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Effects of *Mangifera pajang* Kostermans juice on plasma antioxidant status and liver and kidney function in normocholesterolemic subjects

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ABSTRACT

The effects of a bambangan juice powder (BJP) drink on plasma vitamin and antioxidant enzyme levels and liver and kidney function were investigated. Thirty-two healthy subjects (12 male and 20 female) ages 24–28 years were recruited from the Faculty of Medicine and Health Sciences of University Putra Malaysia, Malaysia. Compared with consuming the placebo, consumption of the BJP drink daily for 9 weeks significantly increased the concentration of plasma β-carotene and ascorbic acid. Plasma total antioxidant status was increased, but liver and kidney functions were unaffected after consumption of the BJP drink. The consumption of a BJP drink resulted in a significant improvement in certain cardiovascular biochemical parameters and thus reduced the risk of cardiovascular disease.

1. Introduction

The term antioxidant refers to any molecule capable of stabilizing or deactivating free radicals before they attack cells. Antioxidants can be enzymatic or non-enzymatic. Enzymatic antioxidant defenses include superoxide dismutase, which accelerates the dismutation of superoxide; glutathione peroxidase, which catalyzes the reduction of hydrogen peroxide and lipid hydroperoxides to water and lipid alcohols at the expense of oxidizing reduced glutathione (Bahorun, Soobrattee, Luximon-Ramma, & Aruoma, 2006); and others, such as catalase. Non-enzymatic antioxidants include ascorbic acid (vitamin C), carotenoids, polyphenols and other phytochemical antioxidants. A balance exists between both the activities and the intracellular levels of these antioxidants under normal conditions. Indeed, this balance is essential for the survival of organisms and their health (Bahorun, Soobrattee, Luximon-Ramma, & Aruoma, 2006; Valko et al., 2007).

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Dietary antioxidants have attracted considerable attention as agents that protect cells or molecules from oxidative stress. The consumption of 5 servings of fruits and vegetables per day has been recommended by the American Dietetic Association to ensure an adequate antioxidant intake starting in early childhood (Nicklas & Johnson, 2004). High intake of fruits and vegetables provides natural antioxidant compounds with health-promoting properties that are associated with the increase of plasma antioxidants and inversely associated with the risk of cardiovascular diseases, according to several intervention studies (Costa, Garcia-Diaz, Jimenez, & Silva, 2013; John, Ziebland, Yudkin, Roe, & Neil, 2002; Samman et al., 2003; Shahidi & Chandrasekara, 2013). Furthermore, antioxidant compounds have important roles in the preservation of plasma antioxidant status (Wu et al., 2013). The results from a cohort study indicated that a lower risk of myocardial infarction incidence is inversely associated with a higher intake of fruits and vegetables in women (Liu et al., 2000). Moreover, high intakes of vegetables have been shown to have an inverse association with coronary heart disease risk in men (Liu et al., 2001).

The fruit of bambangan (*Mangifera pajang* Kostermans) is edible and is one of the most common fruits consumed in Sabah and Sarawak, Malaysia. The fruit is brown-skinned, ovoid in shape and possessed of a pungent smell. The bambangan is a type of wild mango from the Anacardiaceae family and can be found in its native areas, such as East Kalimantan (Indonesia) and Borneo Island (Malaysia-Sabah and Sarawak, Brunei). The nutritional composition (Al-Sheraji et al. 2011, 2012a; Hassan, Ismail, Abdul Hamid, Azlan, & Al-sheraji, 2011a) and several antioxidant actions (Al-Sheraji et al. 2012b; Hassan, Ismail, Abdul hamid, & Azlan, 2011b) of various parts of the bambangan fruit have been studied previously. A study by Ibrahim, Prasad, Ismail, Azlan, and Abdul Hamid (2010) reported that BJP contained ascorbic acid (1321 μg/g), β-carotene (3556 μg/g) and total phenolics (19 mg gallic acid equivalent/100 g) and possessed antioxidant capacity (40 mM/100 g and 53% by ferric radicals antioxidant power and DPPH), as shown in Table 1. Abu Bakar, Mohamed, Rahmat, Burr, and Fry (2010) reported on the identities and contents of some polyphenols in bambangan flesh, namely phenolic acids, including *p*-coumaric acid [29 μg/g dry weight (dw)], caffeic acid (27 μg/g dw) and chlorogenic acid (6 μg/g dw). Flavanones found in the flesh included naringin (1450 μg/g dw) and hesperidin (930 μg/g dw), while the reported flavonols were quercetin (165 μg/g dw) and kaempferol (183 μg/g dw). A flavone compound, luteolin, was reported at 292 μg/g dw. A study by Khoo, Prasad, Ismail, and Esa (2010) showed that bambangan flesh also contained α-carotene (80 μg/g) and cryptoxanthin (12 μg/g) (Table 1). To the best of our knowledge, no study has reported on the effect of this fruit on the risk of degenerative disease *in vivo*. Therefore, our study was considered the first to examine potential health-promoting properties of this fruit in human subjects.

In addition to the positive benefits of high fruit and vegetable intake, the potential adverse effect of the high levels of antioxidant compounds present in these fruits and vegetables should be evaluated. Few studies have documented the effect of fruits and vegetables on parameters of liver and kidney function that reflect the possible toxicity of an excessive intake of the antioxidants present in these plants. A study by Takahashi (1995) suggested that consumption of 0.5% natural β-carotene has a tendency to cause hemorrhage in male rats. Another study among 29,133 Finish male smokers showed an increased incidence of cardiac events, hemorrhagic stroke and the risk for major coronary events after 6 years of β-carotene supplementation (Heinonen & Albanes, 1994). Furthermore, in the Health Professionals Follow-Up Study involving 43,738 men, supplemental vitamins E and C or specific carotenoids did not reduce the risk of stroke (Ascherio et al., 1999).

In this study, we conducted a controlled dietary intervention to investigate the effects of the consumption of a BJP drink on selected enzymatic and non-enzymatic antioxidants and plasma antioxidant status in humans. Parameters of liver and kidney function were assessed as toxicity indicators.

2. Materials and methods

2.1. *Preparation of samples*

Fresh *M. pajang* Kosterm fruits at their commercial ripening stage were collected from Bau, Sarawak, Malaysia. The fruits were then wrapped in paper, placed in boxes and transported via airmail to the Nutrition Laboratory, Faculty of Medicine and Health Sciences, University Putra Malaysia, Serdang,

Table 1 – Bioactive compounds of flesh of *Mangifera pajang* Kost.

	Compound	Amount (μg/g d.w)	Ref.
Phenolic acids	*p*-Coumaric acid	29.46	Abu Bakar et al. (2010)
	Caffeic	26.75	Abu Bakar et al. (2010)
	Chlorogenic	5.81	Abu Bakar et al. (2010)
Flavanones	Naringin	1450.00	Abu Bakar et al. (2010)
	Hesperidin	930.00	Abu Bakar et al. (2010)
Flavonols	Quercetin	165.10	Abu Bakar et al. (2010)
	Kaempferol	182.70	Abu Bakar et al. (2010)
Flavone	Luteolin	292.10	Abu Bakar et al. (2010)
Carotenoids	β-Carotene	355.90	Ibrahim, Prasad, Ismail, Azlan, and Abdul Hamid (2010)
	α-Carotene	79.60	Khoo et al. (2010)
	Cryptoxanthin	11.80	Khoo et al. (2010)
Ascorbic acid	Ascorbic acid	1321.4	Ibrahim et al. (2010)