VRI Press
Phytomedicine
JOURNAL HOME PAGE AT WWW.VEDICJOURNALS.COM
eISSN 2330-0280

ISSN 2330-0280 (Online); CODEN: VRIPBU, VRI Phytomedicine, VRI Press, Vedic Research, Inc. USA

RESEARCH ARTICLE

DOI: http://dx.doi.org/10.14259/pm.v3i2.167

# A Comparative Study on The Phytochemical Analysis of Cooked and Uncooked *Lycopersicon esculentum* Fruit

**EI EDIBAMODE*, BC DIDIA, EJ OLOTU**

*Department of Human Anatomy, Faculty of Basic Medical Sciences, College of Health Sciences, University of Port-Harcort, Nigeria*

**Article Info: Received:** *May 19th, 2014*; **Accepted:** *May 28th, 2014*

## ABSTRACT

**BACKGROUND:** Processed fruits and vegetables have been long considered to have lower nutritional value than their fresh commodities due to the loss of vitamin C during processing. The qualitative and quantitative estimation of the phytochemical constituents of a medicinal plant is considered to be an important step in medicinal plant research. Most studies have confirmed lycopene to be higher in the processed as well as the cooked fruit. **METHOD:** A comparative phytochemical screening and quantitative analysis was conducted on both the cooked and uncooked *Lycopersicon esculentum* fruits. **RESULT:** The phytochemical studies conducted in both the cooked and the uncooked *Lycopersicon esculentum* fruit has quantitatively revealed statistically insignificant difference. **CONCLUSION:** The comparative study of the phytochemical screening and quantitative analysis of the cooked and uncooked *Lycopersicon esculentum* fruits revealed both to contain major nutrients, vitamins, minerals, colouring pigments and anti-nutrients. These phytochemicals even if present in both specimen showed quantitative variations which when passed through test of proportionality difference were found to be statistically insignificant in proportion.

**Keywords:** *Phytochemical,Lycopersicon esculentum, Lycopene, Cooked and Uncooked.*

## Introduction

Phytochemistry is a distinct discipline somewhere between organic chemistry, plant biochemistry and closely related natural products. It deals with a variety of organic substances accumulated in plants. Not only their chemical compounds such as carbohydrate, protein, and lipids that are used as food by man but also a multitude of compounds like glycoside, alkaloids, flavonoid that are used as medicines by man in various ways and means. The qualitative and quantitative estimation of the phytochemical constituents of a medicinal plant is considered to be an important step in medicinal plant research [1].

*Corresponding Author
**EI Edibamode**
*Department of Human Anatomy, Faculty of Basic Medical Sciences, College of Health Sciences, University of Port-Harcort, Nigeria*
*Email:* edibamode.innocent@gmail.com

Phytochemicals, are chemicals or organic compounds that occur naturally in plants. Some are responsible for colour and other for organoleptic properties, such as the deep purple of blueberries and the smell of garlic. The term is generally used to refer to those chemicals that may have biological significance, for example antioxidants, but are not established as essential nutrients [2-4]. There may be as many as 4,000 different phytochemicals having the potential to affect diseases such as cancer, stroke or metabolic syndrome [3].

Phytochemicals are chemical compounds formed during the plant normal metabolic processes. These chemicals are often referred to as secondary metabolites of which there are several classes including alkaloids, flavonoids, coumaeins, glycosides,gums, polysaccharides, phenols ,tannins, terpenes and terpenoids [5,6].

Phytochemicals are present in a variety of plants utilized as

important components of both humans and animal diets. These include fruits, seeds, herbs and vegetables [7].

Phytochemicals in freshly harvested plant foods may be destroyed or removed by modern processing techniques, including cooking [8]. For this reason, industrially processed foods likely contain fewer phytochemicals and may thus be less beneficial than unprocessed foods. Absence or deficiency of phytochemicals in processed foods may contribute to increased risk of preventable diseases [9,10].

Processed fruits and vegetables have been long considered to have lower nutritional value than their fresh commodities due to the loss of vitamin C during processing. However, some studies [11] have shown that thermal processing rather enhanced the nutritional value of tomatoes by increasing the bioaccessible lycopene content and total antioxidant activity as against the notion that processed fruits and vegetables have lower nutritional value than fresh produce. It has been reported that food processing such as cooking or grinding might improve lycopene bioavailability by breaking down cell walls [12, 13].

It was in this regards that the comparative study of the phytochemical properties of the cooked and the uncooked tomato was studied, with a future intention of using both the cooked and the uncooked fruit as a therapeutic agent in wound treatment.

## Materials and Methods

*Lycopersicon esculentum* fruit was procured from the fruit garden market port-Harcourt and immediately taken to the Department of Plant Science and Biotechnology for identification and authentication. The fruits were identified and authenticated by Dr. N. L. Edwin–Wosu of same department with the species name as *Lycopersicon esculentum*, of the family of Solanaceae with identification number: UPH/P/058. All fruits were washed and the very good and healthy ones were selected and thereafter divided into two samples: A and B. The methodology by some researchers [11, 14] were adopted and modified. The sample A fruits tagged the cooked samples were boiled for 30 minutes at 100 degree celsus and thereafter oven dried at 60 degree celsus with the Gallen Kamp Hot box Oven for about 48 hours. The dried fruits were then ground using a blender. The sample B fruits tagged the uncooked sample were directly oven- dried at 60 degree celsus. Two hundred grams (200g) each of samples A and B were forwarded for phytochemical screening and proximate analysis.

Phytochemical screening was done by the Department of Pharmacognosy and Phytotherapy, faculty of Pharmacetical Sciences, University of Port-Harcourt-Nigeria. Simple chemical tests were performed to detect the presence of the following parameters : alkaloids (Drangedorff's Mayer's test was done), flavonoids (NaOH test was done), tannins (FeCI3 and Phlobatannins's test were done), saponins (Frothing and Emulsion tests were done) and anthraquinone (Bontragers test was done) from the dried fruits of both samples. Other phytochemicals also screened were triterpenoids/steroids (Liebermann-Buchard test and Salwoski test was done), carbohydrares (Molisch test and Fehlings test were used) and cardenolide (Keller Killuni test and Kedde test were used). The presence and absence of these parameters were indicated as positive (+ve) and negative (-ve) respectively.

The quantitative analysis for the major nutrients, anti-nutrients, vitamins and minerals were analysed at the Springboard Research Laboratories, Akwa, Anambra state where different techniques were used in quantitatively analysing these different parameters.

**Table 1: Result of phytochemical analysis/screening of cooked (sample A) and uncooked (sample B)** *Lycopersicon esculentum* **fruit.**

| | PARAMETERS | TEST | INFERENCE | |
|---|---|---|---|---|
| | | | SAMPLE A | SAMPLE B |
| 1 | Alkaloids | Drangedorff | +ve | +ve |
| | | Mayer | +ve | +ve |
| 2 | Flavonoids | NaOH | -ve | -ve |
| 3 | Tanins | FeCI3 | +ve | -ve |
| | | Phlobbatanins | -ve | -ve |
| 4 | Anthraquuinone | Bontragers | | |
| | Free | | -ve | -ve |
| | Combinded | | -ve | -ve |
| 5 | Triterpenoids/Steroids | Liebermann-Buchard | +ve | +ve |
| | | Salwoski | +ve | +ve |
| 6 | Carbohydrates | Mulisch | +ve | +ve |
| | | Fehling | +ve | +ve |
| 7 | Cardenolide | Keller Killuni | -ve | -ve |
| 8 | Saponins | Frothing | +ve | +ve |
| | | Emulsion | +ve | +ve |

NOTE: +ve = Present
-ve = Absent

## Results

The results of the phytochemical screening and quantitative analysis of the cooked and the uncooked *Lycopersicon esculentum* fruit, is shown in Tables 1 to 7.

**Table 2: Result of quantitative analysis of major nutrients in cooked (sample A) and uncooked (sample B) *Lycopersicon esculentum* fruit.**

| MAJOR NUTRIENTS | COOKED FRUIT | UNCOOKED FRUIT |
|---|---|---|
| Carbohydrate (%) | 27.90 | 8.11 |
| Energy (kj/100g) | 618.29 | 306.00 |
| Fat content (%) | 5.00 | 7.00 |
| Fibre content (%) | 11.00 | 9.00 |
| Protein content (%) | 3.47 | 2.87 |
| Ash content (%) | 20.00 | 37.00 |

**Table 4: Result of quantitative analysis of minerals in cooked (sample A) and uncooked (sample B) *Lycopersicon esculentum* fruit.**

| MINERALS | COOKED FRUIT (ppm) | UNCOOKED FRUIT (ppm) |
|---|---|---|
| Calcium | 60.20 | 44.85 |
| Copper | 0.18 | 0.15 |
| Iron | 7.45 | 12.04 |
| Manganese | 1.92 | 0.96 |
| Magnesium | 22.27 | 21.82 |
| Phosphorus | 1.43 | 1.54 |
| Potassium | 13.62 | 12.94 |
| Sodium | 8.01 | 8.02 |
| Zinc | 2.43 | 2.80 |

## Discussion

From the result of the study the anti-nutrients, alkaloids and saponins were found in both the cooked and the uncooked fruits; however, tannin was found in the cooked fruit only. Anthraquinone was absent in both specimens (Table 1). These discrepancies are still unclear; however, it could be due to the blend of different fruit varieties present and sold in our locality

**Table 3: Result of quantitative analysis of vitamins in cooked (sample A) and uncooked (sample B) *Lycopersicon esculentum* fruit.**

| VITAMINS | COOKED FRUIT | UNCOOKED FRUIT |
|---|---|---|
| A (mg/100g) | 14.67 | 24.43 |
| B1 (mg) | 0.09 | 0.08 |
| B2 (mg) | 0.07 | 0.07 |
| B6 (mg) | 0.03 | 0.02 |
| B12 (mg) | 0.53 | 0.55 |
| C (mg/100g) | 760.32 | 607.20 |
| E (mg/g) | 1.09 | 6.00 |
| Tocopherol (mg/g ) | 12.89 | 22.33 |

**Table 5 Result of quantitative analysis of pigments in cooked (sample A) and uncooked (sample B) *Lycopersicon esculentum* fruit.**

| PIGMENTS | COOKED FRUIT (mg/g) | UNCOOKED FRUIT (mg/g) |
|---|---|---|
| Beta carotenoids | 21.39 | 20.67 |
| Lycopene | 18.47 | 16.72 |

**Table 6: Result of quantitative analysis of anti-nutrients in cooked (sample A) and uncooked (sample B) *Lycopersicon esculentum* fruit.**

| ANTI-NUTRIENT | COOKED FRUIT | UNCOOKED FRUIT |
|---|---|---|
| Oxalate (mg/g) | 0.012 | 0.144 |
| Phytate (%) | 0.812 | 0.464 |

or due to the food processing done via cooking.

Processed fruits and vegetables have been long considered to have lower nutritional value than their fresh commodities due to the loss of vitamin C during processing. However, studies [11] have shown thermal processing to rather enhanced the nutritional value of tomatoes by increasing the bio accessible lycopene content and total antioxidant activity as against the notion that processed fruits and vegetables have lower nutritional value than fresh produce. More so a converse example may exist in which lycopene, a phytochemical present

**Table 7: Test of proportionality difference in nutritional content of cooked and uncooked lycopersicon esculentum fruit at 0.05 sig level**

| CONTENTS | Sample | Mean content (n) | Total content (N) | Observed proportion | z-value (cal) | \|z\| crit | P-value (obs) | Inference |
|---|---|---|---|---|---|---|---|---|
| Major nutrients | Cooked Tomatoes | 114 | 686 | 0.166 | -0.0577 | 1.96 | 0.9522 | No Significant difference in proportions |
| | Uncooked Tomatoes | 62 | 370 | 0.168 | | | | |
| Vitamins | Cooked Tomatoes | 99 | 790 | 0.125 | -0.0144 | 1.96 | 0.992 | No Significant difference in proportions |
| | Uncooked Tomatoes | 83 | 661 | 0.126 | | | | |
| Minerals | Cooked Tomatoes | 13 | 118 | 0.110 | -0.0972 | 1.96 | 0.9203 | No Significant difference in proportions |
| | Uncooked Tomatoes | 12 | 105 | 0.114 | | | | |
| Pigment | Cooked Tomatoes | 20 | 40 | 0.500 | -0.1185 | 1.96 | 0.9045 | No Significant difference in proportions |
| | Uncooked Tomatoes | 19 | 37 | 0.514 | | | | |
| Anti-nutrient | Cooked Tomatoes | 0.4 | 0.8 | 0.500 | Values insignificant for a proportionality test; indication of no Significant difference in proportions | | | |
| | Uncooked Tomatoes | 0.3 | 0.6 | 0.514 | | | | |

in tomatoes is either unchanged in content [15] or made more concentrated [11] by processing to juice or paste, maintaining good levels for bioavailability. In humans, lycopene bioavailability was greater from heat-processed tomatoes compared to fresh tomatoes [16, 17]. This suggests that heat-processed tomatoes had higher bioaccessible lycopene because of the elevated release of lycopene from the cell matrix. Some researchers [11] believe that the increase in bioaccessible lycopene content is primarily due to the increased release of phytochemicals from the matrix to make it more accessible in the extraction. Most lycopene is located in the outer pericarp and the skin attached to the insoluble fiber portion of the tomatoes [18]. It was also reported that lycopene was relatively stable to survive the commercial thermal processing conditions [19]. Of all the carotenoid pigments, lycopene is the most efficient singlet oxygen quencher [15]. The quenching constant of lycopene was found to be more than twice that of α-carotene and ten times more than that of R-tocopherol, thus making its presence in the diet important [18]

From the investigation by some researchers [11] on thermal processing to the total Antioxidant activity, vitamin C content was observed to decline with increased heating time at 88 °C. The raw tomato had the highest vitamin C content (0.76 ( 0.03 µmol of vitamin C/g of tomato). After 2, 15, and 30 minutes of heating at 88 °C, the vitamin C content dropped to 0.68 ± 0.02, 0.64 ± 0.01, and 0.54 ± 0.02 µmol of vitamin C/g of tomato (decreases of 10.53, 15.79, and 28.95 %), respectively. The decline in vitamin C content was statistically significant between the raw tomato sample and the heat-treated tomato samples.

This present study tends to conform to the findings of some researchers [11] to an extent that thermal processing increases the nutritional value of fruit rather than the contrary. In spite of these increase, a proportionality test conducted showed no statistical significant difference. For instance, lycopene – the powerful anti-oxidant in the cooked fruit was 18.47mg/g as against 16.72mg/g in the uncooked fruit. Another anti – oxidant vitamin C was higher in the cooked (706.32 mg/100 g) as against 607.20 mg/100 g in the uncooked fruit which was very unexpected since cooking of fruits and vegetables has been documented to reduce the vitamin C content [11].

Vitamins A, $B_{12}$ and E were lower in the cooked fruit as against the uncooked fruit, while Vitamins $B_1$, $B_2$ and $B_6$ were slightly higher in the cooked fruit as against the uncooked fruit (Table 3).

Of the major nutrients, carbohydrate, protein and fibre were higher in the cooked fruit as against the uncooked fruit while fat content was reduced in the cooked fruit.

In fact, the energy content in the cooked fruit was twice as much as that in the uncooked fruit (Table 2).

Of the ten minerals analysed in parts per million (ppm), calcium was the highest followed by magnesium, potassium and sodium. These minerals were also more in the cooked fruit than the uncooked fruit. The least of them all was copper followed by phosphorus and these coincidentally were also more in the cooked fruit than the uncooked fruit. Iron and zinc were lesser in the cooked fruits (Table 4). These variations in the phytochemical constituents in both the cooked and the uncooked fruits is making one to suggest that cooking or processing tends to increase some of the phytochemicals as well as reducing some. Despite these variations in the quantitative analysis in both the cooked and uncooked fruits the proportionality test conducted showed a statistically insignificant difference with respect to the major nutrients, vitamins, minerals, colouring pigments and anti –nutrients.

The importance of food dietary micronutrients depends on the total mineral content and on the level of other constituents in the diet that affect their bioavailability. Anti-nutrients affect or inhibit the availability of certain nutrients despite their adequate consumption. They can lead to trace element deficiency since some of them form stable complexes with minerals, which render them unavailable for intestinal uptake [21].

Calcium, being the highest of all the minerals is an important constituent of bones and teeth hence, the consumption of the *Lycopersicon esculentum* fruit especially the cooked fruit could be important in the prevention of osteoporosis, rickets and colon cancer. The fruits contain phosphorous, calcium and magnesium in appreciable amounts that are important in bone formation and their deficiencies can lead to abnormal bone development [22]. The mineral- iron, which was higher in the uncooked fruit, is required for blood formation and it is also important in normal functioning of the Central Nervous system [23].

The ratio of sodium to potassium (Na/K) in the body is of great concern for the prevention of high blood pressure [21] and such usually should not exceed the critical value of 1.0. The Na/K ratio for both the cooked fruit (0.59) and the uncooked fruit (0.62) were all less than the critical value of 1.0 which was similar to the study conducted by some scientistss [21] involving the cherry tomato variety with Na/K of 0.38.

The Ca/Mg ratio of 2.70 and 2.05 for both cooked and uncooked fruits respectively was higher than the recommended value of 1.0 [23] but lesser than the cherry tomato (3.35) in the work by some researchers [21].

Food is considered good if Ca/P ratio is above 1.0 and "poor" if the ratio is less than 0.5, while Ca/P ratio above 2.0 helps to increase the absorption of calcium in the small intestine [24]. The Ca/P ratio in this present study showed both cooked (42.11) and the uncooked (28.96) *Lycopersicon esculentum* fruits to be very good foods with extremely high calcium absorption potential that is even much higher than the cherry tomato (0.97).

The anti-nutrients like oxalate were lesser in the cooked fruit (0.01mg/g) as against the uncooked fruit (0.14mg/g), while phytate was higher in the cooked fruit (0.81%) than the uncooked fruit (0.46%).

## Conclusion

The comparative study of the phytochemical screening and quantitative analysis of the cooked and uncooked *Lycopersicon esculentum* fruits revealed both to contain major nutrients, vitamins, minerals, colouring pigments and anti- nutrients. These phytochemicals even if present in both specimen showed quantitative variations, which passed through test of proportionality difference were found to be statistically insignificant in proportion.

## References


1. Kokate CK: Practical Pharmacognosy. edn 4th. Vallabh Prakashan New Delhi 1994 :120-124.
2. U.S Food and Drug Administration: Guidance for Industry. Evidence-based reviewer system for the scientific evaluation of health Claims, 2009. http://www.fda.gov/Food/GuidanceRegulation/GuidanceDocumentsRegulatoryInformation/LabelingNutrition/ucm073332.htm (Accessed on August 7, 2014)
3. Fruits and Veggies, More Matters: What are phytochemical? Produce for Better Health Foundation, 2013. http://www.fruitsandveggiesmorematters.org/fruit-veggie-nutrition (Accessed on August 7, 2014.)
4. Micronutrient Information Center: Pytochemicals. Linus Pauling Institute, Oregon State University, Corvallis, Oregon, 2008. http://lpi.oregonstate.edu/mic/food-beverages/garlic (Accessed on July 12, 2014).
5. Harborne JB: Phytochemical methods : a guide to mordern techniques of plant analysis. edn 2nd. Newyork: Chapman and Hall Imprint. 1984.
6. Okwu DE: **Phytochemicals and vitamin content of indigenous spices of South Eastern Nigeria**. *J.Sustain. Agric. Environ.* 2004, **6**: 30-34.
7. Okwu DE: **Phytochemicals, vitamins and mineral contents of two Nigeria Medicinal plants.** *Int. J. Mol. Med. Adv. Sci.* 2005, 1(**4**): 375- 381.
8. Bongoni R, Steenbekkers LPA, Verkerk R, van Boekel MAJS, Dekker M: **Studying consumer behaviour related to the quality of food: A case on vegetable preparation**

**affecting sensory and health attributes".** *Trends in Food Science & Technology. 2013,* **33** (2): 139–145.

9. Liu RH: **Potential synergy of phytochemicals in cancer prevention: Mechanism of action.** *The Journal of nutrition 2004,* 134 **(12 Suppl)**: 3479S–3485S.
10. Rao AV, Rao LG: **Carotenoids and Human Health.** *Pharmacological Research,2007, 55* **(3):** 207–16.
11. Dewanto V, Wu X, Adom KK, Liu RH: **Thermal processing enhances the nutritional value of tomatoes by increasing total antioxidant activity.** *Journal of Agricultural and Food Chemistry 2002, 50* **(10)**: 3010–3014.
12. Gartner C, Stahl W, Sies, H: **Lycopene is more Bioavailable from tomato Paste than from fresh tomatoes.** *Am. J. Clin. Nutr.1997, 66* :116-122.
13. Shi J, Maguer ML: **Lycopene in tomatoes: chemical and physical properties affected by food processing.** *Crit. ReV. Food Sci. Nutr. 2000, 40*:1-42.
14. Ojiako OA, Igwe CU: **The nutritive, anti-nutritive and hepatotoxic properties of** *Trichosanthes anguina* **(Snake Tomato) Fruits from Nigeria.** *Pakistan Journal of Nutrition* 2008, *7 (1)*: 85-89.
15. Agarwal A, Shen H, Agarwal S, Rao AV: Lycopene content of tomato products: Its stability, bioavailability and in vivo antioxidant properties. *Journal of medicinal food* 2001, **4 (1)**: 9–15.
16. Bohm V, Puspitasari-Nienaber NL, Ferruzzi MG, Schwartz SJ: Trolox equivalent antioxidant activity of different geometrical isomers of β-carotene, α-carotene, Lycopene, and Zeaxanthin. *J. Agric. Food Chem. 2002, 50*: 221-226.
17. Stahl W, Sies H: **Uptake of lycopene and its geometrical isomers is greater from heat-processed than from unprocessed tomato juice in humans**. *J. Nutr 1996, 122*, 2161-2166.
18. Shi J, Maguer ML**: Lycopene in tomatoes: chemical and physical properties affected by food processing.** *Crit. ReV. Food Sci. Nutr. 2000, 40*:1-42.
19. Nguyen ML, Schwartz S J: **Lycopene stability during food processing.** *Proc. Soc. Exp. Biol. Med* 1998, **218**, 101-105.
20. Elbe JH, Schwartz, SJ: **Colorants: In Food Chemistry**, edn 3rd Edited by Fennema OR, Dekker, New York: 1996, 651-722.
21. Oyetayo FL, Ibitoye MF**: Phytochemical and nutrient / antinutrient interactions in cherry tomato** *(Lycopersicon esculentum)* **fruits.** *I.J.A.B.R.* 2012 2**(4)** : 681-684 .
22. Aletor VA, Aladetimi OO: **Compositional evaluation of some cowpea varieties and some underutilized legumes in Nigeria**. *Nahrung, 1989,* **33**: 999-1007.
23. Shills MY, Young VR, Nieman DC, Butterworth DE, Nieman. **Nutrition**: Edited by C.N, Wmc.Brown publishers, Dubugue, USA; 1992: 276-282.
24. Agatemor C: **Fluted pumpkin** (*Telfairiaoccidentalis*) **Culture and cookery.** Columbia, S.C USA: University of South Carolina press. 2007, ISBN 1-5700-3000-6.

Note: VRI Press, Vedic Research Inc. is not responsible for any data in the present article including, but not limited to, writeup, figures, tables. If you have any questions, directly contact authors.

**Visit us @ www.vedicjournals.com : DOI: http://dx.doi.org/10.14259/pm.v3i2.167**

Copyright © 2013-2015 VRI Press, USA. All rights reserved.

Authors Column