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Post harvest/cold chain services for fresh fruits and vegetables in Albania

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The vegetable and fruit sector in Albania is experiencing a continuous expansion. However, there is no accompanying progress in the improvement of post harvest and cold chain services. No official estimates are available on losses due to improper post harvest handling, but these are believed to be high.

To appreciate the current situation and the potential of companies to adopt post harvest/cold chain systems, a survey was conducted in six representative districts (Tirane, Lushnje, Fier, Korce, Shkoder, Elbasan), where the production of fruits and vegetables is high. The following crops were targeted by this study: potato, onion, tomato, apple, grape, melon, carrot, cauliflower and cabbage, chosen on the basis of the total production and the potential for further production expansion and export. Interviews by questionnaires and direct investigation of the companies were performed.

From this survey twelve companies were identified which can offer post-harvest and/or cold chain services. The summed-up capacity of these companies to store fruits and vegetables was estimated to be 74,708 m³. However, most of this capacity is used for meat and dairy products rather than fruits and vegetables. Private ownership dominates the sector (11 out of 12 companies identified). Six out of twelve companies possessed freezing facilities (capacity = 45,000 m³). None of the companies provide complete facilities to prepare the produce for freezing (cleaning, washing, maceration, blanching, grading and/or packaging). Hence, a full post-harvest service was missing in all companies surveyed. The missing services included: cleaning, sorting, grading, pre-cooling and packaging. Another major problem which was identified is the lack of collection points, with only one exception. Other problems related to the post-harvest services and the quality of produce at the post-harvest stage were identified. These include harvesting (improper maturity harvest, contamination of produce, harvesting during the hot hours of the day), curing (lack of curing/drying facilities for roots, tubers and onions), packing operations (lack of proper sorting, cleaning and washing; rough handling; lack of or inappropriate packaging material), storage (poor sanitation, lack of storing facilities 2 on-farm and at the wholesale points, placing warm produce into the cold room, mixing produce) and transport (lack of cooling during transport, rough handling, use of bulk transport).

From this survey, it is concluded that the post harvest/cold chain service is rather rudimentary with only two companies having adopted almost complete system. Further investments and training are needed to fully establish a post harvest/cold chain system by potential companies identified in this study.

Nutrient content and sensory evaluation of lai (*Durio kutejensis* Hassk. Becc.) fruit flesh of some lai cultivars originated from Indonesia

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Lai fruit belongs to durian family, however it is found not wide spread as durian. The fruit is originated from East Kalimantan Province in Indonesia. Its taste and flavor is different compare to durian. It is more flavorless than durian, so it has potential horticulture to be exported. However, the fruit is not well recognized outside East Kalimantan yet, and until now there is still poor information about its nutrition content. Recently, we have explored nutrient content and sensory evaluation of seven cultivars of Lai fruit originated from Batuah Subdistrict of Kutai Kartanegara Regency of East Kalimantan Province, e.g. Lai Hijau, Lai Durian, Lai Belimbing, Lai Semangka, Lai Besar, Lai Kuning, and Lai Nangka. In general, nutrient content of the Lai cultivars were 59.23-71.46%, 1.12-1.62%, 0.96-1.54%, 2.02-2.45%, 8.80-10.27%, 6.05-6.83% for water content, ash, fat, protein, vitamin C, sugar, and carbohydrate, respectively. While sensory evaluation of the Lai cultivars were 3.40-4.30 and 3.27-4.07 for taste and flavor according to hedonic test, respectively, and 3.00-3.90, 2.47-3.57, 3.23-4.17, and 2.07-3.40 for color, texture, taste, and flavor according to hedonic quality test, respectively. The data were compiled from 3 replications for nutrient content, and 30 replications for sensory evaluation. Lai Kuning has the highest fat, sugar, and fiber content. Lai Nangka has the highest ash and Vitamin C content. Lai Hijau and Lai Kuning have the highest sugar content. Lai Semangka has the highest protein content. Lai Besar has the highest carbohydrate content and most favorite taste and flavor. In general, it was found that Lai Kuning and Lai Besar have the best nutrition content and become the most favorable.



NUTRIENT CONTENT AND SENSORY EVALUATION OF LAI (*Durio kutejensis* Hassk. Becc.) FRUIT FLESH OF SOME LAI CULTIVARS ORIGINATED FROM INDONESIA

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ABSTRACT

Lai fruit belongs to durian family, however it is found not wide spread as durian. The fruit is originated from East Kalimantan Province in Indonesia. Its taste and flavor is different compare to durian. It is more flavorless than durian, so it has potential horticulture to be exported. However, the fruit is not well recognized outside East Kalimantan yet, and until now there is still poor information about its nutrition content. Recently, we have explored nutrient content and sensory evaluation of seven cultivars of Lai fruit originated from Batuah Subdistrict of Kutai Kartanegara Regency of East Kalimantan Province, e.g. Lai Hijau, Lai Durian, Lai Belimbing, Lai Semangka, Lai Besar, Lai Kuning, and Lai Nangka. In general, nutrient content of the Lai cultivars were 59.23-71.46%, 1.12-1.62%, 0.96-1.54%, 2.02-2.45%, 8.80-10.27%, 6.05-6.83% for water content, ash, fat, protein, vitamin C, sugar, and carbohydrate, respectively. While sensory evaluation of the Lai cultivars were 3.40-4.30 and 3.27-4.07 for taste and flavor according to hedonic test, respectively, and 3.00-3.90, 2.47-3.57, 3.23-4.17, and 2.07-3.40 for color, texture, taste, and flavor according to hedonic quality test, respectively. The data were compiled from 3 replications for nutrient content, and 30 replications for sensory evaluation. Lai Kuning has the highest fat, sugar, and fiber content. Lai Nangka has the highest ash and Vitamin C content. Lai Hijau and Lai Kuning have the highest sugar content. Lai Semangka has the highest protein content. Lai Besar has the highest carbohydrate content and most favorite taste and flavor. In general, it was found that Lai Kuning and Lai Besar have the best nutrition content and become the most favorable.

Keywords: Lai, Durio kutejensis, nutritional content, sensory test

INTRODUCTION

There are at least six varieties of durian found in East Kalimantan, Durian (*D. zibethinus*), Lai (*D. kutejensis*), Kerantongan (*D. oxleyanus*), Lahong (*D. dulcis*), Labelak (*D. graveolens*), Durian Monyet (*D. grandilorus*), and Durian Kura-kura (*D. testudinarius*). Among the six varieties of durian, only the first two durians stated above have recognized economic value, however Lai fruit is not well known yet outside East Kalimantan compare to Durian (*D. zibethinus*) (Bernardinus, 2002; M Nipah, 2002). The answer of this fact is because Lai is a specific fruit which is found only in East Kalimantan and there is still limited technology to transfer the fruits outside East Kalimantan.

There are many cultivars of Lai, which are different in fruit morphology and flesh type. The color of Lai flesh varies from red, dark yellow until white, its texture and taste are dry and sweet, as well as it is more odorless than *D. zibethinus*, so that it is very potential become export commodity to many parts of the world. Until this time, there is very limited information about this exotic fruit from East Kalimantan. To promote Lai fruit, we describe the nutrient content and sensory evaluation of this fruit.

MATERIAL AND METHODS

Lai fruits were harvested as they were commercially ripe and were kept for three days to get the ripen fruits. Seven cultivars of Lai fruit from Batuah Subdistrict of Kutai Kartanegara Regency were observed, each with three and thirty replications for nutrient content assay and sensory test, respectively. The chemical reagents from Merck and Riedel Haen were used in this experiment. Eight parameters were observed for nutrient content e.g. water content (oven), ash (muffle furnace), fat (soxhlet), protein (semi-micro Kjeldahl), vitamin C (iodometry), sugar content (hand refractometer), carbohydrate (by different), and fiber (gravimetry). All of the methods used were according to Sudarmadji *et al.*, 1997). Sensory test used in this experiment were hedonic and hedonic quality test described by Soekarto (1985).

RESULTS AND DISCUSSIONS

Nutrient Content

Calculated data of nutrient content of seven Lai cultivars observed was shown in Table 1. All parameters observed were significantly different at α of 0.05, except protein and sugar content. The average value of protein and sugar content were 2.26 and 6.50%, respectively. According to water content, there were three different types of cultivars, which Lai Semangka has the highest value, followed by group of Lai Hijau, Lai Belimbing, Lai Durian, and the group of Lai Kuning and Lai Besar. Meanwhile, Lai Nangka belongs to either middle or the lowest water content group.

Based on fat content, the seven Lai cultivars could be grouped into 2 different types e.g. high and low fat. Fat content of Lai Kuning was 1.5 times greater than Lai besar, each were 1.54 and 0.96%, respectively. Meanwhile, fat content of the rest cultivars were between the value of fat content of Lai Kuning and Lai Besar.

Data of fiber content showed that the seven cultivars could be group to 4 types. Lai Kuning and Lai Nangka has the highest level of fiber content, while Lai Hijau has the lowest level of fiber.

Data on Table1 shows that carbohydrate content of the seven Lai cultivars has the opposite value compare to water content. It means that total content of ash, fat and protein of each cultivars were not differ.

Sensory Evaluation

Calculated data of sensory evaluation of seven Lai cultivars observed was shown in Table 2. All parameters observed were significantly different at α of 0.05. As Indonesian community more prefer sweet food and beverage, as well as smell of Durian or Lai, Lai Besar which was the cultivar with the highest level of sweet was much more preferred compared to other cultivars.

Table 1. Nutrient content of 7 cultivars of Lai from Batuah Subdistrict of Kutai Kartanegara Regency, East Kalimantan Province, Indonesia

Lai cultivars	Nutrient content [%]							
	Water Content	Ash	Fat	Protein	Vit C	Sugar	Carbohydrate	Fiber
Lai Hijau	65.64 b	1.12 b	1.31 ab	2.23	9.04 de	6.83	27.71 b	1.90 e
Lai Belimbing	65.35 b	1.17 ab	1.44 ab	2.02	8.92 de	6.44	30.02 b	2.83 cd
Lai Semangka	71.46 a	1.33 ab	1.04 ab	2.38	8.80 e	6.05	23.80 c	3.36 b
Lai Durian	65.51 b	1.34 ab	1.22 ab	2.45	9.68 bc	6.45	29.48 b	2.72 d
Lai Besar	59.46 c	1.33 ab	0.96 b	2.05	9.97 ab	6.44	36.20 a	3.30 bc
Lai Nangka	60.83 bc	1.62 a	1.45 ab	2.38	10.27 a	6.44	33.72 ab	4.04 a
Lai Kuning	59.23 c	1.47 ab	1.54 a	2.33	9.33 cd	6.83	35.76 a	4.25 a
Average	63.93	1.34	1.28	2.26	9.43	6.50	30.96	3.20

Note: Data were calculated from 3 replications, Values followed by same letter at the same column are not significantly different at $\alpha = 0.05$. Hijau = green; Belimbing = starfruit; Semangka = water melon; Besar = big; Nangka = jackfruit; Kuning = yellow

Table 2. Sensory evaluation on 7 cultivars of Lai from Batuah Subdistrict of Kutai Kartanegara Regency, East Kalimantan Province, Indonesia

Lai cultivars	Hedonic test ¹⁾			Hedonic quality test ¹⁾		
	Taste ²⁾	Flavor ³⁾	Color ³⁾	Texture ⁴⁾	Taste ⁵⁾	Flavor ⁶⁾
Lai Hijau	3.87 ab	3.27 b	3.00 c	2.53 cd	3.80 ab	2.70 b
Lai Belimbing	3.50 b	3.37 b	3.17 c	2.47 d	3.23 b	2.07 c
Lai Semangka	3.83 ab	3.80 ab	3.80 ab	3.57 a	3.70 ab	3.10 ab
Lai Durian	3.40 b	3.37 b	3.30 bc	3.07 abcd	3.37 b	2.57 bc
Lai Besar	4.30 a	4.07 a	3.77 ab	2.57 bcd	4.17 a	3.40 a
Lai Nangka	3.40 b	3.50 ab	3.73 ab	3.20 ab	3.53 ab	2.80 ab
Lai Kuning	3.43 b	3.27 b	3.90 a	3.13 abc	3.70 ab	2.93 ab
Average	3.68	3.52	3.52	2.93	3.64	2.80

Note: Values followed by same letter at the same column are not significantly different at $\alpha = 0.05$ The value was calculated from 30 replications

- 1) Scale: 1 = dislike very much; 2 = dislike; 3 = rather like; 4 = like; 5 = like very much
- 2) Scale: 1 = white; 2 = light yellow; 3 = yellow; 4 = yellowish orange; 5 = red
- 3) Scale: 1 = very flabby; 2 = flabby; 3 = rather flabby; 4 = rather dry; 5 = dry (hard)
- 4) Scale: 1 = not sweet very much; 2 = not sweet; 3 = rather sweet; 4 = sweet; 5 = sweet very much
- 5) Scale: 1 = very odorless; 2 = odorless; 3 = rather smell sharply; 4 = smell sharply; 5 = smell very sharply

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