Chemical and sensory characteristics of white sweet potato (Ipomoea batatas L.), rice (Oryza sativa L.), and tapioca (Manihot esculenta) flours - based seasoning composite flour

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Abstract. Seasoning flour was a food commodity that has a good market trend but currently the raw materials were still dominated by wheat flour that has been known as the triggering agent of some allergic disease. So in order to reduce the domination of wheat flour as raw material of the seasoning flour, an innovation of seasoning composite flour made from non-wheat flour that have suitable characteristics is needed. The objective of this study were to determine the chemical characteristics of seasoning composite flour that made from white sweet potato, rice and tapioca flours, and to determine and characterize the sensory profile of the best seasoning composite flour which was chosen using weighting test. The seasoning composite flour made using 9 formulas contain 13.261 - 14.089% water; 4.467 – 5.729% ash; 1.238 – 2.018% fat; 4.324 – 5.838% protein; 74.371 – 74.863% carbohydrate; 72.781 – 75.613% starch; 21.904 – 25.760% amylose and 0.086 – 0.499% crude fiber. The best formula of seasoning composite flour has 30% tapioca flour, 30% rice flour and 40% white sweet potato flour ratio. The best one contains 13.261% water; 5.728% ash; 1.194% fat; 4.646% protein; 74.427% carbohydrate; 72.781% starch; 21.904% amylose and 0.499% crude fiber. Its sensory characteristic is significantly different from the commercial seasoning flour and overall get hedonic score 3.76 which means neutral.

1. Introduction
Along with the growing trend of fried foods, seasoning flour has experienced a good market increase. Seasoning flour makes the preparation of crispy fried foods easier and faster [1]. Rice flour and tapioca flour are Indonesian major flour commonly applied in seasoning flour recipes. Rice flour and tapioca flour can improve and maintain the crispiness of the fried foods. In addition, rice flour also gives bright effect on fried foods. Tapioca starch consists of 83% amyllopectin and 17% amylose, rice starch consists of 20-25% amylose and 75-80% amyllopectin, while white sweet potato flour consists of 24.37% amylose and 75.63% amyllopectin [2].

Tapioca flour, rice flour, and white sweet potato flour are gluten-free commodities that intended safe for gluten intolerance, such as autism. Gluten causes brain dysfunction in autistic people because autistic people have digestive problems in absorbing abnormal gluten proteins so that proteins turn into peptides that enter the blood and poison the brain. Impaired brain function by this peptide is similar to the effect of morphine which can cause dependence [3]. Gluten has also been known as an initiator of celiac disease. Other facts also mention that accumulation of gluten can also cause other diseases such as ataxia, skin rashes (eczema), decreased muscle strength (hypotonia), stunting,
learning difficulties, depression, migraines and headaches. The number of cases of gluten intolerance is an opportunity for seasoning flour producers to provide gluten-free seasoning flour.

Several studies related to composite flour as a substitute for flour in several types of food have been carried out including research on formulas of taro flour and sweet potato as raw material for dried noodles [4], composite flour formulations made from rice, sweet potatoes, potatoes, soybeans, and xanthan gum [5], cake formulations based on red bean, soybean, and corn composite flour [6], and a hypoglycemic effect of composite flour made from purple sweet potato in streptozotocin induced diabetic rats [7]. Yet, a gluten-free seasoning flour that formulated from composite flour has not been studied.

Based on physical characteristic, composite flour made from tapioca flour, rice flour, and white sweet potato flour has the potential to be a raw material for gluten-free seasoning flour [4]. However, the chemical and sensory characteristic of seasoning flour made from the composite flour is not well understood yet. Thus, it is necessary to determine chemical and sensory characteristic of composite seasoning flour based on tapioca flour, rice flour, and white sweet potato flour as an alternative for making gluten-free seasoning flour.

2. Experimental
Seasoning composite flour formulation and manufacture was based on previous research [4]. The materials, tapioca (Rose Brand), rice flour (Rose Brand) and white sweet potato flour (CV. KUSUKA UBIKU), were sieved 100 mesh and manually mixed into composite flour. The composite flour was further mixed with blended spices consisting refined salt, pepper powder, onion, garlic, and candelunut. Mixing was done using a hand mixer at medium speed for 20 minutes. The nine formulas of seasoning composite flour are shown in Table 1.

| Tapioca Flour (%) | Rice Flour (%) | White Sweet Potato Flour (%) |
|-------------------|----------------|-----------------------------|
| 30                | 70             | 0                          |
| 30                | 65             | 5                          |
| 30                | 60             | 10                         |
| 30                | 55             | 15                         |
| 30                | 50             | 20                         |
| 30                | 45             | 25                         |
| 30                | 40             | 30                         |
| 30                | 35             | 35                         |
| 30                | 30             | 40                         |

2.1. Chemical analysis methods
Water content was analyzed using thermo-gravimetric method [5], ash content using dry method [5], fat content using Soxhlet extraction method [5], protein content using micro Kjeldahl method [5], carbohydrate content using by difference method [2], starch content using acid hydrolysis method [6], amyllose content using spectrophotometric methods [7], and crude fiber content using acid-base hydrolysis [8].

2.2. Determination of the best formula
The best formula was determined using weighting test method with a modification [9]. The parameters being tested were physical [4] and chemical characteristic.

2.3. Sensory analysis methods
Sensory analysis was performed using difference test (i.e., triangle test) and also hedonic test [10].
3. Results and discussion

3.1. Chemical characteristics

Chemical characterization was carried out on nine formulas of composite seasoning flour and two control seasoning flour. Both control were commercial seasoning flour. The chemical characteristics of composite seasoning flour are shown in Table 2.

Table 2. Chemical characteristics of composite flour based on rice flour, tapioca flour and white sweet potato flour

| Tapioca Flour : White Sweet Potato Flour | Water content (%bb) | Ash content (%bb) | Fat content (%bb) | Protein content (%bb) | Carbohydrate content (%bb) | Amilose content (%) | Starch content (%) | Crude fiber (%) |
|-----------------------------------------|---------------------|-------------------|-------------------|-----------------------|----------------------------|---------------------|-------------------|---------------|
| 30 : 70 : 0                             | 14.09±0.04          | 4.49b±0.03        | 1.24b±0.12        | 5.84c±0.01            | 74.35bc±0.00               | 25.76c±0.01        | 75.61c±0.00     | 0.9b±0.07     |
| 30 : 65 : 5                             | 14.14±0.03          | 4.47b±0.03        | 1.24b±0.04        | 5.24d±0.03            | 74.86c±0.01               | 24.88d±0.01        | 74.82c±0.00     | 0.29b±0.04    |
| 30 : 60 : 10                            | 14.10±0.00          | 4.77a±0.00        | 1.29b±0.00        | 5.25d±0.00            | 74.60bc±0.00              | 24.36de±0.01       | 74.59±0.03      | 0.3a±0.02     |
| 30 : 55 : 15                            | 13.95±0.00          | 5.07b±0.06        | 1.59c±0.07        | 4.76bc±0.13           | 74.59bc±0.00              | 24.35c±0.02        | 74.69±0.01      | 0.30b±0.02    |
| 30 : 50 : 20                            | 13.69±0.01          | 5.37b±0.03        | 1.63c±0.03        | 4.94cd±0.55           | 74.37bc±0.00              | 24.04ab±0.01       | 74.33±0.03      | 0.34cd±0.03   |
| 30 : 45 : 25                            | 13.57±0.05          | 5.46d±0.05        | 1.77d±0.01        | 4.73bc±0.44           | 74.47bc±0.00              | 23.76a±0.00        | 74.09±0.00      | 0.37d±0.01    |
| 30 : 40 : 30                            | 13.54±0.01          | 5.65d±0.03        | 1.19bc±0.03       | 4.46abc±0.05          | 74.45bc±0.00              | 22.49df±0.01       | 74.00±0.00      | 0.46±0.01     |
| 30 : 35 : 35                            | 13.51±0.00          | 5.73d±0.04        | 2.02c±0.05        | 4.32ab±0.27           | 74.42bc±0.00              | 22.28bc±0.01       | 73.20±0.00      | 0.499±0.09   |
| 30 : 30 : 40                            | 13.26±0.01          | 5.73c±0.02        | 1.19c±0.03        | 4.65±0.51             | 74.04b±0.05               | 21.90a±0.01        | 72.78±0.00      | 0.19d±0.02    |
| Sajiku Brand                            | 11.27±0.01          | 6.42f±0.01        | 0.58c±0.01        | 7.48c±0.51            | 74.25bc±0.00              | 24.38±0.04         | 71.44±0.02      | 0.27±0.02     |
| Rizkiyya Brand                          | 13.53±0.02          | 5.47d±0.04        | 0.46d±0.12        | 4.32f±0.27            | 74.42c±0.04               | 22.49c±0.02        | 73.20±0.00      | 0.22±0.01     |

Same notation in the same column is not significantly different at α: 0.05

The increasing ratio of white sweet potato flour in seasoning composite flour has a significant effect on the decreasing moisture content of composite seasoning flour. White sweet potato flour itself has lower water content than tapioca and rice flour. The moisture content of composite seasoning flour is higher than the moisture content of Sajiku Brand but is not significantly different compared to Rizkiyya Brand. It caused by the different form of the spice being added into the seasoning flour. The composite seasoning flour and Rizkiyya Brand were using wet blended spices while Sajiku Brand was using dry blended spices. The water content of composite seasoning flour is not too different from the
moisture content of composite flour rice flour, sweet potatoes, potatoes, soybeans and xanthan gum [5].

Ratio of the raw material flour has a significant effect on the ash, lipid, and protein content of seasoning composite flour. The greater ratio of white sweet potato flour, the higher ash and lipid content, yet the lower protein content of composite seasoning flour. Compared to Sajiku Brand, ash and lipid content of composite seasoning flour is lower. Composite seasoning flour with 20-35% white sweet potato contain ash content similar with Rizkiyya Brand. Level of seasoning composite flour’s ash was higher than previous composite flour ash content [5]. This is due to the addition of seasonings and sodium salts to into seasoning composite flour. However, fat content of seasoning composite flour was lower than that previous composite flour [5] due to the form difference of the soy source being added. Previous research [5] using soy flour containing more than 28.26% fat while composite seasoning flour did not use high-fat base flour ingredients.

Ratio of white sweet potato flour also has a significant effect on the protein content of composite seasoning flour. It also has a real effect on carbohydrate content of composite seasoning flour. The greater the ratio of white sweet potato flour, the lower the carbohydrate content of composite seasoning flour. This is because the carbohydrate content of white sweet potato flour is lower than the raw material for tapioca flour and rice flour. But this carbohydrate level is still higher than commercial seasoning flour. The carbohydrate content of seasoning composite flour manufactured in this research is lower than the previous reported composite flour [4].

Amylose and starch content tend to decrease as the white sweet potato flour ratio increase, especially above 20%. Starch content in composite seasoning flour would affect its functional properties, namely water absorption and flour viscosity. The greater the starch content in the composite seasoning flour, the greater the water absorption and flour viscosity [8]. Amylose content of the composite seasoning flour, which ranged from 21.90 - 25.76%, was higher than the amylose content of previous composite flour [15], which was 15.77%.Higher ratio of white sweet potato flour tends to ascend the level of crude fiber in seasoning composite flour. The level of crude fiber of composite seasoning flour is higher than the commercial ones.

3.2. Determination of the best formula

The best formula was determined using result value (RV) calculation. The best one is formula which got highest RV. Thus the best composite seasoning flour was made from 30% tapioca, 30% rice flour and 40% white sweet potato flour. The best formula composite flour contains 13,261% water; 5,728% ash; 1,194% fat; 4,646% protein; 74.427% carbohydrate; 72,781% starch; 21,904% amylose and 0.499% crude fiber.

3.3. Sensory characteristics

Triangle test was conducted to determine whether there are any differences or not in sensory properties between best composite seasoning flour and commercial control seasoning flour. The result of the triangle test for overall parameter is shown in Table 3. The best formula composite seasoning flour is significantly different either from Sajiku Brand and Rizkiyya Brand.

| Table 3. Triangle test result of seasoning composite flour |
|----------------------------------------------------------|
| Control | Compared to Sajiku Brand | Compared to Sajiku Brand |
| The number of panels who stated different | 25 | 24 |
| The smallest amount to be significantly different at α 5% | 18 | 18 |

The best formula composite seasoning flour, however, get lower hedonic score compare to Sajiku and Rizkiyya Brand for appearance, crispiness, and overall. It has darker color and less crispy compared to
both control flour. Crispness has a correlation with the parameters of starch and amylose content [16]. Overall, it gain hedonic score 3.76 which means neutral.

| Hedonic score of seasoning composite flour | Seasoning Flour   | Appearance | Crispness | Overall |
|--------------------------------------------|-------------------|------------|-----------|---------|
| Sajiku Brand                               | 5.68c             | 5.64b      | 5.76c     |         |
| Rizkiyya Brand                             | 4.92b             | 4.68a      | 4.80b     |         |
| Best Formula Composite                     | 2.72a             | 4.28b      | 3.76a     |         |

Score 1 = very dislike, 2 = dislike, 3 = rather dislike, 4 = neutral, 5 = rather like, 6 = likes, 7 = really like

4. Conclusion
The best formula of composite seasoning is 30% tapioca, 30% rice flour, and 40% white sweet potato flour which contains 13.26% water; 5.73% ash; 1.19% fat; 4.65% protein; 74.43% carbohydrate; 72.78% starch; 21.90% amylose and 0.50% crude fiber. Sensory characteristics of composite seasoning flour are significantly different from commercial seasoning flour.

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