Properties of different aged jicama (*Pachyrhizus Erozus*) plants

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Abstract. Jicama crop potential is very large, the tuber is used as a fresh fruit, ice mix fruit, salad, and can be made into flour, starch and inulin. The nutritional content of yam tubers depends on the age of the harvest, while farmers harvest jicama tubers at the age varying between 4-6 months. The research objective is to analyze the content of proximate fresh tubers and three kinds of flour (flour, starch and starch dregs) by harvesting different age plants. The study was conducted in Malang at a height of 560 m above sea level. Planting was done using plastic mulch with a spacing of 80 cm x 20 cm. Research using complete Randomized block Design with one factor harvesting consisting of 16, 18, 20 and 22 weeks after planting. Jicama tubers were harvested and analyzed the proximate for moisture, ash, fat, protein and carbohydrates in the fresh tubers, flour, starch and jicama flour dregs. The results showed that the late harvest resulted in moisture content, ash content, fiber and fat increase while the protein and carbohydrate decreased. The content of carbohydrates in the flour, starch and starch dregs was almost the same at different harvest time. Flour contains carbohydrates from 79.29 to 82.54%, starch from 86.35 to 89.40% starch and starchy dregs from 78.42 to 80.71%. The protein content of the flour is from 4.22 to 5.87%; while protein content of starch and protein content flour dregs is from 1.05 to 1.90% and 3.95 to 4.84%. Flour fiber content increased with increasing age of plants, while the fiber content of starch decreased but the dregs flour fiber content is almost the same

1. Introduction
The use of materials that can be renewed for a variety of human needs is likely to increase in future, because the ingredients are readily available, environmentally friendly and can be described [1]. These materials can be applied to the food industry, cosmetics and pharmaceuticals as a material emulsion, foam, texture and microencapsulation [1]. Yam crop potential is very large, the tuber is used as a fresh fruit, ice mix fruit, salad, and can be made of flour, starch and inulin. In the process of making starch produced pulp and can be made of flour. The results of study [2] states yam flour fiber or pulp can serve as a prebiotic and potential as a functional food component. The nutritional content yam tubers are affected by some factors, tuber phenotype [3] and the place of planting and harvesting [4,5]. Different harvestings produce different chemical contents, while farmers harvest at the age that varies between 4-6 months, depending on considerations of selling price in the market. Research relating to the yam flour has been done primarily and it related to the further process of making starch into material that is more specific to the desired function well for the food, pharmaceutical and cosmetics [1,3,6]. Jicama is not durable at room temperature or low temperature, so processing it into flour and starch will reduce damage and increase the sale value of yam tubers. This study aimed to analyze the
chemical composition of proximate flour, starch and starch dregs yam tubers of different aged jicama plants.

2. Methods
The materials used in this study is the yam tubers with different harvest ages, plastic mulch, chemicals for proximate analysis. The study was conducted in Malang at a height of 560 m above sea level. Planting was done at a spacing of 80 cm x 20 cm using plastic mulch. Research was done using complete randomized block design with one factor of harvesting 16, 18, 20 and 22 weeks after planting. Each treatment was repeated three times.

Yam tubers were harvested and further treated into flour, starch and starch dregs. The process of making each one is as follows: first, yam flour. Yam flour-making process has several stages. Jicama was washed and peeled and then grated roughly using a coarse grater. Coarse grated yam tubers were dried for 3 x 24 hours in the blazing sun and subsequently dried in ovens at 80°C for 1 x 24 hours. Grated were blended and filtered using a fine sieve. Then it was analyzed into proximate flour. Second, yam starch. The process of making yam starch includes: washing yam, peeling it, and extracting by using juicer. Yam juice was then aged for 1 x 24 hours later, so the water was separated from the precipitate. Wet starch precipitate was dried in the sun for 2 x 24 hours. Precipitate was further roasted at a temperature of 80°C for 1 x 24 hours. The starch smoothed by using a blender and was filtered by using a fine sieve. Starch was then analyzed into proximate yam flour dregs. Yam dregs was obtained from the separation of the starch manufacturing process. Dregs were dried for 3 x 24 hours in the blazing sun and subsequently overdried at a temperature of 80°C for 1 x 24 hours. Dregs are dried yam mashed with a blender and filtered by using a fine sieve. Yam flour dregs were analyzed proximatively.

Proximate analysis included moisture content, ash content, fiber content, fat content, protein content and carbohydrate content. Measurement of moisture content was done by using the oven method [7], ash content using AOAC method in 2005 [8], crude fiber content by gravimetric method [9], the fat content by Soxhlet method [10], the protein content by the method Kjehdahl [7]. Data were analyzed by using ANOVA and followed by LSD test with α level of 5%.

3. Results and discussion
Proximate chemical composition of yam tubers affected by harvest time, the phenotype in one variety and planting. [3] reported a 5 phenotypes based on skin color yam tuber varieties Pachyrhizus tuberosus show proximate different chemical constituents of the fresh roots and flour. Tuber water content ranged from 70.96 to 87.45%, carbohydrate content from 3.58 to 21.27%, ash content from 1.58 to 2.49% and protein content from 4.35 to 7.433%. While [5] using P. erosus one phenotype harvested at different ages showed significant differences in ash content, protein and carbohydrate, while the water content and fiber content is no different. The ash content increased with increasing age of plants at harvest is 2.282% at 16 weeks be 5.752% at the age of 22 weeks. While the protein content of the opposite occurs, namely increasing age harvest decreased protein content is 3.731% at 16 weeks be 1.269% at the age of 22 weeks.

Table 1. Proximate chemical composition yam flour with different age plants.

| Age (weeks) | Water (%) | Ash (%) | Fiber (%) | Fat (%) | Protein (%) | Carbohydrate (%) |
|------------|-----------|---------|-----------|---------|-------------|------------------|
| 16         | 9.89 ab   | 4.32 b  | 3.52 a    | 0.38 a  | 5.87 b      | 79.55 a          |
| 18         | 9.86 ab   | 2.89 a  | 6.07 b    | 0.29 a  | 5.86 b      | 81.10 b          |
| 20         | 8.29 a    | 3.50 a  | 6.16 b    | 0.45 a  | 5.24 b      | 82.54 b          |
| 22         | 11.86 b   | 4.34 b  | 9.27 c    | 0.29 a  | 4.22 a      | 79.29 a          |
Table 2. Proximate chemical composition yam starch with different age plants.

| Age (weeks) | Water (%) | Ash (%) | Fiber (%) | Fat (%) | Protein (%) | Carbohydrate (%) |
|-------------|-----------|---------|-----------|---------|-------------|------------------|
| 16          | 8.29 a    | 0.75 a  | 1.94 a    | 0.32 a  | 1.90 b      | 88.73 b          |
| 18          | 8.47 a    | 0.58 a  | 1.62 a    | 0.17 a  | 1.38 a      | 89.40 b          |
| 20          | 9.17 a    | 0.90 a  | 1.79 a    | 0.13 a  | 1.23 a      | 88.57 b          |
| 22          | 11.39 b   | 0.92 a  | 1.34 a    | 0.28 a  | 1.05 a      | 86.36 a          |

Besides consuming fresh yam tubers, these can be processed into flour and starch. In the process of making starch produced pulp juice and pulp results can be made of its flour. Yam harvest age proximate influence the chemical composition of flour, starch and dregs yam as shown in tables 1, 2 and 3. Age significantly affected the harvest moisture, ash, fiber, protein and carbohydrates while the fat had no effect. With increasing age of harvesting the fiber content of flour increased while protein content decreased. The same was reported by [4] but with different values for different cropping place [3]. The yam plant in Tanah Merah, Binjae, North Sumatra, at the age of 16 crops and 22 weeks obtained proximate chemical composition ie flour protein content of 9.83% and 8.45%, 20.29% and fiber content 22.93%. While in this study conducted in Malaysia with the same varieties are Gajah varieties obtained different results ie flour protein content of 5.87% and 5.24%, the fiber content of 3.52% and 6.16%. This shows that the planting of chestnuts can affect the proximate chemical composition of yam flour. Additionally varieties also influence the chemical composition of yam flour proximate, the P tuberosum varieties obtained protein content of 4.35% -7.43% [3].

The proximate chemical composition starch and flour yam showed difference. Ash, fat and protein fibers in the yam starch was lower than the yam flour as shown in tables 1 and 2. Harvesting time of yam significant effected the levels of protein and carbohydrates, moisture, ash, fiber and fat are not significantly affected. The protein content decreased with age, while the fiber in flour increase (Table 1). Harvesting time of yam significant effected the levels of protein and carbohydrates, while the moisture, ash, fiber and fat are not significantly affected. The protein content decreased with age, while carbohydrate in starch from tubers harvested from age 16-20 was not significantly different more than the carbohydrate in tubers harvested at 22 weeks a shown in table 2.

Table 3. Proximate chemical composition dregs yam residual starch with different age plants.

| Age (weeks) | Water (%) | Ash (%) | Fiber (%) | Fat (%) | Protein (%) | Carbohydrate (%) |
|-------------|-----------|---------|-----------|---------|-------------|------------------|
| 16          | 11.99     | 2.78    | 13.83     | 0.32    | 4.73        | 80.18            |
| 18          | 13.63     | 2.48    | 13.03     | 0.62    | 4.84        | 78.42            |
| 20          | 12.24     | 2.98    | 13.24     | 0.61    | 4.41        | 79.76            |
| 22          | 12.45     | 2.47    | 12.76     | 0.42    | 3.95        | 80.71            |

Dregs yam residual starch ranged between 17% - 22% of wet weight or 2.55% - 5.73% [11], and this value is quite large. Dregs quickly ferment and cause odor. Dregs can be made of flour and proximate chemical composition can be seen in table 3. Flour yam pulp fiber is high at 12.76% - 13.83%, this value is higher than the fiber content in flour and yam starch. In addition, dregs yam flour protein content is also quite high 33.95 to 4.84% as shown intable 3, the dregs yam flour can be used as animal feed mixes or mixed foodstuffs [2]. Consumption of fiber yam flour can improve the health of the colon and has potential as a functional food component. Furthermore, Purwandani L [2] stated fiber yam flour contains soluble dietary fiber 4.04%, 51.21% insoluble fiber, inulin 172 ppm. Consuming fiber yam flour reduces the population of E coli, increases the water content, total short chain fatty acid, lowers the pH and gives effect to pour in the stool. Based on the chemical
composition of flour and starch proximate harvested at 18-20 weeks were better than those harvest date the age 22 of weeks. Latitude J A et al [4] reported a flour derived from yam tubers at harvest age of 3 months and 4 months yield methanolic extract, and more antioxidant activity than bengkoang optimum harvesting age 5 months. There is a slight difference in harvesting, allegedly caused by different places namely Malang and North Sumatra.

4. Conclusion
Flour fiber content increased with increasing age of harvest, while the fiber content of starch decreased but the dregs flour fiber content was almost the same. The proximate chemical composition of flour and starch harvested at 18-20 weeks was better than that harvested at the age of 22 weeks.

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