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Physicochemical properties of microwave heated sago (Metroxylon sagu) starch

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ABSTRACT

Sago starch is an underutilized starch due to its low functionality in food formulation. Modification is effective in improving starch functional properties. In this study, the starch were modified to enhance its functional properties. The starch was microwave-heated with different treatment durations of 5, 10, 15, or 20 min, separately, yielding microwave-heated starches (MHT1, MHT2, MHT3, and MHT4). The modified starches have irregular shaped granules and fissures while maintaining their mean diameters. The degree of double helix had increased, indicating more double helix structure of amylose formed. The modified starches' moisture content, solubility, and paste clarity were significantly decreased. The MHT4 had its swelling power and syneresis increase. In conclusion, the treatment duration influenced the physicochemical properties of the sago starch, which is related to the formation of amylose double helix structure. Further study should focus on the formation of double helix structure in starch and its impact towards food structure.

KEYWORDS
amylose; FTIR; irradiation; oil binding; water binding; microwave

PALABRAS CLAVE
amilosa; FTIR; irradiación; unión al aceite; unión al agua; microondas

RESUMEN

El almidón de sagú es infrautilizado debido asu baja funcionalidad para la formulación de alimentos. Su modificación puede resultar eficaz para mejorar sus propiedades funcionales. El presente estudio modificó el almidón para lograr este objetivo. Para ello, el almidón fue calentado por microondas, realizándose tratamientos de diferentes duraciones, 5, 10, 15 o20 minutos, por separado, lo que dio lugar aalmidones calentados por microondas (MHT1, MHT2, MHT3 yMHT4). Los almidones modificados de esta manera presentaron gránulos yfisuras de forma irregular, manteniendo sus diámetros medios. Se constató que aumentó el grado de doble hélice, lo que indica que se formó una estructura adicional de doble hélice de la amilosa. Por otra parte, el grado de humedad, la solubilidad yla claridad de la pasta de los almidones modificados disminuyeron significativamente. El MHT4 incrementó su poder de hinchamiento ysu sinéresis. En conclusión, se comprobó que la duración del tratamiento incidió en las propiedades fisicoquímicas del almidón de sagú relacionadas con la formación de la estructura de doble hélice de la amilosa. Estudios adicionales deberían centrarse en la formación de la estructura de doble hélice en el almidón yen determinar su efecto en la estructura de los alimentos.

Introduction

Sago starch is extracted from the pith of a palm plant, *Metroxylon sagu*. It is mainly produced and exported from Southeast Asia, especially Malaysia. Malaysia exports about 44,000 tonnes of sago starch yearly to many countries including Japan and Europe (Othman et al., 2015). Sago starch is considered underutilized when compared to starch from other sources, such as potato, corn, and rice. Studies have been conducted to improve the physicochemical properties of sago starch. Like other starches such as corn starch, modification of sago starch is essential to improve its properties and increase its usability. Various modification techniques, such as hydrolyzed-hydroxypropylation, octenyl succinic anhydride (OSA), alkaline, heat moisture, and gamma-irradiation treatments have been applied to sago starch (Abiddin et al., 2018; Oladzadabbasabadi et al., 2017; Othman et al., 2015; Ying et al., 2020). There are three main types of modification techniques, namely, physical, chemical, and enzymatic treatments. Examples of commonly used physical treatment are the Heat Moisture Treatment (HMT) and heating-cooling cycles (Alimi & Workneh, 2018; C Zhang et al., 2018). Meanwhile, the chemical treatment of starches has been conducted using various chemicals which mainly forms crosslinking and/or substitutions. Commonly used chemicals are octenyl succinic anhydride (OSA), phosphoryl chloride, and acetic anhydride (Singh & Nath, 2012; Xiao et al., 2018). Additionally, some other chemicals or compounds are also introduced in treatment of starches such as citric acid, lactic acid, ascorbic acid, amino acid, and pectin (Shaikh et al., 2019; Galvão et al., 2018; JI, 2018; B Zhang et al., 2018). The enzymatic treatment on the other hand utilizes amylase, amylosucrase, pullulanase, and many more (Huang et al., 2016; Lee et al., 2018). Other modification techniques utilize a combination of these three techniques to improve starch properties for example, HMT-amino acid treatment and OSA-pullulanase treatment (JI & Yu, 2018; Chang et al., 2019).

Factors considered in choosing a suitable technique for starch treatment include safety issues, characteristics of products, and cost for the modification. Physical treatment is favoured over chemical treatment due to food safety

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