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Nutritional Assessment: Proximate and Mineral Contents of Seed, Flesh and Whole Red *Capsicum chinense* Pepper

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ABSTRACT

Background and Objective: The consumption of different parts of *Capsicum chinense* (seed, flesh and both) locally by various people prompted this study to find its nutritional value. Hence, the proximate and mineral contents of each part of this plant were studied in this article. **Materials and Methods:** The seed and flesh, seed and flesh were separated and oven-dried at 45°C for 5 days, powdered and stored. The proximate analysis was conducted to measure the protein, ash, fiber, crude fat and carbohydrate contents while the mineral analysis was done using an Atomic Absorption Spectrophotometer (AAS). The results were calculated using SPSS, One-way Analysis of Variance (ANOVA). **Results:** The proximate analysis showed that the flesh had more protein (6.084±0.004* %), when compared to the seed and flesh and seed altogether. The mineral compositions showed that the seed had more sodium (91.60±0.17* mg kg^{-1}), calcium (232.17±0.15* mg kg^{-1}), potassium (135.40±0.20** mg kg^{-1}) and magnesium (14.64±0.01* mg kg^{-1}) when compared to others. The ratio of Na/K, of the sample values, was $\leq$1 and K/(Mg+Ca) showed that they were $\leq$2.20. **Conclusion:** The consumption of either the seed, flesh, or both is safe and nutritious since the data obtained falls within the recommended daily allowance.

KEYWORDS

Red *Capsicum chinense* pepper, seed, flesh, proximate, mineral content, electrolyte, nutritional assessment

INTRODUCTION

One of the most significant fruits, vegetables, or spices that are members of the *capsicum* genus is pepper[1]. Pepper comes in a variety of flavors in Nigerian markets. Five of the more than 30 species in the genus *Capsicum, C. annuum*, *C. frutescens*, *C. chinense*, *C. baccatum* and *C. pubescens*-are domesticated and primarily grown for human use[2]. The scotch bonnet, *Capsicum chinense*, is the most popular type, though (Fam. Solanaceae). One of the key plant families that produce food-producing species is *Solanaceae*. The hottest of all commercially grown chili peppers is the *Capsicum chinese*, also known as fresh pepper, english pepper, isawumi (Yoruba), oseoyibo (Igbo), scotch bonnet, Habanero peppers and atarodo. Scotch bonnet is used to flavor and spice a variety of African, American, Asian, European and

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Australian cuisines, as well as pepper recipes such as pepper sauce, hot sauces and pepper soup because of its eye-catching color and flavorful aroma[3]. When ripe, Scotch Bonnet peppers can be any color but are typically red or yellow. Many scientists have reported the abundance of pepper in Nigeria[4], had reported the usefulness of the red pepper as a promising ingredient of all cooking and a rich source of natural colors and antioxidant compounds as well as its richness in vitamins, protein and phytochemicals[5-8]. Second messengers, such as minerals, are crucial for the healthy operation of cells and tissues[9]. Diabetes problems are linked to micronutrient deficiencies in particular[10]. It is impossible to overstate the significance of sodium and potassium in maintaining blood pressure because they are crucial for osmoregulation[9]. In the same way, magnesium is known to speed up a variety of biochemical processes and is necessary for the activity of more than 300 enzymes in the body, where it plays a role in several physiological processes that contribute to the preservation of health and glucose homeostasis. Despite being regarded as being necessary for physiological functions in the body, magnesium has a high potential for toxicity[11]. Additionally, it's been suggested that zinc can lower blood sugar and strengthen the immune system[12]. Copper and iron are also present as trace minerals. Since it is a cofactor for several crucial enzymes and is required for the production of myelin and hemoglobin, copper plays a crucial part in cellular metabolism. By scavenging or neutralizing excess free radicals, copper may also function as an antioxidant to prevent free radical damage[13]. Myoglobin and hemoglobin, which carry oxygen throughout the body, are produced by iron. It also promotes cell division and proliferation. To provide a top-level, extremely comprehensive classification of dietary components, a proximate analysis was established. The system includes analyses of the substances water (moisture), ash, crude fat (ether extract), crude protein and crude fiber. Roles of protein, crude fiber, carbohydrate and crude fats have been well enumerated by scholars and physiological functions include, the human body uses protein to catalyze reactions, transport chemicals like oxygen, maintain our health as part of the immune system and send messages from cell to cell[14]. Fiber is crucial to maintaining a healthy digestive system and consuming adequate fiber helps avoid constipation. This study aims to analyze the proximate and mineral contents of the seed, fresh and the seed and flesh of red pepper in order to uncover their nutritional variations.

MATERIALS AND METHODS

Study area: The study began on the 3rd of June and concluded on the 2nd July, 2022. The research was conducted in the Chemistry Laboratory, Afe Babalola University, Ado-Ekiti, Nigeria.

Cultivation: The *Capsicum chinense* was locally cultivated by peasant farmers in Ado-Ekiti, Nigeria in May, 2021 and it was during the rainy season in the Southwest of Nigeria. Plants were cultivated on loamy soil and there were no applications of fertilizers throughout the planting season. Harvesting of the ripe pepper was conducted by the farmers who finally moved them to the local market for selling.

Collection and preparation of samples: One hundred pieces of red scotch bonnet peppers (*Capsicum chinense*) were bought in 1st June, 2022 at the main market in Ado-Ekiti with herbarium number (UILH/002/1269/2022). The seeds, fresh and the whole were dried in the air for five days before being ground. These were heated to 45°C in a laboratory oven to dry them out. To obtain powdered scotch bonnet pepper samples, each color variant was ground using an electric grinder and stored in airtight plastic containers until needed for analysis. The samples were coded as A: Red flesh and seed, B: Red seed and C: Red flesh.

Proximate analysis: The samples' proximate components (protein, moisture, crude fiber, crude fat, ash and carbohydrate contents) were determined according to Sousa *et al.*[15]. All the analyses were done in triplicate.

Mineral analysis: Atomic Absorption Spectrometry (AAS) utilizing the calibration plot method was the analytical technique used to determine the concentration of heavy metals. The instrument was auto-zeroed for each element using the blank (distilled water) and then the standards were inhaled into the

flame in order of decreasing concentration. The apparatus measured the corresponding absorbance and a graph of absorbance against concentration was drawn. The samples were examined and extrapolating from the standard curve, the concentration of the metals present was shown in parts per million (ppm) for the samples. The Specification of AAS used is Agilent Technologies AA-Model 240 AA, USA.

Statistical analysis: Using SPSS (IBM, Version 21, USA), One-way Analysis of Variance (ANOVA) was Utilized to analyze the data (three replicates) for proximate and minerals contents. All experiments used Duncan's Multiple Range Test with a probability <0.05, multiple comparisons and the data were expressed as mean standard deviation.

RESULTS AND DISCUSSION

Proximate analysis: From the results of Table 1, the moisture contents (dry weight basis) were higher in red flesh (9.592±0.027%) and the seed had the least moisture value (7.684±0.038%). Moreover, the red flesh had the highest protein content 6.084±0.004%) while the red flesh and seed had the least (3.578±0.005%). The carbohydrate content of red seed (63.156±0.053%) had the highest value when compared to the flesh and the flesh and seed. The crude fiber of the pepper ranged from 5.969±0.006 to 4.282±0.009%, with the seed having the highest. Fiber is crucial to maintaining a healthy digestive system and consuming adequate fiber helps avoid constipation, Ogunlade *et al.*[16] reported the protein contents for various species of capsicum, for *Capsicum frutescens* (3.07%), *Capsicum annum* (2.65%), *Capsicum annum* (2.64%) and *Capsicum frutescens* (3.51%), however, when the protein values were compared to this study, for the seed, flesh and the seed and flesh, the results of the current study were higher than the obtained by Ogunlade *et al.*[16]. In addition, the protein contents of the flesh, seed and the seed and flesh were higher than the commonly consumed protein plants in Nigeria as reported by Habib *et al.*[17]. The ash contents were in ascending order B>C>A. According to the ash content, different pepper types might be a reliable supply of important minerals. When compared to the reported case of species of *capsicum* as reported by Ogunlade *et al.*[16], *Capsicum frutescens* (1.21%), *Capsicum annum* (3.03%), *Capsicum annum* (1.62%) and *Capsicum frutescens* (2.12%), the ash contents were higher than these reported case. The proximate contents of *Capsicum chinense* as reported by Sharma *et al.*[18] showed moisture (8.43±0.20%), protein (8.2±0.15* %) and crude fiber (29.26±0.03%) were higher than the results of the study by Grzeszczak *et al.*[19], had reported the protein, crude fiber and ash contents of *Capsicum chenense* foliage to be 1.20±0.00^{e} %, 2.90±0.14^{a} % and 2.00±0.00^{d} %. The observable differences in the results could be linked to some factors such as climatic conditions, soil conditions and the age of the land used for farming. However, from the results of the findings, the red flesh had more protein than the others. Protein functions in the human system have been well enumerated by scientists and food nutritional experts, Among the functions, are the of use protein to catalyze reactions, transport chemicals like oxygen, maintain our health as part of the immune system and send messages from cell to cell[14].

Mineral and electrolyte discussion: The significance of mineral elements in the human system can't be over-emphasized, plants including vegetables are reservoirs of major and trace elements with varying degrees of physiological functions in humans. From the results of Table 2, the red seed (B) had more sodium (91.60±0.17* mg kg^{-1}), calcium (232.1± 0.15* mg kg^{-1}), Iron (2.15±0.01* mg kg^{-1}), magnesium (14.64±0.01* mg kg^{-1}) and potassium (135.40±0.20** mg kg^{-1}), than the flesh (C) and flesh and seed (A). The zinc content of flesh was the highest (9.32±0.01** mg kg^{-1}). The significance of sodium, calcium, potassium, magnesium and iron has been reported by scholars such as[12,19,20]. The K is essential in the regulation of acid-base and water balance of the cells[20]. Every cell in the human body contains zinc. Extra zinc must be obtained through diet because the body cannot keep it. It is essential for a number of processes, such as thyroid function, blood clotting, wound healing and immunity. It may also have antiviral characteristics and is necessary for maintaining vision. The movement of nerve messages, muscular contractions, fluid equilibrium and various chemical reactions all depend on potassium. The most typical

Table 1: Proximate analysis of the flesh, seed and seed and flesh of red pepper

Sample code	Moisture	Ash	Crude fibre	Fats	Protein	CHO
A	8.437±0.418	4.482±0.016	5.872±0.016	15.845±0.005	3.578±0.005	61.787±0.397
B	7.684±0.038	4.137±0.008	5.969±0.006	14.709±0.004	4.379±0.004	63.156±0.053
C	9.592±0.027	4.235±0.032	4.282±0.009	15.743±0.007	6.084±0.004*	60.065±0.061

Values are expressed as mean±SD of two determinations (n = 2), *values with in the same column are significantly ($p < 0.05$) different from the other, A: Red flesh and seed, B: Red seed, C: Red flesh and CHO: Carbohydrate

Table 2: Mineral compositions of flesh, seed and seed and flesh red pepper

Sample codes	Na (ppm)	Ca (ppm)	K (ppm)	Fe (ppm)	Mg (ppm)	Zn (ppm)
A	10.40±0.20	4.65±0.20	21.05±0.20*	2.53±0.01	8.16±0.20	0.58±0.01
B	91.60±0.17*	232.17±0.15*	135.40±0.20**	3.38±0.01	14.64±0.01*	2.15±0.01*
C	12.20±0.10	4.57±0.21	25.93±0.15*	2.91±0.01	10.67±0.04	9.32±0.01**

Values are expressed as mean± SD of three determinations (n = 3), *,**Values with in the same column are significantly ($p<0.05$) different from the other, A: Red flesh and seed, B: Red seed, C: Red flesh and ppm: Parts per million ≡ mg kg^{-1}

Table 3: Ratio of electrolyte of Na/K and K/(Mg+Ca)

Sample	Na/K	Reference standard Na/K	K/(Mg+Ca)	Ref. Std. K/(Mg+Ca)
A	0.494	$\leq$1	0.812	$\leq$2.20
B	0.676		0.548	
C	0.470		1.701	

A: Red flesh and seed, B: Red seed, C: Red flesh and Ref. Std: Reference standard

uses of potassium are to treat and prevent low potassium levels, to lower blood pressure and to prevent stroke. The results when compared to dietary intake, all fall within the recommended daily allowance. 1500 mg of sodium is the recommended daily amount (RDA)[21,22]. The major cation in intracellular fluids that regulates acid-base balance and is responsible for maintaining the osmotic pressure of bodily fluids is sodium[23] and it is crucial for potassium and ATP co-regulation[8]. One of the ten necessary minerals is magnesium, which should be consumed in amounts of 400 mg per day for healthy adult males and 320 mg per day for healthy adult females[24]. The recommended daily allowance (RDA) for males, postmenopausal women and menstrual women for iron is 8 mg/day and 18 mg/day, respectively[25], (this is due to the loss of a lot of blood during their monthly period). From Table 2, all the mineral elements fall within the RDA. From the results of Table 3, the ratio of Na/K showed Na/K for (B) 0.676$\leq$1 and this is suitable as condiments in the preparation of diets for hypertensive patients[17]. It has been stated that food samples' K/(Mg+Ca) levels must be under 2.2 in order to prevent a condition known as hypomagnesemia[17]. Consequently, the consumption of flesh, seed, or both cannot lead to hypomagnesemia since its values are less than 2.2.

The results of this study demonstrated that since the mineral contents and the electrolyte values were all within the accepted ranges, consumption of either of the portions under investigation does not have any physiological impact on people. The results of this study's applications revealed that because the flesh is so high in protein, the sections examined might be advised for intake in accordance with human health needs. For patients who lack protein, it is advised that the red pepper's flesh be prescribed. The limitation of this study is that this study is restricted to determining the proximate and mineral elements. The application of a gas chromatography-mass spectrophotometer might have revealed more information regarding the accessibility of bioactive substances.

CONCLUSION

These research findings revealed differences in the proximate and mineral components of the red pepper seed, flesh, seed and flesh. The findings indicated that the flesh is richer in protein and fat than the flesh and seed, which are both rich in ash and crude fiber. The ratios of the seed, flesh, seed and flesh were less than the reference standard for Na/K and K/(Mg+Ca). The characteristics (proximate, mineral and electrolyte) show that it is safe to consume any part.

SIGNIFICANCE STATEMENT

This investigation uncovered the varying protein amounts of the components that were analyzed and showed that the flesh contains more protein than the other parts. The results also showed that flesh is rich in sodium, potassium, magnesium, zinc and k/(Mg+Ca) minerals. The study has shed a lot of light on the various chemotherapeutic possibilities that flesh red pepper ingestion may have for humans. By subjecting the red pepper flesh to further investigation, this study will assist researchers in casting a wider net over it in an effort to find bioactive components.

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