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Exploration of Local Jackfruit (*Artocarpus heterophyllus* Lamk) in Muara Bangkahulu District, Bengkulu City, Indonesia as a Source of Superior Biodiversity

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ABSTRACT

Bengkulu has agroclimatic conditions that have the potential for the development of various plant resources, including jackfruit (*Artocarpus heterophyllus* Lamk). This study aims to conduct morphological characterization and identify the biodiversity of superior jackfruit in Muara Bangkahulu District, Bengkulu City, Indonesia. This research was conducted from August to November 2024 on 10 jackfruit trees from five villages in the Muara Bangkahulu sub-district. The method used was observation with purposive sampling. Morphological identification uses quantitative and qualitative data based on IPGRI descriptors (2000). Data analysis included variance analysis, standard deviation, and similarity using the PBSTAT (Plant Breeding Statistic) program. Morphological characteristics observed were a crown shape, branching pattern, leaf blade shape, leaf length, leaf width, and stem circumference. Dendrogram analysis showed that jackfruit in the Muara Bangkahulu sub-district has a coefficient value of 0.0-0.6, which is divided into two main groups. Group 1 consisting of Kandang Limun 1, Rawa Makmur Permai 3, Rawa Makmur Permai 4, Beringin Raya 5, Beringin Raya 6, and Pematang Gubernur 7 has a similarity coefficient value of 0.55. Group 2 consists of Kandang Limun 2, Pematang Gubernur 8, Bentiring Permai 9, and Bentiring Permai 10, which have a similarity of 0.45. Fruit sample analysis showed oval and ellipsoid-fruits, fruit weight ranged from 5 kg - 8.2 kg. Fruit soluble solids concentration (SSC) ranged from 21% - 26% Brix indicating variation and superior traits for breeding programs. This diversity can be utilized as an early stage in the identification of superior germplasm sources.

KEYWORDS: *Artocarpus heterophyllus* Lamk., Identification, Bengkulu, Morphology, IPGRI.

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1. INTRODUCTION

Artocarpus heterophyllus Lamk, or jackfruit, is a plant of the Moraceae family that originated in India and has spread throughout the world, including Southeast Asia (Ranasinghe *et al.*, 2019). There are 38 genera and about 1,180 species of jackfruit in tropical and subtropical Asia (Buddhisuharto *et al.*, 2021). In Indonesia, jackfruit is grown in yards as a shade and greening plant to prevent soil erosion (Indriarti, 2015). Jackfruit is a bisexual plant, where male flowers and female flowers grow on the same tree. The female flower is a collection of small flowers that later develop into fruit (Hossain, 2014). Jackfruit has variations in shape, color, aroma, and taste influenced by genetic and environmental factors. The plant is a medium-sized tree, 8-25 m tall, with dark green oval leaves releasing white sap when injured (Elevitch and Manner, 2006). Jackfruit grows in a variety of soils, especially moist and rich in organic matter, with good drainage (Dhakar *et al.*, 2020).

All parts of jackfruit, including seeds, roots, stems, leaves, and rind, can be utilized. People consume jackfruit both as a vegetable and fruit because it is delicious, sweet, and aromatic (Zaman *et al.*, 2021). Fruit contains compounds such as flavonoids, saponins, vitamins, and minerals (Simanjuntak *et al.*, 2022). Jackfruit leaves contain substances with anti-inflammatory, anti-bacterial, anti-oxidant, and anti-melanogenesis attributes (Khan *et al.*, 2021). Although jackfruit's utilization in the food industry is extensive, not all of its parts have been optimally managed (Gupta *et al.*, 2023). Jackfruit has a cross-pollination system resulting in morphological diversity (Anggriana *et al*., 2017).

Identification of plant morphology is essential for detecting specific traits of interest, identifying duplicated accessions, and organizing populations for conservation purposes (Reed *et al.*, 2004). Morphological variations due to environmental conditions indicating the ability to adapt to certain environments are referred to as ecotypes. Ecotypes found in plant populations form patterns based on changes in environmental conditions in geographic distribution areas and certain species. According to Rao and Hodgkin (2002), the emergence of specific genetics is the expression of environmental and ecogeographic factors. The influence of the environment on quantitative characters is affected by several genes, where each gene does not contribute significantly to a phenotypic appearance.

Bengkulu Province has a diverse agroecosystem with an altitude of 0-2000 m above sea level that has the potential for the development of plant resources, including jackfruit (Afrizon, 2015). Muara Bangkahulu District, Bengkulu City, Indonesia is located along the west coast of Sumatra, where agroecosystems have diverse jackfruit genetic diversity. However, there has not been much research on the potential of jackfruit genotypes in Muara Bangkahulu District, Bengkulu City, Indonesia. Therefore, it is important to explore and identify the morphological diversity of jackfruit in the region to develop new superior varieties.

II. MATERIALS AND METHODS

This study was conducted from August to November 2024 in Muara Bangkahulu District, Bengkulu City, Indonesia. Morphological identification was conducted on ten jackfruit trees spread across five villages: Kandang Limun, Rawa Makmur Permai, Beringin Raya, Pematang Gubernur, and Bentiring Permai. After morphological and fruit observations, jackfruit seedlings were planted in the greenhouse of the Agronomy Laboratory of Bengkulu University for vegetative observation.

Figure 1. Geographical map of jackfruit crop location

This study uses the method of direct data collection in the field accompanied by exploration, observation, and identification of jackfruit morphology. Sampling was carried out purposively (purposive sampling), namely the sample was determined according to the criteria, the criteria used are plants that have appeared flowers and fruit, have complete morphology, and are in healthy condition. The tools used were the Global Positioning System (GPS), digital scales, refractometer, penetrometer, vernier caliper, munsell color chart, knife, meter unit, label, stationery, and digital camera. Morphological characters were assessed based on IPGRI guidelines (2000) and analyzed using the PBSTAT program for cluster analysis. The accession labeling used was KL for Kandang Limun, RP for Rawa Makmur Permai, BR for Beringin Raya, PG for Pematang Gubernur, and BP for Bentiring Permai.

Qualitative and quantitative observations were used to identify the morphological characteristics of jackfruit. Qualitative characters include crown shape, branching pattern, leaf color, leaf blade shape, leaf apex shape, leaf base shape, fruit shape, stalk attachment to fruit, seed shape, fruit flesh color, fruit skin color, seed coat color, perianth color, and flake shape. Meanwhile, the quantitative character included stem circumference (cm), leaf length (cm), leaf width (cm), fruit length (cm), fruit diameter (cm), whole fruit weight (kg), fruit skin thickness (mm), fruit circumference (cm), fruit stalk length (cm), fruit firmness (KGF), perianth length (cm), soluble solids concentration (% Brix), fruit flesh thickness (mm), perianth width (cm), fruit flesh weight/kg (g), seed weight/kg (g), perianth weight/kg (g), total number of seeds, and number of seeds/kg.

III. RESULTS

There are 5 types of crown shape, namely pyramidal, broadly pyramidal, oblong, elliptical and irregular. 1 accession was pyramidal (Sub-district Kandang Limun), 2 accessions were broadly shaped (Sub-districts Bentiring Permai and Pematang Gubernur), 2 accessions are oblong (Sub-districts Pematang Gubernur and Bentiring Permai), 2 accessions were elliptical (Sub-districts Kandang Limun and Rawa Makmur Permai), and 3 accessions were irregular (Sub-districts Rawa Makmur Permai and Beringin Raya) (Figure 2).

(a) (b) (c) (d)

Figure 2. Crown shape: (a) Pyramidal (KL1); (b) Broadly Pyramidal (PG8); (c) Oblong (PG7); (d) Elliptic (RP4)

Regarding branching, 2 types of patterns were identified, namely opposite and irregular (Figure 3). Four accessions were opposite branching patterns originating from Kandang Limun, Pematang Gubernur, and Bentiring Permai. In addition, 6 accessions with irregular branching patterns originated from 4 villages, namely Kandang Limun, Rawa Makmur Permai, Beringin Raya, and Pematang Gubernur (Figure 3).

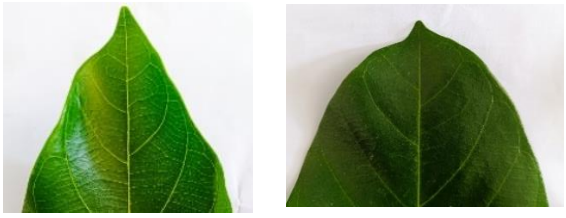
(a) (b)

Figure 3. Branching pattern of jackfruit tree: (a) Pematang Gubernur; (b) Kandang Limun

Regarding the leaf blade, there were 4 leaf blade shapes, namely elliptic, broad, oblong, and narrowly elliptic. Out of 10 accessions, an elliptic-shaped leaf blade was found in 6 accessions, broadly in 1 accession, narrowly elliptic in 2 accessions, and oblong shape in 1 accession (Figure 4). Two forms of leaf apex were found, namely acute and acuminate (Figure 5). Acute leaf tips were found in 3 accessions and acuminate in 7 accessions.

(a) (b) (c) (d)

Figure 4. Leaf blade shape: (a) Elliptic; (b) Broadly; (c) Narrowly elliptic; (d) Oblong



(a) (b)

Figure 5. Leaf apex shape: (a) Acute; (b) Acuminate

From the base leaf standpoint, it was determined that 3 base leaf shapes, namely oblique, rounded, and shortly attenuated (Figure 6). The oblique leaf base shape was found in 4 accessions, the rounded shape was in 3 accessions and shortly attenuated was in 3 accessions.

(a) (b) (c)

Figure 6. Leaf base shape: (a) Oblique; (b) Rounded; (c) Short attenuated

Fruit originating from Kandang Limun, Rawa Makmur Permai, and Bentiring Permai demonstrated a yellow color (Figure 7). Three fruit flake shapes were found, namely spheroid (KL2), oblong (RP1), and twisted (BP1) (Figure 8). Three (3) fruit seed shapes were also identified, namely reniform, ellipsoid, and irregular (Figure 9). The reniform fruit seed shape originated from Kandang Limun, the ellipsoid shape from Rawa Makmur Permai, and the irregular shape from Bentiring Permai. They varied in shape, flesh, and seeds.

(a) (b) (c)

Figure 7. Longitudinal section of jackfruit: (a) Bentiring Permai 1; (b) Kandang Limun 2; (c) Rawa Makmur Permai 1

(a) (b) (c)

Figure 8. Flake shape: (a) Kandang Limun 2; (b) Rawa Makmur Permai 1; (c) Bentiring Permai 1

(a) (b) (c)

Figure 9. Seed shape: (a) Kandang Limun 2; (b) Rawa Makmur Permai 1; (c) Bentiring Permai 1

Based on its morphological characteristics, jackfruit in Muara Bangkahulu District can be grouped into 2 groups. Group 1 consisted of KL1, RP3, RP4, BR5, BR6, and PG7. While Group 2 was comprised of KL2, PG8, BP9, and BP10 (Figure 10).

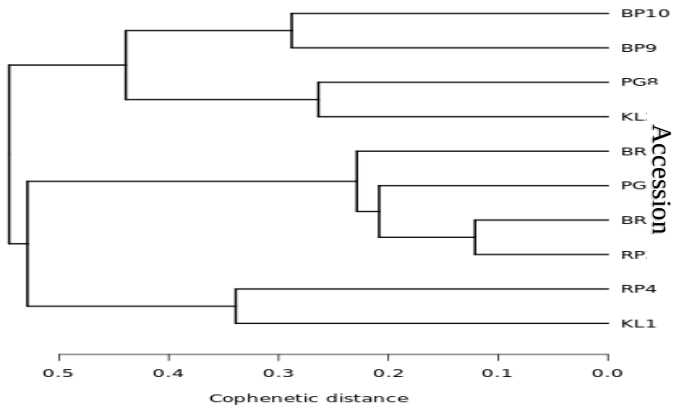


Figure 10. Dendrogram based on crown shape, branching pattern, leaf shape, leaf length, and width and stem circumference

Morphological characters in each accession show different variations, including crown shape, branching pattern, leaf shape, and the shape of the tip and base of the leaf. Group 1 was characterized by pyramidal, oblong, elliptical, and more dominant irregular crown shapes. The branching pattern is an irregular pattern. The leaf blade shape is broadly, narrowly elliptic, and more elliptic. Leaf apex shape acuminate. The leaf base shape is oblique, rounded, and more shortly attenuated. Stem circumference 40-74 cm. Leaf length 13.7-19.85 cm and leaf width 6.65-8.95 cm. While group 2 is characterized by an elliptical, oblong, and broadly pyramidal crown shape. The branching pattern is the opposite. The shape of the leaf blade is elliptic. The shape of the leaf apex is acute and more dominantly acuminate. The leaf base shape is rounded and oblique. Stem circumference 57-94 cm. Leaf length 11.47-22.9 cm and leaf width 6.46-12.85 cm. In general, the results of the dendrogram of morphological characters of jackfruit are not grouped based on location but based on the similarity of morphological characters (Table 1).

Table 1. Characteristics of 10 jackfruit plant accessions in Muara Bangkahulu District

Characteristics	***Group 1***	***Group 2***
Crown shape	Irregular, oblong, elliptical, pyramidal	Elliptical, broadly pyramidal, oblong
Branching pattern	Irregular	Opposite
Leaf color	Dark green	Dark green
Leaf blade shape	Elliptic, broadly, narrowly elliptic	Elliptic
Leaf apex shape	Acuminate, acute	Acuminate, acute
Leaf base shape	Rounded, oblique, rounded, shortly attenuated	Oblique, rounded
Stem circumference (cm)	40-74	57-94
Leaf length (cm)	13.7-19.85	11.47-22.9
Leaf width (cm)	6.65-8.95	6.46-12.85
Fruit shape	Elipsoida	Oblong
Stalk attachment to the fruit	Inflated	Flattened
Seed shape	Elipsoida	Reniform, irregular
Fruit length (cm)	30	33-37
Fruit diameter (cm)	15	17-20.2
Whole fruit weight (kg)	5	5-8.2
Fruit skin thickness (mm)	10.7	10-10.3
Fruit circumference (cm)	60	55-78
Fruit stalk length (cm)	7	6-10
Fruit firmness (KGF)	12.1	5.53-13.7

Characteristics	*Group 1*	*Group 2*
Perianth length (cm)	7	6-8
Soluble solids concentration (% Brix)	21	22-26
Fruit flesh thickness (mm)	6	4-9
Perianth width (cm)	1	1
Fruit flesh color	Yellow	Dark yellow, yellow
Fruit skin color	Greenish yellow	Green, greenish-yellow
Seed coat color	Brown	Brown
Perianth color	Cream	Light yellow, off-white
Fruit flesh weight/kg (g)	279.79	370.81-391.15
Seed weight/kg (g)	50.28	54.23-56.39
Perianth weight/kg (g)	642.98	576.96-811.79
Total number of seeds	52	31-47
Number of seeds/kg	7	6-9
Flake shape	Oblong	Spheroid, twisted

IV. DISCUSSION

Dendrogram analysis indicated that there were two groups of accessions found in the studied area (Figure 10). The first group, consisted of KL1, RP3, RP4, BR5, BR6, and PG7, having a similarity coefficient of 0.55. Group 1 is characterized by pyramidal, oblong, elliptical, and more dominant irregular crown shapes. Irregular branching pattern. The shape of the leaf blade is broadly, narrowly elliptic, and more elliptic. Leaf apex shape acuminate. The leaf base shape is oblique, rounded, and more shortly attenuated. While group 2 consisted of KL2, PG8, BP9, and BP10, with similarity of 0.45. the crown shape was elliptical, oblong, and broadly pyramidal. The branching pattern was opposite to the shape of the leaf blade elliptic. The leaf apex shape is acute and more acuminate. The leaf base shape is rounded and oblique. Abdelkawy *et al*. (2024) found 54.28% of jackfruit genotypes had irregular crown shapes, 28.57% elliptical, and 17.14% rounded. Trunk circumference ranged from 1.25 - 1.96 m. The dominant leaf blade shape is undulate (72.72%) and entire (27.3%). Chandrashekar *et al*. (2019) mentioned the character of jackfruit plants in India had a stem circumference of 60.18-273.3 cm, a dominant crown shape is irregular, a leaf length of 12.36-22.47 cm, a leaf width of 5.62-10.58 cm, acuminate and oblique leaf apex shape, cunaete and rounded leaf base shapes. Genetic and environmental factors influenced the morphological diversity.

Fruit shapes found at KL2 were oblong, at RP1 regular, and at BP1 ellipsoid. All three fruits showed greenish-yellow skin, where the length of the fruit reached 37 cm at KL2, longer than RP1 (30 cm) and BP1 (33 cm). The fruit diameter of KL2 is 17 cm, larger than RP1 which is 15 cm, but smaller than BP1 which is 20.22 cm. whole fruit weight of KL2 and RP1 weighed 5 kg, while BP1 was 8.2 kg. The skin thickness of KL2 fruit is 10.3 mm, slightly thinner than RP1 which is 10.7 mm, but thicker than BP1 which is 10 mm. The fruit circumference of BP1 (78 cm) is larger than RP1 (60 cm) and KL2 (55cm). BP1 fruit hardness (13.7 KGF) was harder than RP1 (12.1 KGF) and KL2 (5.53 KGF). The perianth length of KL2 (6 cm) was shorter than RP1 (7 cm) and BP1 (8 cm). KL2 has a higher soluble solids concentration level (27% Brix) than BP1 (22% Brix) and RP1 (21% Brix). Chandrashekar *et al*. (2019) revealed that fruit length ranged from 15.59-43.67 cm and fruit weight of the genotypes studied ranged from 3.51-9.69 kg. Akter and Rahman's (2018) research on 23 Bangladesh germplasm showed fruit weight ranged from 2.57-11 kg, fruit length 20-47 cm, fruit width 14.6-22.5 cm, skin thickness 0.85-2.5 cm, dominant oval fruit shape, yellow pulp color, and greenish-yellow fruit skin color.

Significant genetic diversity indicated potency to improve desired traits through plant breeding. Dendrograms served as a basis for consideration to select suitable parent lines for breeding programs, either using traditional crosses or genetic engineering techniques (Safitri and Palupi, 2017). Sulassih *et al*. (2015) studied 21 morphological characters covering 71 sub-characters on 30 jackfruit accessions using NTSYS software resulting in 7 groups with a similarity level of 0.544. This grouping was based on fruit shape, with round, oval, and elliptical shapes dominant in most accessions. In addition, a prominent distinctive character was found in naked whole fruit (fruit flesh was visible from the outside skin. Another study conducted by Siregar (2022) revealed that the genetic diversity of jackfruit in Kerinci Regency was grouped into 3 criteria. Characters with very broad coverage included plant height, crown shape, branching patterns, and fruit shape. Characters with broad coverage included stem circumference, leaf blade shape, and leaf base shape. And, characters with very narrow coverage included the length and width of the leaf blade, the shape of the leaf shoot, leaf color, fruit shape and color, stem variation in the fruit, seed shape, and seed coat color.

This study showed that there were uniform characters, such as dami width, rind color, and rind thickness. Fruit weight and soluble solids concentration level showed superior production traits, while the number of seeds and fruit flesh size showed variations. This might be employed as a selection material for varietal improvement. The quality of jackfruit varied, and each accession did not have the exact same characteristics. This indicated that the local jackfruit of Bengkulu was highly diverse. This was due to the nature of jackfruit as a cross-pollinated plant. Jackfruit reproduced through cross-pollination, which caused variations in shape, aroma, color, and taste. The differences in the growing environment also contributed to the morphological diversity of jackfruit (Anggriana et al. 2017).

V. CONCLUSION

Morphological variation in jackfruit (*Artocarpus heterophyllus* Lamk) accessions in Muara Bangkahulu District, Bengkulu City, Indonesia was classified into two different clusters. Cluster 1 consisted of the accessions from Kandang Limun 1, Rawa Makmur Permai 3, Rawa Makmur Permai 4, Beringin Raya 5, Beringin Raya 6, and Pematang Gubernur 7 with a similarity coefficient value of 0.55. While the second group 2 was comprised of accessions from Kandang Limun 2, Pematang Gubernur 8, Bentiring Permai 9, and Bentiring Permai 10 with a similarity of 0.45. Studied jackfruit accessions found in Muara Bangkahulu varied in morphological characters. The results of this study can be utilized in plant breeding to maintain the diversity of local varieties, improve quality, and strengthen the adaptability of jackfruit to certain environmental conditions.

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VII. DISCLOSURE

The writing of this article does not have any element of conflict of interest with any parties.

REFERENCES

1. Ranasinghe RASN, Maduwanthi SDT, and Marapana RAUJ. Nutritional and health benefits of jackfruit (*Artocarpus heterophyllus* Lam.): a review. International journal of food science, 2019;(1):4327183.
2. Buddhisuharto AK, Hegar P, Muhamad I, and Irda F. An updated review of phytochemical compounds and pharmacology activities of *Artocarpus* genus. Biointerface Research in Applied Chemistry. 2021;11(6):14898-14905.
3. Indriarti NA. 2015. Jackfruit cultivatian. CV Sinar Cemerlang Abadi: Jakarta
4. Hossain MT, Hossain MM, Sarker M, Shuvo AN, Alam MM, and Rahman MS. Development and quality evaluation of bread supplemented with jackfruit seed flour. International Journal of Nutrition and Food Sciences. 2014;3(5):484-487.
5. Elevitch CR and Manner HI. *Artocarpus heterophyllus* (jackfruit). Species profiles. For Pacific Island Agroforestry. www.traditionaltree.org. 2006;10:1-25.
6. Dhakar MK, Das B, Sarkar PK, Nath V, Singh AK, and Bhatt BP. Diversity in jackfruit (*Artocarpus heterophyllu*s Lam.): Insights into fruit characterization for the identification of superior genotypes. Plant Genetic Resources. 2020;18(5):307-315.
7. Zaman N, Arsi A, Asril M, Firgiyanto R, Fajarfika R, Wati C, Sudarmi N, and Zulfiyana V. 2021. Agricultural product innovation. Our Writing Foundation.
8. Simanjuntak H, Singarimbun N, Zega D, Sinaga S, Simanjuntak H, and Situmorang T. Study of the potential of jackfruit plants (*Artocarpus heterophyllus* Lam.) in treating infectious diseases. Journal of Herbal Medicine. 2022;5(1):1-7. https://doi.org/10.58996/hmj.v5i1.36
9. Khan AU, Ema IJ, Faruk MR, Tarapder SA, Khan AU, Noreen S, and Adnan M. A review on importance of *Artocarpus heterophyllus* L. (Jackfruit). In Journal of Multidisciplinary Applied Natural Science. Pandawa Institute. 2021;1(2):106–116. https://doi.org/10.47352/jmans.v1i2.88.
10. Gupta A, Marquess AR, Pandey AK, and Bishayee A. Jackfruit (*Artocarpus heterophyllus* Lam.) in health and disease: a critical review. Critical Reviews in Food Science and Nutrition. 2023;63(23):6344-6378.
11. Reed BM, Dulloo ME, and Engels JMM. 2004. Technical guidelines for the management of field and in vitro germplasm collection. IPGRI Handbooks for Genebank No. 7. https://www.researchgate.net/publication/233794578
12. Rao RV and Hodgkin T. Genetic diversity and conservation and utilization of plant genetic resources. In Plant Cell, Tissue and Organ Culture. 2002;68(1):1–19. https://doi.org/10.1023/A:1013359015812
13. Afrizon A. Potential genetic resources of plantation crops as cultivation materials in Bengkulu Province. In Proceedings of the National Seminar of the Indonesian Biodiversity Society. 2015;1(4):757-762.
14. IPGRI. 2000. Descriptors for Jackfruit (*Artocarpus heterophyllus*). International Plant Genetic Resources Institute, Rome, Italy. ISBN 92-90430-450-3.

15. Abdelkawy M, Abo-Rekab ZA, Hamad ASA, and Ahmed SA. Evaluation of eleven genotypes jackfruit in Egypt morphologically, physiologically. Journal of Plant and Food Sciences. 2024;2(2):125-132.
16. Chandrashekar KG, Vijayakumar RM, Subramanian S, Kavino M, and Joel AJ. Fruit characterization of jackfruit (*Artocarpus heterophyllus* Lam.) local genotypes under coffee ecosystem of lower pulney hills in Tamil Nadu, India. Journal of Applied Horticulture. 2019;21(1):47-52.
17. Akter A and Rahman H. Evaluation of jackfruit (*Artocarpus heterophyllus* Lam.) germplasm. J. Bot. 2018;7:38-53.
18. Safitri NB and Palupi T. Identification of genetic diversity with morphological characters of *Artocarpus heterophyllus* Lamk jackfruit of West Kalimantan, Indonesia. Agrovigor*:* Jurnal Agroekoteknologi. 2017;10(1):49-55.
19. Sulassih, Sobir, Santosa, and Tirtawinata MR. Variability genetic analysis for jackfruit (*Artocarpus heterophyllus* Lam.) based on morphological marker. 2015.
20. Siregar MR. 2022. Genetic diversity of jackfruit (*Artocarpus heterophyllus*) in Kerinci regency based on morphological characters (Doctoral dissertation, Jambi University).
21. Anggriana A, Muhardi, and Rostiati. Characteristics of ready-to-serve jackfruit (*Artocarpus heterophyllus* Lamk) marketed in Palu City. In e-J. Agrotekbis. 2017;5(3):278-283.