

Morphological, Structural, and Physicochemical Characterization of Starch Extracted from Madu (*Cycas* sp.) Grown in Sri Lanka

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Cycas sp. is an underutilized carbohydrate source in Sri Lanka that holds significant potential for integration into the human diet. Starch obtained from *Cycas* could serve as a viable alternative to commonly used starch sources in food applications. This study focused on characterising *Cycas* starch, evaluating its structural, physicochemical, and morphological properties to understand its functionality and potential uses. The proximate composition revealed low crude protein ($0.70 \pm 0.02\%$), crude fat ($0.27 \pm 0.06\%$), and ash ($0.23 \pm 0.01\%$), indicating higher purity in extracted starch. The moisture content was $8.23 \pm 0.54\%$, which is within the acceptable range for starch stability and storage. Microscopic examination showed predominantly spherical shaped granules, with diameters ranging from 0.68 to 1.72 μm . FTIR spectral analysis confirmed the typical carbohydrate nature of the starch, with characteristic absorption bands consistent with those of standard starches. XRD pattern revealed that *Cycas* starch was a type-A with relative crystallinity of 27.92%. The amylose content was found to be $15.89 \pm 2.62\%$, suggesting a lower amylose level while the bulk density and pH were recorded as 0.56 ± 0.00 g/ml and 7.28 ± 0.06 , respectively. Colour measurements showed L^* , a^* , and b^* values of 97.51 ± 0.41 , -0.42 ± 0.13 , and 0.57 ± 0.12 , with the notably high L^* value indicating a higher level of whiteness. Water-holding and oil-holding capacities were 1.39 ± 0.09 g/g and 1.15 ± 0.18 g/g, respectively. Solubility and swelling power both increased with temperature, reaching their maximum values at 80 °C, demonstrating typical thermal behaviour of starch. The study shows that the underutilized starch from *Cycas* sp., exhibit physicochemical and functional properties suitable for food industry applications, and holds potential for use in various food formulations.

Keywords: *Cycas* sp., Microscopy, Physicochemical properties, Starch, Underutilized crop