

## THE POTENTIAL OF *Garcinia dulcis* (ROXB.) KURZ. AS A SOURCE OF HYDROXYCITRIC ACID AND ITS HABITAT CONDITIONS

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In Indonesia, between 1993 and 2014, the prevalence of overweight adults alarmingly doubled from 17.1% to 33.0% (Oddo *et al.*, 2019). Some people thus started looking for weight loss procedures, specifically from natural compounds in plants instead of treatment from medical practitioners. Hydroxycitric acid (HCA) is a compound used as a component in obesity and cholesterol-lowering drugs. HCA has the potential to inhibit the synthesis of fat and cholesterol (Moffet, 1998). HCA is a derivative of citric acid, which is found in a variety of plants, including *Garcinia*. In *G. cambogia*, HCA is found in the fruit, stems and leaves, with the highest quantity in fruit (Heymsfield, 1998). Other plant species such as asam gelugur (*G. atroviridis*), asam kandis (*G. parvifolia*) and mundu (*G. dulcis*) are also high in their HCA content (Isnawati, 1997; Wuryandari, 1998). In asam gelugur, the percentage of HCA is 92.9%, while in asam kandis it is 83.1%. However, little is known about HCA content in *G. dulcis*.

*Garcinia dulcis* (Roxb.) Kurtz, known in Indonesia as *mundu*, is a member of the Clusiaceae (Guttiferae) family. This species has many synonyms namely; *Garcinia elliptica* Choisy, *Garcinia longifolia* Blume, *Stalagmitis dulcis* (Roxb.) Cambess., *Stalagmitis javanensis* (Blume) Spach, *Xanthocymus dulcis* Toxb. and *Xanthocymus javanensis* Blume (Lim, 2012). *G. dulcis* is a perennial tree with a height of 5-12 meters. The leaves are ovate to oblong-elliptic in shape, measuring 10-30 cm x 3.5-14 cm (Figure 1). The flowers are axillary, yellow-white in colour, possess a sour odour and generate 5-merous. The male flowers are in small clusters, and measure around 6 mm wide. The female flowers are 12 mm wide with a pedicel 1.5-3 cm long and with 5-lobed stigma. Flowering usually occurs between October-December. The average fruit produced by each tree in one season accumulates to approximately 60-70

kg. The fruit are spherical, measuring 5-8 cm wide and crowned by the persistent stigma. The skin is thin, soft and light yellow when ripe. The fruit has a thick rind (mesocarp), fleshy endocarp and 5-6 seeds. The fruit contains a variety of chemical compounds, including 42 xanthenes derivatives, as well as organic acids such as citric acid, fumaric acid and other organic acids (Heymsfield, 1998). Although it is said that the fruit can be eaten fresh, preserved or made into fruit paste/jam (Lim, 2012), villagers in Klahang rarely eat them due to their sweet taste, high acidity and a specific flavour known locally as gummy. Local people utilise its woody stems for building materials. The species is indigenous to Peninsular Malaysia, Southern Thailand, Java, Borneo and the Philippines (Lim, 2012). Although widely grown in Indonesia, especially in Java and Kalimantan, its potential is not widely known. Therefore, this study was conducted to determine the concentration of HCA in mundu fruit and record the environmental habitat condition. The research was performed in Desa Klahang, Kecamatan Sokaraja, Kabupaten Banyumas, in Central Java.

HCA compounds were revealed to be present in the rind and seeds of *G. dulcis*. An average area of HCA peak appeared at a retention time of 3:03 min. The standard deviation value of retention time was 0.004676, while the average value was 3.038333. The result was similar with several studies about HCA, which also had the value of retention time within the range of three minutes (Vinh *et al.*, 2011). The standard calibration of HCA showed the value of the linear regression as,  $y = 11123x + 136\ 316$  (Figure 2), with a correlation coefficient ( $R^2$ ) = 0.9056.

Mundu rind samples had an average peak area larger than seeds, i.e. 9.261.73, while the seeds were 9.136.51. Broad peak value area of two samples was then converted into concentration of HCA. Mundu fruit skin produced HCA as much as 32.67grams/100gram sample, while the seeds

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Fig. 1. Leaves, branches and fruit of *Garcinia dulcis* grow in Desa Klahang.

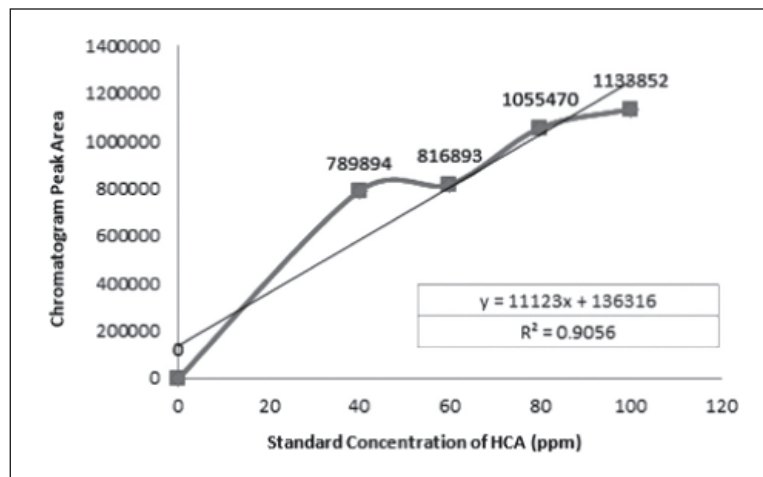


Fig. 2. Calibration graph of HCA at different concentration.

**Table 1.** The comparison of HCA concentration of six species of *Garcinia*

<i>Garcinia</i> spesies	Concentration of HCA (g/100 g sample)
<i>G. oblongifolia</i>	9.508
<i>G. cowa</i>	11,23
<i>G. india</i>	11,50
<i>G. cambogia</i>	17,00
<i>G. dulcis</i>	32,67

produced 32.23 grams/100 grams from seed samples. HCA concentration of *G. dulcis* was higher than *G. oblongifolia*, *G. cowa*, *G. indica* and *G. cambogia*, which were analyzed using the same extraction method (Table 1). *G. cambogia* as a source of hydroxycitric acid, which has been widely used as a weight loss drug, contained as much as 16-18 grams /100 grams of HCA (Vinh *et al.*, 2011).

Plant species distribution was strongly influenced by soil nutrients, environmental conditions as well as land topography. In Klahang village, *G. dulcis* naturally grew in two groups, with a total of 35 trees having different ages. These plants

were only found in the garden or yard area in which vegetation was still maintained, and in areas with a closed canopy. *G. dulcis* were not found in open areas such as residential areas or rice fields. However, this plant tends to grow near rivers. The range of altitudes of *G. dulcis* was 30-45 meters above sea level. *G. dulcis* population was most commonly found at an altitude between 38-42 meters above sea level (Figure 3). These results contrast with (Heyne, 1987) who discovered that *G. dulcis* preferred an altitude of around 500 meters above sea level. This could be possible due to other environmental factors affecting the growth of *G. dulcis* more than altitude, such as soil and air conditions. Environmental conditions of the *G. dulcis* habitat were as follows: air temperature was 29°C and relative humidity was 73%. Soil organic and organic content was 71% and 88% respectively. Soil moisture was 23% and soil temperature was 28.8°C. The N, P, K and C contents had the values of 12.19 mg/kg, 85.82 mg/100g, 62.20 mg/100g, and 1.76 mg/kg respectively (Table 2). Referring to soil criteria from the Indonesia Ministry of Land (2014) the value of P and K soil with 25% HCl extract is considered high (Hutchinson *et al.*, 1998). Overall, our findings of

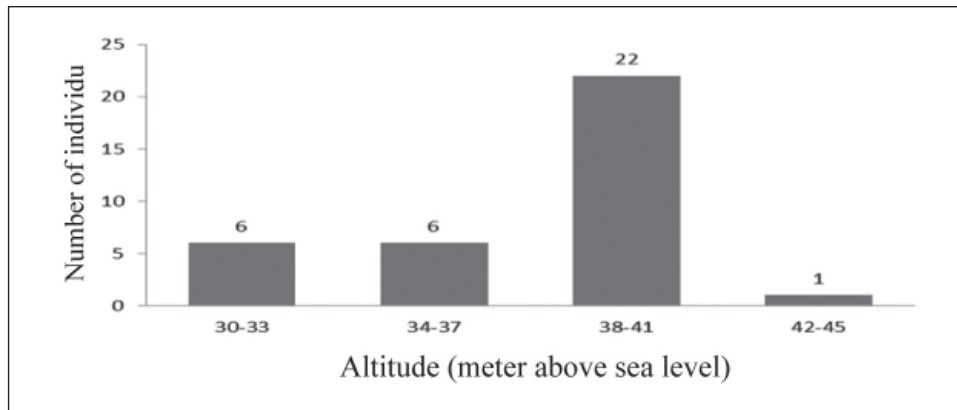


Fig. 3. Distribution of *Garcinia dulcis* at different altitude in Klahang, Central of Java, Indonesia.

**Table 2.** Soil condition of *G. dulcis* in Klahang village in Desa Klahang

Soil Parameter	Value
Nitrogen (mg/kg)	0.19
Posfor (mg/100g)	85,82
Kalium (mg/100g)	62,20
Carbon (mg/kg)	1,76
pH	4.4–5.8
Temperature (°C)	29.8

the environment of mundu habitat was similar to the findings of Lim (2012), showing that mundu preferred to grow in humid areas, in land areas up to 500 m above sea level and was not fastidious to soil types.

Nutrient and soil chemical elements, as well as the acidity (pH) of the soil, plays an important role in the survival of plants. The content of nitrogen in the soil is a major factor limiting the growth of trees in ecosystems (Sollins, 1998; Hutchinson *et al.*, 1998). Composition of carbon and nitrogen in the soil indicate the level of soil organic matter (Sollins, 1998). The value of C/N ratio is 9.3, and is almost equal to the C/N ratio of compost. Therefore, soil is categorized as arable but the level of organic matter is stable (Leu, 2012).

The ratio of sand, clay and silt in the soil in Klahang was 36.67: 32.33: 31.00, respectively, thus the soil can be categorized as clay soil (Soil Survey Staff, 2014), which has good capacity to hold water. Therefore, it tends to be wet due to its fine particles holding more water and more closely than sand. Based on the soil data of *G. dulcis* habitat, it can be suggested that *G. dulcis* growing in Desa Klahang is a fertile soil with both high levels of organic and inorganic matter, as well as high water holding capacity.

HCA concentration in the rind of *Garcinia dulcis* was (32.67 grams/100 grams of sample) which was higher than the fruit seed sample (32.23 grams/100 grams of sample). The concentration of HCA in *G. dulcis* was higher compared to other *Garcinia* species that has been widely studied and used as a weight loss drug. The habitat conditions of *G. dulcis* in Klahang had the characteristics as follows: living in the lowlands (30-45 meters above sea level), possessing air temperature ranging from 29°C, with air humidity 73%. The soil was classified as clay soil, with soil temperature of 28.8°C, and was rich in mineral. Organic content and concentration of N, P, K was high and it also has an acidic pH level.

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