

# Ethnobotany, nutritional composition and sensory evaluation of *Garcinia* from Aceh, Indonesia

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**Abstract.** *Garcinia* species have various benefits, such as the production of edible fruit, oil, and medicine. This study aimed to evaluating ethnobotanical knowledge and nutritional composition and sensory characteristics of *Garcinia* species from Aceh, Indonesia. Eight of the *Garcinia* fruits collected from three regencies in the province of Aceh. Analyzed the composition of *Garcinia* nutrition was conducted in laboratory of Universitas Samudra. The ethnobotanical data were obtained using a semi-structured interview involved sixty respondents. The sensorial evaluation of various *Garcinia* was performed by using 9 points hedonic scale. Ethnobotanical data and sensory evaluation were evaluated using descriptive statistics. The findings showed that *Garcinia* was used by local people in the province of Aceh as a source of food and traditional medicines. *Garcinia xanthochymus* Hook. f. ex T. Anderson was higher in total carbohydrate and crude fiber content, while the highest crude protein was found in *Garcinia celebica* L. Furthermore, *G. mangostana* was superior in flavour and color, while the highest value for flavour attributes was found in *G. celebica*. In general, the highest overall acceptance score was found in *G. mangostana*.

## 1. Introduction

The genus *Garcinia* (family Clusiaceae) include more than 300 species is native to Asia and Africa [1]. Approximately 100 species are spread in Southeast Asia [2] and thirty of them have edible fruit [3]. A total of 64 species of *Garcinia* (*Garcinia* spp.) from Indonesia spread on Kalimantan (25 species), Sumatra and Sulawesi (22 species respectively), Moluccas and Papua (17 species respectively), Java (8 species), and Lesser Sunda Island (8 species) [2]. Species in the genus *Garcinia* retain various benefits, like producing edible fruit, oil, and medicine. Fresh and dry *Garcinia* fruit rinds are used as spice, condiment and garnish in several cuisines [4]. It's also using for ornamental, with a dense canopy of green leaves and red-tinting leaves [1]. Many species of *Garcinia* produce fruits with edible arils that can be eaten. They are rich in carbohydrates, proteins, fats, vitamins, and minerals [5].

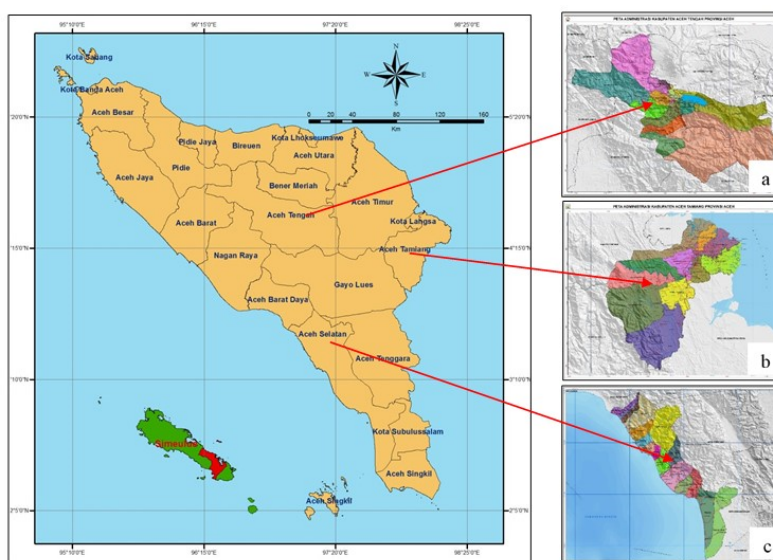
Although the province of Aceh is rich in edible fruit species, include *Garcinia*, but its ethnobotany and nutritional composition have been unexplored so far. *Garcinia* species,

particularly wild species, were widely unrecognized and were well undocumented. This is because economically wild fruits are nevertheless considered to be less essential. Limited data on nutritional value and customer preference for local fruits are an obstacle to *Garcinia*'s cultivated in the Aceh province. Perception of sensory quality and nutritional value on fruit retains a significant role in customer satisfaction [6]. Fruit sensory analysis and physical measurements of fruit properties are useful methods in evaluating fruit quality [7]. Sensory quality is recognized as the interaction between products and consumers. This is necessary to build a connection between a product's physical and chemical composition and its sensory characteristics like colour, texture, flavour (volatile compounds) and taste (sweet, sour, salty and bitter sensations) and sensory perception and consumer acceptance [8]. Taste, aroma, texture, and appearance are generally viewed as one of the most significant sensory characteristics. The present study was intended to assess *Garcinia*'s ethnobotanical knowledge and evaluate its nutritional content.

## 2. Materials and Methods

### Study area

This study was conducted in the province of Aceh, Indonesia. The province is located on the southern island of Sumatra (Fig. 1).



**Figure 1.** Map of the study site. a). Aceh Tengah Regency; b). Aceh Tamiang Regency; c). Aceh Selatan Regency

### 3. Data collection

*Garcinia* fruit was collected from three regencies in Aceh Province, namely Aceh Tamiang, Aceh Tengah, and Aceh Selatan Regency. *Garcinia* fruits analyzed for their nutrition composition. The researcher randomly has selected sixty respondents (twenty respondents each regency). The ethnobotanical data were obtained using a semi-structured interview following the method used by Cotton [9]. Informants were investigated in the languages of Acehnese, Malay or Indonesian, depending on the language they used. The interview questions involved specific information like local plant names, medicinal uses, and

techniques for cooking, harvesting and maintaining plants. The sensorial evaluation of various *Garcinia* was performed by using 9 points hedonic scale as described by Larmond [10]. The judges randomly tested the colour, flavour, taste and overall acceptability in eight *Garcinia* samples. The judges were provided with prescribed questionnaires to record their observation. The information contained on the performance was 9 = Like extremely; 8 = Like very much; 7 = Like moderately; 6 = Like slightly; 5 = Neither like nor dislike; 4 = Dislike slightly; 3 = Dislike moderately; 2 = Dislike very much; 1 = Dislike extremely.

#### **4. Experimental design**

In preparing for assessment of nutritional content, the samples were washed and packed in plastic bags and taken to Universitas Samudra for analyzed their nutrition composition. Edible parts were peeled, cut into small pieces and placed in a refrigerator until the process of extraction. The experiment was conducted in three replications to minimize the experimental error. The result was then gained on average for further statistical analysis.

#### **5. Data analysis**

Ethnobotanical data have been analyzed using descriptive statistics. The sample quantification of ash, moisture, protein, lipid, crude fiber, and carbohydrate total content was determined using the methodology of the Association of Analytical Chemists (AOAC) [11]. The nutritional analysis was carried out using descriptive statistics. Duncan's Multiple Range Test was used to evaluate significant statistical differences between means at a probability level of 5 percent. For this analyzes, the computer programs MS-Excel and the Social Science Statistical Package (SPSS) were used.

#### **6. Results and Discussion**

##### **Ethnobotany of *Garcinia* in Aceh**

The local people in Aceh were found to be knowledgeable about the use of eight species of *Garcinia* (*Garcinia atroviridis* Griff. ex T. Anderson, *Garcinia bancana* Miq., *Garcinia celebica* L., *Garcinia mangostana* Linn., *Garcinia nervosa* Miq., *Garcinia nigrolineata* Planch. ex T. Anderson, *Garcinia parvifolia* (Miq.) Miq., and *Garcinia xanthochymus* Hook. f. ex T. Anderson). This knowledge includes distinguishing of traditional ways of preparation for consumption and medicinal uses. Local people in rural areas who live around the forest collect various edible fruit species from forest as food [12]. They also have to cultivate some plants around the fruit around the back yard of the house as a source of nutrients [13]. Traditionally, local people in the province of Aceh consume *Garcinia* fruit in raw. Most people are using *G. xanthochymus* fruit was used as a spice, jam and curry mixture. Besides, they're also processing *G. atroviridis* as spices and fishy deodorizing. In the interviews, 28.3% of informants revealed that *G. mangostana* has been used for anti-obesity treatment. They believe that by consuming *G. mangostana* fruit can suppresses appetite. *G. mangostana* fruit is known to contain various bioactive compounds like mangostin, xanthones, demethylmangostanin, garcinone, demethylcalabaxanthone, thwaitesixanthon gartanin, mangostenone, and mangostinone, which have many functions, one of which is anti-obesity [1]. However, long term consumption of *G. mangostana* fruit causes severe acidosis [14].

### Nutritional composition of eight *Garcinia* in the study site

The current study has investigated eight *Garcinia* species for their nutritional composition. The investigated parameters include crude protein, crude fiber, moisture, crude fat, total ash, total carbohydrate and crude fiber of the species. Accordingly, *G. xanthochymus* is higher in total carbohydrate content and crude fiber than other *Garcinia* species (Table 2).

**Table 1.** Approximate composition of *Garcinia* species

Species	Moisture content (%)	Total ash (%)	Total carbohydrate (% dry weight)	Crude Protein (%)	Crude Fat (%)	Crude Fiber (%)
<i>Garcinia atroviridis</i>	78.9 ± 0.03	0.7 ± 0.06	18.2 ± 0.05	1.7 ± 0.02	0.5 ± 0.04	2.6 ± 0.08
<i>Garcinia bancana</i>	72.4 ± 0.12	0.4 ± 0.08	22.7 ± 0.11	3.8 ± 0.06	0.7 ± 1.12	3.2 ± 0.04
<i>Garcinia celebica</i>	70.2 ± 0.06	0.1 ± 0.01	19.7 ± 0.02	9.5 ± 0.02	0.5 ± 0.06	3.6 ± 0.04
<i>Garcinia mangostana</i>	80.7 ± 0.11	0.3 ± 0.03	16.1 ± 0.20	1.8 ± 0.13	1.2 ± 0.04	5.1 ± 0.03
<i>Garcinia nervosa</i>	80.6 ± 0.21	0.8 ± 0.02	14.1 ± 0.31	3.9 ± 0.10	0.6 ± 0.02	6.1 ± 0.11
<i>Garcinia nigrolineata</i>	74.5 ± 0.05	0.1 ± 0.03	20.8 ± 0.15	3.2 ± 0.21	1.1 ± 0.04	3.1 ± 0.03
<i>Garcinia parvifolia</i>	79.3 ± 0.01	0.4 ± 0.03	18.3 ± 0.15	0.9 ± 0.03	1.1 ± 0.02	5.3 ± 0.13
<i>Garcinia xanthochymus</i>	68.8 ± 0.50	0.9 ± 0.20	25.1 ± 0.32	4.8 ± 0.62	0.4 ± 0.30	8.4 ± 1.67

*G. celebica* showed a higher number of total proteins (9.5%), while total carbohydrates were higher in *G. xanthochymus*. This indicates that *G. xanthochymus* provides more calories than other *Garcinia* species. The fiber content of *Garcinia* species varied between 2.6% and 8.4%. The *G. xanthochymus* fruit has the highest crude fiber content on average 8.4%. Fiber is known to help to prevent many diseases prevalent in the community such as maintaining digestive and cardiovascular health [15-16]. It also helps regulate blood sugar levels [17].

### Sensory evaluation of eight *Garcinia* species in the study site

Sensorial evaluation of various *Garcinia* showed that the level of panelist acceptance of color, flavor, and taste in each study site varied. The scores for a various sensory attribute of eight *Garcinia* species showed in Table 2.

**Table 2.** Sensory profile of various *Garcinia* in the study site

Species	Sensory characteristics			
	Color	Taste	Flavour	Acceptability
<i>Garcinia atroviridis</i>	6.62 ± 0.12 <sup>b</sup>	5.83 ± 0.07 <sup>bc</sup>	7.35 ± 0.10 <sup>d</sup>	6.60 ± 0.07 <sup>b</sup>
<i>Garcinia bancana</i>	6.25 ± 0.11 <sup>a</sup>	5.18 ± 0.05 <sup>a</sup>	5.53 ± 0.08 <sup>b</sup>	5.66 ± 0.05 <sup>a</sup>
<i>Garcinia celebica</i>	8.22 ± 0.07 <sup>d</sup>	5.77 ± 0.06 <sup>b</sup>	5.33 ± 0.13 <sup>ab</sup>	6.44 ± 0.06 <sup>d</sup>
<i>Garcinia mangostana</i>	8.07 ± 0.07 <sup>d</sup>	7.82 ± 0.07 <sup>f</sup>	7.82 ± 0.08 <sup>e</sup>	7.90 ± 0.04 <sup>d</sup>
<i>Garcinia nervosa</i>	7.23 ± 0.10 <sup>c</sup>	5.15 ± 0.07 <sup>a</sup>	5.27 ± 0.08 <sup>ab</sup>	5.88 ± 0.05 <sup>c</sup>
<i>Garcinia nigrolineata</i>	6.32 ± 0.09 <sup>ab</sup>	7.43 ± 0.08 <sup>e</sup>	5.23 ± 0.06 <sup>a</sup>	6.33 ± 0.04 <sup>ab</sup>
<i>Garcinia parvifolia</i>	6.12 ± 0.08 <sup>a</sup>	6.02 ± 0.05 <sup>cd</sup>	6.02 ± 0.05 <sup>c</sup>	6.05 ± 0.04 <sup>a</sup>
<i>Garcinia xanthochymus</i>	6.62 ± 0.14 <sup>b</sup>	6.15 ± 0.12 <sup>d</sup>	7.47 ± 0.10 <sup>d</sup>	6.74 ± 0.07 <sup>b</sup>

Means sharing similar superscript a-f are statistically significant at 5% level of probability

Consumer visual examination is of significant significance as it constitutes the fitness of any product for consumption and the color of the fruit is one of the important quality parameters [18]. Panelists rated *G. celebica* to be the best among the tested varieties for colour followed by *G. mangostana*. Relatively lower scores were assigned to *G. parvifolia*. Meanwhile, *G. mangostana* seemed to be highly acceptable for flavour since the scores assigned to this species were the highest as compared to seven species (*G. atroviridis*, *G. bancana*, *G. celebica*, *G. nervosa*, *G. nigrolineata*, *G. parvifolia*, and *G. xanthochymus*). The

flavour of many fruits is affected by the sugar and sourness of organic acids in the fruit [19]. Sensory traits are not generally interrelated and contribute independently towards the overall sensory perception of the fruits [18]. The score presented in Tabel 2 for a taste of various *Garcinia* clearly indicated that the *G. mangostana* was perceived to be the best for taste among all the species under experimentation. Nonetheless, *G. Nigrolineata*, a wild *Garcinia* species, is also preferred by the community. This finding is comparable to the results of our previous studies which discovered that wild mango species were also favored by local people in Aceh Tamiang Regency [20]. This suggests that wild edible fruit plants have the potential to be obscured as cultivated plants that can provide extra income to local communities.

*Garcinia* remains a prospective resource that needs to be conserved and improved its functional value for the welfare of the community. Although some species of *Garcinia* such as *G. mangostana*, *G. atroviridis*, and *G. xanthochymus* contributed to local people's income on the study site, this contribution is limited. It is expected that this will enhance the socio-economic aspects of the community in Aceh province through intensive cultivation of *Garcinia* species, including wild *Garcinia* species. *Garcinia* fruit cultivation and processing technology requires to be developed and adjusted to community ability and are based on traditional knowledge.

## 7. Conclusions

The present study was conducted to assess the ethnobotany and nutritional value of eight species of *Garcinia* (*G. atroviridis*, *G. bancana*, *G. celebica*, *G. mangostana*, *G. nervosa*, *G. nigrolineata*, *G. parvifolia*, and *G. xanthochymus*) in Aceh, Indonesia. The results showed that local people in Aceh province used *Garcinia* as a source of food and traditional medicines. *G. xanthochymus* Hook. f. ex T. Anderson was higher in total carbohydrate and crude fiber content, while the highest crude protein is found in *G. celebica*. Furthermore, *G. mangostana* was superior in flavour and color, while the highest value for flavour attributes was found in *G. celebica*. In general, the highest overall acceptance score was found in *G. mangostana*. *Garcinia* fruit cultivation and processing technology requires to be developed.

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