JAFOST
Journal of Agri-Food Science and Technology

P-ISSN 2686-0716 | E-ISSN 2746-5519

Journal homepage http://journal2.uad.ac.id/index.php/jafost
Journal email jafost@tp.uad.ac.id

Determination of Potential in Pratama Taro (*Colocasia esculenta* (L). Schott var. Pratama) in Sumedang District, Bandung Regency, Indonesia

Wawan Gunawan[a*], Ramadhani Eka Putra[a], Pujo Pujo[a], Farhan Ilham Wira Rohmat[b], Dini Siti Hanifah[c], Fitri Awaliyah[c], Raden Dewi Anggraeni[c], Nida Nuradzkia[d]

[a]Biological Research Management, School of Life Sciences and Technology, Institut Teknologi Bandung, Bandung, Indonesia
[b]Agro-Industrial Technology Study Program, Faculty of Technology and Vocational Education, Universitas Pendidikan Indonesia, Bandung, Indonesia
[c]Biomanagement Study Program, School of Life Sciences and Technology, Institut Teknologi Bandung, Bandung, Indonesia
[d]Agricultural Engineering Study Program, School of Life Sciences and Technology, Institut Teknologi Bandung, Bandung, Indonesia

[*]Corresponding author, Email: howari623@itb.ac.id

Received 17/01/2025 Revised 11/02/2025 Accepted 01/03/2025

ABSTRACT
Bandung Regency has several types of cultivated taro, with the largest production center in the Sumedang District. Semir Taro (TS0) is one of the native commodities in this region, and the other types are from the crossbreeding process between Semir Taro and Thai Silk Taro, which is named Pratama Taro (TS1 & TS2). Although it has been widely marketed and consumed by the public, the nutrient content value of this type of taro is still unknown. In addition, TS1 and TS2 have the potential to be developed into products that have higher economic value if processed optimally. This study contributes to determining the nutritious content of three taro varieties and identifies the most appropriate raw materials for the production of taro-derived products. The methods used were chemical analysis and affective organoleptic tests with paired comparison. Organoleptic tests were carried out on TS1 and TS2, and they were steamed to determine whether there was a difference between the two taros. The results of the test showed that there was no difference in the color, aroma, and texture parameters of the two taros, but there was a difference in taste between them. While the results of the chemical analysis show that the three types of taros have a reasonably good nutrient content, because the moisture content is relatively high, there need to be post-harvest management efforts so that taro can be a more durable product for storage.

KEYWORDS
Micro-nutrients; Potential; *Pratama taro*; *Semir taro*; Tubers

1. INTRODUCTION

Taro is one of the functional food commodities that can be consumed as a staple or complementary food. It contains starch as a source of carbohydrates and other nutrients such as protein, fat, and vitamins. The compartments of vitamins and nutrition in these crops are distributed on the leaf, stem/petiole, and tuber/corm. Taro tuber and leaves can be processed into various food innovations and medicines [1]. However, the tubers are known as a source of carbohydrates, fiber, and minerals but are low in calories. Nutritionally, taro tuber is a rich source of energy, moisture, protein, fat, carbohydrate, fiber, calcium, phosphorus, sodium, potassium, iron, vitamin A, thiamine, riboflavin, niacin, and vitamin C, which are essential elements for human diet [2], [3]. Furthermore, in fresh weight of taro tuber included moisture (63-85%), carbohydrate (13-29%), protein (1.4-3.0%), fat (0.16-0.36%), crude fiber (0.60-1.18%), ash (0.6-1.3%), Vitamin C (7-9 mg/100g), thiamine (0.18 mg/100g), riboflavin (0.04 mg/100g), and niacin (0.9 mg/100g) [1], [4].

In addition, taro is vital in achieving food diversification, where it contains an enormous amount of nutrition and promotes dietary foods from local natural resources. In Indonesia, taro (tubers) contributed as a local sources of production, which is designed for annual consumption rate increment [5], [6]. The West Java Province is known as the center of cultivating and producing taro, both in fresh and processing products. Various types with local names of the taro have been cultivated, such as *silk taro*, *semir taro*, *bentul taro*, *gambir taro*, *balitung taro*, *wart taro*, *beneng taro*, *laja taro*, and others [5]. In line with the current technological development in crossbreeding, one of the latest types of taros was found, named *pratama taro*. This type has begun to be intensively developed in Sumedang District, Bandung Regency, Indonesia.

Colocasia esculenta (L). Schott var. Pratama, which is shortly known as *pratama taro/taro SS* was first launched in the middle of 2016 with superior characteristics that were developed. This taro is a crossbreeding variety between *semir taro* from Sudang and *sutra taro* from Thailand. *Pratama taro* is one of the most sought-after taro varieties in domestic and foreign markets, both fresh and frozen. Moreover, *pratama taro* also has the advantages of high productivity and pest resistance when compared to other types. This type of taro is also relatively easy to cultivate, has a fairly high selling price, and rarely causes allergic skin itching reactions compared to other taro varieties [5], [7]. Based on a previous study from a market point of view, *pratama taro* is more in demand and broader in the market. Unfortunately, *pratama taro* is an unpopular cultivar and is underutilized due to limited information on exploring its potential. The lack of available information could be determined by multiple factors, such as the scarcity of scientific research, different databases, and the limited ecological habitat of taro [8]. The field findings also discovered that *pratama taro* is sold in the form of raw materials and the nutritional content is still unexplored, so the economic value of the product is limited. Despite the miscellaneous facts about *pratama taro*, it is still important to explore the potential development of *pratama taro*. This study contributes to analyze the nutritional composition among *pratama taro* (TS1 and TS2) and *semir taro* (TS0), organoleptic test between *pratama taro* (TS1 and TS2), and future prosective between TS1 and TS2.

2. MATERIALS AND METHODS

2.1. Materials

Taro tubers are the main ingredient to be used in this study. Taro tubers were sourced from Tanjunghurip Village, one of the largest taro tuber producers in Sumedang District. Three of the taro samples used in this research are *pratama taro* type 1 (TS1) (Figure 1), *pratama taro* type 2 (TS2) (Figure 2), and *semir taro* (TS0). *Semir taro* (TS0) was chosen because it is one of the crossbreeding parents of *pratama taro*.

Figure 1. P*ratama taro* type 1.

Figure 2. Different morphological tuber (Left TS1, right TS2).

2.2. Chemical Analysis

Chemical analysis method was used to identify and quantify the nutrient content of taro samples TS1, TS2, and TS0. This technique provides important information related to processing, quality control, and ensuring compliance with food standards [9]. The tests were conducted at the Food Technology Laboratory of Pasundan University using three replicates of each taro corm to determine the effect of variety and identify food composition including moisture content, ash content, fat content, protein content, carbohydrate, fiber, and calcium content. Moisture content testing was carried out using the gravimetric method, which measures the dry weight of the material and the moisture that evaporates during the heating process. Ash content testing was carried out using the high-temperature combustion method using a furnace to produce inorganic and mineral materials. Drying treatment is also carried out at the beginning to ensure the material is completely dry before entering the combustion process. Fat testing is done by soxhlet extraction, which is the process of separating lipids (fat) with organic solvents and using a soxhlet device. Protein testing is carried out using the Kjeldahl technique on samples through technical work of deconstruction, distillation, titration, and calculation of the final content. Carbohydrate content testing is carried out by the carbohydrate analysis method (by different) and calculate using equation (1) [10], [11]. Fiber testing was carried out using the enzymatic-deconstruction technique using the Van Soest method, where samples were cut into small pieces and dried to remove moisture and fat content. Furthermore, the fiber extraction process is carried out with the addition of several enzymes. Calcium testing was carried out using Atomic Absorption Spectroscopy (AAS) and quantified by atomic absorption spectrophotometry method.

$$Carbohydrate\ content\ (\%) = 100 - (\%Water + \%Ash\ + \%Protein\ + \%Fat) \tag{1}$$

2.3. Organoleptic Test

The organoleptic test was testing the organoleptic characteristics by using a sensory instrument to review TS1, TS2, and TS0. The two varieties of *pratama taro* are presented in small portions and have undergone steaming before serving. Steamed taro is prepared by peeling and thoroughly washing it. The taro is diced into 2 cm × 2 cm cubes and cooked in several containers based on the variety of taro utilized. Steaming is performed on a gas stove at low temperatures until the taro samples are uniformly cooked. The steaming process required 15 minutes. All panellists, with a total of 20 people, were assessed for the presence or absence of differences in properties, such as taste, color, aroma, and various other sensory attributes, between the samples. The assessment is done through a questionnaire by filling in number 1 if there is a difference and number 0 if no difference is found [6], [12].

2.4. Paired Comparison Test

A Paired comparison test reviews the comparative advantages of two sets of samples. This method allows the evaluation and determine differences between two items at a time by collecting judges' responses [13]. The identification of nutrient test content using chemical analysis and a further review of organoleptic tests was carried out to accommodate the effective data process of paired comparative tests. A paired comparison was made using two product samples, so the chance of each sample being selected was 50%:50%. The testing procedure is to present two samples simultaneously. Samples of steamed taro were prepared and labelled differently. Panellists were asked to choose the best sample based on the organoleptic test’s parameter. This method helps to determine the preference samples of panellists in a reasonable amount of time.

3. RESULTS AND DISCUSSION

3.1. Moisture Content

Chemical analysis is used to compare the standard values of food constituents with the findings to evaluate and analyze the quality of food or feed ingredients. This analysis is also useful for comparing the quality of similar commodities and as a reference to determine whether these foodstuffs have the potential to be a source of calories, protein, minerals, and so on for the body. Taro tubers have a high potential for good nutrient content as a source of carbohydrates, proteins, total fat, vitamins, electrolytes (such as sodium and potassium), and minerals (such as calcium, copper, magnesium, iron, and zinc) [14], [15].

In this study, the parameters tested include analysis of moisture, ash, total protein, total fat, carbohydrates, fiber, and calcium (Ca) contents. The results of the chemical analysis are presented in Table 1. The results showed varying nutritional content among the tested C. esculenta species, where some nutrients showed reasonably close results. In order to achieve nearly identical nutrition content between three varieties of taro, it is known that the TS0 is one of the parent plants that produces a crossbreeding of TS1 and TS2. However, TS1 and TS2 have quite close nutrition values compared to TS0 and TS1 or TS0 and TS2.

The amount of water is one of the most crucial components of food. Moisture content can affect the quality and shelf life of a food product, which can stimulate bacterial growth [14]. Determination of moisture content is a way to measure the amount of water contained in foodstuffs. Based on the results of chemical content (Table 1), the highest moisture content was found in TS1, which is 36.30%, but the difference in value is not much different from TS2, which is 36.26%. The lowest moisture content value is found in TS0, with a figure of 35.84%. The characteristics of a succulent plant partly drive the high-moistire content in taro. Meanwhile, the difference in moisture content is caused by differences in the type of variety, age, and maturity level of tubers. Likewise, climate and soil fertility can affect the amount of moisture content in taro tubers. Moisture content is the primary consideration in the post-harvest processing process of a foodstuff's ingredient. In the post-harvesting process, moisture content is required to prolong the shelf-life of *C. esculenta* species because its high number can make it more susceptible to deterioration during storage. From now on, the technology that is widely used to extend shelf life is to process it into taro flour or other derivative products [1], [3].

Table 1. Chemical content of TS0, TS1, and TS2.

Nutrition Parameters	Results		
	TS0	TS1	TS2
Moisture (%)	35.84	36.30	36.26
Ash (%)	2.44	2.73	2.68
Total Fat (%)	1.44	1.47	1.17
Total Protein (%)	4.49	4.47	4.59
Carbohydrates (%)	53.23	53.38	53.29
Fiber (%)	1.98	1.15	1.6
Calcium (mg/Kg)	15.3	14.16	14.13

3.2. Ash Content

Ash content is one of the parameters in the chemical analysis. It is a mixture of inorganic or mineral content owned by a foodstuff and is an organic residue from the combustion process or oxidation of organic components in foods. Analysis of ash content will provide an overview of the mineral content found in the ashes' foodstuffs. The results show that approximately the ash contents of TS0, TS1, and TS2 are above 2%, whereas taro commodities have a range of ash of 1.56-5.70% [16]. Further, it was explained that ash in food samples determines the extent of mineral content on food substances, and the differences in ash content observed can be caused by several factors such as climate, soil type, and differences in varieties [16]. Based on the test results in Table 1 showed that the highest ash content was also found in TS1 at 2.73%, followed by TS2 at 2.68%. In contrast, the lowest ash content is owned by TS0 at 2.44%. With the high ash content in taro samples, it can be known that taro contains quite a large amount of minerals [17].

3.3. Fat Content

Fat or oil content is the most critical and essential energy reserve in the body. Fat is a heterogeneous compound, and the content of each food item is different. Fats derived from plants are known as vegetable oil [18]. Consumption of foodstuffs that contain essential fatty acids can help the body to function better.

Taro can provide essential fat for the body because it contains vegetable fat. Besides that, the fat content owned by taro tubers is relatively low, generally around 0.2% [1], [19]. The results of the analysis of fat content in Table 1 showed that the highest value was contained in the TS1 at 1.47%. This value slightly differs from the fat content contained in TS0 by 1.44%. This shows that these types of taros are suitable for those who are undergoing a dietary program.

3.4. Protein Content

Protein from food is divided into two types based on the source: animal protein and vegetable protein. Plant protein can be obtained from plants such as soybeans, wheat, corn, tubers, and other fruits, while animal protein can be obtained from meat, eggs, milk, and fish [10], [20]. Protein has an important function in the body because it acts as a biocatalyst in chemical processes [21]. Currently, Indonesian consumers consume more vegetable protein than animal protein. Besides being easy to find and widely available, vegetable protein is cheaper than animal protein. Eating vegetable protein regularly can reduce blood sugar levels and improve the function of the hormone insulin [22]. Based on testing, protein content in Table 1 shows TS2 is superior to the other two types of taros, which is 4.59%. Even so, the protein value contained in TS1 and TS0 is still relatively high at values above 4%. The protein content in the type of taro from Sumedang tested is far superior when compared to other kinds of taros, such as Bogor Taro and Belitung Taro, which only contain protein in the range of 1-3%.

3.5. Carbohydrates Content

Carbohydrates consumed can provide many benefits for the body. Some of the benefits of carbohydrates for the body are as a source of energy and a regulator of fat metabolism [23]. The average Indonesian needs carbohydrates that are around 80-90% of the total calories obtained every day [24]. The analysis results showed that the three types of taros tested had carbohydrate content above 53%. Results are shown in Table 1, where among the three types of taros, TS1 is 0.38% superior, followed by 0.29% TS2 and 0.23% TS0. This shows that taro from Sumedang can be used as an alternative food that supplies carbohydrates to the body.

3.6. Fiber Content

Determination of fiber composition is a common thing to do in addition to the determination of proteins, fats, carbohydrates, or minerals. Fiber is a carbohydrate compound that cannot be digested. Its principal function is to regulate the work of the intestine. The main component of fibers is cellulose, which is primarily present in wood cell walls. Currently, many pay attention to the fiber content in foodstuffs because regular fiber consumption prevents colon cancer onset. Based on the results of the three types of taros that were analyzed, it is known that *semir taro* has the highest percentage of fiber, which is 1.98% (Table 1).

3.7. Calcium Content

The highest calcium content was found in TS0, with an amount of 15.3 mg/kg (Table 1). Meanwhile, when compared to other types of tubers, such as cassava, the calcium content of taro from Sumedang is far below that of other types of tubers. It is noted that the calcium content in cassava is 56 mg/kg [25], [26].

3.8. Organoleptic Result

The results of the organoleptic assessment in four sensory instruments are shown in Table 2. The organoleptic test shows a score with a scale of 0 (zero) if there is no difference in the samples and 1 (one) if there is a significant difference in the samples. Based on the color characteristics shown, most of the panellists found no difference between *pratama taro* samples, both on TS1 and TS2, while the rest of the seven panellists found differences. Similar substances can influence the color diffraction in both TS1 and TS2. Carbohydrates and protein content in taro bring information that affects the color properties [27]. Taro tubers are known as a source of carbohydrates, and one of the substances contains starch [28].

Furthermore, the aroma parameter showed fairly uniform results. The 13 out of 20 panellists indicated that TS1 and TS2 samples have a significant difference based on odor identification. Aroma is an essential volatile compound that influences customer preferences significantly [29]. Basically, taro has a distinct aroma that might differ between raw and cooked materials. In the formula, taro flavors in a raw material compound 2,3,5-Trimethylpyrazine; 2,3-Dimethylpyrazine; 2-Methyl-3-methylthiopyrazine; 2-Methoxy-3-methylpyrazine; 2-Acetylpyrazine; 2-Acetylpyridine; and more substances. Those typical formulas have their taste characteristics, which are raw, subtle, earthy, and a hint of slightly nutty. It depends on the molecules. Moreover, in the cooked version, taro has a pleasant and harmonious natural odor [30]. The steaming process or hot processing technique plays a vital role in enhancing the formation of aromatic compounds [31]. However, the aroma is one of the challenging parameters to be stated because it depends on each personal opinion.

Texture properties are the following characteristics to be measured. Texture is one of the most frequent parameters to be used to determine a customer's decision. Textural properties included elasticity, hardness, and softness of the product that can be felt through skin sensory [28]. The results show that over half of the panellists found differences between the two samples of each *pratama taro*. The firmness of taro might be different because of the loss of moisture content. The texture of products is often influenced by their composition, where the excessive loss of moisture and lipids should impact hard texture [31]. Moreover, the texture is also influenced by the stability of the product and storage condition. Storage methods can affect the change of physiological, physicochemical, and nutritional properties of tuber crops [1]. The storage period can significantly decrease the quality of taro, including deterioration of the quality of starch [32]. Taste aspect results showed that 15 panellists felt a significant difference between TS1 and TS2, even though those two samples are coming from similar *pratama taro*. The taste is influenced by chemical compounds, temperature, concentration, and other components, while processing and storage techniques might make it unstable. The difference in the taste of taro might be caused by varying conditions of growing, maturity, and chemical composition. Overall, the panelist experience of bland taste of steamed taro samples. However, based on the chemical analysis test, TS1 and TS2 have slightly different results in all nutrient content, and also the texture of samples. The unstable of processing and storage will taste of food unstable [28].

Table 2. Organoleptic result of TS1 and TS2.

Code of Panellists	Color	Aroma	Texture	Taste
P1	0	1	0	1
P2	0	1	1	1
P3	0	1	0	1
P4	0	0	0	0
P5	0	1	1	1
P6	1	1	0	1
P7	0	0	1	1
P8	0	0	0	0
P9	1	0	1	0
P10	0	0	1	1
P11	0	1	1	1
P12	0	1	1	0
P13	0	1	1	1
P14	1	1	1	1
P15	0	0	0	0
P16	1	1	1	1
P17	1	1	1	1
P18	0	1	0	1
P19	1	0	1	1
P20	1	1	0	1
Sum	7	13	12	15

3.9. Paired Comparison of The Sample

The paired comparison test is a simple test that determines whether there is a difference between two kinds of products. Paired comparison measures two sets of samples according to specific parameters. The paired comparison test was conducted on both samples of *pratama taro*, TS1 and TS2. Panellists were asked particularly to choose one preferred sample from the two samples presented or the level of liking that represents acceptance or interest in a product.

Based on the organoleptic data (Table 2), the difference between the two samples tested was determined using Table 3, which is the smallest number to express the real difference between the two samples. From Table 3, it is known that for the number of panellists of 20 people, the minimum number of panellists stating the difference at the level of 0.2 is at least nine panellists; 0.1 is at least 10 panellists; 0.05 is at least 11 panellists; 0.01 is at least 13 panellists; and 0.001 is at least 14 panellists. At the degree of significant level in $p < 0.05$, the conclusions that can be drawn from these results are: (1) no color difference between the two types of taros (TS1 and TS2) was detected at 5%; (2) detected a difference in the aroma of the two types of taros (TS1 and TS2) at 5%; (3) detected a difference in texture of both types of taros (TS1 and TS2) at the level of 5%; and (4) the taste of the two steamed taro (TS1 and TS2) differs markedly at 5%.

Table 3. Table of a minimum number of panellists required to understand the difference based on international organization for standardization.

n	0,2	0.10	0.05	0.01	0.001	n	0.2	0.10	0.05	0.01	0.001
6	4	5	5	6	-	27	12	13	14	16	18
7	4	5	5	6	7	28	12	14	15	16	18
8	5	5	6	7	8	29	13	14	15	17	19
9	5	6	6	7	8	30	13	14	15	17	19
10	6	6	7	8	9	31	14	15	16	18	20
11	6	7	7	8	10	32	14	15	16	18	20
12	6	7	8	9	10	33	14	15	17	18	21
13	7	8	8	9	11	34	15	16	17	19	21
14	7	8	9	10	11	35	15	16	17	19	22
15	8	8	9	10	12	36	15	17	18	20	22
16	8	9	9	11	12	42	18	19	20	22	25
17	8	9	10	11	12	48	20	21	22	25	27
18	9	10	10	12	13	54	22	23	25	27	30
19	9	10	11	12	14	60	24	26	27	30	33
20	9	10	11	13	14	66	26	28	29	32	35
21	10	11	12	13	15	72	28	30	32	34	38
22	10	11	12	14	15	78	30	32	34	37	40
23	11	12	12	14	16	84	33	35	36	39	43
24	11	12	13	15	16	90	35	37	38	42	45
25	11	12	13	15	17	96	37	39	41	44	48
26	12	13	14	15	17	102	39	41	43	46	50

Source: [33]

The difference in color criteria was not found clearly between the two samples tested for *pratama taro*. Naturally, *pratama taro* has been identified as having a white-flesh color in the tuber and is covered in a brownish-black color for the skin, both in type 1 (TS1) and type 2 (TS2). This occurs because the samples come from the same cultivar but different varieties. However, the differences in perspective observed by a small number of panellists may vary due to the cooking process. Traditional processing methods can reduce the intensity of color changes in taro corm, including cutting size, cooking time, and water changes during the boiling process [34]. Thus, to enhance the significant difference between the samples, it might be seen if the taro samples (as a raw material) are compared with its processed product. Another research that used *pratama taro* as the main ingredient for making noodles shows that more added *pratama taro* flour will decrease the preference of panellists on the noodles' color, and the use of seaweed flour could increase the noodle's color [28].

The aroma criteria were found to have a significant difference between the two samples. The aromatic is a complex mixture that depends on the combination of volatile compounds, concentration, and description by individual perception [35]. Taro mainly consists of aliphatic hydrocarbons, alcohols, acids, and a small amount of phenolic and heterocyclic compounds [36]. There should be a difference between raw and cooked taro, while the reported cooked taro has a minimum of 11 volatile [37]. The genotype of their parent variation influenced the uniqueness of taro aromatic properties. In several cultivar breeding, the aromatic properties will present after the cooking process [38].

The texture is also reported to be different in both types of taros. On several varieties, the amount of nutrients in tubers is equated with the texture of taro corm. Furthermore, the total soluble solids in taro composition are significantly related to the texture of taro. It refers to the substances in a solution, including sugars, vitamins, minerals, and other compounds. This measurement allows us to determine the optimal time to ensure the quality of the product. The effects of physiological, physiochemical, and nutritional properties of roots and tuber crops depend on the storage condition [1].

The flavour was also determined to be different between the two samples of taro. This varying taste depends on the complement of vitamins and nutrient composition. The complexity of taro flavour has been classified by the character of cooked taro in general, such as caramelly, roast, milky, beany, green, aldehydic, sweet, nutty, vegetative, and fruity. However, the difference in unique taste between the samples might be influenced by the different treatments, time, and also size during the steaming process. Due to the boiling process, it was observed that the oxalate content, total sugar, crude fat, crude fiber, and phenolic compound were significantly reduced. In contrast, the carbohydrates and other content were increased [30].

4. CONCLUSION

Based on the data analysis results, the conclusion can be drawn that the three types of taros originating from the Sumedang District can be used as an alternative food source. The content of moisture, ash, fat, and carbohydrates obtained from the chemical analysis results shows that TS1 is slightly superior to TS2 and TS0. TS2 has the advantage of higher protein content than TS1 and TS0. Meanwhile, the highest fiber and calcium content is found in TS0. Organoleptic tests using paired comparison test methods were also carried out on two types of taros from Sumedang, namely TS1 and TS2. The results showed that there was a marked difference in aroma, texture, and taste between the two, but in terms of color, there was no noticeable difference at the level of 5%. However, taro still has quite extensive development potential, both in the food sector and even medicine. The superior nutrient content in taro should be mixed up with the other ingredient content. It can help to elevate the value of processed products made from taro, especially *pratama taro*.

AUTHOR CONTRIBUTION

All author contributed equally to the main contributor to this paper. All authors read and approved the final paper. **Wawan Gunawan**: Writing (original draft), writing (review & editing), conceptualization, validation. **Ramadhani Eka Putra**: Writing (review & editing), formal analysis, supervision. **Pujo Pujo**: Writing (review & editing), funding acquisition, methodology. **Farhan Ilham Wira Rohmat**: Writing (review & editing), investigation, formal analysis. **Dini Siti Hanifah**: Writing (review & editing), formal analysis, visualization. **Fitri Awaliyah**: Writing (review & editing), data curation, resources. **Raden Dewi Anggraeni**: Writing (review & editing), formal analysis, project administration. **Nida Nuradzkia**: Writing (review & editing), investigation.

CONFLICTS OF INTEREST

The authors declare that they have no conflicts of interest to declare.

ACKNOWLEDGMENT

The researcher would like to thank the Institute for Research and Community Service (LPPM) SITH and ITB for providing support through funds for this research activity. We also express our gratitude to the Hurip Farmer Group, sub-district heads and village heads in Ganeas District, Pasundan University Food Laboratory, and other parties who cannot be mentioned one by one for supporting and helping to provide data and information for this research.

REFERENCES

[1] M. J. Ferdaus, E. Chukwu-Munsen, A. Foguel, and R. C. da Silva, "Taro roots: An underexploited root crop," *Nutrients*, vol. 15, no. 15, p. 3337, 2023, https://doi.org/10.3390/nu15153337.

[2] P. Kaushal, V. Kumar, and H. K. Sharma, "Utilization of taro (*Colocasia esculenta*): a review," *J. Food Sci. Technol.*, vol. 52, no. 1, pp. 27–40, 2015, https://doi.org/10.1007/s13197-013-0933-y.

[3] Y. A. Shah, F. Saeed, M. Afzaal, N. Waris, S. Ahmad, N. Shoukat, and H. Ateeq, "Industrial applications of taro (*Colocasia esculenta*) as a novel food ingredient: A review," *J. Food Process. Preserv.*, vol. 46, no. 11, 2022, https://doi.org/10.1111/jfpp.16951.

[4] N. Van Loi, P. T. Binh, and V. K. Sam, "Changes in physicomechanical, nutritional, and sensory indicators of taro tubers at different harvest times," *Food Sci. Technol.*, vol. 43, 2023, https://doi.org/10.5327/fst.7823.

[5] D. Maretta, So. Sobir, I. Helianti, P. Purwono, and E. Santosa, "Current status of taro (*Colocasia esculenta*) utilization as local food diversification toward climate resilience in Indonesia," *IOP Conf. Ser. Earth Environ. Sci.*, vol. 913, no. 1, p. 012027, 2021, https://doi.org/10.1088/1755-1315/913/1/012027.

[6] S. N. N. Makiyah, I. Setyawati, S. N. Rahmadhia, S. Tasminatun, and M. Kita, "Comparison of yam composite cookies sensory characteristic between sugar and stevia sweeteners," *J. Agri-Food Sci. Technol.*, vol. 5, no. 2, pp. 120–133, 2024, https://doi.org/10.12928/jafost.v5i2.10211.

[7] R. E. Paull, D. Zerpa-Catanho, N. J. Chen, G. Uruu, C. M. J. Wai, and M. Kantar, "Taro raphide-associated proteins: Allergens and crystal growth," *Plant Direct*, vol. 6, no. 9, 2022, https://doi.org/10.1002/pld3.443.

[8] Aditika, B. Kapoor, S. Singh, and P. Kumar, "Taro (*Colocasia esculenta*): Zero wastage orphan food crop for food and nutritional security," *South African J. Bot.*, vol. 145, pp. 157–169, 2022, https://doi.org/10.1016/j.sajb.2021.08.014.

[9] E. Ibañez and A. Cifuentes, "New analytical techniques in food science," *Crit. Rev. Food Sci. Nutr.*, vol. 41, no. 6, pp. 413–450, 2001, https://doi.org/10.1080/20014091091878.

[10] S. Giovani, A. D. Putri, N. M. Adelina, and A. Setiyoko, "Quality characteristics of jack bean (*Canavalia ensiformis* L.) tempeh milk with addition of ajwa date (*Phoenix dactylifera* L.) and various types of stabilizers," *J. Agri-Food Sci. Technol.*, vol. 5, no. 1, pp. 18–32, 2024, https://doi.org/10.12928/jafost.v5i1.10210.

[11] D. P. Wati, M. D. Fajrina, S. S. Putra, and T. Suryani, "The substitution of purslane weed (*Portulaca oleracea* L.) flour and glucomannan powder on organoleptic and proximate test of instant noodles," *J. Agri-Food Sci. Technol.*, vol. 5, no. 1, pp. 44–56, 2024, https://doi.org/10.12928/jafost.v5i1.9380.

[12] L. Sipos, Á. Nyitrai, G. Hitka, L. F. Friedrich, and Z. Kókai, "Sensory panel performance evaluation—Comprehensive review of practical approaches," *Appl. Sci.*, vol. 11, no. 24, p. 11977, 2021, https://doi.org/10.3390/app112411977.

[13] F. F. F. Vennerød, M. Hersleth, S. Nicklaus, and V. L. Almli, "The magic water test. An affective paired comparison approach to evaluate taste sensitivity in pre-schoolers," *Food Qual. Prefer.*, vol. 58, pp. 61–70, 2017, https://doi.org/10.1016/j.foodqual.2017.01.003.

[14] N. Yantih, E. Mulatsari, Y. Sumiyati, I. Sari, C. Qisthiara, A. Prastica, J. Rezon, D. Azka, and D. Ariyanti, "Nutritional analysis of *Colocasia esculenta* L. tubers aqueous extract and comparative analysis with existing literature," *Sci. Phytochem.*, vol. 2, no. 2, pp. 40–47, 2023, https://doi.org/10.58920/sciphy02020040.

[15] T. Wondimu Fufa, H. Ogba Oselebe, C. Veronica Nnamani, C. Azubuike Afiukwa, and E. Aniedi

Uyoh, "Systematic review on farmers' perceptions, preferences and utilization patterns of taro [*Colocasia esculenta* (L.) Scott] for food and nutrition security in Nigeria," *J. Plant Sci.*, vol. 9, no. 4, p. 224, 2021, https://doi.org/10.11648/j.jps.20210904.23.

[16] Z. Kibret Akalu and S. Haile Geleta, "Comparative analysis on the proximate composition of tubers of *Colocasia esculenta* L. Schott and *Dioscorea alata* cultivated in Ethiopia," *Am. J. Biosci. Bioeng.*, vol. 7, no. 6, p. 93, 2019, https://doi.org/10.11648/j.bio.20190706.13.

[17] T. Adane, A. Shimelis, R. Negussie, B. Tilahun, and G. Haki, "Effect of processing method on the proximate composition, mineral content and antinutritional factors to taro (*Colocasia esculenta* L.) grown in Ethiopia," *African J. Food, Agric. Nutr. Dev.*, vol. 13, no. 57, pp. 7383–7398, 2013, https://doi.org/10.18697/ajfand.57.10345.

[18] Z. Tietel, S. Hammann, S. W. Meckelmann, C. Ziv, J. K. Pauling, M. Wölk, V. Würf, E. Alves, B. Neves, and M. R. Domingues, "An overview of food lipids toward food lipidomics," *Compr. Rev. Food Sci. Food Saf.*, vol. 22, no. 6, pp. 4302–4354, 2023, https://doi.org/10.1111/1541-4337.13225.

[19] P. G. Patted, R. S. Masareddy, A. S. Patil, R. R. Kanabargi, and C. T. Bhat, "Omega-3 fatty acids: a comprehensive scientific review of their sources, functions and health benefits," *Futur. J. Pharm. Sci.*, vol. 10, no. 1, p. 94, 2024, https://doi.org/10.1186/s43094-024-00667-5.

[20] L. Ferrari, S.-A. Panaite, A. Bertazzo, and F. Visioli, "Animal- and plant-based protein sources: A scoping review of human health outcomes and environmental impact," *Nutrients*, vol. 14, no. 23, p. 5115, 2022, https://doi.org/10.3390/nu14235115.

[21] J. Xu, Y. Li, L. Kaur, J. Singh, and F. Zeng, "Functional Food Based on Potato," *Foods*, vol. 12, no. 11, p. 2145, 2023, https://doi.org/10.3390/foods12112145.

[22] H. Khusun, J. Februhartanty, R. Anggraini, E. Mognard, Y. Alem, M. I. Noor, N. Karim, C. Laporte, J.-P. Poulain, P. Monsivais, and A. Drewnowski, "Animal and plant protein food sources in Indonesia differ across socio-demographic groups: Socio-cultural research in protein transition in Indonesia and Malaysia," *Front. Nutr.*, vol. 9, 2022, https://doi.org/10.3389/fnut.2022.762459.

[23] V. J. Clemente-Suárez, J. Mielgo-Ayuso, A. Martín-Rodríguez, D. J. Ramos-Campo, L. Redondo-Flórez, and J. F. Tornero-Aguilera, "The burden of carbohydrates in health and disease," *Nutrients*, vol. 14, no. 18, p. 3809, 2022, https://doi.org/10.3390/nu14183809.

[24] H. Khusun, R. Anggraini, J. Februhartanty, E. Mognard, K. Fauzia, N. R. Maulida, O. Linda, and J.-P. Poulain, "Breakfast consumption and quality of macro- and micronutrient intake in Indonesia: A study from the Indonesian food barometer," *Nutrients*, vol. 15, no. 17, p. 3792, 2023, https://doi.org/10.3390/nu15173792.

[25] V. T. Weligama Thuppahige, L. Moghaddam, Z. G. Welsh, T. Wang, and A. Karim, "Investigation of critical properties of cassava (*Manihot esculenta*) peel and bagasse as starch-rich fibrous agro-industrial wastes for biodegradable food packaging," *Food Chem.*, vol. 422, p. 136200, 2023, https://doi.org/10.1016/j.foodchem.2023.136200.

[26] E. O. Alamu, A. Dixon, T. E. Eyinla, and B. Maziya-Dixon, "Characterization of macro and micro-minerals in cassava leaves from genotypes planted in three different agroecological locations in Nigeria," *Heliyon*, vol. 8, no. 11, p. e11618, 2022, https://doi.org/10.1016/j.heliyon.2022.e11618.

[27] M. Arıcı, R. M. Yıldırım, G. Özülkü, B. Yaşar, and O. S. Toker, "Physicochemical and nutritional properties of taro (*Colocasia esculenta* L. Schott) flour as affected by drying temperature and air velocity," *LWT*, vol. 74, pp. 434–440, 2016, https://doi.org/10.1016/j.lwt.2016.08.006.

[28] Y. Taufik, Y. Garnida, T. Gozali, Y. Ikrawan, and D. Apresya, "Quality improvement of wet noodle with the addition of pratama taro flour (*Colocasia esculeta* L. schott var. pratama) and seaweed flour (Eucheuma cottonii)," *J. Penelit. Pertan. Terap.*, vol. 23, no. 3, pp. 468–478, 2023, https://doi.org/10.25181/jppt.v23i3.3050.

[29] L. Junxing, M. Aiqing, Z. Gangjun, L. Xiaoxi, W. Haibin, L. Jianning, G. Hao, Z. Xiaoming, D. Liting, and M. Chengying, "Assessment of the 'taro-like' aroma of pumpkin fruit (*Cucurbita moschata* D.) via E-nose, GC–MS and GC-O analysis," *Food Chem. X*, vol. 15, p. 100435, 2022, https://doi.org/10.1016/j.fochx.2022.100435.

[30] G. Zhu, Z. Xiao, R. Zhou, and D. Lei, "Preparation and simulation of a taro flavor," *Chinese J. Chem.*

Eng., vol. 23, no. 10, pp. 1733–1735, 2015, https://doi.org/10.1016/j.cjche.2015.07.026.

[31] Q. Quan, Y. Zhang, A. Nawaz, L. Feng, and Z. Qin, "Effects of taro [*Colocasia esculenta* (L.) Schott] slices on nutritional quality, sensory quality, and shelf life of Chinese pickled and steamed pork belly," *Front. Nutr.*, vol. 10, 2023, https://doi.org/10.3389/fnut.2023.1290221.

[32] D. Singla, A. Singh, S. B. Dhull, P. Kumar, T. Malik, and P. Kumar, "Taro starch: Isolation, morphology, modification and novel applications concern - A review," *Int. J. Biol. Macromol.*, vol. 163, pp. 1283–1290, 2020, https://doi.org/10.1016/j.ijbiomac.2020.07.093.

[33] Q. Yang and M. L. Ng, "Paired comparison/directional difference test/2-alternative forced choice (2-AFC) test, simple difference test/same-different test," in *Discrimination Testing in Sensory Science*, Elsevier, pp. 109–134, 2017, https://doi.org/10.1016/B978-0-08-101009-9.00005-8.

[34] Y. Zhang, F. Shang, T. Kryzhska, L. Fan, L. Li, Q. Cheng, Z. Duan, and S. Chen, "Effect of hot processing on taste quality, starch structure, and pasting properties of areca taro," *CyTA - J. Food*, vol. 22, no. 1, 2024, https://doi.org/10.1080/19476337.2023.2297777.

[35] M. El Hadi, F.-J. Zhang, F.-F. Wu, C.-H. Zhou, and J. Tao, "Advances in fruit aroma volatile research," *Molecules*, vol. 18, no. 7, pp. 8200–8229, 2013, https://doi.org/10.3390/molecules18078200.

[36] X. Zhou, L. Wen, J. Xiao, X. Mo, P. Wan, and D.-W. Chen, "2- Acetyl-1-pyrroline originated from maillard reaction is the key odorant of cooked lipu taro," *Int. J. Gastron. Food Sci.*, vol. 37, p. 100968, 2024, https://doi.org/10.1016/j.ijgfs.2024.100968.

[37] S. Zhao, Y. Qiu, J. Luo, W. Wang, H. Wu, X. Liu, G. Zhao, H. Gong, X. Zheng, Y. Zhong, X. Yang, and J. Li, "Volatiles and transcriptome profiling revealed the formation of 'taro-like' aroma in the leaf of pumpkin (*Cucurbita moschata*)," *Agronomy*, vol. 12, no. 11, p. 2641, 2022, https://doi.org/10.3390/agronomy12112641.

[38] J. Kristl, V. Sem, A. Mergeduš, M. Zavišek, A. Ivančič, and V. Lebot, "Variation in oxalate content among corm parts, harvest time, and cultivars of taro (*Colocasia esculenta* (L.) Schott)," *J. Food Compos. Anal.*, vol. 102, p. 104001, 2021, https://doi.org/10.1016/j.jfca.2021.104001.