The Potential Of Taka Plants (Tacca Leontopetaloides (L.) Kuntze) As Food Sources In Bangka Belitung Archipelago, Indonesia

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Abstract

The world's food needs are increasing, thereby encouraging people to look for new food sources based on biological resources. Indonesia as a tropical mega-biodiversity country has the potential for diverse food sources, including tuber-based foods, such as the taka plant (Tacca leontopetaloides (L.) Kuntze). Specifically, in Bangka Belitung Archipelago, Indonesia, this plant can be found in Membalong, Simpang Pesak, and Manggar. The problem is that this plant as a carbohydrate food source has not been used optimally by the wider community. This study was carried out qualitatively and quantitatively. Data were collected through open and free interviews with local communities, and direct field observations. Preliminary research was conducted at Herbarium Bogoriense, which investigated the morphology and distribution of the taka plant. The results of this study indicate that the people of Belitung Island use the tubers of the taka plant as the basic ingredients for making rintak cakes and crackers through traditional processes. Based on the local knowledge of the people of the Bangka and Belitung Archipelago, then proximate and mineral analysis was conducted, in which the samples were the tubers of the taka plant from those two islands. The outcome of the analysis shows that the carbohydrate content of the taka plant was 84.97-86.72%, and the

starch content was 91.82%. Therefore, the use of these local tubers as an alternative to flour can be further developed to reduce dependence on wheat flour. The use of coastal land can be optimized with this plant of domestication effort.

Keywords: Tacca leontopetaloides, local food security, tuber carbohydrates, local knowledge

Introduction

The world's food needs are increasing, encouraging people to look for new food sources based on biological resources. Food diversification efforts are a mandatory prerequisite for the realization of food security, which is one of the global issues listed in the 2030 Sustainable Development Goals (SDGs) agenda, specifically in the 2nd goal, namely Zero Hunger, aiming at ending hunger, achieving food security, improving nutrition, and promoting sustainable agriculture (http://sdgsindonesia.or.id/; Tiba, 2023; Vogliano et al., 2021).

In Indonesia, food diversification is carried out as an activity to find and develop natural resources which have the potential to be a food source for rice substitution. Rice is the staple food for most Indonesian people with the popular slogan that they do not feel full if they have not eaten rice. The problem is that those who eat 1.5 times more white rice are more likely to develop diabetes than those who eat small portions of rice (Anonymous, 2019). Diabetes Mellitus (DM) is a group of metabolic diseases characterized by high blood sugar levels (Pramukamto et al., 2018).

The Indonesian population is the largest rice consumer in the world with a consumption rate of 154 kg per person per year. In comparison, the consumption rate of rice in several countries in the world is as follows: China with only 90 kg, India with 74 kg, Thailand with 100 kg, and the Philippines with 100 kg. Food dependence on one type of food source (e.g., rice) may result in food vulnerability. The majority of Indonesian people know rice as a food crop even though Indonesia as an archipelagic country has a wealth of biodiversity, especially those plants that may serve as a food source.

The initial step in substituting rice plants as a food

source can be carried out by identifying the carbohydrate content as the main element of rice. White rice is a type of rice commonly consumed by the people of Indonesia. The nutritional content per 100 grams of white rice is 360 kcal of energy, 6.6 grams of protein, 0.58 grams of fat, and 79.34 grams of carbohydrates (Suliartini et al., 2011). Carbohydrates are contained in some parts of plants, including tubers. The taka plant (English: Polynesian arrowroot) (scientific name: Tacca leontopetaloides (L.) Kuntze) is a plant whose tubers can be used. This plant is presumed to have a fairly high carbohydrate or starch content. According to Farley et al. (2018), the results of the analysis of archaeological evidence indicate that starch content has been known in the initial period of intensive cleaning and gardening from around 3000-2000 BC. They added that Polynesian arrowroot (Tacca leontopetaloides), bananas (Musa spp.), yam (Dioscorea spp.), Tahitian chestnut (Inocarpus fagifer), and breadfruit (Artocarpus sp.) have been cultivated on Ulong Island, Palau, Philippines at that time.

This plant is classified as a plant that may adapt to climate change and is spread on the coast. Moreover, this species has been used by the community, especially those who live on the coast and small islands. However, it has never been cultivated optimally. To address this problem, it is necessary to understand the nutritional content of the 'taka' plant, how to use the plant based on local knowledge, its post-harvest process, and benchmarking of its utilization in other areas. This study was carried out to substitute rice or wheat flour with the 'taka' plant which has high carbohydrate potential. This community-based study was conducted in Bangka and Belitung Is 'taka' lands to determine the ability and knowledge of the community in these islands in utilizing the 'taka' plant as an alternative food source. In analyzing the nutritional content of the 'taka' plant, the researchers conducted a proximate analysis to test the carbohydrate content and other nutritional values contained in this plant.

In this study, the researchers investigated how people in Bangka Belitung Province, specifically those living on the outskirts of the coast, maximize the potential of the taka plant as a food source. Because the location where this

plant grows is close to and/or even in a tourism area, this study needs to be carried out for conservation purposes, thereby encouraging the development of cultivation and diversification of 'taka' plant-based processed foods.

Materials and Methods

This study was carried out qualitatively and quantitatively. We collected data through open and free interviews with local communities and direct field observations. Furthermore, respondents were selected using purposive sampling (Martin 1995, Walujo 2004). A preliminary research was conducted at Herbarium Bogoriense, which investigated the morphology and distribution of the 'taka' plant. The samples of 'taka' plants were collected from Bangka and Belitung Islands. In this study, we dug for knowledge and information from the local community.

Furthermore, it was followed up by conducting more in-depth interviews with people who have knowledge of the 'taka' plant, including housewives who pratice the 'taka' plant as an everyday food. For gaining proximate contents (ash, fat, protein, crude fiber, and carbohydrates), samples were analyzed using the method recommended by AOAC, 1984. Furthermore, proximate and mineral analyses of tubers and starch of 'taka' plants originating from Belitung and Bangka archipelago were carried out at the Research and Development Center for Indonesian Agricultural Post-Harvest Crops, Agricultural Research Agency, Ministry of Agriculture. The performed analysis methods were as follows: ash content was measured gravimetrically; protein content was analyzed by Kjeldahl's method; fat content was analyzed using Soxhlet's method; crude fiber was analyzed by gravimetric method; carbohydrates were analyzed by titration method; calculation of Mg, Fe, Ca, and K was carried out by using AAS (Atomic Absorption spectrophotometry); the calculation of P was conducted by using a spectrograph. The specimen of Tacca leontopetaloides from Bangka Island in Herbarium Bogoriense is a collection of CA Backer taken on April 29, 1919.

This study was located in Bangka and Belitung Archipelago. These two islands are in the administrative region of Bangka Belitung Province, Indonesia. In addition, these

islands are surrounded by small islands. Small islands around Bangka Island are Nangka, Penyu, and Panjang Islands. Meanwhile, small islands surrounding Belitung Island are Lima, Lengkuas, and Seliu Islands. The coordinates of Bangka Belitung Province are 104°50'-109°30' E and 0°50'-4°10' S. Furthermore, this province is bordered by Natuna Sea in the north, Karimata Strait in the east, the Java Sea in the south, and Bangka Strait in the west (see **Figure 1**). Geographically, this province is divided into several parts of land and sea with an area of 81,725.06 km^2, in which the land covers an area of 16,424.06 km^2 (20.10%), while the sea covers an area of 65,301 km^2 (79.90%). Administratively, this province is divided into 6 regencies and 1 city, namely Bangka Regency, West Bangka Regency, Central Bangka Regency, South Bangka Regency, Pangkal Pinang City, Belitung Regency, and East Belitung Regency. The total population of this province is 1,469,800 people, consisting of 756,900 men and 712,900 women. Overall, the average temperature in this province is 27.3°C (from 22.50°C to 34.29°C) with an average humidity of 80.3 (32.0-99). In addition, rainfall per year is around 2073.3 mm with 196 rainy days (Indonesia's Central Statistics Agency, 2021).

Melalatoa (1995) states that Belitung Island is also known as Biliton Island. The name Biliton is mainly found in books published during the Dutch colonial era. Furthermore, the Malays living on this island call themselves Urang Belitong. Similarly, the Malays living in Bangka Island often call themselves as Orang Bangka. In addition to the Malay community, Belitung and Bangka Islands are also inhabited by Chinese people and immigrants from Sumatra, South Sulawesi, Bali, and Bawean Islands.

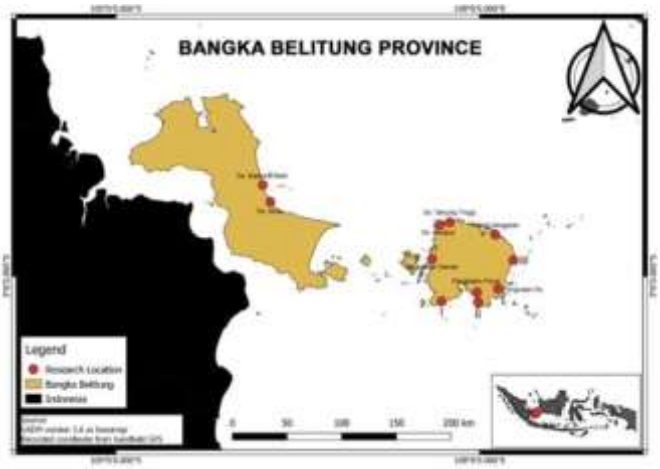

Figure 1. Research location in the of Bangka Belitung Provinces: I. Membalong District, II. Tanjung Pesak District, and III. Manggar District, in which their people utilize Tacca leontopetaloides

Results

The Morphology of 'Taka' Plants Found in Bangka and Belitung Provinces

Indonesia is rich in species of tubers which are a source of carbohydrates. Some of them can be an alternative solution for developing carbohydrate resources. Those that have been widely known for having these characteristics are potatoes and cassava. Another plant that has similar characteristics is the 'taka' plant (Tacca leontopetaloides (L.) Kuntze) which is commonly found in several locations in Bangka Belitung Province. On Belitung Island, this plant can be found in Badau District (Sungai Samak Village), Membalong District (Teluk Gembira Beach and Tanjung Nyabung Beach), and Sijuk District (Keciput Village having Tanjung Tinggi Beach), Tanjung Klumpang Villages having Pangkalan Punai Beach and Pangkalan Ru Beach, and Mayang Village having Sengaran Beach). Meanwhile, on Bangka Island, this plant is found on Padi Beach, Baskara Bakti Village, and Mulia Village, Namang District, Central Bangka Regency. All of these plant discovery sites are near tourist beaches or even within tourist areas (see **Figure 1**).

People on Belitung Island recognize the 'taka' plant as 'nubong' although the name is less well known in general. The name 'nubong' is spread in the southern part of Belitung Regency, namely Padang Kandis (Batu Lobang), Perepat, and Mentigi Villages, Membalong District. Meanwhile, in East Belitung Regency, this plant is known with the name 'genubong', spreading in Lalang Village, Manggar District and Tanjung Klumpang Village, Simpang Pesak District. Even though, these people from different regions recognize this

plant with different names, the scientific name of this plant is still the same, not changing.

The 'taka' plant belongs to the family Taccaceae. They are wild plants, which mostly grow in coastal areas with an altitude of less than 200 meters above sea level. In Belitung, this plant is known as 'nubong' and 'genubong'. Meanwhile, in Central Bangka, it is called 'keladi kecubung'.

The 'taka' plant is a bulbous herbaceous plant that can grow up to 2 m in height. Its tubers are rounded, flattened or broadly pointed, thin-skinned, and light brown when young and turning dark gray or dark brown when old. The inside is milky white. Furthermore, this plant grows below the soil surface to a depth of 50 cm. In its growth, the tubers that are formed first are usually small and grayish brown in color. Meanwhile, the tubers that grow later are lighter in color, larger in size, and have varied shapes based on their natural habitat. From its proportions, in one plant, there can be only vegetative individuals with varying numbers from one to four. However, some can also consist of vegetative and generative individuals.

In the research locations, we found 8 variations of habitus, as follows.

1. Having 1 vegetative phase habit and 2 rounded and elongated tubers.
2. Having 2 vegetative phase habits and 2 rounded and elongated tubers.
3. Having 3 vegetative phase habits and 2 rounded tubers.
4. Having 4 vegetative phase habits and 2 rounded tubers.
5. Having 1 vegetative phase habit, 1 generative phase habit, and 2 rounded and elongated tubers.
6. Having 2 vegetative phase habits, 1 generative phase habit, and 2 rounded and elongated tubers.
7. Having 3 vegetative phase habits, 1 generative phase habit, and 2 rounded tubers, and
8. Having 1 vegetative phase habit, 2 generative phase habits, and 2 rounded tubers.

The morphology of those variations can be seen in **Figure 2**.

Figure 2. Morphological variation of 'taka' plants from Bangka Belitung Province

Variations 1 to 8 indicate that the 'taka' plant has a variety of shapes, characteristics, textures, and sizes based on soil fertility, climate, and salinity levels. The leaves are 1-3 strands, wide breech egg round in shape, having leaf spines, and greenish-white in color. Each lobe segment is pinnate and the lobes are rounded or tapered.

The best vegetative growth found on Bangka and Belitung Islands reached 96 cm with the tuber growth reaching 550 g and having a diameter of 14.5 cm, originating from Mulia Village, Central Bangka. The data on the weight of the main tubers (tuber 1) and the child (tuber 2) of the 'taka' plant are shown in **Table 1**.

Table 1. The average weight of tubers of 'taka' plants found at the research locations on Bangka and Belitung Islands

No	Research Locations	Tuber 1 (g)	Tuber 2 (g)
1	Sungai Samak	70	22.5
2	Keciput	92.01	68.01
3	Tanjung Tinggi	66	30
4	Tanjung Klumpang	77	40.1
5	Mayang/Sengaran	255	58
6	Baskara bakti	32.5	50
7	Mulia	167.5	281.66

Habitat of Tacca

The 'Nubung' or 'genubong' or 'taka' (Tacca leontopetaloides) has a wider distribution and is different from other species in the genus Tacca; this species is rarely found in primary forests but prefers secondary forests and shrubs and is often found in open areas, grasslands, coconut groves, and coastal vegetation (Drenth, 1976). On Belitung Island (Samak River), 'taka' often grows around reeds (Imperata cylindrica). However, several other plants exist, such as 'pace' (Morinda citrifolia), 'tembelekan' (Lantana camara), 'seruni', 'asau', and others (see **Figure 3**). In this area, plants are generally found in the flowering state, having two round tubers, namely the main tuber at the bottom of the stem and the child tubers on the side. The size of the main tubers is generally larger than the child tubers. In Keciput Village, the soil and vegetation conditions are the same as in the Samak River, but the plants are generally already bearing fruit in this area. In the village of Tanjung Tinggi, 'taka' also grows around the reeds; some grow in the shade of the Morinda citrifolia tree and grow better and taller. At Pangkalan Punai Beach, Tanjung Kelumpang Village, 'taka' grows under coconut trees (Cocos nucifera), and many are found still in the juvenile stage. The mature 'taka' plants and aged fruits are prominent on Pangkalan Ruk Beach, which is close to Pangkalan Punai Beach. 'Taka' also grows around reeds, ensuring they do not disrupt community activities. At Sengaran Beach in Mayang village, 'taka' plants thrive abundantly.

Tacca's research in Bangka started from the beaches around Pangkal Pinang; from several beaches (Tanjung Bunga Beach, Sanfur, and Batu Be Lubang), no 'taka' was found. In Bangka Regency, from several locations visited (Matras Beach, Tenggiri Beach, Tanjung Kalayang, Tanjung Ular, and Batu Bedaun), 'taka' was not found. Then, the search continued for 'taka' to Central Bangka Regency and found 'taka' in Tanah Merah, Baskarabakti Village, and Mulya Village. In Baskarabakti, in this area 'taka' with its flowers that dry up and grow among the reeds. In Mulya Village, the growth of 'taka' is almost the same as in Baskarabakti, where the flowers dry up, but in this area, the growth of the tubers is better and bigger. The growth of

'taka' is most abundant in Mulya village, on average, the leaves have turned yellow. Almost all the plants whose tubers were taken were quite large, and in this area all the plants observed had child tubers, larger than the main tubers.

The results of observations of the growth of 'taka'in Belitung and Bangka Islands taken randomly showed that the main tubers were generally larger than the child tubers, except in Mulya Village, on average the child tubers were larger than the main tubers. In Belitung and Bangka, one plant generally has two tubers with two different shapes, namely both round or one round and one elongated. In some locations, the leaves are turning yellow; some may be old if you look at the old fruit, but some are turning yellow because the weather is too hot; this can be seen from the yellowing leaves and the dried flowers.

Figure 3. Habitat of Tacca

The Potential and Utilization as a Food Source

The 'taka' plant (Tacca leontopetaloides (L.) Kuntze) contains starch (amylose and amylopectin) which is similar to potatoes. Their fresh tubers cannot be consumed directly because they have taccalin compounds that cause a bitter taste. Therefore, it is necessary to process it first to become flour.

The outcome of this study is information related to the use of the 'taka' plant based on local knowledge of people living in the Bangka and Belitung Islands, which

becomes the basis for proximate analysis. The obtained values regarding proximate content were compared with the recommendation from the AOAC 1984: 2.28-2.52% for ash content, 5.92-6.08% for protein, 0.42-0.54% for fat, 1.27-3.17% for crude fiber, 84.97-86.72% for carbohydrates, 369.06-374.34 kcal/100g for energy, 51.73-104.02 mg/100g for magnesium, 0.04-2.89 mg/100g for iron, 42.43-50.07 mg/100g for calcium, 31.63-51.72 mg/100g for potassium, 238.37-253.36 mg/100g for phosphorus, and 0.08-0.33 mg/100g ppm for lead (Pb).

The results of chemical analysis (proximate and mineral) indicate that tubers of 'taka' plants collected from Belitung Island contained 2.28% ash, 6.08% protein, 0.54% fat, 1.27% crude fiber, 84.97% carbohydrates, 369.06 kcal/100g available energy, 104.02 mg/100g magnesium, 0.04 mg/100g iron, 50.07 mg/100g calcium, 31.63 mg/100g potassium, 253.36 mg/100g phosphorus, and 0.08 mg/100g ppm for lead (Pb).

The people utilize starch of Tacca leontopetaloides in Membalong subdistrict, Tanjung Pesak subdistrict and Manggar subdistrict in Belitung Island. The results of chemical analysis (proximate and mineral) indicate that starch of 'taka' plants collected from Belitung Island contained 0.23% ash, 0.52% protein, 0.65% fat, 0.12% crude fiber, 91.82% carbohydrates, 374.54 kcal/100g available energy, 23.59 mg/100g magnesium, 3.84 mg/100g iron, 23.59 mg/100 g calcium, 5.25 mg/100g potassium, 207.65 mg/100g phosphorus, and 0.29 ppm Pb.

Meanwhile, the results of chemical analysis (proximate and mineral) of tubers of 'taka' plants collected from Bangka Island indicate containing 2.52% ash, 5.92% protein, 0.42% fat, 3.17% crude fiber, 86.72% carbohydrates, 374.34 kcal/100g available energy, 51.73 mg/100g magnesium, 2.89 mg/100g iron, 42.43 mg/100g calcium, 51.72 mg/100g potassium, 238.37 mg/100g phosphorus, and 0.33 mg/100g ppm Pb. The obtained results are summarized in **Table 2**.

Table 2. Comparison of nutritional contents of tubers and starch of 'taka' plants obtained from research locations in Bangka and Belitung Archipelago

No	Nutritional Contents	Tubers of Tacca		Value Range	Tacca Starch (Belitung)
		Bangka Island	Belitung Island		
1	Ash Content (%)	2.52	2.28	2.28-2.52	0.23
2	Proteins (%)	5.92	6.08	5.92-6.08	0.52
3	Fat (%)	0,42	0.54	0.42-0.54	0.65
4	Crude Fiber (%)	3.17	1.27	1.27-3.17	0.12
5	Carbohydrates (%)	86.72	84.97	84.97-86.72	91.82
6	Energy (kcal/100gr)	374.34	369.06	369.06-374.34	374.54
7	Magnesium (Mg) (mg/100gr)	51.73	104.02	51.73-104.02	23.59
8	Iron (Fe) (mg/100gr)	2.89	0.04	0.04-2.89	3.84
9	Calcium (Ca) (mg/100gr)	42.43	50.07	42.43-50.07	23.59
10	Potassium (K) (mg/100gr)	51.72	31.63	31.63-51.72	5.25
11	Phosphorus (P) (mg/100gr)	238.37	253.36	238.37-253.36	207.65
12	Lead (Pb) (ppm)	0.33	0.08	0.08-0.33	0.29

Based on the summary of the results of the measurement of the nutritional content of the 'taka' plant in Table 2, the samples from Bangka Island had a higher carbohydrate content than those from Belitung Island, which was 86.72% with caloric energy of 374.34 kcal/100gr. However, the levels of protein, fat, magnesium, calcium, and phosphorus were found higher in those from Belitung Island, namely 6.08%, 0,54%, 104.02, 50.07, and 253.36 mg/100 g, respectively.

The carbohydrates of tubers of the 'taka' plant from Bangka Island tended to be higher than those from Belitung Island. This is presumed because the tubers found on Bangka Island are older or the environmental influences are more supportive of the growth of the plants. According to Pratama (2015), the soil conditions that best support the growth of this plant are having 4.60-5.95 for pH, 3.91-4.27% for carbon, 0.28-0.30% for nitrogen, a ratio of 14.0-14.5 for carbon/nitrogen, 393×100-398×100 lux in shade and 710×100-715×100 lux in an open area for light intensity, 42-46°C for temperature, and 40-45% for humidity. Mineral content (e.g., phosphorus) from Belitung Island was higher than that of Bangka Island, which was 253.36 mg/100g. Apart from that, heavy metals, such as lead (Pb), found in Belitung Island and Bangka Island were quite low at 0.08 and 0.33 mg/100g, respectively. Furthermore, the carbohydrate content in overall plants found in Bangka Belitung Province was 84.97-86.72%.

Carbohydrates are the dominant part of tubers of the 'taka' plant. Utilization of local tubers (e.g., 'taka' plants) as an alternative to flour can be further developed to reduce dependence on wheat flour while encouraging sustainable innovations. In Bangka Belitung Province, 'taka' plants (Tacca leontopetaloides) are found on Bangka Island and Belitung Island. The local people take and utilize this plant that grows wild not far from where they live. For example, people living in Tanjung Klumpang take the 'taka' plant, which they call it 'genubong', in Tanjung Ruk. Another example is that people in Batu Lubang take the 'taka' plants around the Tanjung Nyabung Beach or the near small islands (Basar and Belantuk Islands) using boats to get there. Although this plant species is rare in Batu Lubang, one family

can collect, and then process 'taka' plants into flour in as much as a small sack or about ± 2 kg (see **Figure 4**).

Figure 4. The tubers of 'taka' plants and their utilization based on local knowledge (turning the tubers into flour and other processed food products)

We can store the flour from tubers of the 'taka' plant longer depending on the needs. It usually will not be stored for long because it serves as a substitute for wheat flour. The tubers of this plant can only be used after being processed to be flour (local people call it 'tinyok'). If they are boiled, they taste bitter. The stages of processing the tubers of the 'taka' plant are as follows. First, the tubers are cleaned, peeled, and then grinded. The grinded tubers are then squeezed and filtered using a filter as usual. The juice and water are left so that the starch may settle to the bottom. After that, the water on top which is still dirty yellow is discarded and the starch is left. The resulting starch is still bitter. Therefore, this method is repeated up to ± 3-4 times by adding more water until the water is white. By repeating this method, the white starch precipitates until it is no longer bitter. After that, the starch is dried in the sun so that the water content evaporates completely. The flow chart of these traditional stages in processing tubers of the 'taka' plant to be flour can be seen in **Figure 5**.

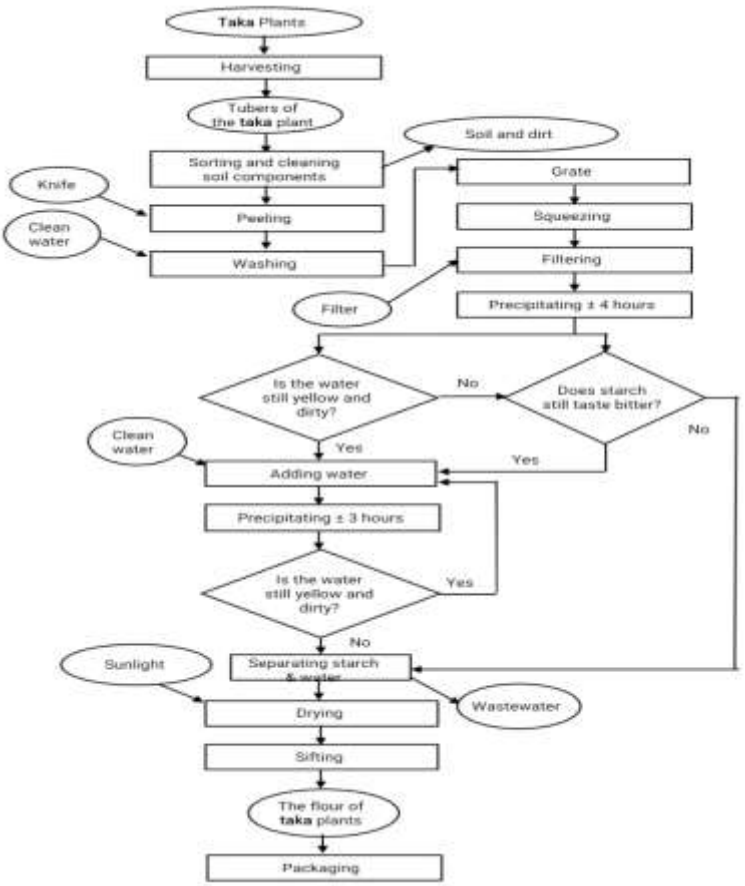

Figure 5. The flow chart of the traditional stages in processing tubers of 'taka' plants into flour

The people of Belitung Island utilize the starch of the 'taka' plant as a basic ingredient to replace wheat flour in making 'rintak' cakes and crackers through a traditional process. This flour is usually used to make various kinds of cookies and cakes, both dry and wet ones. The well-known traditional cake made from this flour is the 'rintak' cake with ingredients of flour from the tuber of the 'taka' plant, coconut milk, sugar, and chicken eggs. Another example is the 'ongol-ongol' cake, in which the processed flour is mixed with palm sugar, cooked, and then added with grinded coconut. The flour can also be used to make 'tekwan' crackers. In making these crackers, the flour of tubers of the 'taka' plant is mixed with fish meat, which the waters of Belitung Island are inhabited by quite a lot of fish. This flour is only for their consumption and not for sale. Local people name this flour 'tinyok of nubong'. Even so, they still may obtain and use other types of flour, such as flour made from

sago (Metroxylon sago) (locally known as 'tinyok of sagu') and cassava (Manihot esculenta) (locally known as 'tinyok of singkong'). Local people usually make the aforementioned cakes and crackers at the beginning of Ramadan or before Eid al-Fitr.

Discussion

Taka plants (Tacca leontopetaloides) in Bangka Belitung Province are known as 'nubong' or 'genubong' by people living in Belitung Island. Meanwhile, those living in Bangka Island call it 'lengkir' (Sakila, 2020). These plants grow in all regencies and city on Bangka Island (i.e., West Bangka Regency, Bangka Regency, Central Bangka Regency, South Bangka Regency, and Pangkal Pinang City).

In Indonesia, 'taka' plants are spread throughout Java from West Java (Port of Ratu), Central Java (Banyumas, Pekalongan, Jepara, and Rembang), to East Java (Kediri). These plants can be even found outside Java (Lampung, Krakatau, and others) This plant generally grows wild. However, in Sumenep, Madura, these plants with the local name 'lorkong' or 'oto'o' are semi-cultivated in the fields. They are planted close to corn, green beans, and cassava (Susiarti et al., 2012). This plant is also found on Karimunjawa archipelago (Karimunjawa National Park), Central Java, i.e., Kumbang, Nyamuk, Katang, Seruni, Cendekia, and Sintok Islands (Alhamd, 2018).

According to Wawo et al. (2015), the growth pattern and propagation of this plant must be studied because they have not been addressed intensively. Globally, the 'taka' plant is evenly distributed starting from West Africa, Southeast Asia (Malaysia), and Western Australia, to Polynesia (i.e., Tuamotus, Marquesas, and Hawaii), as shown in **Figure 6**.

Source: Drenth (1976)

Figure 6. Distribution of the 'taka' plant in the world

According to Susiarti & Sulistiarini (2015), tuber plants other than the 'taka' plant which may serve as a source of carbohydrates from Bangka Belitung Province are those from the genus Colocasia, Dioscorea, Ipomoea, Maranta, Manihot, and Xanthosoma. According to Novalisa, the diversity of tuber plants and those that can be utilized by local people, specifically those living in West Mendoa, Bangka Regency, are from the genus Canna, Colocasia, Dioscorea, Ipomoea, Maranta, Manihot, Pachyrrhizus and Xanthosoma genus. The 'taka' plant is a flowering plant from the Dioscoreaceae family and the genera Tacca. These plants are also produce specific secondary metabolites that have potential as anti-cancer substances because they contain taccalonolides A and E (Risinger & Moobery 2010). Taccalonolide A also has cytotoxic activity against P-388 leukimia cells and antimalarial activity (Chen & Shen 1989). A study by Hapsari et al. (2016) reveals that antioxidants in the 'taka' plant have strong to moderate activities.

'Taka' plants have a variety of shapes, characteristics, leaf stalks with holes, midribs, vertical grooves, and light green to dark purplish-black in color (Erlinawati et al., 2018). However, in Bangka Belitung, no variant with black in color was found.

The carbohydrate content in 'taka' plants found in Bangka Belitung Province is 84.97-86.72%. This is similar to the 'taka' plants found in the Marshall Islands (85.74%) with caloric energy of 346 kcal/100gr (Spennemann, 1994). Based on a study conducted by Murningsih (2013), the carbohydrate content in tubers of 'taka' plants ranged from 80.11% to 88.07%. The highest was obtained in tubers originating from the Karimunjawa archipelago, Central Java. The starch content of 'taka' tuber found on Belitung Islands was 91.82%. However, the higher has been ever found in Nigeria, i.e., 95.02-95.42% (Ukpabi et al., 2009).

Processed flour from the tubers of 'taka' plants can be used as an ingredient in making cake, pasta, and pudding. Tubers of the 'taka' plant have similar content to corn. However, tubers of 'taka' plants are resistant to compression. Therefore, the flour from tubers of 'taka' plants also has the potential as an excipient, which is a

mixture in the manufacture of medicinal tablets (Kunle et al., 2003). In Milingimbi, Northern Australia, ‘taka’ plants are known as ‘nguthumu’ which are used as food by the people living there. The large round tubers of this plant are eaten after being thoroughly cooked. Furthermore, its fruits are eaten raw. Habitat of these plants is monsoon vineyards or eucalyptus open forests (Wightman & Smith, 1991).

The starch or flour of the tubers of the ‘taka’ plant can be used as a substitute for wheat flour (Heyne, 1987; Jukema & Paisooksantivatana, 1996; Lemmens, 2003). Apart from being an alternative food source, tubers and roots of several species from the genus Tacca (e.g., T. leontopataloides, T. chantrieri, T. plantaginea, and T. paxiana) have been found containing taccalin and taccalinolides, which have potential as anti-cancer compounds (Risinger & Mooberry, 2010). The compounds that have the potential as anti-cancer in these plants have a close relationship with free radicals so antioxidant compounds are needed to prevent them. Therefore, as a first step to examining the potential of ‘taka’ plants as an anti-cancer, it is necessary to conduct further research on the content of several important compounds related to phytochemicals and natural antioxidants in these plants.

Conclusion

The 'taka' plant (Tacca leontopetaloides (L.) Kuntze) or known as 'nubong' found in the Bangka and Belitung Islands has a high carbohydrate content so it can be used as an alternative to wheat flour. However, efforts to socialize this plant are still needed so that this plant is better known to the public, which in the end can become a substitute for wheat flour.

Considering that this plant is still categorized as wild, it has the potential to be an alternative food source, with a growth ecosystem on the coast. Apart from that, the development of tourism in the coastal areas of Bangka Belitung Province can allegedly influence the existence of this plant. Therefore, domestication efforts are needed to preserve the existence of this plant in Bangka Belitung Province. Furthermore, efforts to conserve and domesticate cultivation in the community are also needed so that it can sustainably support food security in the community.

Acknowledgment

It will be an injustice if we will not acknowledge such as Ahmad Fathoni, Marwan, Fithrorozi, Yulian Fakhrurozi, and other respondents for their kind cooperation during the study and for sharing their invaluableknowledge in Bangka Belitung Archipelago. In addition, a big thank you to Prof. Dr. Wawan Sujarwo for his contribution to this manuscript.

REFERENCES

1. Alhamd, L. (2018). Ecological study of the arrowroot (Tacca leontopetaloides (L.) Kuntze) at Karimunjawa National Park, Central Java. Reinwardtia 17 (2): 87 – 96.
2. Anonymous. (2019). Kurangi konsumsi nasi putih agar tubuh lebih sehat. https://www.cnnindonesia.com/gaya-hidup/20190114160718-255-360685/kurangi-konsumsi-nasi-putih-agar-tubuh-lebih-sehat. CNN Indonesia. (Accessed on 2 July 2022).
3. AOAC. (1984). Official methods of analysis. Association of official analytical chemists. Washington DC. USA.
4. Badan Pusat Statistik. (2021). Kepulauan Bangka Belitung Province in figures 2021. BPS- Statistics of Kepulauan Bangka Belitung Province. (Accessed on 28 June 2022).
5. Badan Pusat Statistik. (2022). Berita resmi statistik: Luas panen dan produksi padi di Indonesia. 2021 (Angka Tetap). BRS No.21/03/Th. XXV. (Accessed on 1 March 2022).
6. Chen, Z. & Shen, J.G.Y. (1989). Some chemical reactions of taccalonolede A-a bitter substance from Tacca plantaginea. Heterocycles 29: 2103-2108.
7. Drenth, E. (1976). Taccaceae. Flora Malesiana 7 (4): 806 – 819.
8. Erlinawati, I., Lestari, P., Rugayah & Ermayanti, T.M. (2018). Taka (Tacca leontopetaloides) untuk kemandirian pangan. LIPI Press. Jakarta. Indonesia.
9. Farley, G., Schneider, L., Clark, G. & Haberle, S.G. (2018). A late holocene palaeoenvironmental reconstruction of Ulong Island, Palau of starch grain, charcoal and geochemistry analyses. Journal of Archaeological Science: Reports 22: 248 – 256.
10. Hapsari, B.W., Martin, A.F. & Ermayanti, T.M. (2016). Pertumbuhan kultur in vitro dan uji aktivitas antioksidan pada tanaman taka (Tacca leontopetaloides L. Kuntze) hasil radiasi sinar gamma. Proceeding of Pertemuan dan presentasi Ilmiah – Penelitian dasar ilmu pengetahuan dan

teknologi nuklir 2016. Pusat sains dan teknologi akselerator, Batan – Fakultas Matematika dan Ilmu Pengetahuan Alam, UNS Surakarta, 9 Agustus 2016. ISSN 0216. – 3128.243-249.

11. Heyne, K. (1987). Tumbuhan berguna Indonesia I. Badan Penelitian dan Pengembangan Kehutanan, Departemen Kehutanan. Indonesia.
12. Jukema, J. & Paisooksantivatana Y. (1996). Tacca leontopetaloides. In: Plants yielding non-seed carbohydrates (Eds.:Flach M. & Rumawas F). Prosea No. 9. Bogor. Indonesia.
13. Kunle, O.O., Ibrahim, Y.E., Emeje, M.O., Shaba, S. & Kunle, Y. (2003). Extraction physicochemical and compaction properties of Tacca starch – a potential pharmaceutical excipient. Starch/Stärke 55: 319–325. doi:10.1002/star.200390067
14. Lemmens, R. H. M. J. (2003). Tacca JR. Forster & Forster JG. In: Medicinal and poisonous plants 3 (Eds.: Lemmens RHMJ & Bunyapraphatsara N). Prosea No.12 (3): 394. Backhuys Publishers, Leiden.
15. Martin, G. J. (1995). Etnobotany. A Method manual. Springer-Science+Business Media, B V Royal Botanic Gardens Kew UK.
16. Melalatoa, M.J. (1995). Ensiklopedi Suku Bangsa Di Indonesia. (A-K). Departemen Pendidikan & Kebudayaan RI. Jakarta. Indonesia.
17. Murningsih, T. (2013). Evaluasi Kandungan proksimat dan mineral umbi taka (Tacca leontopetaloides) dari beberapa daerah di Indonesia. Proceeding of Seminar nasional biodiversitas 2, "konservasi keragaman hayati berbasis kearifan lokal masyarakat Indonesia". Fmipa Uns & Institut Javanologi Lppm Uns, Solo, 10 November 2012, (Eds. Sugiyarto, Budiharjo A, Susilowati A, Setyawan AD), 106 – 109.
18. Novalisa. (2018). Keanekaragaman dan pemanfaatan umbi-umbian di Kecamatan Mendo Barat. Kabupaten Bangka. Undergraduate diss., University of Bangka Belitung.
19. Pramukanto, Q., Siti, S. & Irmanida, B. (2018). Taman terapi mandiri: diabetes melitus jenis, fungsi, pengolahan tanaman obat dan rancangan taman. Bogor: PT Penerbit. IPB Press. Bogor. Indonesia.
20. Pratama, B.A. (2015). Ekologi dan pola sebaran **taka** (Tacca leontopetaloides (L.) O.K.) di wilayah Kepulauan Bangka Belitung. In: Proceeding of 'Ekspose & seminar pembangunan kebun raya daerah' (Eds. Yuzammi et al.:173 – 184), Pusat Konservasi Tumbuhan Kebun Raya Bogor – LIPI, November 25 – 26, 2013, LIPI Press. Bogor.
21. Risinger, A.R & Mooberry, S.L. (2010). "Taccalinolides novel microtubule stabilizers with clinical potential". Cancer Letter

291: 14–19.

22. Sakila, Henri & Sajidin. (2020). Persebaran karakterisasi morfologi **lengkir** (Tacca leontopetaloides L. Kunzte) sebagai sumber pangan di pulau Bangka. Ekotonia 5 (1): 31-38.
23. Spennemann, D.H.R. (1994). Traditional arrowroot production and utilization in the Marshall Islands. Journal of Ethnobiology 14 (2): 211 – 234.
24. Suliartini, N.W.S., Sadimantara, G.R., Wijayanto, T & Muhidin. (2011). Pengujian kadar antosianin padi gogo beras merah hasil koleksi plasma nutfah Sulawesi Tenggara. Crop Agro 4(2): 43-48.
25. Susiarti, S., Setyowati, N. & Rugayah. (2012). Etnobotani Tacca leontopetaloides (l.) O.K. sebagai bahan pangan di Pulau Madura dan sekitarnya, Jawa Timur. Pangan 21 (2): 161 - 170.
26. Susiarti, S. and Sulistiarini, D. (2015). Keanekaragaman umbi-umbian di beberapa lokasi di Propinsi Bangka Belitung dan pemanfaatannya. Proceeding of Seminar nasional masyarakat biodiversitas Indonesia (Eds. Setyawan et al.), Semarang 9 Mei 2015. Masyarakat Biodiversitas Indonesia, Unsoed Purwokerto, Undip Semarang. Vol I (5) Agustus 2015, 1088-1092. ISSN: 2407-8050.
27. The 2030 Agenda for Sustainable Development Goals. Mengenal Lebih Jauh Penerapan TPB/SDGs di Indonesia http://sdgsindonesia.or.id/. (Accessed on 27 July 2022).
28. Tiba, S. (2023). Unlocking the poverty and hunger puzzle: Toward democratizing the natural resource for accomplishing SDGs 1&2. Resources Policy, 82, 103516.
29. Ukpabi, U.J., Ukenye, E. & Olojede, A.O. (2009). Raw-material potentials of Nigerian wild Polynesian arrowroot (Tacca leontopetaloides) tubers and starch. Journal of Food Technology 7 (4): 135 – 138.
30. Vogliano, C., Murray, L., Coad, J., Wham, C., Maelaua, J., Kafa, R., & Burlingame, B. (2021). Progress towards SDG 2: Zero hunger in melanesia–A state of data scoping review. Global Food Security, 29, 100519.
31. Walujo, E.B. (2004). Pengumpulan data etnobotani. Dalam: Pedoman pengumpulan data keanekaragaman flora. (Eds. Rugayah, Widjaja EA & Praptiwi): 77- 89. Pusat Penelitian Biologi – LIPI. Bogor. Indonesia.
32. Wawo, A.H., Lestari, P. & Utami, N.W. (2015). Studi perbanyakan vegetatif tanaman Tacca leontopetaloides (L.) Kuntze dan pola pertumbuhannya. Berita Biologi 14 (1), 1-9.
33. Wightman, G.M. & Smith, N.M. (1991). Ethnobotany, vegetation and floristics of Milingimbi, Northern Australia. Northern territory botanical bulletin No. 6. Conservation commission of the Northern Territory, Darwin, Australia.