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**PHYSICOCHEMICAL PROPERTIES OF THE SEEDS AND
PEELS FROM *Spondias dulcis* AND *Manilkara zapota***

By

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A dissertation submitted in partial fulfillment of the requirements for the degree of

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DECLARATION BY AUTHOR

This dissertation is composed of my original work and contains no material previously published or written by another person except where due reference has been made in the text. The content of my dissertation is the result of work I have carried out since the commencement of my research project and does not include a substantial part of work that has been submitted to qualify for the award of any other degree or diploma in any university or other tertiary institution.

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LIST OF ABBREVIATIONS

°C	Degree Celcius
°Brix	Degree Brix
µL	Microliter
a*	Red/green coordinate
AAS	Atomic absorption spectroscopy
AES	Atomic emission spectroscopy
ANOVA	Analysis of variance
AOAC	Association of Official Analytical Chemist
ATP	Adenosine triphosphate
b*	Yellow/blue coordinate
cm	Centimeter
dm ⁻³	Decimeter
FAO	Food Agricultural Organization
g	Gram
GAE	Gallic Acid Equivalent
H	Hydrogen
kcal	Kilocalorie
kJ	Kilojoule
L*	Lightness
m	Meter
mg	Milligram
min	Minute
mL	Mililiter

M	Molar
nm	Nanometer
N	Normal
OH	Hydroxyl group
ppm	Part per million
TPC	Total phenolic content
USDA	United States Department of Agriculture

ABSTRAK

Kulit dan biji buah-buahan akan dibuang, dan mengakibatkan pencemaran alam sekitar dan menyebabkan kehilangan biojisim dan nutrien yang bernilai. Oleh itu, kajian ini bertujuan untuk menilai komposisi pemakanan dan fitokimia dan sifat-sifat fizikal kulit dan biji buah ambra dan ciku. Kulit dan biji buah-buahan segar dipisahkan dan dianalisis. Hasil kajian menunjukkan kulit buah ambra mempunyai jumlah kelembapan tertinggi (69.85 ± 0.97) dan biji ciku mempunyai nilai kelembapan terendah diantara semua sampel. Kandungan abu tertinggi terdapat di dalam biji ciku 5.64 ± 0.10 , manakala jumlah yang paling sedikit terdapat di dalam kulit ciku (2.84 ± 0.03). Kandungan protein kasar tertinggi diperhatikan pada biji ciku (8.87 ± 0.04) sedangkan jumlah paling sedikit diperhatikan pada kulit ambarella (3.16 ± 0.03). Seterusnya, kandungan lemak kasar tertinggi terdapat pada produk sampingan ciku, dengan nilai mencecah 15.87 ± 0.18 pada biji dan 6.07 ± 0.02 pada kulitnya. Selain itu, kandungan serat kasar tertinggi dicatatkan pada biji ambra (25.76 ± 0.73), sedangkan jumlah yang terendah dicatatkan pada kulit ambra (11.10 ± 0.88). Di antara keempat-empat sampel, biji ciku menghasilkan jumlah kalsium tertinggi (35.18 ± 0.87) mg/100g, kalium (381.58 ± 0.58) mg/100g dan magnesium (1.97 ± 0.00) mg/100g manakala kulit ciku menghasilkan jumlah natrium tertinggi (5.22 ± 0.32) mg/100g. Kehadiran hidrogen sianida, faitat, alkaloid, dan oksalat di antara empat sampel dikesan berada di dalam had yang selamat. Jumlah kandungan fenolik dari empat sampel berada di dalam julat antara 132.72 ± 0.34 hingga 985.93 ± 0.10 mg GAE/100g. Kulit ambra menunjukkan nilai keasidan tertinggi (2.55 ± 0.01) sementara itu biji ciku pula diperhatikan mempunyai nilai keasidan terendah (6.19 ± 0.03). Nilai keasidan titrat yang paling tinggi dicatatkan pada kulit ambra (5.19 ± 0.23), manakala yang paling rendah dijumpai pada biji ciku (0.40 ± 0.05). Jumlah pepejal larut diperhatikan paling

tinggi di dalam kulit ciku (5.80 ± 0.00) °Brix sedangkan jumlah terendah dicatatkan pada kulit ambra (2.67 ± 0.12) °Brix. Biji ambarella dan sapodilla menunjukkan nilai L^* yang tinggi (masing-masing 74.41 dan 75.28) berbanding kulit masing-masing. Jumlah kemerahan (a^*) meningkat dari biji sapodilla, kulit ambarella dan biji ambarella ke kulit sapodilla (2.05, 3.69, 6.24 dan 8.94). Tahap kekuningan (b^*) meningkat dari biji sapodilla, kulit ambarella dan biji ambarella ke kulit sapodilla (18.42, 24.56, 25.18 dan 26.61). Kulit dan biji buah-buahan mengandung pelbagai bahan yang dapat membantu meningkatkan kesehatan yang dapat digunakan sebagai bahan makanan dalam merumuskan beberapa produk makanan yang sehat.

ABSTRACT

Fruit peels and seeds were discarded as waste, which could lead to pollution problems and represents loss of valuable biomass and nutrients. Thus, this study aims to evaluate the nutritional and phytochemical composition and physical properties of ambarella and sapodilla peels and seeds. The peels and seeds of both fresh fruits were separated and analysed. The highest moisture content was observed in ambarella peels (69.85 ± 0.97) and sapodilla seeds had the lowest moisture content amongst all samples. The maximum ash content in sapodilla seeds was 5.64 ± 0.10 , whereas the least amount was observed in sapodilla peels (2.84 ± 0.03). The maximum crude protein content was observed in sapodilla seeds (8.87 ± 0.04) whereas the minimum amount was noted in ambarella peels (3.16 ± 0.03). Furthermore, the highest crude fat contents were found in sapodilla fruit by-products, with values reaching 15.87 ± 0.18 in seeds and 6.07 ± 0.02 in peels. Moreover, the highest crude fibre content was recorded in ambarella seeds (25.76 ± 0.73), whereas the lowest amount was noted in ambarella peels (11.10 ± 0.88). Amongst the four samples, sapodilla seed produced the highest amount of calcium (35.18 ± 0.87) mg/100g, potassium (381.58 ± 0.58) mg/100g and magnesium (1.97 ± 0.00) mg/100g while sapodilla peel contribute the highest amount of sodium (5.22 ± 0.32) mg/100g. The presence of hydrogen cyanide, phytates, alkaloids and oxalates amongst four sample was detected within the safety limit. The total phenolic contents of four samples ranged from 132.72 ± 0.34 to 985.93 ± 0.10 mg GAE/100g. Ambarella peels showed to have the highest acidity (2.55 ± 0.01) while sapodilla seeds was observed to have the lowest acidity (6.19 ± 0.03). The highest titratable acidity was noted in ambarella peels (5.19 ± 0.23), whereas the lowest was found in sapodilla seeds (0.40 ± 0.05). Total soluble solid was observed to be the highest in sapodilla peels (5.80 ± 0.00) °Brix whereas the lowest amount was noted in ambarella peels (2.67 ± 0.12)