



Comparative analysis of the Nutritional content of Green, white (*Cucumis sativus* L.) and African horned Cucumbers (*Cucumis metuliferus* E.) Sold in Ete Market, Ikot Abasi local Government, Nigeria

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Abstract

Cucumbers play an immediate and crucial role in fighting against micronutrient deficiency and are often consumed crudely. This study aimed to assess the nutritional and phytochemical values of these three whole varieties of cucumber. Fresh cucumber fruits were collected and crushed. Samples were analyzed to determine the proximate, the phytochemicals, the vitamins, and the minerals nutrients. The results show significant variation in nutritional and phytochemical content. White *Cucumis sativus* contained more sugars (704.57±124.79) mg/100g, total polyphenols (133.05±21.26) mg/100g, flavonoids (1.07±0.46) mg/100g, tannins (43.26±5.18) mg/100g, Sodium (28.52±1.37) mg/100g and Potassium (286.58±25.40) mg/100g. Green *C. sativus* concentrated more protein (35.65±5.12)mg/100g and Iron (4.22±5.44) mg/100g while African horned cucumber was richer in acidity (6.5±1.45) meq/100g, vitamin C (275.07±44.23), Magnesium (47.87±10.53) mg/100g and Calcium (21.25±25.40) mg/100g. Cucumbers are recognized as fruits and vegetables with multiple nutritional values. The knowledge of the nutritional contents of the fruits is necessary for better maximization of the nutrient content of the fruits.

Keywords: Phytochemical, Proximate, Fruits, Nutrient, Analysis

Introduction

Cucumbers are a popular vegetable crop grown worldwide for their nutritional and culinary value. They are an excellent source of essential vitamins, minerals, and antioxidants. In

Nigeria, cucumbers are widely consumed in various forms, including fresh, pickled, and cooked. Ete Market in Nigeria is a major hub for cucumber sales, with various varieties available, including green, white, and African horned cucumbers.

Nutritional values refer to all compounds which are naturally present in foods that exert a specified biological effect on the human body. Recent studies reveal that numerous food wastes and non-edible parts are a good source of nutrients that can be extracted and reintroduced into the food chain as natural food additives [1].

The nutritional values derived from different plants, fruits, and vegetables have been studied to maintain food quality, food safety, and appeal, or as food additives or nutraceuticals to improve nutritional quality and support physiological functions [2].

Fruits and vegetables play a significant role in human nutrition by providing important nutrients including proteins, vitamins, minerals (zinc, calcium, potassium, and phosphorus), fiber, folacin, and riboflavin [3]. The nutritional value varies greatly among fruits and vegetables [4]. It is better to consume a variety of commodities rather than limit consumption to a few with the highest nutritional content. Cucumbers are the most important fruits and vegetables consumed and used as food inform of salad. They are sources of nutrients required for human health [5-7]. The major species of cucumbers growing in Nigeria are *Cucumis sativus* and *Cucumis metuliferus* [8]. *Cucumis sativus* or the cucumber has many varieties, including green and white [9]. *Cucumis metuliferus*, horned melon, kiwano, and bitter or non-bitter wild cucumber have high economic and nutritional value that is yet to be fully exploited [10]. It has many common names like jelly melon, Kiwano, Melano, and bitter or non-bitter wild cucumber [11]. It is often eaten raw, as a snack, but may also be used in cooking [9].

The nutritional and phytochemical content of different varieties of cucumber fruit is not well known. There is unproven speculations that the nutritional contents of some varieties of cucumber fruits is better than others. This study aimed to assess and compare the nutritional and phytochemical values of three fruits of cucumber varieties with optimal nutritional value sold in Ete market in ikot Abasi local government of Nigeria.

MATERIALS AND METHODS

The fruits Research Design

This study employed a comparative research design to investigate the nutritional content of green, white, and African horned cucumbers sold in Ete Market, Ikot Abasi, Nigeria.

Sampling Strategy

A total of 30 cucumber samples (10 each of green, white, and African horned) were randomly purchased between Januarys – February, 2025 in Ete Market, Ikot Abasi local Government, Nigeria for analysis.

Sample preparation

All the fruits of Green, White and African horned cucumber (Fig. 1) were purchased washed, peeled, and chopped into small pieces using knife before proximate, phytochemical, vitamin, and mineral analyses (Figure 1).

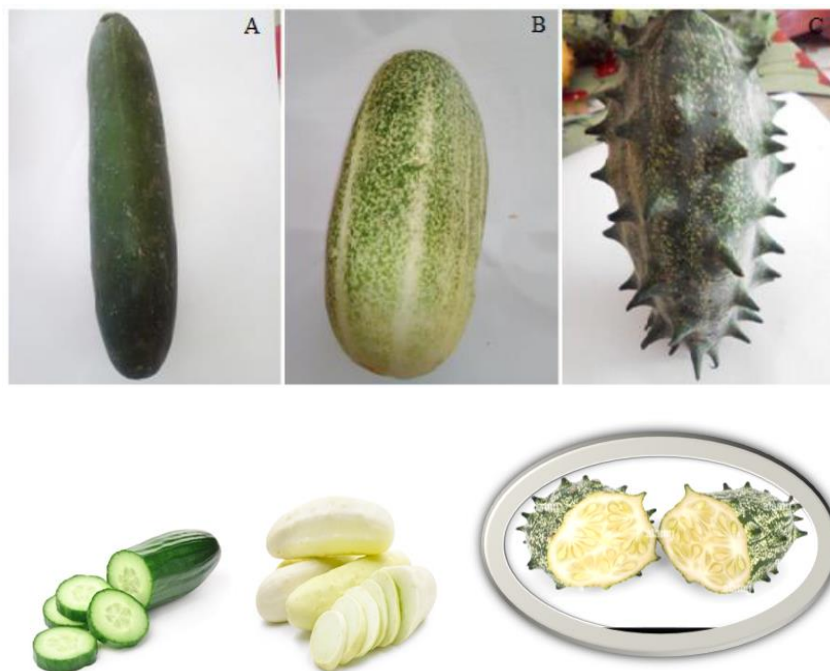


Fig. 1. Green (A), white (B) and African horned(C) cucumber fruits and pieces

Nutritional Analysis

The cucumber samples were analyzed for their nutritional content using standard methods [12].

Proximate, Phytochemicals, vitamins, and minerals analysis

The fruit samples were analyzed to determine Proximate (humidity, ash, sugars, proteins, and acidity), phytochemical properties (polyphenols, flavonoids, and tannins), Vitamins (vitamin c), Protein, and Mineral (nitrogen, calcium, magnesium, sodium, potassium, and Iron) contents.

Proximate Analysis

Samples were dried at 105⁰C in an isothermal oven for three hours and the Ash content was determined. To determine the ash, the samples were incinerated at 525 ± 25 °C for 4 hours using a muffle furnace. Total sugars were evaluated by acid hydrolysis (HCl) by the Luff-Schoorl method [13]. Protein content was determined by the Kjeldahl method [14]. The acidity is

the content of organic and mineral acids determined by titration according to the volumetric method.

Phytochemicals Analysis

Analytical methods were used to separate, identify and quantify nutritional components. Polyphenols, flavonoids, and tannins were analyzed by a separation technique using the Spectrophotometric method. 10 ml of the mixture of acetone and water (70/30) was added to 0.5 g of crushed sample and the mixture was agitated for 30mins to homogenize. In each extract of 50µl, 450 µl of distilled water and 2.5 ml of Folin-Ciocalteu were added. 2.5 ml of sodium carbonate is added to each mixture to extract the polyphenol, tannin, and flavonoid compounds. The homogenate mixture was filtered and the filtrates were incubated for 15 minutes at 50°C and subjected to absorbance at 760 nm. The method consists in oxidizing the oxidizable groups of phenols in the basic medium by the method of Folin-Ciocalteu developed by [15]. Tannins were determined by the colorimetric method of Folin Denis, described by [16]. The Flavonoid content of the extracts was determined using the colorimetric method described by [17].

Vitamin C

One gram of the sample was mixed with 10 mL of distilled water and 50mg of oxalic acid. The mixture was titrated with 2,6-DCPIP (Dichlorophenol Indophenol) solution until a persistent pale pink color appears for 30 seconds to determine the vitamin C content [18].

Minerals

Magnesium (Mg), Calcium (Ca), Sodium (Na), Potassium (K), and Iron (Fe) were analyze by using Atomic Absorption Spectroscopy (AAS) and Inductively Coupled Plasma Emission (ICP). Nitrogen (N) content was determined by the Kjeldahl method [14].

Statistical analysis

Data collected were subjected to a three-way analysis of variance (ANOVA) performed with SPSS model 21.0, to determine the main and interaction effects of the studied variables.

Statistical significance was fixed at 0.05. Considering the varieties/parts' all data are expressed as overall means $\pm$ SD.

RESULTS

Proximate and phytochemicals

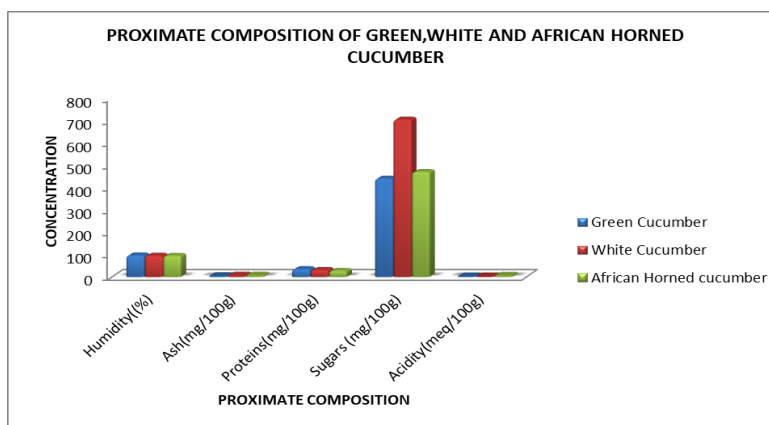
Proximate and phytochemical screening on cucumber fruit samples was summarized in Table 1 and 2.

The results showed a relatively high proportion of moisture (varying between 93.76 ± 1.07 and $95.64 \pm 0.49\%$) and sugars (between 430.34 ± 104.91 and 704.57 ± 124.79 mg/100g), a moderate concentration of polyphenols, proteins and tannin (between 22.31 ± 5.93 and 49.28 ± 17.16 mg/100g) and a slightly present of ash and flavonoids (between 0.50 ± 0.11 and 7.52 ± 1.92 mg/100g). There was significant variation in proximate and phytochemical content between varieties. Comparing proximate and phytochemical parameters of the whole fruits of cucumber, the fruit of green *C. sativus* contained more humidity ($96.73 \pm 0.49\%$) than the white variety ($95.56 \pm 0.70\%$) and African horned ($94.87 \pm 1.07\%$). For ash, white *C. sativus* (7.52 ± 0.78 mg/100g) and African horned (7.35 ± 1.92 mg/100g) had higher content than green *C. sativus* (4.62 ± 0.87), while proteins content was significantly high in green *C. sativus* (35.65 ± 5.12 mg/100g) and white *C. sativus* (31.86 ± 2.61 mg/100g). The lower content of proteins was recorded in African horned (27.83 ± 2.41 mg/100g). White *C. sativus* contained significantly more polyphenols (133.05 ± 21.26 mg/100g), flavonoids (1.07 ± 0.46 mg/100g), tannin (43.26 ± 5.18 mg/100g), and sugars (704.57 ± 124.79 mg/100g) than African horned and green *C. sativus* (Table 1). There was a significant difference in acidity between the fruits of cucumbers with higher acidity content recorded in African Horned cucumber fruits

(6.5 ± 1.45 meq/100g) Table 1.

Table 1: Proximate Composition of the cucumber fruits

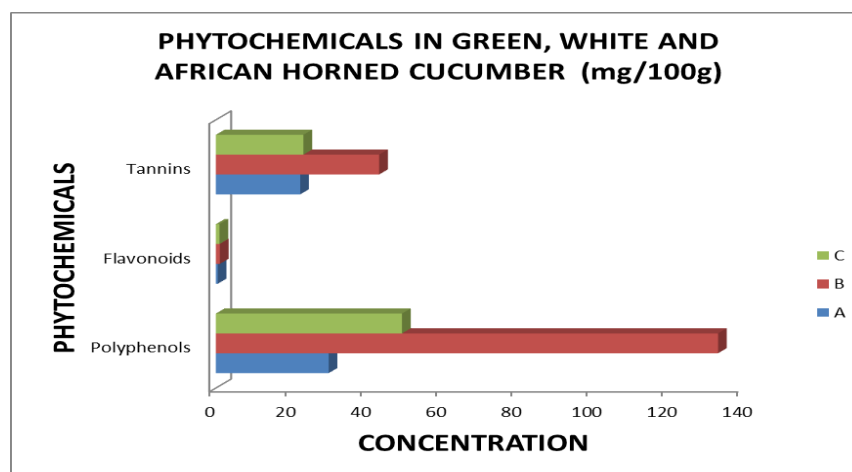
Varieties	Humidity (%)	Ash(mg/100g)	Proteins(mg/100g)	Sugars (mg/100g)	Acidity(meq/100g)
A	96.73 ± 0.49	4.62 ± 0.87	35.65 ± 5.12	440.24 ± 101.90	3.01 ± 0.01
B	95.56 ± 0.70	7.52 ± 0.78	31.86 ± 2.61	704.57 ± 124.79	2.80 ± 0.01
C	94.87 ± 1.07	7.35 ± 1.92	27.83 ± 2.41	469.98 ± 73.42	6.50 ± 1.45



A= Green cucumber, B= white cucumber, C= African horned cucumber

Table 2: phytochemicals

Varieties	Polyphenols(mg/100g)	Flavonoids(mg/100g)	Tannins(mg/100g)
A	29.89±5.21	0.50±0.22	22.35±5.92
B	133.05±21.26	1.07±0.46	43.26±5.18
C	49.32±17.15	0.96±0.19	23.21±3.96

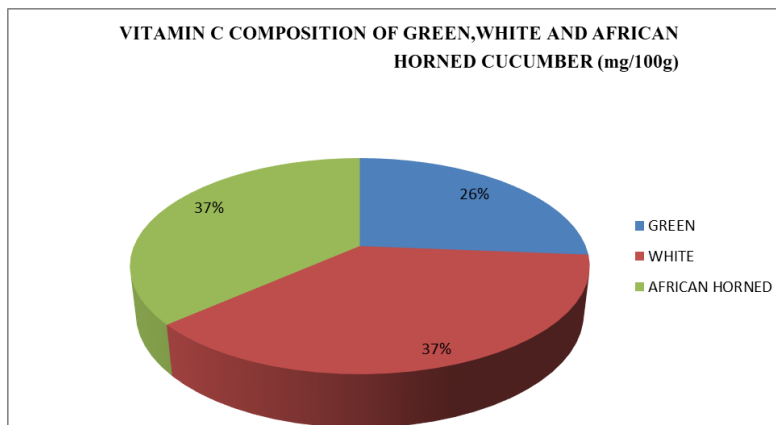


Vitamin C

Cucumber fruits are important source of vitamin C varying between 198.05±27.91 and 275.07±44.23 mg/100g (Table 3). There was a little significant difference in vitamin C content between species. However, there was more vitamin C in African horned (275.07±44.23 mg/100g) and white *Cucumber* (269.57±50.52mg/100g) than the Green cucumber (198.00±27.80).

Table 3: vitamin C content of green, white and African horned cucumber

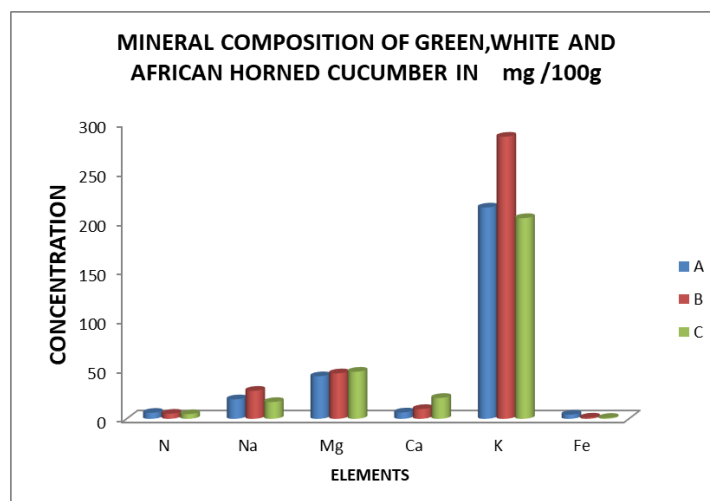
Varieties	Vitamin C (mg/100g)
A	198.00±27.80
B	280.20±44.22
C	275.07±44.23



Minerals

There is no significant difference in Nitrogen (N), Magnesium (Mg), Calcium (Ca), Potassium (K), and iron (Fe) content between varieties was recorded (Table 4). In absolute value, African horned fruit contained more Mg (47.87 ± 10.53 mg/100g) and Ca (21.25 ± 25.40 mg/100g) while higher K (286.58 ± 25.40 mg/100g) and Fe (4224 ± 5.44 mg/100g) were recorded respectively in white and green. There was more Nitrogen in green C. Sativus ($5.70 \pm 0.81\%$) followed by white C. sativus ($5.11 \pm 0.41\%$) and African horned ($4.43 \pm 0.94\%$) (Table 4). Sodium (Na) content recorded in white (28.52 ± 1.37 mg/100g) and green C. Sativus (19.89 ± 5.98 mg/100g) were significantly higher than African horned (17.02 ± 2.51 mg/100g) (Table 4).

Varieties	N	Na	Mg	Ca	K	Fe
A	6.10 ± 0.03	19.80 ± 5.68	43.27 ± 10.23	6.47 ± 2.58	214.70 ± 110.32	4.22 ± 5.44
B	5.20 ± 0.03	28.52 ± 1.37	46.21 ± 12.18	9.97 ± 12.23	286.58 ± 25.40	1.28 ± 1.06
C	4.80 ± 0.02	17.06 ± 2.52	47.87 ± 10.53	21.25 ± 25.40	203.91 ± 82.90	1.00 ± 0.41



Discussion

Proximate, physicochemical, vitamin C and minerals content of fruit

Proximate and phytochemical analysis on cucumber fruit samples showed a relatively high proportion of humidity and sugars, a moderate concentration of polyphenols, proteins, and tannins, and a slightly present of ash and flavonoids. For vitamins and minerals, high concentrations of N and K, and moderate and slight concentrations of Mg, Na, Ca, and Fe were recorded. The high humidity of the whole cucumber (*C. sativus* and *C. metuliferus*) fruit varying between 89 and 96.4% was recorded [6, 19-21]. Cucumber is a rich source of important nutrients and bioactive compounds; it has been used not only as food but also in therapeutic medicine and as an ornamental plant [22-24]. Cucumber considered a fruit and vegetable crop is rich in polyphenolics and other phytochemicals [19]. Uthpala [25] have

conducted a phytochemical screening on cucumber (*C. sativus*) homogenate samples and they have found that relatively higher amounts of steroids, terpenoids, glycosides, and resins are present in cucumber while moderate amounts of saponins, alkaloids, and flavonoids have been reported. Quantitative amounts of the proximate and phytochemicals found reducing sugars in the highest amount (574.4 mg/g) relatively compared to other phytochemicals followed by polyphenols (8.51 mg/g), flavonoids (2.14 mg/g), and tannins (1.26 mg/g) were the lowest available phytochemicals [19]. The analytical composition of *C. metuliferus* showed proteins, lipids, sugars, and minerals including magnesium with high concentration, calcium, potassium, and iron; vitamin C which concentration is four times higher in lemon [26-27]. The phytochemicals present in the fruit of *C. metuliferus* revealed the presence of useful secondary metabolites such as alkaloids, Flavonoids, saponins, tannins, steroids, and terpenoids [28-30]. Comparing the proximate and phytochemicals between varieties, green *C. sativus* contained more humidity and proteins than white *C. sativus* and African horned cucumber. White *C. sativus* contained significantly more polyphenols, flavonoids, tannins, and sugars followed by non-bitter *C. metuliferus*. For the acidity and ash, the higher values were recorded in non-bitter *C. metuliferus*. For vitamin C and minerals (N, Mg, Ca, K and Fe), there was no significant variation between varieties. But more vitamin C, Mg, and Ca were recorded in non-bitter *C. metuliferus* followed by white *C. sativus* while higher K, Fe, and Na were recorded respectively in white and green *C. sativus*. The humidity of the whole fruit of cucumber varied from 89% for *C. metuliferus* and 96.4% for *C. sativus* [6, 19- 21, 31].

Higher ash (5 mg/g) of *C. metuliferus* [21] and lower (0.94 mg/g) of *C. sativus* [19] were recorded. Agatemor *et al* [19] found high polyphenols (8.51 mg/g) and sugars (574.36 mg/g) content in *C. sativus* fruit than in *C. metuliferus* with respectively 0.89 mg/g [17] and 16.10 mg/g [32].

Comparing the minerals content between species, Ferrara [20] found higher Mg (40 mg/100g) and Fe (1.13 mg/100g) content of *C. metuliferus* than *C. sativus* with respectively 16 mg/100g and 0.70 mg/100 [19]. These authors found higher content of K (249 mg/100g) and Ca (15 mg/100g) of *C. sativus* [19] than *C. metuliferus* with respectively 123 mg/100g and 13 mg/g [20].

Conclusion

Cucumber fruits are a rich source of important nutrients and phytochemical compounds. The nutritional values of cucumber fruits varied according to the species and variety. Based on the species and varieties, white cucumber was richer in sugars, polyphenols, flavonoids, tannins, sodium, and potassium while green cucumber was rich in proteins and iron while African horned cucumber was rich in acidity, vitamin C, magnesium, and calcium. Cucumbers are recognized as fruits and vegetables with multiple nutritional values including, proteins, polyphenols, flavonoids, tannin, sugars, vitamin C and minerals. In Nigeria, cucumber fruit is consumed as a healthy food by few and for others only when recommended by medical personnel. The knowledge of the nutritional value of each fruit species was necessary for better understanding. It is important to consume the fruit to maximize the nutrient supply due to their high nutritional value. In other words, the study highlights the nutritional benefits of consuming different cucumber varieties. The results provide valuable information for consumers, farmers, and

nutritionists. Further studies are recommended to investigate the nutritional content of other cucumber varieties and to explore their potential health benefits.

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Conflict of interest

The authors declare no conflict of interest to report.

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