Nutritional Values of Dabai (*Canarium odontophyllum*)

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Dabai (*Canarium odontophyllum*) is a fruit-bearing plant native to Borneo. Its fruit is an indigenous seasonal fruit that is considered to be underutilized due to its short shelf life.

dabai nutrition indigenous fruit

1. Introduction

Dabai (*Canarium odontophyllum*) is a fruit-bearing plant native to Borneo from the Burseraceae family. Dabai fruit is an indigenous seasonal fruit considered a delicacy in Sarawak. The skin and flesh are hard and inedible when ripe, so the fruit needs to be soaked in warm water for up to 10 min to soften the skin. The taste of the flesh is similar to avocado due to its creamy texture and fatty taste. The kernel is edible and rich in oil yet normally discarded. Dabai is devoured as a snack food by locals, with high nutritional values that are good for health. Despite its abundance, the potential of dabai fruit has not been comprehensively explored and it is considered to be an underutilized fruit [1]. In addition, dabai fruit has a minimal shelf life. It can be stored at room temperature for only up to three days before the skin becomes crinkled due to moisture loss [2]. This property is becoming a significant drawback to the distribution and marketing of dabai fruit nationally and internationally. To expedite the growth of the dabai market, the Malaysian Agricultural Research and Development Institute has developed dabai pickles and frozen dabai pulp to ensure a continuous supply is available even during the off seasons [3]. The developed products enable steady processing of dabai fruit throughout the year and enhance its potential to be further explored.

2. Nutritional Values of Dabai

Dabai consumption, marketing, and production have all increased significantly in the commercial market. This scenario has led to advancements and inspired researchers to take a closer look at the nutritional values of dabai. This section discusses the nutritional values, antioxidants, potential future alternative fat, and antimicrobial properties of dabai as one of the indigenous fruits of Borneo (**Table 1**).

Table 1. Nutritional values of dabai.

Nutritional Values	Dabai Part	Findings	References
Antioxidant and Nutritional Values	Peel	Major source of natural antioxidants	[4][5]
	Peel and Pulp	High concentration of carotenoids	[6]
		Contains total phenolic content, i.e., gallic acid, catechin, epigallocatechin, ellagic acid, and flavonoid	[5][7]
	Pulp	Contains minerals, i.e., calcium, sodium, potassium, magnesium, and phosphorus	[8][9]
		High in energy, protein, and total amino acids, i.e., aspartic and glutamic acids	[8][9][10]
Alternative Fat	Pulp	Low in moisture content but high in fat	[9][10]
		The most abundant fatty acids are oleic, linoleic, and palmitic	[11]
		Good source of unsaturated fatty acids	[12]
	Pulp and Kernel	Able to boost the lipid profile	[13][14][15]
	Pulp	Able to lower cholesterol and protect cells from damage	[13][14][15]
		Contains low amount of peroxide values and free fatty acids	[16]
	Pulp	Effective against *Candida glabrata*	[17]
Antimicrobial Properties	Seed	Promising antibacterial against infections associated with *Acinetobacter baumannii* and *Proteus mirabilis*	[18]
	Stem Bark	Antimicrobial effect on *Staphylococcus aureus* ATCC 25923, *Bacillus cereus* ATCC 6633, *Escherichia coli* ATCC 25932, *Pseudomonas aeruginosa* ATCC 27853, *Acinetobacter baumannii* strain sensitive, *Candida albicans* ATCC 64677, *Candida glabrata* ATCC 90028, *Aspergillus niger*, and *Fusarium solani* M2781	[19]
	Leaf	Potentially leading to the identification of a target protein for future novel therapeutic development against methicillin-resistant *Staphylococcus aureus* infections.	[20]
		Antimalarial agent	[21]

2.1. Antioxidant and Nutritional Values

The high antioxidant properties and nutritional values make dabai appreciated by many people, especially the local community in Borneo. Consequently, there are compelling scientific grounds for investigating the phytochemical and nutritional composition of dabai. Dabai fruit has the most influential antioxidant properties. Faridah Hanim et al.

[4] and Pin et al. [5] demonstrated that dabai peel is a major source of natural antioxidants. Prasad et al. [6] added that dabai peel and pulp extracts have a high concentration of carotenoids and a reasonable level of antioxidant capacity in the DPPH (2,2-diphenyl-1-picryl-hydrazyl-hydrate) and ABTS (2,2′-azino-bis(3-ethylbenzothiazoline-6-sulfonic acid)) assays. However, this depends on the geographical location of the growing dabai tree [8]. The fruit's nutritional composition and antioxidant properties are influenced by the growing region or place of production, cultivar, climate, year of production, maturity, and cultural strategies. This is consistent with the work of Koczka et al. [22] and Arvaniti et al. [23], who showed that the antioxidant capacity of rosehip and figs was affected by the growing location.

The mean contractions of phytochemicals for their antioxidant benefit in maintaining longevity were studied by Basri et al. [24] to determine the inhibition of extracellular Ca^{2+} influx that is involved in extract-induced relaxation. After being incubated with EC_{50} of the extract, endothelium-denuded aortic rings were made to contract by phenylephrine (PE) and stimulated by potassium chloride (KCl). The control study did not involve preincubation with 30 min of extraction. **Table 2** shows the effect of the $CaCl_2$ content and reagent type on the contraction amplitude. Comparing the KCl- and PE-precontracted aortic rings to the control group, the vasocontraction responses to the cumulative concentration of Ca^{2+} did not exhibit any significant differences given the presence of dabai. The Ca^{2+}-induced contraction that PE and KCl induced was not noticeably inhibited by dabai.

Table 2. Effect of the $CaCl_2$ content and type of reagent on the amplitude of contraction.

Reagent	$CaCl_2$ Content (mM)	Amplitude of Contraction (%) for Control	Amplitude of Contraction (%) by the Presence of Dabai
Phenylephrine (PE)	0.3	0	0
	1	26.9	61.9
	5	60.3	60.3
	10	100	100
Potassium chloride (KCl)	0.3	0	0
	1	73.0	31.7
	5	88.9	100
	10	100	31.7

The total phenolics in dabai peels were found to be 18.88 to 26.62 mg gallic acid equivalent/g and the total flavonoid content was 15.62 to 46.70 mg quercetin equivalent/g [5]. However, this depends on the dabai peel extraction method. According to Khoo et al. [7], catechin and epigallocatechin were the most abundant phenolics in defatted dabai peel methanol extract. At the same time, ellagic acid was the most abundant phenolic acid in the water extract. Furthermore, the authors found that the defatted dabai peel contained more anthocyanidin than its

pulp. High levels of total phenolics and Trolox-equivalent antioxidant capacity were found in the peel of a defatted dabai fruit extracted with methanol.

Calcium (16.00–67.88 mg/100 g fresh weight (FW)), sodium (7.26–11.19 mg/100 g FW), and potassium (3.64–7.19 mg/100 g FW) are the most abundant minerals in dabai fruit. Still, their concentrations vary significantly depending on the geographical location and variety [8]. In contrast, the study by Hoe and Kueh [9] indicated that the most potent minerals in dabai fruit are potassium (810 mg/100 g edible portion), calcium (200 mg/100 g edible portion), magnesium (106 mg/100 g edible portion), and phosphorus (65 mg/100 g edible portion). The authors also noted that dabai is high in energy (339 kcal/100 g edible portion) and protein (3.8%/100 g edible portion). Surprisingly, no vitamin C was found in dabai fruit. Chew et al. [8] reported that the dabai fruit protein was abundant in aspartic and glutamic acids, which comprised 45 to 49% of the total amino acids.

2.2. A Potential Future as Alternative Fat

Dabai has the potential to be a new source of alternative fat [25]. The most abundant fatty acids in the fruit are oleic (18:1), linoleic (18:2), and palmitic (16:0) acid, with percentages comparable to palm oil [11]. According to Umi Kalsum and Mirfat [10], the fruit has a low moisture content but high fat content. The fat content contributes to the high energy content in dabai fruit. The fruit contains 29.58 to 37.07% fat and contributes 504.12 to 567.12 kcal of energy in dabai fruit. These results are consistent with those of Hoe and Kueh [9], who reported that the fruit contained 26.2% fat and 339 kcal of energy.

Dabai pulp and kernel oils could be used to develop potentially healthy cooking oils due to their favorable fatty acid profile and high antioxidant activity [11]. These claims are consistent with those made by Basri et al. [12], who stated that dabai fruit is a good source of unsaturated fatty acids, and so has the potential to be converted into healthy cooking oil. On the other hand, dabai pulp and kernel fat has been shown in studies to boost the lipid profile of laboratory rabbits given dabai fat. In addition, in vitro and in vivo studies show that defatted dabai peel has a modest cardioprotective effect [13][14]. This may be due to the high dietary fiber and antioxidant activity in dabai fruit, which contributes to the cholesterol-lowering effect. This finding provides evidence that dabai defatted pulp might be able to lower cholesterol and protect cells from damage. A study by Khoo et al. [15] examined the potential use of defatted dabai peel in future bioceuticals. This study revealed that defatted dabai peel had the highest antioxidant capacity and an oxidative-stress-inhibiting effect. The defatted dabai peel increases cellular antioxidant enzymes, i.e., superoxide dismutase and glutathione peroxidase, in rabbits, and inhibits lipid peroxidation, i.e., plasma malondialdehyde.

Recently, Azlan et al. [26] found that the high saturated fat of dabai kernel can be used in place of cocoa butter or palm kernel fat to produce chocolate. Moreover, the authors highlighted that sensory analysis revealed that chocolate bars made from dabai kernel were preferred over dabai oil and oleoresin. This has significant potential for the chocolate bar industry. Similarly, Abdul Kadir et al. [16] indicated that dabai pulp oleoresin is safe to be consumed and has significant potential as a new margarine and cocoa butter substitute with bioactive compounds (vitamin E). The authors also mentioned that the low amount of peroxide values (5.60 ± 0.09 mEq/kg) and free fatty

acids (3.40 ± 0.03%) in dabai pulp oleoresin shows that it is of good quality and can be used for more than just food.

2.3. Antimicrobial Properties

The antimicrobial properties of dabai fruit have been extensively researched. For instance, Basri et al. [17] found that *Candida glabrata* was susceptible to the dabai pulp extract. Next, Basri et al. [18] experimented with dabai seed and showed promising antibacterial activity against infections associated with *Acinetobacter baumannii* and *Proteus mirabilis*. The findings suggest that dabai fruit could be a valuable source of an alternative phytotherapeutic agent with antimicrobial potential. In another study, Basri et al. [19] found antimicrobial effects of stem bark extracts from dabai in methanol, acetone, and distilled water against *Staphylococcus aureus* ATCC 25923, *Bacillus cereus* ATCC 6633, *Escherichia coli* ATCC 25932, *Pseudomonas aeruginosa* ATCC 27853, *Acinetobacter baumannii* strain sensitive, *Candida albicans* ATCC 64677, *Candida glabrata* ATCC 90028, *Aspergillus niger*, and *Fusarium solani* M2781. They discovered that an extract of the stem bark of the dabai tree, when processed with methanol and acetone, had a bactericidal effect against *Staphylococcus aureus* and a bacteriostatic effect against *Acinetobacter baumannii*.

Research into dabai leaves has been started and found to have significant potential in the future pharmaceutical and nutritional food-based industries [20][27]. The potential of leaf extracts of dabai as an antimalarial agent has been extensively investigated by Ishak et al. [21]. This study found that dabai leaf extract in methanol may inhibit plasmodium at 5% parasitemia at different morphological stages, such as young trophozoite, mature trophozoite, and schizont. This study indicated that the leaf extract of dabai can be further developed into an antimalarial drug. A seminal study in this area is the work of Shamsuddin et al. [20]. They revealed that combining dabai leaf extract with acetone could provide insight into the antimicrobial mechanism, potentially leading to the identification of a target protein for future novel therapeutic development against methicillin-resistant *Staphylococcus aureus* infections.

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