International Journal of Food Science and Nutrition
www.foodsciencejournal.com
ISSN: 2455-4898
Received: 08-03-2021, Accepted: 09-04-2021, Published: 18-05-2021
Volume 6, Issue 3, 2021, Page No. 21-24

The effect of various drying methods on the nutritional composition of *Lycopersicum esculentum* and *Abelmoschus esculentus L.*

Jide Alfred, Adanigbo Pelumi*, Osanyinlusi Remi
Department of Science Laboratory Technology, Rufus Giwa Polytechnic, Owo, Ondo State, Nigeria

Abstract
Food drying is one of the methods for preserving perishable foods for long periods of time. The nutritional composition of tomato (*Lycopersicum esculentus*) and okra (*Abelmoschus esculentum*) was investigated using the commonly available drying methods (sun, oven, and solar drying). The nutritional compositions of these food crops were determined after they have been dried using various drying methods and milled to pass through mesh size. The moisture content of these food samples was significantly reduced with these drying processes employed, with solar dried samples having the lowest moisture content(7.45±0.50) as compared to fresh sample (80.85±0.60), The carbohydrate content of the dried samples was very low as compared to that of the fresh sample. The dried samples had a very high content of protein and lipid. The fibre and ash content shows a small rise in the dried sample as against the fall in the other nutrient content when compared to the fresh sample.The mineral composition of the dried samples was lower than that of the fresh samples, and the amount of nutrient retained is influenced by the drying method used. Generally, the higher the temperature, the higher the risk of nutrient loss, since vitamin C is such a sensitive nutrient, the degree to which it is retained in the dried sample okra and tomato (23.50±0.03 – 20.20±0.01; 16.05±0.03 – 15.00±0.01) respectively as compared to that of fresh sample okra and tomato (23.65±0.01, 17.25±0.02) respectively can be used as a yardstick of measurement in describing other nutrients retention in preserved food crop samples. This finding indicates that the effects of the drying methods employed are similar in nutrient retention with no complete loss of volatile minerals. Solar and oven drying were more hygienic and faster than Sun drying, but solar drying was more cost-efficient and offered the lowest moisture content analysis.

Keywords: food crops, nutrients, oven drying, preserving, sun drying, solar drying

Introduction

Farm produce post-harvest drying is one of the most common crop preservation techniques used to enhance crop processing, storage efficiency, nutritional value, and market control (Naidu *et al*., 2016) [18]. Since most fruits and vegetables in Nigeria are seasonal, preserving them for use during the scares season is important, as moisture removal (Sun, Oven, Solar drying) delays many moisture-related deterioration reactions and prevents microorganism growth and reproduction (Fudholi *et al*., 2015) [9].

Tomato (*Lycopersium esculentum*) is edible and belongs to the family Solamacea, it is an herbaceous plant with bisexual flower and it is a genuine berry. Tomato is served in various ways including raw as an ingredeient in many dishes, sauces and drinks (Prashanth, 2003) [20].

The fruit is rich in Lycopene, which is very essential to human health, they are good sources of Vitamin A and C and it serves as an antioxidant that helps prevents the growth of many kind of Cancer (Nguyen, 2012) [19]. Okra (*Abelmoschus esculentus L.*) is a commercially significant vegetable grown in tropical and subtropical area of the world.

This crop is ideal for cultivation as a garden crop as well as major commercial farms (Prashanth, 2003) [20].

These fruits are harvested when immature and eaten as vegetables. The roots and stems are used for clarification of sugarcane juice from which brown sugar is prepared.

In some countries, the ripe seeds are roasted, pulverized and used as a coffee substitute (Varmudy, 2011) [23].

Sun, oven, and solar drying are the most common drying methods for these food crops, with sun drying being the most popular (Matazu and Haroun, 2004) [15].

When these food crops are dried, they are pulverized into flours that can be reprocessed into paste or dough (Emperizatriz *et al*., 2008) [7].

These three drying methods (Sun, Oven, and Solar drying) use heat to evaporatively remove water from the food (Agereyo *et al.*, 2011) [2]. The removal of water by heat is said to have a variety of effects on the nutritional quality of foods.

It can either increase the concentration of certain nutrients by making them more available or decrease the concentration of certain nutrients by making them less accessible (Hassan *et al.*, 2007) [11].

This study was implemented to determine the effect of these various drying methods on the nutritional values of okra and tomatoes, in order to assess the most effective approach for not only maximizing their shelf life but also ensuring sufficient nutrient retention.

Materias and Methods

Plant Materials

Ripe tomatoes (*Lycopesricum esculentum*), Okra (*Abelmoschus esculentum*) were purchased in the open market around Owo, Ondo state of Nigeria.

Preparation of food crop samples

They were washed and chop into small pieces; the food crops chopped into pieces was divided into four portions. The sun, oven, and solar drying methods were used to dry three of the four portions to a constant weight. The fourth portion is a fresh sample which serves as a control.

Sun-drying: A portion of the sample was dried to a constant weight for five days in the sun between 10 a.m. and 5 p.m.

Oven Drying: The second portion of the sample was placed in thermosetting oven and dried to a constant weight for 48hrs at a stable temperature of 100°C

Solar Drying: The third portion of the sample was dried at 60°C for 25 hours in the solar dryer of the Food Chemistry Laboratory at Rufus Giwa Polytechnic in Owo.

Analytical Method

The moisture, ash, and crude fiber content of the samples were determined using the procedure recommended by the Association of Analytical Chemists (AOAC, 2005) [4], while the crude protein content was determined using the AOAC's micro Kjeldahl procedure (2005). According to (Jide *et al* 2018) [12], the carbohydrate content was determined by a percentage difference. Calcium, Magnesium, Potassium, Sodium, and Manganese were all measured using this method (AOAC, 2005) [4]. The ascorbic acid content was determined using titrimetric methods (Moorthy and Padmaja, 2002) [16]. Data were analysed using the analysis of variance and mean deviation were calculated by the general model procedure.

Results and Discussion

Table 1: Proximate Composition of fresh and dried Okra (*Abelmoschus esculentus*)

Drying Method	Protein	Carbohydrate	Lipids	Fibres	Ash	Moisture
Fresh	7.26± 0.13	74.55 ±1.00	11.02±0.12	6.56 ±0.11	7.85±0.12	70.05±0.61
Sun	6.20± 0.06	69.64 ± 0.12	10.80±0.11	6.59 ±0.11	7.82±0.26	9.60±0.09
Oven	5.25±0.03	68.59±0.40	10.90±0.11	6.37±0.12	7.84±0.26	9.65±0.15
Solar	4.30±0.02	67.31±0.35	8.95±0.10	5.30±0.10	6.96±0.17	8.50±0.25

Mean ± Standard deviation are of triplicate determination

Table 1 showed the nutritional composition (% dry matter) of fresh and dried okra. (*Abelmoscusesculentus*) The moisture content of the fresh sample (control) ranged from 70% to 8.5 % in the solar dried sample. The fresh sample had the highest carbohydrate content (74.55%), whereas the oven dried sample had the lowest (66.59%). The fresh sample had the highest protein and lipid levels (7.26 % and 11.02 % respectively) and the solar dried sample had the lowest (4.30 % and 8.95 % respectively). Fresh samples have the highest value of ash and fibre (7.85 % and 6.56 % respectively) and the lowest value of (6.96 %, 5.30 %). The nutrient value decreases as a result of the method employed to dry the vegetable (okra), which has an effect on the amount of nutrient quantity retained.

The lower the temperature used, the greater the chance of higher nutrient retention (Sagar&Sursh, 2010) [21]. The Mailliard reaction causes a decrease in protein and carbohydrate content, resulting in a complex shift in food nutrient because of the reaction between carbohydrate and protein (Boumendjel and Boutebba, 2003) [6]. According to EnomfonAkpan and Umoh (2004) [8], the decrease in protein content of foods caused by heat may be due to the effect of Tannin, which forms complexes with protein and reduces their availability. Lipid oxidation is responsible for the decrease in lipid content of the samples (Savage *et al.*, 2002) [22].

Table 2: Proximate Composition of Fresh and Dried tomatoes (*lycoperiscum esculentus*)

Drying Methods	Protein	Carbohydrate	Lipids	Fibers	Ash	Moisture
Fresh	3.20±0.16	80.65±0.21	7.25±0.09	5.30±0.10	5.60±0.04	80.85±0.60
Sun	3.02±0.22	77.68±0.50	7.14±0.08	5.28±0.30	7.56±0.15	11.53±0.40
Oven	2.18±0.06	71.09±0.60	6.55±0.02	3.35±0.33	6.88±0.21	8.50±0.30
Solar	2.05±0.02	70.96±0.11	5.65±0.01	3.05±0.10	6.56±0.18	745±0.50

Mean ± Standard deviation of triplication determination

Table 2 showed the nutritional composition (% dry matter) of fresh and dried tomato (*Lycoperciscum esculentus*) samples.

The moisture content of the dried sample ranges from 80.85% (Control) to 7.45% (Solar dried sample), indicating that the dried sample could be kept for longer periods of time and increases the product's shelf life (Adejumo *et al.*, 2013). The fresh sample had the highest carbohydrate content, at 80.63 %, while the solar dried sample had the lowest. This is acceptable since most of the vegetable's dry matter is composed of 60-90 % carbohydrate (Jide *et al.*, 2018) [13]. The fresh sample also had the highest levels of protein and lipids (3.20% and 7.25% respectively) and the dried solar sample, on the other hand, had the lowest levels of protein and lipids (2.05 % 5.65 %).

The protein content of both samples will help meet each individual's daily requirements as recommended (Ajayi *et al.*, 2006) [3]. The fresh and solar samples had the lowest ash and fibre content (6.50 % and 3.03 percent, respectively). Although low fiber in food is beneficial to digestive processes, it reduces the vitamin and enzyme content of food materials (Jide *et al.*, 2018) [13].

Table 3: Showed the Vitamin C content (g/100g) of fresh and dried Okra (*Lycoperciscum esculentus*) and Tomatoes (*Lycoperciscum esculentum*)

Drying Methods	Okra	Tomatoes
Fresh	23.65±0.01	17.25±0.002
Sun	23.50±0.02	16.005±0.03
Oven	23.05±0.04	15.20±0.05
Solar	20.20±0.01	15.00±0.01

Mean ± standard deviation of triplicate determination

The result above revealed the Vitamin C content in g/100g of fresh and dried okra (*Abelmoschusesculentus*) and tomato (*Lycoperciscumesculentum*).

Okra and Tomatoes are high in vitamin C, minerals, and antioxidants, ranging from (23.65±0.01g/100g, 17.25±0.002g/100g) for the fresh and that of the other methods ranging from (20.20±0.02g/100g – 23.50±0.01g/100g) and (16.005±0.03g/100g – 15.00±0.01g/100g) respectively which are in good proportion for a healthy diet and disease prevention. However, any form of processing, such as storage, preservation or cooking, has an effect on vegetable quality and nutrient retention (Barret *et al.*, 2010) [5]. The methods used in drying these samples has an effect on how much of nutrient it retained; the lower the temperature applied, the lower the chance of nutrient retention (Sagar& Suresh., 2010) [21]. Vitamin C can be used as an indicator of the quality of preserved/drying nutrients when it is retained in a sufficient quantity in a dried product sample, If a sufficient amount of vitamin C is preserved, the majority of the less sensitive nutrients are retained as well (Gamboa-santos *et al.*, 2014) [10].

Table 4a: The Mineral Composition of Fresh and Dried Okra (mg/100g)

Drying method	Calcium	Magnesium	Sodium	Potassium	Zinc
Fresh	17.32±0.10	4.52±0.20	126.55±0.11	250.55±0.05	3.55±0.02
Sun	17.20±0.08	4.25±0.25	126.52±0.13	250.51±0.07	3.50±0.04
Oven	17.15±0.00	3.95±0.22	125.02±0.15	250.00±0.05	3.25±0.01
Solar	17.05±0.05	3.08±0.32	120.00±0.05	245.50±0.02	3.02±0.03

Mean ± standard deviation of triplicate determination

Table 4b: The Mineral Composition of Fresh and Dried Tomatoes (mg/100g)

Drying method	Calcium	Magnesium	Sodium	Potassium	Zinc
Fresh	6.52±0.04	5.26±0.11	102.00±0.01	220.50±0.05	3.55±0.03
Sun	5.25±0.03	5.21±0.12	101.00±0.01	220.35±0.04	3.50±0.55
Oven	5.05±0.01	4.52±0.22	101.04±0.02	220.05±0.01	3.25±0.25
Solar	5.00±0.02	4.05±0.21	100.05±0.01	220.00±0.01	3.02±0.15

Mean ± standard deviation of triplicate determination

Heat has the potential to be both beneficial and harmful to nutrients it helps to increase food digestibility, palatability, and storage quality, making it healthier to eat. The heating process alters the biochemical and nutritional composition of the food, which possibly causes nutritional loss (Agoreyo *et al*., 2011) [2]. Ash is the inorganic residue that remains after water and organic matter have been removed from the food by heating (Hassan *et al*., 2007) [11].

The mineral content is a measure of the amount of specific inorganic components present in a food, while the ash content is a measure of the overall amount of mineral in the food. Minerals are resistant to heat and have a low volatility compared to other food nutrients.

The drastic reduction in moisture content helps to increase the concentration of nutrients, results in an increase in mineral content in fresh samples of both okra and tomatoes (Morris *et al.*, 2004) [17].

Similarly, as the temperature of the drying process rises, the mineral content of both okra and tomatoes decreases, indicating that the presence of anti-nutritional in the okra and tomatoes renders these minerals inaccessible by reacting with them (EnomfonAkpo and Umoh 2004) [8]. The sodium-to-potassium and calcium-to-magnesium ratios in okra and tomato will help prevent high blood pressure. They appear to be a good mineral source for bone formation due to the calcium/magnesium content (kalidass and Malaptra, 2004) [14].

Conclusion

Drying is one of the techniques employed for preserving perishable produce so that it is available throughout the year, eliminating post-harvest losses and maintaining food security. Investigating the seeds of Okra and Tomatoes showed that both food crops are rich in valuable nutrients for human and animal consumption.

This study used a number of food drying methods, all of which were able to keep the nutrients in the food without causing complete loss. Solar and oven drying was more hygienic and faster than Sun drying, but solar drying was more cost-efficient and offered the lowest moisture content analysis. As a result, solar drying can be the most efficient method of preserving these foods.

References

1. Adejumo BA, Okunade RO, Afolayan OL, Balogun SA. Quality attributes of yam flour (Elubo) as affected by blanching water temperature and soaking time. Int. J. Eng. Sci,2013:2:216-221.
2. Agoreyo BO, Akpiroroh OA, Orukpe AO, Osawereh OR, Owabor CN. The effect of various drying method on the nutritional composition of *Musa paradisiaca*, *Discorearotundata*and *Colocasiaesculenta.* Asian Journal of Biochemistry ISSN 1815-9923, 2011.
3. Ajayi IA, Oderinde RA, Kajogbola DO, Uponi JI. Oil content and fatty acid composition of some underutilized legumes from Nigeria. Food Chemistry, 2006:99(1):115-120.
4. AOAC. Official Method of Analysis Association of Official Analytical Chemist. Washington D.C., 2005, 50–56.
5. Barret DM, Beaulieu JC, Shewfelt R. Color, flavor, texture and Nutritional Quality of fresh cut fruit and Vegetable. Desirable level, Instrumental and Sensory Measurement, The effect of processing. Critical reviews in food Science and Nutrition,2010:50(5):369-389.
6. Boumendjel ME, Boutebba. Heat Treatment effect on the biochemical and Nutritional content of double concentrate Tomatoes Paste. Act a Hortic,2003:613:429-432.
7. Emperatiz PD, Ronald M, Elevina P, Mily S. Production and Characterization of unripe Plantain flour. Inter Science,2008:33:290-296.
8. Enomfon-Akpan J, Umoh IB. Effect of heat and tetracycline treatments on the food quality and Acidity factors in Cocoyam [Xanthosoma sagiltiofolium(L)] *Scholt.* Pak. J. Nutr,2004:3:240-243.
9. Fudholi A, Sopian K, Bakhtyar B, Gabbasa M, Othman MY, Ruslan MH. Review of Solar drying system with air based solar collectors in Malaysia. Renewable and

Sustainable Energy reviews,2015:51:1191-1204.
10. Gamboa Santos J, Megias-Perez R, Soria AC, Olano A, Montila AA, Villannel. Impart of Processing condition on the kinetics of Vitamin C degradation and 2-furoylmethyl amino acid formation in dried Straw berries. Food Chemistry,2014:153:164-170.
11. Hassan SW, Umar RA, Maishanu HM, Matazu IK, Faruk UZ, Sani AA, The effect of drying methods on the nutrients and non-nutrients composition of leaves of Gynandropsisgynandra (Capparaceae) Asian J. Biochem,2007:2:349-353.
12. Jide Alfred O, Aladekoyi Gbenga, Alademeyin JO. Comparative studies on Nutritional evaluation of Wild Yam (*DiscoreaVillosa*) and other varieties for Human consumption. The pharmaceutical and chemical journal,2018:5(4):6-9.
13. Jide Alfred O, AladekoyiGbenga, Karimu O, Alademeyin JO. Proximate and physicochemical properties of flour and oil Extracted from raw and boiled locus Bean (*Parkiabiglobosa*). The pharmaceutical and chemical journal,2018:5(4):1-5.
14. Kalidass C, Mahapatra AK. Evaluation of the proximate and phytochemical composition of an underexploited Legume *Mucunapruriensvautilis* (Wall ex wight) Int. food Research Journal,2004:21(1):303-208.
15. Matazu IK, Haroun AA. The effect of drying method on the nutrients and non-nutrients composition of the fruits of *Hibiscus esculentus* (Okra). Nig. J. Renewable Energy,2004:11:9-13.
16. Moorthy SN, Padmaja. A rapid Titrimetric method for the determination of Starch of Cassava tubers. Journal of root Crops,2002:28:31-38.
17. Morris AA, Barnett and Burrows O. Effect of Processing on Nutrient content of foods *Caj article* 37, 2004, 160-164.
18. Naidu MM, Vedashree M, Satapathy P, Khanum H, Ramsamy R, Hebba HU. Effect of drying methods on the quality characteristic of (*Anethumgraveolens*) green. Food Chemistry,2016:192:849-856.
19. Nguyen C. Biological hazards in the processed fruits and vegetables, Risk factors and impact of processing techniques *LWT*-Food Science and Technology,2012:49:172-177.
20. Prashanth SJ. Genetic variability and divergence Studies in tomato (*Lycopersiconesculentum*) Mill M.Sc Thesis University of Agricultural Sciences, Dharwad (India), 2003.
21. Sagar VR, Suresh KP. Recent Advances in drying and dehydration of fruits and Vegetables: A review. Journal of food Science Technology,2010:47(1):15-26.
22. Savage GP, Dutta PC, Rodriguez-Estrada MI. Cholesterol oxides their occurrence and methods to prevent their generation in foods. Asia Pac. J. ClinNutr,2002:11:72-78.
23. Varmudy V. Making Survey need to boost okra export Deparment of economics, Vivekanandacollege, Putturr, Karnataka, India, 2011.