

Characteristics and Comparison of Red Fruit Varieties (Pandanus Conoideus Lamk) From Gearek District, Nduga - Papua Pegunungan Province

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ABSTRACT

Buah Merah (Pandanus conoideus Lamk.) is an endemic plant of Papua with significant potential in health and economic sectors. This study aims to identify and compare the physical and chemical characteristics of various Buah Merah varieties originating from Gearek District, Nduga Regency, Papua Pegunungan Province. The characteristics analyzed include size, shape, color, and key nutritional components such as beta-carotene, antioxidants, and other essential vitamins. The research method involved sampling different local varieties from Gearek District and conducting laboratory analyses to determine their chemical composition and physical characteristics. The results indicate significant differences in size, color, and nutrient content among the varieties. Some varieties exhibited higher beta-carotene and antioxidant content, highlighting their potential as leading candidates for the development of natural health products. This research provides essential data to support the cultivation, utilization, and marketing of Buah Merah as a valuable local product, promoting sustainable resource management in Papua

INTRODUCTION

Red Fruit (*Pandanus conoideus*) is an endemic plant that holds significant value in Papua, particularly in terms of nutrition, health, and the local economy (Sarungallo et al. 2018). This fruit is known for its high nutritional content, especially antioxidants, beta-carotene, and other vitamins that are highly beneficial for health (Purba et al. 2023; Agnesa et al. 2017). As a potential local resource, Red Fruit has various varieties that grow in the mountainous areas of Papua, such as in Gearek District, Nduga Regency. However, until now, in-depth research on the characteristics and comparisons of Red Fruit varieties from this region has been very limited. A deeper understanding of the differences between these varieties is essential for the development of cultivation, processing, and marketing of Red Fruit as a local flagship product (Soni et al. 2023). Therefore, this study aims to identify and compare the characteristics of five varieties of Red Fruit found in the region.

Gearek District, Nduga Regency, Mountain Papua, is rich in biodiversity, including several varieties of Red Fruit that grow naturally in this area. Red Fruit is one of Papua's distinctive plants with significant potential in the health and economic sectors. Amid the increasing interest in natural and herbal products, Red Fruit has become a highly promising commodity. The differences between the varieties of Red Fruit that grow in this region may include variations in size, color, taste, nutritional content, and other beneficial chemical components (Santoso et al. 2018). Research comparing the characteristics of each variety is essential to provide valid data to support the increase in productivity and utilization of Red Fruit. Thus, this research is relevant to promoting the welfare of the local community through the knowledge-based management of natural resources.

Although Red Fruit is widely known in Papua, detailed information about the differences in characteristics among its varieties, particularly those from Gearek District in Nduga Regency, is still limited. The physical and chemical differences in each variety may offer different health benefits and economic potential. The problems formulated in this study include: 1. What are the main characteristics of the five Red Fruit varieties found in Gearek District? 2. How do the physical and chemical differences compare among these five varieties? 3. What are the implications of these characteristic differences for the cultivation, processing, and utilization of Red Fruit? This study aims to understand and compare the characteristics of five Red Fruit varieties (*Pandanus conoideus*) from Gearek District, Nduga Regency, Mountain Papua. Specifically, the goals of this study are to identify the physical characteristics, such as size, color, and shape, of the five Red Fruit varieties, analyze the chemical and nutritional content of each variety, including antioxidants, beta-carotene, and other beneficial compounds.

The results of this study are expected to contribute to efforts to preserve biodiversity while improving the welfare of the community through the optimization of endemic plants with economic and health potential.

LITERATURE REVIEW

Red Fruit Potential

Non-Timber Forest Products (HHBK) are forest products that are beneficial for the environment. The types of HHBK are defined in the Minister of Forestry Regulation No. 35/MENHUT-II/2007, which consists of 557 species of animals and plants (Anonim, 2007). Red fruit, one of the most important non-timber forest products to be developed today, has a high antioxidant content (Sarungallo et al., 2015a, 2015b). This data shows that red fruit can help reduce and heal diseases and improve the income of the Papuan community. The extract of red fruit oil is highly beneficial and used to boost the immune system and stamina to treat various degenerative diseases and metabolic issues caused by unhealthy eating habits. Red fruit (*Pandanus conoideus* Lam.) is a native plant of Papua, Indonesia. This fruit is most commonly found in Papua, particularly in the mountainous regions.

This fruit is red in color and contains a lot of oil, with a length ranging from 68 to 110 cm and a diameter between 10 and 15 cm. Local communities believe that red fruit can treat various degenerative diseases such as stroke, arteriosclerosis, rheumatoid arthritis, and cancer (Budi and Paimin, 2004). It contains vitamin E (α and α -tocopherol) and β -carotene, and red fruit oil extract demonstrates antioxidant activity (Sarungallo et al., 2015a; Sarungallo et al., 2015b). In addition to reducing total cholesterol levels, red fruit oil extract has the ability to prevent foam cell formation in the aorta (Syarkiah et al., 2008) and pulmonary arsinogenesis (Mun'im et al., 2006). This description shows that, due to its antioxidant content, red fruit extract has the potential as an alternative treatment option. Historically, the coastal and mountainous populations of Papua have used red fruit as a source of vegetable fat (carotenoids). This oil is also used to flavor various staple foods such as sago and sweet potatoes. Red fruit has a high oil content, approximately 35.9% by dry weight, and its fatty acid content is comparable to most cooking oils. Therefore, along with coconut and palm oil, red fruit appears to be a potential source of vegetable oil (Jermia Limbongan and Afrizal Malik, 2009).

The size, color, and shape of the fruit of this plant distinguish its cultivars. In general, red fruit consists of six types: long red fruit, medium red fruit, short red fruit, brown red fruit, long yellow-red fruit, and short yellow-red fruit. Additionally, there are several other types developed in various places. The types that have been cultivated include Maler, Mbarugum, Ibagaya, Kuanggo, Kenen, and Munin.

Conceptual Framework

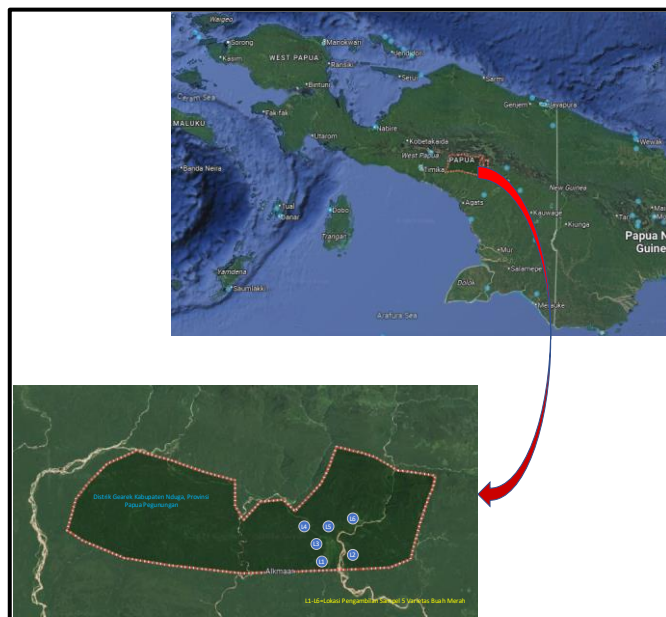
This diagram illustrates the relationship between the main aspects of the Characterization, Potential, and Productivity of Red Fruit. The study of the Morphology/Characterization of Red Fruit focuses on the physical and structural characteristics of the red fruit, which includes the roots. The study of the root system and its role in plant stability and nutrient absorption. Examination of the growth, size, and function of the stem in supporting the plant. Analysis of the shape, size, and photosynthetic efficiency of the leaves. In the flowering section, a study is conducted on flowering patterns and reproduction.

In the fruit section, a description of the shape, size, color, and other external characteristics of the fruit is provided. The potential of red fruit will include analyzing factors such as yield per plant or per area, as well as the conditions affecting its productivity. This study aims to integrate these components to provide a comprehensive understanding of the characteristics of red fruit and its relevance in agriculture and economic development.

METHODOLOGY

Time and Place

The research was conducted in Gearek District, Nduga Regency, Mountain Papua Province. The study lasted for approximately 2 months, from May to June 2024 (Picture 1).



Picture 1. Research Location and Sampling

Tools and Materials

The tools used in this study include a digital camera, thermohygrometer, digital scale, measuring tape, GPS, machete, cassowary bone, cutting scissors, machete, steamer, and baking tray. The materials used are: Red Fruit, raffia string, specimen plastic, and office supplies.

Research Method

This research uses a descriptive method with a survey technique to assess the potential, varieties, and characterization of Red Fruit. Ethnobotanical data was collected through semi-structured interviews using questionnaires for the Nduga people who have knowledge about Red Fruit.

Research Procedure

The procedure in this study will gather data on the characteristics, productivity, and varieties of Red Fruit found in Gearek District, Nduga Regency. Describe the characterization of Red Fruit. Describe the traditional productivity of Red Fruit oil. Describe the varieties of Red Fruit. Conduct exploration in the location to find Red Fruit. Measure total height, branch-free

height, trunk diameter, fruit, and fruit length. Record the habitat condition and morphology of Red Fruit plants. Collect samples from Red Fruit plant species for extraction. Document each type of Red Fruit plant. Data collection for the creation of descriptions will be done on five varieties and calculate the number of fruits in each variety of Red Fruit.

Research Variables

The variables used in this study are main and supporting variables.

a. Main Variables include:

1. Red Fruit Varieties

The determination of Red Fruit varieties is done through plant identification by visual observation, as well as the shape and size of the vegetative and generative morphology of the Red Fruit plants.

2. Tree Height (m), Tree Diameter (cm), Crown Height Projection (m), and Crown Width (m).

3. Vegetative Morphology

The vegetative morphology of Red Fruit plants that were observed and measured includes: Stem Base Diameter (cm): Measurement using a measuring tape wrapped around the base of the Red Fruit tree trunk. Stem Color: Observed visually. Size and Distribution of Thorns: Observed visually. Root Length (cm): Measurements were made on the uppermost live root and the lowest root, using a measuring meter from the root base to the root tip. Leaf Color, Venation Pattern, and Leaf Arrangement: Observations were made visually. Leaf Length (cm): Measurements were taken on the longest leaf, from the base of the leaf to the tip. Leaf Width (cm): Measurements taken at the leaf tip, middle, and base. Leaf Thickness (mm): Measurements taken at the leaf tip, middle, and base using a calliper.

4. Generative Morphology

The generative morphology of Red Fruit plants that were observed and measured include: Flowers: Flower description was done through observation of the flower's shape and parts. Fruits: Observations of the number of fruits on a tree and their colour. Fruit Length (cm): Measurements were made from the base to the tip of the fruit. Fruit Width (cm): Measured using a calliper.

5. Red Fruit Potential and Productivity

Fresh Fruit Weight (kg): Fruit weight measurements were made using a scale. Fresh Weight (kg): Fruit and Red Fruit extract weight (kg); measurements were made on the volume of oil produced by Red Fruit.

Supporting Variables include population data, Profile, and Village Data. Environmental and Climate Data.

Data Analysis

Data analysis was conducted based on the characteristics, productivity, and varieties of Red Fruit, which were collected by creating descriptions of five varieties and presented in a table of types along with images. Statistical data analysis was performed using Analysis of Variance (ANOVA) with SPSS version 10.0 software (Snedecor and Cochran 1989).

RESULTS AND DISCUSSION

Morphological Characteristics of Red Fruit Varieties in Gearek District, Nduga Regency

This study was conducted in Gearek District, Nduga Regency, with the title "Characterization, Potential, and Productivity of Red Fruit (*Pandanus conoideus* Lamk.) in Gearek District, Nduga Regency, Central Papua Province." However, this study focused on five varieties of Red Fruit, specifically Red Fruit known as Depe, Kalua, Arah, Kedeme, and Eperenge. The results of this study show differences in terms of root size, stem size, leaf size, leaf composition, leaf color, fruit weight, and oil weight, as presented in Table 1.

The following table compares several physical parameters of the plants from the five varieties of Red Fruit (Kedeme, Eperenge, Kalua, Depe, and Arah). These parameters include root length, root width, stem (height, diameter), crown height, crown width, and various leaf sizes. The results are averaged, with standard deviation (Stdv) included to show data variation. Statistical analysis is also presented with significance values (p-value), where "*" indicates significance at $p < 0.05$, "***" indicates high significance at $p < 0.01$, and "ts" means not significant.

Table 1. Variance Analysis of the Red Fruit in Gearek District, Papua Pegunungan Province

Parameters	Varieties of red fruit					Total	P
	Kedeme	Eperenge	Kalua	Depe	Arah		
	mean±Stdv	mean±Stdv	mean±Stdv	Mean±Stdv	mean±Stdv	mean±Stdv	
Root							
Length	2.60±0.60	3.10±0.75	47.33±9.25	1.26±0.68	3.20±0.00	11.50±3.76	*
	15.33±1.37	20.40±1.51	14.00±1.24	20.33±1.53	22.33±0.57	18.48±1.99	Ts
Wide	1.37	.51	.24	.53	.57	.99	s
Trunc							
Tinggi Pohon (m)	8.5±1.20a	6.10±1.82b	7.33±0.29b	5.00±1.00b	11.33±1.15a	7.65±2.47	*
	44.33±1.01a	46.67±6.66a	30±0.00a	40±0.00a	67.67±2.52b	45.73±3.62	*
Diameter pohon	0.11a	.66a	a	a	.52b	3.62	*
Crown							
Tinggi Tajuk	9.00±1.00a	7.00±1.73b	7.33±1.15b	6.00±1.00b	12.33±1.15a	8.33±2.53	*
	5.67±0.57	5.00±1.73	5.00±1.00	4.00±1.00	5.33±1.15	5.00±1.13	Ts
Lebar Tajuk Leaf	2.01±0.16	2.53±0.49	2.63±0.57	2.16±0.15	1.80±0.43	2.22±0.47	Ts
	12.00±0.00	11.00±1.73	12.33±2.51	10.00±2.00	10.67±1.15	11.20±1.69	Ts
Panjang Daun	12.00±0.00	11.00±1.73	12.33±2.51	10.00±2.00	10.67±1.15	11.20±1.69	Ts
Lebar Daun	0.00	.73	.51	.00	.15	.69	s

Pangkal Daun

	9.67±0.5	11.00±1	13.26±3	10.00±1	13.00±3	11.38±2	T
<i>Pangkal Daun</i>	7	.73	.61	.00	.46	.56	s
	8.00±1.7	6.83±3.	10.00±1	8.60±1.	8.00±0.	8.28±2.	T
<i>Ujung Daun Fruit</i>	3	.75	.00	.44	.00	.01	s
	77.50±2.	87.50±1	69.25±8	67.50±8	100±00.	80.92±2	T
<i>Panjang</i>	88	4.43	.21	.21	.00	2.50	s
	21.50±1.	21.50±1	17.75±1	28.50±1	25.50±0	23.62±5	T
<i>Lebar</i>	73	.73	.64	.64	.54	.91	s
	16.50±0.	14.00±1	13.75±9	12.50±0	17.50±0	14.87±4	T
<i>Ujung</i>	57	.15	.53	.54	.54	.03	s
	19.00±1.	16.00±1	14.00±9	22.50±2	14.50±6	17.50±5	T
<i>Pangkal</i>	15	.73	.34	.73	.02	.74	s

Roots

The Red Fruit tree of the Kalua variety has significantly longer roots (47.33±39.25m), while the Depe variety has the shortest roots (1.26±0.68m). This difference in root length is significant at $p < 0.05$, indicating a considerable variation. The root width does not differ significantly between varieties (ts), with values ranging from 14.00±6.24cm (Kalua) to 22.33±0.57cm (Arah).



Picture 2. Root of Kedeme



Picture 3. Root of Epperengge



Picture 4. Root of Kalua



Picture 5. Root of Depe



Picture 6. Root of Arah

Tree Height

The Red Fruit trees of the Arah variety ($11.33 \pm 1.15\text{m}$) and Kedeme variety ($8.5 \pm 1.20\text{m}$) have the tallest height compared to other varieties, while the Depe variety ($5.00 \pm 1.00\text{m}$) has the shortest tree height. Statistically, the tree height is highly significant with $p < 0.01$, meaning that the height differences between these varieties are quite distinct.



Picture 7. Height of Kedeme



Picture 8. Height of Epperengge



Picture 9. Height of Kalua



Picture 10. Height of Depe



Picture 11. Height of Arah

Tree Diameter

The Red Fruit tree of the Arah variety has the largest tree diameter ($67.67 \pm 2.52 \text{cm}$), while the Kalua variety has the smallest diameter ($30 \pm 0.00 \text{cm}$). The tree diameter is also highly significant ($p < 0.01$), indicating a considerable difference between the tree varieties.



Picture 12. Diameter of tree trunk of Kedeme



Picture 13. Diameter of tree trunk of Eperengge



Picture 14. Diameter of tree trunk of Kalua



Gambar 15. Diameter of tree trunk of Depe



Picture 16. Diameter of tree trunk of Arah

Crown

As with tree height, the Red Fruit tree of the Arah variety has the tallest crown ($12.33 \pm 1.15 \text{m}$), while Depe ($6.00 \pm 1.00 \text{m}$) has the shortest. The crown height is also significant ($p < 0.01$), showing variation in crown height between the Red Fruit varieties. The crown width is fairly uniform among all varieties, with an average ranging from $4.00 \pm 1.00 \text{m}$ to $5.67 \pm 0.57 \text{m}$. The differences between varieties in crown width are not significant (ts).



Figure 17. Crown of Kedeme

Figure 18. Crown of Epperengge

Figure 19. Crown of Kalua



Figure 20. Crown of Depe



Figure 21. Crown of Arah

Leaves

The leaf length between varieties did not show significant differences (ts), with an average ranging from 1.80 ± 0.43 cm (Arah) to 2.63 ± 0.57 cm (Kalua). Similarly, the leaf width was not significant (ts), with values ranging from 10.00 ± 2.00 cm (Depe) to 12.33 ± 2.51 cm (Kalua). The leaf base also showed no significant differences (ts), with average values ranging from 9.67 ± 0.57 cm (Kedeme) to 13.26 ± 3.61 cm (Kalua). The leaf tip size was also not significant (ts), with an average ranging from 6.83 ± 3.75 cm (Epperengge) to 10.00 ± 1.00 cm (Kalua).



Figure 22. Leaf of Kedeme



Figure 23. Leaf of Eperengge



Figure 24. Leaf of Kalua



Figure 25. Leaf of Depe



Figure 26. Leaf of Arah

From these results, we can see that several parameters such as tree height, tree diameter, crown height, and root length show significant differences between the Red Fruit varieties. However, for other parameters such as crown width, root length and width, and leaf characteristics, the differences are not significant. This analysis shows that some physical aspects of the plants vary significantly between varieties, while others are relatively uniform (Wawo et al. 2019).

Fruit

Based on the table presented, the parameters analyzed include fruit length, fruit width, fruit tip, and fruit base from five Red Fruit varieties: Kedeme, Eperengge, Kalua, Depe, and Arah. The results are measured in averages (mean) with standard deviation (Stdv), and statistical analysis shows that the differences between varieties are not significant (ts) for all parameters.

The Arah variety of Red Fruit has the longest fruit with an average length of 100 ± 0.00 mm, indicating the largest fruit size among all the Red Fruit varieties. In contrast, Depe and Kalua have shorter fruits, measuring 67.50 ± 8.21 mm and 69.25 ± 8.21 mm, respectively. Although there is variation in fruit length between varieties, this difference is not statistically significant, meaning the variation in fruit length is not large enough to be considered a significant difference between

varieties. The Depe variety has the widest fruit (28.50 ± 1.64 mm), while Kalua has the narrowest fruit (17.75 ± 1.64 mm). Despite the differences in fruit width between varieties, statistical analysis shows that this difference is also not significant, meaning the fruit width does not vary significantly among these Red Fruit varieties.



Figure 27. Fruit of Kedeme



Figure 28. Fruit of Epperengge



Figure 29. Fruit of Kalua



Figure 30. Fruit of Depe



Figure 31. Fruit of Arah

The fruit tip size varies between 12.50 ± 0.54 mm in the Depe variety of Red Fruit and 17.50 ± 0.54 mm in the Arah variety. This difference reflects a small variation between the Red Fruit varieties. As with other parameters, the variation in fruit tip size between varieties is also not significant, indicating that the fruit tip size is relatively similar across all varieties. The Depe variety has the largest fruit base size (22.50 ± 2.73 mm), while Kalua has the smallest base size (14.00 ± 9.34 mm). However, the variation in fruit base size is not significant, meaning that the differences between varieties are not strong enough to show a significant difference in terms of the fruit base (Santoso et al. 2018; Wijaya and Pohan 2009; Makaruku 2010; Maran et al. 2022).

Overall, the statistical analysis shows that there are no significant differences in the parameters of fruit length, width, tip, and base between the Red Fruit varieties analyzed. This indicates that while there is variation between varieties, the differences are not large enough to be considered substantially different. The variation in fruit size between varieties could be caused by environmental or genetic factors, but in general, the fruit size among these varieties is quite similar.

CONCLUSIONS AND RECOMMENDATIONS

The conclusion from this study is that there are significant differences in several morphological parameters between the Red Fruit varieties growing in Gearek District, Nduga Regency. Parameters that show significant differences between varieties include tree height, tree diameter, crown height, and root length. The Arah variety has the highest tree height and crown height, indicating more optimal growth compared to other varieties. The Kedeme and Eperengge varieties also perform well in terms of tree diameter and root width, although they are not significant for all other parameters.

Other parameters such as crown width, leaf length and width, and fruit characteristics (fruit length, width, tip, and base) did not show significant differences between the Red Fruit varieties, suggesting that the variation between varieties for these parameters is not very pronounced. These results indicate that although there are differences in some specific morphological characteristics, in general, these Red Fruit varieties share similarities in growth characteristics and fruit size.

FURTHER STUDY

This research still has limitations, so further research is needed related to the topic Characteristics and Comparison of Red Fruit Varieties (*Pandanus conoideus* Lamk) from Gearek District, Nduga - Papua Pegunungan Province in order to perfect this research and increase insight for readers.

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