

REVIEWER'S REPORT

Manuscript No.: IJAR-55176

Title: BIOCHEMICAL AND SENSORY CHARACTERIZATIONS OF COCOA BEANS FROM SIX HYBRID FAMILIES UNDER SELECTION IN COTE D'IVOIRE

Recommendation:

Accept as it is

Rating	Excel.	Good	Fair	Poor
Originality		√		
Techn. Quality		√		
Clarity			√	
Significance		√		

Reviewer Name: Dr. Manju M

Date: 11-12-2025

Detailed Reviewer's Report

Multidimensional Study Objective

The research provides a combined biochemical and sensory assessment of cocoa beans from six CNRA hybrid families to characterize their quality potential.

Justification Rooted in Production Challenges

The study addresses issues in Ivorian cocoa production such as declining plantation productivity, disease pressures, and quality deterioration, reaffirming the need for improved hybrids.

Economic Centrality of Cocoa in Côte d'Ivoire

Cocoa remains a major contributor to national GDP and global supply, making hybrid improvement crucial for sustaining economic competitiveness.

Strategic Selection of Hybrid Genotypes

Six hybrid families (F3, F8, F15, F23, F26, F27) were chosen to represent genetic diversity and evaluate performance variability.

Environment and Terroir Influence

The research station in Divo, with humid forest climate, acidic soils, and bimodal rainfall, provides environmental conditions that shape bean biochemical traits.

Standardized Sampling and Sample Integrity

Beans were hand-sorted, cleaned, and ground into homogeneous powder to ensure analytical reliability and comparability across hybrids.

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Analytical Rigor in pH Profiling

pH values were determined using homogenized aqueous suspensions, enabling accurate evaluation of fermentation quality across genotypes.

Comprehensive Biochemical Analyses

Lipids, proteins, ashes, fibers, and phenolics were quantified using validated methods (Soxhlet, Kjeldahl, enzymatic digestion, Folin–Ciocalteu), ensuring robust compositional profiling.

Marked Inter-Hybrid Chemical Variability

Substantial genetic differences were observed: lipids (46–61%), proteins (11–14%), fibers (14–18%), ashes (2.1–2.9%), and polyphenols (1237–1500 mg GAE/100 g).

pH Values Confirm Good Fermentation

The pH range (5.0–5.8) indicates proper fermentation, preventing excessive acidity or under-fermented characteristics that compromise flavor development.

Genotype-Dependent Lipid Superiority

Hybrids F8 and F26 showed exceptionally high lipid levels (>58%), positioning them as superior candidates for cocoa butter industries.

Protein and Fiber Variation Reflects Nutritional Diversity

F8 exhibited the highest protein and fiber contents, enhancing its potential nutritional and flavor-forming value through Maillard precursors.

Polyphenol-Rich Profiles Support Antioxidant Value

High phenolic contents across hybrids highlight strong antioxidant potential and influence bitterness, astringency, and health-promoting properties.

Cocoa Liquor Production Standardization

Roasting, winnowing, grinding, and refining to 20 µm particle size ensured uniform samples for sensory panel evaluation.

Structured Sensory Assessment Protocol

A trained panel following Cocoa of Excellence guidelines characterized flavor attributes, improving reliability of sensory differentiation among hybrids.

Balanced General Sensory Profile

All hybrids showed medium cocoa intensity with low acidity and moderate bitterness/astringency, consistent with well-fermented beans.

Distinctive Aromatic Signatures among Hybrids

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Secondary flavor notes varied: strong floral and fruity notes in F8, fruity and floral in F26 and F27, and more nutty or woody tones in F15 and F23.

Superior Sensory and Biochemical Quality of F8

F8 emerged as the most promising genotype, combining high proteins, polyphenols, complex aroma (floral/fruity/spicy), and strong cocoa intensity.

Industrial Relevance and Processing Advantages

High-fat hybrids like F26 favor cocoa butter extraction, while aromatic hybrids like F8 support premium chocolate production.

Implications for Future Breeding Programs

Findings reinforce the value of integrating biochemical markers, sensory quality, and agronomic performance to guide advanced selection strategies for next-generation cocoa hybrids.

Conclusion

The study demonstrated significant biochemical and sensory variability among the six cocoa hybrid families evaluated. pH, lipid, protein, fiber, and phenolic contents showed clear genotype-dependent differences reflecting both genetic and environmental influences. Overall sensory profiles were balanced, with low acidity and moderate bitterness typical of well-fermented beans. Hybrid F8 emerged as the most promising for its rich biochemical composition and superior aromatic complexity. Hybrid F26 stood out for its exceptionally high lipid content, ideal for cocoa butter extraction. These findings highlight the value of integrating biochemical and sensory criteria to guide future cocoa breeding and industrial applications.

Recommendations

- Strengthen breeding programs by prioritizing hybrids like F8 and F26 with superior biochemical and sensory qualities.
- Improve fermentation practices to maintain optimal pH and enhance flavor development across all hybrid families.
- Promote industrial use of high-lipid hybrids for cocoa butter extraction and aromatic hybrids for premium chocolate production.
- Expand multi-location trials to validate the stability of biochemical and sensory traits under diverse agro-ecological conditions