Cowpea Consumption Pattern and Comparative Nutritional Quality of Local and Improved Varieties of Cowpea (Vigna Unguiculata L. Walp) in Oyo Town, Southwest Nigeria

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COWPEA CONSUMPTION PATTERN AND COMPARATIVE NUTRITIONAL QUALITY OF LOCAL AND IMPROVED VARIETIES OF COWPEA (*Vigna unguiculata L. Walp*) IN OYO TOWN, SOUTHWEST NIGERIA

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Abstract

Background: Protein-energy malnutrition and micronutrient deficiencies remain public health burden in sub-Saharan Africa, driven in part by low consumption of affordable, nutrient-dense plant foods. Cowpea (*Vigna unguiculata* L. Walp.) is an affordable and nutritionally rich legume that is widely cultivated in Nigeria, yet its utilisation remains suboptimal.

Objective: This study investigated cowpea consumption patterns among adults in Oyo town, Southwest Nigeria, and compared the proximate composition, mineral content, and antinutritional factor levels of two commonly consumed local cowpea varieties (*Oloyin* and *Sokoto white*) with two IITA-improved varieties (IT99K-573-1-1 and IT07K-318-33).

Methods: A mixed-methods cross-sectional design was employed. Qualitative data were collected using six focus group discussion sessions with 60 cowpea sellers and four sessions with 40 consumers across the four Local Government Areas of Oyo town. Laboratory analyses of proximate composition, mineral content, and antinutritional factors (tannin and phytate) were conducted using standard AOAC (2005) methods and atomic absorption spectrophotometry.

Results*:* Fat (g/100g), metabolizable energy (g/100g), zinc (mg/100g) and iron (mg/100g) were higher in IT99K-573-1-1 (1.73±0.06; 445.64±1.55; 0.89 ± 0.01; 3.182±0.01) and IT07K-318-33 (1.61±0.10; 436.45±0.52; 0.73±0.01; 2.791±0.01) compared *to Sokoto white (1.14;* 426.6; 0.73±0.01; 2.091±0.01*)* and *Oloyin* (1.3; 431.7; 0.65±0.01; 2.400±0.01), respectively. Moisture content and Tannin (g/100g) were lower in IT99K-573-1-1 (9.21±0.11; 2.54±0.11) and IT07K-318-33 (9.25±0.10; 2.90±0.10) compared to *Sokoto white (*10.60±0.10; 4.10±0.25) and Oloyin (10.60±0.40; 4.90±0.10). Consumers showed a strong preference for *Oloyin* and *Sokoto white* driven by taste, cooking time, and price. Neither sellers nor consumers were aware of the improved varieties.

Conclusion: Improved cowpea varieties offer superior nutritional quality notably higher micronutrient density and lower antinutritional factor content compared to commonly consumed local landraces. Targeted consumer awareness campaigns and farmer training programmes are urgently needed to promote adoption of improved varieties and enhance cowpea's contribution to dietary adequacy in Southwest Nigeria.

Keywords: cowpea; *Vigna unguiculata*; nutritional quality; antinutritional factors; improved varieties; consumption patterns; food security; Southwest Nigeria

INTRODUCTION

Protein-energy malnutrition and micronutrient deficiencies continue to impose a heavy burden on low- and middle-income countries, particularly in sub-Saharan Africa [1]. While animal-sourced protein offers high bioavailability, its high cost places it beyond the reach of a large proportion of households in Nigeria [2, 3]. Legumes, particularly cowpea (*Vigna unguiculata* L. Walp.), represent an affordable, culturally accepted, and nutritionally significant alternative [4, 5]. Cowpea provides 20–32 g crude protein per 100 g dry weight, alongside complex carbohydrates, essential minerals, and bioactive compounds including polyphenols and antioxidants [6, 7].

Cowpea is grown across sub-Saharan Africa, South Asia, and parts of the Americas, with global production reaching 8.9 million metric tonnes in 2019 [8]. In Nigeria, it is one of the most widely consumed legumes, particularly in the Southwest, where it is popularly called "beans" and features prominently in household diets as cooked whole seeds, bean porridge, bean cake (*akara*), steamed bean pudding (*moin-moin*), and bean soup (*gbegiri*) [9, 10]. Despite its versatility, per-capita cowpea consumption has declined in many parts of Nigeria owing to rising retail prices, long cooking times, and gastrointestinal side effects associated with antinutritional factors [11, 12]. Cowpea contains several antinutritional factors including tannins, phytates, oxalates, polyphenols, and protease inhibitors that impair protein digestibility and mineral bioavailability, contributing to poor utilisation of this otherwise nutritious crop [13, 14]. Tannins reduce iron and calcium absorption and are associated with the hard-to-cook defect in stored cowpeas [15]. Phytic acid chelates divalent cations such as iron, zinc, calcium, and magnesium, reducing their bioavailability [16]. Nonetheless, at low concentrations, phytate may exert beneficial antioxidant, anti-carcinogenic, and lipid-lowering effects [17]. Conventional processing methods including soaking, dehulling, fermenting, germinating, and cooking reduce antinutritional factor levels but also lead to nutrient losses through leaching [18]. Varietal selection therefore offers a complementary and cost-effective strategy to improve the nutritional and techno-functional value of cowpea [19]. Plant-breeding programmes, including those at the International Institute of Tropical Agriculture (IITA), have developed improved cowpea varieties with higher yields, disease resistance, and enhanced nutritional traits; however, the nutritional profiles of these varieties relative to commonly consumed landraces are poorly characterised in many localities [20].

This study was therefore designed to: (i) characterise cowpea consumption patterns and variety preferences among adults in Oyo town; (ii) compare the proximate composition, mineral content, and antinutritional factor levels of two commonly consumed local varieties (*Oloyin* and *Sokoto white*) with two IITA-improved varieties (IT99K-573-1-1 and IT07K-318-33); and (iii) identify barriers to the utilisation of improved cowpea varieties to inform targeted nutrition interventions in Southwest Nigeria.

METHODOLOGY

Study design and location

This was a descriptive, cross-sectional study with a concurrent mixed-methods design combining focus group discussions (qualitative) and laboratory analysis of cowpea varieties (quantitative). The study was conducted in Oyo town, Oyo State, Southwest Nigeria. Oyo town is predominantly agricultural (maize and cassava) and commercial in character, with a land area of 2,427 km^2 and an estimated population of 560,982, growing at 3.13% annually [21].

Study population and sampling

Two groups were recruited: (1) cowpea sellers and (2) adult cowpea consumers. Sellers were recruited using snowball sampling from two major cowpea markets, Ajegunle and Akesan, purposively selected on the basis of being the largest cowpea markets in Oyo town, as confirmed by market heads, consumers, and community members. A total of 60 sellers participated across six focus group sessions (three per market), reaching saturation at that point.

Consumer participants (n = 40) were recruited using proportionate random sampling across the four Local Government Areas (LGAs) of Oyo town, with ten participants per LGA drawn from the most densely populated communities. Sample size was calculated using the Leslie Kish formula: $n = Z^2pq / d^2$, where $Z = 1.96$, $p = 0.5$, $q = 0.5$, and $d = 0.05$ [22].

Inclusion and exclusion criteria

Healthy adults (18 years and above) who consumed or sold cowpea in Oyo town and provided verbal consent were included. Eligible individuals with communication challenges were excluded.

Data collection

Focus group discussions were conducted using a structured guide containing open-ended questions addressing cowpea varieties known, variety preferences, frequency and patterns of consumption, preparation methods, barriers to consumption, and awareness of improved varieties. Six sessions were held with sellers (three at Ajegunle, three at Akesan) and four sessions with consumer groups. Each session lasted 45-60 minutes. Seller sessions were conducted in Yoruba; consumer sessions in English and Yoruba. Field notes were taken and all sessions were audio-recorded with participants' consent. Recordings were transcribed verbatim, back-translated into English, and verified for accuracy by a bilingual language expert.

Sample collection and preparation

Five hundred grams each of two locally consumed cowpea varieties (*Oloyin* [Sample D] and *Sokoto white* [Sample C]) were purchased from Ajegunle and Akesan markets. One hundred grams each of two IITA-improved dry cowpea varieties (IT99K-573-1-1 [Sample A] and IT07K-318-33 [Sample B]) were obtained from the Cowpea Breeding Unit of the International Institute of Tropical Agriculture (IITA), Ibadan. All local variety samples were manually cleaned to remove stalks, stones, and foreign material, then stored in labelled airtight plastic containers at room temperature pending analysis. Eighty grams of each of the four samples were ground into fine powder using a Perten Laboratory Mill 3100 and stored in individually labelled airtight Nasco Whirl-Pak cellophane bags at 4°C until analysis. Laboratory analyses were conducted at the Food and Nutrition Science Laboratory, IITA, Ibadan.

Laboratory analysis

Proximate composition

Moisture, crude protein, crude fat, crude fibre, and ash were determined using standard AOAC (2005) methods [23]. Nitrogen content was determined by the micro-Kjeldahl method and converted to crude protein by multiplying by the factor 6.25. Petroleum ether was used as the solvent for crude fat determination. Carbohydrate content was calculated by difference: %

carbohydrate = 100 − (% protein + % moisture + % crude fibre + % ash + % fat). Metabolisable energy was calculated using the Atwater factors (protein: 4 kcal/g; fat: 9 kcal/g; carbohydrate: 4 kcal/g).

Mineral composition

The concentration of calcium, potassium and sodium were determined using the Jenway Digital Flame Photometer with the appropriate filter for individual mineral element. Other mineral element such as magnesium (Mg), copper (Cu), manganese (Mn), iron (Fe) and zinc (Zn) using the Atomic Absorption Spectrophotometer (AAS) and read at their individual wavelengths with their respective hollow cathode lamps using appropriate fuel and oxidant combination (AOAC, 2005).

The phytate content of each cowpea sample was determined through titration until a persisting slightly brownish-yellow coloration for 5 min. The % content of phytic acid was gotten through:

Mineral analysis

Calcium, potassium, and sodium concentrations were measured using a Jenway Digital Flame Photometer with wavelength-specific filters. Magnesium, copper, manganese, iron, and zinc concentrations were determined using an Atomic Absorption Spectrophotometer (AAS) at individual element wavelengths with appropriate hollow cathode lamps, following AOAC (2005) procedures [23].

Antinutritional factor analysis

Phytate (phytic acid) content was determined by titration. Titre values were converted to phytic acid content using the formula:

$$\% \text{ Phytic acid} = \frac{\text{Titre value} \times 0.00195 \times 1.19 \times 100 \times 3.55}{\text{Weight of Sample}}$$

Tannin (tannic acid) content was determined spectrophotometrically at 760 nm wavelength and calculated as:

$$\% \text{ Tannin} = \frac{\text{Sample absorbance} \times \text{average gradient factor} \times \text{dilution factor}}{\text{Weight of Sample} \times 10000}$$

Data Analysis

Quantitative laboratory data were analysed using one-way analysis of variance (ANOVA). Post-hoc pairwise comparisons were performed using the Duncan's Multiple Range Test. Statistical significance was set at $p < 0.05$. All analyses were performed using IBM SPSS Statistics version 26. Qualitative data from focus group discussions were analysed using thematic analysis following the framework of Braun and Clarke (2006) [24], incorporating the stages of familiarisation, coding, theme generation, review, and definition of themes.

Ethical approval

Ethical approval was obtained from the University of Ibadan/University College Hospital Ethics Committee at the Institute of Advanced Medical Research and Training (IAMRAT; approval number: UI/EC/22/0017). Community heads granted permission for data collection. All participants provided verbal informed consent after being informed of the study purpose, voluntary nature of participation, and the right to withdraw at any time.

Results

Sociodemographic characteristics of participants

A total of 94 participants took part in the qualitative component of this study: 54 cowpea sellers (all female; mean age 41.5 years) and 40 cowpea consumers (mixed gender; mean age 30 years). Sellers were recruited from two markets: 27 sellers across three sessions at Ajegunle market, and 27 sellers across three sessions at Akesan market. Consumer focus group sessions were held with ten participants each, drawn from four communities corresponding to the four LGAs of Oyo town: Bode Thomas Estate community (Atiba LGA), Araromi community (Oyo East LGA), Ojongbodu community (Oyo West LGA), and Ilora community (Afijio LGA).

Consumer participants represented low-, middle-, and high-income groups; 60.0% were married. All sellers were female, predominantly of low-to-middle income, mostly married (78.5%), with basic education as their highest qualification. Over 60% of sellers (60.2%) had engaged in cowpea trading for more than five years.

Cowpea consumption patterns and perceived health benefits

Participants generally consumed cowpea frequently, citing its protein content as the principal motivation. Consumption frequency varied, with the majority reporting intake once or twice per week (Table 1). A female participant from Araromi community stated: *"I consume just once in a week" (Female, Araromi community, age 25).* A male participant from Ojongbodu community reported consuming cowpea more frequently: *"I consume it 2 times in a week" (Male, Ojongbodu community, age 30).*

Participants articulated health beliefs connected to cowpea consumption. Participants from Bode Thomas Estate community stated: *"The beans we eat gives nutrient for our health, helps us to grow, helps to repair our body tissues, beans aids body growth and development" (Male and Female, Bode Thomas Estate, ages 26 and 23; Female, Ilora community, age 42).* A female participant in Araromi community (age 33) also noted: *"The beans I eat and the form the beans is prepared and served tells on our health."*

Economic constraints shaped the pattern of consumption for some respondents. A male participant (age 23) explained: *"Sometimes you know in this country you consume the food that is available not the one you want. So that is what sometimes makes me consume it and as a result I have come to like it."*

Table 1. Frequency of cowpea consumption by age group among adult consumers in Oyo town (n = 40)

Age group (years)	Everyday n (%)	Once/week n (%)	Twice/week n (%)	>2 times/week n (%)
18–25 (n = 28)	2 (7.1)	8 (28.6)	8 (28.6)	10 (35.7)
26–33 (n = 27)	3 (11.1)	7 (25.9)	9 (33.3)	8 (29.6)
34–41 (n = 27)	4 (14.8)	10 (37.0)	7 (25.9)	6 (22.2)
42–49 (n = 21)	5 (23.8)	6 (28.6)	5 (23.8)	5 (23.8)
50–57 (n = 28)	2 (7.1)	9 (32.1)	11 (39.3)	6 (21.4)
Overall (n = 40)	**16 (40.0)**	**40 (100.0)**	**40 (100.0)**	**35 (87.5)**

Respondents reported a single consumption category; age-group totals may differ from the overall n = 40 owing to overlapping ranges in the original data.

Cowpea varieties known by sellers and market supply chains

Sellers identified seven cowpea varieties by name: *Oloyin, Sokoto white, Drum, Milk, Pigeon pea, Gbomogungi*, and *Oloo*. Of these, only *Oloyin, Sokoto white, Drum*, and *Milk* were actively sold. All sellers sourced their stock primarily from Bodija market, Ibadan, which in turn received supplies transported from northern Nigeria including Mokwa, Oko Baru, and Basita in Niger State. A seller at Akesan market described the supply chain: *"We send money to our customer in Bodija market and they supply to us" (Female, age 45, Akesan market).*

Seasonality data obtained from sellers revealed that *Sokoto white* was available throughout the year, whereas *Oloyin* was most available in September and *Drum* in October. This seasonal variability in availability of the most preferred variety (*Oloyin*) is a potential structural driver of dietary inadequacy during off-peak months.

Consumer demand for cowpea varieties and purchase drivers

Focus group discussions confirmed that *Oloyin* and *Sokoto white* dominated consumer demand. *Oloyin* was predominantly purchased by middle- and high-income consumers owing to its distinctive sweet taste, and retailed between ₦1,200 and ₦1,500 per 1.36 kg. *Sokoto white* was favoured by low-income consumers and food vendors, retailing between ₦800 and ₦1,000 per 1.38 kg, and was valued for its lower price, swelling properties, reduced susceptibility to weevil infestation, and versatility for processing into *akara* and *moin-moin*. A seller from Ajegunle market stated: *"Have been selling only Oloyin and Sokoto white for over 5 years due to their frequent demand by my customers" (Female, age 30, Ajegunle market).*

Table 2 presents the distribution of preferred varieties among the 40 consumer respondents. *Sokoto white* was preferred by the highest proportion of respondents (16; 40.0%), followed by *Oloyin* (11; 27.5%), *Milk* (6; 15.0%), *Drum* (4; 10.0%), and *Oloo* (3; 7.5%). *Gbomogungi* was not preferred by any consumer respondent.

Table 2. Preferred cowpea varieties among adult consumers in Oyo town (n = 40)

Cowpea variety	**n (%)**
Sokoto white	16 (40.0)
Oloyin	11 (27.5)
Milk	6 (15.0)
Drum	4 (10.0)
Oloo	3 (7.5)
Gbomogungi	0 (0.0)
Total	**40 (100.0)**

Varieties are sorted by frequency of preference in descending order. n (%): number (percentage) of total consumer respondents.

Barriers and factors affecting cowpea consumption

The major barriers to cowpea consumption identified were high and rising retail prices, long cooking time, and taste dissatisfaction. Gastrointestinal complaints including flatulence, belching, constipation, diarrhoea, indigestion, vomiting, mild abdominal discomfort, and sleepiness were widely reported as deterrents. A male participant from Ojongbodu community (age 30) captured several of these concerns simultaneously:

"I consume anytime I feel like eating it. If I have something like plantain I always love to eat it with beans because I love the taste and bread also. In terms of taste again, if I buy it outside and the taste is not good I will just eat little and leave the rest. Cooking time also affect my consumption because it burns a lot of gas."

A female participant from Bode Thomas Estate community (age 37) underscored the role of price and taste in driving preference for *Oloyin* specifically:

"Price, because cowpea is expensive nowadays, and for sweetness that is why I consume Oloyin because it tastes really good. Cooking time doesn't matter to me."

Foods prepared with cowpea: sensory experiences and consumer dislikes

The most commonly prepared cowpea dishes identified were *moin-moin* (steamed bean pudding), *akara* (bean cake), bean porridge, *gbegiri* (bean soup), cowpea cooked with rice, and cowpea with corn. The first three were identified as the most frequently consumed. Respondents appreciated the appearance, taste, and aroma of cowpea-based dishes, particularly when prepared with vegetable oil and spices. A male participant from Ilora community (age 40) stated: *"I love it when my wife prepares any cowpea-based food or eaten with cowpea are prepared with vegetable oil, it tastes so nice."*

Conversely, gastrointestinal side effects were the most commonly expressed dislikes. A female respondent from Bode Thomas Estate community (age 22) stated: *"I hate beans because it makes me have constipation and I farts whenever I consume it."* Belching, flatulence, bad breath, and offensive stool were also repeatedly cited as deterrents to cowpea consumption.

Awareness of improved cowpea varieties

All consumer and seller participants reported having no knowledge of improved cowpea varieties. No seller had ever stocked an improved variety, and no consumer had ever consumed or heard of one. A male consumer (age 35) stated: *"I have not heard it anywhere not even on the radio because I listen to radio a lot. What we know is that the one we consume, it is the Hausas that bring it."* A female consumer from Araromi community (age 25) echoed this: *"I don't know of anything or any food called improved varieties, talk less of cowpea."*

A female seller from Ajegunle market (age 36) confirmed the universal absence of improved varieties from the market: *"Nobody selling cowpea in this market know any variety of cowpea than the common Oloyin, Sokoto white, drum and others been sold."* Importantly, the majority of respondents expressed interest in learning more about improved varieties following the discussion. A female seller from Akesan market (age 48) stated: *"We are just hearing of improved varieties today, and we would like to know and see these varieties, they may even be cheaper than the ones we are selling."* This openness to new information suggests that targeted extension and communication efforts could find a receptive audience among both sellers and consumers.

Proximate composition of cowpea varieties

Table 3 presents the proximate composition of the four cowpea varieties. Moisture content was significantly lower in the improved varieties (IT99K-573-1-1: 9.21 g/100g; IT07K-318-33: 9.25 g/100g) compared to local varieties (both at 10.60 g/100g; $p = 0.004$). Crude protein was highest in IT99K-573-1-1 (24.31 g/100g; $p = 0.008$), thereby highlighting the nutritional advantage of the improved variety for populations reliant on plant proteins. Crude fat was significantly higher in the improved varieties (1.61–1.73 g/100g) compared to local varieties (1.14–1.30 g/100g; $p = 0.005$). Ash content ranged from 3.40 to 3.60 g/100g across varieties, indicating comparable mineral density. Carbohydrate content and metabolisable energy were significantly higher in the improved varieties (carbohydrate: 83.21–84.13 g/100g vs. 82.40–82.70 g/100g; energy: 436.45–445.64 kcal/100g vs. 426.62–431.73 kcal/100g; $p < 0.05$). Crude fibre did not differ significantly across varieties ($p = 0.21$).

Table 3. Proximate composition of two improved and two local cowpea varieties (g/100g dry weight, mean ± SD, n = 3 per variety)

Parameter	IT99K-573-1-1 (Sample A)	IT07K-318-33 (Sample B)	Sokoto white (Sample C)	Oloyin (Sample D)
Moisture	9.21±0.11^{a}	9.25±0.10^{a}	10.60±0.10^{b}	10.60±0.40^{b}
Crude protein	24.31±0.40^{b}	21.40±0.10^{a}	22.40±0.10^{a}	21.65±0.80^{a}
Crude fat	1.73±0.06^{b}	1.61±0.10^{b}	1.30±0.04^{a}	1.14±0.10^{a}
Crude fibre	2.33±0.01	1.70±0.02	1.99±0.45	2.20±0.20
Ash	3.53±0.04^{b}	3.40±0.04^{a}	3.50±0.06^{ab}	3.60±0.01^{c}
Total carbohydrate	83.21±0.12^{b}	84.13±0.13^{b}	82.70±0.43^{a}	82.40±0.60^{a}
Metabolisable energy (kcal/100g)	445.64±1.55^{d}	436.45±0.52^{c}	431.73±1.80^{b}	426.62±0.10^{a}

Different superscript letters within the same row indicate statistically significant differences (Duncan's Multiple Range Test; $p < 0.05$). Rows without superscripts indicate no significant difference ($p > 0.05$).

Mineral composition of cowpea varieties

Table 4 presents the mineral composition of the four varieties. Mineral content differed significantly between varieties for most elements ($p < 0.05$). Iron content was highest in IT99K-573-1-1 (3.182 mg/100g), followed by IT07K-318-33 (2.791 mg/100g), *Oloyin* (2.400 mg/100g), and *Sokoto white* (2.091 mg/100g). Zinc was also higher in improved varieties (IT99K-573-1-1: 0.89 mg/100g; IT07K-318-33: 0.73 mg/100g) compared to local varieties (0.65–0.73 mg/100g).

Manganese was significantly higher in IT99K-573-1-1 (3.180 mg/100g) than in the other varieties. Copper was highest in IT07K-318-33 (7.64 mg/100g). Magnesium did not differ significantly across varieties ($p = 0.80$). Sodium and potassium values were notably highest in *Oloyin* (2010 mg/100g for both), with IT99K-573-1-1 second highest (1710 mg/100g). Calcium was significantly higher in the local varieties, with *Sokoto white* having the highest concentration (1200 mg/100g), suggesting that local varieties retain an advantage for calcium bioavailability.

Table 4. Mineral composition of two improved and two local cowpea varieties (mg/100g dry weight, mean ± SD, n = 3 per variety)

Mineral	IT99K-573-1-1 (Sample A)	IT07K-318-33 (Sample B)	Sokoto white (Sample C)	Oloyin (Sample D)
Calcium	1100±0.01^{b}	1030±0.01^{a}	1200±0.01^{c}	1130±0.01^{b}
Magnesium	240±0.01	240±0.01	230±0.01	230±0.01
Sodium	1710±0.01^{b}	1200±0.01^{a}	1200±0.01^{a}	2010±0.01^{c}
Potassium	1710±0.01^{b}	1200±0.01^{a}	1200±0.01^{a}	2010±0.01^{c}
Iron	3.182±0.01^{a}	2.791±0.01^{c}	2.091±0.01^{d}	2.400±0.01^{b}
Zinc	0.89±0.01^{b}	0.73±0.01^{a}	0.73±0.01^{c}	0.65±0.01^{b}
Copper	5.46±0.01^{b}	7.64±0.01^{d}	5.45±0.01^{a}	5.56±0.01^{c}
Manganese	3.180±0.01^{d}	2.310±0.01^{b}	1.764±0.01^{a}	2.390±0.01^{c}

Different superscript letters within the same row indicate statistically significant differences (Duncan's Multiple Range Test; $p < 0.05$). Rows without superscripts indicate no significant difference ($p > 0.05$).

Antinutritional factor content

Tannin content was significantly lower in the improved varieties (IT99K-573-1-1: 2.54 g/100g; IT07K-318-33: 2.90 g/100g) than in the local varieties (*Sokoto white*: 4.10 g/100g; *Oloyin*: 4.90 g/100g; $p < 0.001$; Table 5). Phytate content was significantly higher in the improved varieties (IT99K-573-1-1: 3.60 g/100g; IT07K-318-33: 4.43 g/100g) than in local varieties (*Sokoto white*: 1.70 g/100g; *Oloyin*: 2.90 g/100g; $p = 0.05$).

Table 5. Antinutritional factor content of two improved and two local cowpea varieties (g/100g dry weight, mean ± SD, n = 3 per variety)

Variety (Sample ID)	Tannin	Phytate
IT99K-573-1-1 (A)	2.54 ± 0.11^{a}	3.60 ± 0.05^{b}
IT07K-318-33 (B)	2.90 ± 0.10^{a}	4.43 ± 1.20^{b}
Sokoto white (C)	4.10 ± 0.25^{b}	1.70 ± 0.05^{a}
Oloyin (D)	4.90 ± 0.10^{c}	2.90 ± 0.60^{ab}
p-value	<0.001	0.05

Different superscript letters within the same column indicate statistically significant differences (Duncan's Multiple Range Test). Improved varieties: IT99K-573-1-1 (Sample A) and IT07K-318-33 (Sample B); local varieties: Sokoto white (Sample C) and Oloyin (Sample D).

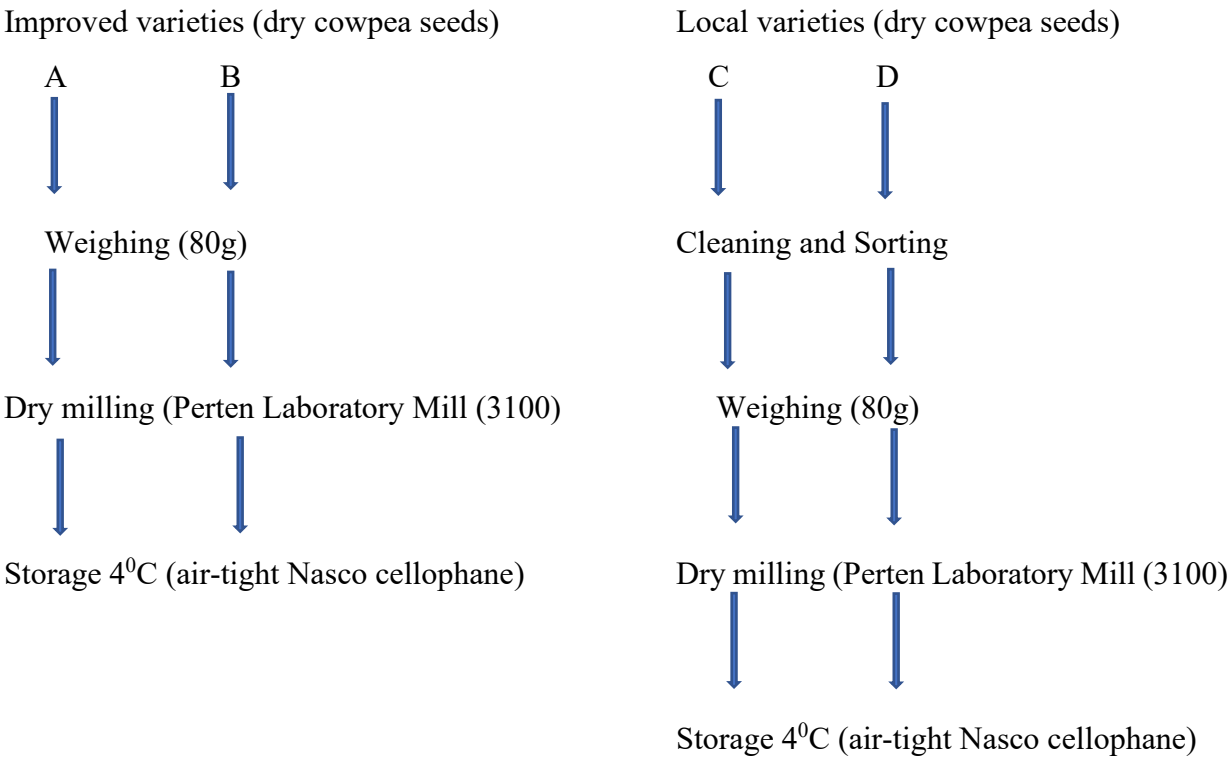

Figure 1.0 Sample preparation flowchart for laboratory analysis of improved (IT99K-573-1-1 [A] and IT07K-318-33 [B]) and local (*Sokoto white* [C] and *Oloyin* [D]) cowpea varieties.

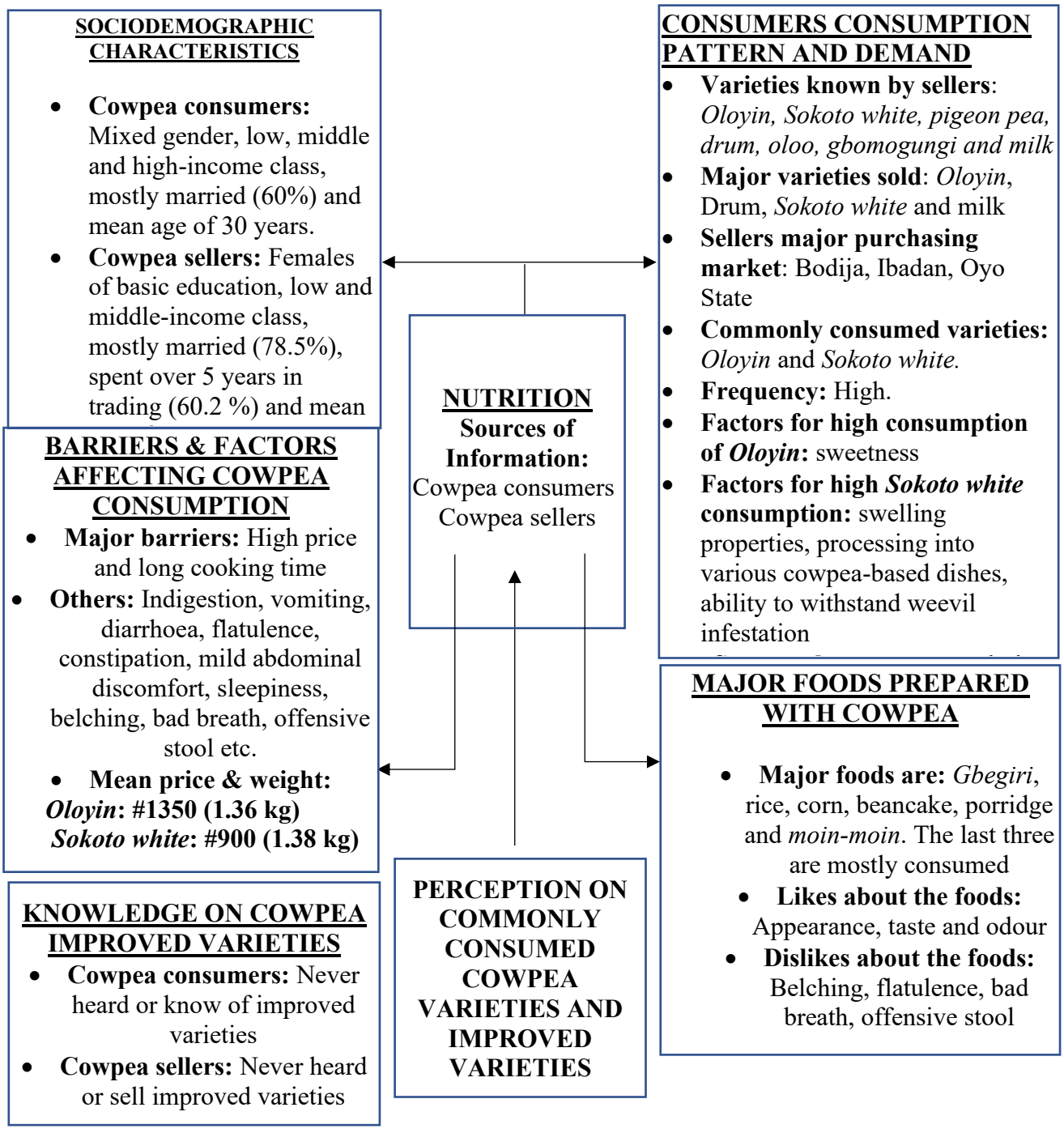

Figure 2. Mind map of key themes from focus group discussions with cowpea sellers and consumers in Oyo town, Southwest Nigeria

Discussion

This study provides comparative data on the proximate composition, mineral content, and antinutritional factors of locally consumed and improved cowpea varieties in Oyo town, while simultaneously characterising consumption patterns and barriers to utilisation of cowpea. The finding that improved cowpea varieties offer superior nutritional quality yet remain completely unknown to the study population underscores an important translational gap between agricultural research and community nutrition outcomes.

The higher crude protein content of the improved varieties, particularly IT99K-573-1-1 (24.31 g/100g), is nutritionally significant for populations in Southwest Nigeria, where animal protein is frequently unaffordable and plant legumes are the primary dietary protein source [5]. This exceeds values reported by Owolabi et al. [20] for improved and local varieties in Zaria, possibly reflecting differences in growing conditions, soil type, and varietal improvement programmes. In the context of protein-energy malnutrition and the growing recognition of the protein quality gap in sub-Saharan Africa, improved cowpea varieties with higher protein content represent an important opportunity for dietary improvement at scale [1, 7].

The significantly lower moisture content in improved varieties implies longer shelf life, a practically important trait for rural households and traders who may lack access to cold-chain storage [25]. This finding aligns with reports that brown beans have higher moisture content than white varieties [26], suggesting that the colouration and seed coat characteristics of cowpea landraces influence moisture retention.

Higher iron and zinc in improved varieties are of particular public health importance. Iron deficiency anaemia and zinc deficiency are among the most prevalent nutritional disorders in Nigeria, disproportionately affecting women of reproductive age and children [21]. Cowpea consumption could contribute meaningfully to addressing these deficiencies if improved varieties with higher micronutrient concentrations are adopted. Zinc, iron, and magnesium function as co-factors for over 300 enzyme systems involved in immune function, DNA synthesis, and energy metabolism [14, 19, 20]. The finding that calcium was higher in local varieties warrants further investigation into whether this reflects soil mineralisation effects or intrinsic varietal differences.

The lower tannin content in improved varieties (2.54–2.90 g/100g) compared to local varieties (4.10–4.90 g/100g) is a nutritionally important finding. Tannins are well documented to reduce protein digestibility, impair non-haem iron absorption, and contribute to the hard-to-cook defect in cowpea, which is itself a significant disincentive to consumption [15]. Reduced tannin in improved varieties could therefore enhance mineral bioavailability and improve cooking experience simultaneously. The higher phytate in improved varieties is a nutritional trade-off that should be addressed in consumer food preparation guidance, as conventional household processing methods such as soaking and boiling can substantially reduce phytate concentrations [18].

The qualitative findings reveal that consumer preference for *Oloyin* and *Sokoto white* is driven by sensory and pragmatic factors: sweetness, cooking time, swelling properties, price, and storage stability. These findings are consistent with the broader literature on legume adoption, which consistently identifies sensory quality and cooking time as primary determinants of variety preference [27, 28]. The total absence of awareness of improved cowpea varieties among both sellers and consumers is a significant finding that points to a breakdown in agricultural extension and nutrition communication systems. Farmers cannot adopt what they do not know exists, and consumers cannot demand what they have never encountered. The rising price of cowpea cited as a barrier to consumption reflects macro-level market pressures that dietary diversification messaging alone cannot address. Policies that support cowpea production and reduce post-harvest losses, alongside targeted promotion of improved varieties with appealing organoleptic characteristics, are needed to simultaneously improve affordability and nutrition.

Limitations

This study was conducted in a single town within Oyo State and may not represent the full diversity of consumption patterns across Southwest Nigeria. The laboratory analysis was limited to proximate composition, selected minerals, and two antinutritional factors; amino acid profiles, vitamin content, polyphenol characterisation, and in-vitro mineral bioavailability were not assessed. The sodium values obtained by flame photometry for all varieties were unusually high (1,200–2,010 mg/100g) and should be interpreted cautiously; authors are encouraged to validate these values against external reference data for cowpea prior to final publication. The qualitative sample size, though adequate for thematic saturation in focus group designs, limits statistical generalisability.

Conclusion

This study demonstrates that IITA-improved cowpea varieties (IT99K-573-1-1 and IT07K-318-33) have superior nutritional profiles compared to locally consumed landraces, with higher protein, iron, zinc, fat, and energy content, and lower tannin levels. Despite these advantages, improved varieties remain entirely unknown to cowpea sellers and consumers in Oyo town, where *Oloyin* and *Sokoto white* dominate the market, driven by taste preferences, cooking convenience, and price considerations. Promoting the adoption of improved cowpea varieties through farmer extension services, consumer education, and integration into nutrition-sensitive agricultural programmes represents a cost-effective strategy to improve dietary protein and micronutrient intakes in Southwest Nigeria. Future studies should assess amino acid profiles, vitamin content, and in-vitro mineral bioavailability of these varieties, and evaluate strategies for improving the organoleptic acceptability of improved varieties to accelerate consumer uptake.

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Declarations

Human Ethics and Consent to Participate

Ethical approval was granted by the University of Ibadan/University College Hospital Ethics Committee at the Institute of Advanced Medical Research and Training (IAMRAT), approval number UI/EC/22/0017. The study was conducted in accordance with the Declaration of Helsinki.

Consent to participate

Written informed consent was obtained from all participants. Community heads also granted study permission.

Consent for publication

Not applicable.

Clinical trial number

Not applicable

Availability of data and materials

The datasets used and/or analysed during the current study are available from the corresponding author on reasonable request.

Competing interests

The authors declare that they have no competing interests.

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Authors' contributions

VTO, PA and OA: conceptualisation, study design, data collection, data analysis, and manuscript writing. VTO and MA: laboratory analysis and data validation. VTO, OA and PA: study design advisory and critical review of the manuscript. OA, MA and PA: supervisory oversight, critical review, and manuscript revision. All authors read and approved the final manuscript.

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Supplementary Files

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