

PROFILING STARCH PROPERTIES AND THEIR GENETIC MARKERS IN SELECTED EAST AFRICAN HIGHLAND COOKING BANANAS

ABSTRACT

The East African Highland Cooking bananas (EAHCBs), a staple food and a key source of carbohydrates for millions in the Great Lakes region, are primarily consumed as cooked products. Despite their nutritional and economic significance, limited scientific attention has been given to understanding the diversity of starch properties in these cultivars and their underlying genetic basis. This study aimed to profile the starch physicochemical characteristics and identify associated genetic markers in selected EAHB cultivars to support value-added utilization of this banana and its targeted breeding for commercial industrial applications. A total of 11 banana cultivar starches were analyzed for starch content, amylose-to-amylopectin ratio, granule morphology, solubility indices and swelling power, pasting properties and molecular structure and chemical composition using standard biochemical and AOAC analysis techniques. Concurrently, molecular profiling was conducted using real time PCR for differential expression levels and Sanger sequencing to identify genetic markers linked to observed starch traits. Results revealed significant variability in the physicochemical and functional characteristics among the cultivars in key starch parameters, with certain varieties showing traits desirable for industrial or nutritional applications when compared to common commercial starches (native and modified). Marker-trait association studies identified specific gene potentially controlling starch quality attributes. PLSR analysis revealed that GBSS1, MaSSIII-1, and SDE each play distinct but complementary roles in regulating starch properties in East African Highland Cooking Bananas (EAHCB). It further pinpointed specific starch biosynthesis genes that influence specific starch parameters. GBSS1 strongly influences viscosity traits such as pasting temperature. MaSSIII-1 affects starch yield, content, particle size, and mechanical strength through its role in amylopectin branching. SDE moderately affects swelling, solubility, and amylose balance, helping fine-tune granule structure. Together, these genes highlight multi-gene control useful for targeted breeding in starch-quality improvement. These findings provide foundational knowledge for the development of improved EAHCB cultivars tailored for both food and non-food applications through marker-assisted selection. The study contributes to bridging the gap between traditional crop use and modern genetic improvement approaches, enhancing the value chain of cooking bananas in the region.

Future work should validate the identified markers in larger populations and explore their role in starch biosynthesis pathways.