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Potential of neglected and underutilized tacca tuber (*Tacca leontopetaloides*) for sustainable food system in Indonesia

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Tacca tubers (*Tacca leontopetaloides*) are a tuber plant variety that is neglected and underutilized. Understanding tacca tubers' nutritional and anti-nutritional composition is necessary as a scientific basis for their development in the food industry. This study aims to evaluate the proximate composition, nutritional, and anti-nutritional compounds of tacca tubers grown in various regions in Indonesia, in particular Garut, Bangkalan, and Sumenep. As a result, the growing location did not affect the proximate composition (crude protein, ash, crude fiber, and fat) of tacca tubers except for water content. Significant differences were observed in starch content (25.77-32.43 %), vitamin C (11.85-14.32 mg/100 g), and vitamin E (0.25-0.42 mg/100 g). The growing location also significantly influences tacca tubers' mineral components (phosphorus, magnesium, calcium, iron, copper, zinc, sodium, and potassium). In addition, anti-nutritional compounds such as phytic acid (633.25-538.80 mg/100 g), tannin (45.43-64.03 mg/100 g), oxalate (201.14-338.01 mg/100 g), cyanide (2.17-3.05 mg/100 g), alkaloids (253.68-487.91 mg/100 g) and saponins (97.54-105.24 mg/100 g) in tacca tubers identified in different amounts at each growing location. In conclusion, tacca tubers Indonesia from Garut contain a high starch component. This potential can be an energy source, especially for coastal communities. Thus, tacca tubers can support creating a sustainable food system in Indonesia.
Keywords: Tacca tuber; potential; nutritional; anti-nutritional; Indonesia varieties.

INTRODUCTION

Humans have depended on plants to answer their energy needs for centuries. Root and tuber plants are the second most important type of plant after cereals as a source of energy from starch components. Cultivation of root and tuber plants is often found in tropical areas. Asia (43%) is the leading producer of root and tuber plants, followed by Africa (33%), and the rest is spread across Europe and America (Chandrasekara and Kumar, 2016). There are many varieties of tubers throughout the world. However, only a few types are used in the food industry, such as cassava, potato, sweet potato, yams, and taro. Many root and tuber plants are not yet known to the wider community. This plant is a neglected and underutilized crop species (NUCS). This is caused by a lack of interest in development and research, so its potential and benefits have yet to be discovered by the wider community (Chiranthika *et al*., 2022; Price *et al*., 2017).

Conservation of agricultural biodiversity, especially NUCS, is very important to overcome environmental pressures, ensure food security, improve nutrition and food diversity. NUCS can reduce dependence on certain cash crops and increase the resilience of agricultural systems (Joseph *et al*., 2023). Tacca tuber (*Tacca leontopetaloides*) is one of the NUCS from the Taccaceae family, often found on coasts at an altitude of 3 to 300 m above sea level. The tacca plant is thought to have originated in Southeast Asia and then spread to tropical areas in the Pacific Islands and Africa (Lim, 2016). The tuber part of this plant is reported to contain high starch components, reaching 35.82% (Binh and Dao, 2020). Tacca tubers also contain bioactive compounds with many health benefits (Rachmawati *et al*., 2022). However, some bioactive components from tacca tubers are classified as anti-nutritional and toxic when consumed. At least tacca tubers from Nigeria and Vietnam have been reported to contain phytic acid, tannin, saponin, oxalate and cyanide compounds (Borokini and Ayodele, 2012; Binh and Dao, 2020). This plant's other potential has yet to be identified due to the limited information.

In Indonesia, tacca tubers are found growing wild on the north and south coasts of the island of Java. Precisely on the coasts of Garut, Bangkalan, and Sumenep (Erlinawati *et al*., 2018;

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Winara and Murniati, 2018; Winara *et al*., 2019). Tacca tubers in Indonesia are generally neglected. Some coastal communities use tacca tubers as animal feed. Only a few process them into traditional food (Wardah and Ariani, 2020). Information regarding tacca tubers in Indonesia is very limited. Although some research efforts in Indonesia explore the morphology, cultivation techniques, and post-harvest of tacca tubers (Syafi *et al*., 2020;Wardah and Ariani, 2020), there is a critical gap in understanding the nutritional and anti-nutritional. This information is very important for development, especially in the food industry. Considering that tacca tubers populations are quite high when cultivated, reaching 8.7 million tonnes/ha (Winara and Murniati, 2018). Each NUCS has nutritional content and anti-nutritional components that are different from each other. These traits are greatly influenced by genetics and the growing environment, so the results obtained by a particular species may differ in each region (Padhan and Panda, 2020). It is necessary to study the chemical properties at this underutilized tacca tuber's macro and micro levels to study its application in food processing. Therefore, this research aims to determine the nutritional and anti-nutritional composition of tacca tubers from Indonesia, especially those from Garut, Bangkalan, and Sumenep. The main objective of the research is to determine the growing location for tacca tubers with the highest starch content. Tacca tubers with the highest starch content have the potential to be cultivated on a massive scale to support the creation of a sustainable food system in Indonesia.

MATERIALS AND METHODS

***Sample collection*:** The samples used were tacca tubers obtained locally in three different regions in Indonesia, namely Garut, Bangkalan, and Sumenep. The tacca tubers used were ten months after planting and harvested in September 2022.

***Proximate composition and starch content analysis*:** The proximate composition of tacca tubers was analyzed using the method described by Fauziah *et al*. (2020). Water and ash content were determined using the oven method, which was calculated based on the dry matter of the tubers according to standard procedures. Crude protein content was estimated based on nitrogen content and tuber dry matter using the Kjeldhals distillation method. The fat content was determined by the soxhletation method; the sample was extracted using petroleum benzene, passing the digest through filter paper, extracted using a soxhlet type extractor, the solvent evaporated, and the fat was obtained through gravimetric. Crude fiber is calculated as the weight of the filtered and dried residue, then reduced by the weight of protein and ash. Meanwhile, starch content uses the Nelson-Somogyi method described by Yonata *et al*. (2023).

***Vitamin analysis*:** The spectrophotometric method determined the vitamin A content as β-carotene (A'yuni *et al*., 2022). A total of 5 g of tacca tubers was extracted using petroleum ether and acetone (1:1). The extract was separated using a separating funnel by adding distilled water. The carotene fraction was added with anhydrous Na_2SO_4 to absorb the remaining distilled water, and petroleum ether was added to a volume of 25 mL. The absorbance was measured at 450 nm, and pure β-carotene was used as a standard. The iodine titration method determined the vitamin C (ascorbic acid) content (A'yuni *et al*., 2022). Tacca tubers are prepared in a 100 mL measuring flask, distilled water is added to the mark, and the filtrate is filtered to separate. 5 mL of filtrate was put into an Erlenmeyer, 2 mL of 1% starch, and 20 mL of distilled water, titrated with 0.01 N iodine. The calculation of vitamin C was determined by standardizing the iodine solution. 1 mL of 0.01 N iodine is equivalent to 0.88 mg of ascorbic acid.

***Minerals analysis*:** The AOAC method (AOAC, 2012) is used for mineral analysis including Calcium (Ca), Magnesium (Mg), Phosphorus (P), Iron (Fe), Copper (Cu), Zinc (Zn), Sodium (Na) and Potassium (K) using the AAS instrument (Perkin Elmer Aanalyst 400).

***Tannins*:** Tannin content was determined using the Folin Denis colorimetric method (A'yuni *et al*., 2022). A total of 5 g of tacca tubers was prepared into a 100 mL measuring flask, and distilled water was added to the mark and then homogenized. The seaweed is filtered to obtain the extract. A total of 1 mL of extract was mixed with 0.5 ml of Folin Denis reagent, 1 mL of saturated NaCO3, and distilled water until the volume reached 10 mL. The mixture was vortexed, and the absorbance was read at 730 nm. Pure tannic acid was used as standard.

***Oxalates acid*:** Oxalic acid levels were determined based on the method of Ndouyang and Schinzoumka (2022). A total of 5 g of tacca tubers was prepared in an Erlenmeyer, and 100 mL of hot distilled water was added, shaken for 15 minutes, and filtered. The filtrate obtained was then added to 10 mL of H_2SO_4 4 N and titrated with $KMnO_4$ 0.0892 N until the color was magenta. Oxalic acid levels were obtained using standard calculations. The result is expressed as dissolved oxalic acid. Insoluble oxalic acid levels were obtained by measuring using an AAS instrument. The total oxalic acid content is obtained by adding dissolved oxalic acid to insoluble oxalic acid.

***Phytic acid*:** The method described by Yonata *et al*. (2022) was used to measure tacca tuber phytic acid. A total of 2 g of tacca tubers was put into a measuring cup, then 100 ml of 2% HCl was added, left for 5 hours at room temperature (25-27 °C), and filtered using Whatman grade 1 paper. After that, the filtrate was put into an Erlenmeyer. As much as 25 ml and 5 ml of 0.3% KSCN solution were added and titrated with a standard $FeCl_3$ solution. Persistence of brownish yellow color for 5 minutes, indicating the endpoint. The concentration of $FeCl_3$ is 1.04 %w/v, and the mole ratio of Fe to phytate = 1:1.

***Alkaloids*:** Alkaloid contents were determined gravimetrically (Ndouyang and Schinzoumka, 2022). Briefly, 5 g of tacca tubers were dispersed in 50 mL of 10% acetic acid

Table 1. Proximate composition and total energy of tacca tubers from Indonesia.

Place of origin	Moisture (%)	% dry weight basis				Energy Total (kcal/100 g)
		Protein	Ash	Crude Fiber	Fat	
Garut	59.12 ± 0.61[a]	3.20 ± 0.44[a]	1.67 ± 0.18[a]	1.27 ± 0.32[a]	0.39 ± 0.03[a]	147.67 ± 0.87[c]
Bangkalan	65.72 ± 0.50[c]	3.31 ± 0.72[a]	1.59 ± 0.05[a]	1.26 ± 0.68[b]	0.40 ± 0.06[a]	123.84 ± 0.46[a]
Sumenep	63.41 ± 0.35[b]	3.39 ± 0.07[a]	1.42 ± 0.11[a]	1.32 ± 0.34[a]	0.32 ± 0.09[a]	127.56 ± 0.62[b]

Note: Data are presented means ± standard deviations. Values in the same column followed by the same superscript are not significantly different ($p < 0.05$)

solution in ethanol. The mixture was shaken and left for 4 hours before being filtered. The filtrate is evaporated to a quarter of its original volume on a hot plate. Concentrated ammonium hydroxide is added drop by drop to precipitate the alkaloids. Filter paper of known weight filters the sediment and then washes it with a 1% ammonium hydroxide solution. The paper is then dried to a constant weight. Alkaloids are obtained based on the difference between filtered rice.

***Cyanides*:** Total cyanide was extracted by distillation followed by colorimetric determination following the method described by Ndouyang and Schinzoumka (2022). A total of 4 g of tacca tubers was put into a heating balloon, to which 125 ml of distilled water and 2.5 ml of chloroform were added, and the glassware was stirred for homogenization. After that, 4 ml of distillate was put into a test tube, and 4 ml of alkali picrate solution was added, mixed well, and heated in a boiling water bath for 5 minutes to allow color development. The color intensity was read at 520 nm against a blank made with water. Cyanide content is expressed in mg HCN, equivalent to 100 g of dry matter.

***Saponins*:** Tacca tuber saponin was obtained using the method described by Ndouyang and Schinzoumka (2022). A total of 10 g of tacca tubers was dried, then the fat was removed using ethanol for 15 hours, followed by centrifugation for 20 minutes at 3000 rpm. The supernatant was collected, and the residue was resuspended in 80% aqueous ethanol and processed in the same way as before. The two supernatants were combined and filtered on Whatman paper to attract particles that might float on the surface. Then, the ethanol is evaporated at 42-45 °C in a Rotary evaporator, and the water phase is centrifuged to depart water-insoluble materials before being transferred to a separatory funnel for decantation and undergoing two extractions with equal volumes to extract the pigment. The exact final volume of each extract was recorded. The calibration curve was carried out with saponin standards. Absorbance was read at 544 nm on a UV spectrophotometer against a blank. The results are expressed in mg sapogenin/100g dry matter.

***Statistical analysis*:** All data obtained was then analyzed using SPSS version 22.0 software. The difference test was obtained using the one-way ANOVA method. Then, the LSD further test method was used to determine significant differences between variable means on selected parameters with a significance level of difference at $p < 0.05$.

RESULTS AND DISCUSSION

***Proximate composition, starch content and total energy value*:** The proximate composition and starch content of tacca tubers from various regions is presented in Table 1. Based on these data, growing location significantly influences water content (59.12-65.72 %), while the levels of crude protein (3.20-3.39 %), ash (1.42-1.67 %), crude fiber (1.27-1.32 %) and fat (0.32- 0.40 %) tacca tuber not different. Tacca tubers in Garut are reported to grow on sandy soil, while tacca tubers in Bangkalan and Sumenep grow on clay and sandy clay types (Yonata *et al.*, 2023). Clay soil tends to contain more water and has a high density, so the tubers absorb water more quickly in the growing environment. In general, the water content of tacca tubers in this study was lower than uwi tubers, precisely 72.94 % (Fauziah *et al.*, 2020), and *Ceiba aesculifolia* tubers, precisely 88.34 % (Suastegui-Baylón *et al.*, 2021). Tubers with low water content tend to have a longer shelf life and are more efficient for industrial processing.

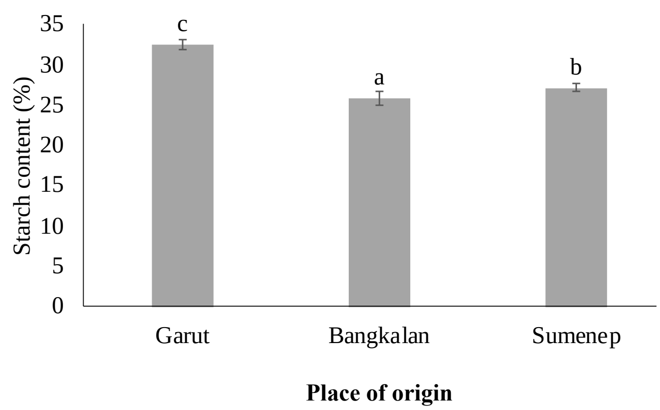

Figure 1. Starch content of tacca tubers from Indonesia

These tubers generally contain more starch contents (Polycarp *et al.*, 2012), in line with the results of this study. This study's starch content of tacca tubers ranged from 25.77 to 32.43% (Figure 1). This result is higher than the potato starch content (11.9-13.4%) reported by Vasilyev *et al.* (2021) but lower than the sweet potato starch content (40.10-55.10%) reported by Zhang *et al.* (2018). Starch content is an important characteristic of tubers. Tubers with high starch content have good agronomic value. The starch content of tubers is generally controlled by genetic and environmental factors (Lu et al., 2015). Starch is the main energy source for tacca tubers. The total energy value of the three tacca tubers ranged from 122.4 to 148.6 kcal/100 g (Table 1). Slightly higher than water yam tuber 106 kcal/100g, wild yam tuber 119 kcal/100 g, potato 69 kcal/100g and sweet potato 86 kcal/100g (Fauziah et al., 2020; Bhandari et al., 2003; Haytowitz et al., 2019). Due to the high total energy provided, tacca tubers in this study can be recommended as a food source supporting food security in Indonesia.

Vitamin**:** Tacca tubers are known to contain vitamin and mineral components that are micronutrients. The human body needs these components in small amounts (Gharibzahedi and Jafari, 2017). Tacca tubers have vitamins C (ascorbic acid) and E (tocopherol), which are antioxidant compounds. The vitamin C content of tacca tubers is 11.85 to 14.32 mg/100g (Figure 2), there are significant differences between tubers. These differences are greatly influenced by species, location and year of growth, maturity at harvest, soil conditions, and the availability of nitrogen and phosphate fertilizers during growth. Vitamin C in tacca tubers is much higher than in sweet potato (4.85-5.73 mg/100 g) from Bangladesh (Alam et al., 2020). Generally, tubers contain 6-10 mg/100g of vitamin C and can vary up to 21 mg/100g (Chandrasekara and Kumar, 2016). Tubers are not a source of vitamin C, but fruit and vegetables are. This is because the daily need for vitamin C is relatively high, reaching 90-110 mg/day for men and 75-95 mg/day for women (Fenech et al., 2019). Vitamin C is needed in various physiological processes, such as iron absorption, collagen synthesis, immune stimulation, and epigenetic regulation (Paciolla et al., 2019). However, consuming 100 g of tacca tubers can contribute 11.85-19.09% of the daily vitamin C needs of adults in Indonesia (Ministry of Health Republic Indonesia, 2023).

The tacca tubers' vitamin E content (total tocopherol) ranges from 0.25 to 0.42 mg/100g (Figure 2). This value is similar to various wild yam species from India, namely 0.30 – 0.70 mg/100 g (Padhan et al., 2020), as well as sweet potato around 0.26 mg/100 g, cassava 0.19 mg/100 g, and yam 0.35 mg/100 g (Chandrasekara and Kumar, 2016). Vitamin E content differences are influenced by variety, growing location, and harvest age (Leng et al., 2019; Groth et al., 2020; A'yuni et al., 2021). In Indonesia, the recommended adequate figure for vitamin E for adults ranges from 134-268 mg per day (Indonesian Food and Drug Authority, 2020). As an antioxidant, vitamin E can protect polyunsaturated fatty acids in membranes from oxidation, regulate the production of reactive oxygen and reactive nitrogen species, and modulate signal transduction (Lee et al., 2018). Therefore, vitamin E is associated with many aspects of human health. There is a rapidly growing literature examining the relationship between circulating vitamin E intake and various disorders and diseases. For example, consuming vitamin E supplements is

Table 2. Mineral contents of tacca tubers from Indonesia.

Components	Tacca tubers		
	Garut	Bangkalan	Sumenep
Phosphorus (P) (mg/100 g)	265.91 ± 4.33^{b}	239.30 ± 2.98^{a}	274.60 ± 3.12^{c}
Magnesium (Mg) (mg/100 g)	154.63 ± 2.69^{b}	169.85 ± 1.98^{c}	147.56 ± 2.43^{a}
Calcium (Ca) (mg/100 g)	95.32 ± 0.90^{c}	88.04 ± 0.83^{b}	84.67 ± 0.55^{a}
Iron (Fe) (mg/100 g)	7.60 ± 0.11^{c}	5.41 ± 0.05^{a}	6.14 ± 0.10^{b}
Copper (Cu) (mg/100 g)	1.13 ± 0.04^{b}	1.30 ± 0.03^{c}	0.92 ± 0.04^{a}
Zinc (Zn) (mg/100 g)	4.05 ± 0.09^{c}	3.40 ± 0.05^{b}	3.17 ± 0.04^{a}
Sodium (Na) (mg/100 g)	132.22 ± 4.09^{a}	203.28 ± 2.04^{c}	170.08 ± 2.06^{b}
Potassium (K) (mg/100 g)	374.72 ± 6.35^{b}	435.08 ± 8.16^{c}	263.84 ± 2.53^{a}
Na/K ratio	0.35	0.47	0.64

Note: Data are presented means ± standard deviations. Values in the same row followed by the same superscript are not significantly different ($p < 0.05$)

Table 3. Antinutrients contents of tacca tubers from Indonesia.

Components	Tacca tubers		
	Garut	Bangkalan	Sumenep
Phytic acid (mg/100 g)	538.80 ± 3.23^{b}	435.13 ± 3.67^{a}	633.25 ± 2.95^{c}
Tannins (mg/100 g)	56.42 ± 0.82^{b}	45.43 ± 0.81^{a}	64.03 ± 0.61^{c}
Oxalates (mg/100 g)	228.24 ± 2.41^{b}	338.01 ± 2.22^{c}	201.14 ± 2.69^{a}
Cyanides (mg/100 g)	2.17 ± 0.02^{a}	3.05 ± 0.09^{c}	2.61 ± 0.04^{b}
Alkaloids (mg/100 g)	305.69 ± 4.39^{b}	487.91 ± 4.25^{c}	253.68 ± 2.37^{a}
Saponins (mg/100 g)	105.24 ± 1.26^{c}	101.34 ± 1.47^{b}	97.54 ± 1.42^{a}

Note: Data are presented means ± standard deviations. Values in the same row followed by the same superscript are not significantly different ($p < 0.05$)

linked to preventing cardiovascular disease because it acts as an antioxidant, preventing lipoprotein oxidation and avoiding platelet aggregation (Rycter *et al.*, 2022; Xiong *et al.*, 2023).

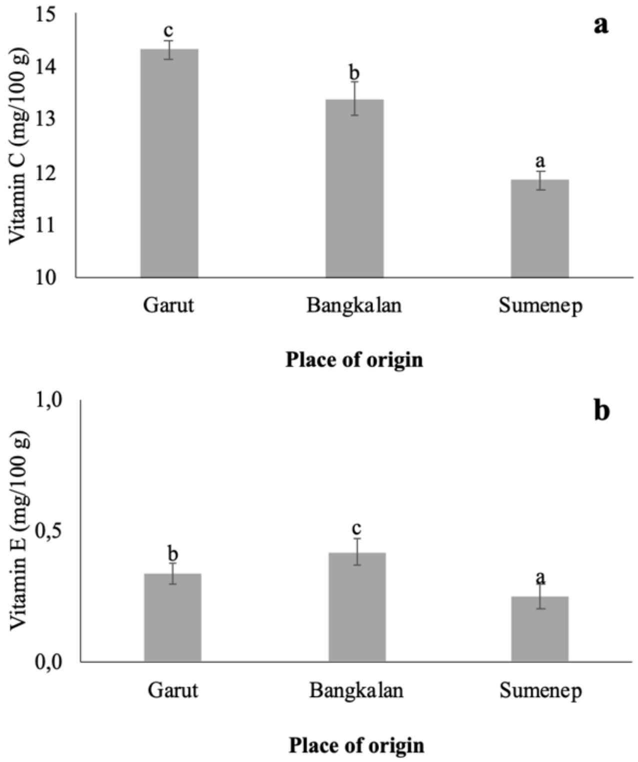

Figure 2. Vitamin C (a) and E (b) levels of Tacca tuber from Indonesia.

***Mineral content*:** Minerals play an important role in most metabolic processes in the body. The body needs more than 100 mg/dl of macro minerals and less than 100 mg/dl of micro minerals daily (Soetan *et al.*, 2010). The mineral composition of tacca tubers in this study varied greatly and differed between growing locations. These results align with previous research that differences in growing areas cause variations in mineral content (A'yuni *et al.*, 2021; Moussou *et al.*, 2019). Each growing location has climate, geology, agricultural techniques, and soil composition differences, which influence the composition and availability of minerals (Bella *et al.*, 2016). Tacca tubers contain phosphorus minerals around 239.30-274.60 mg/100 g, magnesium 147.56-169.85 mg/100 g, calcium 88.04-95.32 mg/ 100 g, iron 5.41-7.60 mg/100 g, copper 0.92-1.30 mg/100 g, zinc 3.17-4.05 mg/100 g, sodium 132.22-203.28 mg/100 g and potassium 263.84-435.08 mg/100 g (Table 2). The mineral component of Indonesian tacca tubers is much higher than Nigerian tacca tubers, which only contain 0.06 mg/100 g phosphorus, 1.40 mg/100 g magnesium, 0.25 mg/100 g calcium, 1.37 mg/100 g iron, 0.68 mg/100 g copper, 1.64 mg.100 g zinc, 34.71 mg/100 g sodium and 40.18 mg/100 g potassium (Ogbonna *et al.*, 2017). The data in Table 2 shows that potassium and phosphorus are macro minerals in tacca tubers. In contrast, micro minerals in tacca tubers are copper, zinc, and iron. Potassium in the body can increase iron utilization and control hypertension through diuretics (Elinge *et al.*, 2012). Potassium is also an essential electrolyte in the nervous system (Burgos *et al.*, 2020). Sodium and potassium are the main elements that regulate fluid distribution in the body, especially for normal kidney function and blood pressure control (Tsuji *et al.*, 2016). Low sodium and high potassium intake can help prevent hypertension and reduce high blood pressure (Gemede, 2014; Padhan *et al.*, 2020). The Na/K ratio is very important from a nutritional point of view, it is associated with the incidence of hypertension (Moussou *et al.*, 2019), less than one is recommended (Soris *et al.*, 2010). Thus, tacca tubers have the potential to be developed as a menu for hypertension patients.

***Antinutrient content*:** Anti-nutritional composition is a secondary metabolite plants produce as a defense medium (Popova and Mihaylova, 2019). Its presence can reduce the bioavailability of food nutrients (Padhan *et al.*, 2020). However, at specific concentrations, it can benefit health (Bora, 2014). The anti-nutritional factors in Indonesian tacca tubers include phytic acid, tannin, oxalate, cyanide, alkaloids, and saponins. Phytic acid in food has the property of chelating micronutrients such as zinc and iron during digestion in the intestine, producing insoluble complexes that cannot be absorbed by the intestinal mucosa, thereby reducing the bioavailability of micronutrients. However, the consumption of phytic acid as a single compound has been reported to increase the absorption of flavonoid and anthocyanin compounds (Bloot *et al.*, 2021). The phytic acid content was significantly higher in Sumenep tacca tubers (633.25 mg/100 g), as were tannin compounds (64.03 mg/100 g). Tannin is a polyphenolic compound with unique characteristics. Tannin is an antioxidant, its activity is even higher than vitamins C and E, but it is also anti-nutritional because it can reduce the absorption of glucose and protein when consumed in excess (Ojo, 2022; Yonata *et al.*, 2022).

Meanwhile, oxalate, cyanide, alkaloid, and saponin compounds were significantly higher in tacca tubers from Bangkalan. The oxalic acid content in tacca tubers is classified as very high, reaching 201.14 to 338.01 mg/100 g. Oxalic acid hurts mineral bioavailability, especially in calcium absorption, and helps the formation of kidney stones (Popova and Mihaylova, 2019). Kidney stone patients are advised to limit their intake of foods containing oxalic acid to no more than 50-60 mg per day (D'alessandro *et al.*, 2019). Tacca tuber cyanide ranges from 2.17-3.05 mg/100 g, relatively safe for consumption because it is still below the lethal dose, namely 36 mg/100 g or 360 ppm (Kalpanadevi and Mohan, 2013). The alkaloid content of tacca tubers in this study was 253.68-487.91 mg/100 g, much higher than various wild yam species in India, which only ranged between 7.2-16.0 mg/100 g (Padhan *et al.*, 2020). Consumption of tubers with high alkaloid content is associated with acute poisoning, including gastrointestinal and neurological disorders in humans. Environmental factors during growth have been confirmed to influence tuber alkaloid levels (Sha'a *et al.,* 2019). Saponin is the last anti-nutritional compound identified in Indonesian tacca tubers, which contains around 97.54-105.24 mg/100 g. At low concentrations, saponins can lower blood lipids, reduce the risk of cancer, blood glucose response, and stimulate the immune system. However, at excessive concentrations, saponins hurt nutrient absorption by inhibiting enzymes during digestion, interacting with zinc, and causing an unpleasant taste when consumed by humans (Veer *et al.,* 2021). Variations in anti-nutritional components, such as the situation described, may be related to genetic origin, geographical source, soil fertility level, and harvest time (Polycarp *et al.,* 2012; Padhan *et al.,* 2020).

In general, the anti-nutritional components of Indonesian tacca tubers are much higher than those of Nigerian tacca tubers, as Ogbonna *et al.* (2017) reported. This indicates proper handling is needed so the tacca tubers can be utilized optimally. Wardah *et al.* (2016) recommend processing tacca tubers into flour before applying it to various snack products. Processing tacca tubers into starch is also an alternative for eliminating toxic compounds in tubers (Vu *et al.,* 2017). Tacca tuber starch has been reported to have functional characteristics that have the potential to be developed into noodle and pudding products (Yonata *et al.,* 2023), as well as being produced into resistant starch, which is known to have good functional properties for human health (Nurhayati *et al.,* 2023).

***Conclusion*:** This research shows variations in the nutritional and anti-nutritional components of tacca tubers grown in various locations in Indonesia. The starch content of tacca tubers is very high, so it can be optimized as a source of carbohydrates. Apart from that, tacca tubers generally have high nutritional content in vitamins C and E, also rich in mineral components, especially potassium, phosphorus, sodium, and magnesium. However, tacca tubers contain various anti-nutritional compound components at high concentrations. Processing tacca tuber from Garut into starch is the best option so that its use in the food sector becomes wider and can be used to support a sustainable food system, especially in Indonesia.

***Author's contribution*:** All the authors contributed to conceiving the idea, planning the study, manuscript writing and publication the paper.

***Conflict of interest*:** The authors declare that there is no conflict of interest.

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***Availability of data and material*:** We declare that the submitted manuscript is our work, which has not been published before and is not currently being considered for publication elsewhere.

***Code Availability*:** Not applicable.

***Consent to participate*:** All authors are participating in this research study.

***Consent for publication*:** All authors are giving the consent to publish this research article in JGIAS.

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