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Determination of the Nutritional Composition and Vitamin Profile of Species of Three Hot Pepper Locally Consumed in Mubi Local Government Area, Adamawa State.

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ABSTRACT:

The study determined the nutritional composition and vitamin profile of species of hot pepper locally consumed in Mubi Local Government Area Adamawa State Nigeria. Fresh pepper fruits of Cayenne, Bell pepper and Birds eye were purchased from local market in Mubi. The samples were air dried at room temperature and grinded into powder. They were then stored in an air tight container. 100g of each sample used for the analysis were then weighed. Colorimetric method was used to attained the determination of vitamin A. Titration method was used for the determination of Vitamin C. Liquid chromatography was on the other hand used in the determination of Vitamin E. Dry ash method was used to determine the minerals. Data obtained were analyzed using the analysis of variance (ANOVA), means of the samples were separated by Duncan Multiple Range Test (DMRT) at 5% probability level using Statistical Package for the Social Sciences (SPSS). Results of the study showed that compared to bird pepper and bell pepper, cayenne pepper had the highest mineral compositions. Similarly, cayenne pepper carried the highest composition of vitamin A and Vitamin C. It also recorded highest in crude protein fibre and carbohydrate in the proximate composition. Cayenne pepper showed significant difference compared to bird pepper and bell pepper. It was therefore recommended by the study that Cayenne pepper being a stimulant and of high nutritional value compared to the other pepper be considered for consumption. Also, further studies should be conducted to determine the proximate, phytochemical, mineral composition of hot pepper species locally consumed.

Keywords: Nutritional Composition, Vitamin Profile, Hot Pepper, ANOVA, Mubi

1. Introduction

The genus *Capsicum* L. belongs to the family Solanaceae. Some members of the Solanaceae family climb, while the majority are herbs or beneath shrubs. There are over 3000 species and 90 genera in the family. According to Hutchinson and Dalziel (2020), there are eight genera and fifty-three species in the Solanaceae family. It was in Central and South America that pepper (Capsicum spp.) first appeared. According to archaeological evidence, people in the Andean areas of Peru and Mexico were already consuming capsicum species at least 8,600–5,600 BC and 6,500–5,500 BC, respectively (Grubben & El Tahir, 2004). According to Csilléry, (2006), *Capsicum* comprises about 30 species and five are domesticated. These comprise *Capsicum annuum* L. (Hot and Sweet peppers), *Capsicum chinense* Jacq. (Aromatic chili pepper), *Capsicum frutescens* L. (Bird pepper), *Capsicum baccatum* L. (Aji) and *Capsicum pubescens* Ruiz and Pav. (Rocoto). In temperate and tropical climates, the first three species are most often grown. According to Costa et al. (2009), they are commonly regarded as C. annuum L. in Africa. Capsicum annuum, Capsicum frutescens, and Capsicum chinense are three of the five domesticated species that thrive in rural areas of Nigeria and add a lot of flavour to many different foods. Pepper is one of Nigeria's main sources of income and the most important and widely used spice in the world (Hutchinson & Dalziel, 2020). There are two species of capsicum grown in Nigeria: *Capsicum* annum L. and capsicum frutescens L., which are two of the six typical varieties in the genus. Bell pepper (Tatase) and sweet pepper (Ata rodo) are two varieties of *Capsicum* frutescen that are commonly grown and eaten in the southwestern region of Nigeria. Capsicum frutescen also includes cayenne red pepper, bird pepper (Ata wewe), and bird eye chilli pepper (Ata bawa).

Pepper is the second ranked most important vegetable globally. It is mostly used as a condiment and spice and can be eaten either fresh or processed. In Nigeria, pepper consumption makes up over 20% of the average daily vegetable intake per person (Sonago, 2003). Among the vegetables grown in Nigeria, *Capsicum* species are ranked third in significance (Uzo, 1982). The classic African sorghum or maize porridge would taste bland without chilli peppers, yet it is nearly difficult to envision Asian and Pacific cuisine today without them (Weis, 2002). A significant amount of long pepper fruits is added to Nigerian and other international cuisine to give it a distinctive flavour. They are well-known for their medicinal and preservation properties in addition to their ability to enhance taste. Essential minerals including magnesium, zinc, iron, phosphorous, and potassium are abundant in them (Otunola et al., 2010).

The very hot varieties of pepper (Chilies) have a high content of the alkaloid capsaicin ($C_{18}H_{27}O_3$) which imparts pungency or spicy taste. To keep chronic diseases like cancer, asthma, coughs, sore throats, toothaches, diabetes, and cardiovascular disorders at bay, it is a wonderful source of flavonoids, capsaicinoids, steroid saponins, and other substances (Wahyuni et al., 2013). Like other vegetable crops, pepper provides nutrients that other foods might not have. Hot pepper seeds are high in proteins, lipids, and minerals, according to several studies. These dietary components are needed for maintaining a healthy body, especially essential fatty acids and essential amino acids (Koyuncu, et al., 2014). As a result, hot pepper seeds might be a cheap way to get minerals, lipids, and proteins for your diet. The globe over, people like eating chilli in all its forms: fresh, dried, or powdered. According to El-Ghoraba et al. (2013), it contains a wealth of nutrients, including proteins, lipids, carbohydrates, fibres, mineral salts (Ca, P, Fe), and vitamins A, D3, E, C, K, B2, and B12. Another benefit of eating fresh capsicum fruits is that they aid digestion of starchy meals. More so, to its hypocholesterolemic, immunosuppressive, anti-mutagenesis, and antioxidant qualities, chilli also prevents platelet aggregation and bacterial development (Wahyuni et al., 2013).

It is projected that pepper output in Africa would reach 2.88 million metric tonnes on 363,937 hectares of land. West Africa accounts for 754,260 metric tonnes on 108,452 hectares, with 500,000 metric tonnes coming from Nigeria on 60,000 hectares (FAO, 2014). In South-West Nigeria, Ogun State produces the most capsicum spp. (51.753 metric tonnes) from 29,800 hectares, followed by Ekiti State (48.85 metric tonnes) from 38,130 hectares. More over half of the region's pepper crop comes from the two States (APS, 2009). The importance of Pepper and the strategic role it plays in the economy and as vegetable is what stirred up the curiosity to determine both the nutritional composition and the vitamin profile of three hot pepper species consumed in Mubi and to compare the nutritional composition with the vitamin profile of the different varieties locally consumed in Mubi local government area of Adamawa State, Nigeria.

2. Methodology

Study Area

The study was conducted at department of Botany Science Laboratory Complex, Adamawa State University Mubi.Mubi North Local Government Area of Adamawa State lies between Latitude 10^0 20'N of the equator and Longitude 13^0 24'E of the time median.

Collection and preparation of Samples

Fresh pepper fruits of Cayenne, Bell pepper and Bird's eye were purchased from the local market in Mubi Local Government Area. Before being thinly sliced and treated with a powerful chlorine solution, the fresh pepper fruit types were rinsed with distilled water. After a day in the oven at 60 degrees Celsius, these samples were considered typical. The samples were grounded into powder and stored in air-tight container. Each sample (100 g) was weighed and extracted with methanol which was used for the analysis.

Determination of vitamin A

Colorimetric method invented by Louis J Duboscq was adopted in the study. Sample (2 g) were weighed into a reflux flask with a flat bottom, then 10 millilitres of distilled water were added and gently shaken. After adding 25 millilitres of alcohol KOH solution, a reflux condenser was connected. The aforementioned combination was cooked for an hour while being shaken frequently in a boiling water bath. 30 millilitres of water were added once the mixture had quickly cooled. The produced hydrolysate was then transferred to a separating funnel. Using three separate 250 ml volumes of chloroform, the solution was extracted. To eliminate any remaining water, 2 grammes of anhydrous Na2S04 were added to the extract. After filtering, the mixture was filled to the mark with chloroform and transferred to a 100 ml volumetric flask. By dissolving 0.003 g of standard beta-carotene in 100 ml of chloroform, one may create a standard solution of beta-carotene Vitamin A with a concentration range of 0 to 50 µg/ml. Vitamin A (beta-carotene in µg/100g) was calculated by averaging the gradients of several standard solutions, which were determined by the absorbance. The Spectrometer (MetrohmSpectronic 2 1 D Model) was used to measure the absorbance of the sample and standards at a wavelength of 328 nm.

Calculation:

$$\text{Vitamin A (µg/100g)} = \frac{\text{Absorbance of sample} \times \text{Dilution Factor}}{\text{Weight of sample}}$$

Determination of vitamin C

Titration method invented by Kuster and Gruters in 1903 was used in the study. Sample slurry (10 g) was weighed into a 100 ml volumetric flask and diluted to 100ml with 3% meta phosphpric acid solution (0.0033 M EDTA). The diluted samples were filtered using Whatman filter paper No. 3. The filterate was quickly titrated to a pale pink end point using a standardised solution of 2, 6-dichlorophenol-in-dephenol after 100 ml had been pipetted into a small flask. The following relationship was used to determine the sample's ascorbic acid content:

$$\text{Ascorbic acid (mg) per 100 g sample} = \frac{V \times T \times 100}{W}$$

Where V = -ml dye used for titration of aliquot of diluted sample; T = ascorbic acid equivalent of dye solution conveyed as mg per ml of dye; W = weight (g) of sample in aliquot titrated

Determination of vitamin E

Sample (1 g) was weighted into a 250 ml conical flask filtered with a reflux condenser. Twenty millilitres of 1 M alcohol sulphuric acid and ten millilitres of pure alcohol were added. After being covered in aluminium foil, the condenser and flask refluxed for forty-five minutes and cooled for fifteen minutes. 5 × 30 ml of dimethyl ether was used to extract the mixture after 50 ml of distilled water was added. Following an acid-free wash and low-temperature dry evaporation, the combined extracts' residues were promptly dissolved in 10 millilitres of absolute alcohol. Carefully adding 5 ml of 100% alcohol and 1 ml of pure HNO3 to a 20 ml volumetric flask followed by the transfer of aliquots of the sample and standards solution (0.3-3.0 mg vitamin E). For precisely three minutes after the alcohol started to boil, the flasks were set on a water bath set at 900C. Reduce the temperature by passing it under cold water, and then add or subtract volume using pure alcohol. A blank containing 5 ml of 100% alcohol and concentration HNO3 prepared in the same way was used to test the absorbance at 470 nm.

$$\text{Vitamin E (µg/100g)} = \frac{\text{Absorbance of Sample} \times \text{Gradient Factor} \times \text{Dilution Factor}}{\text{Weight of Samples}}$$

Determination of minerals

Liquid chromatography was the method used. It was invented by a Russian Botanist Mikhali Tsvet in 1903. The dry ash extraction method outlined by AOAC (2005) was used to ascertain the mineral content of each pepper leaf. Five grammes of each pepper leaf were burned for three hours at 550°C in a muffle furnace. Each ashed sample received three millilitres of concentrated HCl before being placed in a 250-millilitre volumetric flask. The crucible used for ashing was rinsed three times with deionised water, and all of the solutions were combined into the corresponding ashed leaf samples before adding more deionised water to reach the 100 mL level. The various mineral elements were examined using the diluted digest. Using FP640 Flame photometer, sodium and potassium levels were measured (Wincom, Hunan China). The absorbance of the colour complex generated for zinc and molybdovanadate, respectively, was used to analyse phosphorus and zinc. For phosphorus and zinc, the absorbance was measured at 400 and 615 nm, respectively (Säbel, 2010) utilising a Measuretech Instrument, Shanghai, China, UV/Vis 721N spectrophotometer. Calcium and magnesium levels were determined using EDTA titration (AOAC, 2005). Iron was analyzed by orthophenanthroline red ferrous complex method (Jackson 2018).

Data analysis

One-way analysis of variance (ANOVA) was used to analyze data (two replicates) using SPSS (IBM, Version 21, USA). The data were presented as mean ± standard deviation and all trials passed through multiple comparisons using Duncan's Multiple Range Test with a probability of p=0.05. The data obtained from the study were presented in tables where logical and statistical conclusions were drawn.

3. Results

Proximate Composition of Cayenne, Bell and Bird Peppers

To determine the nutritional value of the sampled pepper, a proximate composition was done and the result presented in table 1

Table 1: *The Proximate Composition of Cayenne, Bell and Bird Peppers Collected from Mubi L.G.A of Adamawa State*

	Proximate Composition (%)					
Sample	**Protein**	**Fat**	**Fibre**	**Ash**	**Moisture**	**Carb.**
Cayenne pepper	14.97±0.40^{a}	11.82±0.69^{a}	21.30±0.81^{b}	5.12±0.58^{b}	8.21±0.53^{a}	38.86±1.30^{a}
Bell pepper	9.96±0.09^{b}	13.00±0.51^{a}	30.28±2.77^{a}	8.16±0.54^{a}	8.22±0.48^{a}	33.74±0.23^{b}
Bird pepper	11.15±0.60^{b}	12.96±0.12^{a}	29.23±0.85^{a}	6.26±0.53^{ab}	7.57±0.89^{a}	32.84±0.77^{b}

[Source: Summarized computational output, (2023)]

Means along the column with same superscript letter are not significantly different p≤0.05.

Key: Carb. = Carbohydrate

From the study the result in Table 1 revealed that the proximate composition of Cayenne, Bell and Bird Peppers were significantly different at $p \leq 0.05$. The highest protein (14.97%) and Carbohydrate (38.86%) of Cayenne pepper was comparable with that of Bird pepper, but significantly higher than the lowest protein of Bell pepper (9.96%). Similarly, the Bell pepper had fiber content (29.23%) that was comparable with that of Bird pepper (29.23%), but was significantly higher than the lowest Fiber content (21.30%) of Cayenne pepper which was significantly similarly to that of Bird pepper. Also, the highest moisture (8.22%) and Carbohydrate (38.86%) content of Cayenne pepper respectively was significantly higher than the lowest (7.57% and 32.84%) due to Cayenne and bird pepper respectively.

Mineral Composition of Cayenne, Bell and Bird Pepper

To determine the value of the mineral content present in the sampled pepper in the study area, mineral composition of Cayenne, Bell and Pepper was carried out and the result presented in Table 2

Table 2: *Mineral Composition of Cayenne, Bell and Bird Pepper*

	Mineral Composition (mg/100 g)					
Sample	**Mg**	**K**	**Ca**	**P**	**Zn**	**Fe**
C. pepper	72.56±1.52^{a}	740.15±42.14^{a}	325.34±53.59^{a}	164.35±4.52^{a}	4.36±0.44^{a}	9.26±0.52^{a}
B. pepper	55.70±4.28^{b}	565.39±30.45^{b}	232.03±21.70^{a}	119.05±2.94^{b}	3.57±0.27^{a}	8.38±0.42^{a}
Bi. Pepper	33.27±3.31^{c}	675.87±13.47^{a}	235.22±22.48^{a}	129.43±11.08^{b}	3.67±0.27^{a}	6.53±0.21^{b}

[Source: Summarized computational output, (2023)]

Means along the column with same superscript letter are not significantly different at p≤0.05.

Key: C. pepper = Cayenne pepper; **B. pepper =** Bell pepper; **Bi. Pepper =** Bird pepper.

From the study the result in Table 2 revealed the mineral composition of Cayenne, Bell and Bird Pepper were significantly different at p≤0.05. The highest K (740.15%) and Phosphorus (164.35%) of Cayenne Pepper was comparable with that of Bird pepper but significantly higher than the lowest K of Bell Pepper (565.39%). Similarly, the Bell Pepper has mineral zinc content (3.57%) that was comparable with that of Bird pepper (3.67%) but was significantly lower than the highest zinc content (4.36%) of Cayenne Pepper which significantly similar to that of Bird pepper. Also, the highest Ca (325.34%) and Mg (72.56%) content of Cayenne Pepper respectively was significantly higher than the lowest (55.56%) and (232.03%) content of Bell pepper compared to Cayenne and Bird pepper. Also, the highest iron (9.26%) of Cayenne pepper was comparable with iron content (8.38%) of Bell pepper but shows higher significant amount than the iron (6.53%) content of Bird pepper.

Vitamin Composition of Cayenne, Bell and Bird Peppers

To determine the vitamin content of Cayenne, Bell and Bird Pepper, vitamin composition was conducted and the result presented in Table 3

Table 3: *The Vitamin Composition of Cayenne, Bell and Bird Peppers*

	Vitamin Composition (mg/100 g)					
Sample	**A**	**B2**	**C**	**D**	**E**	**K**
C. pepper	212.69±14.72^{a}	0.33±0.05^{c}	84.28±3.54^{a}	0.35±0.02^{b}	0.28±0.02^{b}	0.20±0.01^{a}
B. pepper	182.36±5.04^{a}	1.05±0.07^{a}	71.46±0.94^{b}	0.65±0.09^{a}	0.33±0.03^{b}	0.08±0.01^{b}
Bi. Pepper	127.35±2.57^{b}	0.68±0.02^{b}	47.29±4.21^{c}	0.49±0.01^{ab}	0.48±0.05^{a}	0.08±0.01^{b}

[Source: Summarized computational output, (2023)]

Means along the column with same superscript letter are not significantly different at p≤0.05.

Key: C. pepper = Cayenne pepper; **B. pepper =** Bell pepper; **Bi. Pepper =** Bird pepper

From the study the result in Table 3 revealed that the vitamin composition of Cayenne pepper, Bird pepper and Bell pepper were significantly different at p ≤0.05. The highest proportion of vitamin A (212.69%) and vitamin C (84.28%) content of Cayenne pepper was comparable with that of vitamin A (182.36%) and vitamin C (71.46%) content of Bell pepper, but significantly higher than the lowest vitamin A (127.35%) and vitamin C (71.46%) content of Bird pepper. Also, the Vitamin D (0.35%) E (0.28%) and K (0.20%) are in small proportion compared to that of the vitamin D (0.65%) E (0.33%) and K (0.08%) content of Bell pepper of which the vitamin D of Bell pepper was slightly different from that of Cayenne pepper. Also, the vitamin B2 (1.05%) of Bell pepper was significantly different from that of Cayenne B2 (0.33%) and Bird pepper B2 (0.68%).

4. Discussion

From the study, the result revealed that the proximate composition of Cayenne, Bell and Bird Peppers were significantly different at p ≤ 0.05. The highest protein (14.97%) and Carbohydrate (38.86%) of Cayenne pepper was comparable with that of Bird pepper, but significantly higher than the lowest protein of Bell pepper (9.96%). This agreed with the study carried out by Ogunlade et al., (2011), Bird pepper, or *Capsicum frutescens*, "Ata wewe" The greatest crude protein values (3.51%) were discovered in sweet peppers (Ata rodo) and *Capsicum frutescens* (cayenne pepper) (Ata sombo), whereas bell peppers (2.64%) had the lowest value.

The study further revealed the mineral composition of Cayenne, Bell and Bird Pepper were significantly different at p≤0.05. The highest K (740.15%) and Phosphorus (164.35%) of Cayenne Pepper was comparable with that of Bird pepper but significantly higher than the lowest K of Bell Pepper (565.39%). Rohman et al., (2010) carried a study on the mineral composition. Bird pepper (Ata wewe) consistently had the greatest concentrations of the first three most prevalent mineral elements (P, K, and Na). With bird pepper having highest levels, all pepper species in the research may be a rich source

of important minerals. In actuality, bird pepper has the highest levels of every mineral element except magnesium and magnesium. With the exception of cayenne pepper, all pepper types have greater P contents than other mineral components.

The research also showed that the vitamin composition of Cayenne pepper, Bird pepper and Bell pepper were significantly different at $p \leq 0.05$. The highest proportion of vitamin A (212.69%) and vitamin C (84.28%) content of Cayenne pepper was comparable with that of vitamin A (182.36%) and vitamin C (71.46%) content of Bell pepper, but significantly higher than the lowest vitamin A (127.35%) and vitamin C (71.46%) content of Bird pepper. This result is in contrast with the study of Rahman et al., (2013). Chilli peppers (Capsicum annuum L.), which are members of the Solanaceae family, were found to have the greatest vitamin content, according to their research. There is more vitamin C in a fresh green chilli pepper than in a citrus fruit, and more vitamin A in a fresh red chilli pepper than in a carrot (Chigoziri & Ekefan, 2013).

5. Conclusion

It can be concluded that the mineral composition cayenne pepper recorded the highest compared to bird pepper and bell pepper, cayenne pepper also carried the highest vitamin composition of vitamin A and Vitamin C. It also recorded highest in crude protein fibre and carbohydrate in the proximate composition. Cayenne pepper showed significant difference compared to bird pepper and bell pepper.

Recommendation

Based on the findings of this study, it was recommended that:

1. Consumers of pepper should go for Cayenne pepper being a stimulant and of high nutritional value compared to the other pepper in this study.
2. Further research needs to be carried out on the species of pepper.

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