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Physicochemical drivers of resistant starch and comparative suitability of East African Highland cooking banana cultivars (*Musa acuminate, AAA*) for food industry applications

Stellamaris Kembabazi[a,b], Florence Muranga[c], Martin Mutambuka[a], Ediriisa Mugampoza[a] and Norhasnida Zawawi[d]

[a]Department of Food Science and Technology, Kyambogo University, Kampala, Uganda; [b]Department of Biochemistry, School of Health Sciences, Soroti University, Soroti, Uganda; [c]Banana Industrial Research and Development Centre, BIRDC, Bushenyi, Uganda; [d]Laboratory of Halal Science Research, Halal Products Research Institute, Universiti Putra Malaysia, UPM, Serdang, Selangor, Malaysia

ABSTRACT

East African Highland Cooking Bananas (EAHCB), constituting 70% of Uganda's banana production, represent an abundant and sustainable starch source for the food industry. However, their low amylose content (13–14%) contradicts the high resistant starch (RS) content (57–68%). This study evaluates four cultivars *Mpologoma, Bukumu, Mbwazirume*, and *Enyeru* for physicochemical and structural properties, and *in vitro* digestibility with respect to industrial suitability. Starch yields varied (10–20%), with *Bukumu* highest and *Mpologoma* lowest, influenced by pulp moisture and A-genome prevalence. Granule sizes ranged 12.9–21.8 µm, exhibiting B-type crystallinity. Despite low amylose, *Enyeru* showed highest RS (68%), low rapidly digestible starch, and optimal pasting temperatures (75–83 °C), revealing crystalline structure, amylopectin chain length distribution, and granule morphology as primary digestibility influencers. These properties position EAHCB starches as potential thickeners, low-GI functional ingredients, and RS sources matching modified corn/cassava starches. *Enyeru* emerges as the best cultivar for functional food applications like food for diabetic patients. These findings call for targeted breeding for enhanced RS/crystallinity and *in vivo* validation.

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1. Introduction

Grains and tubers (cassava, wheat, rice, sweet potato, corn and potato) have been recognised as the conventional starch sources (Kembabazi et al., 2025); however, banana has shown potential as an alternative source of starch due to its abundance in the tropics but also potential health benefits (Marta et al., 2019). Cooking bananas are a major staple food in Uganda, accounting for 70% of banana production, providing up to 30% of daily caloric intake, and serving as a key income source that generates approximately US$1,244 annually for over 4 million smallholder households across East Africa (Marimo et al., 2020; Kikulwe & Asindu, 2020; Mulugo et al., 2022).

To utilise the physiological properties of banana starch, particularly its high resistant starch (RS) content, the food industry has increasingly developed functional foods incorporating this starch (Marta et al., 2022). East African Highland cooking bananas exhibit high RS content (above 70%), positioning them as a promising starch source for food applications (Chang et al., 2022).

Resistant starch has been shown to offer numerous health benefits, primarily through fermentation in the colon, producing short-chain fatty acids (SCFAs) like acetate, butyrate and propionate, which contribute to improved gut barrier function, immune regulation, and reduced inflammation (Zhang et al., 2022). These effects are significant in managing metabolic disorders such as obesity, type 2 diabetes, and insulin resistance, as SCFAs influence energy metabolism, glucose homeostasis, and lipid metabolism, thereby

CONTACT Stellamaris Kembabazi kembabazi.stellamaris@kiu.ac.ug Department of Food Science and Technology, Kyambogo University, P.O. Box 1, Kyambogo, Kampala, Uganda