Alternatif Main Food from *Dioscorea alata*: Its Potency from Central Java, Indonesia

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Abstract. *Dioscorea alata*, (local name ‘uwi’), is one of the potential local food sources in Central Java, Indonesia. Tubers are still found in several locations in Central Java. This study aimed to characterize the morphology of *D. alata*, to analyze the antioxidants, starch, amyllose, amylopectin, and its potential as a functional food source. The materials for this research were seven variants of *D. alata* collected from Boyolali, Semarang and Kudus, Central Java. Morphological characterization was approached base on the tuber characteristics. The antioxidant analysis was done by Diphenylpicrylhydrazyl (DPPH) method whereas amylum and amylose analysis were done by spectrophotometry method. There are variations of tuber characters, especially in its shape, exoderm character, flesh color, and texture. *D. alata* has high antioxidant activity. The comparison of amylose towards amylum is 7.541 – 26.735%, however, the comparison of amylopectin towards amylum is around 73.265 – 92.469%. Uwi ungu Kudus is the best *Dioscorea alata* variety for diabetics.

1. Introduction

*Dioscorea* spp. Belongs to Dioscoreaceae. Dioscorea is herbaceous plants that grow propagate and twisting, half of them produce tubers that can be used as food and medicine. *Uwi* (*Dioscorea alata*), *gembili* (*Dioscorea esculenta*), and *gadung* (*Dioscorea hispida*) are examples of Dioscorea which commonly can be found in the countryside. This type of plant was popular in Javanese society, because of its role as a traditional food resource. As long as the food pattern changes on the society which is mainly consuming rice, therefore the role of tubers from Dioscorea is marginalized.

Based on the data from FAO in 2002, tubers are stapled food which is economically important for millions of people in the tropics and subtropics [1]. As the traditional food resource, it is also potential as a functional food foodstuff. Functional food is food or foodstuff which can provide additional benefits in addition to the basic function of the food itself [2]. While Tapsell defines functional food as food that has a function not only to meet the basic nutritional needs for the body but also has other functions [3]. They are often referred to like foods that have health functions, especially for the prevention of disease.

In the modern century, the philosophy of eating has undergone a lot of shifts. Eating is not just about full, but more importance is the benefits of food for the health of the body. Food is expected to provide more than just nutrients as the body's basic needs and sensory satisfaction, but it can also have physiological functions namely prevention of the onset of disease, increasing endurance, slowing down the aging process, and rejuvenating or recovering [4].

*Uwi* (*D. alata*) is a type of tuber that grows in Indonesia. *Dioscorea alata* has a high diversity regarding shape, size, color, and taste of the tuber. Based on the research by Chen et al. in Mojiono et
al [5]. Dioscorea group has sapogenin which has the potential to reduce blood sugar index especially in *D. alata* that has several polysaccharides which can inhibit sucrase activity which plays a role in the absorption of blood sugar [6].

Although there is less abundance of functional food, these types of plants can be found in the suburban area, for example in rural areas or karst mountains in various regions in Central Java [7]. Most people still utilize and cultivate these plants for food, medicine or other necessities while other communities have developed these materials into processed products that have a high economical value.

The knowledge of genetic diversity of *D. alata* germplasm is a key to species utilization and conservation. Morphological characterization is the first step that is highly recommended to do before performing biochemical and molecular studies [8]. Information regarding the diversity and characteristics of the *D. alata* variant and analysis of antioxidants, starch, and amylose are still limited. This study aimed to characterize some variants of *D. alata* tubers and to analyze content amyllum, amylose, amyllopectin, and antioxidant by referencing to its development as a functional food.

### 2. Material and Method

This study used 7 variants of *D. alata* based on Jamari and Suedy collections from Boyolali [9], Semarang and Kudus areas, which are: *uwi ungu* (UBY2), *uwi bangkulit* (UBY4), *uwi wulung* (USM1), *wi legi* (USM2), *uwi bangkulit* (USM4), *uwi bangkulit* (UKD4), *uwi ungu* (UKD5). Characterization of *D. alata* tubers uses Descriptor Yam while biological tests to determine the potential nutritional value of *D. alata* varieties include starch analysis: starch, amylose, and amyllopectin, as well as antioxidant analysis [10].

The starch analysis was carried out by the Somogy Nelson reactor [11]. Amylose analysis was determined spectrophotometrically, with amylose standard derived from pure potato amylose [12]. Analysis of antioxidants using Diphenylpicrylhydrazyl (DPPH) method [13], this method is an easy, fast, and sensitive method for testing the antioxidant activity of certain compounds or plant extracts [14,15].

### 3. Result and Discussion

#### 3.1. Morphological characteristics of *D. alata* tuber

The result of morphological characterization of 7 *D. alata* variants showed that there were several variations in the tubers, which were tuber shape, its flesh color, its texture, exoderm color and exoderm texture. The tuber shape is generally elongated round, but there are variations in shape to be oval or flat, without branching or slightly branching to the ones with many branches.

| Accession Code | Local name | location | Tuber Shape | Flesh color | Texture flesh | Exoderm color at inner | Exoderm color outer | Exoderm Texture |
|----------------|------------|----------|-------------|-------------|---------------|------------------------|---------------------|-----------------|
| UBY2           | Uwi ungu   | Simo, Boyolali | Oval-oblong branched | Light purple | smooth | purple | Dark brown | Rough, many wrinkles and cracks |
| UBY4           | Uwi bangkulit | Boyolali | Oval-oblong | White | smooth | Purple | Light brown | Rough, many wrinkles |
| USM1           | Uwi Wulung | Jabungan, Ungaran Semarang | Oblong, highly branched | Purple with white | Smooth grainy | Dark purple | Dark brown | Rough, many wrinkles and cracks |
| USM2           | Uwi Legi | Jabungan, Ungaran Semarang | Oblong, slightly branched | Pale white | Smooth grainy | Pale white | Dark brown | Rough, few wrinkles |
| USM4           | Uwi Bangkulit | Semarang | Flattened highly branched | White | grainy | Purple | Dark brown | Rough, many wrinkles |
| UKD4           | Uwi bangkulit | Kudus | oval-oblong, slightly branched | Orange | fibrous | Dark purple | Dark brown | Smooth |

**Table 1. Characteristics of the *D. alata* Variant Tubers from Central Java**
Table 2. Results of Analysis of Antioxidants, Amylum, Amylose and Amylopectin D. alata from Central Java

| No | Code  | Local name   | Location   | Antioxidants (%) | Amylum (%) | Amylose (%) | Amylopectin (%) |
|----|-------|--------------|------------|------------------|-------------|-------------|-----------------|
| 1  | UBY 2 | Uwi ungu     | Boyolali   | 71.29            | 31.45       | 3.48        | 27.97           |
| 2  | UBY4  | Uwi bangkulit| Boyolali   | 84.70            | 80.57       | 30.69       | 49.88           |
| 3  | USM1  | Uwi wulung   | Semarang   | 75.04            | 57.08       | 12.18       | 44.89           |
| 4  | USM2  | Uwi legi     | Semarang   | 62.34            | 31.26       | 7.81        | 23.45           |
| 5  | USM4  | Uwi bangkulit| Semarang   | 85.28            | 72.15       | 23.04       | 49.11           |
| 6  | UKD4  | Uwi bangkulit| Kudus     | 62.34            | 65.01       | 17.38       | 47.62           |
| 7  | UKD5  | Uwi ungu     | Kudus     | 85.71            | 81.40       | 20.85       | 60.55           |

The outside appearance of the tubers can be seen based on the differences of their exoderm texture ranging from smooth or rough to those that have wrinkles or cracks. The difference also can be seen in the tuber flesh color which varies from dark purple, bright purple, white to purple in the edges, pale white to orange. The texture of the tuber shows the variation of a smooth, grainy, fibrous texture—these character variations, besides the genetical factors that possibly due to the differences in the habitat.

Anokye et al. (8) found that the phenotype of D. alata bulbs were five kinds of tuber colors: white, white with purple, yellowish/white, orange and yellow flesh. The main color of genetic diversity D. alata was shown in yellowish white color, then followed by purplish white and the lowest is orange. While the exoderm color was obtained from grey to concentrated maroon, tuber flesh shows a different texture which was smooth to rough or granulated.

3.2. Analysis of Antioxidant, Amylum, Amylose and Amylopectin

To determine its potential as the functional food, hence an analysis of several functional components was carried out. The results of the analysis of antioxidants, amylum, amylose, and amylopectin showed the differences in each variant of D. alata as can be seen in Table 2.

Tubers are food sources which also have antioxidants (16). The results of the antioxidant analysis showed that D. alata had an antioxidant activity of 62.34 - 85.71%. The antioxidant D. alata is high; the highest antioxidant is obtained by Uwi Ungu Kudus (UKD5) of 85.71%. It means that Uwi Ungu from Kudus can change as much as 85.71% of the dangerous free radicals into unradical materials when it is compared to the antioxidant power of uwi ungu. D. alata's antioxidant power is much higher. Based on the research of Husna et al. (17), uwi ungu has antioxidant power of 59.25%. Whereas according to Lubag et al. (18) uwi ungu has a methanol extract containing higher antioxidant power compared to 200 µg of BHA (butylhydroxyxyanisole) and ten µg of α-tocopherol.

Antioxidant activity of plant secondary metabolites is very important because its function as prevention of cardiovascular disease. Also, these compounds can also be used as antibacterial (16). D. alata has secondary metabolite compounds which have the potential as natural antioxidants. Uwi contains anthocyanin components and phenolic compounds (19).

The results of amylin analysis showed that D. alata has varied levels of amylin, i.e., between 31.26 - 81.40%. In contrast to the research by (20), D. alata had amylin levels reaching 83.38 - 86.68% (20). According to Sari et al. (21), the differences in starch levels can be caused by the differences in harvesting age and tuber storage time during analysis. According to Abbot & Harker (22), the older the age of tubers the texture of the tuber will be harder and the starch content will increase, but if it is too old then it will have increased fibers, so the starch content will decrease.

The amylin consists of amylose and amylopectin. The comparison of amylose and amylopectin to amylin can be used to determine the utilization of a tuber. The comparison of amylose and amylopectin from 7 uwi varieties D. alata is shown in Table 3.
Based on the results of the analysis, the ratio of amylose to starch is ranged from 11.07 to 38.09%, while the ratio of amylopectin to amylose is ranged from 61.91 to 88.93%. *Uwi Bangkulit Kudus* has the highest ratio of amylose to amylose, which is 39.09%. The comparison of amylopectin to the highest starch was obtained by *Uwi Ungu Boyolali*. The difference in the ratio of amylose and amylopectin will give different tuber textures. High amylose value that will generate grainy character whereas amylopectin will produce a sticky character.

Based on these comparisons, it is known that in general the value of amylopectin in *uwii* is higher than the amylose value. It shows that *uwii* is good to be used as a source of processed food. According to Rohmah (23), amylose and amylopectin affect the properties of flour produced. Amylopectin is an important component to form gelatinous properties (23). High levels of amylose can reduce the ability of starch/flour to undergo gelatinization. According to Wang & Copeland (24), the level of gelatinization is a major determinant of starch susceptibility to enzymatic digestion and functional properties for food processing.

4. Conclusion

Varieties from *D. alata* are distinguished based on the morphological characteristics of the tuber. *Uwi* (*D. alata*) is a prospective local food crop as a functional food source that can be promoted as the main food, replacing rice, particularly for people who had a diabetic problem. *Uwi Ungu Kudus* has the highest antioxidant and amylopectin that are useful for diabetics.

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