Leaf nutrition content and organoleptic of Jeruju (*Acanthus ilicifolius* L) and processed products in Lubuk Kertang Village, North Sumatera

M Basyuni¹,², Y S Siagian¹, B Slamet¹,², N Sulistiyono¹,², L A P Putri³, E Yusraini⁴ and I Lesmana⁵

¹ Department of Forestry, Faculty of Forestry, Universitas Sumatera Utara, Jl. Tri Dharma Ujung No. 1 Medan, North Sumatera 20155, Indonesia
² Center of Excellence for Mangrove, Universitas Sumatera Utara, Medan, North Sumatera 20155, Indonesia
³ Department of Agroecotechnology, Faculty of Agriculture, Universitas Sumatera Utara, Medan, North Sumatera 20155, Indonesia
⁴ Department Food Science and Technology, Faculty of Agriculture, Universitas Sumatera Utara, Medan, North Sumatra 20155, Indonesia
⁵ Department of Aquatic Resource Management, Faculty of Agriculture, Universitas Sumatera Utara, Medan, North Sumatera 20155, Indonesia

E-mail: m.basyuni@usu.ac.id

Abstract. Mangrove forests in North Sumatera existed in the east coast of Sumatera Island and are promptly disappearing due to anthropogenic activities. Utilization of mangrove forest products currently lacks of consent, thus application of appropriate technology is necessary for sustainable use of mangrove forest products to improve economy of coastal communities without impacting damage to the mangrove ecosystem. This study aims to examine the content of nutrients of jeruju leaves (*Acanthus ilicifolius*), jeruju crackers, the processed products and also the storage period of jeruju cracker. The nutritional content and the storage period of the product were performed using proximate analysis and hedonic test. Results showed that the storage time of jeruju leaves, original jeruju crackers, and spicy jeruju crackers affected on decreasing of the moisture content, ash content, fibre content, and antioxidants. Contrary, the fat and protein content increased by prolonging the storage time. Concerning on the nutritional content of jeruju leaf, jeruju crackers, the quality and selling value of the mangrove processed products could be improved. The present study suggests that processing of mangrove products affected the nutrients content and the storage time of the product.

1. Introduction

Mangrove forests are the most productive ecosystem in the world that provide many benefits to coastal environment and commercial forest products, such as to protect coastlines and to support coastal fisheries [1]. However, utilization of mangrove forest products currently lacks in empowerment. Because of the lack of consent on existing mangrove products, it is necessary to implement appropriate technologies for the sustainable use of mangrove forest products without causing damage to the mangrove ecosystem. It is expected that application of technology for the utilization of mangrove forest products could improve the economic development of local communities and the living standards of
coastal communities through sustainable use of mangrove forest products, and also act as a controller of damage to mangrove forest ecosystems [2−5]. The utilization of mangrove ecosystems can be categorized into the usage of the ecosystem as a whole in the form of ecological values and the utilization of products produced from the mangrove ecosystem in the way of social, economic and cultural benefits. People who live in coastal areas generally use mangrove products to fulfil their needs [3−5].

Mangrove forest products are currently widely used as various types of food processing products [6] such as sweet taffy made of sticky rice, coconut milk, and palm sugar (jenang or dodol), syrup, crackers (krupuk), tea, and others. Mangrove processed products are generally managed by people living on the coast of mangrove forests. In some areas, mangrove products are controlled by community groups, which later results obtained from the production of processed food from mangrove products, are used as income for economic development by the local community.

Jeruju (Acanthus ilicifolius), as a mangrove vegetation plant, is a shade-tolerant plant which can grow on all types of soil, especially muddy areas along the banks of the river [7, 8]. A. ilicifolius is naturally found in wetland areas in river mouths, as mangrove vegetation. This study was conducted to determine the nutritional content of jeruju leaves and jeruju crackers, as mangrove processed products.

2. Materials and method

2.1. Materials

The fresh jeruju (Acanthus ilicifolius) leaves and crackers (figure 1A and 1B) were collected from Lubuk Kertang mangrove forest, Langkat, North Sumatra. The plant species is deposited as specimen voucher and verified in Medanese Herbarium, Department of Biology, University of Sumatera Utara.

2.2. Nutritional content analysis of fruits

The nutritional parameters of edible leaves were analyzed for attributes such as moisture content, total ash, fat content, protein, fiber content, and antioxidant with standard analytical procedures [9−10].

2.3. Organoleptic test on the processed product (jeruju crackers)

Jeruju crackers as the processed product were evaluated according to organoleptic score for variable parameters in 5 points hedonic scale as previously reported [11]. The hedonic test was carried out in various storage periods (1-4 weeks of treatment time). The followings are criteria for the hedonic analysis [11]:

5 – like very much
4 – like
3 – either like or dislike
2 – dislike, and
1 – dislike very much

2.4. Shelf life evaluation of jeruju cracker

Shelf life evaluation of jeruju cracker either original or spicy taste was performed through a continuous evaluation method. The samples were examined for physicochemical properties, colour, flavour, crispness, taste, size, product label, and packaging for four weeks of storage period as previously reported [9].

3. Results and discussions

3.1. The morphological character of jeruju leaves and jeruju cracker

Generally, A. ilicifolius can be found in muddy areas which affected by tides. The leaves are shiny green with slippery leaf surface. The leaves edges are spiny like saws, and the leaves have two wings of spiny leaf handles located on the stalk [7, 8]. A. ilicifolius is a low herbaceous plant with 2 m in height, strong and supported by branches appearing from older parts and aerial roots appearing from the horizontal bottom surface [7]. Kitamura et al. 1997 [7] reported that the length of jeruju leaves reached 5-15 cm,
and the length of the flower was 10-20 cm which located at the tip with bright blue or purple flower crown colour.

![Figure 1](image)

**Figure 1.** Jeruju leaves (A), original jeruju cracker and spicy jeruju cracker (B).

Fresh jeruju leaves are used in the processing of jeruju crackers by coastal communities in the village of Lubuk Kertang. The jeruju leaves were first cleaned from the thorns on the leaves edges. Then, jeruju leaves were processed together with other supporting ingredients, such as tapioca flour, coriander, garlic, salt, sugar, and red chili as a spicy flavor in crackers [3]. Characteristics of jeruju crackers is divided as a yellowish colour for pungent flavour and white colour for original flavour crackers [3].

### 3.2. Nutritional parameters of jeruju leaves and jeruju crackers

This research was conducted to compare changes in nutritional content in leaves after being processed into crackers by determining the nutrient content in jeruju leaves and jeruju crackers using proximate analysis [11, 12]. The parameters used in the proximate analysis included moisture content, ash content, fat content, fiber content, protein and antioxidant content as shown table 2. *A. ilicifolius* belongs to emergent aquatic plants. The chemical compounds in *A. ilicifolius* are known to have function as neuralgia, analgesics, anti-inflammatory, antioxidant, anticancer, antileukemia, antimicrobial, antifungal, antiviral, and insecticides [9, 13].

| Parameter          | Jeruju leaves (%) | Total ash (%) | Fat level (%) | Protein (%) | Fiber content (%) | Antioxidant (µg/mL) |
|--------------------|-------------------|---------------|---------------|-------------|-------------------|---------------------|
| Moisture           | 72.32 ± 0.64      | 5.03 ± 0.15   | 0.58 ± 0.40   | 43.83 ± 0.34 | 44.72 ± 21.79     | 76.63 ± 8.64        |
| Original cracker   | 0.83 ± 0.48       | 1.43 ± 0.02   | 36.47 ± 1.95  | 40.02 ± 1.94 | 5.14 ± 0.16       | 85.41 ± 8.68        |
| Spicy cracker      | 2.44 ± 1.34       | 1.63 ± 0.05   | 37.07 ± 2.98  | 54.69 ± 0.94 | 4.06 ± 0.62       | 88.87 ± 10.62       |

Data were expressed as triplicate analyses ± SD (n= 3)

Table 1 summarizes the average of moisture content, ash content, fat content, protein content, fiber and antioxidant content in jeruju leaves and the processed products of original and spicy crackers, respectively.

The results indicated that the moisture content of the processed products decreased significantly due to processing of jeruju leaves into crackers, such as frying. Frying is a method of cooking and drying food that takes place through contact with heat conductive media and carried out at high temperatures. The higher the temperature used, the higher the decrease in water content [14]. The decreasing of moisture content lead to the increasing of products shelf life.

In the cracker processing, tasty flavour was derived from red chili mixed with raw materials. The mixed red chilli may cause an increase in protein, fat and antioxidants contents in the crackers. Thus, the protein content of spicy jeruju crackers is supposed to be higher than that of the fresh jeruju leaves.
and original jeruju crackers. Furthermore, the lowest protein content was found in the original crackers because the crackers had passed through a high-temperature frying process which caused a reduction in the protein content of the original crackers [14]. The frying temperature usually reaches 160 °C which lead to losses of some nutrients, including vitamins and proteins [14]. The increased fat content was found in the processed jeruju leaf or crackers which had passed through a frying process in cooking oil. In frying process, the crackers absorbed much oil reaching up to 18% which increased fat content in the crackers. The highest fiber content was found in fresh jeruju leaves. The processed jeruju leaves used low amount of jeruju leaves mixed with supporting materials. In addition, the leaves used in jeruju crackers had been through the refining process before being put into the mixture. Thus, fibre content in the unprocessed leaves is supposed to be higher than those in the crackers [16].

For antioxidant, the fresh leaves of jeruju contained higher antioxidant than that in jeruju crackers which related with the low amount of jeruju leaves used in the crackers and also its process in frying [13]. *A. ilicifolius* also contains some active compounds as antibacterial agents [13]. In previous research, *A. ilicifolius* was reported containing secondary metabolite compounds, such as alkaloids, flavonoids, fatty acids, steroids, lignans, phenols, terpenoids and saponins which grouping as antibacterial [10, 15]. The antioxidant is important in maintaining the quality of food ingredients and products, as well as being able to inhibit food damage such as rancidity, changes in color and aroma, changes in texture, changes in nutritional value, preventing oxidative damage to oils, maintaining nutritional value and increasing shelf life of foodstuffs [17, 18]. The local wisdom of local communities also impacted the product [18].

3.3. Evaluation of processed product of jeruju crackers

Jeruju cracker is evaluated by hedonic test which includes some parameters of colour, flavour, crispness, taste, size, product label, and packaging. The hedonic test results of original and spicy jeruju crackers are displayed in figure 2-3.

The tests were carried out on the same panel for four weeks with three times repetition. Hedonic test results indicate that the scale preference on syrup colour was 4 (like) from the first month to the seventh month. The preference on aroma of syrup was at scale 4 (like) in the first month to the fifth month, then decreased to scale 1 (very dislike) in the sixth and seventh months. The preference on syrup taste also same in the first month to the fifth month, then decreased in the sixth and seventh months with scale 3 (neither like or dislike), while in the seventh month with a range of 2 (disliked).

![Figure 2](image_url). Change in panel’s preference in original jeruju crackers.
Figure 3. Change in panel’s preference in spicy jeruju crackers.

The result of hedonic test for colour of the original jeruju crackers was at scale 2 (dislike) in the first week to the fourth week (figure 2). According to panel members, the colour of original jeruju crackers was too pale or less brown. For the colour of spicy jeruju crackers, it was at scale 4 (like) in the first week to the second week, then slightly increasing in the third week as much as 0.13 (like) (figure 3). The flavour or aroma of the original and spicy crackers decreased every week from the first week to the last week with scale preference 3 (rather like) and 2 (not like).

The crispness of the cracker also decreased from the first week to the last week with a scale 3 (rather like) to 2 (not like) and a scale 3 (rather like) to 1 (very dislike) for the original and spicy crackers, respectively.

Last, the taste of the original cracker was at scale 2 (dislike) from the first week to the fourth week. The present study indicates that stability of food product is related with resistance against chemical, physical and microbiological changes. The change or damage might be cause by oxidation during processing and storage. These changes could be determined by colour, aroma, flavour, and nutritional value [10, 11].

4. Conclusions
The present study confirmed that the processed mangrove products could improve the quality and the value of the mangrove. The present study suggests that processing of mangrove products affected the nutrients content and the storage time of the product.

Acknowledgment
This study was partly supported by Program Pengembangan Desa Mitra (PPDM) 2018 from the Directorate for Research and Community Service, Ministry of Research, Technology and Higher Education, Republic of Indonesia and a community service of Non-PNBP Grant 2018 from Universitas Sumatera Utara also funded to this work.

5. References
[1] Barbier EB, Hacker SD, Kennedy C, Koch EW, Stier AC, Silliman BR 2011 The value of estuarine and coastal ecosystem services Ecol. Monogr. 81 169-193
[2] Datta D, Chattopadhyay RN, Guha P 2012 Community based mangrove management: a review on status and sustainability J. Environ. Manage. 107 84-95
[3] Basyuni M, Harahap MA, Wati R, Slamat B, Thoha AS, Nuryawan A, Putri LA, Yusriani E 2018 Evaluation of mangrove reforestation and the impact to socioeconomic-cultural of community in Lubuk Kertang village, North Sumatra IOP Conf. Ser.: Earth Environ. Sci. 126 012113
[4] Basyuni M, Harahap FK, Wati R, Putri LAP 2018 Effect of mangrove rehabilitation on socio-cultural of Pulau Sembilan society, North Sumatera, Indonesia IOP Conf. Ser.: Earth Environ. Sci. 126 012115
[5] Basyuni M, Telaumbanua TF, Wati R, Sulistyono N, Putri LA 2018 Evaluation of Rhizophora mucronata growth at first-year mangrove restoration at abandoned ponds, Langkat, North Sumatra. IOP Conf. Ser.: Earth Environ. Sci. 126 012118

[6] Gibbs HK, Ruesch AS, Achard F, Clayton MK, Holmgren P, Ramankutty N, Foley JA 2010 Tropical forests were the primary sources of new agricultural land in the 1980s and 1990s Proc. Natl. Acad. Sci. U.S.A. 107 16732-16737

[7] Kitamura S, Anwar C, Chaniago A, 1997 Baba S Handbook of Mangroves in Indonesia –Bali & Lombok- Japan International Cooperation Agency and International Society for Mangrove Ecosystems 119 p

[8] Basyuni M, Wati R, Sagami H, Sumardi, Baba S, Oku H 2018 Diversity and abundance of polyisoprenoid composition in coastal plant species from North Sumatra, Indonesia Biodiversitas 19 1–11

[9] Basyuni M, Ginting PY, Lesmana I 2017 Phytochemical analysis of binahong (Anredera cordifolia) leaves extract to inhibit in vitro growth of Aeromonas hydrophila AIP Conf. Proceed. 1904 020072

[10] Sumardi, Basyuni M, Wati R 2018 Antimicrobial activity of polyisoprenoids of sixteen mangrove species from North Sumatra, Indonesia Biodiversitas 19 1243-1248

[11] Hersleth M, Ilseng MA, Martens M, Naes T 2005 Perception of cheese: a comparison of quality scoring, descriptive analysis and consumer responses J. Food Qual. 28 333-349

[12] Nascimento AC, Mota C, Coelho I, Gueifão S, Santos M, Matos AS, Gimenez A, Lobo A, Samman N, Castanheira I 2014 Characterisation of nutrient profile of quinoa (Chenopodium quinoa), amaranth (Amaranthus caudatus), and purple corn (Zea mays L.) consumed in the North of Argentina: proximates, minerals and trace elements Food Chem. 148 420-426

[13] Patra JK, Thatoi HN 2011 Metabolic diversity and bioactivity screening of mangrove plants: a review Acta Physiol. Plant. 33 1051-1061

[14] Pereira RN, Vicente AA 2010 Environmental impact of novel thermal and non-thermal technologies in food processing Food Res. Int. 43 1936-1943

[15] Van Boekel M, Fogliano V, Pellegrini N, Stanton C, Scholz G, Lalljie S, Somoza V, Knorr D, Jasti PR, Eisenbrand G 2010 A review on the beneficial aspects of food processing Mol. Nutr. Food Res. 54 1215-1247

[16] Basyuni M, Amri N, Putri LA, Syahputra I, Arifiyanto D 2017 Characteristics of fresh fruit bunch yield and the physicochemical qualities of palm oil during storage in North Sumatra, Indonesia Indones. J. Chem. 17 182–190

[17] Brewer MS 2011 Natural antioxidants: sources, compounds, mechanisms of action, and potential applications Compr. Rev. Food Sci. Food Saf. 10 221-247

[18] Basyuni M, Rouf RA, Saragih M, Asbi AM, Yuriswan W 2017 Local wisdom and mitigation action to maintain secondary mangrove forest: a case study of Jaring Halus village in Langkat, North Sumatra, Indonesia Adv. Soc. Sci. Educ. Hum. Res. 81: 551–555