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Pasting Properties of Cassava, Wheat, and Soybean Flour Blends

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Abstract

This study investigated the pasting characteristics of composite flour blends formulated with varying ratios of cassava, wheat, and soybean flours (45:50:5, 40:50:10, and 35:50:15, alongside 50:45:5, 50:40:10, and 50:35:15). The research focused on how these ratios affect the blends' viscosity, stability, and thermal properties. The results indicated that increasing the proportion of cassava flour enhanced peak, trough, final, and setback viscosities, which contributes to greater structural integrity and a firmer texture in baked goods. Conversely, higher soybean content reduced peak and setback viscosities, resulting in a softer texture and improved heat stability. These findings suggest that by adjusting flour proportions, manufacturers can tailor the textural attributes and cooking characteristics of flour-based products to meet specific consumer preferences, offering an adaptable approach to functional food development in bakery applications.

Keywords: Proximate, Mineral, Cassava, Wheat, Soybean

1. INTRODUCTION

Flour is a powder produced by milling cereals or other starch-based crops. Wheat flour remains the global standard for baking; however, its heavy utilization has led to an overdependence on wheat imports, particularly in developing nations like Nigeria (Chinma *et al.,* 2017). This reliance poses a major financial and logistical constraint for local cookie and pastry production. For context, in 2010 alone, Nigeria spent approximately ₦635 billion (around $4.2 billion) on wheat importation, highlighting an enormous national economic burden (Adeola *et al*., 2019). Consequently, finding local, sustainable flour sources to substitute for wheat is of vital economic importance. Cassava (Manihot esculenta) is a resilient, carbohydrate-rich staple crop cultivated extensively across tropical agro-ecological zones. Between 2010 and 2016, global cassava production grew by 18.9%, escalating from 132.2 million to 157.27 million metric tons. During the 2017–2018 period, Africa accounted for 60.7% of this global output, followed by Asia at 29.3%. By 2018, Africa's total annual production reached an estimated 1.697 billion metric tons. Despite its high agronomic yield, cassava suffers from rapid enzymatic and oxidative breakdown within 24 to 72 hours of harvest—a phenomenon known as Postharvest Physiological Deterioration (PPD). Transforming cassava into stable flour prevents this spoilage while preserving its culinary value (Zainuddin *et al*., 2018; Akinwale *et al.,* 2018).

Meanwhile, soybean serves as an affordable source of high-quality protein and essential oils. Soybean protein features a strong balance of essential amino acids, including a significant amount of lysine (6.2 g/16gN), though it is minorly limited by methionine and cystine (2.9 g/16gN). Because it is entirely free of cholesterol and lactose, soybean is highly valuable for child nutrition and general dietary maintenance (Kure *et al.,* 2019). This study evaluates the potential of combining local cassava and soybean flours as a partial substitute for wheat in cookie production. Ultimately, this research aims to provide the scientific data needed to reduce reliance on imported wheat, lower production costs, and improve the nutritional profile of everyday baked goods by understanding how these composite blends behave when cooked.

2. MATERIALS AND METHODS

2.1 Source of Raw Materials

Whole wheat, cassava roots, and soybeans were purchased from the Emure Market in Owo, Ondo State, Nigeria. Laboratory processing and subsequent analyses were conducted using the specialized equipment at the Department of Food Technology Laboratory, Rufus Giwa Polytechnic, Ondo State, Nigeria.

2.2 Sample Processing

Production of High-Quality Cassava Flour (HQCF)

A 50 kg batch of fresh cassava roots (variety IITA-TMS-IBA011368) was provided by the International Institute of Tropical Agriculture (IITA). Roots showing minimal postharvest damage were manually peeled with stainless steel knives, washed thoroughly, grated, pressed, and pulverized. The pulverized mash yielded an initial wet weight of 34.70 g at lab scale, which was then flash-dried at 180°C for 8 minutes to a weight of 22.22 g. The dried grit was finely milled using a cyclone hammer mill equipped with a 250-micron sieve, yielding 21.92 g of finished HQCF and leaving behind 0.3 g of residual chaff. The flour was cooled, packed in high-density polyethylene bags, and heat-sealed (Alimi *et al.,* 2024; Lagnika *et al.,* 2019).

Production of Soybean Flour

Soybeans were sorted to remove debris, washed with potable water, and parboiled for 30 minutes. After cooling to room temperature (20°C), the beans were dehulled, drained, and sun-dried. The dried soybeans were then ground using an attrition mill and passed through a 0.45 mm mesh sieve to obtain a fine, uniform protein powder.

2.3 Blend Formulations

The wheat, cassava, and soybean flours were blended into six distinct combinations to evaluate their performance against one another, as detailed in Table 3.1. Each batch was mixed exhaustively to ensure complete homogeneity.

Table 3.1: Flour Blend Formulations

Samples	Wheat Flour (%)	Cassava Flour (%)	Soybean Flour (%)
A	50	45	5
B	50	40	10
C	50	35	15
D	45	50	5
E	40	50	10
F	35	50	15

2.4 Determination of Pasting Properties

Pasting profiles were mapped using a Rapid Visco Analyzer (RVA). For each test, 3.5 g of the composite flour blend was mixed with 2.5 mL of distilled water inside a test canister. The paddle and canister assembly were loaded into the RVA to begin the thermal cycle.

The starch suspension was held at 50°C for 1 minute, heated steadily to 95°C at a rate of 12.2°C per minute, held constant at 95°C for 2.5 minutes, and finally cooled back down to 50°C. The instrument automatically recorded peak viscosity, trough viscosity, breakdown viscosity, final viscosity, setback viscosity, peak time, and pasting temperature.

3. RESULTS AND DISCUSSION

The exact pasting metrics for all six flour formulations are recorded below in Table 4.1.

Table 4.1: Pasting Profiles of Cassava-Wheat-Soybean Flour Blends

Sample	Peak Viscosity (cP)	Trough Viscosity (cP)	Breakdown Viscosity (cP)	Final Viscosity (cP)	Setback Viscosity (cP)	Peak Time (mins)	Pasting Temp (°C)
A	2653.00	1579.00	1074.00	3013.00	1434.00	5.47	84.80
B	1967.00	1334.00	633.00	2395.00	1061.00	5.53	85.65
C	1203.00	835.00	368.00	1569.00	734.00	5.40	86.35
D	1592.00	1133.00	459.00	2017.00	884.00	5.60	85.65
E	1166.00	891.00	275.00	1629.00	738.00	5.40	86.25
F	1393.00	1081.00	312.00	1883.00	802.00	5.47	86.45

Note: Samples A, B, and C feature a fixed 50% wheat base with descending cassava and ascending soy. Samples D, E, and F feature a fixed 50% cassava base with descending wheat and ascending soy.

3.1 Peak and Trough Viscosity

Peak viscosity reflects the water-binding capacity and swelling limits of starch granules when heated. It serves as an indicator of a blend's ultimate thickening potential. Peak viscosity values varied wildly, ranging from 1203.00 cP to 2653.00 cP. Sample A (containing 45% cassava and 5% soy) recorded the highest peak viscosity (2653 cP), whereas Sample C dropped to the lowest (1203 cP). As soybean content increased, peak viscosity consistently fell. This confirms that adding fat- and protein-rich legumes dilutes the starch matrix, reducing overall water-holding capacity. This behavior matches observations by Adebowale *et al*. (2017), who noted that rich legume proteins actively suppress the swelling potential of composite starches.

Trough viscosity—the minimum hot-paste viscosity—measures how well the swollen starch structure withstands continuous heat and physical shearing. This metric ranged from 835.00 cP (Sample C) to 1579.00 cP (Sample A). The drop in trough viscosity as more soybean flour was introduced suggests that legume proteins weaken the hot paste's stability under mechanical mixing, a finding supported by Adepeju *et al*. (2018).

3.2 Breakdown and Final Viscosity

Breakdown viscosity gauges how easily starch granules disintegrate under continuous cooking and stirring. High breakdown values point to low thermal stability. Sample A showed the highest breakdown (1074 cP), while Sample E proved the most stable (275 cP). The clear downward trend in breakdown values as soybean flour increased indicates that the soy components actually reinforce the paste during prolonged heating, which is ideal for industrial baking lines (Kure *et al*., 2019). Final viscosity determines the ability of the flour mixture to form a stable gel upon cooling. This parameter ranged between 1569.00 cP (Sample C) and 3013.00 cP (Sample A). Blends with higher cassava fractions developed significantly higher final viscosities. This indicates robust gel structures and increased crumb firmness during cooling—attributes highly sought after to give specific pastries and baked goods their structural shape (Adetuyi *et al.,* 2020; Alimi *et al.,* 2021).

3.3 Setback Viscosity, Peak Time, and Pasting Temperature

Setback viscosity indicates the degree of starch retrogradation (recrystallization) that occurs as the paste cools, which directly correlates to the final firmness and shelf-life of baked foods. Setback values varied from 734.00 cP (Sample C) to 1434.00 cP (Sample A). The higher setback values seen in cassava-dominant mixtures indicate stronger recrystallization, creating a firmer texture. This reinforces findings by Akinwale *et al.* (2018) and Alimi *et al.* (2023), which establish cassava flour as an excellent ingredient for target products requiring a crisp or defined structural bite. Finally, peak cooking times (5.40 to 5.60 minutes) and pasting temperatures (84.80°C to 86.45°C) stayed relatively close across all formulations. Sample A had the lowest pasting temperature (84.80°C), meaning it gelatinizes faster and cooks quicker, saving energy. Adding more soybean flour steadily pushed the pasting temperature upward (with Sample F topping out at 86.45°C). According to Chukwuemeka *et al.* (2021), this occurs because soy proteins compete with starch granules for available water, requiring higher heat energy to trigger gelatinization.

4. CONCLUSION

This study demonstrates that composite flour blends utilizing local cassava and soybean can successfully match or alter the structural traits required for commercial baking. Adjusting the ratio of these ingredients gives food manufacturers direct control over texture and performance:

Increasing the cassava flour fraction boosts peak, final, and setback viscosities, yielding a firmer, highly cohesive structural crumb. Increasing the soybean flour content limits breakdown and setback viscosities, providing excellent thermal stability during production and creating a softer, protein-enriched, less dense final product. These flexible properties prove that local composite flours can reliably reduce reliance on imported wheat while providing custom functional advantages for the baking industry.

References

Adebowale, A. A., Sanni, S. A., Karim, O. R., & Adeniyi, A. G. (2017). Functional, pasting and sensory properties of biscuits produced from wheat–cocoyam–soybean flour blends. *Journal of Food Science and Technology*, 54(9), 2632–2641. https://doi.org/10.1007/s13197-017-2681-6

Adeola, A. A., Olagunju, A. I., & Oloyede, F. M. (2019). Pasting properties and functional characteristics of wheat–legume flour blends for baked product applications. International *Journal of Food Properties,* 22(1), 1456–1468. https://doi.org/10.1080/10942912.2019.1651729

Adepeju, A. B., Gbadamosi, S. O., Adeniran, A. H., & Omoba, O. S. (2018). Effect of legume addition on functional, pasting and sensory properties of flour blends and cookies from wheat, cocoyam and soybean. *Food Science and Nutrition*, 6(5), 1173–1183. https://doi.org/10.1002/fsn3.635

Adetuyi, F. O., Badejo, A. A., Ikujenlola, A. V., & Akinoso, R. (2020). Nutritional, functional, pasting and sensory characteristics of composite flours from cocoyam, soybean and wheat for biscuit production. *Heliyon*, *6*(3), e03615. https://doi.org/10.1016/j.heliyon.2020.e03615

Akinwale, T. O., Adegunwa, M. O., & Akinwande, F. F. (2018). Functional, pasting and baking properties of cocoyam–wheat composite flours. *Journal of Culinary Science & Technology,* 16(5), 418–431.

Alimi, J.P., Otitodun, O.G., Akanni, A.A., Jimoh, M.O., Adegbola, R.Q., Haruna, P.B., Akande, E.J., Ishola, D.T., Ajayi, O.A., Yissa, A.I. & Odutola, B.S. (2024). "Quality Characteristics of Cake Produced with Blends of Flour from Bambara Nut Seeds (Vigna Subterranea) and Cassava (Manihot Esculenta)". *Asian Food Science Journal*, 23(12):99- 116. https://doi.org/10.9734/afsj/2024/v23i12762.

Alimi J.P., Ahemen S.A., Alimi J.O., & Iluebbey P.O. (2023). Effect of varietal differences on chemical and pasting properties of composite wheat-cassava flours produced from low postharvest physiologically deteriorated cassava roots (Manihot esculenta Crantz). *Croatia Journal of Food Science Technology*, 15 (1): 1-10, (2023a). Available on DOI: 10.17508/CJFST.2023.15.1.09.

Alimi J.P., Ahemen S.A., Ikeme A.I., Iluebbey P.O., & Alimi J.O. (2021). Physical, proximate and pasting properties of flours from selected clones of low postharvest physiological deterioration of cassava. *Research Journal of Chemical Sciences*, 11(3): 24-32. Available online at: www.isca.in, www.isca.me

Chinma, C. E., Ariahu, C. C., & Alakali, J. S. (2017). Proximate composition, pasting and baking properties of wheat and unripe plantain flour blends enriched with bambara groundnut flour. *African Journal of Food, Agriculture, Nutrition and Development*, 17(1), 11648– 11663.

Chukwuemeka, A. C., Ojimelukwe, P. C., & Okorie, S. U. (2021). Effect of soybean flour substitution on functional, pasting and baking properties of wheat–cocoyam composite flours. *Food Research International,* 144, 110358. https://doi.org/10.1016/j.foodres.2021.110358

Kure, O. A., Danbaba, N., & Okoye, I. P. (2019). Functional and pasting properties of wheat and legume-based composite flours for baked goods. *African Journal of Food Science*, 13(5), 127–136. https://doi.org/10.5897/AJFS2018.1761

Omoba, O. S., Oyewole, O. E., & Adeyeye, S. A. O. (2018). Effect of legume supplementation on the pasting and retrogradation properties of wheat-based flour blends. *Journal of Culinary Science and Technology*, 16(6), 551–567. https://doi.org/10.1080/15428052.2017.1405862

Zainuddin, I. M., Fathoni, A., Sudarmonowati, E., Beeching, J. R., Gruissem, W., & Vanderschuren, H. (2018). Cassava post-harvest physiological deterioration: From triggers to symptoms. *Postharvest Biology and Technology*, *142*, 115-123.