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Nutritional and Physico-Chemical Properties of Snake Gourd *Trichosanthes Cucumerina* Pulp Compared to Tomato

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ABSTRACT

Trichosanthes cucumerina (snake gourd), a lesser-known fruit was investigated for its nutritional and physicochemical properties, and compared with pear-shaped tomato. The fruits of both snake gourd and pear shaped tomato were harvested at two stages of ripeness (turning and fully ripe stages), deseeded and pulped. Half portion of the pulped samples was kept as untreated while the other was concentrated as puree. The samples were subjected to proximate, chemical and physico-chemical analyses. The pulp of ripe fruit of snake gourd was found to contain among other nutrients appreciable ($p<0.05$) levels of crude protein (28.0g/kg), potassium (83.04mg/100g) and calcium (24.39mg/100g), which are higher than those of pear-shaped tomato (6.6g/kg, 37.16mg/100g and 16.82mg/100g for crude protein, potassium and calcium, respectively). However, the contents of carbohydrate, total acidity, and ascorbic acid were lower in snake gourd (30.12g/kg, 0.14% and 0.0mg/100g, respectively) than in the pulp of pear-shaped tomato (56.7 g/kg, 1.28%, and 22.12mg/100g, respectively). Puree made by concentration of the pulp of snake gourd had higher ($p<0.05$) lycopene (79.24mg/100g) and ß-carotene (1.04mg/100g) but lower in viscosity (55cp) than puree made from pear-shaped tomato. The degree of ripeness was also observed to have direct influence on the emulsion capacity and pectin content of both the snake gourd and the pear-shaped tomato. The fruit of snake tomato is considered as an excellent dietary source of lycopene, ß -carotene and potassium.

Keywords: ***Snake gourd, tomato, nutrition, physico-chemical, mineral composition.***

INTRODUCTION

Trichosanthes cucumerina var. anguina is a herbaceous climber cucurbit. It produces long, cylindrical and narrow fruit that is yellow to red in colour when ripe. The unripe fruit is whitish in colour. Common names for this plant are snake tomato, n Nigeria; patole, in French; and in China, Chinese cucumber and snake gourd (due to the long snake-like gourds produced by the plant). The narrow curled shape of the fruit may have given it the name "snake" tomato.

Report by Badifu and Ogunsua (1991) and Ndukwu (2000) recorded that *Trichosanthes cucumerina* has fascinating agronomic characteristics such as disease, drought and humid (shade) resistant, and has a high yield. In the area of medicinal uses, the seeds and leaves of this plant have been explored extensively especially in Chinese and Indian herbal medicine (Zhang, 1990; Badifu and Ogunsua, 1991). Unfortunately not much is known about its food uses. Locally, the ripe fruit are used by few

consumers in the villages for preparing stew and soup (Dupriez and Deleener,1989; Onyeka, 2002).

In Nigeria, about 50% of the harvested ripe fruit of *Trichosanthes cucumerina* are wasted as a result of spoilage (decay), while about 40% of the ripe fruits are not even harvested at all from the farm (Onyeka 2003). The wastage associated with this fruit is enormous and farmers are no longer keen on cultivating the crop, the agronomic advantages notwithstanding. Limited knowledge of its nutritional and functional properties coupled with lack of appropriate processing technology, are associated with its low utilization. Knowledge of the food characteristics of this fruit would no doubt help to beefup its popularity in terms of consumption, utilization and processing.

This research is aimed at finding some of the nutritional and physico-chemical potentials of snake gourd and comparing them with those of spear-shaped tomato.

MATERIALS AND METHODS

Two kilograms of the fruit of *Trichosanthes cucumerina* (snake tomato) and *Lycopersicum esculentum* (pear shaped tomato) were harvested at two stages of ripeness (turning and fully ripe stages). After harvesting the fruit were washed, deseeded manually and pulped separately using National electric kitchen blender (Model 419, Japan) at speed number 2. For snake tomato, the yellowish pulp attached to the skin was scrapped with kitchen knife and blended with the reddish pulp (pulp attached to the seed). Half of the samples from both snake gourd and tomato were separately blanched at 60°C for 15 minutes and later concentrated to half the original volume. The concentrated samples were considered as "puree", though no additional ingredient was added to them. Both untreated (raw) and concentrated samples were tested for proximate, chemical and some functional properties. Proximate determination was done using the standard methods of AOAC (1990). Carbohydrate was determined by "difference" while total titratable acidity (TTA) was by titration method. Total soluble solids (TSS) and pH were determined with digital refractometer (Model PR-100, ATAGO Co. Ltd., Japan) and digital pH meter (Model 3010/3115 Jenway, Ltd. UK), respectively. The method of atomic absorption spectrophotometer AOAC (1990) was used for mineral analyses. A modified method of Okezie and Bello (1998) was used for the determination of emulsion capacity and stability. One gram of each sample was blended with 34ml distilled water for 30 sec in a high-speed homogenizer. Refined vegetable oil was added at the rate of 5 ml per min for 3min

The mixture was centrifuged at 2500rpm for 30min. The emulsion capacity was the amount of oil emulsified per gram of sample, while percentage of oil separation after 30 min of standing gave the value for emulsion stability. Pectin content was determined by the method of Pearson (1976). Lycopene content was determined using the Darbishire photometric method described by Pearson (1976) while AOAC (1990) method was employed for the determination of ß-carotene and ascorbic acid. Brookfield viscometer, (Model LVF synchro-lectric, Stoughton, MS, USA) was used to determine the viscosity of the samples. All the analyses were carried out in triplicates.

RESULTS AND DISCUSSION

The fruit of snake gourd was found to contain a higher ($p<0.05$%) value of moisture and protein compared to tomato (Table 1). At fully ripe stage it had values of 963.4g/kg and 28.0g/kg while tomato had 932.6g/kg and 6.6g/kg for moisture and

protein, respectively. In both fruits, the values of potassium and calcium increased with ripening while magnesium decreased (Tables 2 and 3). Generally snake gourd had higher ($p<0.05$%) values of potassium (83.03mg /100g) and calcium (24.39mg/100g) than tomato which had 37.16 and 16.82mg/100g for potassium and calcium, respectively (Table 3). The minerals that occurred in low ($p<0.05$%) quantities in the fruit of snake gourd are magnesium and iron (Tables 3 and 4). The ripe pulp of snake gourd contained 16.82 and 3.1 mg/100g magnesium and iron respectively while tomato had 37.95 and 5.41mg/100g, respectively

The values of ascorbic acid, total soluble solids and total titratable acidity in the fruit of snake gourd were significantly ($p<0.05$%) low compared to tomato (Table 5). Unlike the tomato, acidity in snake gourd decreased with ripening. Raw and

Interestingly, high quantities of ß-carotene and lycopene in snake gourd are commendable. Lycopene is the most effective antioxidant among carotenoids in lowering the risk of oxidative chronic diseases including cancer (Rao and Agarwal (1999). This means that products (e.g puree) made from snake gourd alone or in combination with other fruits such as tomato would have enhanced antioxidative potency. Like tomato, the nutritional composition of the fruits of snake gourd was not significantly affected by heat processing. The little increase in nutrient levels observed in concentrated samples could be due to loss of moisture during heating, which somewhat increased the concentration of those nutrients

Apparent problem associated with the puree made from the ripe fruit of snake gourd was its poor consistency (low viscosity) which might have been as a result of low total solid content of the pulp.

puree samples of ripe tomato had 22.12 and 23.15mg/100g of ascorbic acid respectively. For snake gourd, the values were only 0.0 and 0.34 mg/100g, respectively. pH values were also higher in snake gourd (5.5-5.41) than tomato (4.36-4.87). A higher ($p<0.05$%) amount of lycopene and ß-carotene was found in the fruit of snake gourd. Puree samples made from ripe fruit of snake gourd had the highest lycopene and ß-carotene content of 79.24 mg/100g and 1.04mg/100g (Table 6). In terms of viscosity, significantly low values of 40 and 55cp for fresh and puree samples respectively were observed in snake gourd as against 46 and 65cp respectively for tomato. Highest ($p<0.05$%) emulsion capacity occurred in ripe fruit pulp and puree of both snake gourd and tomato. The emulsion stability of the pulp of snake gourd was significantly higher (66.33%) than that of tomato (48.70%).

CONCLUSION

Though a lesser-known fruit, snake gourd could serve as a good culinary substitute to tomato in the area of paste/puree applications. The observed differences in the compositions of snake gourd compared to spear-shaped tomato were expected, since the fruits are not from the same specie of fruit.

The observed difference is considered as an advantages, since the fruits can play a complementary role to each other, so that some of the nutrients lacking in one will be supplied by the other. The two fruits could be combined during processing. The right proportion of combination would be determined through further research.

The problem of poor consistency could be eliminated by the use of processing aids such as food gums (e.g gum arabic), sucrose or commercial pectin. Another factor that needs adjustment during processing of the snake gourd fruit is acidity. The acid level of the pulp may be enhanced through the use of acidic food additives. Obviously, the high pulp yield (Onyeka 2003) of the snake gourd fruit would offset the cost of the additives.

Table I. Proximate compositions of fresh pulp of the fruit of snake gourd and tomato*.

Parameters	Turning stage of ripeness		Fully ripe stage of ripeness		
(gkg^{-1})	Snake Gourd	Tomato	Snake gourd	Tomato	$LSD_{5\%}$ For rows
Moisture	936.2 ± 2.3^{b}	921.5 ± 8.2^{a}	963.4 ± 4.2^{c}	932.6 ± 5.2^{b}	5.31
Protein (crude)	20.4 ± 0.01^{b}	9.8 ± 0.02^{a}	28.0 ± 0.3^{c}	6.6 ± 1.2^{a}	4.8
Ash	4.1 ± 0.03^{b}	$2.3\pm0.1^{a,b}$	$2.6\pm0.2^{a,b}$	1.9 ± 0.4^{a}	2.1
Fibre	0.5 ± 0.01^{c}	0.2 ± 0.01^{b}	0.2 ± 0.01^{b}.	0.1 ± 0.0^{a}	0.01
Fat (crude)	$2.9\pm0.04^{a,b}$	3.8 ± 0.1^{b}	2.4 ± 0.2^{a}	$3.7\pm0.12^{a,b}$	1.31
Carbohydrate	36.5 ± 0.8^{b}	62.9 ± 0.6^{d}	30.1 ± 2.1^{a}	56.7 ± 4.1^{c}	4.21

*Carbohydrate was calculated "by difference" Protein = N x 6.25

Values on the same row having similar superscript are not significantly different (p<0.05%)

Table II. Proximate compositions of puree made from the fruit of snake gourd and tomato*.

Parameters	Turning stage of ripeness		Fully ripe stage of ripeness		
(gkg^{-1})	Snake Gourd	Tomato	Snake gourd	Tomato	$LSD_{5\%}$ For rows
Moisture	427.11 ± 09^{a}	432.12 ± 4.5^{b}	451.10 ± 4.9^{c}	451.11 ± 6.7^{c}	4.31
Protein (crude)	48.20 ± 2.6^{a}	60.36 ± 9.1^{b}	48.21 ± 2.4^{a}	69.10 ± 2.0^{c}	2.24
Ash	15.05 ± 05^{a}	14.00 ± 2.6^{a}	15.21 ± 2.4^{a}	13.02 ± 2.1^{a}	3.11
Fibre	40.00 ± 2.1^{b}	$22.51\pm.3.1^{a}$	65.20 ± 2.1^{c}	57.15 ± 3.1^{c}	9.32
Fat (crude)	45.22 ± 08^{b}	45.22 ± 07^{b}	22.11 ± 06^{a}	19.71 ± 08^{a}	8.76
Carbohydrate	424.42 ± 10^{b}	455.81 ± 7.4^{c}	398.17 ± 7.0^{a}	389.91 ± 6.6^{a}	10.2

*Carbohydrate was calculated "by difference" Protein = N x 6.25

Values on the same row having similar superscript are not significantly different (p<0.05%)

Table III. Mineral composition of fresh pulp of the fruit of snake gourd and tomato.

Parameters ($Mg100g^{-1}$)	Turning stage of ripeness		Fully ripe stage of ripeness		$LSD_{5\%}$
	Snake Gourd	Tomato	Snake gourd	Tomato	For rows
Iron	2.22 ± 0.61^{a}	5.71 ± 0.42^{c}	$3.16\pm0.4^{a,b}$	$5.41\pm0.04^{b,c}$	2.31
Sodium	15.43 ± 1.4^{b}	16.48 ± 1.1^{b}	11.64 ± 3.1^{a}	15.52 ± 2.4^{b}	3.12
Potassium	42.72 ± 3.6^{b}	20.16 ± 2.3^{a}	83.04 ± 4.6^{c}	37.16 ± 2.7^{b}	5.64
Phosphorous	13.40 ± 1.3^{a}	15.95 ± 0.19^{a}	15.83 ± 2.1^{a}	19.92 ± 1.4^{b}	2.56
Calcium	12.12 ± 2.1^{a}	$14.72\pm2.5^{a,b}$	24.39 ± 2.2^{c}	16.82 ± 1.9^{b}	2.89
Magnesium	36.19 ± 1.5^{b}	50.49 ± 3.9^{c}	16.82 ± 1.8^{a}	37.95 ± 3.5^{b}	4.44

Values on the same row having similar superscript are not significantly different ($p<0.05\%$)

Table IV. Mineral composition of puree made from the fruit of snake gourd and tomat

Parameters ($Mg100g^{-1}$)	Turning stage of ripeness		Fully ripe stage of ripeness		$LSD_{5\%}$
	Snake Gourd	Tomato	Snake gourd	Tomato	For rows
Iron	9.43 ± 0.21^{a}	9.15 ± 2.2^{a}	15.34 ± 4.1^{b}	17.24 ± 4.4^{b}	4.31
Sodium	119.30 ± 1.2^{c}	559.51 ± 13^{d}	44.01 ± 3.3^{a}	62.81 ± 9.4^{b}	11.11
Potassium	817.21 ± 1.6^{d}	591.81 ± 11^{c}	410.04 ± 10^{b}	132.32 ± 7^{a}	12.62
Phosphorous	109.45 ± 1.4^{b}	103.34 ± 19^{b}	75.51 ± 5.1^{a}	103.01 ± 6^{b}	6.86
Calcium	875.71 ± 2.1^{c}	403.46 ± 5.3^{a}	920.03 ± 2.2^{d}	605.12 ± 5^{b}	19.88
Magnesium	104.28 ± 1.5^{a}	193.18 ± 4.2	95.71 ± 8.0^{a}	105.02 ± 3.5^{a}	14.99

Values on the same row having similar superscript are not significantly different ($p<0.05\%$)

Table V. Physico-chemical properties of fresh pulp of snake gourd and tomato fruits.

Parameters	Turning stage of ripeness		Full ripe stage of ripeness		$LSD_{5\%}$ for rows
	snake gourd	Tomato	Snake gourd	Tomato	
Vitamin C (mg/100g)	0.4^{a}	20.2^{b}	0.0^{a}	22.12^{c}	1.80
Beta carotene (")	NA	NA	0.32^{a}	0.21^{a}	0.20
Lycopene (")	6.2^{b}	11.8^{d}	8.96^{c}	3.12^{a}	1 03
TTA (%) as citric acid	0.31^{b}	1.03^{c}	0.14^{a}	1.28^{d}	0 01
TSS (°Brix))	1.43^{a}	5.97^{b}	3.31^{a}	7.63^{b}	2 26
pH	$5.37^{a,b}$	4.36^{a}	5.67^{b}	$4.63^{a,b}$	1.30
Pectin (g/100g)	0.8^{a}	3.2^{b}	1.3^{a}	4.5^{c}	1.20
Viscosity (cp)	35^{a}	40^{a}	40^{a}	46^{b}	5.62
Emulsion capacity (%)	$6.13^{a,b}$	5.40^{a}	7.77^{b}	7 03	2.01
Emulsion stability (%)	66.33^{b}	48.74^{a}	54.53^{a}	48.51^{a}	8.13

NA = not available; ***Values on the same row bearing similar superscript are not significantly different (p<0.05%)***

Table VI. Physico-chemical properties of puree made from the fruit of snake gourd and tomato.

Parameters	Turning stage of ripeness		Fully ripe stage of ripeness		$LSD_{5\%}$
	Snake Gourd	Tomato	Snake gourd	Tomato	For rows
Vitamin C (mg/100g)	1.70^{a}	22.22^{b}	0.34^{a}	23.15^{b}	1.43
Beta-carotene (")	NA	NA	1.04 (^{n}0.97)	0.80^{a}	0.02
Lycopene (")	66.5 (^{z}1.96)	11.2	79.24 (^{z}2.82)	39.21	1.14
TTA (%) as citric acid	1.2^{a}	4.01^{b}	1.10^{a}	5.17^{c}	0.12
TSS (°Brix)	13.51^{a}	20.42^{b}	15.31^{a}	22.80^{b}	2.69
pH	5.41^{b}	4.63^{a}	5.83^{b}	4.87^{a}	1.21
Pectin (g/100g)	2.0^{b}	1.9^{b}	1.9^{b}	1.7^{a}	0.10
Viscosity (cp)	52^{a}	$60^{b,c}$	$55^{a,b}$	65^{c}	5.60
Emulsion capacity (%)	4.93^{a}	5.63^{a}	8.70^{b}	8.77^{b}	2.41
Emulsion stability (%)	85.19^{b}	68.02^{a}	80.08^{b}	70.34^{a}	8.31

N value is for the red part of fruit only; z values are for the yellow part of fruit only

NA not available; Values on the same row bearing similar superscript are not significantly different (p<0.05%)

REFERENCES

AOAC. (1990) *Official Methods of Analysis*. Association of Official Analytical Chemists, Washington D.C.

Badifu, G.I.O. and A.O. Ogunsua. (1991) Chemical composition of kernels from some species of Cucurbitaceae grown in Nigeria. *Plant Foods Human Nutrition*. 41:35-44.

Dupriez, H and Deleener P (1989) *African Garden and Orchard*. Macmillan Publishers, London. 275-281.

Ndukwu, B E (2000). Conservation of germplasm of Trichosanthes cucmerina in Southeast Nigeria. *Paper presented at the regional workshop organised by Agricultural Society of Nigeria. FUTO Chapter*, Owerri August 2000. 115-119

Okezie B.O and Bello A.B (1988.) Physico-chemical and functional properties of winged beans flour and isolate compared with soy isolate *Journal Food Sci.* **53** (2) 450-454

Onyeka E. U. (2002). Preliminary nutritional evaluation of T*richosanthes cucumerina* (*var. anquina*) fruit. In: *Proceeding of 26th Annual Conference of Nigerian Institute of Food Science and Technology,* 4-8th November, 2002, Owerri Nigeria.(Eds. C. Ubbaonu, O. Eke & A Uzomah) 211-213.

Onyeka E.U (2002) Production of ketch-up from the fruit of *Trichosanthes cucumerina* (snake tomato). *A research report* Presented to Federal University of Technology, Owerri, Nigeria. p5.

Pearson D. (1976). *The chemical Analysis of Foods*. Churchill Livingstone, Edinburgh. 175-178

Rao AV, Agarwal S. (1999). Role of lycopene as antioxidant carotenoid in the prevention of chronic disease: A review. *Nutr Res*. **19**: 305-323.

Recommended dietary allowances (1974). 8th edition. National Academy of Sciences. Washington, USA.

Zhang Qingcai, (1990) Compound Q: Trichosanthin and Its Clinical Applications, *Oriental Healing Arts Institute*, Long Beach, California.