin has a color that tends to be white so when it is mixed with pandan leaves that have been extracted in dark green color, it will give a lighter color [9]. Therefore, the more maltodextrin added the higher the brightness level, and the lower the greenness level. Based on the results of variant analysis, the differences of maltodextrin concentrations affect the level of brightness and greenness. A 5% maltodextrin (w/v) sample has the lowest brightness, while 35% Maltodextrin (w/v) sample has the lowest greenness level.

![Figure 2. The effect of maltodextrin concentration on the brightness level.](image1)

![Figure 3. The effect of maltodextrin concentration on the greenness level.](image2)
3.3. Moisture content

Moisture Content increases along with the increasing of maltodextrin concentration addition to pandan preparations. Maltodextrin has hydrophilic properties on the surface of pandan preparations, so that the more maltodextrin addition the more ability of the product to bind the water [8]. The effect of maltodextrin addition to the water content of pandan preparations can be seen in Figure 4. The results of variance analysis show that different concentrations of maltodextrin affect the water content. The highest water content is obtained from the treatment of 35% maltodextrin (w/v) addition, namely 4.33%.

![Figure 4. The effect of maltodextrin concentration on the water content.](image)

3.4. Total dissolved solids

The component of dissolved solids consists of total sugar, pigments, organic acids, and proteins. In this study, the total dissolved solids referred to maltodextrin [11]. The results show that the higher maltodextrin concentration addition to pandan preparations, the higher total dissolved solids obtained (Figure 5). This is due to the maltodextrin function, one of which is to increase the total amount of dissolved solids [9]. Maltodextrin which functions as a filler will increase the total amount of dissolved solids in pandan preparations. The results of variance analysis show that the differences in the concentration of maltodextrin has no significant effect on the total dissolved solids.

![Figure 5. The effect of maltodextrin concentration on the total dissolved solid.](image)
3.5. Water solubility

The increasing of maltodextrin concentrations is directly proportional to the percentage of water solubility in pandan preparations (Figure 6). This can be explained because when pandan preparations are dissolved, the hydroxyl groups contained in maltodextrin will interact with water. Therefore, the more maltodextrin added, the more hydroxyl groups interact with water, so that the solubility of pandan preparations will automatically increase [12]. Based on the variance analysis, the differences in maltodextrin concentration significantly affect water solubility. Sample of 5% maltodextrin (w/v) addition has the lowest solubility of 89.37%.

![Figure 6. The effect of maltodextrin concentration on the water solubility.](image)

3.6. Chlorophyll stability under various conditions

The green color contained in pandan leaves comes from chlorophyll [13]. The stability of chlorophyll is tested to determine the stability of chlorophyll content of pandan preparations in a certain time periods and under certain storage conditions. In this study chlorophyll stability test was carried out within 4 weeks starting from the 0th week to the 4th week. The storage conditions of pandan preparations were carried out in two parameters, namely temperature and lighting. Storage temperature was set at 10°C, 30°C, 40°C, and 50°C, while the lighting parameters were carried out in dark and light conditions. For dark conditions, the products were stored in the locker while for light conditions, products were stored under the light. The results show that the longer the storage time take, the more total chlorophyll reduced in pandan preparations. Over the six storage conditions, the best chlorophyll stability was obtained by the storage condition at 10°C. This can be seen in Table 1 which shows the rate of decrease in chlorophyll stability at a temperature of 10°C, which is lower than that in other storage conditions. Chlorophyll substance has properties that is sensitive to light, heat, oxygen, and chemical degradation [14], therefore the storage condition at 10°C is an effective way of handling pandan preparations.

| Table 1. The rate of decrease in chlorophyll stability (slope) under various conditions. |
|-----------------------------------------------|-----------|-----------|-----------|-----------|-----------|-----------|-----------|-----------|
| Temp. (°C)                                  | 5         | 10        | 15        | 20        | 25        | 30        | 35        |
| 10                                          | -0.162    | **-0.1259**| **-0.175**| **-0.183**| **-0.1307**| -0.3855   | -0.2217   |
| 30                                          | **0.0192**| -0.4769   | -0.2142   | -0.2088   | -0.214    | -0.211    | -0.2273   |
| 40                                          | -0.0987   | -0.5147   | -0.4964   | -0.3046   | -0.2782   | -0.3054   | **-0.2043**|
| 50                                          | -0.4963   | -0.5042   | -0.551    | -0.2948   | -0.3506   | -0.5186   | -0.2433   |
3.7. Hedonic test of pandan preparations

The organoleptic test aims to compare the level of panelists’ preference for pandan preparations. Organoleptic test used is a hedonic test or a preference test with the parameters are color and flavor of pandan preparations. The hedonic test results on pandan preparations show that the 20% maltodextrin (w/v) sample is the most preferred of the color and flavor parameters (Figure 7). Figure 8 shows that the most preferred sample is a sample of 10% maltodextrin (w/v) followed by a sample of 20% maltodextrin (w/v). From the two hedonic test results it can be determined that the 20% maltodextrin (w/v) sample is the best because the 10% maltodextrin (w/v) and 20% maltodextrin (w/v) are not significantly different at the 2nd repetition of hedonic test, as well as the consideration that a sample of 20% maltodextrin (w/v) results a higher yield.

| Condition | -0.1824 | -0.3282 | -0.3279 | -0.1845 | -0.2812 | -0.1876 | -0.3218 |
|-----------|---------|---------|---------|---------|---------|---------|---------|
| Light     |         |         |         |         |         |         |         |
| Dark      | -0.4178 | -0.5166 | -0.1995 | -0.2332 | -0.2766 | -0.2632 | -0.4393 |

Figure 7. Hedonic test results of pandan preparations at the 1st repetition.

Figure 8. Hedonic test results of pandan preparations at the 2nd repetition.

3.8. Hedonic test of final products

Pandan preparations were applied to make pandan cake. Furthermore, pandan cake was tested by organoleptic (hedonic) test using the parameters of color, flavor, and taste of pandan cake. Figure 9 and
10 show the results of hedonic test on pandan cake. At the first repetition of hedonic test, all samples were not significantly different in flavor and taste parameters, while the most preferred color was 35% maltodextrin (w/v). The second repetition of hedonic test shows that all pandan cakes were not significantly different in color, flavor, and taste parameters. This shows that the most preferred pandan cake is a sample with the addition of 35% maltodextrin (w/v).

![Figure 9. Hedonic test results of pandan cake at the 1st repetition.](image1)

![Figure 10. Hedonic test results of pandan cake at the 2nd repetition.](image2)

3.9. Hedonic test with commercial coloring and flavoring

Previous hedonic test showed that the most preferred pandan cake was a sample with the addition of 35% maltodextrin (w/v). Then the sample was re-tested in a same way and it was compared to commercial coloring and flavoring, namely pandan leaves extract and pandan paste by applying it in the making of pandan cake. Pandan leaves extract is obtained from pandan leaves which were extracted with water using a blender, while pandan paste is commercial product in the market (‘koepoe-koepoe’ brand). This test was carried out to compare the best pandan preparations obtained from the previous test with commercial coloring and flavoring using the parameters of color, flavor, and taste of pandan cake. The test results show that pandan preparations were not significantly different from pandan leaves extract at the parameters of color, flavor, and taste. Pandan preparations were not significantly different from pandan paste from the flavor and taste parameters, but significantly different from the color parameters (Table 2). From the several advantages of pandan preparations such as safe and healthy
aspects, these pandan preparations can be a better substitute for the use of synthetic coloring and flavoring.

Table 2. Comparison test of coloring and flavoring with Duncan method.

| Parameter | Pandan Preparation | Pandan Leaves Extract | Pandan Paste |
|-----------|--------------------|-----------------------|--------------|
| Color     | Liked              | Liked                 | More Liked   |
| Flavor    | Liked              | Liked                 | Liked        |
| Taste     | Liked              | Liked                 | Liked        |

4. Conclusions
The test results show that the addition of maltodextrin has a significant effect on all parameter tests except the total dissolved solids. The higher the maltodextrin concentration addition to pandan preparations, the higher the total yield, water content, color intensity (brightness level), water solubility, and total dissolved solids. Whereas the other parameter tests such as color intensity (greenness level) and total chlorophyll are inversely proportional with the increasing of maltodextrin addition. Hedonic test shows that a sample of 20% maltodextrin (w/v) addition is the most preferred by panelists. When a hedonic test was performed on the final product in the form of pandan cake, a sample of 35% maltodextrin (w/v) addition is not significantly different from the parameters of color, flavor, and taste of pandan cake. While the sample of 35% maltodextrin (w/v) is significantly different from the pandan paste at the color parameters, but not significantly different at the flavor and taste parameters. Based on several test parameters, especially yield and organoleptic tests, the best treatment of pandan preparations is the addition of 35% maltodextrin (w/v). From several advantages, these natural pandan preparations can be a better substitute for the use of synthetic coloring and flavoring. The suggestion of this research is that it is necessary to test the chlorophyll stability with a longer period of time to determine the quality of the coloring preparations produced.

5. References
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