QUANTITATIVE ESTMATES AND THE INTERRELATIONSHIP OF SOME BIOCHEMICAL CONSTITUENTS IN *CAPSCIUM ANNUUM L.* VARIETIES FROM SOUTH EASTERN NIGERIA

CHUKWUMA S. I. ODOEMENA* & KINGSLEY E. AKPABIO
Department of Botany, Horticulture and Microbiology
University of Uyo
P. M. B. 1017, Uyo, Nigeria

ABSTRACT

Quantitative estimation of carotenoid, capsaicin and ascorbic acid contents and their interrelationship with each other were evaluated in seven varieties of *Capsicum annuum.* The highest carotenoid content was in N-LRP variety which also recorded the least capsaicin concentration. The N-YAP showed the highest value in capsaicin and ascorbic acid amounts than all the other varieties but least in carotenoid level. Ascorbic acid content was not significantly ($P < 0.05$) correlated with that of capsaicin in all the varieties while the carotenoid level gave a negative linear correlation with the capsaicin level, indicating an increase rate of 58%. In conclusion the study has revealed that the higher the carotenoid content in Capsaicum peppers the lower the capsicin and the pungency levels.

KEY WORD: ***Capsicum annuum*** *varieties*, Biochemical constituents, interrelationship.

*Corresponding author

INTRODUCTION

Peppers of the genus Capsicum are spices, and those cultivars or varieties with strong pungent flavours have been used in the past, not only in cooking of dishes, but also for preserving of perishable food materials especially before the advent of refrigerators. The pungent taste from pepper on consumption has been associated with an alkaloid compound called capsaicin which is also responsible for the heat effect on the touch receptors 1. The efficacy of capsaicin in health treatment has been documented by several workers 2, 3, 4. Several factors have been attributed to the variations in capsaicin content in pepper fruits 1, 5.

Carotenoids are the most important group of natural pigments found in pepper 6, 7. The hydrocarbon and oxygenated carotenoids have been associated with pro-vitamin A activity and anti-cancer effect respectively 8, 9, 10. It has been reported that the carotenoid concentration in pepper fruits varies with the fruit colour 6, 11.

Ascorbic acid, a hexose carbohydrate derivative 12 has been isolated in different species and varieties of pepper fruits 13, 14, 15. However, the main purpose of cultivation of pepper in Nigeria by the peasant farmers may not primarily be for its ascorbic acid value but rather for its pungency and spicy attributes.

There is dearth of literature information on interrelationship of some biochemical constituents of *Capsicum annuum* varieties, hence this study was carried out.

MATERIALS AND METHOD

Seven varieties of fresh, mature and ripe pepper fruit types used for the study were locally purchased from the direct growers. Six out of the seven varieties were three identical pairs purchased from Ibesikpo in Uyo Local Government Area of Akwa Ibom State and Opi in Nsukka Local Government of Enugu State of Nigeria. The six varieties were as follows: "acuminatum" – small red cluster pepper (U-SRCP & N-SRCP); grossum – red sweet pepper (U-RSP & N-RSP); longum – long red pepper (U-LRP & N-LRP). In addition a yellow fruited variety also a "grossum" but endemic to Nsukka environs known as Nsukka yellow aromatic pepper (N-YAP) was only obtained from Nsukka. The peppers were designated as follows: U-SRCP, U-RSP, U-LRP from Uyo and N-SRCP, N-RSP, N-LRP, N-YAP from Nsukka.

Extraction and estimation of capsaicin contents in the pepper varieties were determined 16. This was achieved by absolute methanolic extraction of the macerated pepper fruits and the capsaicin separated and purified using column chromatography. The content of the capsaicin isolated was estimated by Gibbs colourimetric method 16.

The isolation and quantitative determination of carotenoids from the pepper varieties were carried out spectophometrically 17 using UNICAM SP 8700 spectrophotometer.

Ascorbic acid estimation was according to the standard methods 18, 19 involving, spectrophotometric difference method. The whole experimental analyses were replicated five times in order to establish the reproducibility of the extracts and the results obtained are presented as the mean of five determinations. The regression coefficient analysis was determined according to the method of Sokal and Rohlf 20, using regression equation ($Y = a + bx$).

RESULTS AND DISCUSSION

The results of the quantitative estimation of carotenoid, capsaicin and ascorbic acid contents are presented in Table 1. The concentrations of carotenoid showed slight variations among the seven pepper varieties from the two locations. The carotenoid levels in the pepper samples from Uyo were lower than those from Nsukka. Though the differences in concentration among related varieties across locations were small while in some varieties the variations were high and significant ($P < 0.05$). N-LRP variety contained the

highest amount of carotenoid (88 ± 1.0mg/100g) while U-LRP variety was closer with 85±0.65mg/100g. The least carotenoid content was obtained from N-YAP variety (2.40 ± 0.02mg/100g). The carotenoid values of SRCP varieties from both locations were 40 folds higher than that of N-YAP (Nsukka yellow aromatic pepper) variety. The carotenoid level in the yellow fruited pepper variety (N-YAP) was about 98 fold lower than those in red pepper fruits. This seems to agree with earlier reports of Davies *et al.*, 6. They attributed the low values of carotenoid in yellow coloured pepper fruits to be due to the absence of an enzyme responsible for the conversion of capsanthin 5-6 expoxide which normally appears during ripening of red coloured pepper fruits. The slight variations in carotenoid amount in the pepper fruits across location in the related varieties might be due to genetic effect 21.

In addition the pepper varieties from Nsukka indicated higher capsaicin levels than those from Uyo. The least capsaicin content was obtained from U-LRP and N-LRP varieties, the concentrations of capsaicin in SRCP varieties from both locations measure favourably with that of N-YAP but were significantly ($P< 0.05$) lower than that of N-YAP but higher than those of other varieties (Table 1). The capsaicin levels in the Capsicum peppers determined the amount of the pungency, thus the higher the capsacin content, the greater the pungency. The high capsaicin content in N-YAP and SRCP varieties might be attributable to the presence of Lutein (a yellow carotenoid pigment) detected in the varieties (18.6% for N-YAP and 0.9% for SRCP respectively) 15. the yellow pigment has been associated with the degree of pungency in Capsicum peppers. 1, 15.

Data presented on the ascorbic acid levels (Table 1) showed that *Capsicum annuum* is an excellent source of vitamin C as all the varieties showed high contents of ascorbic acid in their fruits with the N-YAP variety ranking highest.

The results on the level of correlationship between pairs of the biochemical constituents in the pepper varieties are presented in Table 2. The data showed that the ascorbic acid and capsaicin contents were not significantly ($P > 0.05$) correlated ($r = 0.54$). The concentration of ascorbic acid increased positively and linearly with capsaicin content at the rate of 30% while that of the carotenoid showed a negative linearly increase with capsaicin level at the rate of 58%. The variation between ascorbic acid value and that of carotenoid was 48%. The linear regression equation of all the variables are presented in Table 2. The equations were relevant to the estimation of the relationship between the biochemical constituents examined.

In conclusion, it is significantly clear that the higher the carotenoid concentration in *Capsicum annum* fruit, the lower the capsaicin and the pungency levels and vice versa.

Table 1. Carotenoid, Capsaicin and Ascorbic acid concentrations of seven varieties of *Capsicum annuum* from Uyo and Nsukka

Location	Varieties	Carotenoid	Capsaicin	Ascrobic Acid
Uyo	U-SRCP	42±0.1	3.02±0.25	275±2.5
	U-RSP	78±0.6	2.26±0.13	258±3.6
	U-LRP	85±0.65	1.30±0.10	233±1.9
Nsukka	N-SRCP	45±0.2	3.0±0.51	279±3.2
	N-RSP	81±0.2	2.40±0.63	266±2.6
	N-LRP	88±1.0	1.37±0.15	240±1.5
	N-YAP	2.40±0.02	3.96±0.35	288±1.7

*mg/100g: Data are mean of 5 determination ± standard deviation.

REFERENCES

1. Huffman, V. L., Schadle, E. R., Vallalon, B. & Burns, E. E. (1978) Journal of Food Sci. 43, 1809

2. Sambauch, K. Satyanarayan, T. & Rao, M. I. (1978) Effect of red pepper (Chillies) and capsacin on fat absorption and liver fat in rats. Nutri. Reports Intern. 18 (5): 521-529.

3. Limlonwongse, S. & Chaitauchawong, R. (1979). Effect of capsaicin on gastric acid secretion and mucosal blood flow in rat. Jour. Of Nutri., 109 (5) 773-777

4. Srinivasan, M. R. & Sambuah, K. (1980) Influence of red pepper and capsaicin on growth blood constituents and nitrogen balance in rats. Nutri Reports Intern. 21, (3) 455-567.

5. Suzuki, T. Kawada, T. & Iwai, T. (1980) Effective Separation of capsaicin and its analogues by reversed phase high performance thin layer chromatography (HPTLC). Jour. Of Chomatography 198, 217-223.

6. Davies, B. H., Mathews, S. & Kirk, J. T. O. (1970). The nature and biosynthesis of the carotenoids of different colour varieties of Capsicum annuum. Phytochemistry 9, 797-805.

7. Nakayama, R. M. & Mata. F. B. (1973) Extractable red colour of chilli peppers as influenced by fruit maturity and alar, gibberellic acid and ethephone treatments. Hortic. Sci. 8 (3) 16.

8. Simpson, P. A. Brogdon, J. L. Sweeney, J. P., Mobley, E. O & Davis, D. W. (1983). Quality of six tomato varieties as affected by some compositional factors. Proceedings of Amer. Soc. Hortic., Sci 89, 532-538.

9. Beecher, G. R. & Khachik, F. (1984) JNCL. Journal of Natural cancer Institute, 73, 1897.

10. Moon, R. C. & Itri, L. M. (1984). Retinoids and cancer in the Retinoids. New York, chapter 14.

11. Kirk, J. T. & Juniper, B. E. (1967). Biochemcistry of chloroplasts (Edited by T. W. Goodwin) vol. 11p. 691, Academic Press, London and New York.

12. Pike, R. L. & Brown, M. L. (1975) Nutrition: An integrated approach (second edition) John Wiley and sons incorporated, New York U.S.A. 1082 pp.

13. Uzo, J. O. (1982) Inheritance of Nsukka yellow aroma, Ascorbic acid and carotene in *Capsicum annuum* L. Crop Research 22, 72-83.

14. Tindal, H. D. (1992). Solanaceae. In: Vegetables in the Tropics (9^{th} edition) Macmillan Publishing company Press, London P. 347-387.

15. Odoemena, C. S. (1997). Phytochemical study on seven varieties of *Capsicum annuum* L. Ph.D Dissertation. Department of Botany, University of Uyo, Nigeria.

16. Analyst (1963). Recommended methods of assay of crude drug. The determination of the capsaicin content of capsicum and its preparation. 89, (1059) 377-388.

17. Davies, B. H. (1976). Carotenoid. In: Chemistry and Biochemistry of plant pigments. (Goodwin, T. W. edition) Academic Press, London, chapter 19.

18. Pearson, D. (1976). The chemical analysis of foods (7^{th} edition) Churchill Livingstone, Edinhurg Press London. P. 107-157.

19. Osborn, D. R. & Voogt, P. (1978). The analysis of Nutrients in foods. Academic Press, London. P. 12-124.

20. Sokal, R. R. & Rohlf, F. J. (1973). Introduction to Biostatistics (second edition) W. A. Freeman and company San Francisco. 368pp.

21. Ibarbia, E. A. & Lambeth, V. N. (1969). Inheritance of soluble solids in a large/small fruited tomato cross. Journal America. Soc. Hortic. Sci. 94, 496-498.

Table 2: Interrelationship between Capsaicin, Ascorbic acid and Carotenoid contents in *Capsicum annuum* varieties using regression equations.

Dependent Variable (X)	Independent Variable (Y)	Prediction Equation	Correlation Coefficient (R)	Coefficient Determination	Significant of R^2 in equation (P=0.05)
Ascorbic acid	Capsaicin	Y=263.82±0.049X	0.5429941	0.2948425	NS
Carotenoid	Capsaicin	Y=130.70±0.265X	0.7613437	0.5796442	S
Carotenoid	Ascorbic Acid	Y=387.98±0.1808X	0.6896882	0.4756698	NS

Y = a + bx = Regression equation

df = 5

NS = Not significant

S = Significant