

EXPLORATION AND IDENTIFICATION OF LAI DURIAN, NEW HIGHLY ECONOMIC POTENTIAL CULTIVARS DERIVED FROM NATURAL CROSSING BETWEEN *DURIO ZIBETHINUS* AND *DURIO KUTEJENSIS* IN EAST KALIMANTAN

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Abstract - Most of genetic resources and species diversity of *Durio* spp was reported existing in Kalimantan Island. Due to the open pollinated characteristic, the genetic diversity of *Durio* spp is enlarging and spreading significantly. The most popular of edible *Durio* species in East Kalimantan is *Durio zibethinus* (Durian, Local Name) and *Durio kutejensis* (Lai, Local Name). Here, we report our exploration and identification of Lai Durian, a putative new variety derived from natural crossing between *Durio zibethinus* and *Durio kutejensis* in East Kalimantan showing high performance of fruit characters and economic potential cultivars. Our findings showed that *Lai Durian* is existing in 6 districts of East Kalimantan, i.e. Samarinda, Kutai Barat, Kutai Kartanegara, Penajam Paser Utara, Bulungan, and Nunukan. Based on plant morphology, fruit performance, and nutritional value analysis, there is a strong indication that *Lai Durian* is originated from the natural crossing of *D. zibethinus* and *D. kutejensis* and called as *Durio* ^{*zibethinus x kutejensis*}. *Lai Durian* fruit has positive combination properties originated from its parents (*D. zibethinus* and *D. kutejensis*) such as sweet (high sugar content), thick and attractive color (yellow) aril, soft and dry texture (low water and fiber content), not fragrant, high protein content, long shelf life at room temperature, and high percentage of the edible fruit part that are more preferred by consumers. Therefore, *Lai Durian* has a high economic potential value to be improved as a National Excellent Fruit Varitey in Indonesia.

INTRODUCTION

Most genetic resources and species diversity of *Durio* were reported existing in Kalimantan Island. It was reported that from a total 20 *Durio* species encountered in Indonesia, 18 species occur in Kalimantan (Ruwaيدا, 2005). Due to the open pollinated characteristic, the genetic diversity of *Durio* spp is enlarging and spreading significantly. The most popular of edible *Durio* species in East Kalimantan is *Durio zibethinus* (Durian, local name) and *Durio kutejensis* (Lai, Local Name). Both species

have different fruit characters such as sweetness, texture, aril thickness and colour, nutritional value and water content to make differences in taste and preference of consumers.

Lai Durian (local name), a member of *Durio* spp, is one of the *Durio* species found in East Kalimantan possessing good fruit characters such as sweet, soft and dry texture, yellow aril color, low water and alcohol content, and not fragrant. These make *Lai Durian* more preferred by consumers. Local communities in East Kalimantan call *Lai Durian* by different names. In West Kutai District, *Lai Durian* is

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called as *HOLAI* or *SENTAWAR*. In Kutai Kartanegara District, it is called as *LAI MANDONG* and In Bulungan District the name is *LAI KAYAN*. Many people in East Kalimantan considered and grouped *Lai Durian* in *Durio kutejensis* species because the tree architecture of both species is quite similar. The other people classified *Lai Durian* as *Durio zibethinus* due to the sweetness and fruit performance. In other report, *Lai Durian* was classified as *Durio excelsus*. Nowadays, the misunderstanding about the taxonomic status of *Lai Durian* continues. Therefore, comprehensive exploration, identification and characterization of *Lai Durian* in East Kalimantan are required.

Classification and identification of plant species, as reported by some researchers, could be performed by morphological and/or molecular analyses. *Durio* spp diversity has been indentified and classified by morphological, fenological, location, local name, and habitat observation (Ruwaida, 2005). The morphological features of leaves were used to recognize the plants (Aptoula and Yanikoglu, 2013; Du *et al.*, 2007). The morphological characteristics observations were also used to identify the wild rose genotype biodiversity (Riaz *et al.*, 2007). The genetic relationship among *Durio* species was analyzed using RFLP and RAPD markers (Santoso, 2005; Ruwaida *et al.*, 2009). The investigation of genetic diversity of hybrid *Durio* resulted from cross breeding between *D. kutejensis* and *D. zibethinus* was performed based on random amplified polymorphic DNAs (RAPDs) (Hariyati *et al.*, 2013). In this paper, we report the exploration and morphological identification of *Lai Durian* in East Kalimantan.

MATERIAL AND METHODS

The study was conducted by field visits to the centers of *Durio* spp cultivation in East Kalimantan. We focused to observe and collect samples of *Lai Durian*, *D. zibethinus* and *D. kutejensis* from 13 districts in East Kalimantan. Data and information of the sample plants including number, type, origin of plants, local name and location were collected and tabulated in a specific form of data collection. The whole tree and specific organ pictures such as leaves, branches, main stem, flower, and fruit were taken using a Nikon Camera and collected as samples required for the next analysis. Identification and characterization of a species and varieties, or cultivars were done based on

morphological characteristics of leaves, stems, flowers, branches, and fruit characters. The fruit characterization was conducted to test the fruit performance such as fruit color, fruit shape, aril thickness, the percentage of edible part of fruit, fruit diameter and length, chemical content, and shelf life of fruit at room temperature. The chemical analysis of fruit aril was performed at the Laboratory of Food Chemistry, Faculty of Agriculture, Mulawarman University. The criteria of plant and fruit morphological characters used in this reserach were based on the " Guiding Book to make Description and test the Correctness of Horticulture Plant Varieties, The Decision of Agriculture Ministry, Republic of Indonesia, number: 700/Kpts/OT.320/D/12/20118.

RESULTS AND DISCUSSION

Of the 13 districts in East Kalimantan, we found there were 18 putative *Lai Durian* sample plants located in Samarinda, West Kutai, Kutai Kertanegara, Bulungan, Penajam Paser Utara and Nunukan districts. In addition, we also identified 19 varieties of *D. zibethinus* and 14 varieties of *D. kutejensis* from the same location as a control in the analysis (Table 1).

Lai Durian had consistent morphological characters for leaf size and flower color as an intermediate feature originated from the leaf size of *D. zibethinus* and *D. kutejensis* (Table 1, Figure 1B, D, Figure 2E). This shows a strong indication that *Lai Durian* is derived from natural crosses between *D. zibethinus* and *D. kutejensis*. The observation of other morphological properties also showed that there were variations in morphological properties, but the variations were still within the properties of its parents (*D. zibethinus* and *D. kutejensis*) (Table 1). The mean value of the leaf length and width of *Lai Durian* was 19.62 cm and 7.03 cm which was in the range of the mean value of the *D. zibethinus* leaf size (16.40 cm and 5.23 cm) and *D. kutejensis* leaf size (23.86 cm and 9.10 cm). The flower color of all *Lai Durian* samples was pink (Figure 2B.), while the flower color of *D. zibethinus* was white or yellowish white (Figure 2A) and the flower color of *D. kutejensis* was red (Figure 2C). The leaf apex almost all of *D. zibethinus* was long tapered (15 of 19 samples), while *D. Kutejensis* was short tapered (9 of 14 samples) and *Lai Durian* was Medium tapered (10 of 18 samples) (Table 1, Figure 1D). It also indicates that *Lai Durian* is putatively originated from the natural

crossing of *D. Zibethinus* and *D. kutejensis*.

The branching direction of most *D. zibethinus* samples (10 of 19 plants) was upward pointing , the

other samples were horizontal pointing (7 of 19 plant samples) and downward pointing (2 of 19 samples). On the other hand, most *D. kutejensis* (8 of

Table 1. Important morphological properties of *Lai Durian* compared to *D. zibethinus* and *D. kutejensis* from East Kalimantan.

No.	Observed Morphological Characters	<i>Durio zibethinus</i>	<i>Lai Durian</i>	<i>Durio kutejensis</i>
1.	Mean value of leaf length (cm)	16,40	19,62	23,86
2.	Mean value of leaf width (cm)	5,23	7,03	9,10
3.	Mean value of petiole (cm)	1,94	2,17	2,14
4.	Flower colour (number of samples)			
	White	19	0	0
	Pink	0	18	0
	Red	0	0	14
5.	Leaf shape (number of samples)			
	Oblong	14	7	11
	Ovate	4	7	0
	Obovate	1	3	3
	Elliptic	0	1	0
6.	Leaf apex (number of samples)			
	Long	15	3	0
	Medium	3	10	5
	Short	1	5	9
7.	Leaf base (number of samples)			
	attenuate	14	6	9
	Rounded	0	4	1
	Obtuse	5	9	4
8.	Leaf margin (number of samples)			
	Entire	19	18	14
	Crenate	0	0	0
9.	Upper leaf color (number of samples)			
	Dark green	2	1	1
	Green	12	12	6
	Light green	5	5	7
10.	Lower leaf color (number of samples)			
	Silvery	2	4	0
	Brownish silver	7	5	5
	Brownish	8	1	3
	Gray	2	8	6
11.	Branching Architecture (number of samples)			
	High looming	19	3	0
	Umbrella-shaped	0	14	13
	Irregular shape	0	1	1
12.	Branching Direction (number of samples)			
	Upward pointing	10	6	0
	Horizontal pointing	7	8	6
	Downward Pointing	2	4	8
13.	Branching Angle (number of samples)			
	Acute	13	13	10
	Straight	4	1	3
	Obtuse/Blunt	2	4	1
	Total number of samples	19	18	14

Note: * : The criteria of plant morphological characters was based on the Guiding Book to Make Description and Test the Correctness of horticulture plant varieties, The Decision of Agriculture Ministry, Republic of Indonesia, number: 700/Kpts/OT.320/D/12/20118.

Table 2. Fruit performance and nutritional value analysis of *Lai Durian* compared to *D. zibethinus* and *D. kutejensis* from East Kalimantan.

Fruit performances and Nutrition	<i>Durio Zibethinus</i> (*)	<i>Lai Durian</i> (**)	<i>Durio kutejensis</i> (***)
Sugar	20,18° brix	17,5°brix	10,8° brix
Protein	3,21 %	6,60 %	4,81 %
Lipid	3,18 %	2,23 %	2,05 %
Water content	62,70 %	57,10 %	58,36 %
Carbohydrates	30,98 %	20,00 %	19,87 %
Fibre	3,04 %	2,5 %	1,35 %
Aril thickness	0,79 %	1,01 %	0,90 %
Aril color	White-yellowish	Yellow-golden yellow	Yellow -orange
The percentage of edible part	20,51 %	28,16 %	33,85 %
Shelf life at room temperature	7 days	8 days	8,6 days
Texture	Smooth, Soft and Wet Smooth, Dense and Dry Smooth, Dense and Dry		
Aroma	Sharply fragrant	Not fragrant	Not fragrant
Sweetness	Sweet	Sweet	Less sweet

Keterangan: *: Data were the mean value of previous results (Anonymous, 1981; Antarlina *et al.*, 2003; Antarlina, 2009; Wahdah *et al.*, 2003; BPSB, 2005). **: Data were the mean value of results in this research. ***: Data were the mean value of previous results (Antarlina *et al.*, 2003; Wahdah *et al.*, 2003; BPSB, 2012) .

14 samples) had downward pointing of branching direction. Interestingly, the different results shown by *Lai Durian* samples which had a majority (8 of 18samples) of horizontal pointing branching direction (Table 1).

The leaf shape of almost all of *D. zibethinus* or *D. kutejensis* was oblong, while the leaf shape of *Lai Durian* samples varied from oblong, ovate and obovate (Table 1, Figure 1D). The variation of *Lai Durian* morphological characters was also observed in leaf base and the lower side leaf color (Table 1, Figure 1D).

There were no differences of leaf margin, the upper side leaf color and the branching angle among the observed samples. The leaf margin of all samples was entire, while the upper side leaf color was green and the branching anggle wa acute (Table 1, Figure 1D).

Interestingly, the canopy architecture of most *Lai Durian* samples was quite similar to *D. kutejensis* (umbrella shaped) while the *D. zibethinus* canopy was high loomig (Table 1). This feature cause local people in East Kalimantan classified *Lai Durian* in the same group with *D. kutejensis*.

The morphological properties related to the performance and nutritional value of *Lai Durian* fruits showed differences compared to *D. zibethinus* and /or *D. Kutejensis*, but they were still in the range of *D. zibethinus* and /or *D. Kutejensis* fruit characters (Table 2, Figure 1D, E, F).

It is known that *Durio spp* has very high variation in terms of plant morphology, fruit morphology and nutritional content. This diversity is due to the open pollinated- polination system. Therefore, results of morphological and nutritional value analysis of *Durio spp* showed variations as reported by previous research9,10, 11, 12, 13, 14. However, the fruit performance and nutritional value of *D. zibethinus* and *D. kutejensis* were significantly different (Table 2, Figure 2D, F). *Lai Durian* had fruit performance and nutritional value in between of *D zibethinus* and *D. kutejensis*. This results strengten the previous indication from plant morphological observation that *Lai Durian* is originated from the natural crossing of *D. zibethinus* and *D. kutejensis*.

The sugar content of *D. zibethinus* was the highest compared to that of *Lai Durian* and *D. kutejensis*, while the sugar content of *D. kutejensis* was the lowest among them (Table 2). This result is consistent with the peope perception that *D. zibethinus* aril is sweeter rather than *D. kutejensis* aril. Although some variants of *D kutejensis* showed a high sugar content (BPSB, 2012). Interestingly, *Lai Durian* aril had higher sugar level compared to *D. kutejensis* and very closed to *D. zibethinus* sugar content. This property makes *Lai Durian* is more preferred by consumer than *D. kutejensis*.

D. zibethinus had higher content of lipid and carbohydrates compared to *D. kutejensis* or *Lai*

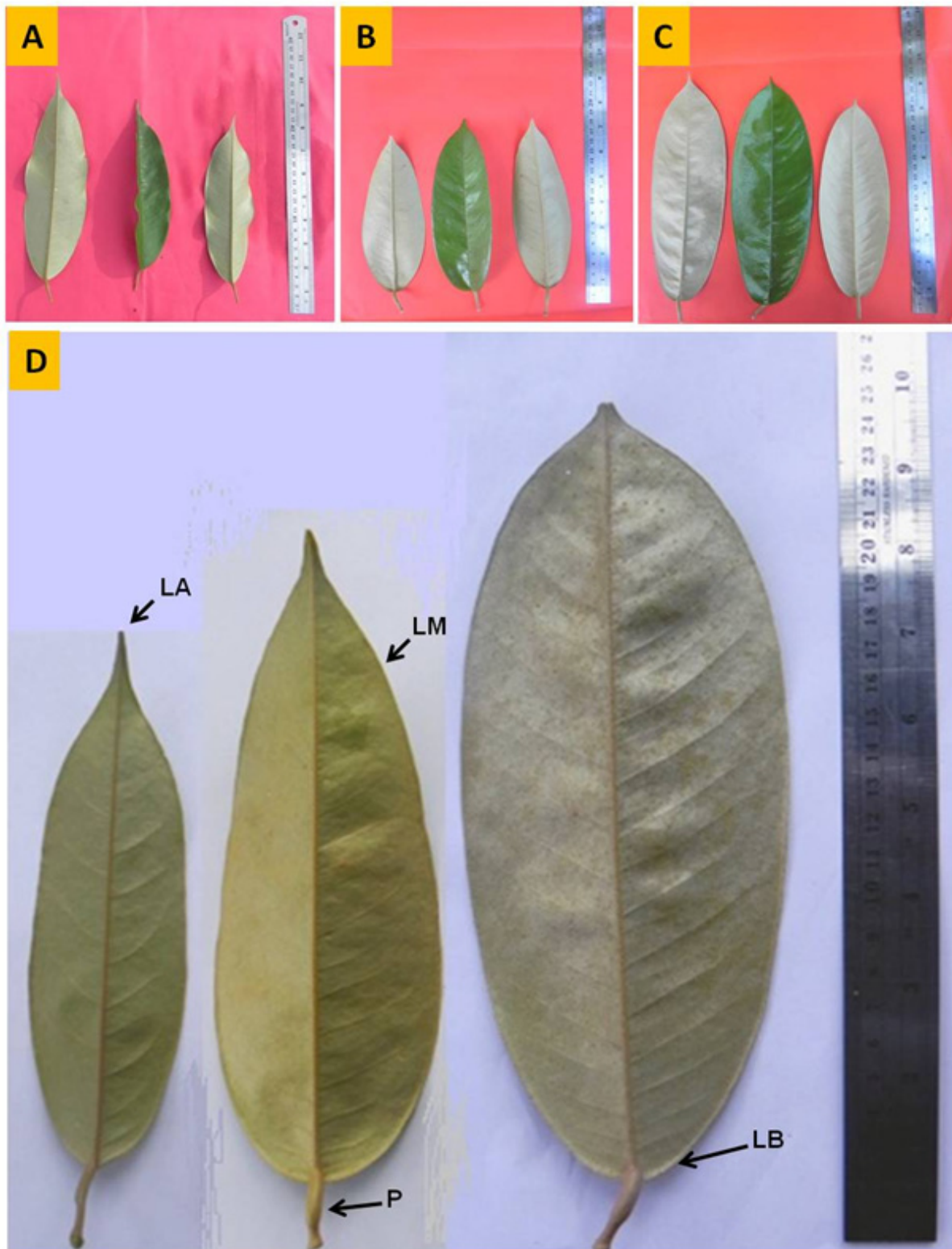


Fig. 1 Morphological characters of leaves of *D. zibethinus* from East Kalimantan (A), *Lai Durian* (B), and *D. kutejensis* (C). D: From the left to the right, single leaf of *D. zibethinus*, *Lai Durian* and *D. kutejensis*.

LA: Leaf Apex, LM: Leaf Margin, P: Petiole, dan LB: Leaf Base.



Fig. 2 Flower and fruit aril of *Durio* from East Kalimantan. A, D: *D. zibethinus*, B, E: *Lai Durian*, and C, F: *D. kutejensis*.

Durian (Table 2). This is consistent with the previous result that *D. zibethinus* had higher sugar content. During fruit ripening process, carbohydrates and other organic compounds will be degraded, in glycolysis metabolism, into simple compounds like sugars as a major product (Ahmed and Labavitch, 1980; Carrari and Fernie, 2006; Martinelli *et al.*, 2012). The higher the carbohydrate and lipid content the higher the sugar content will be produced. The content of carbohydrates and lipid of *Lai Durian* was higher than that of *D. kutejensis*, therefore *Lai Durian* was sweeter than the *D. kutejensis*.

Lai Durian had lower water and fiber content than *D. zibethinus*, but it had almost similar water and fiber composition to *D. kutejensis* (Table 2). This causes *Lai Durian* and *D. kutejensis* has softer and drier texture of fruit aril compared to *D. zibethinus*. The soft and dry texture of fruit aril is more preferred by consumers, because it does not make hands dirty and sticky during eating.

Surprisingly, protein content of *Lai Durian* was much higher than *D. zibethinus* or *D. kutejensis*. Protein is one of the most important nutritional values in fruit characteristics as healthy food. The higher content of protein in *Lai Durian* is an important feature that can be used to increase its economic value. The other interesting properties of

Lai Durian were the thicker fruit aril, longer shelf life at room temperature, not fragrant/smelling and higher percentage of the edible fruit part compared to or *D. kutejensis* (Table 2). The aril color of *Lai Durian* was from yellow to golden-yellow while the aril color of *D. zibethinus* was white to yellowish, and the aril color of *D. kutejensis* was from yellow to orange (Figure 2D, E, and F). The consumer preference of aril color in *Durio* spp was varied, but the more colorful the aril, the more preferred by consumer. This aril color property also suggests that the fruit property of *Lai Durian* is in between the properties of *D. zibethinus* and *D. kutejensis* and strengthen the indication that *Lai Durian* is originated from the natural crossing of *D. zibethinus* and *D. kutejensis*.

CONCLUSION

Based on plant morphology, fruit performance, and nutritional value analysis, there is strong indication that *Lai Durian* is originated from the natural crossing of *D. zibethinus* and *D. kutejensis* and called as *Durio zibethinus* x *kutejensis*. *Lai Durian* fruit has positive combination properties originated from its parents (*D. zibethinus* and *D. kutejensis*) such as sweet (high sugar content), thick and attractive color (yellow) aril, soft and dry

texture (low water and fiber content), not fragrant, high protein content, long shelf life at room temperature, and high percentage of the edible fruit part that are more preferred by consumers. Therefore, *Lai Durian* has a high potential economic value to be improved as a National Excellent Fruit Variety in Indonesia.

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