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EFFECTS OF ENVIRONMENTAL VARIABILITY ON THE CHEMICAL COMPOSITION AND NUTRITIVE VALUES OF FOUR VARIETIES OF *CAPSICUM ANNUM L* GROWN IN SOUTH EASTERN NIGERIA.

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ABSTRACT: The chemical composition and nutritive values of varieties of ripe *Capsicum annum L* fruits, grown at two varied environmental locations during the late wet season, were evaluated. The results show that variations due to environmental locations, significantly ($p<0.05$) influenced the proximate composition as well as the mineral and vitamin compositions of the fruits. Meteorological observations revealed that lesser rainfall and warmer climate of Nsukka Zone appeared to favour higher chemical and nutritive compositions of the *C. annum* fruits examined.

INTRODUCTION

Capsicum peppers are all year round international vegetable crops used in many ways for domestic consumption, catering and industrial purposes. In Nigeria, its consumption rate accounts for about 40% of the total vegetable intake per person per day[1]. In terms of nutrition, pepper forms an important part of the diet, supplying higher amounts of some of the nutrients in other food materials such as β-carotene and Ascorbic acid[2] and it adds flavour and pungency to foods, cooked with it.

Literature reveals that identical crop varieties show marked differences in their yield and yield components when grown under widely diverse environmental conditions.[3,4,5]

There is dearth of information on the effect of environmental variabilities on the proximate composition, mineral elements and vitamins content of *C. annum* fruits grown in Nigeria. This paper therefore considers the variations in chemical and nutritive compounds in four varieties of *Capsicum* peppers grown in two different environmental locations in Nigeria. Such results could be an added knowledge to agronomists and food processors as well as plant breeders.

MATERIALS AND METHODS

Seed Collection:

Four seed varieties of *Capsicum annum L* were collected from the Department of Crop Science Seed bank, University of Nigeria, Nsukka. The varieities were '*acuminatum*' – small red cluster pepper (SRCP); '*grossum*' – Red sweet pepper (RSP) and '*longum*' – long red pepper (LRP). These three were all red fruited cultivars. The fourth variety was a yellow fruit type and also a '*grossum*', referred to as yellow aromatic pepper (YAP). Each seed variety was divided equally into two lots. The first lots were designated N-SRCP, N-RSP, N-LRP and N-YAP while the second lots were designated U-SRCP, U-RSP, U-LRP and U-YAP respectively.

Experimental Design:

The first seed lots were grown at the University of Nigeria, Nsukka farm (derived Savannah tropical zone) at 05°52'N, 07°24'E, with average annual rainfall of 1325mm and minimum and maximum temperatures 23.6 and 33.7°C respectively in 1996. The second seed groups were planted at the University of Uyo farm (humid tropical rainforest zone) at 05°02'N, 07°56'E with average annual rainfall of 2851mm and minimum and maximum temperatures of 17.8 and 28.6° respectively in 1996. These meteorological data were recorded during the study period from the respective meteorological stations at the two study locations. The planting were within the late rainy (wet) season and the farmlands were fallow prior to the plantings. Seeds were sown in the nursery bed and seedlings transplanted at seven weeks old. The filed design was a randomized complete block with three replications.

Fertilizers at the rate of 250kg/ha of single super phosphate (18%P_2O_5) was broadcast before ridging while 60kg/ha as calcium ammonium nitrate (26%N) was applied as top dressing in two equal split doses 2 and 5 weeks after transplanting according to an established method[3]. Weeding was manually done and when necessary. All efforts to raise the YAP variety at Uyo failed as seedlings died at the early stage.

The fruits were harvested at the on set of ripening and left in the laboratory for complete ripening to occur at room temperature (25±2°), prior to chemical analysis.

Chemical Compositional Analyses:

The proximate composition of the fruit was determined as follows: moisture, crude fat and ash content were determined as described by AOAC[6]. The total nitrogen was determined using the Microkjeldahl technique[7]. This involved an autoanalyzer with hydrogen peroxide as the solvent[8] and converted to crude protein by multiplying by 6.25; the carbohydrate was determined by difference. Determinations from each source were carried out in triplicate and results expressed on dry weights basis.

The fresh fruit was wet oxidized and the following mineral elements determined using Atomic Absorption Spectrophotometer (Model 703) for Ca, P, Fe, Zn, Mg[8].

Estimation of Vitamins:

Vitamins were estimated using the methods of AOVS[10]. Riboflavin was determined by the modified method of Scharffer and Kingsley[11]. Vitamin C was determined by the N-bromosuccinimide method[12].

Statistical Analysis:

Data were evaluated using a parametric students T-test in a completely randomized design (CRD)[13].

RESULTS

The effect of environmental variations on the nutritive values of pepper fruits were pronounced and are shown in tables 1, 2 and 3.

Table 1: Proximate chemical composition* of *C. annum* varieties grown in Uyo and Nsukka

Location	Fraction	U-SRCP	U-RSP	U-LRP	N-YAP
UYO	Moisture	50.93±0.43	64.17±1.22	58.21±1.33	
	Carbohydrate	3.56±0.25	6.03±0.57	11.52±0.95	
	Protein	2.40±0.13	2.10±0.10	2.16±0.23	
	Fat	0.64±0.16	1.77±0.06	1.86±0.13	
	Fibre	1.75±0.18	2.31±0.25	3.16±0.21	
	Ash	4.93±0.17	3.15±0.17	5.45±0.14	
NSUKKA	Moisture	48.57±1.38	60.36±1.46	53.63±1.75	59.25±1.45
	Carbohydrate	5.12±0.13	7.90±0.24	12.62±0.26	9.61±0.83
	Protein	3.67±0.06	3.53±0.21	3.80±0.25	5.10±0.25
	Fat	0.72±0.01	1.87±0.06	1.92±0.02	1.94±0.06
	Fibre	2.66±0.08	3.74±0.13	4.02±0.14	4.83±0.17
	Ash	5.32±0.14	6.44±0.17	6.81±0.27	7.90±0.33

*mg/100g. Each data is a mean of three determinations ± standard deviation.

In terms of proximate chemical composition of the fruits (Table 1), the moisture contents were higher in fruit varieties from Uyo than those from Nsukka. Contrarily, the carbohydrate, protein, fat, fibre and ash contents of the fruits harvested from Nsukka were significantly ($P<0.01$) higher than the values of related Uyo varieties. Irrespective of the planting location, carbohydrate amounts in U-LRP and N-LRP were higher than those of other varieties (11±0.95g/100g and 12.62±0.26g/100g). The N-YAP variety had superior proximate composition values than all other varieties except in carbohydrate where N-LRP proved better.

Table 2 shows the mineral element composition of the pepper fruits from both locations.

Table 2: Mineral element composition* of *C. annum* varieties grown at Uyo and Nsukka.

Uyo Varieties				
Element	U-SRCP	U-RSP	U-LRP	N-YAP
Calcium	6.02±0.23	4.23±0.28	3.91±0.25	
Potassium	20.52±2.15	23.61±1.88	31.10±2.85	
Sodium	5.14±1.12	1.96±0.23	2.21±0.52	
Magnesium	28.22±1.66	33.19±2.41	35.13±3.50	
Iron	2.19±0.64	1.42±0.01	0.82±0.01	
Phosphorus	21.16±1.90	49.31±3.24	33.85±3.12	
Nsukka Varieties				
Element	**U-SRCP**	**U-RSP**	**U-LRP**	**N-YAP**
Calcium	7.17±0.93	5.92±0.55	5.01±0.15	3.04±0.12
Potassium	22.73±1.85	25.73±1.57	34.80±2.80	26.83±1.73
Sodium	6.67±0.28	2.10±0.03	2.85±0.08	3.52±0.03
Magnesium	31.18±3.56	34.29±3.25	38.30±3.54	30.79±2.52
Iron	3.63±0.21	1.86±0.01	1.42±0.03	3.53±0.27
Phosphorus	23.36±1.71	51.12±2.65	36.13±2.52	39.62±3.11

***mg/100g. Each data is a mean of three determinations ± standard deviation.**

Among the major elements, phosphorus constituted the highest proportion in N-SRP and U-SRP (51.21mg/100g and 49.31mg/100g respectively) at both locations followed by magnesium (39.18mg/100g and 38.22mg/100g) in N-SRCP and U-SRCP respectively and potassium in N-LRP and U-LRP (22.73mg/100g and 205mg/100g respectively).

In both locations, varietal differences were highly significant (P<0.01) for the vitamin evaluated (table 3)

Table 3: Vitamin contents* of *C. annum* fruits grown at Uyo and Nsukka

	Uyo Varieties			
Vitamin	U-SRCP	U-RSP	U-LRP	N-YAP
	0.09±0.001	0.12±0.002	0.08±0.001	
	0.35±0.12	0.60±0.001	0.58±0.001	
	0.08±0.01	0.11±0.002	0.12±0.001	
	72.6±2.50	98.3±0.001	88.4±1.60	
	7.6±0.80	11.7±0.001	15.1±0.90	
	Nsukka Varieties			
Vitamin	U-SRCP	U-RSP	U-LRP	N-YAP
Thiamin	0.12±0.01	0.08±0.001	0.10±0.03	0.14±0.01
Niacin	0.50±0.03	0.82±0.02	0.73±0.04	0.84±0.3
Riboflavin(B_2)	0.10±0.01	0.12±0.001	0.15±0.02	0.13±0.02
Ascorbic acid	80.1±1.40	101.4±1.30	95.3±1.80	121.3±2.6
β-carotene	8.3±0.60	10.6±0.90	15.8±1.20	0.1±0.001

*mg/100g. Each data is a mean of 3 determinations ± standard deviation.

Ascorbic acid contents were paramount in terms of β quantity than the other components followed by β-carotene. All other vitamins evaluated were very low in quantity. The varietal X environmental interaction was highly significant (P<0.01) for the nutrient compositions although the interactions variances were small in magnitude when compared to their respective variety variances.

DISCUSSION

The higher moisture content in the pepper fruits at Uyo could be attributed to the humidity of the location of growth as observed in the mean annual rainfall of Uyo environment. However, the moisture levels were within the range expected of most vegetable fruits[14]. The higher carbohydrate concentration in N-LRP variety from Nsukka than that of Uyo could be due to very low rates of daily photosynthesis, possibly because of the humid climatic nature of Uyo leading to reduced photosynthetic sink[15]. The choice of this long peppers, locally referred to as "tatashi", for stew preparations by consumers, appears relative to the thickening ability of the peppers in cooked stews due possibly to their high carbohydrate levels. Therefore, those grown at Nsukka would be preferred on this score. The significant (P<0.01) variations in protein, fibre and ash contents of the pepper fruits between those grown at Nsukka and Uyo were normal; similar variations have been reported[16,17].

These variations they stated, may be due to different agro climatic soil conditions or even variety differences.

The low levels of mineral elements in the pepper fruits simply indicate that peppers are generally poor sources of mineral elements. The high phosphorus accumulation in the fruits from both locations might be attributed to the efficient mobilization of phosphorus from other parts of the plants such as leaves, to the fruit, to aid the ripening process[18]. The high magnesium content in the fruits agrees with the general observation of Meyer *et al*[15], for plant fruits. They have also associated magnesium with carotene formation in plants, hence the high level of β-carotene observed in LRP varieties in this study. The low values of calcium, sodium and iron might be associated with the acidic nature of south eastern Nigeria utisols[19,20]. The low contents of these elements in the soil invariably affect their absorption rate and quantity into the plant system, especially in the fruit[15].

The wet season is always characterised by higher relative humidity and lower evaporation. The higher vitamin contents of pepper fruits from Nsukka could be attributed to variety and environmental location effect. The lesser annual rainfall and warmer climatic nature of Nsukka environment were assets to the enhanced vitamins biosynthesis in the pepper fruits.

CONCLUSION

In conclusion, the differences in results obtained could be explained by the differences in the varieties tested as well as differences in the environmental conditions of the experimental sites. *C. annum* fruit is a poor source of food substances, but an excellent source of ascorbic acid. The high demand of "LRP" variety (*tatashi*) for stew preparations by consumers should be associated with the appreciable high level of carbohydrate content in them as discovered in this study. This is assumed to enhance the thickening of stews prepared with the variety. Finally, the chemical and nutritive compositions of four pepper varieties studied under the two environmental locations extend the knowledge of food quality assessment of a horticultural vegetable crop.

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