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Antioxidant properties of coastal and inland populations of *Hibiscus tiliaceus*

Background

Hibiscus tiliaceus L. (Malvaceae) or sea hibiscus is a coastal plant of the tropics and sub-tropics. The species is commonly found along the sandy shores of tropical Asia and Australia, and is abundant in the Pacific Islands. Being a mangrove associate, it occurs in the coastal environment and is also found within mangroves. It is a fast-growing tree that reaches 15 m tall (Chan & Baba, 2009). Leaves are leathery, hairy beneath, heart-shaped and have 1–3 nectary glands at the base of the underside mid-rib. Flowers occurring singly are bell-shaped, each with a maroon heart and stigma (Fig. 1). They are yellow in the morning, turning orange-red in the evening. Floral colour change is a characteristic of flowers of *Hibiscus*.

Fig. 1. Leaves and flowers of *Hibiscus tiliaceus*

Timber of *H. tiliaceus* is used for making canoes and tool handles (Tan, 2001). Leaves are eaten or used as fodder. Barks contain tough fibres used for making rope. Medicinal uses of leaves include cooling fever, soothing cough and removing phlegm. Flowers are used to treat ear infection and abscess. In Asia and Africa, flowers are used in birth control (Rosa *et al*., 2006).

Leaves of *H. tiliaceus* displayed the highest tyrosinase inhibition among 39 tropical plant species in Okinawa (Masuda *et al*., 2005). Leaves have strong antioxidant and tyrosinase inhibition activities, and moderate activity against Gram-positive bacteria (Wong, 2008).

There are very few studies comparing the antioxidant properties (AOP) of coastal and inland plant populations. As coastal plants are exposed to high solar UV radiation, this study was conducted to find out if AOP values of leaves and flowers of natural coastal populations of *H. tiliaceus* are higher than planted inland populations.

Methodology

Fresh leaves and petals of *H. tiliaceus* (1 g) were separately powdered with liquid nitrogen in a mortar and extracted using methanol (50 ml), with continuous swirling for 1 hour at room temperature using an orbital shaker. Extracts were filtered under suction and stored at –20°C for further use.

AOP evaluated were total phenolic content (TPC) and 2,2-diphenyl-1-picrylhydrazyl (DPPH) radical scavenging activity expressed as ascorbic acid equivalent antioxidant capacity (AEAC). TPC and AEAC were determined using the Folin-Ciocalteu and DPPH assays, respectively (Chan *et al.*, 2008; Wong *et al.*, 2009).

Results and discussion

AOP of leaves and flowers

TPC and AEAC of leaves of *H. tiliaceus* ranged from 1760–2670 mg GAE/100 g and from 1650–3890 mg AA/100 g, respectively (Table 1). Values of flowers ranged from 1340–2240 mg GAE/100 g and from 1200–3180 mg AA/100 g, respectively. AOP values were comparable in leaves and flowers, with the exception of one inland population (SB) where values of leaves were significantly higher than flowers.

AOP of leaves of coastal and inland populations

TPC and AEAC of leaves of coastal *H. tiliaceus* populations ranged from 1760–2220 mg GAE/100 g and from 1650–2300 mg AA/100 g, respectively (Table 1). Values of leaves of inland populations ranged from 1800–2670 mg GAE/100 g and from 2010–3890 mg AA/100 g, respectively. Values of flowers of coastal populations ranged from 1730–2240 mg GAE/100 g and from 1660–1820 mg AA/100 g, respectively. Values of flowers of inland populations ranged from 1340–2420 mg GAE/100 g and from 1200–3180 mg AA/100 g, respectively.

It is generally believed that seashore plants, which are exposed to full sunlight, possess strong antioxidant activity (Masuda *et al*., 1999). There is greater radiation of UV in coastal areas due to reflection of sunlight from sand and sea surfaces (Kawanishi *et al.*, 1994). With greater UV radiation in coastal areas, one would therefore expect coastal plant populations to have stronger AOP.

Table 1. Antioxidant properties of leaves and flowers of coastal and inland populations of *Hibiscus tiliaceus*

Location (dist. from shore)	Plant part	TPC (mg GAE/100 g)	AEAC (mg AA/100 g)
Coastal	Leaves		
PJ I (15 m)		2220 ± 751ab	2300 ± 598a
PJ II (10 m)		1760 ± 271a	1650 ± 222a
PR (20 m)		1940 ± 465ab	1830 ± 525a
Inland			
JK (42 km)		2080 ± 419ab	2370 ± 539a
SB (40 km)		1800 ± 296a	2010 ± 425a
TTI (33 km)		2670 ± 300b	3890 ± 437b
Coastal	Flowers		
PJ I (15 m)		1730 ± 51a	1660 ± 157a
PJ II (10 m)		2240 ± 469ab	1800 ± 352a
PR (20 m)		2170 ± 535ab	1820 ± 464a
Inland			
JK (42 km)		2420 ± 167b	3180 ± 678b
SB (40 km)		1340 ± 177c	1200 ± 232c

For each column, values followed by the same letter (a-c) are not statistically different at $P < 0.05$ as measured by the Tukey HSD test. ANOVA does not apply between plant parts. TPC, total phenolic content; AEAC, ascorbic acid equivalent antioxidant capacity; GAE, gallic acid equivalent; AA, ascorbic acid; PJ, Pantai Jeram; PR, Pantai Remis; JK, Jalan Kuching; SB, Selayang Baru; TTI, Taman Tun Ismail.

Results from this study did not show any distinct variation between AOP of coastal and inland populations of *H. tiliaceus* for both leaves and flowers. With greater UV radiation in coastal areas, there is no evidence that coastal populations have stronger AOP. Hashiba *et al.* (2006) have similarly found inconsistent variation in leaf flavonoid content of coastal and inland populations of *Campanula punctata*. However, Keiko *et al.* (2005) found higher flavonoid and phenolic acid content in inland populations of *Adenophora triphylla* var. *japonica* than in coastal populations. It is likely that coastal influence on AOP of plant populations is more complex, varying between species and may be influenced by other environmental factors beside greater exposure to sunlight and UV-B.

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