GSC Advanced Research and Reviews

eISSN: 2582-4597 CODEN (USA): GARRC2

Cross Ref DOI: 10.30574/gscarr

Journal homepage: https://gsconlinepress.com/journals/gscarr/

(Research Article)

Impact of sun-drying and oven-drying on the biochemical and phytochemical properties of eggplant (*Solanum aethiopicum*)

Patricia Penan Dehegnan Oulaï [1,*], Silvere Gninfanni Ouattara [1], Edwige Bahanla Oboulbiga [2], Davilla Kpini Gniminou [1] and Sébastien Niamké [3]

[1] *Department of Biochemistry and Genetics, Laboratory of Biotechnology and Valorization of Agroresouces and Natural Substances, Peleforo GON COULIBALY University, Bp 1328 Korhogo, Côte d'Ivoire.*

[2] *Department of Food Technology, Institute for Research in Applied Sciences and Technologies, National Center for Scientific and Technological Research, P.O. Box 03 Bp 7047 Ouagadougou 03, Burkina Faso.*

[3] *Laboratory of Agricultural Biotechnology and Valorization of Biological Resources, UFR Biosciences, Félix Houphouët Boigny University, 22 Bp 582 Abidjan 22, Côte d'Ivoire.*

GSC Advanced Research and Reviews, 2026, 28(01), 215–224

Publication history: Received on 14 June 2026; revised on 15 July 2026; accepted on 18 July 2026

Article DOI: https://doi.org/10.30574/gscarr.2026.28.1.0175

Abstract

In developing countries, vegetables such as the eggplant *Solanum aethiopicum* are grown locally. Its high water content makes this vegetable highly perishable; to address this problem, this study was conducted with the aim of reducing the water content in the eggplant as much as possible to extend its shelf life. Analysis of biochemical and phytochemical compounds was performed using standard methods. The results showed variations among most of the parameters analyzed. The water content in fresh eggplant is 90.2%, whereas dried eggplant samples have a water content of 9.1%. Regarding biochemical properties, sun-dried eggplants had higher levels than oven-dried eggplants and fresh eggplants. The ash, fat, protein, and fiber contents, as well as the energy value, ranged from (0.67 to 6.7%), (0.23 to 10.3%), (1.98% to 15.03%), (3.03 to 28.75%), (24.83 to 273.3%). As for minerals, with the exception of potassium and manganese, sun-dried eggplants had the highest levels compared to oven-dried and fresh eggplants. The levels range from Ca (6.11 to 57.14 mg/kg), Fe (3.75 to 35.88 mg/kg), K (3.45 to 37.89 mg/kg), Mg (7.42 to 89.78 mg/kg), Mn (3.39 to 33.60 mg/kg), Na (6.33 to 66.16 mg/kg), Zn (7.18 to 71.77 mg/kg). The levels of phytochemicals range from polyphenols (31.67 to 730.63 mg EAG/100 g), flavonoids (1.08 to 66.28 mg EAG/100 g), tannins (5.55 to 154.79 Emg/100 g), antioxidant activity (18.27 to 63.02 Emg/100 g). Drying is an effective method for adding value to African eggplants, as it both improves their shelf life and optimizes their nutritional quality.

Keywords: Eggplant; *Solanum aethiopicum*; Perishable; Preservation; Nutritional quality

1. Introduction

The eggplant, a vegetable grown for its leaves and/or fruit, is widely appreciated in West and Central Africa. It belongs to the Solanaceae family and the genus Solanum, which includes many cultivated species, the best known of which in Côte d'Ivoire are *Solanum aethiopicum*; *Solanum melongina*; and *Solanum macrocarpon* [1]. The eggplant is considered one of the five most important crops in sub-Saharan Africa, alongside tomatoes, onions, peppers, and okra [2]. In Côte d'Ivoire, the eggplant is the leading vegetable crop, both in terms of production volume and cultivated area. A study published by FAOSTAT in 2008 estimated annual national production at approximately 60,000 metric tons. According to recent FAOSTAT projections, this production is expected to reach 86,470.45 metric tons in 2023, reflecting the growing importance of this crop in the Ivorian agricultural sector [3]. The share of African eggplant entering the market is reportedly growing steadily in response to rising demand from urban markets and for export—particularly to

* Corresponding author: Patricia Penan Dehegnan Oulaï

Europe—from countries such as Uganda, Côte d'Ivoire, and Senegal. It is primarily grown by small-scale farmers in both rural and urban areas [4]. Eggplants play an important role in the diet of Côte d'Ivoire, where they are used in the preparation of many traditional sauces such as gnangnan, kedjenou, and eggplant sauce. Beyond their culinary importance, they are also a highly valuable nutritional resource. Studies conducted on various cultivars show, in particular, that *Solanum aethiopicum* is rich in fiber, thereby contributing to proper digestive function and reducing bloating. Thanks to its low soluble sugar content, this species also helps limit glucose absorption [5]. Furthermore, several research studies attribute beneficial pharmacological properties to it, including anti-inflammatory, antibacterial, antidiabetic, anti-obesity, and antioxidant effects [5]. The high water content of eggplant makes it a particularly perishable crop after harvest. Indeed, *Solanum aethiopicum* is characterized by a short shelf life, generally estimated at three to four days, due in particular to post-harvest practices that are often inadequate. Several factors directly influence fruit quality after harvest, including the stage of ripeness, harvesting methods and timing, as well as sorting, packaging, storage, temperature, and humidity conditions during storage [6]. In the Ivorian market, white eggplants that have changed color due to an advanced stage of ripeness are frequently sold at discounted prices of up to 50% of their original value, or even rejected [7]. Given its large production volumes, the income it generates, and its role in food security and dietary diversification, the eggplant is thus a strategic crop for strengthening the food and nutritional security of the Ivorian population. Furthermore, its wide diversity of species and varieties makes it a promising candidate for resilient market gardening systems based on the principles of agroecology. To limit post-harvest losses and ensure greater availability of eggplant over a longer period, drying appears to be an effective and suitable preservation method. The aim of this study is to contribute to the post-harvest utilization of eggplant.

2. Materials and Methods

2.1. Biological Materials

The biological material used in this study is the eggplant *Solanum aethiopicum*. The eggplants were purchased at three different markets in Korhogo, in northern Côte d'Ivoire: the Grand Market, the Sinistré Market, and the Téguéré Market. After purchase, the eggplants were transported to the laboratory for subsequent analyses.

2.2. Method

2.2.1. Preliminary Processing of Eggplants

The harvested eggplants were washed under running water to remove impurities, mud, pesticide residues, and other contaminants, and then sliced. They will then be blanched in boiling water for 5 minutes.

2.2.2. Different Drying Methods

Sun-drying

500 gram batch of eggplant samples, sliced and then blanched in boiling water for about 5 minutes, was spread out on a drying rack and left in the sun at approximately 33°C for 72 hours. The sun-dried eggplant was then weighed, ground, and packaged in jars for subsequent analysis.

Oven-Drying

A 500-gram batch of eggplant samples, sliced and then blanched in boiling water for about 5 minutes, was placed in an oven at 55 °C for 24 hours. After cooling in a desiccator, the oven-dried eggplants were weighed, ground, and packaged in jars for subsequent analysis.

2.2.3. Study of the Biochemical Properties of Eggplants

Moisture content

The water content is determined according to [8]. A mass of 5 g of bean seed flour (P0) was placed in a porcelain crucible with a previously determined empty mass (P1). The porcelain crucible and flour sample were placed in an oven at 105°C for 24 hours to obtain a constant mass. After cooling in the desiccator, the mass (P2) of the whole was determined. The water or moisture content is determined in g/100 g of bean flour sample according to the following formulae: $Moisture = [(P2 - P1) * 100]/Po]$.

Ash content

Ash content was determined using the [8] method. 5 grams of 5 g of bean seed flour were weighed into a pre-weighed crucible and incinerated in a muffle furnace at 550°C for 12 hours. After incineration, the crucible containing the ash was cooled in a desiccator and weighed. Ash content was calculated as follows: Ash (%) = $[(m2 – m0) / (m1–m0)]*100$

Proteins content

Proteins content was determined using the Kjeldahl method [8]. 1 gram of bean seed flour was digested in 20 mL of concentrated sulfuric acid at 400°C for two hours with a mineralization catalyst (potassium sulfate + selenium). After digestion, the digest was diluted to 100 mL with distilled water. A 10 mL aliquot was mixed with 10 mL of 40% NaOH, and the mixture was distilled. Distillate was collected in 20 mL of 4% boric acid containing a mixed indicator (methyl red + bromocresol green) and titrated with 0.1 N sulfuric acid. Protein content was calculated as follows: Proteins (%) = $(V1 – V0) \times 14 \times N \times 6.25/me$

Fibres content

For crude fibers, [9] method was used. 2 g of bean seed flour were weighed into separate 250 mL round-bottom flasks, and 50 mL of 0.25 M sulfuric acid solution was added. The mixture obtained was boiled under reflux for 30 min. Thereafter, 50 mL of 0.3 M sodium hydroxide solution was added and the mixture was boiled again under reflux for 30 min and filtered through Whatman paper. The insoluble residue was then incinerated, and weighed for the determination of crude fibers content. Fibers (%) = $(m1 – m2) \times 100/2$

Lipid content

Lipids content was determined using the [10] Soxhlet extraction method. 10 grams of bean seed flour were weighed into a cellulose extraction cartridge, sealed with cotton, and placed in the Soxhlet extractor with 300 mL of hexane. Extraction was carried out under reflux for seven hours. After extraction, the hexane was evaporated using a rotary evaporator, and the pre-weighed flask containing the oil was dried at 100 °C for 20 minutes, cooled in a desiccator, and weighed Lipid content was calculated as follows:

$$\text{Lipids (\%)} = (m – m0) \times 100/me.$$

Carbohydrates and energy value

Carbohydrates content and calorific value were calculated and expressed on a dry matter basis using the following formulas [11]: Carbohydrates (%) = 100 − [Moisture (%) + Lipids (%) + Proteins (%) + Ash (%) + Fiber (%)];

$$\text{Energy (kcal/100 g)} = (\text{\% proteins x 4} + (\text{\% carbohydrates x 4}) + (\text{\% lipids x 9}).$$

Mineral analysis

5 grams of bean seed flour were burned to ashes in a muffle furnace. The ashes obtained were dissolved in 10 mL of HCL/HNO3 and transferred into 100 mL flasks and the volume was made up using deionized water. The mineral composition of each sample was determined using an Agilent 7500c inductively coupled argon plasma mass spectrometer ICP-MS method [12]. Calibrations were performed using external standards prepared from a 1000 ppm single stock solution made up with 2 % (v/v) nitric acid.

2.2.4. Détermination des propriétés phytochimiques

Extraction of Phenolic Compound

Phenolic compounds are extracted with methanol using the method described by [13]. 1 gram of the combination of oven-dried and crushed leaves is homogenized in 10 mL of 70% (v/v) methanol. The resulting mixture is centrifuged at 1000 rpm for 10 min. The pellet is recovered in 10 mL of 70% methanol (v/v) and centrifuged again. The supernatants are combined in a 50 mL flask and adjusted with distilled water to the mark. The solution thus obtained is called the methanol extract.

Polyphenol content

Add 1 mL of Folin-Ciocalteu reagent to 1 mL of methanolic extract, then add 1 mL of 20% (w/v) sodium carbonate solution. Fill the tube to 10 mL with distilled water and place it in the dark for 30 min. The optical density is read at 725 nm against a blank. A standard curve established from a stock solution of gallic acid (1 mg/mL) under the same conditions as the test is used to determine the amount of phenols in the sample

Flavonoid content

The method used to determine flavonoid content is that described by [14]. To 0.5 mL of methanolic extract, 0.5 mL of distilled water, 0.5 mL of aluminum chloride, 0.5 mL of potassium acetate, and 2 mL of distilled water are added successively. The tube is left to stand for 30 min in the dark and the optical density (OD) is read at 415 nm against a blank. A calibration curve prepared under the same conditions as the test using a 0.1 mg/mL quercetin stock solution is used to determine the flavonoid content of the samples.

Tannin content

The tannin content is determined using the method described by [15]. 1 mL of methanolic extract is placed in a test tube to which 5 mL of vanillin reagent has been added. The tube is allowed to stand for 30 minutes in the dark, and the optical density (OD) is measured at 500 nm against a blank containing a mixture of 37% methanol and 8% HCl in equal volumes. The tannin content of the samples was determined using a calibration curve established with a series of tannic acid standard solutions, prepared under the same conditions as the assay, starting from a 2 mg/mL stock solution.

Measurement of antioxidant activity using the DPPH method

Antioxidant activity is determined according to the method described by [16]. About 1 mL of 0.3 mM DPPH solution in ethanol was added to 2.5 mL of sample solution 1 g of dried powdered sample mixed in 10 mL of methanol, filtered through Whatman No. 4 filter paper, and allowed to react for 30 min at room temperature. Absorbance values were measured with a spectrophotometer (PG Instruments, England) set at 415 nm. The average absorbance values were converted to percentage antioxidant activity using the following formula: Antioxidant activity (%) = 100 – [(Abs of sample – Abs of blank) × 100/Abs positive control].

2.3. Statistical Analyses

All analyses were conducted in triplicate, and the results were analyzed using Excel. Analysis of Variance (ANOVA-1) and the Student-Newman-Keuls (SNK) test at the 5% significance level were employed to compare and distinguish means utilizing IBM SPSS Statistics version 20 software.

3. Results

3.1. Effect of Drying on the Biochemical Composition of Eggplant (*Solanum aethiopicum*)

Table 1 presents the biochemical characteristics of fresh, sun-dried, and oven-dried eggplant of the *Solanum aethiopicum* variety. Statistical analysis of the data indicates a significant difference between the values obtained for all biochemical parameters of the eggplant samples evaluated at a p-value < 0.05. The moisture content of the oven-dried and sun-dried eggplant samples is 9.1%. These values are significantly lower than that found for the fresh eggplant sample (AuF), which is 90.2%. The ash content of the fresh eggplant was (0.67±0.02%), while that of the oven-dried and sun-dried samples ranged from (5.4±0.2%) to (6.7±0.3%), respectively. The fat content of the fresh eggplant sample was (0.23 ± 0.02%), while that of the oven-dried and sun-dried samples ranged from (5.9 ± 0.1%) to (10.3 ± 0.1%), respectively. Protein contents ranged from (14.52 ± 0.06%) to (15.03 ± 0.05%) for the oven-dried and sun-dried samples, respectively. The sun-dried eggplant samples had the highest fiber content (28.75±0.75%) compared to the oven-dried eggplant samples (27±2%) and fresh eggplant (3.03±0.13%). The carbohydrate content was highest in the oven-dried sample (38.08 ± 1.66%), while the sun-dried and fresh samples had carbohydrate contents of 30.12 ± 0.1% and 3.89 ± 0.5%, respectively. The highest energy value was observed in the sun-dried eggplant sample (273.3 ± 1.1 kcal/100 g), followed by the oven-dried (263.5 ± 7.3 kcal/100 g) and the fresh sample (24.83 ± 2.49 kcal/100 g).

Table 1 Effect of drying on the biochemical composition of *Solanum aethiopicum* eggplant after drying

Sample	AuF	AuSS	AuSE
Moisture (%)	9 0.2 ±0.4[a]	9.1±0.3b	9.1±0.1b
Ash (%)	0.67±0.02c	6.7±0.3a	5.4±0.2b
lipids (%)	0.23±0.02c	10.3±0.1a	5.9±0.1b
protéins (%)	1.98±0.02c	15.03±.,05a	14.52±0.06b
fibres (%)	3.03±0.13c	28.75±0.75a	27±2b
Carbohydrate (%)	3.89±0.5c	30.12±0.1b	38.08±1.66a
Calorific value (Kcal/100g)	24.83±2.49c	273.3±1.1a	263.5±7.3b

Different letters in a column indicate a significant difference at the P ≤0.05 % level, while identical letters indicate that there is no significant difference. AuSS: sun-dried eggplant; AuSE: oven-dried eggplant; AuF: fresh eggplant.

Table 2 presents the mineral content of the eggplant samples. Statistical analysis of the data indicates a significant difference between the values obtained for all biochemical parameters of the eggplant samples evaluated at a p-value < 0.05. Calcium content ranged from (6.11 ± 0.8 mg/kg) to (57.14 ± 0.12 mg/kg). The highest content was observed in the sun-dried eggplant samples (57.14 ± 0.12 mg/kg), and the lowest content was observed in the fresh eggplant (6.11 ± 0.8 mg/kg). The iron content increased significantly after drying. Fresh eggplant samples had a content of (3.75 ± 0.75 mg/kg), while sun-dried and oven-dried eggplants had contents of (35.88 ± 0.06 mg/kg) and (32.06 ± 0.04 mg/kg), respectively. Sun-dried eggplants had the highest iron content. The potassium content increased from 3.45 ± 0.45% in fresh eggplants to 24.68 ± 0.06 mg/kg in sun-dried eggplants and to 27.89 ± 0.01 mg/kg in oven-dried eggplants; the highest value was observed in oven-dried eggplants. The magnesium content ranged from (7.43±0.32 mg/kg) in the fresh eggplant samples to (89.78±0.06 mg/kg) in the sun-dried eggplant samples and (44.42 ± 0.12 mg/kg) for oven-dried eggplant samples. Sun-drying yielded the highest content. Manganese levels ranged from (3.93 ± 0.13 mg/kg) to (33.60 ± 0.05 mg/kg). The lowest concentration was recorded in the fresh eggplant samples, while the highest concentration was observed in the oven-dried eggplant samples. The sodium content increased very significantly after drying, with (6.93±0.11 mg/kg) for the fresh eggplant samples compared to (48.53±0.02 mg/kg) for the sun-dried eggplant samples and (66.16 ± 0.06 mg/kg) for oven-dried eggplant samples. The oven-dried eggplant samples had the highest sodium content. The copper, lead, and selenium contents remained at trace levels in all treated samples. The zinc content increased after drying, with a concentration of (9.18 ± 0.01 mg/kg) for fresh eggplants, (41.47 ± 0.52 mg/kg) for sun-dried eggplants, and (68.38 ± 0.24 mg/kg) for oven-dried eggplant samples. The highest value was observed in the sun-dried eggplant.

Table 2 Effect of drying on the mineral content of *Solanum aethiopicum* eggplant after drying

Sample	AuF	AuSS	AuSE
Ca (mg/kg)	6.11±0.89c	57.14±0.12a	53.70±0.2b
Cu (mg/kg)	0.01±0.01a	0.12±0.19a	0.08±0.01a
Fe (mg/kg)	3.75±0.75c	35.88±0.06a	32.06±0.04b
K (mg/kg)	3.45±0.45c	24.68±0.06b	37,89±0.00a
Mg (mg/kg)	7.42±0.31c	89.78±0.06a	44.72±0.2b
Mn (mg/kg)	3.39±0.3c	27.74±0.12b	33.60±0.01a
Na (mg/kg)	6.33±0.11c	48.53±0.02b	66.16±0.06a
Pb (mg/kg)	0.001±0.00a	0.002±0.00a	0.001±0.00a
Se (mg/kg)	0.01±0.00c	0.06±0.01b	0.08±0.00a
Zn (mg/kg)	7.18±0.01c	71.77±0.52a	58.36±0.24b

Different letters in a column indicate a significant difference at the P ≤0.05 % level, while identical letters indicate that there is no significant difference. AuSS: sun-dried eggplant; AuSE: oven-dried eggplant; AuF: fresh eggplant.

3.2. Effect of drying on the phytochemicals in *Solanum aethiopicum*

The composition of polyphenols, flavonoids, and tannins, as well as antioxidant activity, is shown in Figures 1, 2, 3, and 4. Polyphenol content ranged from (711.49 ± 6.84 to 730.63 mg EAG/100 g) for the sun-dried and oven-dried eggplant samples, respectively. In contrast, the fresh eggplant sample had a content of (31.67 ± 0.84 mg EAG/100 g). The oven-dried sample (AuSE) had the highest content. Flavonoid contents ranged from (62.06 ± 0.35 to 66.28 ± 0.879 mg EQuer/100 g) for the oven-dried and sun-dried eggplant samples. These levels are significantly higher than that found in the fresh eggplant sample (1.08 ± 0.28 mg EQuer/100 g). The sample from sun-drying (AuSS) had the highest content (66.28±0.875 mg EQuer/100g). Tannin contents ranged from (122.01 ± 19.62 to 154.79 ± 11.89 Emg/100g) for sun-dried and oven-dried eggplant samples, respectively, and for the fresh eggplant sample, the content was (5.55 ± 0.505 Emg/100 g). The highest value was observed in the oven-dried eggplant sample (AuSE), which was (154.79 ± 11.89 Emg/100 g). Antioxidant activity ranged from (58.60 ± 10.15) to (63.02 ± 8.98 Emg/100g) for the dried eggplant samples; with the lowest value being (18.27 ± 6.43 Emg/100g) for fresh eggplant (AuF) and the highest value observed in the sun-dried eggplant sample (AuSS).

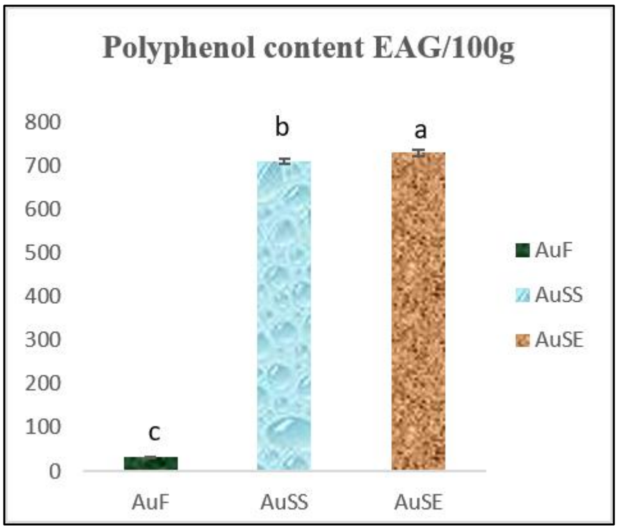

Figure 1 Polyphenol Content of Fresh and Dried Eggplant Samples

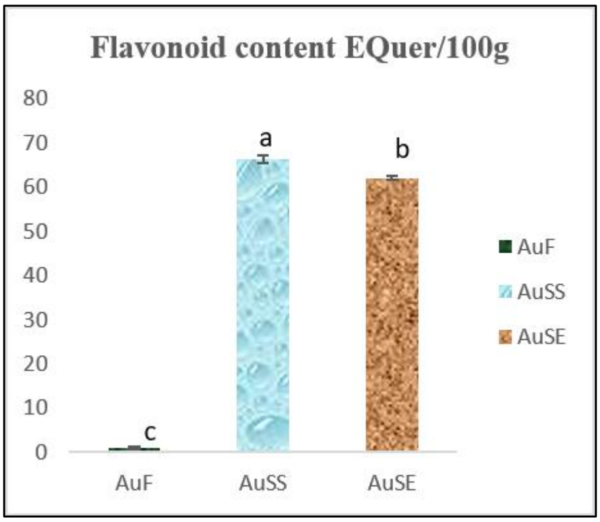

Figure 2 Flavonoid Content of Fresh and Dried Eggplant Samples

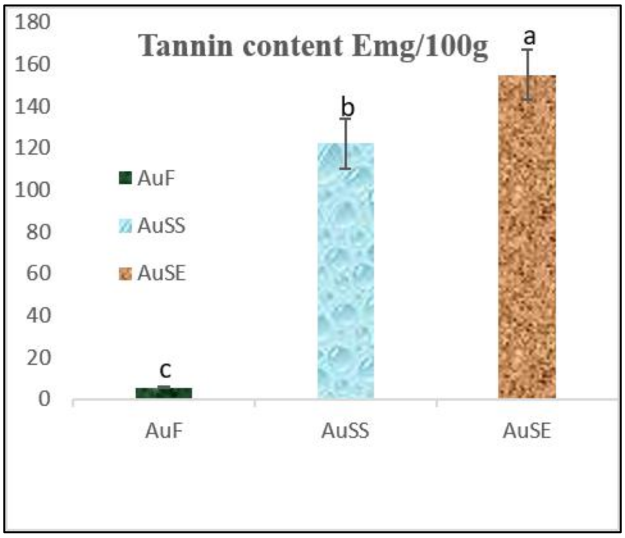

Figure 3 Tannin Content of Fresh and Dried Eggplant Samples

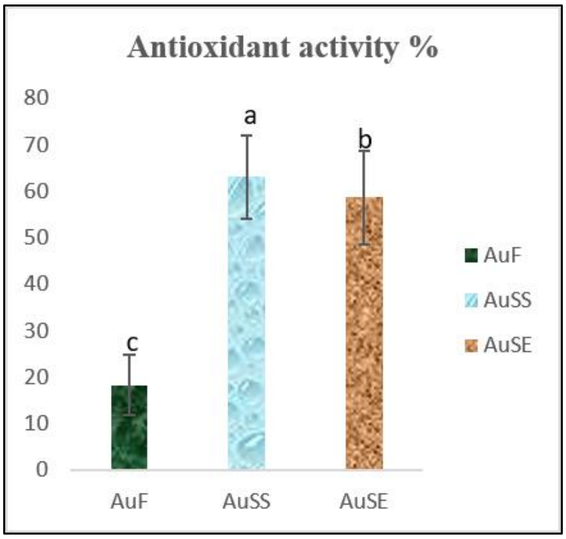

Figure 4 Antioxidant Activity of Fresh and Dried Eggplant Samples

4. Discussion

The water content of fresh *Solanum aethiopicum* eggplant in this study decreased significantly after both drying methods examined. These results are fully consistent with those of [17], who reported moisture contents ranging from

85 to 92% for fresh vegetables, with a decrease to less than 10% after drying. This reduction could be explained by the gradual elimination of free water followed by bound water under the effect of heat, which would allow for better preservation of nutritional value by reducing the proliferation of microorganisms in the dried eggplants. Furthermore, the similarity in the results obtained from solar drying and oven drying suggests that both methods are effective in achieving a moisture level suitable for storage. However, oven drying offers better control over conditions (temperature, duration), unlike solar drying, which depends on weather conditions. Drying is a useful technique for limiting post-harvest losses of eggplants, which are highly perishable due to their high water content. The ash content increases from 0.67% in the fresh sample to 5.4% and 6.7% in the oven-dried and sun-dried samples, respectively. This significant increase is attributable to a concentration effect of mineral matter resulting from water loss. Similar observations were made by [4] on market vegetables, where drying led to a notable increase in ash content. According to [18], this increase does not reflect mineral production but rather a relative increase in their proportion within the dry matter. Furthermore, the higher ash content in the sun-dried sample could be explained by slower evaporation, which allows for greater concentration of mineral elements. With regard to minerals, the higher calcium content in dried eggplant compared to fresh eggplant could be explained by the fact that calcium is a thermally stable and non-volatile element, which accounts for its retention and concentration during the drying process. Furthermore, heat can cause calcium bound to cell walls particularly to pectins to be released, thereby increasing its analytical availability. This increase in calcium in dried eggplants is particularly noteworthy, as calcium plays an essential role in bone mineralization, nerve transmission, and blood clotting [19]. The iron content also increases significantly after both drying methods, which is consistent with the principle of concentration resulting from water loss. Studies on *Solanum aethiopicum* indicate iron levels of up to 21 mg/100 g in the fruits, confirming that this species is an important dietary source of iron [20]. [18] also highlighted the high iron content of local vegetables and their importance in the diet. The increase in iron observed in this study could be explained by the thermal stability of iron, which does not degrade during drying, as well as by its release from organic complexes under the effect of heat. However, the bioavailability of iron can be influenced by the presence of antinutritional compounds such as tannins, the levels of which also increased in this study. These compounds can form insoluble complexes with iron, thereby reducing its absorption [14]. It should be noted, however, that the results confirm the potential of sun-dried and oven-dried eggplant in combating iron deficiency, particularly in African countries where anemia remains a major public health problem [19]. The magnesium content increases significantly after both drying methods compared to fresh eggplant. From a physiological standpoint, magnesium is essential for many biological functions, including enzyme activation, protein synthesis, and nervous system function. Thus, the high values obtained in this study confirm the nutritional value of dried eggplant as a source of magnesium. The zinc content also increases after drying compared to fresh eggplant. Studies on *Solanum aethiopicum* indicate zinc contents ranging from 2 to 20 mg/100 g, depending on the plant parts and growing conditions [20,21]. However, the bioavailability of zinc can be affected by the presence of tannins and phytates, which can form complexes with this mineral [14]. Despite this, zinc remains an essential element involved in the immune system, cell growth, and wound healing. Potassium levels also increase during both drying methods compared to fresh eggplant. The increase in potassium during sun-drying and oven-drying is beneficial to the body because potassium plays a fundamental role in regulating fluid balance, nerve transmission, and muscle contraction [19]. Its high concentration in dried eggplant therefore enhances the nutritional value of processed eggplant. In this study, the copper content increased slightly after sun-drying and oven-drying compared to the fresh sample, which could be explained by the concentration of minerals following water removal, as well as by the release of copper bound to enzymes and plant proteins under the effect of heat. However, unlike macrominerals, copper is a trace element present in low concentrations, which explains why its increase remains moderate. Copper plays an essential role in iron metabolism, enzymatic reactions, and antioxidant defense. According to [19], copper deficiency can lead to hematological and immune disorders. Thus, even in small amounts, the presence of copper in dried eggplant provides a valuable nutritional contribution. The manganese content also increases after drying. This increase is due to a concentration effect resulting from dehydration, which reduces the total mass of the sample and increases the proportion of minerals. Studies conducted on *Solanum aethiopicum* have reported manganese levels generally ranging from 1 to 10 mg/100 g, with significant variations depending on soil conditions [20]. Furthermore, studies on African vegetables have shown that manganese is a relatively abundant element in plants, although it has been studied less than iron or calcium [18]. It should also be noted that manganese content can be strongly influenced by soil composition, soil pH, and farming practices. It should be noted, however, that manganese is an essential trace element involved in carbohydrate and lipid metabolism, bone formation, and antioxidant defense mechanisms. According to [14], manganese also contributes to the activity of certain antioxidant enzymes, which underscores its importance in the diet. Thus, the results obtained in this study confirm that dried African eggplant is a valuable source of manganese. The low levels of lead and selenium observed indicate the absence of contamination in the eggplants studied. These results are consistent with studies conducted on African vegetables, which generally show low levels of heavy metals under normal growing conditions [22]. This low level of contamination could be explained by soil quality and the absence of industrial pollution. These results confirm the sanitary quality of dried eggplant and its safety for human consumption.

The lipid content increases from 0.23% in fresh eggplant to values ranging from 5.9% to 10.3% after drying. This significant increase is mainly due to the concentration of the constituents. Studies conducted by [23] have shown that drying vegetables leads to a significant increase in lipid content. However, it should be noted that lipids can undergo oxidation during drying, particularly in the presence of oxygen and light. According to [24], these reactions can impair the nutritional quality of lipids, even though their apparent content increases. Protein content ranges from 1.98% in fresh eggplants to approximately 14.52% and 15.03% in dried eggplants. This increase is due to a concentration effect, but also to heat-induced structural changes. These results are consistent with those of [25], who observed a similar increase in protein content in dried vegetables. Heat can cause protein denaturation, facilitating their extraction and quantification. Given these values, sun-dried and oven-dried eggplants could therefore be recommended for children and vulnerable individuals who require an increased protein intake. Fiber content increases from 3.03% to approximately 27% and 28.75% after drying. This increase is due to the concentration of structural components such as cellulose, hemicellulose, and lignin. According to [26], eggplants are naturally rich in fiber, and drying them further enhances this characteristic. Fiber plays a crucial role in regulating digestion, preventing diabetes, and lowering cholesterol [27]. Consuming sun-dried and oven-dried eggplants would therefore be ideal for promoting healthy bowel movements. The carbohydrate content increases from 3.89% to values ranging from 30.12% to 38.08%. This increase is due to the concentration of sugars and polysaccharides. The energy value increases from 24.83 kcal/100 g to more than 260 kcal/100 g after drying. This increase reflects the concentration of macronutrients. According to the [28], dried foods have a high energy density, which is beneficial for populations that need a high caloric intake for their development.

Polyphenol content increases from 31.67 mg EAG/100 g in fresh eggplant to 711.49 mg EAG/100 g and 730.63 mg EAG/100 g in sun-dried and oven-dried eggplants. This remarkable increase reflects the significant effect of drying on the concentration and availability of phenolic compounds. Indeed, the reduction of more than 80% in moisture content leads to an increase in the proportion of solid compounds, including polyphenols. This phenomenon was described by [29], who observed a similar increase in polyphenols in dried plant materials. Furthermore, heat treatment causes the disruption of plant cellular structures, particularly the breakdown of cell walls and membranes, which facilitates the release of polyphenols bound to plant matrices. According to [30], these compounds often exist in a bound form and become more extractable after heat treatment. The higher content observed in oven-dried samples compared to sun-dried samples can be explained by the fact that oven drying takes place under controlled conditions (constant temperature, absence of UV radiation), thereby limiting the oxidative degradation of polyphenols. Conversely, solar drying exposes the samples to light and oxygen, which can lead to slight degradation of certain sensitive compounds. The results of this study are consistent with those of [31], who showed that controlled thermal drying preserves phenolic compounds better than traditional drying. From a nutritional standpoint, this high polyphenol content gives sun-dried eggplants a high antioxidant potential, contributing to the prevention of diseases linked to oxidative stress, such as cardiovascular disease and other cancers. Tannin levels range from 5.55 mg/100 g in the fresh sample to 122.01 mg/100 g (sun-dried) and 154.79 mg/100 g (oven-dried). This significant increase follows a trend similar to that observed for polyphenols. The increase in tannins can be explained primarily by a concentration effect, as described earlier. In fact, tannins are often present as complexes with proteins or polysaccharides. When heated, these complexes can be hydrolyzed, thereby releasing free tannins that are more easily quantifiable. According to [15], heat treatments in an acidic environment promote this release. The difference observed between the two drying methods—with a higher content in the oven-dried samples—could be explained by a more stable temperature that promotes hydrolysis reactions, as well as reduced exposure to UV radiation, which can degrade certain phenolic compounds. Although the sharp increase in tannins during drying improves certain functional properties, it must be taken into account in the overall assessment of nutritional quality, as it could reduce the bioavailability of proteins and certain minerals through complexation. Flavonoid levels increased from 1.08 mg EQuer/100 g in the fresh sample to 66.28 mg EQuer/100 g in sun-dried eggplants and 62.06 mg EQuer/100 g in oven-dried eggplants. As with other bioactive compounds, this increase could be partly explained by a concentration effect. The higher values observed in the sun-dried samples can be attributed to exposure to UV radiation, which can trigger defense mechanisms in plant tissues, leading to an increased accumulation of flavonoids. According to [14], flavonoids play a protective role against radiation, and their synthesis can be stimulated by light. Furthermore, heat promotes the release of flavonoids bound to cellular structures. However, prolonged exposure to high temperatures can lead to their degradation, which could explain the slight difference between the two methods. The increase in flavonoids during drying would be beneficial to consumers, as flavonoids are known for their antioxidant, anti-inflammatory, and cardioprotective properties. Thus, this increase enhances the functional value of dried eggplant. Antioxidant activity increased from 18.27% in the fresh sample to 58.60% and 63.02% in oven-dried and sun-dried eggplants, respectively. This significant increase reflects the overall change in bioactive compounds, which may be due to an increase in polyphenols, flavonoids, and tannins, as well as the release of antioxidant compounds associated with the formation of new compounds resulting from thermal reactions. The fact that sun-drying results in slightly higher antioxidant activity could be explained by the stimulating effect of UV radiation and the formation of compounds resulting from Maillard reactions.

5. Conclusion

The objective of this study was to evaluate the impact of sun-drying and oven-drying on the biochemical composition and phytochemicals of *Solanum aethiopicum*. Overall, the results show that both sun-drying and oven-drying lead to an improvement in the nutritional and functional density of *Solanum aethiopicum*, primarily through concentration and biochemical transformation. Oven drying is more effective at preserving phenolic compounds, while sun drying improves biochemical properties and certain antioxidant properties. Thus, this study confirms that drying is an effective method for adding value to African eggplants, allowing both for improved preservation and optimized nutritional quality.

Compliance with ethical standards

Disclosure of conflict of interest

The authors declare no conflicts of interest regarding the publication of this paper.

References

[1] Schippers RR. Native African Vegetables: An Introduction to Cultivated Species. Margraf Publishers-CTA. 2004.

[2] Bancal V, Kablan T, et Disseka W. Assessment of Post-Harvest Food Losses Among Peri-Urban Farmers and Merchants in Abidjan—Final Activity Report—MARIGO Project, WP5. 2025.

[3] FAOSTAT. Agricultural Production, Primary Crop Database. Food and Agriculture Organization of the United Nations, Rome. 2023. http://www.fao.org/faostat/en/#data/QC /

[4] Fondio L, Kouamé C, Nzi JC, Mahyao A, Agbo E, and Djidji H. Survey of indigenous leafy vegetables in the urban and peri-urban areas of Cote d'Ivoire. In I International Conference on Indigenous Vegetables and Legumes. Prospectus for Fighting Poverty, Hunger and Malnutrition. 2006; 752 pp. 287-289.

[5] Choi SM, et Choi CI. Nutritional Composition, Phytochemical Profiles, and Pharmacological Effects of Ethiopian Eggplant (*Solanum aethiopicum* L.). Nutrients. 2024;16 (23), 4228. https://doi.org/10.3390/nu16234228

[6] Han M, Opoku KN, Bissah NAB, Su T. *Solanum aethiopicum*: The Nutrient-Rich Vegetable Crop with Great Economic, Genetic Biodiversity and Pharmaceutical Potential. Horticulturae. 2021; 7 (6), 126.

[7] Bancal V, et Tano K. Study on Methods for Reducing Post-Harvest Losses in Vegetable Production Chains (Tomatoes, Eggplant, Okra, Chili Peppers, Cabbage) in Côte d'Ivoire. PRO2M Project.

[8] AOAC (1990). Official methods of analysis. Association of Official Analytical Chemists Ed., Washington DC. 2019; 684 p.

[9] Wolf. Manuel d'analyses des corps gras. Azoulay Ed., Paris, France. 1968; 519 p.

[10] AFNOR. Collection of French Standards: Fats, Oilseeds, and Derived Products, AFNOR Ed., Paris. 1986; 27 p

[11] FAO. Expanding the Food Resource Base Through Native Plants. Rome (Italy). 2002.

[12] CEAEQ. Determination of Metals. Method Using Argon Plasma Ionization Mass Spectrometry. MA 200 – Met 1.2, Rev. 4. Quebec. 2013; p. 24.

[13] Singleton VL, Orthofer R, and Lamuela-Raventos RM. Analysis of total phenols and other oxydant substrates and antioxydants by means of Folin-ciocalteu reagent. Methods Enzymology. 1999 ; 299: 152-178. https://doi.org/10.1016/s0076-6879(99)99017-1.

[14] Meda A, Lamien CE, Romito M, Millogo J, and Nacoulma OG. Determination of total phenolic, flavonoid and proline contents in Burkina Faso honeys as well as well as their radical scavenging activity. Food Chemistry. 2005;91(3):571-577. doi: https://dx.doi.org/10.1016/j.foodchem.2004.10.006.

[15] Bainbridge Z, Tomlins K, Wellings K, and Westby A. Analysis of condensed tannins using acidified vanillin. Journal of the Science of Food and Agriclture. 1996; 29: 77-79.

[16] Choi CW, Kim SC, Hwang SS, Choi BK, Ahn HJ, Lee MZ, Park SH, and Kim SK. Antioxydant activity and free radical scavenging capacity between Korean medicinal plant and flavonoids by assay guided comparison. Plant Science. 2002;163:1161-1168. https://doi.org/10.1016/s0168-9452(02)00332-1.

[17] Kouamé CR, Batchep, and Kamga RT. Assessment of post-harvest losses in the production and marketing chain for traditional leafy vegetables in Yaoundé (Cameroon). Agronomie Africaine. 2013; 25 (1): 61–70.

[18] Status of Plant Genetic Resources for Food and Agriculture: Second National Report. National Report on the Status of Plant Genetic Resources for Food and Agriculture. 2009;64p.

[19] FAO. International Symposium on "Food Security: Assessing International Policies in Achieving the Millennium Development Goals." (2013).

[20] Chinedu SN, Olasumbo AC, Eboji OK, Emiloju OC, Arinola OK, Dania DI. Proximate and phytochemical analyses of *Solanum aethiopicum* L. Research Journal of Chemical Sciences. 2011;1(3), 63-71.

[21] Yaméogo, Boubacar S, Franck G, and Charles P. Comparative Study of *Solanum aethiopicum* Leaves and Fruits Nutritional Quality. Global Journal of Nutrition and Food Science. 2024;5(1) pp 3-5. doi: 10.33552/GJNFS.2024.05.000602.

[22] Traoré A. Characterization of the physicochemical, mineral, and phytochemical composition of Akée (*Blighia sapida*) fruits in Côte d'Ivoire. Jean Lorougnon Guede University. 2022; 34p.

[23] Adepoju OT et Oyewole EO. Nutritional Importance and Micronutrient Potentials of Two Non-Convectional Indigenous Green Leafy Vegetables from Nigeria. Agricultural Journal. 2008; 3 : 362-365.

[24] Yao DN, Kouassi KN, Erba D. Nutritional evaluation of the local Ci12 variety of Bambara groundnut [Vigna subterranea (L.) Verdc. (Fabaceae)] produced in Côte d'Ivoire. International Journal of Molecular Sciences. (2015);16(9),21428-21441. https://doi.org/10.3390/ijms160921428

[25] Koffi KK, Komenan AO, Goba KAE, Zoro BIA. Structure and genetic diversity of two populations of Garcinia kola Heckel (Clusiaceae) revealed by RAPD markers. International Journal of Current Research in Biosciences and Plant Biology. 2022;9(1): 32-41. doi: https://doi.org/10.20546/ijcrbp.2022.901.004

[26] Aglinglo AL, Adjinda RO, Legb CE, Houdégbé CA, Francisco AR, Fassinou HVN, Achigan-Dako GE. Summary Technical Data Sheet for Eggplant (*Solanum melongena* L.) Production. Laboratory of Genetics, Horticulture, and Seed Science (GBioS). University of Abomey-Calavi (UAC). 2018 ; 5 p. doi : 10.13140/RG.2.2.26332.21124.

[27] Slavin J. Fiber and prebiotics: Mechanisms and health benefits. Nutrients. 2013;5(4): 1417–143. doi :https://dx.doi.org/10.3390/nu5041417.

[28] FAO. Expanding the Food Resource Base Through Native Plants. Rome (Italy). (2002).

[29] Oulai DP, Zoué TL, Niamkey JA, Niamké LS. Impact of sun-drying on the nutritive and antioxidant properties of five leafy vegetables consumed in Northern Côte d'Ivoire. Asian Journal of Applied Sciences. (2015);(3): 628-637.

[30] Oboh G, Ademosun AO, Olumuyiwa TA, Olasehinde TA, Ademiluyi AO, Adeyemo AC. Insecticidal activity of essential oil from orange peels (Citrus sinensis) against Tribolium confusum, Callosobruchus maculatus and Sitophilus oryzae and its inhibitory effects on acetylcholinesterase and Na+/K+- ATPase activities. J. Phythoparasitica. 2017;45 (4): 501-508. https://dx.doi.org/10.1007/s12600-017-0620-z.

[31] N'Dri D, Calani L, Mazzeo T, Scazzina F, Rinaldi M, Del Rio D, Brighenti F. Effects of different maturity stages on antioxidant content of Ivorian Gnagnan (Solanum indicum L.) berries. Molecules. 2010;15(10),7125-7138. Available at: https://dx.doi.org/10.3390/molecules15107125.