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Research Article

# NUTRITIONAL EVALUATION OF SOME WILD EDIBLE TUBEROUS PLANTS AS AN ALTERNATIVE FOODS

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**ABSTRACT**

**Objective:** The objective of this study was to determine the nutritional composition of wild edible tuberous plants that have potential as an alternative food in Lokop, Aceh.

**Methods:** Wild edible tuberous plants were collected from Lokop forest, East Aceh district, Aceh (Indonesia), in June 2016. The nutritive value of the wild edible tubers used as alternative food plants by local people in Lokop village, Aceh, Indonesia, was assessed by their nutritional composition.

**Results:** A total of five wild edible tuberous plant species were founded in Lokop forest, i.e., *Amorphophallus muelleri* Blume (Araceae), *Dioscorea hispida* Dennst. (Dioscoreaceae), *Homalomena philippinensis* Engl. (Araceae), *Tacca chantrieri* André (Taccaceae), and *Tacca minor* Ridl. (Taccaceae). The fat crude concentrations varied from 0.18% (*A. muelleri*) to 1.33% (*T. minor*) and the protein content ranged from 1.72% to 4.27%. *Homalomena philippinensis* has highest carbohydrates and Vitamin C which were 26.9% and 1.144 mg/g, respectively.

**Conclusion:** This result indicated that the species have a good nutritional content and have suitable for use as an alternative food source. This information may serve as a basis for increased consumption and utilization.

**Keywords:** Wild edible plants, Proximate, Alternative food, Lokop, Aceh.

## INTRODUCTION

Many local people in the world were living near the forest use the wild edible plants as food resources [1-7]. These are free and easily collected by the local people as a good source of nutrients. Wild edible plants provide carbohydrates, fats, proteins, and minerals that are important to human life [8]. Some of the edible wild plants are regularly consumed by local people in Lokop in the form of staple food. Many wild species may constitute an interesting genetic resource for the development of new food sources which could be used as alternative food and select promising types of domestication [9].

The Lokop village is located in the eastern part of Aceh, Indonesia. These villages have large forest enriched with floristic diversity and plant resources. Preliminary observation indicates that people in Lokop village mostly use wild tuber plants as food. Nevertheless, until now, there is no information on the nutritional composition of wild edible tubers used by local people in Lokop village. In fact, this information is very important in improving food security for them. Proximate analysis of wild edible plants is the right way of assessing they're nutritional [10]. The utilization of wild edible tuberous species by the local people in the Lokop village for their diet motivated us to carry out the present nutrient analysis. The objective of this study was to determine the nutritional composition of wild edible tuberous plants that have potential as an alternative food in Lokop, Aceh.

## MATERIALS AND METHODS

### Collection and preparation of the sample

Wild edible tuberous plants were collected from Lokop forest, East Aceh district, Aceh (Indonesia), in June 2016 (Fig. 1). Each species that has been found in the field was placed in a polythene bag to prevent loss of moisture during transportation to the laboratory. We collect these plants in stems, leaves, flowers, and tuber conditions for the correct botanical identification. The plant was identified in the Laboratory of Biology, University of Samudra, while the proximate analysis was conducted at the Food Analysis Laboratory of the Faculty of Agriculture, Syiah Kuala University. Tubers were washed with distilled water, weighted, cut into small pieces, and dried at 40°C until constant weight was obtained. The dried samples ground into powder using an electric grinder. The samples were packed into bottles and stored in the refrigerator.

### Proximate analysis

Crude fat was determined using Soxhlet methods. Crude protein content was analyzed using the Kjeldahl procedure. Crude fiber content was determined in accordance with the standard methods of the AOAC [11]. Carbohydrate content was determined according to the following formula: Carbohydrate (%) = 100 - (Moisture + Ash + Crude protein + Crude fat) [12]. The Vitamin C content present in fresh tuber was determined by the iodine titration method [13]. Carbohydrate content was determined by the difference method according to the following formula: Carbohydrate (%) = 100 - (Moisture + Ash + Crude protein + Crude fat) [12]. The Vitamin C content present in fresh tuber was determined by the iodine titration method [13].

### Interviews regarding the traditional utilization of wild edible plants

When the wild edible plants were collected, local people were interviewed about the traditional use of the plants. For each plant, as many as 10 people were interviewed, both women and men of different ages, all of whom had lived in Lokop. This interviews to obtain information on knowledge of traditional habits for consumption, processing, and storage of wild tuberous plants.

## RESULTS AND DISCUSSION

### Ethnobotanical of the wild edible tuberous plants in Lokop

A total of five species of the wild edible tuberous plants has been found in the Lokop forest, East Aceh, Indonesia. The species has been used by local people as an alternative foodstuff (Table 1).

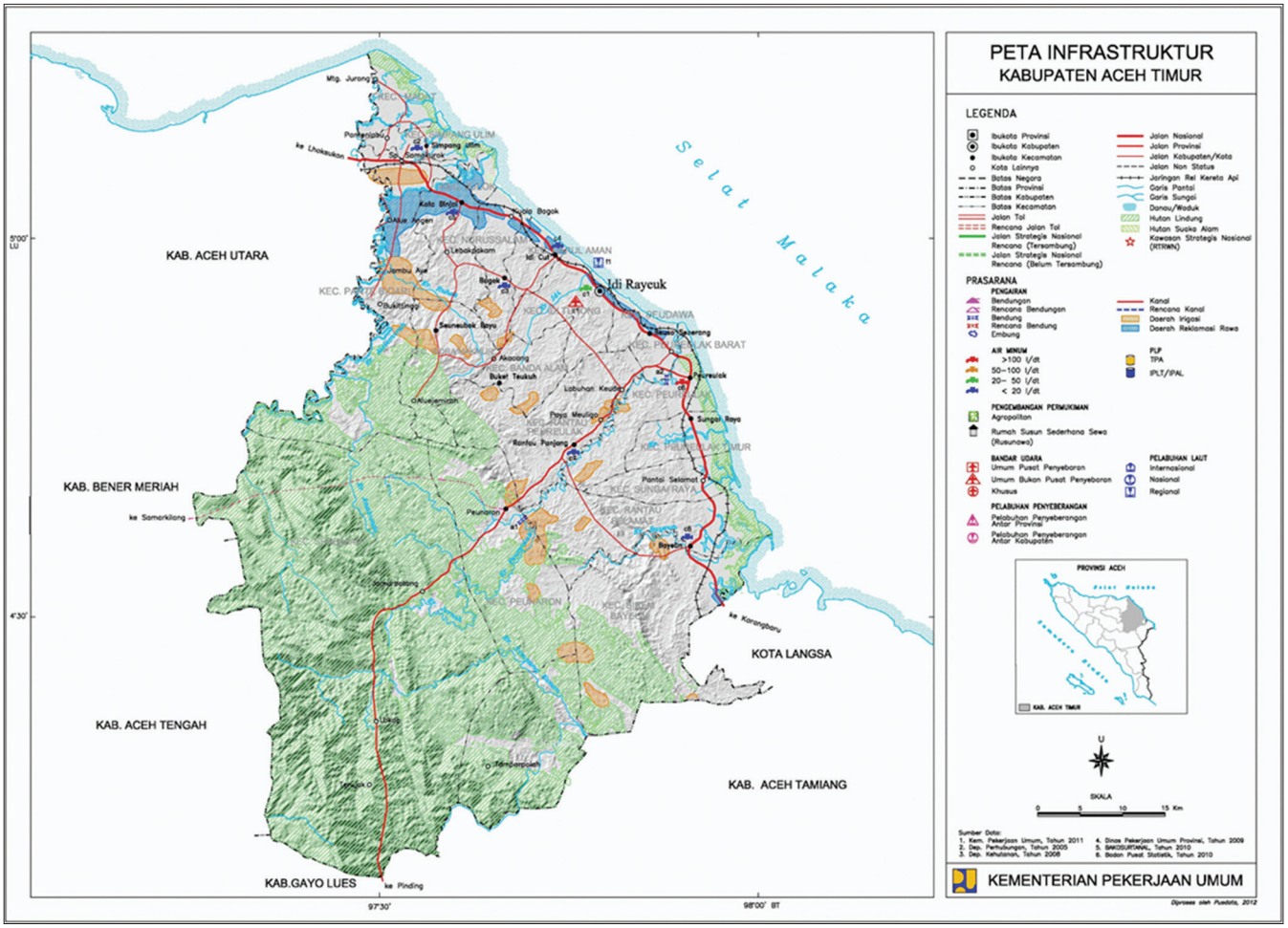


**Fig. 1: Study site for collecting edible tuberous plants**

**Table 1: Description of the wild edible tuberous plants and its ethnobotanical information**

| Botanical name | Family | Local name | Habit | Local preparation and consumption |
|---|---|---|---|---|
| *Amorphophallus muelleri* Blume | Araceae | Rekil | Shrub | Tuber peeled, cut into small pieces, immersion in salt water, boiled or steamed |
| *Dioscorea hispida* Dennst. | Dioscoreaceae | Janeng | Climber | Tuber peeled, cut into small pieces, immersion in salt water, boiled, steamed or fried |
| *Homalomena philippinensis* Engl. | Araceae | Lange | Herb | Tuber peeled, cut into small pieces, immersion in salt water, boiled, or steamed |
| *Tacca chantrieri* André | Taccaceae | Dengrawan | Shrub | Tuber peeled, cut into small pieces, immersion in salt water, boiled |
| *Tacca minor* Ridl. | Taccaceae | Grenseng | Shrub | Tuber peeled, cut into small pieces, immersion in salt water, steamed |

Local people in Lokop village, East Aceh district, are known to have used *Amorphophallus muelleri* tuber for a long time. They picked up the tubers in the forest around their dwellings to boil and serve as food. Amorphophallus tuber has long been consumed by Lokop villagers since the war of independence. They use Amorphophallus tuber as food because they are very difficult to obtain tuber as food. Currently, local people in the Lokop village to still harvest Amorphophallus tuber directly from nature.

Amorphophallus tubers cannot be processed directly into foodstuffs but must go through a process of immersion in the salt solution and boil before eating. Amorphophallus tuber causes vomiting and itching of the tongue and esophagus when eaten raw. Amorphophallus tuber has a Ca-oxalate that it feels itchy if eaten raw [14]. The immersion process in salt solution can accelerate the dissolution of Ca-oxalate and other phytoconstituents in Amorphophallus tuber. Processing by immersion in salt water will facilitate the occurrence of hydrolysis which causes the dissolution of calcium oxalate in the immersion water [14]. The reaction that occurs between calcium oxalate and salt produces sodium oxalate and potassium chloride. The boiling process will also decrease the levels of calcium oxalate in Amorphophallus tubers [14]. Amorphophallus tuber is believed by the local people in Lokop which can prevent diabetes and cancer. Amorphophallus tuber has a chemical content of glucomannan which may perform various physiological functions related to the digestive system, diabetes, and heart diseases [15]. This tuber also is known to contain phytoconstituents such as alkaloids, steroids, and flavonoids [16]. Flavonoids have a wide range of therapeutic effects for cancer [17].

*Dioscorea hispida* was found growing wild in the Lokop forest, and some of the local people have cultivated it in the fields. *D. hispida* produces tuber which was used by local people as food. This plant requires the host plant as a place to propagate. Utilization of the Dioscorea tuber as food by Lokop community is still very limited because this tuber can

**Table 2: Proximate composition of wild edible tuberous plants in Lokop**

| Sample | Moisture (%) | Ash (%) | Total carbohydrate (% dry weight) | Crude fat (%) | Crude protein (%) | Crude fiber (%) | Vitamin C (mg) |
|---|---|---|---|---|---|---|---|
| *Amorphophallus muelleri* Blume | 80.24±0.310 | 0.157±0.063 | 14.66±0.234 | 0.18±0.006 | 3.82±0.028 | 0.92±0.006 | 0.88±0.006 |
| *Dioscorea hispida* Dennst. | 72.69±0.303 | 0.497±0.044 | 20.19±0.139 | 0.99±0.006 | 4.27±0.048 | 1.35±0.006 | 0.70±0.013 |
| *Homalomena philippinensis* Engl. | 69.79±0.299 | 0.001±0.001 | 26.90±0.234 | 0.28±0.005 | 2.14±0.014 | 0.87±0.007 | 1.14±0.004 |
| *Tacca chantrieri* André | 75.25±0.342 | 0.634±0.004 | 18.63±0.207 | 0.31±0.006 | 2.58±0.020 | 2.58±0.001 | 0.35±0.001 |
| *Tacca minor* Ridl. | 83.06±0.208 | 1.212±0.014 | 10.28±0.089 | 1.33±0.005 | 1.72±0.023 | 2.38±0.005 | 0.26±0.002 |

cause nerve disorders. This tuber is known to contain cyanide that can cause poisoning and deadly [18]. This compound will cause dizziness and vomiting if consumed without going through a special process. However, the toxic compound may be removed by immersing Dioscorea tubers into salt or ash water. This immersion can also be done on water that does not flow by replacing the water immersion once every 4 h. Then, the tuber was washed with running water for 2 days. In general, local people treat the Discorea tuber by boiling or steaming and eaten them with grated coconut mix sugar.

Lokop villagers have long consumed Dioscorea tuber as a foodstuff. They believe that consuming Dioscorea tuber can lower the risk of high blood pressure and lower cholesterol levels. Dioscorea tuber is also known to contain dioscorin, diosgenin, and dioscin which are very important for health [19,20]. Dioscorin may inhibit angiotensin-converting enzymes that can increase renal blood flow and lower blood pressure *in vivo* and *in vitro* [21,22]. Dioscorin also showed the activity of carbonic anhydrase enzyme, trypsin inhibitor, dehydroascorbate reductase, and monodehydroascorbate reductase [23]. Diosgenin plays an important role in regulating cholesterol metabolism, reducing the risk of heart disease, lung, and blood cancer [24] and has an estrogenic effect [25].

*Homalomena philippinensis, Tacca chantrieri*, and *Tacca minor* are plants that produce tubers that can be consumed by local people in Lokop. According to informed people who have ever consumed them, the plant tubers have a distinctive taste and aroma. The utility of these tubers is still limited only if they stay in the forest to hunt animals. In general, the tubers are processed by steaming or boiling. To avoid the presence of harmful compounds, they generally soak the tuber pieces in salt water.

**Proximate composition of wild edible tuberous plants in Lokop**

The moisture, protein, fat, carbohydrate, fiber, Vitamin C, and ash composition from five species are shown in Table 2.

The moisture content of tubers ranged from 69% to 83% moisture of fresh weight with the highest being in a tuber of T. minor (83.06%) and the lowest content in *H. philippinensis* (69.79%) and similar to wild edible tuberous plants such as *Brachystelma edulis* (80.84%), *Ceropegia bulbosa* (78.24%), and *Ceropegia hirsuta* (75.82%) [26]. The high carbohydrate content was found in a tuber of *H. phillipinensis* (26.9%), and *T. minor* tuber has the lowest content (10.28%). Carbohydrate content in *H. philippinensis* tuber was higher than other tubers such as *Solanum tuberosum* (20.63%) [27], *Ipomea batatas* (20,71%), and *Colocasia esculenta* (18.02%) [28]. For the organic nitrogen content, expressed in terms of proteins (nitrogen × 6.25), the highest values were found in *D. hispida* tuber (4.27%), while the lowest was in *T. minor* (1.72%). These observations suggest the relative dietary importance of *D. hispida* tuber to the improvement of the protein content of foods made from them.

The fiber content of tuber plants varied between 0.87% and 2.58%. The tubers of *T. chantrieri* have the highest crude fiber content on average 2.58%. Fiber is known to help to prevent many diseases prevalent in the community such as maintaining digestive and cardiovascular health [29,30]. It also helps regulate blood sugar levels [31]. Low in fat (0.315%) while rich in fiber (2.582%) can make tubers of *T. chantrieri* attractive and healthy food component to be consumed safely and securely by people.

The fat content of the different tuber samples varied from 0.28% (*H. philippinensis*) to 1.33% (*T. minor*) similar with *Costus speciosus* (0.14%) and *Pueraria tuberosa* (1.68%) [32] but less amount in comparison with *Stephania glabra* (2.23%), *Pueraria thomsonii* (2.45), and *Cassimiroa edulis* (1.48%) and greater amount in comparison with *Careya arborea* (1.02%), *Aesculus assamica* (0.51%), and *Canna edulis* (0.30%) [33]. Fat is another important component of starch that has a strong effect on the starch properties. The formation of the starch-lipid or starch-surfactant complexes improves the textural properties of various foods [32]. The low-fat content of the tuber makes it safe for consumption by people in the era where obesity possesses a serious threat to health and life of people. It can, therefore, frequently be consumed by individuals on weight reduction.

*H. philippinensis* tuber is a plant that has the highest Vitamin C content compared to other plant tubers in the study sites. Vitamin C is an important element in maintaining the health of the human body. Vitamin C is needed to maintain the structure of collagen and a type of protein that connects all the tissues of fibers, skin, veins, cartilage, and other tissues in the human body. A good collagen structure can heal broken bones, bruises, small bleeding, and minor injuries [34]. As an antioxidant, Vitamin C is able to neutralize free radicals throughout the body [35]. In some further research turned out, Vitamin C has also been proven to play an important role in improving the work of the brain. The students whose Vitamin C levels are higher in blood have resulted in better IQ tests than those with lower Vitamin C [36].

## CONCLUSION

A total of five wild edible tuberous plant species which were consisting of three families were found in Lokop forest. The fat crude content of wild edible tuberous plants ranged between 0.18% and 1.33% and the protein content ranged from 1.72% to 4.27%. *Homalomena philippinensis* has highest carbohydrates and Vitamin C which were 26.9% and 1.144 mg/g, respectively. This result indicated that the species have a good nutritional content and suitable for use as an alternative food source. This information may serve as a basis for increased consumption and utilization.

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## CONFLICTS OF INTEREST

The authors have no conflicts of interest.

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