

What Factors Affect the Nutritional Value of Dried Tomatoes?

Postharvest Loss Alliance for Nutrition (PLAN)

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BACKGROUND

Drying is a proven method of reducing loss and waste of tomatoes, but a recent study from Nigeria shows that the nutritional value of dried tomatoes depends on which variety is used, how the tomatoes are dried, and how they are stored.

Nigeria is a significant producer of tomatoes, but it is falling short of its potential as a supplier of tomatoes to both domestic and export markets, in part because of high levels of loss and waste. Nigeria ranks as the 16th largest tomato-producing nation in the world and has the comparative advantage and potential to lead the world in tomato production and exports. Moreover, tomato is a highly attractive commodity for both tomato producers and consumers. As a relatively short-duration, high-yielding crop, it is economically attractive to farmers. It can be processed into a range of products, including ketchup, puree, paste, sauce, powder, and juice, and these multiple uses makes it a source of income for farmers.¹ It also offers health benefits to consumers. Tomatoes are rich in minerals, vitamins, sugars, dietary fiber, vitamins B and C, iron, and phosphorus. They are a good source of carotenoids, a vitamin A precursor.

Demand for tomato and its by-products in Nigeria far outpaces supply. One important factor is the high rate of postharvest losses that occurs because of the highly perishable nature of fresh tomatoes. Globally, postharvest losses of tomatoes are as high as 30–40 percent.² According to Nigeria's Federal Ministry of Agriculture and Rural Development, more than 45 percent of fresh tomatoes produced in Nigeria are lost at the processing, packaging, and distribution stages in the supply chain. These losses are usually the result of poor handling practices, inadequate storage and transportation facilities, and lack of ability to process and add value to tomatoes that can preserve and extend their shelf life.³

OBJECTIVE

Dehydration, which has long been practiced to preserve tomatoes, offers potential for improving the supply of tomatoes. Some studies have noted that factors in the drying process can affect the nutrient content of dried tomatoes,⁴ but the full implications of

¹ U. Ugonna, M. A. Jolaoso, and A. P. Onwualu, "Tomato value chain in Nigeria: Issues, challenges, and strategies," *Journal of Scientific Research and Reports*, 7, no. 7 (2015): 501–515.

² Agrios, 2005

³ Idah et al., 2007

⁴ N. Andritsos, P. Dalampakis, and N. Kolios, "Use of geothermal energy for tomato drying," *Geo-Heat Center Bulletin*, 24, no. 1 (2003): 9–13; J. Shi, "Lycopene in tomatoes: Chemical and physical properties as affected by food processing," *Critical Review in Biotechnology*, 20, no. 4 (2000): 293–334; T. Aktas, F. Hasturk, H. Orak, and P. Ulger, "Influence of pre-treatments and different drying methods on colour parameters and lycopene content of dried tomato," *Bulgarian Journal of Agricultural Science*, 17, no. 6 (2011): 867–881.

drying for nutrient content and retention have not been clear. To address this issue, the Global Alliance for Improved Nutrition (GAIN), through the Postharvest Loss Alliance for



Nutrition (PLAN) project and with support from the Rockefeller YieldWise program commissioned the Department of Food Science and Technology of the Federal University of Agriculture, Abeokuta, Nigeria (FUNAAB), to investigate nutrient retention in dried tomatoes. The objectives of the study were to

examine the following questions:

- What is the nutritional composition of fresh and dried tomatoes?
- What is the effect of variety, pretreatment, and drying methods on the composition and retention of nutrients in dried tomatoes?
- How well were the nutrients in dried tomatoes retained when they were stored in different packaging materials?

METHODOLOGY

Researchers obtained three varieties of freshly harvested tomatoes from the Olomore tomato market in Abeokuta (UC82B, Roma, and Kerewa varieties) and one variety from the Ogun State Greenhouse Technology Vegetable Farm, Kotopo, in Abeokuta (Eva-F1 variety). These varieties were washed, sliced, and pretreated in one of three ways: (1) sulphiting for 3 minutes in sodium metabisulphite (1 percent, weight/volume), (2) hot water blanching for 60 seconds, or (3) a combination of sulphiting and hot water blanching. Some untreated slices served as a control group.

Next the tomatoes were dried using one of three drying methods: sun, cabinet, or oven. Samples of dried tomatoes were then stored for 6 months in four different packaging materials—high-density polyethylene (HDPE) bags, low-density polyethylene (LDPE) bags, plastic containers, and glass jars—and stored under ambient conditions.



The fresh and dried tomato slices were analyzed for carotenoids (such as lycopene and beta-carotene), phenolic acids, flavonoids, vitamins C and E, and total dietary fiber, and they calculated how well the dried tomatoes retained these nutrients. They then measured the retention of nutrients and the moisture content of the dried tomatoes in the four types of storage packaging.

These nutrients hold a host of benefits for human health. Lycopene is a powerful antioxidant. Beta-carotene is a precursor to vitamin A and has been shown to promote physiological functions such as cell-to-cell communication, immunomodulation, and UV skin protection.⁵ In the study, the researchers extrapolated the results of the beta-carotene analysis to determine vitamin A levels. Flavonoids and other phenolic compounds have important antioxidant, cardio protective, and anti-carcinogenic properties, and they protect against other nontransmissible chronic diseases as well.⁶ Vitamin C helps protect against immune system deficiencies, cardiovascular disease, and eye disease. Vitamin E plays a role in forming red blood cells and muscle and other tissues, preventing the oxidation of vitamin A and fats, and promoting cell maturation and differentiation. Deficiency of vitamin E causes sterility in both males and females. Finally, diets rich in fiber such as fruits and vegetables have been linked to decreased incidence of several diseases.

THE FINDINGS

Variety, pretreatment, and drying methods all affect the nutrients in dried tomatoes

Two varieties—the hybrid variety UC82B and the local variety Kerewa, commonly grown in southwest Nigeria—appeared promising for the dried tomato market. These two varieties **retained relatively greater amounts of nutrients after drying and even after being stored for six months under ambient conditions.**

Pretreatment with potassium metabisulphite helped retain nutrients, regardless of tomato variety and drying method. The cost-benefit calculation of pretreatment needs to be further clarified, but the study suggests that the added cost of using potassium metabisulphite pretreatment is not significant because it is used at a very low concentration. Furthermore, the cost of potassium metabisulphite treatment might fall significantly if the slices were dipped in metabisulphite solution, allowing a particular solution to be used repeatedly.

Irrespective of tomato variety, oven-dried slices retained larger amounts of nutrients than slices dried using other methods (Figure 1). As drying time lengthened, however, especially in sun drying, it led to high losses of lycopene, beta-carotene, vitamin C, and vitamin E in the dried tomato slices. This is a serious concern because sun drying is the cheapest and most widely used drying method in Nigeria. It is important, therefore, to develop and disseminate cheap, locally adaptable cabinet drying systems for local farmer and processors.

⁵ V. Lavelli, B. Zanoni, and A. Zaniboni, “Effect of water activity on carotenoid degradation in dehydrated carrots,” *Food Chemistry*, 104 (2007): 1705–1711.

⁶ G. Celli, A. Pereira-Netto, and T. Beta, “Comparative analysis of total phenolic content, antioxidant activity, and flavonoids profile of fruits from two varieties of Brazilian cherry (*Eugenia uniflora* L.) throughout the fruit developmental stages,” *Food Research International*, 44 (2011): 2442–2451.

Overall, then, **oven drying is recommended for drying pretreated sliced tomatoes** because it results in the highest nutrient retention, but to prevent significant losses in lycopene, beta-carotene, and vitamin C, the drying period should not be too long.

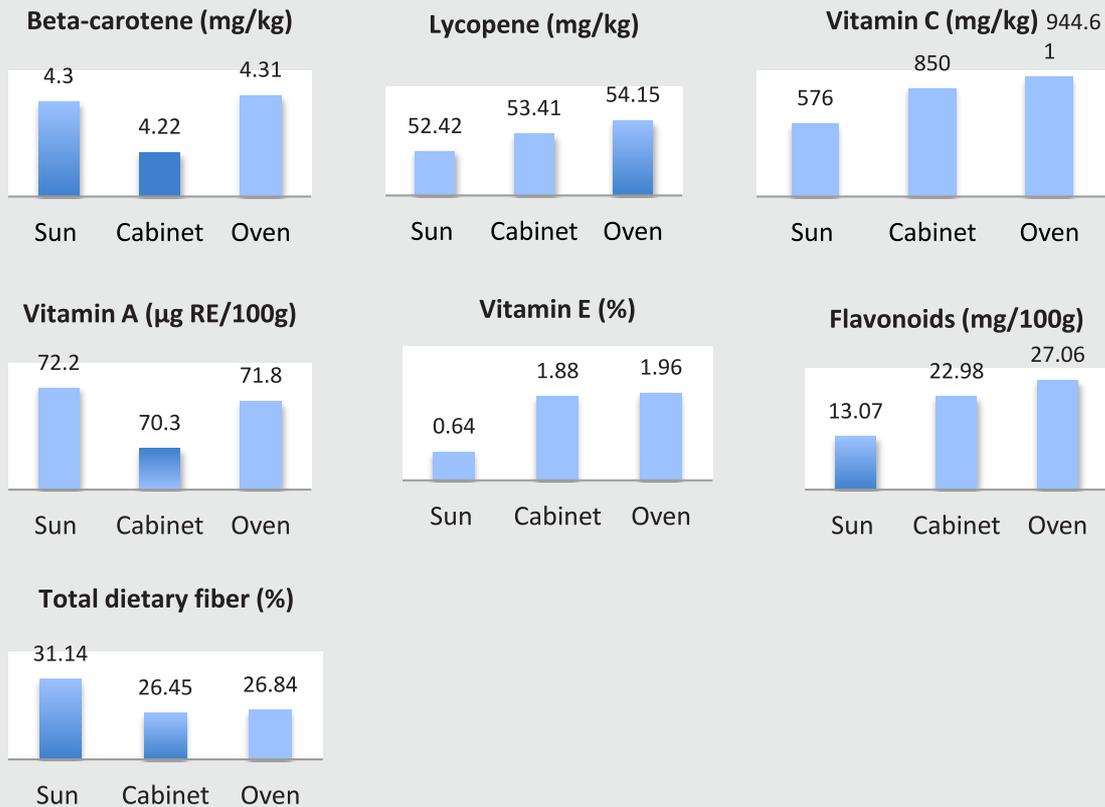


Figure 1—Nutrient content for dried Kerewa tomatoes by drying method

Storage method matters for both nutrients and moisture content

Generally, the nutrient content of the dried tomato slices decreased during storage. Samples stored inside glass jars retained the highest percentage of nutrients, irrespective of tomato variety. After six months of storage, the Kerewa variety retained the most nutrients.

The moisture content of dried tomatoes is an indicator of shelf stability; when moisture content is too high, it can enhance microbial growth, leading to the deterioration of food.⁷ All of the dried tomato slices in the study showed a significant percentage increase in moisture during storage, regardless of the packaging material. **Glass, however, gave the best results, followed by HDPE bags. When stored in LDPE bags or plastic, dried slices should be stored for no more than three months in ambient conditions, after which the**

⁷ B. A. Adejumo, "Some quality attributes of locally produced wheat flour in storage," *IOSR Journal of Environmental Science, Toxicology and Food Technology*, 5, no. 2 (2013), 47–49.

study showed that moisture content would exceed safe levels. In terms of cost and ease of handling, HDPE is recommended over glass; it is cheaper and less brittle, and it can be formed into different shapes and sizes for convenience.

Conclusion

Postharvest losses of fresh tomatoes in Nigeria represent a significant waste of the resources used to grow this crop as well as a missed opportunity to supply nutrients to Nigerian consumers. This is precisely the situation that GAIN's PLAN project was designed to address: it aims to reduce postharvest loss of nutritious foods and make them more accessible in the market, particularly for low-income consumers. One way to extend the shelf life of tomatoes is to process the fresh fruit into a dried form. This study, commissioned by GAIN, sheds light on the nutritional benefits of dried tomatoes and shows how the nutrient content is affected by the various drying and storage methods used in Nigeria. In doing so, it points the way toward processing approaches that can reduce losses and maximize the nutritional value of Nigeria's tomato harvest, thereby helping Nigerian producers meet the sizable unmet demand for this valuable crop.



For questions about the PLAN Network in Nigeria, please contact Dr. Augustine Okoruwa at aokoruwa@gainhealth.org

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