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Nutritional Composition and Physicochemical Properties of Different Parts of Powdered Immature Japanese Muskmelon

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ABSTRACT

The "One-fruit per plant" cultivation system of Japanese muskmelon generates waste. To address this issue, the present study evaluated the nutritional and physicochemical properties of powdered immature Japanese muskmelon (*Cucumis melo* var. Casanova), focusing on pulp, peel, and seeds. The fruit parts were separated and processed into fine powders. Proximate and physicochemical analyses were conducted. The results showed significant differences (P<0.05) among fruit parts. The pulp recorded the highest moisture content, total soluble solid, and total titratable acidity. The peel displayed the highest ash content, and water activity, with marked greenness and yellowness attributed to chlorophyll and carotenoids but showing the lowest lightness value. Seeds demonstrated the highest crude protein, crude fat, crude fiber, available carbohydrate, caloric value, and pH. These findings highlight the potential valorisation of immature Japanese muskmelons into functional ingredients, providing a sustainable strategy to reduce food loss in muskmelon production.

Keywords: Food waste valorisation, functional ingredients, Japanese muskmelon, physicochemical properties, proximate composition

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INTRODUCTION

Japanese muskmelons (*Cucumis melo* L.) are cultivated in Malaysia as premium fruits, with the Casanova variety grown under greenhouse conditions at Melon Manis

Terengganu Farm, Besut, Terengganu. In muskmelons cultivation, farmers meticulously select only one well-developed fruit each plant to reduce competition for nutrients. Consequently, approximately 45% by weight of immature muskmelons are discarded, causing a signigicant amount of waste. With increasing concerns about sustainability, food security, and reducing waste, it is important to investigate strategies to use these leftover fruits and reduce losses after harvest. Previous studies show that fruit wastes such as mango, banana, citrus, apple, and pineapple residues are abundant in pigments, phytochemicals, antioxidants, dietary fibre, vitamins, and minerals, offering value-added potential (Ong et al., 2022; Shahidan et al., 2022). Immature Japanese muskmelon, particularly the Casanova variety, may exhibit distinct nutritional values and physicochemical properties across different parts such as pulp, peel, and seeds, compared to other muskmelon cultivars. However, there is currently no published information on these aspects. Therefore, this study evaluates the nutritional composition and physicochemical properties of pulp, peel, and seed of Japanese muskmelons cultivated in Malaysia.

MATERIALS AND METHODS

Preparation of Samples

Immature Japanese muskmelons (*Cucumis melon* var. Casanova) were washed, separated into pulp, peel, and seeds, and treated with sodium metabisulphite seeds underwent mucilage extraction with hydrochloric acid. All parts were then dried at 50ºC for 24 h, ground and sieved for further analysis.

Proximate and Physicochemical Analyses

Proximate analyses were conducted according to Association of Official Agricultural Chemists (AOAC) method. Colour was measured using a Hunter Lab colour meter, total soluble solids with a digital refractometer, pH with a calibrated pH meter, and water activity with a dew point hygrometer. Total titratable acidity was determined by titration method.

RESULTS AND DISCUSSION

Proximate Composition

The proximate composition of immature Japanese muskmelon revealed seeds as the most nutrient-dense part (Table 1). Seed moisture was higher than *Cucumis melon* seeds (Saeed et al., 2023) but comparable to Melon Manis Terengganu (Shahidan et al., 2022). Peel ash exceeded pulp and seeds. Seeds contained notable crude protein though lower than *C. melo* seeds (Saeed et al., 2022), and had the highest crude fat, consistent with reports of melon seeds being oil-rich (Mallek-Ayadi et al., 2018), suggesting their suitability for oil extraction. The seeds also had highest levels of crude fibre, available carbohydrate and

caloric value, aligning with earlier findings for *C. melo* and *C. lanatus* seeds (Saeed et al., 2023). These characteristics further enhance their potential for inclusion in dietary fibre-enriched products such as bakery items, pre-mixed beverages, and energy bars.

Table 1
*Proximate composition of Japanese muskmelon (*Cucumis melon *var. Casanova)*

Proximate Composition	Pulp	Peel	Seed
Moisture	16.24 ± 0.02 ^{c}	8.47 ± 0.15 ^{b}	5.51 ± 0.09 ^{a}
Ash	9.58 ± 0.38 ^{b}	10.14 ± 0.30 ^{b}	3.75 ± 0.46 ^{a}
Crude protein	13.31 ± 0.43 ^{a}	15.61 ± 0.07 ^{b}	16.84 ± 0.56 ^{c}
Crude fat	0.56 ± 0.12 ^{a}	3.98 ± 0.27 ^{b}	8.70 ± 0.83 ^{c}
Crude fibre	10.32 ± 1.39 ^{a}	28.98 ± 0.97 ^{b}	48.33 ± 1.07 ^{c}
Available carbohydrates	60.31 ± 0.32 ^{a}	61.78 ± 0.42 ^{a}	65.20 ± 1.21 ^{b}
Calorie value	299.55 ± 2.05 ^{a}	345.47 ± 0.83 ^{b}	406.48 ± 4.74 ^{c}

Data are presented as mean ± SD (n=3). Different superscripts within the same row indicate significant differences (P<0.05)

Physicochemical Properties

The physicochemical attributes of immature Japanese muskmelon showed significant differences among pulp, peel, and seeds (Table 2). Seeds recorded the highest L*, followed by pulp and peel. The peel exhibited strong greenness and yellowness due to chlorophylls and carotenoids (Ong et al., 2022), suggesting its potential use as a natural food colourant. All parts showed positive b* values, indicating yellow tones linked to carotenoid pigments in melon tissues (Fundo et al., 2018). Pulp contained the highest TSS. Seed pH closely resembling cantaloupe seed values (Fundo et al., 2018). Water activity for all parts was below the growth threshold for pathogenic bacteria (Ong et al., 2022). Total titratable acidity was greatest in the pulp, consistent with its stronger organic acid content (Fundo et al., 2018).

Table 2
*Physicochemical properties of Japanese muskmelon (*Cucumis melon *var. Casanova)*

Parameter	Pulp	Peel	Seed
L*	80.53 ± 0.68 ^{b}	60.92 ± 1.00 ^{a}	85.76 ± 0.29 ^{c}
a*	-5.37 ± 0.04 ^{b}	-12.57 ± 0.12 ^{a}	0.80 ± 0.01 ^{c}
b*	21.59 ± 0.19 ^{a}	25.29 ± 0.43 ^{b}	24.53 ± 0.09 ^{a}
Total Soluble Solid (^{o} Brix)	2.16 ± 0.00 ^{b}	1.19 ± 0.00 ^{a}	1.19 ± 0.00 ^{a}
pH	5.97 ± 0.02 ^{a}	6.25 ± 0.01 ^{b}	6.39 ± 0.02 ^{c}
Water Activity	0.47 ± 0.00 ^{b}	0.53 ± 0.00 ^{c}	0.42 ± 0.01 ^{a}
Total titratable acidity (%)	0.08 ± 0.02 ^{b}	0.03 ± 0.01 ^{a}	0.03 ± 0.01 ^{a}

Data are presented as mean ± SD (n=3). Different superscripts within the same row indicate significant differences (p<0.05)

CONCLUSION

Immature Japanese muskmelon seeds were nutrients-rich, the peels were the darkest in colour, and the pulp had highest in TSS and acidity. All parts demonstrate potential for sustainable application in food products such as bakery product, noodle, and functional beverages.

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