

# Physicochemical Characterization of *Dioscorea* spp. in Manokwari Regency, West Papua

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## ABSTRACT

*Dioscorea* spp is a wild plant which is an important food source, however there are no published studies on the nutritional composition of this plants growing at Manokwari Regency. Physical analysis includes color testing using the brand Minolta Reflectance Chromameter type CR-300. Chemical analysis includes HCN content, proximate composition, and crude fiber determining based on AOAC standard methods. The results of the physicochemical characterization of tubers in four species of *Dioscorea* spp explored in Manokwari Regency showed that their variations influenced by genetic difference, soil fertility, location, and plant age.

**Keywords:** *Dioscorea* spp, Physicochemical, Manokwari

## I. INTRODUCTION

Yam (*Dioscorea* spp) is an annual shrubs that propagate from the Dioscoreaceae family. This family consists of about 650 species, 10 of which can be consumed, distributed either in the tropical and subtropical regions, which are included in dioecious plants, growing wrapped around and creep, with large, single or clustered tubers [1,2].

Species belonging to the genus *Dioscorea* (yam) may have originated in Southeast Asia [3]. The species diversity of this plant on the three separate continents due to its evolution differences as a result of the formation of the Atlantic Ocean and the drying up of the Middle East [4]. As a result, the diversity of the main species arose in the three centers: West Africa, Southeast Asia and Tropical America [5].

*Dioscorea* spp. is the third most important tuber crop after cassava and sweet potato in West Africa, Central America, the Caribbean, Pacific Islands and Southeast Asia [6]. According to [7], yam (6%), is included among the top five food crop species contributing 99% of the world production, and ranks number four in the world after potatoes (46%), cassava (28%), cassava (28%) 18%), followed by types of taro (1%).

Tubers are important source of carbohydrates as a major source of energy and food in the tropical and subtropical countries [8]. Various forms and cultivars of wild edible yam species can be found in different places with different

nutritional value and composition. The composition of wild yam tubers is not widely known and that is the reason to expect that some wild species have different compositions than cultivated varieties [9].

Moreover, yam (*Dioscorea* spp.) is a wild plant which is an important and best food source for our knowledge, but there are no published studies on the nutritional composition of this plants originated from Manokwari Regency. Therefore, the purpose of this research was to do the physicochemical characterization of yam tubers (*Dioscorea* spp) explored in Manokwari Regency, West Papua Province.

## II. MATERIALS AND METHODS

### a. Sample Eploration and Preparation

The exploration in Manokwari Regency was successfully obtained 40 accessions of wild yam (*Dioscorea* spp.) which consisted of 8 plants of *Dioscorea bulbifera* L., 7 *Dioscorea pentaphylla* L., 3 *Dioscorea alata* L. and 1 *Dioscorea hispida* Dennst. The explored tubers were wrapped immediately by newspaper in the field without being cleaned or washed and stored between 3-4 days at room temperature. By the time of shipment preparation, the tuber samples were then cleaned, washed, dried by tissue paper and wrapped by straw paper then put in plastic bag. The tubers were then analyzed at Laboratory of the Center for Research and Development of Postharvest Agriculture, Agricultural Research and Development Agency, Ministry of Agriculture, Bogor.

### b. Sample Preparation

The tuber sample preparation was carried out by peeling the tuber without being washed and then cut off part of the tuber flesh for colour testing and partly mashed for HCN content analyses. Other tuber samples were washed and mashed after being peeled to analyze the content of proximat and crude fiber.

### c. Physical Analysis

Physical analysis includes testing the color immediately after the preparation is complete. The color testing was conducted by inserting the sample pieces into a plastic cup, then covered with black cardboard. The sensor tool then attached to the mouth of the cup, before the power button on the device is turned on. Test results that are legible were then recorded. The color test included the value of L which is the brightness level of the sample, a is the difference between red and green (red: + ; green: -), and b

is the difference between yellow and blue (yellow: +; blue: -) by using the brand of Minolta Reflectance Chromameter CR type CR-300, while the value of  $\Delta E$  is the total color difference obtained from the formula  $\sqrt{(L^2 + a^2 + b^2)}$ .

### d. Chemical Analysis

Chemical analysis included analysis content of HCN [10], water, ash, fat, protein, crude fiber [11], and carbohydrates by various methods.

## III. RESULTS AND DISCUSSION

Physicochemical analysis of yam tuber (*Dioscorea* spp.) explored in Manokwari Regency, West Papua Province is shown in Table 1 and Table 2. Variations were found in the analysis results of both physical and chemical characteristics between the tubers of yam plants.

**Table 1.** The characteristic of *Dioscorea* spp tuber colour based on fresh weight

Species	Hunter Scale			$\Delta E$
	L*	a*	b*	
<i>Dioscorea bulbifera</i> L.	73.64	1.96	23.25	77.75
<i>Dioscorea pentaphylla</i> L.	69.55	0.78	5.50	69.86
<i>Dioscorea alata</i> L.	68.41	4.53	9.30	69.99
<i>Dioscorea hispida</i> Dennst	67.59	-2.02	34.04	75.70

**Table 2.** Chemical characteristic of *Dioscorea* spp. tuber based on fresh weight

Parameter	<i>Dioscorea bulbifera</i> L.	<i>Dioscorea pentaphylla</i> L.	<i>Dioscorea alata</i> L.	<i>Dioscorea hispida</i> Dennst.
Moisture Content (%)	82,76	85,69	78,18	76,43
Ash Content (%)	0,62	0,62	0,63	1,02
Fat Content (%)	0,13	0,14	0,13	0,14
Protein Content (%)	1,80	1,69	1,57	3,85
Carbohydrate Content (%)	14,69	11,86	19,48	18,56
Crude Fiber Content (%)	0,63	1,28	1,25	0,43
HCN (ppm)	31,04	39,80	35,30	10,81

The results of physical or color testing of tubers found the highest L (brightness) value from *D. bulbifera* L. with a value of 73.64 and followed by *D. pentaphylla* L. At 69.55; *D. alata* L. At 68.41 and *D. hispida* Dennst. at 67.59. On the other hand, *D. alata* L. bulbs showed the highest a (red colour) value of 4.53 followed by *D. bulbifera* L. at 1.96; and *D. pentaphylla* L. at 0.78; and *D. hispida* Dennst with the lowest a value of -2.02 indicating the the green color of tubers. The highest value of b (yellow colour) was found at *D. hispida* Dennst. at 34.04 followed by *D. bulbifera* L. at 23.25; *D. alata* L. at 9,30; and *D. pentaphylla* L. at 5.50. The highest total color difference ( $\Delta E$ ) was performed by *D. bulbifera* L. at 77.75

and followed by *D. hispida* Dennst. At 75.70; *D. alata* L. at 69.99; and *D. pentaphylla* L. at 69.86.

Chemical analyses consist of proximate analysis, fiber content and HCN content. Moisture content of *Dioscorea* spp tubers were varied between 76.43% to 85.69% higher than 69.5% to 80.2% [12] but still in the interval of 71.06% to 92.48% [13]; 76.36% to 92.01% [14]; and 69.7% to 87.0% [15]. The tubers with lower water content could be stored for a long time and more efficiently processed on an industrial scale [16].

Tuber ash content varied between 0.62% to 1.02% which are very low compared to 2.60% to 6.36% [14] and 2.48%

to 8.50% [13 but still corresponds to 0.5% to 1.2% [12] and 0.35% to 1.23% [15]. While the fat content based on fresh weight was 0.13% to 0.14% which are lower than 0.2% to 0.3% [12].

Protein levels of 1.57% to 3.85% corresponds to 1.6% to 3.1% based on fresh weight [12] [12] and are very low compared to 6.48% to 13.42% based on dry weight [14]; 5.25% to 15.75% [14] and 8.13% to 15.07% [15].

Carbohydrates content based on fresh weight was found varied between 11.86% to 19.48%, lower than 17.4% to 25.9% [12]. Crude Fiber content were 0.43% to 1.28%, lower compared to 0.6% to 1.5% based on fresh weight [12]; 3.48% to 7.69% based on dry weight [14]; 3.21% to 9.23% [13]; 1.62% to 6.88% [15]; and 0.67% to 1.50% [17].

The content of Cyanide Acid (HCN) based on fresh weight were 10.81 ppm to 39.80 ppm which are very high compared to 3.2 mg.kg<sup>-1</sup> to 6.0 mg.kg<sup>-1</sup> (Bhandari, MR and Kawabata, J., 2004); and 49.70 mg.100g<sup>-1</sup> to 79.40 mg.100g<sup>-1</sup> [18]. However, the high content of HCN can be reduced/eliminated by processing it before consumption by washing after peeling the tuber, soaking it with water for 9 hours or soaking it in sodium bicarbonate solution for 9 hours or cooked it for 90 minutes or steaming it at 121°C with a pressure of 15 lbs. [13]; tubers then cut into thin slices and soaked in salt water for 3 days, after which they are put in sacks and soaked in running water for 3 days by the Redang Island community, Malaysia [19]; thinly cut and boiled for two days by communities of Papua New Guinea [20] and boiled with wood ash for a long time by the Sakai tribe, Thailand [21].

The variations of the tubers physical characteristics consist of the value of brightness level (L), red (a), b (yellow), and the total color difference (maupunE) as well as variations in the chemical characteristics of the tuber namely the proximate composition, fiber content and HCN content of the four yam plant species (*Dioscorea* spp.) explored from Manokwari Regency are related to genetics, soil fertility, location, and age of plants [22]; genetic differences [17].

#### IV. CONCLUSION

The physicochemical characterization of tubers from four yam species plants explored in the Manokwari Regency region showed variations influenced by genetic differences, soil fertility, location, and age of plants.

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