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# ASSESSMENT OF THE PHYTOCHEMICAL AND NUTRIENT CONTENT OF FLUTED PUMPKIN (*TELFAIRIA OCCIDENTALIS)*, MORINGA (*MORINGA OLEIFERA)*, TOMATO (*LYCOPASICUM ESCULENTUS*) AND GARLIC (*ALLIUM SATIVUM)*

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## ABSTRACT
Plants are composed of phytochemical constituents that serve different purposes for them, these include protection against destruction by animals. These phytochemicals also have medicinal properties for humans and animals. The test ingredients were dried and grounded into powder then were analysed for the phytochemicals, minerals and proximate compositions. The results showed significantly ($P \leq 0.05$) higher phytochemicals, minerals and proximate compositions in fluted pumpkin and moringa than tomato and garlic. It was concluded that fluted pumpkin and moringa have higher phytochemicals, minerals and proximate compositions than tomato and garlic.

**Keywords:** Fluted pumpkin, moringa, tomato, garlic, phytochemicals

## INTRODUCTION
Phytochemicals are chemicals synthesized by plants for self-defense against enemies (plant eaters), these chemicals give unpleasant tastes such as bitter, acrid, sour etc. Despite this unpleasant taste, these phytochemicals are nutritionally important in affecting the synthesis of serum cholesterol as such reducing the rampancy of cardiovascular diseases (Liu, 2004). The arterial fat deposit is affected by phytochemicals such as carotenoids, alkaloids, flavonoids and phenols (Anderson, 2004). Cholesterol synthesis in the body is reduced by compounds such as allixin and S-allyl-cysteine as and as such keep the blood pressure low (Anderson, 2004). It can be achieved one phytochemical or in conjunction with other food nutrients (Liu, 2004). Phytochemicals inhibit oxidation of lipid and lipoxygenases *in vitro* (Amarowicz *et. al*., 2000).

Fluted pumpkin leaf meal are leafy vegetables notable to Western and Central Africa. It's shown to contain tannins, phenols, alkaloids, saponins, terpenoids and glycosides in abundance. In recent study by Ibrahim et al. (2024) confirmed that fluted pumpkin contains an appreciable amount of minerals and antioxidants. The pharmacognostic and nutritional profiles of fluted pumpkin is significantly high.

Moringa tolerate drought and has pharmacological and nutritional importance. It contains good amount of saponins, phenolics and polyphenols. It also contains good amount of glucomoringa which contains isothiocyanate moringin which has metabolic, antioxidant, anti-inflamatory and antimicrobial properties. Methods of extraction has resulting effects on the bioactivity of moringa (Divya et al., 2025)
Tomato is a rich source of carotenoids such as lycopene, β-carotene and lutein. Xiaosong & Yuru (2025) links the reduction of mortality due to cardiovascular diseases to the high presence of lycopene in tomato.



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Garlic contains high organosulfur compounds. An enzyme, allinase converts S-allyl-L-cysteine sulfoxide to allicin which generates sulfides that are of lipid-soluble and those of water solubles when a tissue is disrupted. These however, results in its cardioprotective, antimicrobial, anti-inflamatory, metabolic and immunomodulatory properties (El-saadony et al., 2024).

This study analysed four vegetables; fluted pumpkin leaf powder (*Telfairia occidentalis*), tomato powder (*Lycopersicom esculentus*), moringa leaf powder (*Moringa oleifera*) and garlic bulb powder (*Allium sativum*) for their chemical constituents thus, health benefits.

## LITERATURE REVIEW

Fluted pumpkin leaf had alkaloids 12.15mg/g, flavonoids 18.5mg/g, steroids 19.92mg/g, and tannin 5.58mg/g (Aghara, 2014). Dried tomato meal contains lycopene 350µg/g, lutein 8.3µg/g, zeaxanthin 2.1µg/g and β-carotene 19.2µg/g (Leke et al., 2015; Habanabashaka et al*.,* 2014). Lycopene is the most abundant carotenoid in tomato, accounting for 80–90% of the total carotenoids (Nour et al*.,* 2018). The moringa leaf contains flavonoids such as myrecytin 5.8mg/g, quercetin 100mg/100g and kaempferol 7.57mg/g (Lako, et al 2007; Sultana et al*,* 2008; Atawodi, et al 2010; Coppin, et al 2013,). Aghara (2014) reported the alkaloids, flavonoids, steroids, tannin, cyanogenic glycoside and saponin composition of moringa as 21.53, 15.42, 15.28, 7.79, 0.03mg/g and 0.59%, respectively. The phenolic acid present in moringa include gallic acid 1.034mg/g, chlorogenic acid 0.018-0.489mg/g and caffeic acid 0.409mg/g (Vergara-Jimenez et al*.,* 2017). Chlorogenic acid has anti-dyslipidemic properties, as it reduces plasma total cholesterol and triglycerides in obese Zucker rats or mice fed a high fat diet (Cho et al., 2010). Phenolic compounds, as well as flavonoids, have important roles in lipid regulation (Siasos et al*.,* 2013). They are involved in the inhibition of pancreatic cholesterol esterase activity, thereby reducing and delaying cholesterol absorption, and binding bile acids, by forming insoluble complexes and increasing their faecal excretion, thereby decreasing plasma cholesterol concentrations (Adisakwattana and Chanathong, 2011).

Garlic contains a compound, allicin (organosuphur compound), an oily colourless liquid, comprises 70–80% of the thiosulfinates, (Harunobu et al*.,* 2001). Allicin is an odorous and extremely unstable compound that decomposes to sulfides, including ajoene and dithiins, (Freeman and Kodera, 1995). Allicin has been shown to be an effective antimicrobial agent *in vitro*, (Harunobu et al*.,* 2001). Garlic contains also several sulfur-containing compounds, such as allicin, 1,2-vinyldithiin, allixin and S-allyl-cysteine ( Kopeć, et al*.,* 2013).

The use of these herbs and fruits as feed supplements will not only exerts their medicinal properties but also have the capacity to influence the nutritive value of the eggs. Fluted pumpkin (*Fluted pumpkin*) leaf has Zn 7.50 mg/100g, Fe 18.5 mg/100g (Idris, 2011), and iron 1.38mg/g (Aghara, 2014). Nour et al. (2018) reported that dried tomato contains iron 56.5 mg/kg and zinc 63.3 mg/kg. Moringa (*Moringa oleifera*) dried leaf contents iron 205-573mg/kg and zinc 25.9-34.1mg/kg (Aslam et al*.,* 2005). Garlic (*Allium sativum*) 4.21 mg/100g iron and 0.34 mg/100g zinc (Marina et al*.,* 2014).

This study analysed four selected supplements; fluted pumpkin leaf powder (*Telferia occidentalis*), tomato powder (*Lycopersicom esculentus*), moringa leaf powder (*Moringa oleifera*) and garlic bulb powder (*Allium sativum*) for their chemical constituents.

## METHODOLOGY

### Experimental Site and Duration

The feeding experiment was carried out at the Poultry Meat Research Laboratory and Biochemistry Laboratory of Obafemi Awolowo University, Ile-Ife, Osun State, Nigeria, which lies on longitude 4° 33E and latitude 7° 28N.



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**Collection and Preparation of the Test Ingredients**

Fresh fluted pumpkin leaf (*Telfeiria occidentalis*), Moringa leaf (*Moringa oleifera*) Tomato (*Lycopersicom esculentus*), and Garlic (*Allium sativum*) were purchased from local market in Ile-Ife. Fluted pumpkin and moringa leaves were air dried, tomato was oven dried while garlic was sun dried before they were all milled and stored in freezer for subsequent chemical analyses.

**Phytochemicals Determination**

**Determination of Total Phenol Content`**

The method of determining the total phenolic content as described by Gulcin *et al.* (2005) using the folinciocalteu's phenol reagent which is an oxidizing reagent.

The sample was extracted using phosphate buffer, to a mixture 0.1ml of sample extract and 0.9ml of distlled water was added 0.2ml of folin-ciocalteu's phenol reagent and the resulting mixture voltexed. After 5 minutes of standing, 1.0ml of 7% (w/w) $Na_2CO_3$ solution then added and the solution was then distilled to 2.5ml before incubated for 90 minutes at room temperature. The absorbance against a negative control containing 1ml of water in place of the sample was then taken at 750nm. The standard used was the Gallic acid at 0.1mg/ml in order to determine Gallic acid Equivalent (GAE) of sample, after preparing a calibration curve. Distilled water was used as blank.

**Determination of Total Flavonoid Content**

Standard quercetin was prepared with varying concentrations of 0.1, 0.2, 0.3, 0.4 and 0.5mg/ml was used as standard in comparison to the sample extract. Aluminium chloride colorimetric assay method according to Zhilen *et al.* (1999) as modified by Miliauskas *et al,* (2004).

To 0.1ml of extract and standard was added 0.4ml of distilled water. This was followed by 0.1ml of 5% sodium nitrite. After 5minutes, 0.1ml of 10% Aluminum Chloride and 0.2ml of sodium hydroxide was added and the volume was made up to 2.5ml with distilled water. The absorbance at 510nm was measured against the blank. The total flavonoid content of the plant, expressed as mg quercetin equivalents per gram of the plant extract is calculated as:

$$X = q * \frac{V}{w}$$

Where:
X = Total content of flavonoid compound in quercetin equivalent
q= concentration of quercetin established from the standard curve
V= volume of extract (ml)
w= weight of the crude methanolic extract obtained.

**Beta-Carotene Bleaching Assay (BCBA)**

The experiment was carried out by measuring the coupled autoxidation of β-Carotene and linoleic acid by emulsion preparation method of Sarker et al. (2009).

**Preparation of Emulsion**

5mg of β-Carotene dissolved in 50ml of chloroform, 3ml of this solution was taken and evapourated under reduced pressure at temperature not exceeding 40$^{o}$C in rotary evaporator or Nitrogen gas bubbled into the solution. To the evapourated solution, add 40µl of linoleic acid, 40µl of Tween 80 or Tween 20, 100ml/50ml distilled water. Quercetin as positive control.
Shake vigorously to form the emulsion.


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| | Test sample | Negative Control |
|---|---|---|
| Standard/Extract | 20 µl | --- |
| Methanol | ----- | 20 µl |
| Emulsion | 150 µl | 150 µl |
| Read absorbance at 470nm immediately [Time(To)] | | |
| Incubate at 50$^{o}$C for 60 min ($T_{60}$). Read d absorbance @ 470nm at $T_{60}$ | | |

The antioxidant activity (AA) of beta-carotene is alsomeasured as percentage inhibition, thus

$$AA\ (\%\ \text{inhibition}) = \left[\frac{\text{DRc} - \text{DRs}}{\text{DRc}}\right] * 100$$

Where:
AA= Antioxidant activity
DRc= Degradation rate of control=ln (a/b)/60
DRs= Degradation rate of sample=ln (a/b)/60
a= Initial absorbance
b= Final absorbance after 60min

**Determination of Total Alkaloid**

To 1ml of the plant extract (1mg/ml) was added 1ml of 2 N HCl and filtered. This solution was transferred to a separating funnel, 5 ml of bromocresol green solution and 5 ml of phosphate buffer were added. The mixture was shaken with 1, 2, 3 and 4 ml chloroform by vigorous shaking and collected in a 10-ml volumetric flask and diluted to the volume with chloroform. A set of reference standard solutions of atropine (20, 40, 60, 80 and 100 µg/ml) were prepared in the same manner as described earlier. The absorbance for test and standard solutions were determined against the reagent blank at 470 nm with an UV/Visible spectrophotometer. The total alkaloid content was expressed as mg of AE/g of extract.

**Minerals Content of the Test Ingredients**

**Digestion for Mineral Analysis**

1g of the samples was weighed and transfer into a separate 50 mL conical flask. 10 mL of concentrated $HOCl_3$ and $HNO_3$ (1:3) was added to it and heated to about 115$^{o}$ C for about 90 minutes until it gives a clear solution. The solution was allowed to cooled and filtered before making up to the make of 100 mL of volumetric flask. Blank was also prepared in the same way but the sample was replaced with distilled water. Lanthanum was added to these solutions to prevent potential anionic inference.

**Preparation of Reagents for Phosphorous Analysis**

Ammonium molybdate solution (Dissolve 5g of ammonium molybdate $(NH4)^6$ Mo7O24.4 $H_2O$) in 35 mL of distilled water. Add 62mL of concentrated $H_2SO_4$ to 80 mL of distilled water, cool and add the molybdate solution and make the volume to 200 mL by adding more distilled water.

**Spectrophotometry**

Add 2mLs of digested sample, 2mLs of ammonium molybdate and 1 mL of stannous chloride solution, blue colour appeared and waited for 5 minutes. The absorbance was taken at 690 nm and calculates the value of phosphate from standard curve prepared by making different concentrations from 0.2 to 1.0 mg/l.

**RESULTS**

**The phytochemical composition of the test supplements**

The phytochemicals analysed in these supplements include flavonoids, alkaloids, phenolics and β-Carotene as shown in Table 1. The result showed significantly ($P \leq 0.05$) high phytochemicals in leaves. The flavonoid composition of the test supplements was significantly ($P \leq 0.05$) higher in fluted pumpkin leaf meal followed by moringa leaf meal. The alkaloid content of fluted pumpkin (226.67 mgAAE/g) and moringa (215.88 mgAAE/g) were higher than those found in dried tomato fruit (199.61 mgAAE/g) and dried garlic bulb (94.44 mgAAE/g). The result of phenol in moringa and fluted pumpkin were significantly ($P \leq 0.05$) higher than that of tomato and garlic. The β-carotene was however, significantly ($P \leq 0.05$) higher in dried tomato powder than other test supplements.

**Table 1: The phytochemical composition of test supplements**

| Parameters | **Fluted pumpkin leaf meal** | **Dried tomato fruit** | **Moringa leaf meal** | **Dried garlic bulb** | **SEM** |
|---|---|---|---|---|---|
| Phenol (mg GAE/g) | $57.48^{b}$ | $43.28^{c}$ | $60.21^{a}$ | $11.20^{d}$ | 0.55 |
| Flavonoid (mgQUE/g) | $29.81^{a}$ | $23.44^{c}$ | $26.34^{b}$ | $24.24^{c}$ | 2.14 |
| Alkaloid (mgAAE/g) | $226.67^{a}$ | $199.61^{c}$ | $215.88^{b}$ | $94.44^{d}$ | 6.23 |
| β-Carotene (mg/kg) | $138.48^{b}$ | $174.81^{a}$ | $179.64^{a}$ | $66.50^{c}$ | 6.50 |

$^{abcd}$Means in the same row having different superscripts differ significantly at $P \leq 0.05$

**The mineral composition of the test supplement**

The result of mineral content of the test supplements (Table 2) showed that the leaf meals contain high major mineral. Calcium was significantly ($P \leq 0.05$) higher in moringa leaf meal compared to other test supplements. The magnesium content was significantly ($P \leq 0.05$) higher in fluted pumpkin leaf meal compared to other test supplement followed by moringa leaves. The phosphorus content of the test supplements was significantly ($P \leq 0.05$) higher in moringa leaf meal followed by dried garlic bulbs.

The iron content of fluted pumpkin and moringa were significantly ($P \leq 0.05$) higher than the content of other test supplements. The zinc content of the test supplement was significantly ($P \leq 0.05$) higher in dried garlic bulb than other test supplement.

**Table 2: The mineral composition of test supplements**

| **Parameters** | **Fluted pumpkin leaf meal** | **Dried tomato fruit** | **Moringa leaf meal** | **Dried garlic bulb** | **SEM** |
|---|---|---|---|---|---|
| Calcium (g/kg) | $10.10^{b}$ | $1.5^{d}$ | $13.13^{a}$ | $1.76^{c}$ | 0.004 |
| Magnesium (g/kg) | $4.32^{a}$ | $2.00^{c}$ | $2.58^{b}$ | $1.06^{d}$ | 0.003 |
| Sodium (g/kg) | $1.80^{d}$ | $3.02^{a}$ | $2.92^{b}$ | $2.01^{c}$ | 0.009 |
| Phosphorus(g/kg) | $0.27^{d}$ | $0.28^{c}$ | $0.66^{a}$ | $0.46^{b}$ | 0.004 |
| Iron (mg/kg) | $155.00^{a}$ | $76.00^{c}$ | $154.00^{a}$ | $94.00^{b}$ | 0.763 |
| Copper (mg/kg) | $8.00^{c}$ | $12.33^{a}$ | $4.00^{d}$ | $11.00^{b}$ | 0.004 |
| Zinc (mg/kg) | $49.00^{d}$ | $62.33^{c}$ | $73.00^{b}$ | $76.00^{a}$ | 0.287 |

$^{abcd}$Means in the same row having different superscripts differ significantly at $P \leq 0.05$

**The proximate composition of the test supplements**

The results of crude protein in the test ingredients (18.07-27.96%) are moderately higher to furnish requirement for farm animals except in garlic which had 8.93%. The fibre content of the test supplements were significantly low in dried tomato fruit (3.37%) and dried garlic bulb (3.5%), Ether extract was higher in fluted pumpkin (9.06%) than dried garlic (1.13%). The nitrogen free extract was significantly high in dried garlic than other test supplements.



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**Table 3: The proximate composition of test supplements**

| Parameters (%) | FPLM | DTFM | MOLM | DGBM |
|---|---|---|---|---|
| Dry matter | 90.81 | 92.79 | 90.13 | 87.39 |
| Crude protein | 25.27 | 27.96 | 18.07 | 8.93 |
| Crude fibre | 10.91 | 3.37 | 10.63 | 3.5 |
| Ether Extract | 9.06 | 3.97 | 5.10 | 1.13 |
| Ash | 5.15 | 4.29 | 4.59 | 2.44 |
| NFE | 49.61 | 60.41 | 61.60 | 84.00 |

NFE=nitrogen free extract, FPLM=fluted pumpkinleaf meal, DTFM=dried tomato fruit meal, MOLM=moringa leaf meal, DGBM=dried garlic bulb meal

## DISCUSSION

Flavonoids (myrecytin, quercetin and kaempferol) have high antioxidant ability as reported by Salawu et al., (2006) and Vergara-jimenez et al. (2017). Higher phytochemicals in the test ingredients may be responsible for their medicinal properties. Vergara-jimenez et al. (2017) reported that alkaloid contain several nitrogen compounds which include N,α-L-rhamnopyranosyl vincosamide, phenylacetonitrile pyrrolemarumine which have an anti-inflammatory effect on patients with conditions such as hypertension and cardiovascular diseases. Phenolic acids such as gallic acid and chlorogenic acid have free radical scavenging activities which have health promoting effects (Nour et al., 2018). Tomato contained high lycopene (a form carotenoid) which was reportedly essential for the alleviation of oxidative stress in chicken (Sahin et al. 2016), meaning that tomato could be used to address challenges of oxidative stress. The relative high phenol, flavonoid and alkaloid in fluted pumpkin and moringa portends their higher antioxidant ability and anti-inflammatory effect.

Sebola et al. (2017) reported significantly higher calcium content (19.15g/kg) in moringa. The magnesium content of fluted pumpkin was in line with the result reported by Nworgu et al. *(*2007a). The higher phosphorus content of moringa leaf shows the potentiality of moringa in improving egg shell thickness as found in work of Abdel-Wareth & Lohakare (2021). The minor minerals were also significantly higher in leaf meals. The iron requirement of laying hens is 6mg (NRC, 1994). Iron is very essential in the host body as it play significant role in haemoglobin, enzyme electron transport chain and very important constituents of proteins such as transferrin, ferritin and haemosiderin (McDonald et al. 2010). This may be responsible for their effectiveness in the treatment of anaemia. Nworgu et al. *(*2007b) and Ustundag and Ozdogan (2016) reported significantly ($P \leq 0.05$) higher iron in fluted pumpkin and moringa, respectively. Revell et al. (2009) reported an increased in the total iron content by over 15% compared to the control when an iron riched diet was fed to laying hens. Based on iron concentration, fluted pumpkin and moringa show superiority in their potential to improve the nutritive value of egg. Ustundag and Ozdogan (2016) reported higher content of zinc in moringa than copper.

The results of crude protein in the test ingredients (18.07-27.96%) are moderately higher to furnish requirement for farm animals except in garlic which had 8.93%. This tallied with result reported by Karangiya et al. (2016) who reported low crude protein in garlic when fed to broiler chicken. The low composition of crude fibre in dried tomato and dried garlic bulb showed their potentiality for inclusion into the poultry diet as they cannot withstand high fibre diet. The nitrogen free extract was significantly high in dried garlic than other test supplements. This was the same with 85.83% nitrogen free extract reported by Karangiya et al. (2016).


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**RECOMMENDATION**

Based on the outcome of this research, the following recommendations were made

1. Fluted pumpkin and moringa can be used in food fortification. Researchers that want to produce egg that is rich in mineral and phytochemicals should feed their laying birds with feed included with fluted pumpkin and moringa.
2. Further studies should be conduct to assess the bioavailability of the nutrients and phytochemicals present in the test ingredients.
3. Research should also be conducted on level of heat that will dry the test ingredients without affecting the nutrients present in the test ingredients.
4. Further studies should be conducted on blinding the four test ingredients together to ascertain the nutrient and phytochemical level of the blinded form.

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