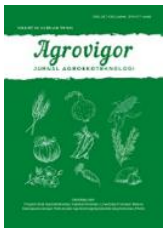
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Article

Morphological Character and Simplicia of Galangal (*Alpina galanga* L.) in Bangkalan

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ABSTRACT

The aim of this research is to determine the differences in morphology, growth and yield of simplicia galangal in several sub-districts in Bangkalan. This research uses a purposive sampling method where the determination of sample locations is carried out based on the snowball sampling. The results of this research show that the morphological characters of galangal in Socah, Geger and Kamal have no differences in characteristics of the leaf color, leaf shape, leaf tip, leaf base, leaf surface, stem type, stem color, stem shape, stem surface, root type, root shape, root color, rhizome skin color and rhizome flesh color. The results of the Independent T Test with a level of 95% on the growth and production parameters of galangal show that there are differences in root length in Socah and Geger for the number of leaves, number of roots and root length in Kamal and Socah. Meanwhile, in Geger and Kamal, there are differences in the number of leaves, plant height and number of roots. The yield of the rhizome simplicia of the galangal shows that there are differences between Geger and Kamal District.

INTRODUCTION

Indonesia is a country with diverse geographical conditions, a tropical climate, and an archipelagic nature. As a nation located in the tropics, Indonesia possesses a wide range of plant genetic resources that are beneficial for medicinal purposes. The local population utilizes medicinal plants as an alternative treatment for various purposes, including prevention, healing, recovery, and health enhancement. According to Suharno (2018), Indonesia is home to no fewer than 9,606 species of medicinal plants, with 1,845 species already documented, mostly found in natural ecosystems, particularly forest ecosystems.

Bio-pharmaceutical plants (medicinal plants) produced on an industrial scale in Indonesia consist of seven main species. Based on data from the Central Bureau of Statistics (BPS) in 2022, these seven bio-pharmaceutical plants include ginger, galangal, aromatic ginger (kencur), turmeric, lempuyang, Javanese turmeric (temulawak), and black turmeric (temuireng). According to the report, East Java Province is the region that produces the most diverse types of medicinal plants (BPS, 2022).

The use of medicinal plants has been practiced for generations by ethnic groups and communities across various regions of Indonesia, including East Java Province. One of the ethnic groups known for extensively utilizing medicinal plants in East Java is the Madurese. According to Muslichah (2022), the Madurese are among the ethnic groups with the highest use of plants for medicinal purposes in Indonesia. As a result, Madura Island has become a center for medicinal plants, which are commonly found both cultivated by the community and growing wild. The medicinal plants commonly used by the Madurese include cabe jamu (medicinal chili), betel leaf, ginger, fingerroot (kunci), turmeric, black turmeric, lempuyang, galangal, and others. These plants are distributed across all four regencies on Madura Island, including Bangkalan Regency. Based on statistical data, the production of bio-pharmaceutical plants in Bangkalan Regency reached 111,526 tons in 2023 (BPS Bangkalan, 2023).

The highest production of bio-pharmaceutical plants in Bangkalan Regency in 2023 was galangal, with a production volume of 13,799 tons. The demand for galangal is quite high, not only for use as a cooking spice but also for the traditional medicine industry. The use of galangal in traditional medicine in Bangkalan typically follows ancestral practices passed down through generations, rooted in a culture of using plants as natural remedies.

Increasing the productivity of galangal plants is crucial to meet the demand for both culinary and medicinal uses. One approach is through morphological analysis to identify differences among galangal plants in various sub-districts of Bangkalan Regency. According to Astuti (2011), identifying morphological characteristics is essential for supporting taxonomic development. Morphology serves as the foundation for studying the entire structure of galangal rhizomes, and the resulting data can guide the development of improved cultivation technologies to enhance yields and productivity. Moreover, to optimize the use of rhizome raw materials, it is also important to determine the simplisia yield. Supartini (2020) states that yield information is needed to assess the quantity of fresh rhizome raw materials in production fields prior to harvest.

MATERIALS AND METHODS

This research will be conducted in February 2024 in three sub-districts of Bangkalan Regency: Socah, Geger, and Kamal. The tools used in this research include a pH meter, lux meter, trowel, GPS camera, sample plastic bags, knife, oven, scissors, cardboard paper, labels, analytical scale, measuring tape, and stationery. The material used is galangal plant samples. The method applied in this research is a survey method carried out in the three aforementioned sub-districts. Research locations were determined using purposive sampling, taking into account the harvested area and production volume of galangal in Bangkalan Regency in 2022, based on data from BPS Bangkalan (2023), as well as the altitude of the study areas. Sampling locations and points were selected using the snowball sampling method.

The research was conducted in nine location, with three villages selected from each sub-district. In each village, three hamlets were chosen as sampling points. From each sampling point, three galangal plants were collected, so all sampels are 81 plants. The plant samples taken for morphological and growth observations were galangal plants aged less than nine months. For production analysis, galangal plants aged between nine and twelve months were sampled. At each sampling point, environmental parameters were

observed, including soil pH, temperature, light intensity, and soil moisture. Morphological identification was conducted both qualitatively and quantitatively on the leaf, stem, root, and rhizome structures of the galangal plants. The yield of the dried simplicia was calculated using the formula from Safrina (2018), as follows:

*Rendemen Simplisia= (bobot kering simplisia (g))/(bobot basah rimpang (g)) x*100%

Data Analysis

The observational data were statistically analyzed using an independent T-test with a 95% confidence level. The decision criteria for the T-test are based on the following hypotheses:

H_0: There is no significant difference in growth and yield parameters between Socah and Geger Sub-districts, Kamal and Socah Sub-districts, Kamal and Geger Sub-districts.
H_a: There is a significant difference in growth and yield parameters between Socah and Geger Sub-districts, Kamal and Socah Sub-districts, Kamal and Geger Sub-districts.
H_0 is accepted if the sig. (2-tailed) $>\alpha$ (0.05)
H_0 is rejected if the sig. (2-tailed) $<\alpha$ (0.05) (Hulu, 2019)

RESULTS AND DISCUSSION

Morphology of Galangal

The morphological characteristics of galangal (Alpinia galanga L.) plants from Socah, Geger, and Kamal Sub-districts were observed, including the leaves, stems, roots, and rhizomes. The galangal samples used for morphological observation were approximately 7 months old, while those used for productivity analysis were around 9 months old.

Leaf Morphology of Galangal

Galangal plants from Kamal Sub-district had fewer leaves compared to those from Socah and Geger. According to Hemelda (2012), leaf growth is influenced by abiotic or environmental factors, particularly temperature. Verma (2011) states that galangal thrives in temperatures between 25°C and 29°C. Galangal plants from Kamal Sub-district had fewer leaves compared to those from Socah and Geger. According to Hemelda (2012), leaf growth is influenced by abiotic or environmental factors, particularly temperature. Verma (2011) states that galangal thrives in temperatures between 25°C and 29°C. Based on this requirement, Socah Sub-district had the most suitable temperature for optimal galangal leaf growth, making it the most favorable location for this parameter. All observed galangal leaves across the three sub-districts were green and elongated, with pointed tips and blunt bases. The leaf surfaces were smooth in all areas.

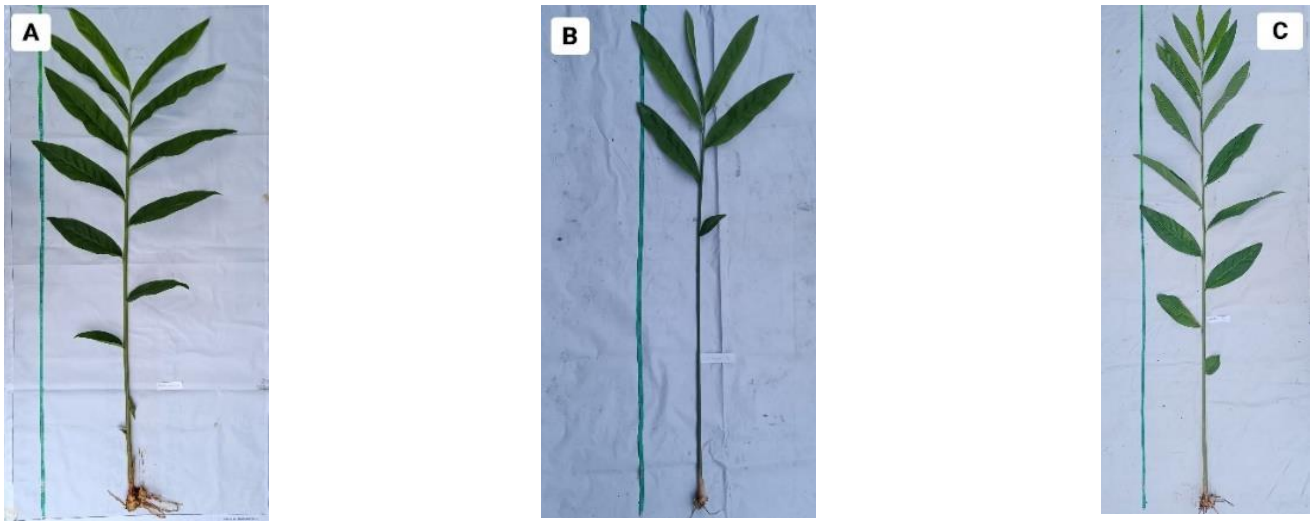


Figure 1. Morphological characteristics of galangal plants:A) Socah Sub-district, B) Kamal Sub-district, C) Geger Sub-district

Table 1. Leaf Morphological Characteristics of Galangal Plants in Socah, Geger, and Kamal Sub-districts

No.	Characteristic	Sub-districts		
		Socah	**Geger**	**Kamal**
1.	Leaf Color	Green	Green	Green
2.	Leaf Shape	Elongated	Elongated	Elongated
3.	Leaf Tip	Pointed	Pointed	Pointed
4.	Leaf Base	Blunt	Blunt	Blunt
5.	Leaf Surface	Smooth	Smooth	Smooth

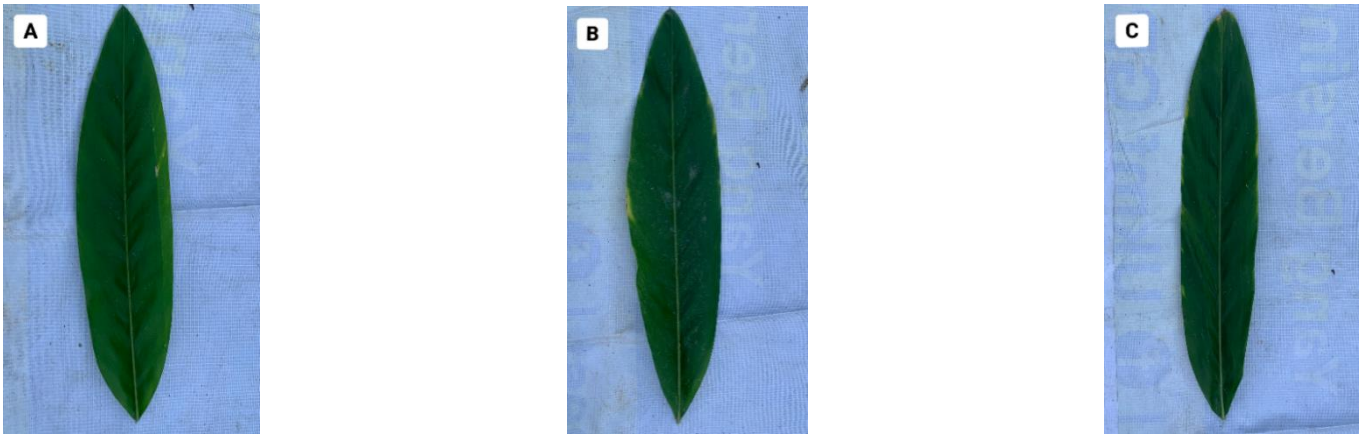


Figure 2. Leaf Morphology: A) Socah, B) Kamal, C) Geger

Table 2. Stem Morphological Characteristics of Galangal Plantsin Socah, Geger, and Kamal Sub-districts

No.	Characteristic	Sub-districts		
		Socah	**Geger**	**Kamal**
1.	Stem Type	Pseudo	Pseudo	Pseudo
2.	Stem Color	Green	Green	Green
3.	Stem Shape	Round	Round	Round
4.	Stem Surface	Smooth	Smooth	Smooth

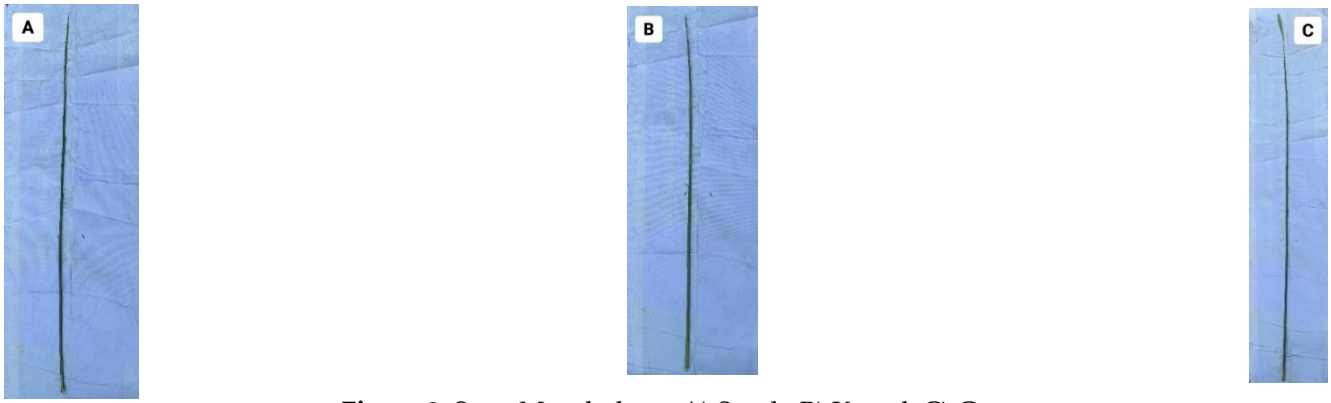


Figure 3. Stem Morphology: A) Socah, B) Kamal, C) Geger

Stem Morphology of Galangal

Stem characteristics in Socah, Geger, and Kamal showed no observable differences. All plants had pseudo-stems that were round, green, and smooth. Tambun (2016) noted that galangal stems can grow up to 1–1.5 meters tall. Light intensity affects plant height Nur (2014), and Verma (2011) emphasized that galangal requires high light levels for optimal growth. Additionally, phosphorus (P) as noted by Lakitan (2011), contributes to increased plant height.

Root Morphology of Galangal

Root observations showed no variation among the three sub-districts. All roots were fibrous, round, and white in color. Root development is influenced by soil properties. According to Rusdiana (2000), compact soil inhibits root penetration due to reduced macro pore space. Conversely, crumb-textured, loose soil supports optimal root growth Anam (2015).

Rhizome Morphology of Galangal

Observed rhizome traits included skin and flesh color. No significant differences were found across the three sub-districts. All rhizomes had yellowish-white skin and white flesh. According to Roy (1990), rhizome production positively correlates with overall plant growth, including leaf, stem, and root development. Better plant growth leads to higher rhizome yields.

Growth Parameters

An Independent T-Test at 95% level on growth parameters of galangal in Socah and Geger indicated a significant difference in root length. However, it does not show significant differences on the other parameters. The comparision of growth for galangal in Kamal and Socah revealed significant differences in the number of leaves, roots, and root length. Conversely, the growth of galangal in Geger compared to Kamal District showed significant differences in the number of leaves, roots, and plant height. The results of the Independent T-Test for galangal growth are presented bellow.

Tabel 3. Root Morphological Characteristics of Galangal Plantsin Socah, Geger, and Kamal Sub-districts

No.	Characteristic	Sub-districts		
		Socah	Geger	Kamal
1.	Root Type	Fibrous	Fibrous	Fibrous
2.	Root Shape	Round	Round	Round
3.	Root Color	White	White	White

Tabel 4. Rhizome Morphological Characteristics of Galangal Plantsin Socah, Geger, and Kamal Sub-district

No.	Characteristic	Sub-districts		
		Socah	Geger	Kamal
1.	Rhizome Skin Color	Yellowish-white	Yellowish-white	Yellowish-white
2.	Rhizome Flesh Color	White	White	White



Figure 4. Rhizome Morphology: A) Socah, B) Kamal, C) Geger

Table 5. Results of the Independent T-Test on the growth of galangal plants in Socah and Geger, Kamal and Socah, and also Geger and Kamal Sub-district

District	Growth Parameter					
	Number of Leaves	Leaf Length	Leaf Width	PlantHeight	Number of Roots	RootLength
			cm			
Socah	12,07	38,77	8,86	181,12	7,93	12,51
Geger	10,76	38,11	8,28	215,83	8,05	15,36
Sig (2-tailed)	0,48	0,75	0,19	0,06	0,83	0,00
Kamal	7,44	32,94	8,59	174,88	5,96	14,42
Socah	12,07	38,77	8,86	181,12	7,93	12,51
Sig (2-tailed)	0,04	0,56	0,83	0,56	0,01	0,01
Geger	10,76	38,11	8,28	215,83	8,05	15,36
Kamal	7,44	32,94	8,59	174,88	5,96	14,42
Sig (2-tailed)	0,01	0,61	0,81	0,02	0,00	0,09

Sig (2-tailed) < 0.05 indicates a significant difference

Table 6. Results of the Independent T-Test on the yield of galangal plants in Socah and Geger, Kamal and Socah, and also Geger and Kamal Sub-district

District	Yield Parameter	
	Fresh Rhizome	Simplicia
	g	
Socah	140,56	15,00
Geger	126,11	13,33
Sig (2-tailed)	0,32	0,45
Kamal	130,89	12,00
Socah	140,56	15,00
Sig (2-tailed)	0,23	0,07
Geger	126,11	13,33
Kamal	130,89	12,00
Sig (2-tailed)	0,75	0,51

Sig (2-tailed) < 0.05 indicates a significant difference

Yield Parameters

The highest average of fresh rhizome was found in Socah at 140.56 g. The lowest one was 126.11 g, found in Geger District. The lowest average of simplicia was 12.00 g in Kamal District, where the highest one was in Socah District with an average value of 15.00 g.An Independent T-Test at 95% level on the parameters of fresh rhizome and simplicia of galangal showed no significant differences between Socah and Geger, Kamal and Socah, and also Geger and Kamal that is proven by the Sig (2-tailed) results being greater than 0.05. The results of the Independent T-Test on the yield parameters of the galangal plant can be seen in Table 6.

Simplicia

The result of the Independent T-Tes between Socah and Geger and also Kamal and Socah was 0.84 and 0.13. It means there was no significant differences amoung them. Meanwhile, the Independent T-Test at 95% level for Geger and Kamal showed a significant difference that was known from the Sig (2-tailed) which was smaller than 0.05. it can be seen in Table 7.

Table 7. Results of the Independent T-Test on simplicia of galangal in Socah and Geger, Kamal and Socah, and also Geger and Kamal Sub-district

Kecamatan	Rendemen Simplisia
	%
Socah	11,00
Geger	11,00
Sig (2-tailed)	0,84
Kamal	9,00
Socah	11,00
Sig (2-tailed)	0,13
Geger	11,00
Kamal	9,00
Sig (2-tailed)	0,02

Sig (2-tailed) < 0.05 indicates a significant difference

CONCLUSION

The morphological characteristics of galangal plants in Socah, Geger, and Kamal Sub-districts showed no differences in leaf, stem, root, and rhizome morphology. The results of the Independent T-Test at a 95% confidence level indicated that there was a significant difference in root length between Socah and Geger. In Kamal compared to Socah, significant differences were found in the number of leaves, number of roots, and root length. Meanwhile, the comparison between Geger and Kamal showed significant differences in the number of leaves, plant height, and number of roots. For rhizome simplisia yield, a significant difference was observed between Geger and Kamal. However, there were no significant differences between Socah and Geger, nor between Kamal and Socah.

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