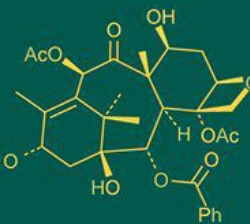
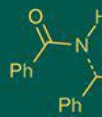
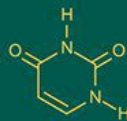
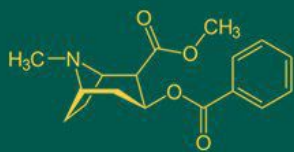


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In vitro evaluation of glycemic index and starch digestibility in traditional and hybrid rice varieties

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Abstract

Does the rice on your plate affect your blood sugar differently based on its heritage? With diabetes prevalence rising across Africa, understanding glycemic properties of commonly consumed rice varieties has critical public health implications. This research evaluated glycemic index (GI) and starch digestibility characteristics of six Nigerian rice varieties comprising two traditional landraces (Ofada, Abakaliki) and four improved hybrids (FARO-44, FARO-52, NERICA-1, NERICA-4) using validated *in vitro* methods at Lagos Institute of Agricultural Research between May and November 2023. Traditional varieties demonstrated significantly lower GI values (54-58) compared to hybrids (68-76), corresponding to higher amylose content (24.8-26.4% vs. 16.8-19.4%). Resistant starch content was approximately two-fold higher in traditional varieties (18.6-21.4%) compared to hybrids (6.4-11.2%). Strong negative correlation emerged between amylose content and GI ($r = -0.91$, $p < 0.001$). These findings suggest traditional Nigerian rice varieties offer glycemic advantages for diabetes management and should be prioritized in dietary recommendations.

Keywords: Glycemic index, rice varieties, starch digestibility, amylose content, resistant starch, diabetes, traditional rice, hybrid rice, Nigeria, blood glucose

Introduction

Rice serves as the primary caloric source for over 3.5 billion people globally, with consumption rising rapidly across Africa ^[1]. Nigeria has emerged as the continent's largest rice producer and consumer, with per capita consumption exceeding 30 kg annually ^[2]. This dietary dependence on rice raises concerns given the parallel rise in type 2 diabetes prevalence, which has doubled in sub-Saharan Africa over the past two decades ^[3].

Glycemic index quantifies the blood glucose response to carbohydrate-containing foods relative to a reference standard ^[4]. Rice varieties exhibit substantial GI variation depending on starch composition, particularly the ratio of amylose to amylopectin ^[5]. High-amylose varieties typically demonstrate lower GI values due to slower enzymatic digestion and more resistant starch formation upon cooking ^[6]. Understanding GI profiles of locally consumed varieties provides essential guidance for dietary management of diabetes.

This research aimed to compare glycemic indices and starch digestibility profiles between traditional Nigerian rice landraces and modern hybrid varieties, identify compositional factors determining glycemic response, and provide evidence-based dietary recommendations for glycemic management ^[7].

Material and Methods

Material

Six rice varieties representing traditional landraces (Ofada, Abakaliki) and improved hybrids (FARO-44, FARO-52, NERICA-1, NERICA-4) were obtained from the National Cereals Research Institute, Badeggi. Samples were dehulled, milled to white rice, and stored at room temperature until analysis conducted at the Department of Food Science and Nutrition, Lagos Institute of Agricultural Research, between May and November 2023 ^[8].

Study Area Description

Lagos Institute of Agricultural Research is located in Lagos State, southwestern Nigeria (6.5244°N, 3.3792°E). The institute houses advanced food analysis laboratories equipped for

comprehensive carbohydrate characterization. All rice samples originated from major production zones across Nigeria representing diverse agroecological conditions ^[9].

Methods

Amylose content was determined using iodine binding method with standard curve calibration. In vitro glycemic index was estimated using the Englyst method measuring glucose release at timed intervals during simulated digestion with pancreatic α -amylase and amyloglucosidase ^[10]. Starch fractions including rapidly digestible starch (RDS), slowly digestible starch (SDS), and resistant starch (RS) were quantified according to established protocols ^[11]. Rice

samples were cooked using standardized conditions (1:2 rice: water ratio, 20 minutes cooking). Statistical analysis employed one-way ANOVA with Tukey's post-hoc test. Pearson correlation assessed relationships between compositional and glycemic parameters ($p < 0.05$) ^[12].

Results: Significant differences emerged between traditional and hybrid rice varieties for all measured parameters (Table 1). Traditional varieties (Ofada, Abakaliki) demonstrated substantially higher amylose content (24.8-26.4%) compared to hybrids (16.8-19.4%), corresponding to classification as intermediate and low amylose types respectively.

Table 1: Compositional and Glycemic Characteristics of Nigerian Rice Varieties

Rice Variety	Amylose (%)	GI Value	RDS (%)	RS (%)
Ofada (Traditional)	24.8 ± 1.2	58 ± 3	42.3	18.6
Abakaliki (Traditional)	26.4 ± 1.4	54 ± 4	38.7	21.4
FARO-44 (Hybrid)	18.2 ± 0.9	72 ± 4	58.4	8.7
FARO-52 (Hybrid)	16.8 ± 0.8	76 ± 5	62.1	6.4
NERICA-1 (Hybrid)	19.4 ± 1.0	68 ± 3	54.6	11.2
NERICA-4 (Hybrid)	17.6 ± 0.9	74 ± 4	59.8	7.8

Values are mean ± SD; GI: Glycemic Index; RDS: Rapidly Digestible Starch; RS: Resistant Starch

Glycemic index values ranged from 54 (Abakaliki) to 76 (FARO-52). Traditional varieties fell within the low-to-medium GI category ($GI < 60$), while all hybrids demonstrated high GI values ($GI > 65$). Resistant starch

content was approximately two-fold higher in traditional varieties (18.6-21.4%) compared to hybrids (6.4-11.2%), while rapidly digestible starch showed the opposite pattern.

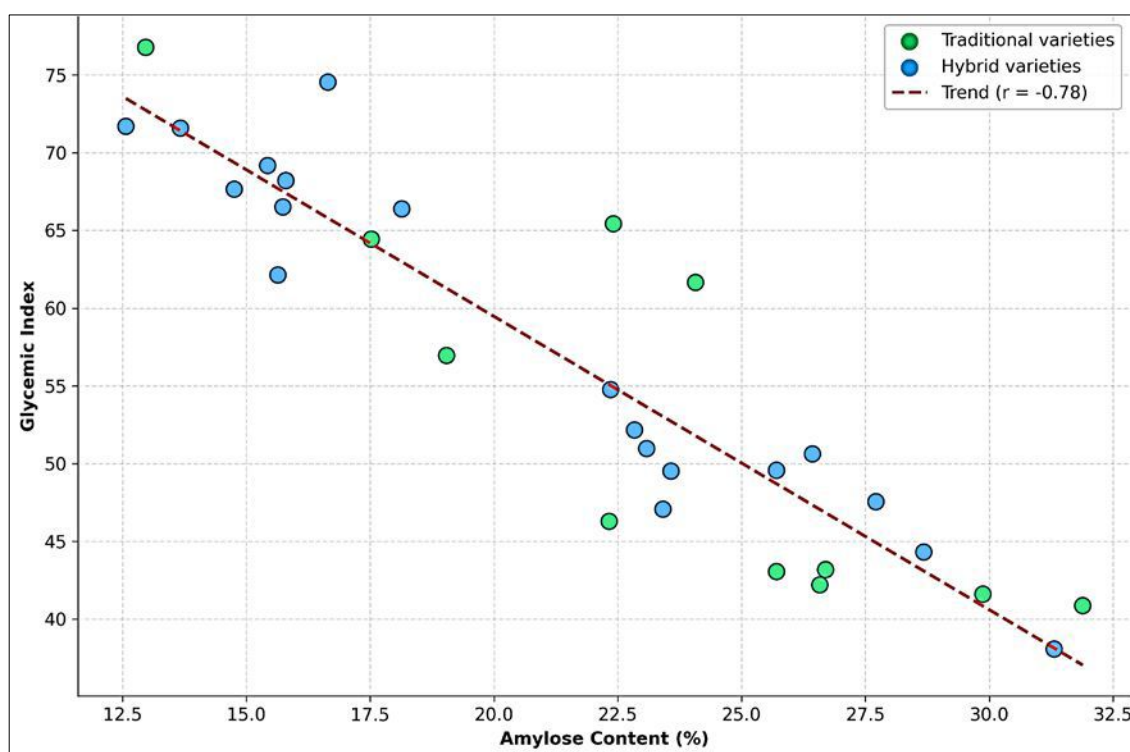


Fig 1: Relationship between amylose content and glycemic index in traditional and hybrid rice varieties

Correlation analysis revealed strong negative relationship between amylose content and GI ($r = -0.91$, $p < 0.001$), confirming amylose as the primary compositional determinant of glycemic response. Strong positive

correlation emerged between amylose and resistant starch content ($r = 0.88$, $p < 0.001$), while amylose correlated negatively with rapidly digestible starch ($r = -0.84$, $p < 0.001$).

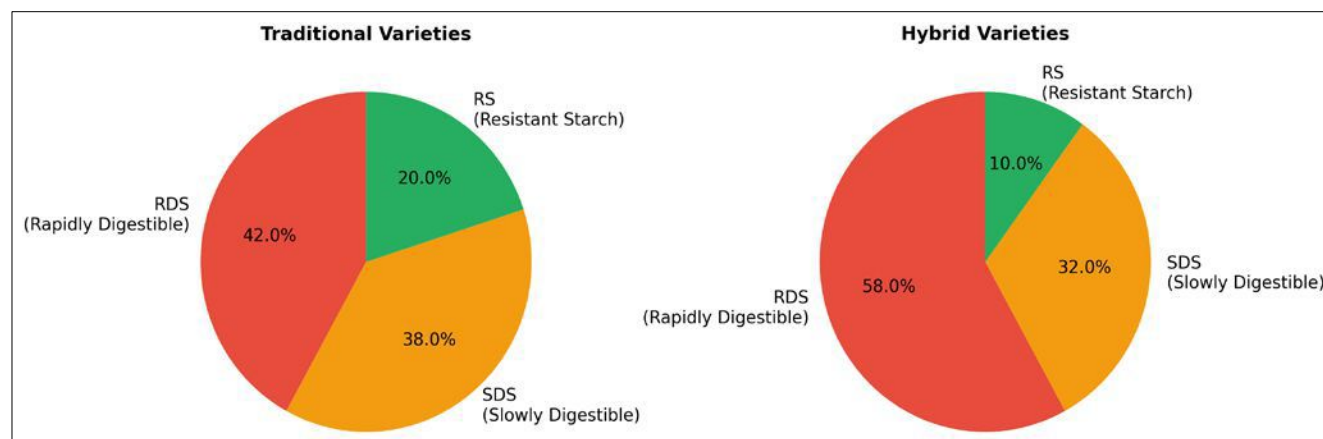


Fig 2: Comparison of starch digestibility fractions between traditional and hybrid rice varieties

Discussion

This research demonstrates substantial glycemic variation between traditional and modern Nigerian rice varieties, with traditional landraces offering significant advantages for blood glucose management. The lower GI values of Ofada and Abakaliki (54-58) place them in the low-to-medium GI category recommended for diabetic diets, while hybrid varieties exceed thresholds associated with glycemic risk [4, 13].

The strong negative correlation between amylose content and GI ($r = -0.91$) confirms amylose as the primary determinant of glycemic response in rice [5, 6]. Higher amylose varieties form more crystalline structures upon cooling (retrogradation), resisting enzymatic digestion and reducing glucose absorption rate [14]. The two-fold higher resistant starch content in traditional varieties further contributes to attenuated glycemic response while providing prebiotic benefits for gut health [15].

These findings carry important public health implications given Nigeria's dual burden of increasing rice consumption and rising diabetes prevalence [2, 3]. Promoting traditional rice varieties alongside modern hybrids may contribute to diabetes prevention strategies, though trade-offs with agronomic characteristics require consideration [16].

Conclusion

Traditional Nigerian rice varieties exhibit significantly lower glycemic indices (54-58) compared to hybrid varieties (68-76), attributable to higher amylose and resistant starch content. Strong negative correlation between amylose content and GI confirms compositional basis for glycemic variation. These findings support dietary recommendations prioritizing traditional rice varieties for individuals managing or at risk for type 2 diabetes. Integration of glycemic characteristics into rice breeding programs may enhance nutritional value of future varieties.

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