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# Effect of Postharvest Treatments on the Nutritional Composition and Phytochemical Content of Fluted Pumpkin *(Talfairia Occidentalis)* Leaf

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***Abstract*—** The effect of two different drying techniques (Sun drying at ambient temperature for 2 days, and oven drying at 65$^{o}$C for 4 hours, on the proximate, mineral composition, vitamin content and ant-nutrients of fluted pumpkin leaf were studied. The results obtained showed that oven drying technique had higher protein (21.75%), moisture (82.25%) and Ash (6.50). High levels of vitamins A (17.25mg/100), $B_1$ (2.35 mg/100g), and $B_2$ (2.17mg/100g) content were observed in sun-drying of fluted pumpkin leaf. Low levels of P (156.25 mg/100g), Na (405.45 mg/100g) and K (178.40 mg/100g), were observed in the sun-drying. Oven-dried fluted pumpkin leaf showed significant lower level of anti-nutrients contents of Tanins (1.34 mg/100g), saponin (61.35 mg/100g), oxalate (70.20 mg/100g), phyates (1.12 mg/100g) and Trpsin (22.50 mg/100g) and microbial count of total plate count (2.4 x $10^2$ Cfu/g) and Yeast/Mold (1.4 x $10^1$ Cfu/g). This work showed that oven-drying of fluted pumpkin could be the best method of preserving it without compromising on its quality.

***Keywords***— Postharvest, Vegetables, Bioactive compounds, Health-Promoting, Preservation, Food System

## I. INTRODUCTION

The expanding number of urban people, as well as the changing lifestyles and nutritional habits of the burgeoning middle class in developing nations, are exerting enormous demand on the planet's resources. Food production must grow by 70% by 2050, according to the FAO, to feed the world's population. Food costs have risen dramatically in recent years, highlighting the already challenging access to food for the poorest people in both industrialised and developing countries. Furthermore, approximately 815 million people suffer from chronic malnutrition [1], mainly in portions of Sub-Saharan Africa (SSA) and South Asia, where 22.8 percent and 14.7 percent of the total population, respectively, are malnourished [2];[3]. A key stumbling block is high post-harvest food losses caused by insufficient food preservation alternatives in the Global South, where seasonal food shortages and nutritional deficiencies remain a major concern [4].

Fruits and vegetables are a rich source of dietary fiber and micronutrients such as vitamin C, thiamin, riboflavin, B-6, niacin, folate, A, and E. Phytochemicals in fruits and vegetables, such as polyphenolics, carotenoids, and glucosinolates, may also have nutritional value [5];[6]. Leafy vegetables deteriorate very rapidly after harvest and therefore require proper postharvest handling to preserve the quality at harvest. Lack of knowledge on appropriate quality preservation practices and technologies can result in high qualitative and quantitative losses in vegetables [7]. High postharvest losses (upwards of 50%) in leafy vegetables are attributed to various biological and environmental factors [6].

During or after harvest, postharvest loss (PHL) of food crops is a loss of important food and the inputs necessary for its production and distribution [8]. Reducing PHL will assist establish more sustainable and resilient food systems while also lowering greenhouse gas emissions due to their large size. Reduced PHL can boost agricultural output while also increasing revenues for small-scale food producers and other value chain players, particularly women, who are historically in charge of many post-harvest tasks [3].

Fruits and vegetables are nutrient-dense, tasty foods that contribute to the world's supply of key vitamins, minerals, and fibre, nourishing populations in both developed and developing countries. However, in low-income nations, inadequate plant care and handling typically result in a loss of quality, especially if not consumed right away. People in these nations are under-informed about how to make technical decisions that will improve the preservation of fruits and vegetables. *Telfairia occidentalis* (fluted pumpkin), a member of the Cucurbitaceous family, is one of Nigeria's most widely eaten leafy and seed vegetables. It is a popular leaf and seed vegetable that is native to southern Nigeria and may be found all throughout Africa.

The fluted pumpkin has recently garnered medical attention. It has been discovered to be blood purifying [9], and hence may be effective in maintaining good health, especially in resource-poor rural parts of developing nations.

Anemia, chronic tiredness, and diabetes have all been treated using the plant's herbal preparation in Nigeria [10]. Because it is rich in protein (29%) and fat (18%), as well as minerals and vitamins (20%), the leaf has a great nutritional, therapeutic, and industrial value. The oil in the seeds does not dry up and may be used to make soap and cook with [11]. The seed oil might also be used to manufacture margarine and pomade, as well as a carrier for pharmaceuticals [12]. According to [12], the seeds' protein and oil contents were 30.1% and 47%, respectively. The seed also contains water 6.0 g; energy 2280 kj (543 kcal); protein 20.5 g; fat 45.0 g; carbohydrates 23.5 g; fibre 2.2 g; calcium (Ca) 84 mg and phosphorus (P) 572 mg; seeds are rich in essential amino acids (except lysine) and can be compared to soybean meal with 95% biological value. The oily seeds are also known to help with breastfeeding and are regularly ingested by nursing moms.

Fruits and vegetables are vital parts of the human diet, and customers are increasingly demanding minimally processed foods that retain the organoleptic qualities of fresh produce [13]. Fresh food is perceived to be healthier, fresher, better quality, and safer than pre-packaged produce, as well as higher quality. When demand is strong, consumers are more attentive to quality qualities such as colour, texture, flavour, and nutritional content [14], and items that offer convenience, are devoid of additives and preservatives, and preserve the attributes of a fresh product [15]. However, in Nigeria and other nations in the Global South, epileptic energy supply makes wet storage of fruits and vegetables impossible. As a result, when fresh leaves are unavailable owing to overstock or food miles, the leaves might be blanched and then dried. During the dry season, when fresh leaves are limited, dry leaves are in high demand [16].

Like other vegetables, fluted pumpkin is a perishable meal whose qualities alter with time. As a result, it is vital to employ conservation techniques that allow its qualities to be preserved. Drying, which is considered the oldest and most significant method of food preservation, is one of the most regularly employed ways of preservation [17]. This method involves eliminating water from the product in order to diminish water activity and, as a result, microbiological alterations [18] or enzymatic reactions [19]. It also reduces weight and volume, reduces packing, storage, and transportation costs, and allows the product to be stored without refrigeration [20]. The increased consumption of dry leafy greens during the dry season necessitates research into the impact of various drying processes on the nutritional components of some of the country's most prevalent edible leafy greens. The goal of this study is to see how sun drying and oven drying affect the nutritional composition and phytochemical content of the Fluted Pumpkin *(Talfairia Occidentalis)* Leaf.

The rest of the paper is organized as follows, Section I contains the introduction of background information on postharvest losses and vegetables, Section II contain the related work on fruits and vegetable Section III explain the processing methodology and analysis with a flow chart, and Section IV describes results and discussion of the effect of sun and oven drying on the nutritional composition and phytochemical content of fluted pumpkin *(Talfairia Occidentalis)* leaf, and Section V concludes the research work with future directions.

## II. Related Work

Goal 12.3 of the Sustainable Development Goals (SDGs) has set targets for reducing supply chain losses [21]. As part of the Malabo Declaration, African Union member states have committed to decreasing post-harvest food losses by 2025 [22]. Reduced post-harvest food losses have ramifications for other SDGs connected to food systems, as well as socioeconomic and environmental repercussions on SDGs 1, 2, 5, 6, 7, 8, 9, 10, 11, 13, 14, 15, and 17 [23];[3]. Fruit and vegetable post-harvest losses are difficult to anticipate; the major causes of spoiling are physiological damage and the interactions of numerous species. Fruits and vegetables can be preserved in a variety of ways. Fermentation, sun drying, osmotic dehydration, and refrigeration are all methods used to preserve vegetables in rural areas. Scalding (balancing) fruits and vegetables can be used to remove enzymes and bacteria before processing. Fermentation of fruits and vegetables is a rural preservation method that does not require expensive equipment due to its simplicity; pickled items, sour herbs, and wine are examples of this procedure.

Convection air drying and freeze-drying were used to dry pumpkin (Cucurbita maxima L.), with freeze-drying giving products with less sugar reduction but greater amounts of fibre and vitamin C degradation. The scientists observed that in terms of antioxidant activity and phenolic chemicals, the various dried goods are relatively similar and exhibit no significant variations when compared to the fresh product [24].

Ref [25] evaluated the impact of blanching on the phytochemical content and bioactivity of *Hypochaeris laevigata* (HL), *Hypochaeris radicata* (HR), *Hyoseris radiata* (HRA), and *Hyoseris lucida subsp. taurina* (HT) leaves and observed a general decrease in the phytochemical content in order of fresh > blanching water > blanched samples. The authors also observed similarities in the antioxidant activity independently of the applied test as well as in the inhibition of lipase and carbohydrates-hydrolysing enzymes which demonstrated that blanching water should be reused in food preparation since it is a good source of bioactive compounds and its consumption should be recommended in order to increase the uptake of micronutrients.

Ref [26] investigated the impact of dehydration on the micronutrient content of six commonly consumed greens namely *Amaranthus spinosus*, *Chenopodium album*, *Spinaciaoleracea*, *Phyllanthus amarus*, *Talinum triangulare* and *Ludwigia adscendens* using four different drying methods, i.e. sun drying, shade drying, cabinet dryer drying, and microwave oven drying. Among the nutritional parameters, total mineral content, iron, calcium, potassium, phosphorous and ascorbic acid content was found highest in cabinet dryer dried samples, followed by microwave dried samples. The authors concluded that the mineral content of all of the selected greens became concentrated after dehydration making the dehydrated leaves have a good rehydration capacity for incorporation into various products to reduce micronutrient deficiency.

Ref [27] evaluated the best packaging materials for maximum retention of quality characteristics in the selected green dehydrated leafy vegetables during storage: 300-gauge high-density polyethylene (HDPE), 200-gauge polypropylene (PP), and 300-gauge metallized polypropylene (MPP), and found that MPP retained significantly higher levels of chlorophyll, ascorbic acid, beta-carotene, and rehydration ratio and decreased moisture content in the chosen dried green leafy vegetable powder samples during a three-month storage period than HDPE and PP.

The effects of drying procedures on the nutritional composition, volatile profile, phytochemical content, and bioactivity of *Salicornia ramosissima* J. Woods were studied by [28]. The authors found that oven-drying had a minor influence on the nutritional qualities of *Salicornia ramosissima*, but it drastically lowered phytochemical content and antioxidant activity when compared with freeze-drying. Neither the antiproliferative nor the antihypertensive characteristics were impacted by any of the drying techniques [29].

The majority of studies on vegetable drying have concentrated on freeze-drying, convection drying, and oven drying; however, nothing has been done to compare and contrast the effects of sun drying and oven drying on rippling gourd leaves. As a result, the purpose of this study was to see how sun and oven drying affected the nutritional composition and phytochemical content of fluted pumpkin *(Talfairia Occidentalis)* leaf.

## III. METHODOLOGY

***Sample Collection and Sample Treatment***

The sample of *Telfairia occidentalis* used in this study was obtained from local Alamis market in Lafia town, Nasarawa State, Nigeria.

***Samples Preparation***

The fresh leafy vegetable samples were destalked, sorted, sliced, and washed with clean potable water to remove extraneous matters and steam balanced for 5mins.

***Oven Drying***

250 g of the Fluted pumpkin slices were distributed uniformly as a thin layer onto the stainless-steel trays of size 0.3-0.2 m and dried in an oven at 65$^{O}$C until a constant weight was obtained. The dried leaves were then ground in a porcelain mortar, sieved through a 2 mm mesh sieve, and stored in a polythene bag until used for analyses.

***Sun Drying***

250 g of fluted pumpkin slices were distributed uniformly as a thin layer onto the stainless steel trays of size 0.3-0.2 m and dried under direct sunlight at temperatures between 45 and 70$^{o}$C for 2 days. The dried leaves were then ground in a porcelain mortar, sieved through a 2 mm mesh sieve, and stored in a polythene bag until used for analyses.

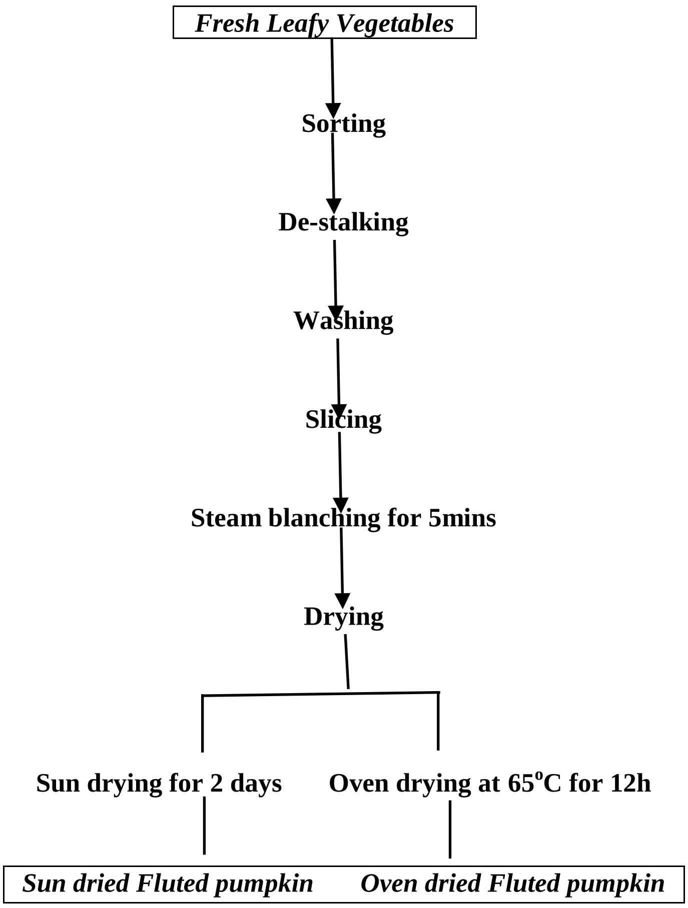


Fig 1: Flow chart for fluted pumpkin drying

**Nutritional Characterization**

**Nutritional Parameters**

As indicated by the Association of Official Analytical Chemists [30], moisture was assessed in an oven drying at 105 °C, and ash content was determined by sample combustion in a Muffle furnace (600 °C) [30]. The Kjeldahl technique (F = 6.25) was used to quantify total protein, and the Soxhlet extraction method was used to calculate total fat [30]. Official AOAC method 985.29 [30] was used to calculate total dietary fibre. Equation (1) was used to compute carbohydrate content. For each analysis, all measurements were made in triplicate.

*[Carbohydrates = 100 − (Ash + Moisture + Protein + Total fat)]* -----------------------------------------------(1)

**Determination of Mineral Content**

For total mineral determination, the AOAC [30] technique was employed. Two grams of oven-dried cake samples were weighed and mineralized at 600°C for three hours in a crucible. The ash was transferred to separate beakers after cooling in desiccators, and 120 ml of concentrated $HNO_3$ and 10 ml of $H_2O_2$ were added to each. The mixture was heated to 90°C for 1 hour before being cooled and filtered. The filtrate was transferred to a 250 mL volumetric flask and filled with distilled water to the desired volume. 2 ml of the stock solution was pipetted into a 50 ml flask and filled with distilled water to the necessary volume. An atomic absorption spectrophotometer was used to determine the mineral content of these solutions for the different elements. Dilution of a 1000 ppm stock solution yielded working standard solutions of the element at 100 ppm. Magnesium, calcium, potassium, and iron are among the elements present. Standard solutions of 0.4, 1.0, 1.5, and 2.0 ppm for each element are generated by diluting the previous 100 ppm stock solution with distilled water.

The absorbance of the sample solutions obtained and their elemental concentration will be calculated using the formula.

$$\text{Conc. In ppm of mineral in test} = \frac{\text{Atest x Concentration std}}{\text{Astd}}$$

Where,
Atest is the absorbance of the unknown element
Astd is the absorbance of standard concentration.

**Vitamin Analysis**

The vitamins in the leafy vegetables were determined by the official methods of the Association of Official Analytical Chemists [30].

**Ant-Nutrient and Toxicant Composition Determination**

Ant-nutrient and toxicant such as oxalate, phytate, saponin and Tannin was determined using AOAC [30] method.

**Microbiological Analysis**

10 g of each sample was chopped using a sterile knife, then blended with a sterile Warring blender and homogenised in 100 ml sterile peptone water. The homogenate was then diluted $10^{-2}$, $10^{-3}$, $10^{-4}$, and $10^{-5}$ times. Using the spread plate method, 0.1 ml of the relevant dilution was plated in duplicate onto the various medium. Total aerobic plate counts, coliform counts, and fungal counts were performed on nutrient agar, eosin methylene blue agar, and potato dextrose agar. Except for potato dextrose agar plates, which were incubated at 28°C for 72 hours, all inoculation plates were incubated at 37°C for 24-48 hours to achieve viable bacterial counts. The colony counter (Gallenkamp, England) was used to count colonies at the end of the incubation period. Colony forming units per ml (cfu/ml) of sample homogenate were used to calculate the counts.

**Statistical Analysis**

Statistical analysis was done using Tukey's HSD test at a significance threshold of 5% ($P<0.05$) to determine if the differences between the mean scores of the features evaluated in this study were significant. Tukey's HSD (Honestly Significant Difference) test is a statistical test that combines a one-stage multiple comparison technique with an analysis of variance (ANOVA) to determine whether means are substantially different from one another [24]. The test checks if the difference between two means exceeds the standard error allowed. The statistical analysis was performed using Satsoft's Statistica V6.1 programme.

## IV. Results and Discussion

## Results

***Proximate Composition***

The result of the proximate composition of sun and oven dried fluted pumpkin is presented in Table 3. The protein, crude fat, ash, crude fibre, moisture content, carbohydrate and energy ranged from 21.74% to 19.50%, 0%, 6.50% to 6.40%, 21.25% to 22.45, 8.25% to 7.10, 60.30% to 63.50% and 83.20% to 4.05% respectively. The crude protein, ash and moisture were significantly ($p \leq 0.05$) high in oven dried while crude fiber, carbohydrate and energy were significantly ($p \leq 0.05$) higher in sun dried.

**Table 3: Proximate Composition of the Dried Fluted Pumpkin (%)**

| Samples | A | B |
|---|---|---|
| Crude Protein | 21.75±0.07[a] | 19.50±0.07[b] |
| Ash | 6.50±0.00[a] | 6.40±0.01[b] |
| Crude Fibre | 21.25±0.07[b] | 22.45±0.07[a] |
| Moisture | 8.25±0.07[a] | 7.10±0.00[b] |
| Carbohydrates | 60.30±0.00[b] | 63.50±0.57[a] |
| Energy | 3.20±0.00[b] | 4.05±0.07[a] |

Mean values in the same column with different superscripts are statistically different ($P<0.05$).
Key:
A = Oven Dried
B = Sun Dried

**Mineral Composition**

Table 4 presents the result of the mineral composition of the dried fluted pumpkin leaf. The concentrations of phosphorus, magnesium, sodium, potassium, iron and copper show significant difference ($p \leq 0.05$) with calcium showing no significant difference. Results also showed that lead (Pb), was not detected. The values of calcium (138.46 mg/100g), phosphorus (158.15 mg/100g), Sodium (415.35mg/100g), and potassium (198.75 mg/100g) were higher in oven -dried sample while magnesium (226.35

mg/100g), iron (25.35mg/100g) and copper (1.15mg/100g) recorded higher value in sample B (sun-dried)

**Table 4: Mineral Contents of the Dried Fluted Pumpkin (mg/100g)**

| Samples | A | B |
|---|---|---|
| Ca | 138.46±0.07$^a$ | 137.64±0.07$^a$ |
| P | 158.15±0.07$^a$ | 156.25±0.07$^b$ |
| Mg | 222.20±0.14$^b$ | 226.35±0.07$^a$ |
| Na | 415.35±0.50$^a$ | 405.45±0.21$^b$ |
| K | 198.75±0.07$^a$ | 178.40±0.07$^b$ |
| Fe | 22.35±0.07$^b$ | 25.35±0.07$^a$ |
| Cu | 1.00±0.00$^b$ | 1.15±0.07$^a$ |
| Pb | ND | ND |

Mean values in the same column with different superscripts are statistically different (P<0.05).
Key:
A = Oven Dried
B = Sun Dried
LSD = Least Significant Difference

### *Vitamin Composition*

The result of the vitamin concentrations of dried fluted pumpkin are presented on Table 5. There was significant difference ($p \leq 0.05$) among samples. The sample A has a higher level of vitamin $B_6$ (3.55 mg/100g) while sample B has a higher level of vitamins $B_1$ (2.35 mg/100g), A (16.45 mg/100g) and $B_2$ (2.17 mg/100g). However, there was no significant difference in the level of vitamin C (1.38 mg/100g)

**Table 5: Vitamins Composition of the Dried Fluted Pumpkin (mg/100g)**

| Samples | A | B |
|---|---|---|
| A | 16.45±0.07$^b$ | 17.25±0.07$^a$ |
| $B_1$ | 2.21±0.01$^b$ | 2.35±0.07$^a$ |
| $B_2$ | 2.06±0.00$^b$ | 2.17±0.00$^a$ |
| $B_6$ | 3.55±0.07$^a$ | 2.75±0.07$^b$ |
| C | 1.38±0.07$^a$ | 1.38±0.14$^a$ |

Mean values in the same column with different superscripts are statistically different (P<0.05).
Key:
A = Oven Dried
B = Sun Dried

### Anti-Nutritional Contents of the Dried Fluted Pumpkin

Table 6 showed the anti-nutrient content of the dried fluted pumpkin leaf. The anti-nutrient screening revealed that the dried leaf evaluated contain generally low values of tannins, saponin, oxalate, phytic acid, phytates and trypsin. However, all the ant-nutrient evaluated were significantly ($p \leq 0.05$) higher in the sun-dried samples with Tanins (1.67mg/100g), Saponin (88.35mg/100mg), Oxalate (91.25mg/100g), Phytic (34.55mg/100g), Phytates (1.44mg/100g), and Trypsin (34.75mg/100g).

**Table 6: Ant- nutrients Composition of the Dried Fluted Pumpkin (mg/100g)**

| Samples | A | B |
|---|---|---|
| Tanins | 1.34±0.20$^b$ | 1.67±0.13$^a$ |
| Saponin | 61.35±0.21$^b$ | 88.35±0.07$^a$ |
| Oxalate | 70.20±0.14$^b$ | 91.25±0.07$^a$ |
| Phytic | 41.95±0.44$^a$ | 34.55±0.05$^b$ |
| Phytates | 1.12±0.07$^b$ | 1.44±0.07$^a$ |
| Trypsin | 22.50±0.07$^b$ | 34.75±0.07$^a$ |

Mean values in the same column with different superscripts are statistically different (P<0.05).
Key:
A = Oven Dried
B = Sun Dried

### Microbial load

The Table 7 shows the result obtained when microbial load analysis were carried out on each of the vegetables. It shows that the Sun-dried had the highest microbial load ($6.8 \times 10^4$ cfu/g), while the oven-dried had the least microbial load ($2.4 \times 10^2$ cfu/g). It further reveals that microbial load was being reduced due to drying through oven.

**Table 7: Microbial Load Analysis (Cfu/g)**

| Samples | A | B |
|---|---|---|
| Total Plate Count | $2.4 \times 10^2$ | $6.8 \times 10^4$ |
| Yeast/Mold Count | $1.4 \times 10^1$ | $2.9 \times 10^3$ |

Key:
A = Oven Dried
B = Sun Dried

## Discussion

### *Proximate Composition*

The sun-drying procedure was more effective than the oven drying process at removing water from the plant matrix (7.10 percent and 8.25 percent, respectively). Sun-drying at varying temperatures for a long time eliminates both primary (unbound water) and secondary (bound water), resulting in the driest final product [31]. Oven drying at 70 °C (72 h) closes the surface capillaries of the samples and inhibits water leakage from the matrix [32];[28]. Leafy vegetables are well-known for providing a reasonable quantity of protein [33]. Accordingly, plant-based foods that deliver more than 12 percent of their caloric content from protein are considered good sources of protein. Proteins are the building blocks of bones, hair, teeth, and the skin's outer layer.

Regardless of the leafy vegetables studied, [34] found that ash levels decreased gradually after blanching and then freezing. Because the ash level of each sample is indicative of mineral content and the mineral element was preserved by oven drying, the ash content of the leaves (6.50) was high in A, indicating that the leaves contain important mineral elements. Leafy vegetables are typically a low source of fat, with some possessing a significant quantity of this nutrient. This was reflected in the results, as no fat was discovered in this study, which is consistent with the general observation that leafy greens are a low-lipid food and thus beneficial to health in terms of preventing obesity [35]. According to the literature, vegetables provide fibre or roughage to the diet [36]. In terms of the influence of different drying procedures on fibre content, it was discovered that oven drying caused the most loss, which correlates to polymer fibre breakdown [37];[38]. The fibre content of *Telfairia occidentalis* leaves was determined to be between 21.25 and 22.45 percent. The leaves of this plant might be a source of dietary fibre for the human diet, compared to the RDA of dietary fibre, which is 19-25 percent for children, 21-38 percent for adults, 28 percent for pregnant women, and 29 percent for nursing mothers [39].

Carbohydrates give the body the fuel and energy it requires to carry out everyday tasks and exercise. During the drying phase, the values obtained varied from 60.30 to 63.50 percent. This is in line with other studies published in the literature [40]. Indigestible fibres like cellulose, hemicellulose, and lignin, as well as minor quantities of sugars like glucose, fructose, sucrose, and starch, make up the majority of carbohydrates in vegetables [33].

***Mineral Content***

The mineral composition of Telfairia occidentalis leaves is shown in Table 4. Calcium (138.46 mg/100g), phosphorus (158.15 mg/100g), sodium (415.35 mg/100g), and potassium (198.75 mg/100g) were greatest in the oven-dried fluted pumpkin leaves, whereas magnesium (226.35 mg/100g), iron (25.35 mg/100g), and copper (1.15 mg/100g) were highest in the sun-dried sample. Ref [41] for example, has made similar observations. The results are in line with those from previous studies [42]. The K, Cu, and Na values found are marginally lower than those reported by [41]. Potassium levels in the sample were 198.75 mg/100g and 178.40 mg/100g, respectively. *Telfairia occidentalis* leaves were found to be useful potassium sources, which is beneficial to one's health because a diet rich in this mineral element is important in preventing hypertension as potassium lowers blood pressure [39].

In the body, sodium works in tandem with potassium to keep the acid-base balance and nerve transmissions in check. The sodium content of *Telfairia occidentalis* dry leaves was 415-405.81 mg/100 g. Calcium is essential for the development of strong and healthy bones and teeth in both childhood and adulthood. The calcium concentration in the dried leaves of *Telfairia occidentatis* was 138.46-137.64 mg/100 g. The major role of phosphorus in the human body is in the creation of bones and teeth. The leaves' phosphorus content was determined to be 13.02 mg/100 g. According to [20], the Ca/P ratio in the intestine must be close to one for proper calcium and phosphorus utilisation. The ratio of *Telfairia occidentalis* leaves was very high. This revealed that the leaves are higher in calcium than in phosphorus; as a result, extra phosphorus-rich food materials had to be added to the diet based on these leaves. An Mg content of 76.46 mg/100 g was determined in this investigation. Because Mg is a component of the chlorophyll in these leaves, a high Mg content is predicted. The copper level of *Telfairia occidentalis* dried leaves was determined to be 1.00-1.15 mg/100 g, which corresponds with [39] findings. Copper's Recommended Daily Allowance (RDA) is 1.5-3 mg per day for adults, pregnant and nursing women, and 1-3 mg per day for children (7-10 years) [43]. However, according to the RDA, *Telfairia occidentalis* leaves are an excellent source of copper [44].

Iron is required for the production of the oxygen-carrying proteins haemoglobin and myoglobin in the human body. *Telfairia occidentalis* leaves had iron values of 22.35–25.35 mg/100 g, which were greater than those reported by [39]. Based on the RDA for iron, which is 10 mg/day for adult males and children (7-10 years), 13 mg/day for pregnant and nursing moms, and 15 mg/day for adult females, the leaves of this plant are rich sources of this mineral element [43]. The comparatively high Fe content in ruffled gourd leaves may explain why the leaf extract is routinely given to convalescent patients as a blood tonic [44]. Phosphorus and zinc are important in active cellular metabolism, especially in connection to energy metabolism, according to [41], whereas photosynthetic leaves are important in energy cycling. Chlorophyll is made up of magnesium and iron. Vitamins, iron, calcium, magnesium, zinc, and other minerals are known to be found in vegetables, and they are the most cost-effective source of minerals and vitamins for Africans [41].

***Vitamins***

Table 5 shows the levels of water-soluble vitamins (vitamin C, thiamine, vitamin $B_1$, and riboflavin, vitamin $B_2$), vitamin A, and vitamin $B_6$ (pyridoxine) in the samples. At the 5% level, the vitamin C content of the samples was not substantially different, with values of 1.38 mg/100 g. Vitamin C levels did not decrease dramatically, which is to be expected given how sensitive this chemical molecule is to temperature changes [45]. Oven-dried ridged gourd leaves showed the greatest concentration of losses of the three water-soluble vitamins studied. Cooked and blanched vegetables have been found to have up to 66 percent, 70 percent, and 90 percent of vitamins, according to other studies [46] and [47]. The degradation of water-soluble vitamins (vitamin C, thiamine, and riboflavin) in fluted pumpkin leaves after drying appears to be driven by thermally generated energy intensity on the physicochemical changes rather than the composition of the vegetables [47].

**Ant- Nutrients Composition**

The antinutrient content of the dried fluted pumpkin leaf is shown in Table 6. The dried leaves tested had low levels of tannins, saponin, oxalate, phytic acid, phytates, and trypsin, according to anti-nutrient screening. However, all ant nutrients examined were considerably greater in the sun-dried samples, comparable with the results of [42]. Tannins, oxalates, and phytates are recognised to have an impact on human nutritional and metabolic processes [41]. High quantities of oxalate, for example, reduce calcium

bioavailability. According to reports, oxalate forms insoluble compounds with calcium, magnesium, zinc, and iron, impairing their usage [41]. Tannic acid has been associated to a reduction in protein nutritional value.
In humans, higher ingestion has been linked to cancer, poor protein utilisation, and liver and kidney damage [51]. It has also been shown that phytic acid consumption of 4-9 mg/100 g DM lowers iron absorption in humans by 4-5 times [48]. These figures were lower in this study. However, according to [49], most of these toxicants are normally removed throughout the processing phases, especially when heat is used.

**Microbial load**

The results of the microbial load investigation on each of the vegetables are presented in Table 7. It was discovered that sun-dried foods had the largest microbial burden, whereas oven-dried foods had the lowest. It also demonstrates that due to oven drying, the microbial burden was lowered. Ref [50] came up with a similar finding. When these two findings are combined, it is clear that drying has an effect on vegetables. So, based on microbiological standard specifications, we can deduce that the microbe is not high enough to do harm to the body and that the veggies may be maintained without spoiling.

## V. Conclusion and Future Scope

The proximate result showed that oven drying enhanced and maintained the crude protein, ash, and moisture content. In the sun-dried sample, the vitamin content of the leaf was substantially greater. The mineral composition of the leaf was unaffected by either drying process. The antinutrient content of the leaf is greatly reduced when it is dried in the oven. In addition, oven drying reduced the microbial burden on the leaf. The oven drying process should be adapted for the preservation of glutted pumpkin leaves, as it keeps most of the vital nutrients in the plant and minimises the number of anti-nutrients in the leaf, according to the findings of the study.

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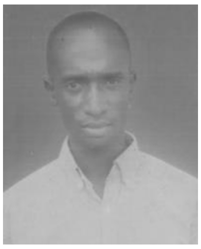

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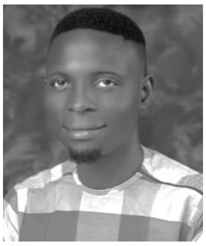

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