

Transformation of Fresh Tomato Into Powder and its Conservation by the Artisanal Drying Method in the Province of Uíge in Angola

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ABSTRACT

Tomato is a plant belonging to the Solanaceae family, scientifically named *Lycopersicum esculentum* Mill. Essential for the agricultural industry; the tomato is one of the most cultivated and consumed used agricultural products by most of the population of the province of Uíge in Angola. It has excellent nutritional value, rich in vitamins, lycopene, and mineral salts, and can be eaten fresh or processed. The tomato is essential not only for its nutrients but also for its health benefits [9]. When making field observations, two aspects caught our attention: When large quantities of tomatoes are produced but not sold, we noticed that the rest of the merchandise gets rotted due to their water content. On the other hand, almost all markets and supermarkets in Uíge sell fresh tomato and other tomato products (tomato paste, ketchup, etc.). However, there is a shortage of tomato powder in the market. Thus, this research aims to transform fresh tomato into powder, analyze the quality of the powder, conserve it to minimize post-harvest losses, and at the same time offer a different sensory product to the population of Uíge. In order to achieve the objective of our research, we have built a small-scale greenhouse for drying fresh tomatoes. The tomato powder was taken to the chemical laboratory of Kimpa Vita University (Uíge/Angola) for chemical analysis of the product stored for 75 days. Organoleptic analyses, such as glycogen content (reducing sugars), titratable acidity, pH, and moisture content, were carried out. In addition, the identification of some phytochemical substances such as flavonoids, lycopene, anthocyanins, and reducing sugar. The samples analyzed within the 75 days of storage presented the following results: The colour remained light red from day 1 to day 48, and from December 9th to the end of the experiment, it changed to dark red. Odour and taste changed from very good to good. The texture remained powdery. During the identification of chemical substances, we found flavonoids, lycopene, and glycosides in the tomato powder. As for the physical-chemical parameters, the following averages were obtained respectively: pH: 4.02, acidity in citric acid: 0.4%, moisture content: 36.6%, Glucose content: 4.46%.

Keywords: tomato, processing, drying, conservation, chemical analysis.

INTRODUCTION

Food is essential for life because human health depends on it (SESC , 2003). For millions of years, most foods (agricultural products) were harvested and consumed almost immediately so that they do not decompose and endanger human health.

However, "only" about two hundred years ago, a fast and sustained evolution in human nutrition began. Around this time, the first step was taken to create an industry devoted to transforming and conserving food (agricultural products).

This technological innovation made it possible to guarantee the preservation of foodstuffs for more extended periods. Thus, it became possible to do the following:

- Storing foods that will be consumed during shortage;
 - Transport certain foods to places where their consumption was not possible due to their perishable nature and the lack of proper transportation conditions;
- To provide consumers with new flavours of agri-food products

Among the vegetables grown worldwide for consumption in nature and, above all, industrialized, the tomato (*Lycopersicon esculentum* Mill), a vegetable whose edible part is the fruit, stands out, the reason why it is considered of universal production and use. This climacteric fruit is highly perishable; thus, conservation techniques in post-harvest can contribute to minimizing its losses and adding value). [1]

Tomato (*Solanum Lycopersicum L*) is a fruit of great socio-economic importance and an important source of minerals, vitamins, and antioxidant pigments such as lycopene. A study of over 47,000 men showed that those who consumed tomato products ten times or more per week had less than half the risk of developing advanced prostate cancer. [6]

Thus, a diet rich in lycopene is essential to reduce the risk of developing various types of cancer and cardiovascular diseases.

However, this fruit is quite perishable, and with a relatively short shelf life, post-harvest losses are very high (25% - 50%) compared to other vegetables. These are among the significant problems faced by farmers, wholesale traders, and consumers. [5]

Post-harvest preservation methods for tomatoes can contribute to minimizing losses. One of these methods is drying. Drying is one of the oldest methods of food preservation; it consists of eliminating water from the food. There are two methods of drying: the natural, which is done in the sun, and the artificial, which needs energy supply, different from the solar one. [4]

Tomato powder is obtained by grinding dried tomatoes; this has several advantages, such as ease of packaging, transport, and handling. It can be reconstituted into pulp or juice and used as a base for preparing products such as sauce, ketchup, soups, seasonings, etc.

The quality of tomato powder depends on the characteristics of the raw material and the drying process. Therefore, the study of the efficiency of the drying method and the factors influencing the quality of dehydrated products is essential to establish the best process condition to obtain a high-quality product. [10]

It is necessary to analyze the quality parameters to know the conservation status of tomato powder. Several researchers studied physicochemical parameters and summarized them in the table below.

Table 1: Quality parameters of tomato powder

Parameter	Values
pH	4,0 – 4,5 (ácid)
Soluble solids	4,3 – 5,4 (salad/italian tomato) 8,0 (sweeter mini tomato)
Acidity in citric acid (g/100g)	0,33 – 0,5
Vitamin C (mg/100g)	21,2
Lycopene (mg/g)	60 – 80
Potassium (mg/100g)	22,0

Source : [11]

MATERIALS AND METHODS

Origin of raw material

We used tomato fruits of the Italian variety purchased at the conventional market fair in the municipality of Uige /Angola.

Tomatoes were selected according to the following criteria:

- Intense red colouration in the skin and pulp;
- Uniformity of size
- Good quality
- Physiologically developed;
- Absence of stalk;
- Clean;
- A pH $\leq$ 4.5; [13].

Transformation of fresh tomato into powder

To make tomato powder, we used a handmade wooden stove.

Description of the apparatus

The device is made of wood, powered by 220V-50Hz from the outlet, and has the following dimensions: 13.2cm in length, 19.5cm in width, and 19.2cm in height. Its interior is coated with aluminum paper, with an iron grid also coated with aluminum paper to avoid oxidation; it contains two 75 Watts lamps, a 12 V fan, and two mercury thermometers.



Figure 1: Drying process
Source : Authors

Analysis of quality parameters

For quality control of tomato powder, organoleptic and physicochemical parameters were analyzed.

Organoleptic parameters

To analyze the organoleptic parameters, it was necessary to count on the help of 20 families to express their opinions about the product.

Physical-Chemical parameters

Due to the lack of laboratory materials, we use classical analytical methods in chemical analyses.

Identification of some Organics and natural substances

✓ Reducing sugar in glucose

The identification of reducing sugars was made according to Instituto Adolfo Lutz, 2008, based on the Fehling method.

✓ Flavonoids

For flavonoid identification, 1g of tomato powder was placed in a test tube containing 3ml of 5% sulfuric acid (blue-violet fluorescence) in the filtrate and added a few drops of distilled water with a syringe to have a white residue (indicating the presence of flavonoids).

✓ Anthocyanins

A decoction (5 minutes) of tomato powder was done in the filtrate; we added a few drops of the hydrochloric acid solution and sodium hydroxide. Therefore, there was a change in color (blue).

✓ Lycopene

Lycopene is identified using a three-step soxhlet extraction process.

Quantification of any quality parameter of tomato powder

✓ pH

The pH was determined with a pH meter that is handled according to the manufacturer's manual instructions.

✓ Titratable Acidity

The acidity expressed as % citric acid was determined by neutralization volumetry. [2]

The equation calculated the acid concentration:

$$\% \text{ acidity} = \frac{V_{NaOH} \times C_{NaOH} \times 0,070 \times 100}{V_{sample}} \quad (1)$$

✓ **Moisture content**

Moisture contents were determined using the Dean-Stark method. (2004)

The moisture content (%U) was calculated using the following equation:

$$\%(U) = \frac{P_1 - P_2}{P_1} \times 100 \quad (2)$$

Where:

P1: weight of fresh (wet) sample

P2: weight of the dry sample

P1-P2 = weight loss

100 = conversion factor to percentage

✓ **reducing sugar in glucose**

It is determined according to Instituto Adolfo Lutz, 2008.

The equation calculates the content of reducing sugars in glucose:

$$\% \text{ glucose} = \frac{100 \times A \times a}{m \times V} \quad ((3))$$

Where:

A = total volume of the sample solution (A = 100 ml)

a = mass of glucose reacting with 10 ml Fehling's solution (previously determined in the laboratory; a = 0,045 g)

m = mass of the sample (tomato powder in grams)

RESULTS AND DISCUSSION

Quantity of tomato powder obtained.

From 1000 g of fresh tomatoes, 99.76 g of tomato powder (approximately 100 g of dry matter) was produced. This significant difference is due to the water content lost in the drying process.

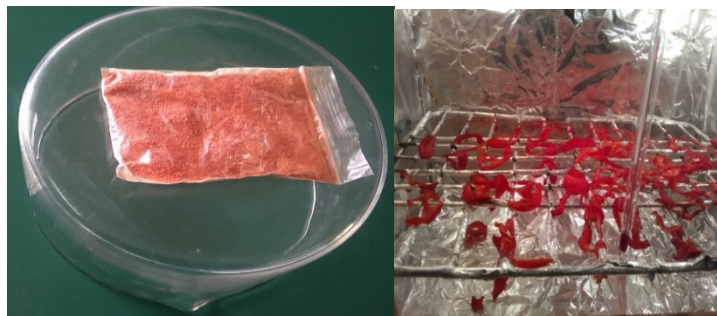


Figure 2: Dried tomato powder (final product)
Source: Authors

Organoleptic analysis

Table 1: Organoleptic characteristics of tomato powder

Dates	Colour	Odour	Taste	Texture
10/10/2020	Light red	V.G	V.G	Powder
15/10/2020	Light red	V.G	V.G	Powder
22/10/2020	Light red	V.G	V.G	Powder
29/10/2020	Light red	V.G	V.G	Powder
12/11/2020	Light red	V.G	V.G	Powder
26/11/2020	Dark red	V.G	G	Powder
09/12/2020	Dark red	G	G	Powder
23/12/2020	Dark red	G	G	Powder

Source: Authors

Where:

V.G: Very Good

G: Good

It is perceived that there were no significant changes in the organoleptic parameters during the conservation process. Except for the taste, which changed from V.G to G, and the colour changed from light red to dark red from the 34th day to the end of the experiment. The results demonstrate that the product retained its quality during storage.

Identification of the analyzed natural substances

Table 2: Summary of identification

The substance to be identified	Test	Results
Carotenoid	Lycopene	+
Phenolic compounds	Flavonoid	+
Anthocyanin	Anthocyanin	-
Glycidium	Reducing sugar	+

Source: Authors

Where: +: indicating the presence of the identified substance, - : absence of the substance.

Based on the table above, it was shown that tomato powder resulting from the processing of fresh tomatoes by oven drying contained the following substances: Lycopenes, flavonoids, glycides (reducing sugars), except anthocyanin (not detected).

Physico-chemical analysis

a. pH

Table 3: pH value of fresh tomato

Fresh tomatoes	
Theoretical value	Experimental value
≤ 4,5	4,31

Source: Authors

The average of the experimental values was 4.31, within the range of the desirable theoretical value described in point 2.1. This proves that the tomatoes were at the expected pH for the experiment.

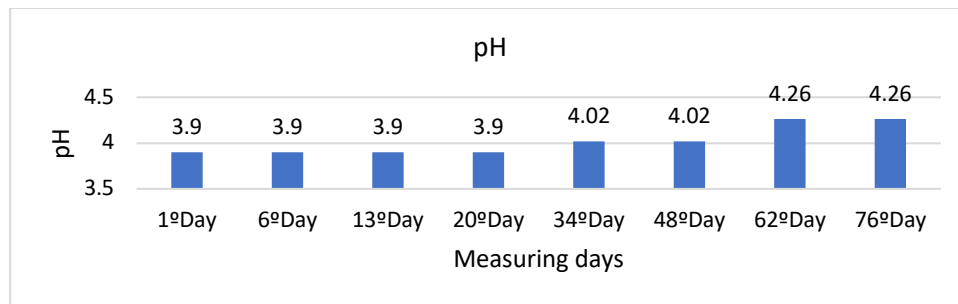


Figure 2: pH evolution during storage

Source: Authors

It can be seen that there are no significant differences in the pH values during storage. The pH values obtained are within the recommended values for conservation, with an average of 4.02, pH in the range of 4.0 - 4.5 as shown in Table 1.

b. Acidity

Table 4: Acidity value of fresh tomato used for kiln drying

Fresh tomatoes	
Theoretical value (%)	Experimental value (%)
0,2 – 0,6	0,37

Source: Authors

The values obtained in the analyses showed an average of 0.37, within the desirable theoretical value range of 0.2 - 0.6 as shown in table 1.

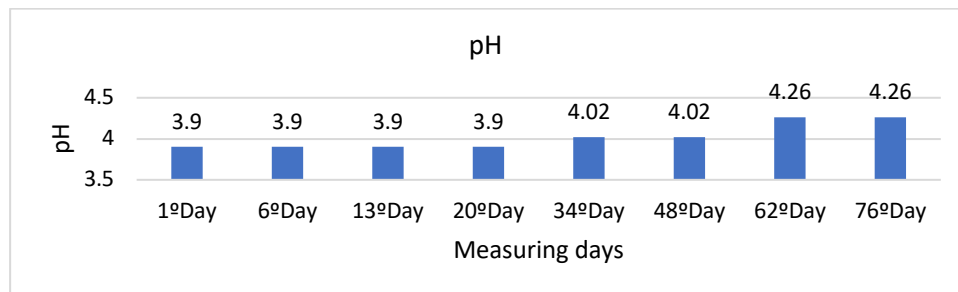


Figure 3: Evolution of acidity

Source: Authors

An average of 0.4% was obtained, an acceptable value, meaning that the powder maintained its quality during storage. Moisture content

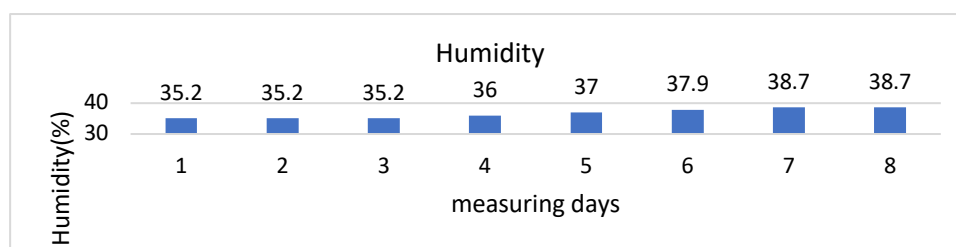


Figure 9: Evolution of humidity
Source: Authors

A slight decrease over the product's storage time. From the 1st day until the 20th day, there was a constancy in the values. From the 34th day until the end of the experiment, a slight increase in humidity ranging from 36 to 38.7% was observed. This result justifies the alteration in colour and texture of the product due to the various undesirable reactions caused by: packaging, temperature variation, and air humidity.

c. Glycidium content

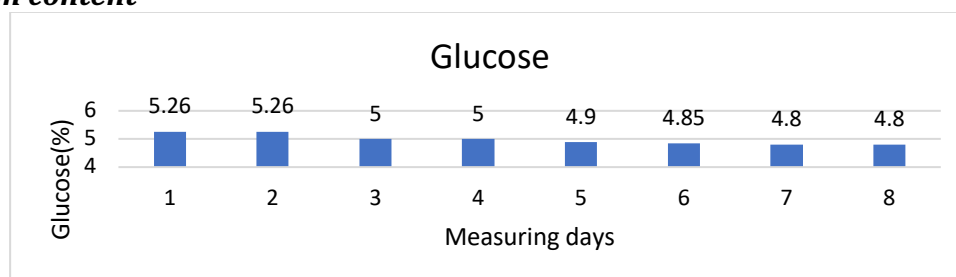


Figure 10: Glucose evolution
Source: Authors

It can be observed that there is no significant difference. The results obtained are satisfactory, with an average of 4.46%, within the range observed by several authors; Sampaio & Fontes, 2000. Taste and flavour are related to the sugar content as observed by consumers. These parameters remained satisfactory from the first day until the end of conservation.

CONCLUSIONS

Based on the results of this research, we can confirm the hypotheses that it is possible to transform fresh tomatoes into powder and preserve them with easy and simple methods. From the organoleptic and physicochemical quality perspective, the tomato powder will be approved by consumers. The samples were dried in an oven (temperature of 55°C) for 15 hours, and the product obtained was stored for 75 days. After performing the analyses on the stored samples, the following results were obtained:

In terms of organoleptic characteristics, the product was approved by consumers. The experimental values of pH, acidity, and the reduction of sugar concentration and moisture content confirmed the product's good quality; the cut geometry, temperature, and drying time are the key factors for tomato drying.

The natural tomato substances identification test showed that powder from fresh tomato (Italian variety) contains several chemical components, such as lycopene, flavonoids,

anthocyanin, and reducing sugar. Other contents are not listed because of a lack of lab materials, apparatus, and reagents. In nutritional terms, tomato is rich in vitamins and minerals, in which its nutritional value can be attributed almost entirely to vitamin C. Due to a lack of financial means and specialized materials in the laboratories of the universities of Uige, as stated in the beginning, the analysis of this parameter was not performed. As it is already known, the tomato contains minerals and many vitamins likewise its derived products.

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