# PASTING PROPERTIES AND AMINO ACID PROFILE OF CASA BEAN SNACK PRODUCED FROM BLEND OF CASSAVA AND HONEY BEAN FLOURS

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**ABSTRACT**
*Malnutrition is the leading cause of death in most developing countries such as Nigeria. Poverty, dietary pattern and ignorance are some of the leading cause of malnutrition. The consumption of high calorie and low protein foods are the instigating causes. Cassava is an underutilize crop in Nigeria and its use has being strictly based on semi processes food. Therefore, the use of cassava fortified with honey beans to produce a ready to eat snack will promote the utilization of the crop and reduce the rate of malnutrition in the country.This study explores the pasting properties of casa bean flour and the amino acid profile of the casa bean snack. Casa bean snack was produced by sorting the cassava, washing, peeling, soaking for 6hrs at ambient temperature, chipped into thin and small sizes, oven dried at 60ºC for 48hrs, milled into flour, sieve and stored while honey beans were winnowed, milled sieved and stored. The resulting flour of cassava and honey beans were blended in the ratio 70:30, 50:50, 30:70 and 100:0 respectively to achieve samples A,B,C and D (control). The casa bean composite flour were separately measured, salt and magi was added, mixed thoroughly, than water and onions were added and finally mixed to form a slurry. Vegetable oil was placed on heat and the slurry was passed through a special nozzle into the hot oil, continuously steering to obtain a uniform golden brown colour, scoop out from the oil, allow to cool and packaged. Pasting temperature, peak time, and viscosity indicators such as peak, trough, breakdown, setback, and final viscosity were analyzed. Control sample D exhibits distinctive values, including the highest breakdown viscosity and setback, influencing retrogradation. Sample C has lowest breakdown and set back viscosity. The study correlates setback values with dough digestibility and underscores the impact on the final product's quality. The results revealed variations in these properties among the samples, emphasizing the significance of amylographic viscosity. Additionally, the amino acid profiles of cassava snacks vary, with sample C (81.71) having the total highest level of the amino acid making it a good source of protein. The findings suggest that sample C is off outstanding qualities interms of nutrient and longer shelflife making it essential for evaluating their suitability in food and industrial applications.*

Keywords: Casabean snack, Amino acid profile, Pasting properties

## INTRODUCTION

Snacking has become more and more common, and research indicates that it makes up a substantial portion of people's daily energy consumption everywhere. Snacking makes up roughly 25% and 22% of an adult's and child's daily energy consumption, respectively (Hess *et al., 2016*). Consumers are becoming more interested in choosing healthier snack options, especially those that use underutilized but locally available crops. This is in an effort to alleviate the issue of hunger in developing countries such as Nigeria. Customers must adopt this new snacking paradigm, which puts an emphasis on making healthy food choices and enables snack products to be customized with ingredients that can be found locally. Hess *et al*. (2016) state that eating modest amounts of food in between meals is known as snacking. Snacks come in a variety of forms, from premade goods created with fresh ingredients to packaged and processed foods. Traditionally, snacks are made with easily accessible domestic components and need little preparation. Because of their low levels of proteins, vitamins, and minerals, as well as their high calorie and fat content, these snack items are sometimes labeled as junk food. According to Ocheme *et al*. (2018), snacks are typically short, high-calorie foods that momentarily sate hunger. They are also frequently devoured quickly.

Casa bean snacks are a type of snack made from a blend of cassava and honey bean flour. Cassava is a starchy root vegetable, while honey beans, also known as lima beans, are legumes that have a slightly sweet taste and are protein based. Casa bean snacks are made from cassava and honey bean flours which are mixed with other ingredients such as oil, seasonings, and spices. The mixture is then shaped into bite-sized pieces and typically baked or fried until crispy. The resulting Casa bean snacks offer a unique combination of flavors and textures. The cassava flour contributes a light and slightly nutty taste, while the honey bean flour adds a subtle sweetness. These snacks are often enjoyed as a healthier alternative to processed snacks, as they are gluten-free and may have a higher nutritional content due to the inclusion of legume flour (Arora *et al.*, 2020). The development of *Casa bean* snack in the food industry is a new trend in maximizing the use of underutilize crop such as cassava and also the in cooperation of protein based legume to cop the increasing malnutrition among infants. Therefore, standardized procedures for making Casa bean snack will also be develop and can pave way for industrialization of the products. As cities become more populated, dietary habits change and convenience becomes more important. This necessitates the creation of nutrient-dense, aesthetically pleasing local resources for snack production, reducing reliance on imported raw ingredients. Every year cassava is cultivated in large quantity in Niger State where most of the produce are used to make semi processed food product and lost at post-harvest stage. Also, the use of cassava in the production of ready to eat snack has not being fully utilized. Therefore, producing snack from cassava will reduce the wastage since there will be optimum utilization of cassava crop. The fortification of cassava snacks with a protein based such as honey bean will provide a snack with optimum nutrient that will help to reduce malnutrition. This study seeks to evaluate how varying blend ratios of cassava and honey beans affect the pasting characteristics and amino acid composition of cassava bean snacks.

## MATERIALS AND METHODS

Cassava (Manihot esculenta), Honey beans (Phaseolus vulgaris), Chili pepper (Capsicum annuum) Salt, Seasoning and Vegetable oil were obtained from Kure Ultra-Modern market, Minna.

**Preparation of cassava flour**

After sorting to remove any extraneous material, fresh cassava roots were peeled, cleaned, and soaked in water for six hours to minimize the amount of hydrocyanide and remove mucilage. The cassava was then chopped into short, thin pieces. Following that, these chips were dried in an oven set at 60°C for 48 hours. After the chips dried, they were processed into a fine flour using an industrial hammer mill. The powder was sieved, cooled, and then stored in an airtight container for additional analysis.

**Preparation of honey bean flour**

Honey beans was sorted and winnowed to remove extraneous material and then milled into a fine powder with a commercial hammer mill. After being sieved and cooled, the powder was kept for further examination in an airtight container.

**Sample formulation**

The cassava and honey beans were blended in different ratio as follows:

**Table 1. Sample formulation**

| Sample | Cassava | Honey beans |
|---|---|---|
| A | 70% | 30% |
| B | 50% | 50% |
| C | 30% | 70% |
| D | 100% | 0 |

**Production of casa bean snack**

300 grams of casa bean flour were measured for each sample, along with 10 grams of salt and 4 grams of seasoning, all of which were thoroughly mixed in separate bowls. To this mixture, 40 ml of water was added, along with 10 grams of grated onions, and the entire mixture was stirred until it formed a firm paste for a duration of 1 minute and 40 seconds. A dry pan was placed on heat and 50 cl of vegetable oil was heated to a temperature of 260ºC, the sample was passed through a special nozzle into the hot oil and was continuously steer in the oil to obtain a uniform color of golden brown, scoop out from the oil and allow to cooled and stored. This was repeated for all the samples.

**Pasting properties**

A Rapid Visco Analyzer (RVA) (RVA 4500, Perten Instruments, Australia) was used to assess the pasting properties of casa bean flour. Twenty-five milliliters (25 mL) of distilled water and two grams (2 g) of casa bean flour were mixed and put in a canister. The canister was heated to 95°C in increments of 12°C after being held at 50°C for one minute. The suspension was cooled to 50°C for 4 minutes after being kept at 95°C for 6 minutes. For the first ten seconds of the test, the stirring rate was set at 960 rpm; after that, it was dropped to 160 rpm for the duration. (Ocheme *et al.* 2018).

**Amino acid composition**

Using HPLC, the amino acid composition of the casa bean snack was evaluated with minor modifications to the methodology described by Ramsookmohan *et al*. (2020). 50 mg of flour samples were placed in vials and hydrolyzed with 0.5 mL of 6 M HCl. After that, the suspensions were vortexed and kept at 110°C for a whole day. After hydrolysis, syringe filters with a pore size of 0.2 µm were used to filter the suspensions, and the filtrates were then put into microcentrifuge tubes. The samples were then vacuum-centrifuged using a Speed-Vac device from Savant Instruments in New York, USA, to dry them.Using a photodiode array (PDA) detector and a Waters UltraTag C18 column (2.1 × 50 mm × 1.7 µm in dimensions), a Waters Acquity Ultra Performance

Liquid Chromatography System was used to analyze the dried samples.

**Statistical Analysis**

SPSS version 16.0, the Statistical Package for the Social Sciences, was used to perform statistical analyses. With a 95% probability, a one-way ANOVA with the Duncan Multiple Range (DMR) test was employed.

**RESULTS AND DISCUSSIONS**

**Pasting Properties of Casa Bean Flour**

The outcomes of the pasting properties of casa bean flour samples are presented in Table 2. Pasting properties refer to functional attributes associated with the capacity of a substance to behave in a manner similar to paste, as described by Otegbayo *et al*. (2006). As outlined by Wang *et al*. (2013), when starch granules are subjected to heat, they undergo hydration, swelling, and transformation into a paste-like consistency. This process includes hydrogen bond rupture, double helix unwinding, and granule structural collapse brought on by the melting of crystallites. Together, these changes result in starch gelatinization, which is accompanied by the birefringence that is typical of intact granules disappearing. When the starch chains cool, they slowly reform into somewhat organized structures that are different from those found in native granules. Significant differences ($p < 0.05$) in the pasting properties of the samples were observed.

**Peak Viscosities**

The casa bean composite flour were found to have peak viscosities ranging from 1801 to 4480.5 RVU, where sample D showed the highest value and sample C the lowest. The peak viscosity of the flour blends showed a noteworthy increase ($P < 0.05$) from 1801 RVU in the control sample D to 4480.5 RVU in the sample with 50% inclusion of honey bean flour. Thereafter, the sample with 30% inclusion of honey bean flour showed a progressive decline to a maximum of 2281 RVU. According to Rincón-Londoño *et al*. (2017), peak viscosities are markers of the starch granules' ability to expand and absorb water prior to physical breakdown which affects the final product's quality. The increasing substitution of cassava flour with honey bean flour is responsible for the observed progressive rise in peak values in samples containing more than 50% honey bean flour. Higher peak values are associated with more starch swelling, whereas lower peak values are associated with better solubility as a result of starch degradation or dextrinization (Shittu *et al*., 2018).

**Trough Viscosity**

The range of the trough viscosity was observed in the casa bean composite flour ranging from 1241 RVU to 2031.5 RVU. The trough viscosity significantly decreased as the quantity of honey bean flour inclusion increases. Peak viscosity is a measure of the paste resistance to breaking down while cooling, it was observed that the values obtained in this study were higher than in the enriched noodles values published by Adegunwa *et al*. (2018). Specifically, the chosen blend sample D, comprising 100% cassava flour, demonstrated the highest peak and trough viscosities. This characteristic is favorable for snack production, as elevated peak viscosity suggests that the starch structure will remain intact during cooking. Furthermore, Bhattacharya *et al*. (2019) pointed out that high trough viscosity is a sign of low cooking loss and excellent eating quality.

**Breakdown Viscosity**

The casa bean composite flour showed varying breakdown viscosities, ranging from 560 to 2449 RVU. Sample D showed the highest breakdown viscosity, while sample C had the lowest. According to Rincón-Londoño *et al*. (2017), breakdown viscosities are markers of the degree of paste instability brought on by shear pressures. Breakdown viscosities decreased when honey beans was substituted with cassava flour. This phenomenon happens as a result of the protein in honey bean flour entangling swelling starch granules in an insoluble system, which prevents the surface disintegration that would otherwise produce sticky and soft textures (Harvey & Morgenstern, 2019). Dhull and Sandhu (2018) noted a comparable decrease in wheat-fenugreek composite flour noodles. This index evaluates the ease with which gelatinized starch can collapse and represents the stability of the starch (Maninder *et al*., 2017). Protein entrapment of gelatinized starch increases starch stability and decreases breakdown viscosity. Thus, it is preferable to have a low breakdown viscosity while producing high-quality goods.

**Final Viscosity**

The ultimate viscosities of the casa beans flour ranged from 203.17 to 320.92 RVU. These results were greater than those reported by Adegunwa *et al*. (2019), who reported values ranging from 126.42 to 217.08 RVU for noodles boosted with soy flour and carrot powder. The ultimate viscosity decreased in sample C, which included the highest amount of honey bean flour, whereas it increased in sample D, which did not contain any honey bean flour. The fact that bean flour contains less starch than cassava flour may account for this discrepancy.

**Setback Viscosity**

Setback viscosities, according to Rincón-Londoño *et al*. (2017), gauge the paste's ability to retrograde and affect the final viscosity by joining starch chains. Sample C, which contained more honey bean flour, had the lowest setback viscosity while sample D, the control sample, had the highest value, ranging from 649 to 439. Increased setback values in flours signify a reduced tendency for retrogradation, hence delaying the aging process of the resulting product.

The setback viscosity of sample C was significantly different from the other samples and significantly lower than the others, indicating that sample C would have good shelf stability. High setback viscosity values are associated with syneresis (Bakare *et al*., 2018).

**Pasting Temperature and Peak Time**

Pasting temperature shows energy expenditure and indicates the lowest temperature required to cook or gelatinize the flour (Iwe *et al*., 2017). The observed pasting temperatures varied between 73.85°C and 81.60°C. Significant divergence was seen in sample C's pasting temperature when compared to the other samples. Peak time varied significantly between the samples, ranging from 4.17 to 5.24 minutes. The intensity of associative forces inside starch granules and the minimum temperature and cooking time required for flours are both indicated by pasting temperature and peak time (Alamu *et al*., 2017). Sample D had the shortest peak duration while sample C showed the longest. This indicates that sample D had the lowest resistance to swell and rupture while sample C showed the highest resistance. The results obtained in this investigation were relatively lower. Iwe *et al*. (2017) reported greater pasting temperatures (74.4–95.5°C) and longer peak times (5.15–6.88 minutes) for cassava flours. The pasting temperature and peak time results support the idea that the flours in this study would require reduced cooking time (Iwe *et al*., 2017), which would result in time and fuel savings for cooking.

**Table 2. Pasting Properties of Casa Bean Flour**

| Sample | Peak (RVU) | Tough 1 (RVU) | Breakdown Viscosity (RVU) | Final viscosity (RVU) | Setback (RVU) | Time (min) | Pasting temp. ($^{O}$C) |
|---|---|---|---|---|---|---|---|
| **A** | 2923.5±8$^{c}$ | 1465.5±5$^{c}$ | 1458±12$^{c}$ | 2114.5±23$^{c}$ | 649±27$^{d}$ | 4.77±0.04$^{b}$ | 74.30±0.05$^{b}$ |
| **B** | 2281± 31$^{b}$ | 1377.5±20$^{b}$ | 903.5±12$^{b}$ | 1861±18$^{b}$ | 483.5±2$^{b}$ | 5.20±0.07$^{c}$ | 76.38±0.43$^{c}$ |
| **C** | 1801±17$^{a}$ | 1241±9$^{a}$ | 560±8$^{a}$ | 1680±11$^{a}$ | 439±2$^{a}$ | 5.24±0.04$^{d}$ | 81.60±0.05$^{d}$ |
| **D** | 4480.5±9$^{d}$ | 2031.5±22$^{d}$ | 2449±13$^{d}$ | 2672±16$^{d}$ | 640.5±6$^{c}$ | 4.17±0.04$^{a}$ | 73.85±0.45$^{a}$ |

Mean value of duplicate analysis ± standard deviation. different letters (a,b,c,d)in the sample indicate a significant statistical difference in the observed data($P < 0.05$)

**Key**

**Sample A: 70% cassava and 30% bean.**

**Sample B: 50% cassava and 50% bean.**

**Sample C: 30% cassava and 70% bean.**

**Sample D: 100% cassava.**

**Essential Amino acid profile of *Casa* bean snacks**

The amino acid composition of a food item serves as a crucial indicator of the protein quality it offers and is employed in the analysis and processing of materials to identify and eliminate undesirable fractions from potential protein sources (Olatidoye *et al*., 2020). In this study, the amino acid profiles of the casa bean snacks were examined to evaluate their protein attributes, with the results summarized in Table 3. The addition of honey bean flour had a significant effect on both essential and non-essential amino acid levels in all the sample. Notably, when cassava flour was replaced with honey bean flour in the snack formulation, there was a significant increase ($p < 0.05$) in the quantity of lysine and methionine, which are thought to be limiting amino acids in cereals and tubers but are rich in legumes. Sample C (70:30) had the highest total essential amino acid content. This finding is in line with research by Adebayor *et al*. (2021), which found that adding sprouted velvet bean flour to maize-based complementary food significantly increased the amount of essential amino acids. These findings coincide with those of Maude and colleagues (2023). One of the main nutritional constraints is the absence of tryptophan, an essential amino acid that is frequently absent from tubers like cassava. Nonetheless, the results of this study suggested that adding honey bean flour to the recipe led to a minor improvement in the composition of tryptophan.

The casa samples' non-essential amino acid content showed a range of values for different amino acids. Glycine, for example, varied between 3.65 and 7.34 mg/100 g, alanine between 0.55 and 0.98 mg/100 g, proline between 1.70 and 2.29 mg/100 g, aspartate between 3.16 and 582 mg/100 g, glutamate between 1.77 and 4.15 mg/100 g, arginine between 2.71 and 3.45 mg/100 g, tyrosine between 3.14 and 4.43 mg/100 g, asparagine between 3.60 and 6.32 mg/100 g, and cysteine between 3.00 and 6.05 mg/100 g. Because there was more cowpea flour added to sample C, which had a 30:70 cassava-honey bean flour combination, the cysteine content was noticeably higher—it reached 6.05 mg/100 g.The greatest concentrations of some non-essential amino acids, such as alanine (0.98 mg/100 g), glycine (7.34 mg/100 g), glutamate (4.15 mg/100 g), aspartate (3.34 mg/100 g), and arginine (3.45 mg/100 g), were found in Sample C, which had a 30:70 cassava-honey bean flour ratio. Furthermore, the sample with a 30:70 blend of cassava and honey bean flour had the highest levels of serine and proline, with values of 2.29 mg/100 g and 4.84 mg/100 g, respectively. With a total amino acid level of 81.71 mg/100 g, Sample C also had the highest total non-essential amino acid content (42.35 mg/100 g). The most common non-essential amino acids were glutamate and arginine, which is in line with results for complementary diets like mixes of sprouted honey bean flour and maize flour. Protein energy malnutrition (PEM) is a common problem among newborns in Sub-Saharan Africa. The addition of honey bean flour to the casa snacks often resulted in enhanced levels of both necessary and non-essential amino acids, demonstrating its potential in addressing PEM.

**Table 3. Essential andnon-essentialamino acid profile for casa bean snacks**

| Amino Acid | A | B | C | D |
|---|---|---|---|---|
| **Isoleucine** | 2.01 ± 0.01$^{b}$ | 2.85 ± 0.01$^{c}$ | 4.04 ± 0.01$^{d}$ | 1.65 ± 0.00$^{a}$ |
| **Leucine** | 1.75 ± 0.01$^{b}$ | 2.25 ± 0.00$^{c}$ | 3.66 ± 0.01$^{d}$ | 1.55 ± 0.00$^{a}$ |
| **Lysine** | 3.87 ± 0.01$^{a}$ | 4.01 ± 0.01$^{b}$ | 4.26 ± 0.01$^{c}$ | 3.85 ± 0.00$^{a}$ |
| **Methionine** | 2.74 ± 0.04$^{b}$ | 3.78 ± 0.01$^{c}$ | 5.26 ± 0.01$^{d}$ | 2.65 ± 0.01$^{a}$ |
| **Phenylalanine** | 6.25 ± 0.01$^{b}$ | 7.34 ± 0.01$^{c}$ | 8.93 ± 0.00$^{d}$ | 5.89 ± 0.01$^{a}$ |
| **Threonine** | 1.54 ± 0.02$^{a}$ | 1.87 ± 0.01$^{b}$ | 3.85 ± 0.01$^{c}$ | 1.51 ± 0.01$^{a}$ |
| **Tryptophan** | 1.54 ± 0.01$^{b}$ | 2.62 ± 0.01$^{c}$ | 4.17 ± 0.01$^{d}$ | 1.06 ±0.01$^{a}$ |
| **Valine** | 2.75 ± 0.00$^{b}$ | 3.84 ± 0.01$^{c}$ | 3.87 ± 0.01$^{d}$ | 2.71 ± 0.01$^{a}$ |
| **Histidine** | 0.86 ± 0.01$^{b}$ | 1.13 ± 0.01$^{c}$ | 1.32 ± 0.01$^{d}$ | 0.79 ± 0.01$^{a}$ |
| **Asparagine** | 3.62 ±0.01$^{a}$ | 4.24 ±0.01$^{b}$ | 6.32 ± 0.01$^{c}$ | 3.60 ± 0.00$^{a}$ |
| **Arginine** | 2.80 ± 0.01$^{b}$ | 3.13 ± 0.01$^{c}$ | 3.45 ± 0.00$^{d}$ | 2.71 ± 0.01$^{a}$ |
| **Alanine** | 0.56 ± 0.01$^{a}$ | 0.70 ± 0.01$^{b}$ | 0.98 ± 0.01$^{c}$ | 0.55 ± 0.00$^{a}$ |
| **Aspertate** | 3.23 ± 0.01$^{a}$ | 4.62 ± 0.01$^{b}$ | 5.82 ± 0.01$^{c}$ | 3.16 ± 0.08$^{a}$ |
| **Glutamate** | 1.77 ± 0.01$^{b}$ | 2.72 ± 0.01$^{c}$ | 4.15 ± 0.00$^{d}$ | 1.45 ± 0.00$^{a}$ |
| **Glycine** | 4.57 ± 0.01$^{b}$ | 6.52 ± 0.00$^{c}$ | 7.34 ± 0.01$^{d}$ | 3.65 ± 0.00$^{a}$ |
| **Tyrosine** | 4.43 ± 0.01$^{d}$ | 3.14 ± 0.00$^{a}$ | 4.11 ± 0.01$^{b}$ | 4.10 ± 0.00$^{b}$ |
| **Cysteine** | 3.13 ± 0.01$^{b}$ | 3.42 ± 0.01$^{c}$ | 6.05 ± 0.01$^{d}$ | 3.00 ± 0.00$^{a}$ |
| **Proline** | 1.71 ± 0.01$^{a}$ | 1.83 ± 0.01$^{b}$ | 2.29 ± 0.00$^{c}$ | 1.70 ± 0.00$^{a}$ |
| **Serine** | 2.75 ± 0.01$^{b}$ | 3.12 ± 0.01$^{c}$ | 4.84 ± 0.01$^{d}$ | 3.33 ± 0.96$^{a}$ |
| **TEAA** | **23.04** | **29.66** | **39.36** | **21.66** |
| **TNEAA** | **28.57** | **33.44** | **42.35** | **27.25** |
| **TAA** | **81.71** | **48.91** | **51.61** | **63.10** |

**Mean value of duplicate analysis ± standard deviation. Different letters (a,b,c,d)in the sample indicate a significant statistical difference in the observed data(P < 0.05)**
**Key**
**Sample A: 70% cassava and 30% bean.**
**Sample B: 50% cassava and 50% bean.**
**Sample C: 30% cassava and 70% bean.**
**Sample D: 100% cassava.**

## Conclusion

Production of casa bean snack is a new product development to maximize the utilization and consumption of high energy protein dense snack. Sample C exhibited a high potential and nutritional value snack that can be used for the stabilization and treatment of malnutrition cases.

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