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Comparative Analysis of Nutritional Quality of Capsicum Annuum (Pepper) and Allium Cepa L. (Onion) Cultivated from War Liberated Communities and Normal Communities in Yobe State

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Abstract
Vegetables have become an integral part of human's diet due to their nutritional values thus any form of contamination especially by heavy metals is of great concern. It is therefore imperative to assess the effect of war on nutritional quality of the cultivated vegetables within Yobe State. A composite sample of plants cultivated from normal and war liberated communities was formed by merging the samples from respective local government accordingly. Proximate and heavy metal analysis were carried out using standard of AOAC. A significant increase in nutritional quality was observed in samples cultivated from war liberated communities than normal communities, heavy metals analysis shows all metals are higher than the tolerable ranges set by International Standard Tolerable Limits and European Regulatory Standard. The study conclude that potential hazard may be speculated due to detected high levels of these metals.
Keywords: Proximate; Heavy Metals; Pepper; Onion; War; Yobe State and Nigeria
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1. Introduction

Pollution of the natural environment by heavy metals is a universal problem because these metals are indestructible and most of them have toxic effect on living organisms, when permissible concentration levels are exceeded. Heavy metals frequently reported in literature with regards to potential hazards and occurrences in contaminated soil are cadmium, copper, zinc and lead (Akoto *et al*., 2008., Alloway, 1995). The vehicular exhausts, as well as several industrial activities emit these heavy metals so that soils, plants and even residents along roads with heavy traffic loads are subjected to increasing levels of contamination with heavy metals (Ghrefat and Yusuf, 2006). However, heavy metals are natural components of the earth's crust and cannot be degraded nor destroyed. They enter the human body through food, water and air. Heavy metals are ubiquitous; therefore they tend to bio accumulate, thus causing an increase in their concentration in a biological system. Chronic heavy metal toxicity has been the result of long term low level exposure to pollutants and is associated with many chronic diseases. Heavy metals are given significant interest throughout the globe due to their toxic, mutagenic and teratogenic effects even at very low concentrations.

Vegetables constitute an important part of the human diet since they are rich in carbohydrates, proteins as well as vitamins, minerals and trace elements however; they contain both essential and toxic elements over a wide range of concentrations. Metals accumulation in vegetables may pose a direct threat to human health. Heavy metals are one of a range of important types of contaminants that can be found on the surface and in tissue of dry vegetables. Vegetables are also part of daily diets in many households forming an important source of vitamins and minerals required for human health. They are made up of chiefly cellulose, hemi-cellulose and pectin substances that give them their texture and firmness (Sobukola and Sairo, 2007). Vegetables takes up metals by absorbing them from contaminated soils, as well as from deposits on different parts of the vegetables exposed to the air from polluted environments (Suruchi and Khana, 2011). Vegetable plants growing on heavy metal contaminated medium can accumulate high concentrations of trace elements to cause serious health risk of consumers. Regular monitoring of these heavy metals from effluents, sewage, in vegetables and in other food materials is essential for preventing excessive buildup of the metals in the food chain. Heavy metals depositions are associated with a wide range of sources such as small scale industries (including battery production, metal products, metal smelting and cable coating industries); brick kilns; vehicular emissions; re-suspended road dust and diesel generator sets. These can be important contributors to the contamination found in vegetables.

Due to the nutritional values of vegetables, people are encouraged to add vegetables to their meals. *Capsicum annuum* (*Pepper*) and *Allium cepa* L. (Onion) are vegetables that are consumed in almost every house across Yobe state Nigeria. However, reports have shown deposition of heavy metals through man-made activities such as mining and war. Yobe state has experience the Boko Haram insurgencies and as such various farming communities were turned into war zones. Although much of these communities were liberated and have

since returned to farmlands, the evaluation of heavy metal, phytochemical and proximate composition (Nutritional Value) on commonly consumed vegetables would help in determining the safety or otherwise of crops cultivated from these region and thus improving the health status of final consumers.

2. Materials and Methods

2.1 Study Area

Yobe state is found in north-eastern Nigeria and is located between latitudes 10^{o} 30^{1} to 13^{o} 25^{1} north and longitude 9^{o} 35^{1} to 12^{o} 30^{1} East. Yobe state is boarder to the north by Niger Republic, to the East by Borno state, to the West by Jigawa and Bauchi states and to the south by Gombe and Borno states (Orouonye; 2009.). It has an area of 47,153 km^2 with a population of 2.7 million based on the 2006 National Census. It lies mainly in dry savannah belt or rather in Sahel". The state is dry and hot for most of the year except in the southern part of the state which has a milder climate.

2.2 Vegetable Sampling

The same varieties of the two species of vegetables *Capsicum annuum* (*Pepper*) and *Allium cepa* L. (Onion) were sampled from ten (10) farms; ten (05) from war liberated communities and (05) from normal communities within Yobe state. The samples were collected from the farmlands during harvesting season. Three sampling plots of 9m2 were demarcated within each farmland. Each plot served as replicate, within each plot samples of six plants of each vegetable *Capsicum annuum* (*Pepper*) and *Allium cepa* L. (Onion) were randomly collected. The samples of plants were then placed into separate polythene bags and labelled according to their plant type, part and farmland. A composite sample of plants cultivated from normal and war liberated communities was formed by merging the samples from respective local government accordingly. Thus obtaining two main samples from normal communities and war liberated communities respectively.

2.3 Sample Preparation and Digestion

All glass wares were cleaned with 10% concentrated nitric acid (HNO_3) in order to clean and clear out any heavy metal on their surface and then rinsed with distilled – deionized water. The digestion tubes were soaked with 1% (W/V) potassium dichromate in 89% (V/V) H_2SO_4 and volumetric flask in 10% (v/v) HNO_3 for 24-hours by rinsing with deionized water and then dried in oven and kept in dust free place until analysis began. Each apparatus was soaked and rinsed in deionized water, prior to each use.

The collected samples were cleaned with distilled water to eliminate suspended particles and cut into smaller pieces with a plastic knife. The samples were ashed in a furnace at 650^{o}C for two hours. 0.4g of each plant sample was weighed separately into a beaker. To each beaker, 3 ml of concentrated HCl and 1 ml of concentrated HNO3 were added, and heated on a hot plate at 100^{o}C for 10 minutes to destroy any oxidizable materials and carbonates. The solutions were topped with deionized water to the 30 ml mark and filtered using a Whatman No 1 filter paper. The heavy metals content of the samples were determined using the atomic absorption spectrophotometer (AAS) and calculated using the relation $y = mx + c$ from calibration of each metal standard (AOAC, 2005).

2.4 Proximate Composition

The method described by A.O.A.C (2005) was adopted in proximate analysis.

2.5 Statistical Analysis

Samples analysis were carried out in triplicate and the result were reported as mean ± Standard deviation. Data analysis were carried out using Microsoft office excel for comparing mean concentration of heavy metals between the vegetables.

3. Results and Discussion

3.1 Results

Table 1 and 2 present the result for proximate analysis of pepper and onion cultivated normal communities and war liberated communities respectively. Although there is a slight variation on the values of all parameters, only crude protein was found to be statistically significant in both pepper and onion.

Table 1: Proximate Compositions of *Capsicum annuum* (pepper) fruit in (%) dry weight (DW)

Parameter	PNC	PWLC
Moisture	6.12 ± 1.02	7.33 ± 2.20
Ash	9.55 ± 3.12	11.30 ± 1.60
Crude lipid	9.51 ± 0.96	11.34 ± 0.56
Crude fibre	58.69 ± 4.50	62.56 ± 6.50
Crude protein	1.19 ± 0.02[a]	3.08 ± 1.33[a]
Available carbohydrate	8.80 ± 2.22	11.40 ± 3.55

Data were presented as mean ± standard deviation (SD) of three replicates. Values bearing similar superscript in the same row are statistically significant at $p<0.05$
Key: PNC=pepper from Normal community
PWLC= pepper from war liberated community

Table 2: Proximate Compositions of *Allium cepa* (Onion) fruit in (%) dry weight (DW)

Parameter	ONC	OWLC
Moisture	16.67 ± 3.40	17.22 ± 4.09
Ash	4.51 ± 0.45	5.47 ± 0.88
Crude lipid	24.65 ± 4.10	31.34 ± 3.62
Crude fibre	15.13 ± 4.33	18.55 ± 3.32
Crude protein	4.25 ± 1.05[a]	10.23 ± 2.20[a]
Available carbohydrate	20.10 ± 4.11	28.56 ± 3.10

Data were presented as mean ± standard deviation (SD) of three replicates. Values bearing similar superscript in the same row are statistically significant at $p<0.05$
Key: ONC=Onion from Normal community
OWLC= Onion from war liberated community

The mean concentration of some heavy metals in pepper and onion cultivated from normal and war liberated communities were presented in table 3 and 4 respectively. A significant variation in both pepper and onion was observed only in the level of zinc between the normal communities and war liberated communities.

Table 3: Heavy Metals Concentration of Pepper Cultivated From Normal Communities and War Liberated Communities

Parameter	PNC	PWLC
Cadmium (mg/kg)	0.84± 0.12	0.89 ± 0.20
Nickel (mg/kg)	1.93 ± 0.60	1.55± 0.12
Mercury (mg/kg)	1.45± 0.96	1.76 ± 0.56
Lead (mg/kg)	1.18 ± 0.50	0.76 ± 0.50
Chromium (mg/kg)	1.55 ± 0.02	1.56 ± 0.33
Zinc (mg/kg)	2.44 ± 0.12[b]	4.10 ± 1.32[b]

The data are presented as mean ± standard deviation (SD) of three replicates. Values bearing similar superscript in the same row are statistically significant at $p<0.05$
Key: PNC=Pepper from Normal community
PWLC=Pepper from war liberated community

Table 4: Heavy Metals Concentration of Onion Cultivated From Normal Communities and War Liberated Communities

Parameter	ONC	OWLC
Cadmium (mg/kg)	0.33± 0.09	0.32 ± 0.03
Nickel (mg/kg)	0.95± 0.05	0.99± 0.10
Mercury (mg/kg)	0.66± 0.06	0.78± 0.09
Lead (mg/kg)	3.93± 0.90	3.51± 0.88
Chromium (mg/kg)	4.11± 1.02	4.67± 1.45
Zinc (mg/kg)	1.98 ± 0.32[a]	5.44 ± 1.09[a]

The data are presented as mean ± standard deviation (SD) of three replicates
Key: ONC=Onion from Normal community
OWLC= Onion from war liberated community

3.2 Discussion

Proximate composition of pepper and onion cultivated from war liberated communities was found to be

nutritionally richer than those cultivated from normal communities. The study shows moisture content of onion to be higher than that of pepper fruit. Fruits are known for their high moisture composition which is accountable for their vulnerability to microbial attack during storage which account for their short shelve life (Hassan *et al.,* 2008). The observed value is higher compared to that reported by Otu (2017).

The Ash content of was found to be higher in pepper than in onion in both normal and war liberated communities. The value was low compared to that reported by Otu (2017) and Okoronkwo *et al.* (2014). Ash content is reported to be directly proportional to mineral content (Aberoumand and Deokule, 2009).

Onion from war liberated communities was found to be higher in crude lipid than those cultivated from normal communities. High level of crude lipid could be in indication of good source of edible vegetable oil if well utilized. Lipids were also reported to possess some pharmacological activities (Yeats and Rose, 2013). The crude fibre was found to be very high in pepper particularly those cultivated from war liberated zones. This is by far higher than that of the same fruit as reported by Kudirat *et al* (2011). High fibre content in the diet lessens serum cholesterol level and assimilates essential trace elements in the gut (Abolaji, 2007). Fiber also aids in bowel regularity and decreases constipation (Wasagu *et al*., 2013).

Crude protein was found to be low in both pepper and onion from normal communities compared to liberated communities. Protein is a crucial source of amino acids and is required for development and maintenance of the body (Pugalenthi *et al*., 2004). The protein content was found to be lower than those reported from most vegetables and fruits (Okia *et al*., 2013).

Toxic metals analysis reveals higher content in both pepper and onion cultivated from war liberated communities than normal communities. It was observed that all the analyzed heavy metals were at the higher side of tolerable ranges set by International Standard Tolerable Limits and European Regulatory Standard (2001). Thus, the high level of Mercury in almost all the samples indicates potential hazards associated with human activities in those areas. It was reported that man-made activities like mining and war contaminates the environments by depositing these metal in the affected communities (Roberts, 1999)

The levels of these toxic metals in the farm produce may indicate their buildup to food chain as they are non-destroyable and bio accumulating, thus exposing human population to their harmful effects (Davidson *et al.,* 2004). This study established an alarming concentration in the samples analyzed.

Alhassan *et al* (2012) pointed out that human exposure to Lead can result in many biological effects depending on the level and duration of exposure. Lead resembles Calcium as divalent ion, it is therefore handled by the body as if it were Ca^{2+}, hence replacing the calcium in many biological systems and protein matrix with concomitant loss of biological activity. In addition other biochemical toxicity of Lead could be associated to its affinity to cell membrane and mitochondria, where it interferes with oxidative phosphorylation, and Na^{+}, K^{+} and Ca^{2+} ATPase pumps (Schumacher *et al.,* 1991).

The observed variation in nutritional quality of vegetable cultivated from different zones might be due to accumulation of nutrient in the soil as a result of abandoning of farm land for over three years during the occupation by Boko Haram insurgents.

4. Conclusion

The study demonstrated that pepper and onions cultivated from war liberated communities possesses higher nutritional quality than those cultivated from normal communities. The study also shows the presence of high toxic metals in pepper and onions cultivated in both communities. They should therefore be consumed with caution as chronic exposure to these Heavy metals even at low concentrations should can lead to various disorder.

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