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Proximate Analysis and Total Lycopene Content of Some Tomato Cultivars Obtained from Kano State, Nigeria.

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ABSTRACT

Standard analytical techniques were employed to determine the proximate composition and lycopene content of three tomato cultivars namely: Roma VF, Ronita and UTC grown in six local government areas of Kano state, Nigeria. Results indicated mean values of 0.15±0.03, 0.16±0.01, 0.15±0.01% titratable acidity; 8.36±0.01, 8.14±0.02, 8.25±0.03% total soluble solids; 1.19±0.04, 1.25±0.03, 1.12±0.01% crude fiber; 2.26±0.05, 2.32±0.02, 2.60±0.02% crude protein; 0.18±0.01, 0.14±0.01, 0.14±0.02% ash content; 90.75±0.03, 88.43±0.04, 84.15±0.01% moisture content; 3.73±0.09, 4.59±0.09, 4.34±0.18 mg/100g vitamin C and 6.88±0.06, 6.88±0.02, 7.83±0.04 mg/100g lycopene content for Roma VF, Ronita and UTC respectively. The levels of the proximate parameters and lycopene contents have shown that the cultivars were of high nutritional quality and can be good sources of raw material for industrial use due to their high total soluble solids which are twice the minimum level recommended for tomato to be employed for industrial processing.

Keywords: Antioxidant, lycopene content, proximate composition, tomato cultivars

INTRODUCTION

Vegetables constitute a major source of vitamins, crude fiber, protein, antioxidant and minerals even though their protein content is usually low. Vitamins, lycopene and minerals are the main regulator of activities in humans (Robinson, 1997). As such, vegetable production has been adopted as a strategy for improving livelihood by reducing malnutrition through regular consumption of fruits and green leafy vegetables (SPF, 1995). Tomato (*lycopersicon esculentum Mill*.) has been noted as one of the most important nutritious vegetable crops consumed by man. It belongs to the family *solanaceae*, and cultivated in almost all home gardens and also in the field for its adaptability to wide range of soils. It is widely cultivated in tropical, sub-tropical and temperate climates, and ranks the third in terms of world vegetable production (Aoun *et al*., 2013).

Tomato is perishable vegetable, with a very short shelf life, usually 2-3 weeks (ANON, 2002). It is a popular fruit vegetable in Nigeria, though, its production is low compared to those of the temperate zones due to differences in environmental conditions, non-availability of high yielding varieties and cultural practices in the crop production. It is regarded as the most vital vegetable after onions and pepper (Adelana, 1975). Some of the key proximate factors such as moisture, acidity, crude fibre, protein, vitamin C and lycopene differ with cultivars, cultural and postharvest handling practices. Moisture is of importance in food processing as a number of biochemical reactions, stability, and physiological changes in food depend very much on it (Lees, 1971). Organic acids dictate the dominant micro flora in foods as many pathogenic and food spoilage microorganisms are unable to grow in high acids foods. This is because the acid levels tend to decrease with the maturity of vegetables and fruits, while the sugar, sucrose and fructose levels increase.

The ingestion of dietary fiber from variety of foods such as tomato prevents colon cancer, heart disease and also normalizes blood lipids thereby reducing cardiovascular diseases. The introduction of fiber rich foods in child's early life and continued consumption of these foods later in life has been encouraged (Nielsen, 2002). Ascorbic acid is widely distributed in nature and it is obtained richly in tomatoes. Its reducing ability makes it necessary to maintain the enzyme prolylhydroxylate in an active form by keeping the iron atom in a reduced state. It also ensures that the enzyme involved in the synthesis of collagen performs effectively due to its ability to solubilize all vitamins and keep them in a stable form. It has been observed that ripe tomatoes harvested mature-green and as ripe fruit contained the same quantity of ascorbic acid (Tee *et al.*, 1997).

Lycopene which is the red colored pigment found in tomatoes is a hydrocarbon with extended conjugated double bond as the carotenoids (Rodriguez and Kimura, 2004). As a fat soluble compound, lycopene has a similar absorption property as dietary fat. In the stomach

and duodenum, lycopene will separate from the food matrix and subsequently dissolve in the lipid phase (Krinsky and Yeun, 2005). Food processing is one of the factors that affect the bioavailability of lycopene and thus increase absorption. For instance heat induces isomerization of all *trans* lycopene to *cis*-isomers which would increase its bioavailability (Unlu *et al*., 2007). Dietary supplementation or adequate intake of lycopene and vitamin A rich foods is beneficial in asthmatic and rheumatoid arthritis patients and has been reported to be safe when used as food additive (Thrumbo, 2005). In recent times, the Roma VF, Ronita and UTC cultivars have become very popular among farmers in Kano state and this study has been designed to ascertain the proximate composition of some key factors that can determine their use for both domestic and industrial purposes.

MATERIALS AND METHODS

Reagents: All solvents used were of analytical grade produced by Sigma Aldrich (Madrid, Spain) and used without further purification.

Sample Collection and Pretreatment

The varieties of tomato were randomly purchased from Yankaba and Janguza vegetable markets within Kano metropolis and transported to the Chemistry laboratory. The samples were washed with tap water then rinsed with distilled water, stored in labeled black polythene bags and packed in a 2L plastic bucket.

Determination of Moisture Content

10 g of chopped tomato was into a pre-weighed petri-dish dried in an oven at 105ºC for four hours and then allowed to cool. The petri dish was then weighed. This process was repeated many times until the weight of the petri-dish with its content remained constant. Triplicate determinations were made for each cultivar (Gharezi *et al*., 2012).

Determination of Total Soluble Solids

10 g of homogenized tomato sample was placed into a 50 cm^3 centrifuge vial and span at 300 rpm for 10 min. Then, 2 cm^3 of the supernatant was measured into pre-weighed glass petri-dish and the weight taken before drying in an oven at 60ºC for 17 hr. Samples were weighed after oven drying and the results expressed in percentages. All determinations were carried out in triplicate (Quartey *et al*., 2012).

Crude Fiber Determination

100 g of the chopped sample was weighed into a beaker and 50 cm^3 of H_2SO_4 (1.25%) was added. The mixture was then boiled for 1 hour, filtered and the residue boiled with distilled water to dilute the excess acid. 50 cm^3 of NaOH (1.25%) was added and the mixture was boiled for another 1 hour. It was then filtered, washed with distilled water until free from alkali. The residue was then rinsed with acetone and dried in oven at 110ºC for 2 hr. The dried residue was ashed in a muffle furnace at 600ºC for 3 hours, cooled in a desiccator and weighed. The crude fiber content was calculated by difference (Adebooye *et al.,* 2006).

Crude Protein Determination

0.2 g of each homogenized sample was weighed into the digestion tube followed with the addition of 5 g of Kjeldahl catalyst mixture and 15 cm^3 of concentrated sulphuric acid. The tube was swirled gently until the mixture has thoroughly mixed. The mixture was heated continuously for 2 hr until the solution became clear and 15 cm^3 of 40% NaOH was added. The mixture was allowed to cool and then transferred into 100 cm^3 volumetric flask and diluted mark with distilled water. Another 10 cm^3 of 2% boric acid was measured into 100 cm^3 Erlenmeyer flask and few drops of Methyl red indicator were added. Furthermore, 10 cm^3 of digested aliquot was transferred into a distillation apparatus and then distilled into the boric/indicator for 15 min. The distillate was then titrated with 0.025M HCl to a pink end point (AOAC, 1990).

Determination of Titratable Acidity

10 cm^3 of the filtered tomato juice was added to 50 cm^3 of distilled water and titrated with 0.1M NaOH using phenolphthalein indicator (Gharezi *et al*., 2012).

Determination of Ash Content

2.0 g of the chopped, dried tomato sample was placed in a porcelain crucible and ashed in a muffle furnace at 600ºC for 3 hr. The crucible was allowed to cool and the weight of the ash taken (Owusu *et al.,* 2012).

Determination of Vitamin C

5 cm^3 of the homogenized sample was added to 1 cm^3 of acetic acid and titrated with 0.1M NaOH to the end point using indophenol indicator. Another 5 cm^3 of standard ascorbic acid in an Erlenmeyer flask was titrated with the indophenol until a faint pink color persisted as obtained above. These were carried out in triplicate and the volumes of NaOH were used to calculate the vitamin C levels in the standard as well as the samples (Egan *et al*., 1981).

Determination of Lycopene

100 g sample was ground to a homogeneous puree using an electric tissue blender and transferred into 250 cm^3 beaker. Subsequently, 50 cm^3 hexane-acetone-ethanol mixture (2:1:1 v/v/v) was added into the beaker and shaken for 15 min on an electric shaker. Thereafter, 3 cm^3 of distilled water was added and the sample was shaken for another 5 mins. The solution was transferred into 250 cm^3 separatory funnel and allowed to stand for

5 min to enable phase separation thereafter the upper layer (hexane) was then collected into an amber screw capped vial. An aliquot of the hexane extract was then transferred into a 1 cm^3 quartz cuvette and the absorbance taken at 503 nm against the solvent-blank using JENWAY (6405) UV-Visible spectrophotometer. The lycopene content of each sample was then estimated (Fish *et al.*, 2002).

RESULTS AND DISCUSSION

The moisture contents of the three cultivars are with the average levels 90.75±0.03, 88.43±0.04 and 84.15±0.01% for Roma VF, Ronita, and UTC respectively. Since foods with low moisture content have longer shelf life, thus UTC would have relatively longer shelf lives compared with Roma VF and Ronita. Various levels of moisture content for tomatoes have been previously reported and the results of this findings were in agreement with those of Oko-Ibom and Asiegbu, (2007), Adubofuor *et al.*, (2010) and Hossain *et al.*, (2010) who have reported the moisture content in the range of 88.19 - 90.67%, but higher than those of Adebooye *et al.*, (2006) who reported 78.56%. The variation in moisture content as regards the cultivar with respect to the location of cultivation is not significant.

The average ash contents of Roma VF, Ronita, and UTC were 0.18±0.01, 0.14±0.01, and 0.14±0.02% respectively and were closely in agreement with the results of Adubofuor *et al.*, (2010) and Suleiman *et al.*, (2011) who reported values ranging from 0.2 – 0.4%. The Roma VF has more ash and hence contains more mineral than Ronita and UTC and this observation is corroborated by the findings of Nielsen (2002) who evaluated the nutritional quality of these cultivars and observed that Roma VF has more minerals than those of Ronita or UTC. In this study, the highest levels of ash were found in Roma VF cultivars obtained from Dawakin Tofa, Rimin Gado and Ungogo indicating that the mineral levels were independent of the source.

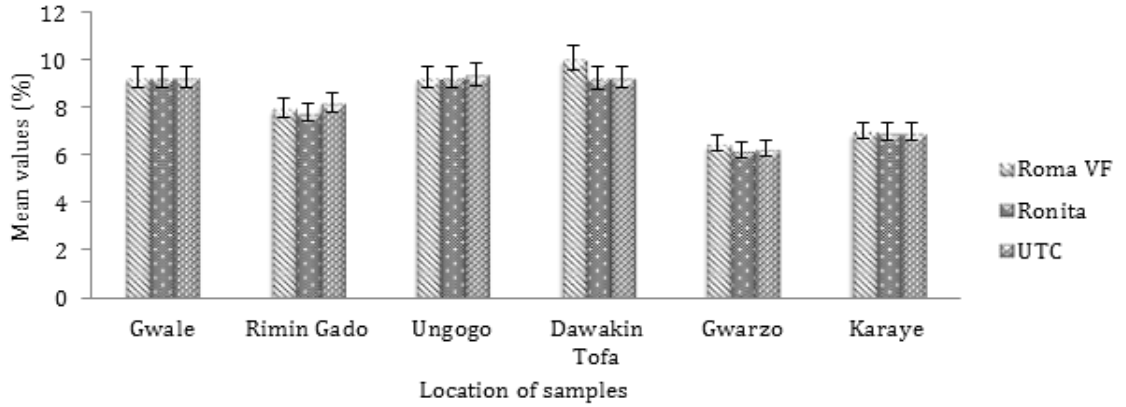

Figure 1: Levels of total soluble solids content in the three cultivars. Error bars represent standard deviation of results, *n* = 3

The average levels of total soluble solids (TSS) of Roma VF, Ronita, and UTC were as shown in Figure 1. These results agree with Nunoo *et al.*, (2014); Oko-Ibom and Asiegbu, (2007) with values ranging between 8.00 - 8.40% but higher than Adebooye *et al.*, (2006) and Adubofuor *et al.*, (2010) with values that ranged between 3.25 - 4.22%. These values were also about double the TSS values as reported by Adubofuor *et al.*, (2010) which was accepted as good for quality tomatoes, though Campos *et al.*, (2006) have earlier reported value of TSS of around 4.5% to be considered low for industrial grade tomatoes. The three cultivars would be good in paste production industrially as can be seen from their high TSS levels.

The average levels of crude fiber content in the three cultivars Roma VF, Ronita, and UTC were found to be 1.19±0.04, 1.25±0.03, and 1.12±0.01% respectively which were within the range of 0.70 – 3.25% obtained by Onifade *et al.*, (2013), Alvi *et al.*, (2003), Adebooye *et al.*, (2006) and Olaniyi *et al.*, (2010). The crude fibre values were found to vary widely with the location of cultivation as shown in Figure 2.

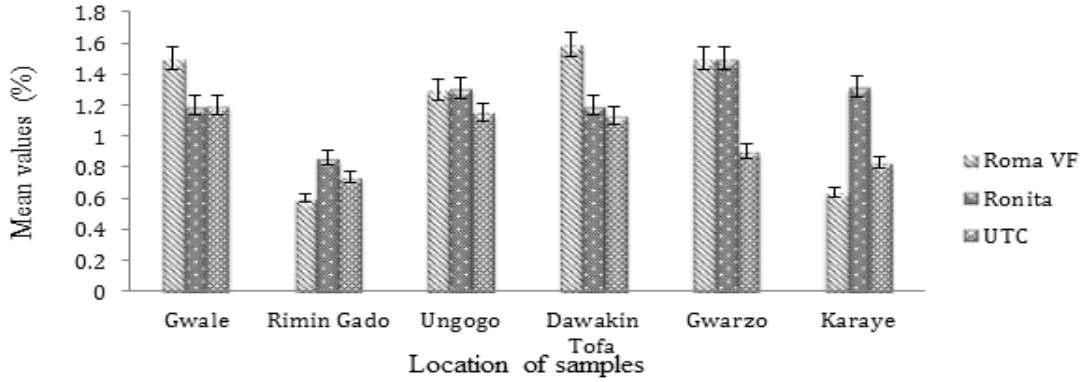

Figure 2: Levels of crude fiber content in the three cultivars. Error bars represent standard deviation of results, *n* = 3.

The average titratable acidity content of Roma VF, Ronita, and UTC was 0.15±0.03, 0.16±0/01, and 0.15±0.01% respectively and these values were much lower than the range ot 0.24 – 4.32 reported by previous researchers (Adebooye *et al*., 2006; Olaniyi *et al*., 2010; Gharezi *et al*., 2012; Suleiman *et al*., 2011). Since higher fruit acidity is an advantage as it causes a lower incidence for fungal infection (Mohammed *et al.*, 1999), these cultivars are susceptible to spoilage.

The average crude protein content of Roma VF, Ronita, and UTC were 2.26±0.05, 2.23±0.02, and 2.60±0.02% respectively which are in the lower range than previously reported values for other tomato cultivars. There was no significant difference among the three cultivars in relation to the location of cultivation.

Figure 3 indicated the average vitamin C content of Roma VF, Ronita, and UTC as 3.73±0.09, 4.59±0.09, and 4.34±0.18 mg/100g respectively. The three tomato cultivars had vitamin C in the lower range of reported values (Adebooye *et al*., 2006; Olaniyi *et al*., 2010; Adubofuor *et al*., 2010; Gharezi *et al*., 2012) which might be due to environmental factors. The level of vitamin C which decreases with increase in total soluble solids in tomato is known to vary with weather. It can be observed that the level of total dissolved solids for all the cultivars is double the amount of their vitamin C contents.

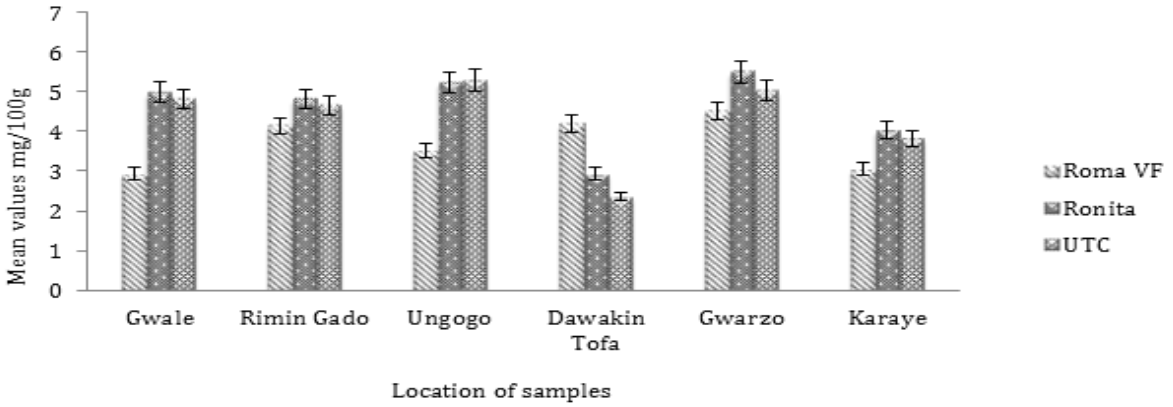

Figure 3: Levels of Vitamin C Content in the three cultivars in relation to the location of cultivation. Error bars represent standard deviation of results, n = 3

The average lycopene levels as shown in Figure 4 have content of Roma VF, Ronita, and UTC as 6.88, 6.88, and 7.83 mg/100g respectively. The UTC cultivar physically has a deeper red color compared with the other two varieties which is in agreement with these results. Various values have been previously reported for tomatoes, the values obtained in this work were in agreement with Malami and Mohammed, (2013); Wawrzyniak *et al.*, (2005) within the range of 3.79 - 17.53 mg/100g.

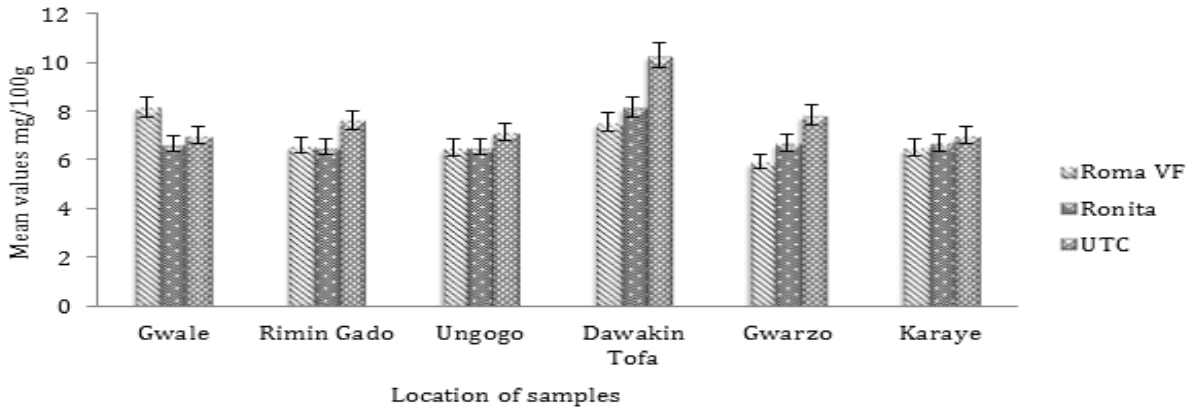

Figure 4: Levels of lycopene content in the three cultivars. Error bars represent standard deviation of results, n = 3

CONCLUSION

Each of the three cultivars of tomato irrespective of location showed no significant difference in physicochemical quality parameters such as moisture, ash, total soluble solids, crude fiber, ascorbic acid, titratable acidity, crude protein, and lycopene content. However, all the three cultivars have indicated high lycopene content which can meet the daily intake of lycopene by man. The three cultivars can provide fruits that can serve as good industrial raw material for the paste production because of their high total soluble solids.

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