Mocaf characteristic test of different varieties of cassava in Gunung Kidul

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Abstract. Cassava is one of the many crops developed in the Gunung Kidul to be used as food. There are many of varieties planted and characteristic are unknown of various cassava varieties, requires the need for research on the characteristics of nutrient content and physical properties, especially for Mocaf production. This research was arranged in a Completely Randomized Design (CRD) with single factor and consisting of 5 treatments, Kirik, Gambyong, Jawa, Gatotkaca, and Bamban varieties. Every treatment was repeated 3 times and every varieties was 9 months of harvest age. Observed variables include moisture content, protein, ash, starch, fiber, fat, carbohydrate, HCN, white color, organoleptic, and viscosity. The result showed that kind varieties of fresh cassava possess nutrient content and different physical properties. Bamban variety is the best quality for making Mocaf which is has the white color (91.53), HCN content of 18.10 ppm, starch content of 77.84%, protein content of 1.11%, and dietary fiber content of 9.04%, but not yet meet the standards of SNI on HCN variables and the amount of starch.

1. Introduction

Cassava (Manihot esculenta Crantz) is a carbohydrate source in Indonesia which ranks third largest after rice and corn. Cassava plants can grow well in areas that have heights up to 2,500 m above sea level [1]. Cassava in Indonesia is widely used as food. One way to extend shelf life of cassava is by making it in the form of modified cassava flour (mocaf).

Mocaf is a flour made from cassava tubers which are formed due to fermentation process of lactic acid producing bacteria. In Indonesia wheat flour is an important product especially as raw material for noodle. Unfortunately we do not grow wheat in Indonesia therefore we have to import from other countries, such as Australia and US. At the moment, the value of wheat import is currently millions of tons and each year continues to increase. Therefore, mocaf is precisely used as an alternative product capable of substituting wheat flour.

Gunung Kidul has many cassava varieties and each variety has different physical and chemical characters. The number of varieties grown in Gunung Kidul demands to be assessed specifically for the purpose of producing better products, especially for Mocaf production. However, there are several problems with cassava varieties that will be used for the manufacture of mocaf, namely the character of the nutrient content and physical properties of various cassava varieties that are planted in Ponjong Village, Gunung Kidul. The purpose of this study is to examine the nutrient content and physical properties of various cassava varieties developed in Gunung Kidul and to obtain cassava varieties suitable as raw material for mocaf.
2. Materials and Methods
The research was conducted at the Post Harvest and Agrobiotechnology Laboratories, Faculty of Agriculture, University of Muhammadiyah Yogyakarta, from August to September 2017. The materials used were 5 cassava varieties (Kirik, Jawa, Gambyong, Gatotkaca, and Bamban), MRS Broth, aqua dest hexane, Kjeldahl tablets, and others. The tools used were blender, oven, analytic balance, petri dish, and others.

The study was carried out by laboratory experiment methods arranged in Completely Randomized Design (CRD) with a single treatment design consisting of 5 treatments, namely A = Kirik variety, B = Gambyong variety, C = Javanese variety, Gatotkaca D = variety, E = Bamban variety and each treatment was repeated 3 times. Cassava was harvested at the age of 9 months, cleaned from the soil manually, and washed thoroughly.

Nutrient content in cassava tested in this study included total starch content, crude fiber content, fat content, carbohydrate content, protein content and HCN levels. Protein was determined by Kjeldhal method. The data from the observations were analyzed using Analysis of Variance (ANOVA) at an error rate of 5% real difference between treatments then Duncan's Multiple Range Test (DMRT) test was carried out at the level of 5%.

3. Results and Discussion

3.1. Protein content analysis
The result shows that cassava with the highest protein content is Gatotkaca variety at 1.71%. On the contrary, cassava with the lowest protein content is Javanese variety at 0.47% (Table 1) and there was a significant difference on the protein content of various kinds of cassava varieties. Table 1 shows that mocaf which has the highest protein content is Gambyong variety of 1.24% and the lowest protein content is Javanese variety of 0.76%. The results of the analysis of variance showed that there were significant differences in the protein content of various mocaf varieties.

This shows that protein levels have increased after fermentation by the bacterium Lactobacillus plantarum. This increase in protein levels is due to the ability of Lactobacillus plantarum to secrete several extracellular enzymes (proteins) into cassava during the fermentation process. In addition, during fermentation, the Lactobacillus plantarum bacteria also produce proteinase enzymes. Proteinase will hydrolyze proteins into simpler peptides. Thus, an increase in protein content is obtained from the activity of protease enzymes produced by microbes present in the fermentation process [2].

However in Gatotkaca variety, mocaf protein levels decreases. This happens because in the fermentation process Lactobacillus Plantarum produces protease enzymes which cause complex proteins to break up into shorter peptide fractions and amino acids, thereby increasing levels of dissolved protein. According to Hidayat et al. [3], most types of proteins can dissolve in water. The fermentation process also creates hydration, so the presence of some proteins that are dissolved in the water undergoes leaching and is wasted in the marinade water. Thus, the protein contained in mocaf decreases.

3.2. Starch content analysis
Table 1 shows that cassava that the highest starch content is namely Javanese variety at 34.40% and which has the lowest starch content, namely Bamban variety at 19.41%. Based on the results of variance analysis there is a significant difference in the starch content of various kinds of cassava varieties. Mocaf which has the highest starch content, Bamban variety at 77.84 % and the lowest starch content is Kirik variety at 66.14 % (Table 1). The results of the analysis of variance showed a significant difference in the starch content of various mocaf varieties.
### Table 1. Comparison of protein, starch and HCN content between fresh cassava root and mocaf of various local varieties

| Varieties | Protein (%) | Starch (%) | HCN (ppm) |
|-----------|-------------|------------|-----------|
| **Fresh roots** |             |            |           |
| *Kirik*   | 0.70 c      | 32.50 c    | 104.31 b  |
| *Gambyong* | 0.92 b     | 23.60 d    | 104.71 b  |
| *Jawa*    | 0.47 d      | 34.40 a    | 81.65 a   |
| *Gatotkaca* | 1.71 a     | 34.02 b    | 157.48 d  |
| *Bamban*  | 0.86 b      | 19.41 e    | 146.81 c  |
| **Mocaf** |             |            |           |
| *Kirik*   | 0.81 b      | 66.14 e    | 18.04 a   |
| *Gambyong* | 1.24 a     | 75.57 b    | 27.58 c   |
| *Jawa*    | 0.76 b      | 71.35 d    | 22.25 b   |
| *Gatotkaca* | 0.88 b     | 72.98 c    | 23.27 b   |
| *Bamban*  | 1.11 a      | 77.84 a    | 18.10 a   |

Numbers followed by the same letter in the same column were insignificantly different based on DNMRT at 5% significance level.

The difference in starch levels in mocaf is thought to be due to differences in cassava varieties. Whereas the increase in starch content is suspected because of the fermentation process at the time of making Mocaf flour. In fermentation, bacterial activity is able to form starch, so starch levels in all varieties increase. This is in line with the statement of Tandrianto et al. [4] stating that the length of fermentation time makes the population of *Lactobacillus Plantarum* increase so that the dissolved starch levels also increase. The more the starters added, the more the starch formed [5].

#### 3.3. HCN level analysis

Cassava which has the highest HCN content is Gatotkaca variety at 157.48 ppm and the lowest HCN variety is namely Javanese variety at 81.65 ppm (Table 1). The analysis of variance showed that there were significant differences in HCN levels of various cassava varieties. Based on table 4, mocaf which has the highest HCN content is Gambyong variety at 27.58 ppm and the lowest HCN content is *Kirik* variety at 18.04 ppm. The results of the analysis of variance with an error rate of 5 % showed a significant difference in HCN levels of various mocaf varieties. The lower the HCN content in a food, the better the quality of the food and the safer it is for consumption.

Mocaf in all varieties shows a decrease on HCN levels. This is due to the fermentation process. Fermentation is one method that can reduce cyanogenic glucoside in cassava. Fermentation also produces volatile compounds which give a unique flavor to the product [1]. This description is in line with the explanation of Kurniati et al. [6] in her research, stating that the decrease in HCN levels was due to microorganism capable of breaking down cyanogenic glycosides and their derivative products.

#### 3.4. Food fiber analysis

Table 2 shows that Mocaf flour which has the highest dietary fiber content is the Kirik variety at 11.60 % and the one with the lowest fiber content is the Javanese variety at 8.33 %. The results the analysis of variance showed a significant difference in the levels of food fiber from various mocaf varieties. This is due to the difference from the cassava variety itself, although the difference is not too large. Based on the results of this study, food fiber levels are higher than crude fiber content of all varieties. This is in line with the statement of Beck [7] mentioning that the value of crude fiber substances is always lower than food fiber, approximately only one fifth of the value of food fiber.
Table 2. Content of food fiber found in the fermented mocaf from various local varieties of cassava.

| Varieties  | Food fiber (%) |
|------------|----------------|
| Kirik      | 11.60 a        |
| Gambyong   | 8.41 c         |
| Jawa       | 8.33 c         |
| Gatotokaca | 8.65 cb        |
| Bamban     | 9.04 b         |

Numbers followed by the same letter in the same column were insignificantly different based on DNMRT at 5% significance level.

3.5. White-level test
Mocaf with Javanese varieties has the highest white degree (L) which is equal to 92.19, while *Gambyong* variety has the lowest white degree (L) which is equal to 91.28 (Table 3). The results of the analysis of the white-level test of variance with a 5% error level indicate that there is a significant difference in the degree of white mocaf from various kinds of cassava varieties. This is thought to be caused by differences in varieties. In various varieties of cassava have different nutrient content, resulting in different degrees of white. The nature of nutrients that can affect the degree of leucorrhoea in mocaf is protein. According to Kurniawan [8], the protein content in cassava flour can cause brown color when drying or heating. The more protein content in mocaf, the brightness of mocaf decreases. This is evidenced by the results of a study that shows that the low protein content of Javanese varieties of mocaf compared to other varieties, resulting in whiter mocaf flour. Whereas mocaf has the lowest brightness level in *Gambyong* varieties, this is in line with the high content of mocaf in *Gambyong* variety compared to other varieties.

Table 3. Brightness level of mocaf from various local varieties of cassava.

| Varieties   | White-level  |
|-------------|--------------|
|             | L* (light)   | A**         | B***         |
| Kirik       | 91.92 b      | 3.65 b      | 1.43 ba      |
| Gambyong    | 91.28 d      | 3.65 b      | 1.43 ba      |
| Jawa        | 92.19 a      | 3.68 a      | 0.64 c       |
| Gatotokaca  | 91.52 c      | 3.57 c      | 1.15 b       |
| Bamban      | 91.53 c      | 3.69 a      | 1.70 a       |

Numbers followed by the same letter in the same column were insignificantly different based on DNMRT at 5% significance level.

*L* notation represented the reflected light which produces white gray and black chromatic colors.

**A** notation represented the mixed red-green chromatic.

***B*** notation represented the mixed blue-yellow chromatic.

4. Conclusion
Various kinds of cassava varieties have different nutrient contents and physical properties. Cassava varieties of Bamban are best to be processed into mocaf, with the superiority of white grade at 91.53, HCN content of 18.10 ppm, the starch at 77.84%, the protein at 1.11%, and dietary fiber at 9.04%, but not yet meet the standards of SNI on HCN variable and the amount of starch.
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