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# INFLUENCE OF DRYING ON THE LYCOPENE CONTENT OF TOMATOES GROWN IN BURKINA FASO

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## ABSTRACT

Drying operations aim to preserve food for extendedstorage periods. They induce variations in the food composition. This work aims to evaluate the influence of drying on the lycopene contents of twenty tomato samples of the Mongal F1 variety grown in Burkina Faso. The results in milligrams of lycopene per hundred grams of tomatoes are thus expressed. The fresh tomato had an average lycopene content of 4.37 mg/100g, while the dried tomato samples had an average content of 3.07mg/100g; a drop of 29.75%. The highest content for fresh tomatoes is 5.41 mg/100g, and the lowest is 3.11 mg/100g. As for the dried samples'the highest content is 4.22 mg/100g, and the lowest is 2.06 mg/100g. Generally, lycopene contents decreased during drying. Given these results, it would be desirable to encourage the consumption of tomatoes in their fresh state and for the cultivation of tomatoes to be encouraged and popularized, given their high lycopene content.

**Keywords:** Burkina Faso, Tomatoes, Lycopene.

## 1. Introduction

Tomato (*Lycopersicon esculentum L.*) is one of the most consumed vegetables mainly for its contribution of provitamin A in the form of carotenoid terpenes (Abushita et al., 2000, Boumendjel et al., 2012). It is an agricultural product rich in nutrients, in lycopene, the predominant carotenoid of tomatoes, with a rate of 80% (Rajoria et al., 2010). Lycopene, the primary dye responsible for the characteristic dark red color of ripe tomato fruits, has received much attention recently due to its beneficial effect in preventing pathologies (Markovic et al., 2006). Epidemiological studies have shown that the consumption of tomatoes and tomato-based products could prevent chronic diseases such as cancers of the oral cavity, pharynx, esophagus, stomach, rectum, prostate, and breast (Vaishampayan et al., 2007;Ferreira et al., 2000) as well as the risks of cardiovascular diseases (Riccioni, 2009).

Tomato production in 2010 in Burkina Faso wasestimated at 157,086 tons or 21% of total market garden production. According to the General Agricultural Census, the Northern region has the largest production with 39,639 tons, or 25% of total tomato production (Sawadogo et al., 2015). Several varieties of tomatoes are grown there.

Transformation and preparation processes often involve heat treatments that are likely to affect the micronutrient content and nutritional quality of the finished products.

For tomatoes grown in Burkina Faso, very few studies have focused on the evaluation of lycopene contents and the influence of solar drying on lycopene, hence the interest of this study, whose objectives are to, on the one hand, to determine the lycopene contents of fresh tomatoes grown in the Northern region and on the other hand to highlight the influence of solar drying on these contents.

## 2. Materials and Methods

**Plant material**: The plant material consisted of tomato (*Lycopersicon esculentum L.*) collected in March 2022 from a vegetable garden in Ouahigouya.

**Sampling**: A sample of twenty (20) tomatoes of the Mongal F1 variety produced in the vegetable garden was chosen randomly for chemical analysis in the laboratory. Fresh, firm tomatoes were washed in a water bath, disinfected for 10 min with 0.24% sodium hypochlorite, and then rinsed with water. The samples were then divided into two parts.

One part is intended for the analysis of fresh mash, and the other is designed for drying. The puree was obtained using a SEVEN 7 STAR type blender. The lycopene content of fresh samples was measured. After drying, the same series of samples was assayed to verify the presence or absence of an impact of drying on the lycopene content in the tomato.

**Drying and storing the tomato**: Dryingwas carried out in the sun for fourdays using a solar dryer. For this purpose, the carefully washed and cut tomatoes were exposed to the sun. After drying, they became hard and brittle, easy to crush. After drying, all samples were removed from the dryer and placed in an aluminum plate. The dried biomass was immediately weighed and crushed using a SEVEN 7 STAR mixer. The powder was manually packaged in plastic bags (2g/sachet). The tomato powder samples were immediately transported in an insulated bag to the health sciences research institute's laboratory, where chemical analyses of the nutrients were carried out. High-Performance Liquid

Chromatography (HPLC) was used to determine lycopene in tomatoes.

**Methods for measuring lycopene by HPLC**

**High-Performance Liquid Chromatography:** The HPLC chain used for the analysis of lycopene consists of a JASCO PU 980 model pump, a JASCO 975 UV/Visibledetector, a C18 nucleosyl chromatographic column of model SUPELCO LC18 25 cm long, 4.6 mm in diameter with particles of 5µm size. The system is coupled to an HP 3395 type integrator and a computer equipped with software (Galaxie Work Station) for recording, integrating and processing data.

Principle of HPLC analysis: the sample to be analyzed passes through a column filled with a stationary phase and is entrained by a vector solvent called a mobile phase. The active ingredients in the sample migrate differentially depending on their polarity and density. At the column outlet, a detector quantifies each active ingredient. On the chromatogram, the active ingredient is shown by a curve characterized by its area and retention time. To obtain the content, it is therefore necessary to have a lycopene standard.

**Calibration:** Calibration is an essentialstep in the analysis. It makes it possible to identify the peaks and the different retention times of the elements to be analyzed on the chromatogram, but also to calculate for each compound a relative calibration factor which will act as a correction factor during the concentrations calculations of the different substancesidentified. Determining the concentration of each compound of the calibration mixture is an important step in its preparation. To do this, dissolve X quantity of pure lycopene standard powder in 3 ml of hexane which will constitute the stock solution. We then diluted this stock solution with hexane by multiprocessing successive dilutions of 1/10, 1/100 and 1/1000. We then measure the optical densities (OD) of the 4 solutions (stock solution, dilution of 1/10, and 1/100 and that of 1/1000).

The analytical wavelength is 450 nanometers, corresponding to the optimal analysis wavelength of lycopene. The concentration of the lycopene standard solution is calculated using the value of the optical density of the dilution between 0.1 and 0.9. The following formula is used to calculate the concentration of the Standard: $C= (OD/\varepsilon \times L).10^{-3}$ µg/ml.

C = Concentration in µg/ml

O.D. = Optical Density

ε = Molar extinction coefficient

L = Length of the tank in cm

From the standard solution whose concentration has been accurately determined, a precise volume of this solution is taken, evaporated under a gaseous flow of nitrogen and taken up in 1 ml of acetonitrile to obtain a solution of final concentration 60 pmol/20µl. We thus obtain a solution ready for injection, which will be used to identify the peak and its corresponding area from the chromatogram. The injection is done in duplicate, and an average of the regions is calculated.

**Extraction:** Ten (10) mg of samplewere weighed. To this weighing, 1 ml of hexane was added. After vortexing for 2 minutes, this mixture is centrifuged at 3000 rpm for 5 minutes to break the emulsions. The hexanic phase is then taken and transferred to another tube. The mixture is then subjected to shaking and centrifugation. One (1) ml of the extract is then taken for evaporation under a jet of nitrogen, and the dry extract obtained is recovered in 1 ml of acetonitrile, the majority component of the mobile phase.

**Assay**: Sixty (60) µl of the extract recovered in acetonitrile are taken for injection in duplicate to quantify the different lycopene contents. The analyses were conducted with a mobile phase

composed of acetonitrile, dichloromethane, and methanol at 70%, 20%, and 10%, respectively.

## 3. Results

Lycopene contents in fresh samples and after drying: The determination of lycopene was carried out on twenty (20) fresh samples and after drying of the tomato. The results are recorded in the table below.

Table 1 presents the lycopene contents in twenty (20) tomato samples before and after drying. Overall, before drying, we note an average content of 4.37 ± 0.4 mg/100g; after drying, an average content of 3.07±0.3 mg/100g, a drop of 29. 75%.

The results presented in Table 1 are the mean ± standard deviations (each sample was analyzed in duplicate, and the mean was calculated). The Fisher's Exact Test, which was carried out, shows that samples bearing different letters in subscripts (a and b) indicate a statistically significant decrease. On each line, values with identical letters are considered not significantly different ($p > 0.05$). The results are expressed in mg/100g of tomato. Figure 1 presents the histogram of the lycopene contents of the twenty (20) fresh tomato samples after drying. There is generally a reduction in the contents after drying.

**Table 1: Lycopene contents in fresh samples and after drying**

| SampleNumber | Contents (mg/100g) of lycopene in fresh samples | Contents (mg/100g) of lycopene in dried samples |
|---|---|---|
| 1 | 4,12 ± 0,3[a] | 2,82 ± 0,3[a] |
| 2 | 3,11 ± 0,2[a] | 2,06 ± 0,1[a] |
| 3 | 5,17 ± 0,4[a] | 3,13 ± 0,4[b] |
| 4 | 4,18 ± 0,3[a] | 2,94 ± 0,2[a] |
| 5 | 3,38 ± 0,2[a] | 2,13 ± 0,3[b] |
| 6 | 4,31 ± 0,4[a] | 3,31 ± 0,4[a] |
| 7 | 5,22 ± 0,5[a] | 3,54 ± 0,3[a] |
| 8 | 4,51 ± 0,4[a] | 3,26 ± 0,5[a] |
| 9 | 3,64 ± 0,3[a] | 2,31 ± 0,4[b] |
| 10 | 3,58 ± 0,2[a] | 2,25 ± 0,2[b] |
| 11 | 4,17 ± 0,3[a] | 3,04 ± 0,4[a] |
| 12 | 5,01 ± 0,4[a] | 4,22 ± 0,5[a] |
| 13 | 3,39 ± 0,2[a] | 2,18 ± 0,3[b] |
| 14 | 5,41 ± 0,4[a] | 4,14 ± 0,4[a] |
| 15 | 4,41 ± 0,4[a] | 3,05 ± 0,3[a] |
| 16 | 5,13 ± 0,4[a] | 3,85 ± 0,3[a] |
| 17 | 4,45 ± 0,4[a] | 3,28 ± 0,3[a] |
| 18 | 4,51 ± 0,3[a] | 3,11 ± 0,4[a] |
| 19 | 4,54 ± 0,3[a] | 3,15 ±0,5[a] |
| 20 | 5,13 ± 0,3[a] | 3,61 ± 0,4[a] |
| **Average** | **4,37 ± 0,4[a]** | **3,07 ± 0,3[a]** |

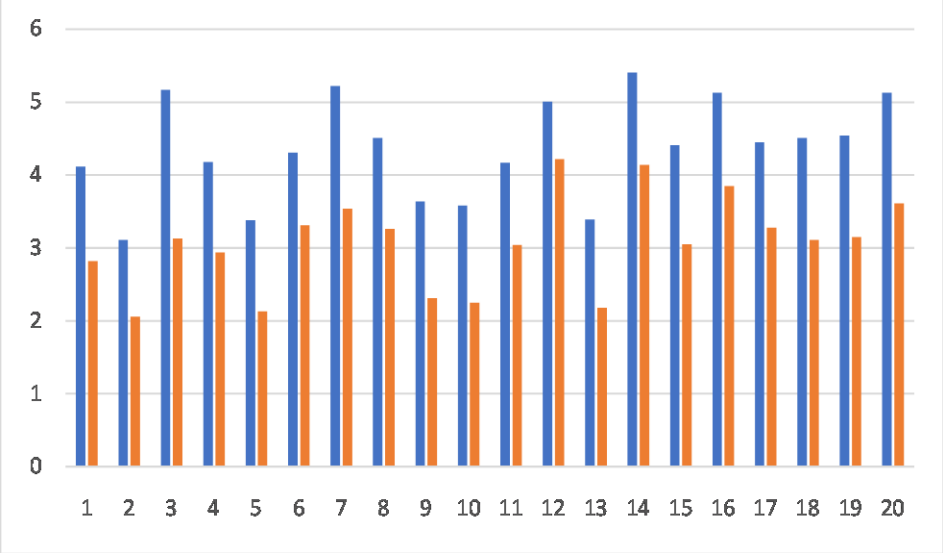


**Figure 1:** Comparative histogram of lycopene contents in tomatoes before and after drying.
X= sample number (from 1 to 20).
Y= Lycopene content (in mg/100g).
Blueseries : Histogram of lycopene contents of fresh samples.
Redseries : Histogram of lycopene contents of dried samples

## 4. Discussion

The present study showed the presence of lycopene in all tomato samples (both fresh and dried tomatoes) with, however, more or less significant variations in contents. The highest content for fresh tomatoes is 5.41 mg/100g, and the lowest is 3.11 mg/100g. As for the dried samples'the highest content is 4.22 mg/100g, and the lowest is 2.06 mg/100g. These variations could be due to the different degrees of ripening within the tomato fruits, even if, in appearance, the tomatoes had approximately the same degree of ripening. The variation in dried tomato contents could be due to the different degrees of exposure to sunlight and the difference in homogeneity of tomato powder. To this could be added the bias linked to the active ingredient extraction. For fresh tomatoes, the average lycopene content of all samples is 4.37 mg/100g. The average lycopene content of dried tomatoes is 3.07 mg/100g; a drop of 29.75%. There was a drop in content in all the dried tomato samples, with significant differences in five samples (samples 3, 5, 9, 10, and 13). Studies conducted by Sawadogo et al. in 2015 on the lycopene content of four varieties of tomato in Burkina Faso showed a decrease in the lycopene content of dried tomatoes compared to fresh samples. Indeed, the Mongal F1 variety suffered a drop of 15%, and the drop was much more significant for the

Rio Grande variety, with a loss of 31.1%; the Tropimech variety lost 30.7% of the lycopene content, while Royale declined by 23.5%. (Sawadogo et al., 2015).

Other factors could also explain this difference in content. Indeed, Helyes et al. (2007) showed that environmental factors, such as high fruit surface temperature caused by high air temperature or direct sunlight, decrease the lycopene content in the fruit skin and also decrease significantly the lycopene content of the whole fruit (Helyes et al., 2007). Helyes et al. (2006) further showed that lycopene content increases with fruit ripening (Helyes et al., 2006). Also, Chanforan (2010) showed that growing conditions (harvest date in the year, sunshine, temperature, soil quality, etc.) can significantly affect the carotenoid content (Chanforan, 2010).

A study conducted by Mendelová et al. (2013) showed that the lycopene contents of fresh tomatoes of six tomato varieties (Darina F1, Denár, Kecskeméty, Orange, Paulína F1, and Šejk F1) vary both intra-varietally and inter-varietally (Mendelová et al ., 2013). Similarly, Toor et al. (2006) found values of between 2.7 and 4.7 mg/100 g in three varieties studied (Toor et al., 2006). These differences in results confirm that lycopene contents differ from one variety to another.

According to Kumar et al. (2014), the chemical structure of lycopene, particularly the long conjugated chain of C=C double bonds, predisposes lycopene to isomerization and degradation upon exposure to light and heat (Kumar et al., 2014). Solar drying negatively affects the lycopene contents of all tomato samples. The dual action of heat and sunlight could justify this reduction. Antioxidant microconstituents, mainly carotenoids sensitive to heat and light, can be partially degraded during oxidation and/or isomerization reactions (Chanforan, 2010). Also, oxygen is likely to react with radicals derived from carotenoids to produce peroxide radicals capable of propagating lipid peroxidation.

## 5. Conclusion

The tomato variety studied generally has an exciting lycopene content. The lycopene content varies in both fresh and dried samples. An overall decrease is also noted in dried tomatoes. A significant reductionwas observed at the level of five samples. Because of these results, it would be desirable to encourage the consumption of tomatoes in their fresh state and for the cultivation of tomatoes to be encouraged and popularized, given their high lycopene content. Further investigations must also be carried out to valorize lycopene from by-products of tomato processing units and its incorporation into human food in terms of its beneficial effects on health.

**Conflict of interest :**

The authors declare that there is no conflict of interest for this publication.

**Acknowledgment :**

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