The Quality of Taro (*Colocasia esculenta*) Corm Flour on Various Tropical Habitat

ABSTRACT

Aims: to provide information on the Quality of Taro (*Colocasia esculenta*) Corm Flour on Various Tropical Growing Media.

Study Design: The research design used in this study is descriptive research, a research method used to investigate the condition of the object directly in a non-experimental manner.

Place and Duration of Study: Sample: Soil Laboratory, The Faculty of Agriculture, Mulawarman University, Indonesia, between June 2023 and February 2024.

Methodology: The data collection method employed involves gathering primary data through direct observation of the objects and their environments according to the observation parameters. The stages of the research conducted include a pre-survey to gather information regarding the growing habitats of taro. After the pre-survey, a survey is conducted at several locations with terrestrial, semi-terrestrial, and neuston habitats. Once the taro habitats are identified, the determined locations are explored to select sampling points. Four sample points are taken at each taro growth location. The samples collected are the largest taro corms that are ready for harvest. Subsequently, the processing and observation of the taro corm flour are carried out.

Results: The terrestrial habitat is the best condition to improve the quality of taro flour (Colocasia esculenta) compared to the semi-terrestrial and neuston habitats. The terrestrial habitat consistently shows higher nutrient content, including fat, total carbohydrates, sucrose, total sugar, crude fiber, and starch. The environmental conditions in the terrestrial habitat, such as optimal water availability, light intensity that supports photosynthesis, and adequate nutrients, provide an ideal environment for the accumulation of essential nutrients in taro corms.

Conclusion: It was found that the habitat in which taro corms grow has a significant influence on the quality of the corms. The terrestrial habitat appears to be the most supportive environment for the accumulation of these nutrients, followed by the neuston habitat, and lastly, the semi-terrestrial habitat.

Keywords: habitat; rural farming; carbohydrate; tidal; peat land; corm; flour.

1. INTRODUCTION

The Araceae family consists of 110 genera and 3,200 species. Araceae belong to the taro family, which includes terrestrial (land) plants, aquatic (floating) plants, and epiphytic trees. The Araceae family exhibits high diversity and is spread across all regions of the Indonesian archipelago [1]. The Araceae family is often regarded by the public as merely wild plants with no useful value. However, these plants have potential for development, particularly in the field of food, as an example of local food diversification as an alternative source of carbohydrates [2,3].

Taro (*Colocasia esculenta*) is one of the Araceae commonly cultivated for its corms, which are used as food. Taro grows in tropical areas with adequate rainfall (175–250 cm/year) and requires fertile soil in humid areas with temperatures around 21–27°C. This plant can thrive in lowlands up to an altitude of 2700 meters above sea level but is not tolerant of very low (cold) temperatures [4]. Taro has significant potential as a promising alternative carbohydrate source compared to other carbohydrate-producing commodities such as rice, corn, and sweet potatoes. With its high starch content, taro provides a good energy source and can be processed into various food products such as flour, which can be used in making bread, cakes, and baby food. Additionally, the low-fat content of taro makes it a healthier choice for those needing a low-fat diet. Taro is known to be gluten-free, making it suitable for those with gluten intolerance or following a gluten-free diet. On the other hand, the high-water content in taro provides a soft texture and easy digestibility, although it also demands better processing and storage methods to avoid spoilage. In the context of food diversification and increasing food security, taro can be a significant alternative to reduce reliance on the current main carbohydrate commodities.

Araceae are abundant and diverse in wet tropical areas [4]. The Central Mahakam region has a tropical rainforest climate with high rainfall throughout the year, supporting the growth of taro plants that require a lot of water. The Central Mahakam region, East Kalimantan, has many taro plants that grow abundantly and are spread across terrestrial, semi-terrestrial, and neuston habitats. Until now, no information has been found regarding the types and potential of these plants from ecological, economic, and societal benefits perspectives. This inventory activity includes exploration and identification activities. The inventory and characterization activities are expected to reveal the potential of taro plants in the peat and tidal swamp areas of Central Mahakam. This research aims to provide information on the impact of various tropical growing media namely mineral soil (terrestrial), tidal swamp (semi-terrestrial), and neuston, on the quality of taro (*Colocasia esculenta*) corm flour.

2. METHODOLOGY

The research design used in this study is descriptive research, a research method used to investigate the condition of the object directly in a non-experimental manner. The data collection method employed involves gathering primary data through direct observation of the objects and their environments according to the observation parameters. The stages of the research conducted include a pre-survey to gather information regarding the growing habitats of taro in the Central Mahakam region, East Kalimantan Province, Indonesia. After the pre-survey, a survey is conducted at several locations with terrestrial, semi-terrestrial, and neuston habitats. Once the taro habitats are identified, the determined locations are explored to select sampling points. Four sample points are taken at each taro growth location. The samples collected are the largest taro corms that are ready for harvest. Subsequently, the processing and observation of the taro corm flour are carried out in Soil Loboratory, The Faculty of Agriculture, Mulawarman University, Indonesia. Measurements are carried out with:

a. Sample Preparation

1) Drying: Slice the taro corms into thin pieces. Dry the slices in an oven at 60°C until a constant weight is achieved. Grind the dried slices into flour using a grinder.
2) Storage: Store the taro flour in an airtight container in a cool, dry place until ready for analysis.

b. Proximate Analysis

1) Moisture Content: Weigh 5 grams of the sample and dry in an oven at 105°C until a constant weight is achieved (AOAC 925.09).
2) Ash Content: Weigh 5 grams of the sample and incinerate in a furnace at 550°C for 5-6 hours or until a white ash residue is obtained (AOAC 923.03).
3) Protein: Analyze nitrogen content using the Kjeldahl method and multiply by a factor of 6.25 to obtain protein content (AOAC 979.09).
4) Crude Fat: Extract fat using an organic solvent and analyze using the Soxhlet method (AOAC 962.09).
5) Crude Fiber: Use the Van Soest method to determine crude fiber. Weigh the residue remaining after acid and base treatment (AOAC 923.05).
6) Total Carbohydrates: Calculate total carbohydrates by subtracting the sum of protein, fat, moisture, ash, and crude fiber from 100%.

7) Total Sugars: Use the phenol-sulfuric acid method to measure total sugars after acid hydrolysis of the sample.
8) Reducing Sugars: Use the DNS (*Dinitrosalicylic Acid*) method to measure reducing sugars.
9) Sucrose: Hydrolyze sucrose into glucose and fructose with invertase, then measure using the phenol-sulfuric acid method.
10) Starch: Sample preparation, measurement of total sugar content by saccharimeter, measurement of sugar content of water soluble, active substance by saccharimeter, and calculation of starch content.

3. RESULTS AND DISCUSSION

Taro corms are the part of the taro plant that serve as storage organs for food reserves. The growth and development of taro corms are influenced by the conditions of the land where the plant grows.

The results of this study show significant variations in moisture content and ash content among the three habitats, with the highest values found in the semi-terrestrial habitat. The analysis of moisture content is shown in Fig. 1.

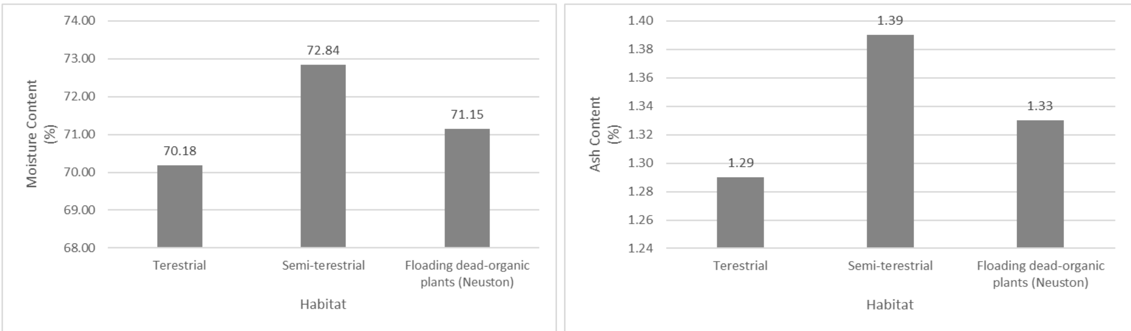


Fig. 1. Variation in moisture content and ash content in three different habitats

Moisture content in plants is an important indicator that reflects the plant's ability to retain water and the environmental conditions where the plant grows. In contrast, ash content shows relatively consistent values across all habitats, with minor variations ranging from 1.29% to 1.39%. The semi-terrestrial habitat showed the highest ash content (1.39%), while the terrestrial and Neuston habitats had ash contents of 1.29% and 1.33%, respectively. Ash content reflects the minerals present in the corm, and this variation may be influenced by the type and availability of minerals in each growing medium. The highest moisture content was found in taro corms growing in the semi-terrestrial habitat (72.84%), followed by the Neuston habitat (71.15%), and the lowest in the terrestrial habitat (70.18%).

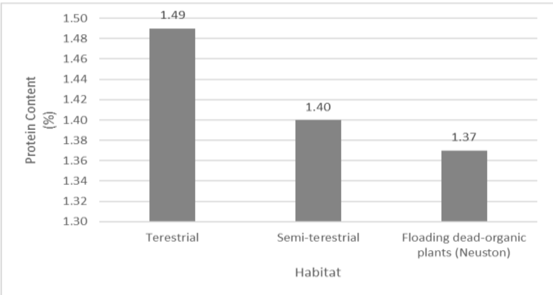
These differences are attributed to the growing medium's ability to retain water. The variation in moisture content among the three habitats can be due to various environmental factors and soil characteristics [5,6]. The semi-terrestrial habitat, showing the highest moisture content, might be due to the combination of terrestrial and aquatic soil properties that can better retain moisture and accumulate minerals. Conversely, the terrestrial habitat had the lowest moisture and ash content, which could be due to higher evaporation rates, better drainage, and more intensive leaching processes.

Taro is an economically and nutritionally important root crop. The protein content in taro corms is one of the determining factors of nutritional quality. Unlike the moisture and ash content in taro corms, the highest protein content was found in corms growing in the terrestrial habitat (1.49%), followed by the semi-terrestrial habitat (1.40%) and the Neuston habitat (1.37%). The terrestrial habitat might provide more favorable conditions for protein synthesis in the corms, such as better nitrogen availability or other environmental factors that support protein biosynthesis.

The differences in protein content between taro corms from the three habitats are due to various environmental factors and nutrient availability. The terrestrial habitat, showing the highest protein content, may have more fertile soil conditions with sufficient nitrogen availability for protein synthesis. These conditions support better taro growth and increased protein content. In contrast, the semi-terrestrial and Neuston habitats indicate limitations in nitrogen availability, affecting protein synthesis in taro corms. The protein content in the semi-terrestrial habitat is slightly lower than in the terrestrial habitat, possibly due to the mixed soil conditions combining terrestrial and aquatic properties, which may not be entirely optimal for protein synthesis. The lowest protein content was found in taro corms growing in the Neuston habitat. Nutrient limitations and potential environmental stress in this habitat likely contribute to the lower protein content in taro corms [7].

The highest reducing sugar content was found in corms growing in the terrestrial habitat (0.42%), followed by the semi-terrestrial habitat (0.40%) and Neuston (0.38%). The terrestrial habitat may provide more favorable conditions for the decomposition of complex carbohydrates into reducing sugars. This study shows that the terrestrial habitat is the most optimal for taro cultivation with the highest protein and reducing sugar content, followed by the semi-terrestrial and Neuston habitats.

Different habitat conditions have varying impacts on the fat, sucrose, total carbohydrates, total sugar, crude fiber, and starch content of taro. The terrestrial habitat yields the highest values for each of these parameters, while the semi-terrestrial habitat shows the lowest values.



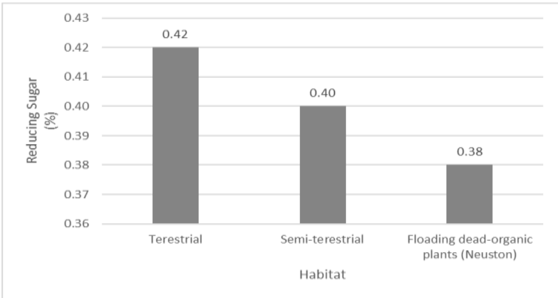


Fig. 2. Variation in protein and reducing sugar content in three different habitats

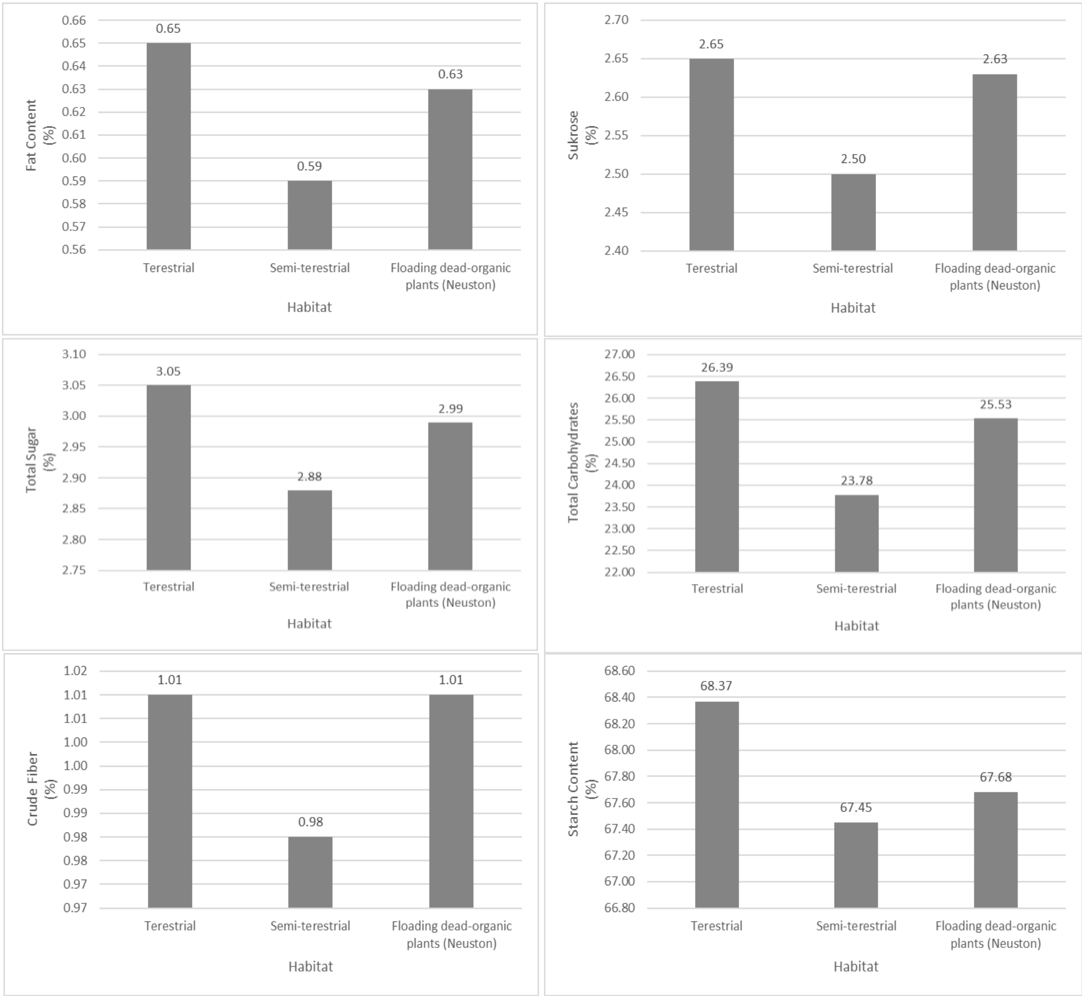


Fig. 3. Variation in fat, sucrose, total sugar, total carbohydrate, crude fiber, and starch content in three different habitats

Based on Fig. 3, there are differences in the fat content of taro corms grown in three different habitats. In the terrestrial habitat, taro corms show the highest fat content with a value of 0.65%. This terrestrial habitat is suspected to provide more stable soil conditions and richer nutrients, allowing taro corms to accumulate more fat [6,8]. Conversely, in the semi-terrestrial habitat, taro corms recorded the lowest fat content, at 0.59%. The semi-terrestrial habitat may have more fluctuating conditions, such as changes in water levels and unbalanced nutrients, which can affect the ability of taro corms to store fat. Meanwhile, in the habitat consisting of floating organic dead plants (neuston), the fat content of taro corms is in the middle with a value of 0.63%. This habitat may provide sufficient nutrients from decomposing organic matter, but unstable environmental conditions such as water movement can affect fat accumulation in taro corms. The terrestrial habitat appears to be the most supportive environment for fat accumulation in taro corms, followed by the neuston habitat, and finally the semi-terrestrial habitat.

Sucrose and total sugar content showed slight variations among habitats. The terrestrial habitat produced the highest sucrose and total sugar content (2.65% and 3.05%), followed by the neuston habitat (2.63% and 2.99%) and semi-terrestrial habitat (2.50% and 2.88%). This variation may be influenced by differences in enzymatic activity regulating sugar metabolism in each habitat. Similarly, the highest total carbohydrate content was found in corms grown in the terrestrial habitat (26.39%), followed by the neuston habitat (25.53%) and semi-terrestrial habitat (23.78%). The terrestrial habitat may provide conditions that support photosynthesis and carbohydrate accumulation, such as optimal light intensity or nutrient availability.

Crude fiber content showed slight variations among habitats, with the highest values in the terrestrial and neuston habitats (1.01%) and the lowest in the semi-terrestrial habitat (0.98%). Crude fiber content reflects the structural components in corms, and this variation may be influenced by differences in cell wall composition caused by environmental conditions in each habitat. The highest starch content was found in corms grown in the terrestrial habitat (68.37%), followed by the neuston habitat (67.68%) and semi-terrestrial habitat (67.45%). Starch is the main form of carbohydrate storage in corms, and variations in starch content may reflect differences in photosynthesis efficiency and energy reserve accumulation in each habitat. The semi-terrestrial and neuston habitats showed the lowest starch content, which can be compared to the research results [9] showing starch content ranging from 68% to 72%.

From the above analysis, it is evident that the habitat where taro corms grow has a significant impact on the quality of taro corms. The terrestrial habitat appears to be the most supportive environment for nutrient accumulation, followed by the neuston habitat, and finally the semi-terrestrial habitat. The stable and nutrient-rich soil conditions in the terrestrial habitat allow taro corms to accumulate carbohydrates and sugars more efficiently compared to other habitats. Terrestrial land is land located on the mainland, usually rich in nutrients and well-drained. Nutrient-rich soil and good drainage on terrestrial land support strong taro root growth and optimal nutrient absorption. This can result in large taro corms rich in nutrients [7,10,11].

Taro plant growth is influenced by environmental factors such as soil moisture, temperature, and nutrient availability. If taro plants do not get suitable environmental conditions, their growth can be stunted, and the nutrient content in their corms can also decrease. Therefore, it is important to pay attention to the habitat conditions where taro plants are grown to ensure optimal growth and maintained nutrient content.

Thus, planting the same type of taro in different habitat conditions can result in differences in plant growth and nutrient content in its corms [12]. This highlights the importance of considering environmental factors in taro cultivation to ensure optimal yields and good nutritional content.

It can be concluded that the terrestrial habitat is the best condition to improve the quality of taro flour (*Colocasia esculenta*) compared to the semi-terrestrial and neuston habitats. The terrestrial habitat consistently shows higher nutrient content, including fat, total carbohydrates, sucrose, total sugar, crude fiber, and starch. The environmental conditions in the terrestrial habitat, such as optimal water availability, light intensity that supports photosynthesis, and adequate nutrients, provide an ideal environment for the accumulation of essential nutrients in taro corms. The findings of the study emphasize the importance of selecting suitable growing media to maximize the potential quality of food crops, particularly in the production of high-quality taro flour. Therefore, applying terrestrial habitat conditions in taro cultivation can be an effective strategy to improve yield and quality of the final product.

Taro plants are carbohydrate-producing plants. This is because the primary storage organs of the taro plant are its corms, these corms are rich in starch, a complex carbohydrate. Starch is a major source of energy for humans and is the primary carbohydrate found in taro corms. Its make taro has ahave a strategic role not only as a source of food and industrial raw materials but also for animal feed. Taro plants have high economic value because most parts of the plant can be utilized for human consumption. Taro plants, which are carbohydrate producers, have the potential to substitute rice. Compared to other alternative carbohydrate sources such as sweet potatoes [13], taro corms have advantages such as high water and starch content, helping to maintain softness and texture when cooked, making them softer and easier to chew, and lower fat content, making them a healthier choice for those who need to control fat consumtion [14,15,16].

4. CONCLUSION

This study indicate that the terrestrial habitat can produce taro corms flour with the best nutritional quality compared to semi-terrestrial and neuston habitats. The fat, total carbohydrate, sucrose, total sugar, crude fiber, and starch content in taro corms grown in the terrestrial habitat are consistently higher. This suggests that the environmental conditions in the terrestrial habitat, such as optimal water availability, light intensity that supports photosynthesis, and adequate nutrients, provide an ideal environment for the accumulation of essential nutrients in taro corms. The findings of study indicates that the terrestrial habitat in the Central Mahakam region is the most effective growing medium for improving the quality of taro corm flour, providing valuable insights for local cultivation and food production strategies.

DISCLAIMER (ARTIFICIAL INTELLIGENCE)

NO generative AI technologies such as Large Language Models (ChatGPT, COPILOT, etc) and text-to-image generators have been used during writing or editing of manuscripts.

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COMPETING INTERESTS

Authors have declared that no competing interests exist.

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