

**NUTRITIONAL POTENTIAL AND ANTINUTRIENTS OF COMMON PUMPKIN  
LEAVES AND FLOWERS (YELLOW VARIETY)**

**BY**

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**CERTIFICATION**

This is to certify that this research project titled "Nutritional Potential and Antinutrients of Common Pumpkin Leaves and Flowers (yellow variety)" reported here was conducted by

Abdrahman Rianat Oluwakemi (2010302010) has been read and approved by the undersigned as meeting the requirement for the award of Bachelor of Science (Hons) Degree in Biology in the Department of Biological Sciences, Faculty of Chemical and life Sciences, Usmanu Danfodiyo University Sokoto.

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### **DEDICATION**

This project is dedicated to my beloved parents, Mr and Mrs Abdrahman, for their unwavering moral and financial support throughout my academic journey. Your love,

sacrifices, and constant encouragement have been my greatest source of strength and inspiration. I pray that Almighty Allah rewards you abundantly and grants you long life, good health, and happiness. (Ameen)

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## ABSTRACT

This study investigated the nutritional and anti-nutritional compositions of the leaves and flowers of the common pumpkin (*Cucurbita moschata*), focusing on their potential contribution to food security and human health. The samples were collected, processed, and analyzed using standard procedures as described by the Association of Official Analytical Chemists (AOAC, 2019). The proximate composition revealed that the leaf contained higher crude protein (2.18%), ash (12.23%), and carbohydrate (51.92%), while the flower recorded higher moisture content (47.43%). Vitamin analysis showed that the leaf had higher vitamin C (24.67 mg/100g) compared to the flower (18.40 mg/100g), suggesting greater antioxidant potential. Mineral analysis indicated that potassium and sodium were present in beneficial concentrations within WHO acceptable limits, essential for maintaining electrolyte balance and normal body function. Phytochemical screening showed the presence of flavonoids, glycosides, tannins, and saponins, which possess antioxidant, antimicrobial, and therapeutic properties. These findings reveal that *Cucurbita moschata* leaves and flowers are rich sources of nutrients and bioactive compounds that can help reduce malnutrition and improve health, especially in rural and low-income communities. Proper preparation and processing are recommended to minimize anti-nutritional factors and enhance nutrients availability.

## CHAPTER ONE

### 1.0 INTRODUCTION

#### 1.1 Background of *the* Study

Vegetables are vital components of the human diet, supplying essential nutrients such as vitamins, minerals, fiber, and phytochemicals necessary for healthy growth, development, and disease prevention. They contribute significantly in improving immunity, digestion, and reducing risks of chronic diseases like cancer, diabetes, and cardiovascular disorders. In developing countries such as Nigeria, vegetables like pumpkin, spinach, and amaranthus play a key role in combating malnutrition and micronutrient deficiencies, offering affordable and accessible sources of vital nutrients (Silva Dias, 2022; Dada *et al.*, 2021). Rich in vitamins A, C, and E, as well as minerals like iron, calcium, and potassium, vegetables enhance body functions such as blood formation, bone development, and immune response. Their fiber content aids digestion and blood sugar regulation, while phytochemicals like flavonoids and carotenoids provide antioxidant protection (WHO, 2023).

Vegetables also have significant socio-economic and cultural value, particularly in Africa where indigenous leafy varieties form part of traditional diets, promoting food security and sustainable livelihoods (Dada *et al.*, 2021). Despite their benefits, vegetable consumption

remains below the recommended 400 grams per day due to factors such as high postharvest losses, seasonal scarcity, and poor preservation facilities. Increasing production, improving storage, and promoting awareness of their nutritional importance can help address this challenge.

Vegetable availability and quality are largely affected by seasonal variations and short shelf life. Most vegetables are highly perishable, containing up to 95% water, which accelerates spoilage after harvest (Ayeni *et al.*, 2019). In tropical regions like Nigeria, leafy vegetables such as pumpkin and amaranthus are abundant during the rainy season but scarce in the dry season (Eze *et al.*, 2021). This seasonality affects cost and access, leading to reduced intake during off-seasons. Preservation methods both traditional (drying, fermentation) and modern (refrigeration, blanching, dehydration) are essential to prolong shelf life and maintain nutrient quality (Akinola *et al.*, 2021).

Some vegetables naturally store longer due to their structure and moisture content. Root and tuber crops like yam, potato, and carrot, as well as bulb vegetables like onion and garlic, can stay fresh for weeks or months under proper storage conditions (Abebe *et al.*, 2022; Adeola and Akinyele, 2021). Similarly, fruit vegetables such as pumpkins and squashes have thick rinds that reduce spoilage, enabling storage for up to three months (Ibrahim and Okoro, 2023).

Vegetables provide edible parts from nearly every section of the plant, including roots, stems, leaves, flowers, fruits, and seeds. Each part contributes unique nutrients and culinary uses (FAO, 2021). Root and tuber vegetables are rich in carbohydrates and minerals, leafy vegetables supply vitamins and iron, flowers like those of pumpkin contain flavonoids and glycosides, while fruit vegetables such as tomato and cucumber offer fiber and antioxidants. Leguminous vegetables like beans and peas are high in protein and can be dried for long-term storage, supporting food security and sustainable agriculture (Khan *et al.*, 2020).

Pumpkin (*Cucurbita spp.*), in particular, is a highly nutritious and versatile vegetable valued for its edible leaves, fruits, seeds, and flowers. It provides essential vitamins (A, C, and E), minerals (iron, calcium, potassium), and bioactive compounds such as carotenoids, flavonoids, and glycosides (Olawale *et al.*, 2020; Ibrahim and Okoro, 2023). However, its nutritional value is influenced by several factors including variety, soil fertility, climate, harvest time, and storage conditions. Loamy soils enhance mineral accumulation, moderate sunlight promotes carotenoid synthesis, while poor handling and prolonged exposure to heat reduce vitamin content (Abebe *et al.*, 2022; Chukwuma *et al.*, 2020). Cooking and processing methods also affect nutrient retention; mild steaming preserves more vitamins and antioxidants than boiling or frying (Olatunde *et al.*, 2019).

In conclusion, vegetables are indispensable for human nutrition, health, and economic development. Despite challenges of seasonality and perishability, proper handling,

preservation, and processing can enhance their availability and nutritional value throughout the year. Pumpkin, as one of the most widely consumed vegetables, serves as an excellent example of how vegetable crops contribute to dietary quality, food security, and sustainable livelihoods.

## **1.2 Statement of the Research Problem**

Malnutrition and food insecurity remain major challenges in many developing countries, especially in sub-Saharan Africa. Millions of people suffer from “hidden hunger” caused by deficiencies in micronutrients such as iron, zinc, and vitamin A, which are vital for health, growth, and productivity (FAO, 2020). Although pumpkin fruit is well recognized for its high  $\beta$ -carotene content, the leaves and flowers of the common pumpkin (*Cucurbita moschata*, yellow variety) are often underutilized despite being rich in proteins, vitamins, minerals, and bioactive compounds (Hussain *et al.*, 2021).

However, these edible plant parts also contain anti-nutritional factors such as oxalates, phytates, and tannins, which can reduce the bioavailability of nutrients if consumed without proper processing (Adepoju and Oyewole, 2021). Unfortunately, limited scientific data exist on the nutritional and anti-nutrient composition of pumpkin leaves and flowers in the yellow variety, leading to their neglect in dietary planning and food security strategies.

Without proper research and awareness, these valuable but underutilized resources may continue to be overlooked, thereby limiting their potential role in improving household nutrition, health, and food security among poor populations.

### **1.3 Justification of the Study**

In many African communities, including Nigeria, pumpkin leaves (*Telfairia occidentalis* and *Cucurbita moschata*) and flowers are commonly used in the preparation of local dishes such as soups, stews, and porridges, contributing significantly to a balanced diet (Adebisi *et al.*, 2020). These leaves and flowers serve as important vegetables due to their rich green color, pleasant taste, and high nutritional value, often complementing staple foods like yam, rice, or maize (Olaoye and Ogunwolu, 2021). Regular consumption of these plant parts provides essential nutrients such as proteins, vitamins, and minerals that are vital for maintaining good health and preventing nutritional deficiencies.

Studying the nutritional and anti-nutritional composition of pumpkin leaves and flowers is important for several reasons. Firstly, these plant parts are affordable and easily accessible sources of essential nutrients, making them valuable in addressing malnutrition, especially in resource-poor communities (Olaniyi *et al.*, 2019). Secondly, pumpkin is a climate-resilient crop that thrives even in marginal soils, and its leaves and flowers can provide year-round food and nutrition, thereby contributing to food security and helping to reduce seasonal hunger (Gwanfogbe *et al.*, 2020). Furthermore, there is limited scientific data on

the yellow variety of pumpkin, particularly on the nutrient content and anti-nutrient levels of its leaves and flowers, which makes this research timely and necessary to fill existing knowledge gaps. Lastly, the outcomes of such studies can be used to guide nutritionists, policymakers, and agricultural extension workers in promoting pumpkin leaves and flowers as low-cost, nutrient-rich options, especially in Nigeria and other developing countries where affordable nutrition is urgently needed.

#### **1.4 Aim and objectives**

##### **1.4.1 Aim:**

This study aims to evaluate the nutritional potential and anti-nutrient composition of leaves and flowers of the common pumpkin (yellow variety, *Cucurbita moschata*).

##### **1.4.2 Objectives:**

1. To determine the proximate composition (carbohydrates, proteins, fats, fiber, moisture and ash) of pumpkin leaves and flowers.
2. To analyze the vitamin and mineral content of pumpkin leaves and flowers.
3. To identify and quantify the major anti-nutrients (e.g., saponins, tannins) present in pumpkin leaves and flowers.

## CHAPTER TWO

### 2.0 LITERATURE REVIEW

#### 2.1 Overview of the Study

Pumpkins (*Cucurbita spp.*), members of the family Cucurbitaceae, are among the most economically important vegetables cultivated in tropical and subtropical regions. They are valued not only for their edible fruits but also for their seeds, leaves, and flowers, which are utilized as food and medicine in various parts of the world (Rahman *et al.*, 2019). The genus *Cucurbita* comprises several cultivated species, of which *Cucurbita moschata* (butternut pumpkin) and *Cucurbita pepo* (field or summer squash) are the most common. These species have received growing scientific and nutritional interest for their potential contributions to food security, human health, and sustainable agriculture (Olowolaju *et al.*, 2024).

The common yellow pumpkin, particularly *Cucurbita moschata*, is known for its vigorous growth habit, extensive creeping vines, broad green leaves, and large bright yellow flowers, which later develop into orange-yellow fruits. Its leaves and flowers, though often less emphasized compared to the fruit, are highly nutritious and form essential components of local diets in many African, Asian, and Latin American communities (FAO, 2020).

## **Botanical Description and Distribution**

The pumpkin plant is an annual herbaceous climber with angular, hairy stems and tendrils for support. The leaves are alternate, simple, and large, with long petioles and rough surfaces. The flowers are large, funnel-shaped, and bright yellow; male and female flowers occur separately on the same plant (monoecious). The fruits are variable in size, round to elongated, and contain numerous flat, cream-colored seeds. *Cucurbita moschata* and *Cucurbita pepo* are widely distributed across tropical and subtropical regions, thriving in well-drained soils and warm climates. In Nigeria and other West African countries, pumpkins are commonly intercropped with staple crops such as maize, yam, and cassava, contributing to sustainable small-scale farming systems (FAO, 2020).

Pumpkin leaves and flowers are now recognized for their outstanding nutritional and functional significance. They are rich in essential nutrients such as proteins, vitamins (particularly A, C, and E), minerals (iron, calcium, magnesium, potassium), dietary fiber, and various bioactive compounds such as phenolics, flavonoids, and carotenoids (Yang *et al.*, 2021). These phytochemicals are responsible for antioxidant, anti-inflammatory, and immune-boosting properties, which help prevent oxidative stress-related diseases. In addition to their nutritional benefits, pumpkin leaves and flowers are affordable, easily cultivated, and available throughout the growing season, making them a valuable food source in low-income communities (Rahman *et al.*, 2019).

Studies have also reported significant antioxidant activity in *Cucurbita moschata* leaves due to their phenolic compounds. Mashitoa *et al.* (2021) found that household cooking methods such as boiling, steaming, and microwaving significantly reduced anti-nutrients like oxalates, tannins, and phytates by more than 50%, while increasing beneficial phenolic acids such as p-coumaric and ferulic acids. Steamed leaves retained higher antioxidant capacity than other cooking methods, suggesting that processing enhances the bioavailability of some beneficial compounds.

A related study in 2022 demonstrated that fortifying foods with leafy vegetable powders, such as fluted pumpkin leaf powder, significantly improved the nutritional composition of local staples by boosting levels of vitamin A, iron, and zinc, as well as total phenolic and flavonoid content. This shows that pumpkin leaves can be used to improve the nutritional quality of common foods and address micronutrient deficiencies.

Despite their nutritional advantages, pumpkin leaves and flowers also contain certain anti-nutritional factors such as oxalates, phytates, tannins, and saponins, which may reduce nutrient bioavailability by forming insoluble complexes with minerals like calcium, iron, and zinc (Mashitoa *et al.*, 2021). However, these compounds are not inherently harmful when consumed in moderate amounts and can be significantly reduced through cooking and fermentation processes, enhancing nutrient absorption.

For the yellow varieties (*Cucurbita pepo* and *Cucurbita moschata*), the nutritional patterns are similar across species. The leaves and flowers contain appreciable amounts of micronutrients and phytochemicals, contributing to their functional and health-promoting roles. Their rich composition of antioxidants makes them effective in protecting against chronic diseases such as diabetes, cardiovascular diseases, and inflammation (Yang *et al.*, 2021).

Pumpkin cultivation is particularly important in developing regions because it requires minimal inputs, adapts well to various soils, and provides year-round edible plant parts leaves, flowers, fruits, and seeds. These characteristics make pumpkins a key crop for food and nutrition security, especially in rural areas where malnutrition remains prevalent. According to Gwanfogbe *et al.* (2020), the inclusion of pumpkin leaves and flowers in diets can help reduce micronutrient deficiencies, particularly vitamin A and iron deficiencies that are common in sub-Saharan Africa.

In Nigeria, pumpkin leaves, locally known as **Ugu** (fluted pumpkin leaf), are among the most popular green leafy vegetables. They are consumed in soups and stews and serve as a major source of dietary iron, protein, and vitamins for low-income families (Olaniyi *et al.*, 2019). Research conducted in rural communities of Oyo State reported that regular consumption of pumpkin leaves improved hemoglobin levels in children and women of reproductive age, significantly reducing anemia and vitamin A deficiency. These findings

affirm the potential of pumpkin leaves and flowers as accessible, nutrient-dense food sources that can improve nutritional status and overall health outcomes.

## **2.2 Nutritional Properties of Pumpkin Fruit**

Pumpkin (*Cucurbita pepo*, *C. moschata*, and related species) is a nutrient-dense vegetable widely cultivated and consumed across the world. The fruit is characterized by its soft, edible flesh and seeds, and it provides a wide range of nutrients important for human health.

### **1. VITAMINS**

Pumpkin fruit is exceptionally rich in vitamins, especially carotenoids, which includes:

- Vitamin A ( $\beta$ -carotene): Pumpkin fruit is one of the richest natural sources of  $\beta$ -carotene, which is converted into vitamin A in the body. Vitamin A supports vision, immune defense, and skin integrity (El-Sheikha, 2019).
- Vitamin C: Present in moderate amounts; contributes to collagen synthesis, immune support, and antioxidant defense (Rahman *et al.*, 2019).
- B-complex Vitamins: Contains small amounts of riboflavin, niacin, and folate, which play roles in energy metabolism and red blood cell formation (Gwanfogbe *et al.*, 2020).
- Vitamin E (Tocopherols): Acts as a lipid-soluble antioxidant, protecting cell membranes from oxidative damage (Nawirska-Olszańska *et al.*, 2020).

## **2. PROTEIN**

Although pumpkin fruit flesh is not protein-dense compared to legumes, but it contributes useful amounts. The flesh contains about 1–2 g of protein per 100 g fresh weight (FAO 2022). The protein profile includes essential amino acids, though in lower concentrations compared to pumpkin seeds (Hussain *et al.*, 2021). This modest protein contributes to dietary balance when combined with other protein sources.

## **3. MINERALS**

Pumpkin fruit is a good source of essential macro- and micro-minerals, which includes:

- Potassium: Abundant in pumpkin flesh (about 340 mg per 100 g), helps regulate fluid balance and blood pressure (Kim *et al.*, 2018).
- Calcium: Important for bone health, though present in moderate levels (~20 mg/100 g).
- Iron: Contributes to hemoglobin formation and prevention of anemia; found in smaller but significant amounts (~0.8 mg/100 g).
- Magnesium and Phosphorus: Support enzyme activation, energy metabolism, and bone development (Nawirska-Olszańska *et al.*, 2020).

## **2.3 Nutritional Composition of Pumpkin Leaves and Flowers**

Pumpkin leaves and flowers are rich in nutrients essential for human health, including proteins, vitamins, minerals, and antioxidants. They have been identified as potential tools for addressing nutritional deficiencies, particularly in low-resource region

### **2.3.1 Macronutrients**

Pumpkin leaves contain moderate amounts of proteins (2–4%), crude fiber (1–2%), and carbohydrates (8–15%) (Oloyede *et al.*, 2020). The high fiber content aids digestion and promotes bowel regularity. Flowers contain slightly lower macronutrient levels but are rich in moisture and natural sugars that enhance their palatability (Rahman *et al.*, 2019).

### **2.3.2 Micronutrients**

Leaves and flowers of *Cucurbita moschata* and *C. pepo* are rich in vitamin A (carotenoids), vitamin C, calcium, and iron (Adepoju and Oyewole, 2021). Vitamin C enhances iron absorption and serves as an antioxidant, while carotenoids support eye health.

### **2.3.3 Phytochemicals and Antioxidants**

Pumpkin leaves and flowers contain polyphenols, flavonoids, saponins, and tannins, which possess antioxidant and anti-inflammatory properties (Mashitoa *et al.*, 2021). Flavonoids,

for instance, neutralize free radicals and protect against chronic diseases such as diabetes and cardiovascular disorders (Yang *et al.*, 2021).

## 2.4 Anti-Nutritional Factors in Pumpkin Leaves and Flowers

Anti-nutritional factors are naturally occurring compounds that interfere with nutrient absorption and utilization. The main anti-nutrients in pumpkin leaves and flowers include oxalates, tannins, phytates, saponins, and alkaloids.

- **Oxalates:** Form insoluble salts with calcium, leading to decreased calcium absorption (Mashitoa *et al.*, 2021).
- **Phytates:** Bind minerals such as iron and zinc, inhibiting their absorption. Soaking, boiling, and fermentation reduce phytate levels significantly (Adepoju and Oyewole, 2021).
- **Tannins:** Interfere with protein digestibility but have beneficial antioxidant effects at moderate concentrations (Rahman *et al.*, 2019).
- **Saponins:** Cause foaming in aqueous solutions and reduce nutrient bioavailability but can lower blood cholesterol and triglycerides (Oloyede *et al.*, 2020).

The level of anti-nutrients depends on the maturity of the leaves, environmental conditions, and processing method. Boiling and steaming significantly decrease oxalate and tannin contents (Mashitoa *et al.*, 2021).

## **2.5 Effect of Processing on the Nutritional and Anti-Nutritional Composition of Pumpkin Leaves and Flowers**

Processing plays a crucial role in enhancing the nutritional quality, safety, and shelf-life of vegetables, including pumpkin (*Cucurbita moschata*) leaves and flowers. The raw leaves and flowers, though rich in nutrients and phytochemicals, also contain anti-nutritional factors such as oxalates, tannins, and phytates that can interfere with mineral absorption and protein digestibility (Mashitoa *et al.*, 2021). Hence, processing techniques such as boiling, steaming, fermentation, and drying are used to reduce these undesirable components while retaining or improving the nutritional value.

### **2.5.1 Boiling**

Boiling reduces anti-nutritional compounds such as phytates, oxalates, and tannins by 50–80%, improving mineral availability. However, excessive boiling may cause losses of heat-sensitive nutrients, especially vitamin C and B-complex vitamins. Moderate boiling enhances palatability and reduces toxicity without major nutrient destruction (Mashitoa *et al.*, 2021).

### **2.5.2 Steaming**

Steaming retains higher levels of vitamin C, phenolic compounds, and antioxidants compared to boiling. The method limits direct nutrient leaching into water and helps

preserve texture and flavor. It moderately reduces anti-nutrients, making it suitable for household consumption of pumpkin leaves and flowers (Yang *et al.*, 2021).

### **2.5.3 Fermentation**

Fermentation improves nutritional quality by reducing anti-nutrients through microbial enzymatic breakdown. It enhances mineral bioavailability, flavor, and shelf life, while slightly increasing B-vitamins and organic acids. This process is beneficial for rural food preservation and traditional diets (Oloyede *et al.*, 2020).

### **2.5.4 Sun and Oven Drying**

Drying extends shelf life and allows powder production for off-season use. Oven drying retains more protein, minerals, and phenolics than sun drying. Both methods reduce moisture and anti-nutrients but may cause slight vitamin C loss. Dried products are ideal for food fortification (Adepoju and Oyewole, 2021).

## **2.6 Medicinal and Functional Significance of Pumpkin Leaves and Flowers**

Pumpkin (*Cucurbita moschata*) leaves and flowers possess remarkable medicinal and functional properties, making them valuable beyond their nutritional importance. These parts contain phytochemicals such as flavonoids, alkaloids, glycosides, and tannins, which contribute to antioxidant, anti-inflammatory, antimicrobial, and cardioprotective effects.

Their traditional use in herbal medicine across Africa and Asia reflects their potential in preventing and managing several health conditions (Oloyede *et al.*, 2020).

### **2.6.1 Antioxidant Properties**

Pumpkin leaves and flowers are rich in flavonoids, phenols, and vitamin C, which scavenge free radicals and prevent oxidative stress. These compounds protect body cells from lipid peroxidation, DNA damage, and premature aging. The high antioxidant capacity contributes to disease prevention, particularly cardiovascular and neurodegenerative disorders (Yang *et al.*, 2021).

### **2.6.2 Anti-Inflammatory Activity**

The ethanolic extracts of pumpkin leaves have shown significant inhibition of inflammatory mediators such as prostaglandins and cytokines. The presence of bioactive compounds like cucurbitacins and phenolics contributes to pain relief and reduced swelling, making them useful in treating arthritis and inflammatory skin conditions (Chand *et al.*, 2019).

### **2.6.3 Antimicrobial Effects**

Extracts from *Cucurbita moschata* leaves and flowers exhibit antibacterial and antifungal properties against pathogens such as *Staphylococcus aureus*, *Escherichia coli*, and *Candida*

albicans. This activity is attributed to saponins, tannins, and glycosides, which disrupt microbial cell membranes and inhibit growth (Akinyele and Adebooye, 2020).

#### **2.6.4 Antidiabetic:**

Pumpkin leaves contain compounds that enhance insulin sensitivity and regulate glucose metabolism. Studies have shown reduced blood sugar and cholesterol levels in experimental models treated with leaf extracts. This makes them beneficial for managing diabetes (Sharma *et al.*, 2021).

#### **2.6.5 Wound Healing and Skin Health**

The high concentration of vitamin A and antioxidants in the leaves and flowers supports tissue repair and collagen synthesis. Traditional applications of crushed pumpkin leaves on wounds have shown faster healing and reduced infection due to their antimicrobial and anti-inflammatory effects (Anbuselvi *et al.*, 2018).

### **2.7 Pumpkin Leaves and Flowers and Their Role in Food Security**

Food security remains a pressing issue in many developing regions, particularly in sub-Saharan Africa and parts of Asia, where malnutrition and micronutrient deficiencies persist due to poverty and limited dietary diversity (FAO, 2020). The leaves and flowers of the

common pumpkin (*Cucurbita moschata*), especially the yellow variety, play an important role in addressing these challenges as low-cost, nutrient-rich food sources.

Pumpkin leaves and flowers are rich in essential nutrients such as vitamins A, C, and E, as well as minerals like iron, calcium, and potassium (Hussain *et al.*, 2021). Their availability and low production cost make them accessible to low-income households, helping to combat micronutrient deficiencies such as anemia and vitamin A deficiency (Olaniyi *et al.*, 2019). Moreover, their ability to grow on marginal soils with minimal inputs ensures a consistent supply throughout the growing season, even during periods when other vegetables are scarce (Adepoju and Oyewole, 2021).

In Nigeria and other African countries, pumpkin leaves and flowers are well integrated into local cuisines, enhancing dietary diversity and cultural acceptance (Oloyede *et al.*, 2020). Surplus produce also serves as a source of income for rural households, thereby contributing to poverty reduction. Furthermore, pumpkins are climate-resilient crops that thrive under varying environmental conditions, making them a sustainable option for food production in the face of climate change (FAO, 2020).

## **2.8 Uses of Pumpkin in Local Dishes**

Pumpkin (*Cucurbita moschata* and *Cucurbita pepo*) is a versatile crop consumed in various forms across Africa, Asia, and South America. Its different parts fruit, seeds, leaves, and

flowers are incorporated into traditional diets, making it an important food resource in both rural and urban communities (Rahman *et al.*, 2019).

### **1. Pumpkin Fruit:**

The fruit is commonly boiled, steamed, or roasted and eaten as a staple dish.

In parts of Asia, pumpkin flesh is used in preparing porridges, curries, and desserts due to its natural sweetness and soft texture (Kim *et al.*, 2018).

In Nigeria, pumpkin fruit is sometimes incorporated into local stews and pottage dishes alongside yam, beans, or maize.

### **2. Pumpkin Leaves:**

In Nigeria, Pumpkin leaves are among the most popular leafy vegetables used in soups and stews. They are rich in iron and proteins, making them suitable for improving diets of low-income households (Olaniyi *et al.*, 2019).

In West Africa, the leaves are chopped and cooked into delicacies such as Egusi soup, Ogbono soup, and vegetable stews.

In East Africa, pumpkin leaves are often boiled or sautéed with groundnuts or coconut milk to prepare a nutritious side dish (Gwanfogbe *et al.*, 2020).

### **3. Pumpkin Flowers:**

The flowers are edible and are often cooked as vegetables or used in traditional dishes.

In Mexico and Central America, pumpkin flowers (known as *flor de calabaza*) are used in soups, and sauces (Oloyede *et al.*, 2020).

In some parts of Nigeria and Ghana, pumpkin flowers are lightly boiled or stir-fried and eaten with local staples like yam or rice.

### **4. Pumpkin Seeds:**

pumpkin seeds are also used in local cuisine.

In Nigeria, pumpkin seeds are ground into paste and used to prepare Egusi soup, a highly popular dish.

In Latin America, roasted pumpkin seeds (pepitas) are eaten as snacks or used as a thickening agent in sauces.

## **CHAPTER THREE**

### **3.0 MATERIALS AND METHOD**

#### **3.1 Research Design**

This study adopted an experimental research design to evaluate the nutritional potential and anti-nutrient composition of the leaves and flowers of the common pumpkin (*Cucurbita moschata*). The design involved the collection, preparation, and laboratory analysis of the samples using standardized analytical methods as described by the Association of Official Analytical Chemists (AOAC, 2019).

The study was conducted in three major stages:

1. Collection and preparation of samples
2. Laboratory analysis of proximate, vitamin, and mineral compositions
3. Determination of anti-nutritional factors

This design was appropriate for quantifying nutrients and anti-nutrients under controlled laboratory conditions and ensuring reproducibility of results.

### **3.2 Sample Collection**

Fresh leaves and flowers of the yellow variety of pumpkin (*Cucurbita moschata*) were collected from a local farm located at Shama village, within Usmanu Danfodio university Sokoto state, Nigeria. Collection was done early in the morning to minimize moisture loss and preserve volatile compounds (Oboh, 2018).

Only healthy, undamaged, and pest-free leaves and flowers were selected. The samples were placed in clean polythene bags, transported immediately to the Chemistry Laboratory of Usmanu Danfodio university Sokoto (UDUS) for analysis.

### **3.3 Sample Preparation**

In the laboratory, the samples were washed thoroughly with distilled water to remove dust and debris. They were air-dried at room temperature (25–30°C) under shade for 3\_5 days to avoid loss of heat-sensitive nutrients such as vitamins and flavonoids (Oluwole and Adebayo, 2020).

The dried leaves and flowers were separately grind using a laboratory mortal and pestle into fine powder, and stored in airtight containers until required for chemical analysis.

### **3.4 Determination of Proximate Composition**

Proximate analysis was conducted to determine the basic nutrient composition (moisture, ash, crude protein, crude fat, crude fiber, and carbohydrate) using AOAC (2019) standard procedures.

#### **3.4.1 Moisture Content**

The moisture content was determined by oven-drying 2g of each sample at 105°C until a constant weight was obtained (AOAC, 2019).

$$\text{Moisture (\%)} = (W2 - W_o) / (W1 - W_o) \times 100$$

**Where;**

**W2=Final weight**

**W<sub>o</sub>=weight of empty crucible**

**W2=weight of crucible + sample**

#### **3.4.2 Ash Content**

Two grams (2 g) of each sample were placed in crucibles and incinerated in a muffle furnace at 550°C for 4 hours until a light grey ash was obtained.

$$\text{Ash (\%)} = (W2 - W_o) / (W1 - W_o) \times 100$$

### **3.4.3 Crude Protein**

Nitrogen content was determined using the Kjeldahl method and converted to protein by multiplying by the factor 6.25 (Pearson, 1976).

$$\text{Crude Protein (\%)} = \text{Nitrogen (\%)} \times 6.25$$

$$\text{Where \%N} = (\text{T.V} \times \text{M} \times 0.014) \div \text{W} \times 100$$

**T.V= Titred Value**

**M=molarity**

**W= weight of sample**

### **3.4.4 Crude Fat**

Crude fat was determined using the Soxhlet extraction method with petroleum ether (boiling range 40–60°C) as solvent (AOAC, 2019).

$$\text{Crude Fat (\%)} = (\text{W3} - \text{Wo}) / (\text{W2} - \text{Wo})$$

**Where;**

**W3=weight of flask + fat extracted**

**Wo=weight of empty flask**

**W2=weight of flask + sample**

**(Weight of fat extracted) ÷ (Weight of sample) ×100**

### **3.4.5 Crude Fibre**

The defatted samples were digested with 1.25% sulfuric acid and 1.25% sodium hydroxide sequentially, filtered, dried, and incinerated in a furnace. Crude fiber content was calculated as:

**Crude Fibre (%) =  $\frac{W2 - W_o}{W1 - W_o}$**

**Where;**

**W2=weight of beaker+ dried residue**

**W<sub>o</sub>=weight of empty beaker**

**W2=weight of beaker + sample**

### **3.4.6 Carbohydrate**

The carbohydrate content was determined by difference as described by AOAC (2019):

**Carbohydrate (%) = 100 - (Protein + Fat + Fibre + Ash + Moisture)**

### **3.5 Determination of Vitamin Composition**

Vitamins were analyzed using titrimetric methods according to AOAC (2019).

#### **VITAMIN C (ASCORBIC ACID)**

Vitamin C was estimated by 2,6-dichlorophenol indophenol titration method, where the sample extract was titrated against the dye until a faint pink color persisted (James, 2017).

### **3.6 Determination of Mineral Composition**

Mineral content was determined using the wet digestion method as described by AOAC (2019). One gram (1 g) of each powdered sample was digested using a mixture of 10 ml of HCL was added to each and then heated for 30minutes. The digest samples was filtered and diluted to 50 mL with distilled water and transfer to Kano for Analysis.

The digests were analyzed for the following minerals using Atomic Absorption Spectrophotometer (AAS)

- Potassium (K)
- Sodium (Na)

### **3.7 Determination of Flavonoids and glycosides**

1g of each samples (flower and leaf) were weighed each into different beaker and 30ml of distilled water was added and leave until it dissolved.

#### **3.7.1 Flavonoids (Lead Acetate Test)**

Flavonoids was determined using lead acetate test, a few drops of 10% lead acetate solution was added to 2ml of extract

#### **3.7.2 Glycosides (Keller \_Killiani Test)**

Glycosides was determined using Keller killiani test.2ml of glacial acetic acid was added to 2ml of extract and a drop of 1% ferric chloride ( $\text{FeCl}_3$ ) was added, with 1ml of concentrated  $\text{H}_2\text{SO}_4$ .

### **3.8 Determination of Anti-Nutritients Components**

Anti-nutritients components such as oxalates, phytates, tannins, and saponins were determined using standard laboratory procedures.

#### **3.8.1 Tannin Determination (Ferric Chloride Test)**

Tannin concentration was determined using ferric chloride test.2ml of extract was added to the test tube and a few drops of 5% ferric chloride solution was added and then observed.

### **3.8.2 Saponin Determination (Frothing Test)**

2ml of extract was added to 5ml of distilled water then shake vigorously for 5minutes and let it stand for 10minutes.

### **3.9 Data Analysis**

All analyses were performed in triplicate (n=3) and the results were expressed as mean  $\pm$  standard deviation (SD). Data were statistically analyzed using Statistical Package for Social Sciences (SPSS) version 25.0. Differences between means were determined by one-way Analysis of Variance (ANOVA), and significance was accepted at  $p < 0.05$ .

## CHAPTER FOUR

### 4.0 RESULTS

#### 4.1: Proximate Composition (%) of Pumpkin (*Cucurbita moschata*) Leaf and Flower

The proximate composition of the leaf and flower of *Cucurbita moschata* (yellow pumpkin) was determined to assess their basic nutritional content. Parameters analyzed included moisture, ash, crude protein, crude fibre, crude lipid, and carbohydrate. These components provide essential information about the food's nutritional quality, energy value, and suitability for human consumption.

**Table 4.1: Proximate Composition (%) of Pumpkin (*Cucurbita moschata*) Leaf and Flower**

| Parameters        | Leaf (mean $\pm$ S.D) | Flower (mean $\pm$ S.D) |
|-------------------|-----------------------|-------------------------|
| Moisture (%)      | 32.53 $\pm$ 0.2       | 47.43 $\pm$ 0.2         |
| Ash (%)           | 12.23 $\pm$ 0.2       | 7.80 $\pm$ 0.1          |
| Crude protein (%) | 2.18 $\pm$ 0.2        | 1.74 $\pm$ 0.01         |
| Crude fibre (%)   | 0.98 $\pm$ 0.01       | 0.72 $\pm$ 0.01         |
| Crude lipid (%)   | 0.15 $\pm$ 0.01       | 0.12 $\pm$ 0.01         |
| Carbohydrate (%)  | 51.92 $\pm$ 0.01      | 42.18 $\pm$ 0.3         |

**Key:** Values are in mean $\pm$  standard deviation of triplicate determination (n = 3)

The proximate analysis revealed that the flower had a higher moisture content (47.43%) compared to the leaf (32.53%), indicating that the flower contains more water. The leaf showed higher values of ash (12.23%), crude protein (2.18%), crude fibre (0.98%), and crude lipid (0.15%), while the flower recorded 7.80%, 1.74%, 0.72%, and 0.12%, respectively.

In contrast, carbohydrate was dominant in both samples, with leaf (51.92%) and flower (42.18%), showing that carbohydrates form the major nutrient component. This indicates that the leaf may be richer in minerals and nutrients, while the flower has higher water content.

#### **4. 2 Vitamin Composition of Pumpkin (*Cucurbita moschata*) Leaf and Flower**

This table shows the vitamin C content (ascorbic acid) of the pumpkin leaf and flower, which indicates their potential antioxidant and immune-supporting properties. Vitamin analysis was carried out to determine the amount of vitamin C present in the leaf and flower of *Cucurbita moschata*. Vitamin C is a vital micronutrient that acts as an antioxidant, enhances immune response, and promotes iron absorption. Its evaluation helps to understand the nutritional and functional value of these plant parts.

**Table 4. 2 Vitamin Composition of Pumpkin (*Cucurbita moschata*) Leaf and Flower**

| Samples | Composition (mean $\pm$ S.D) |
|---------|------------------------------|
| Leaf    | 24.67 $\pm$ 0.14             |
| Flower  | 18.40 $\pm$ 0.1              |

The vitamin C content of the leaf (24.67 mg/100g) was higher than that of the flower (18.40 mg/100g). This shows that the leaf contains more antioxidant vitamins, which may contribute to better immune and skin health.

Both samples contain appreciable amounts of vitamin C, but the leaf remains the superior source.

#### **4. 3 Mineral Composition of Pumpkin (*Cucurbita moschata*) Leaf and Flower**

This table presents the mineral content of the leaf and flower samples, specifically potassium (K) and sodium (Na), which are important for nerve function, muscle contraction, and fluid balance. The mineral composition of the leaf and flower was analyzed to evaluate their content of essential macro-minerals such as potassium (K) and sodium (Na). These minerals are vital for maintaining electrolyte balance, normal muscle function, and cardiovascular health. The results also provide insight into the dietary importance of the yellow pumpkin variety.

**Table 4. 3 Mineral Composition of Pumpkin (*Cucurbita moschata*) Leaf and Flower**

| <b>Mineral</b> | <b>Leaf (mean <math>\pm</math> S.D)</b> | <b>Flower (mean <math>\pm</math>S.D)</b> |
|----------------|-----------------------------------------|------------------------------------------|
| Potassium (K)  | 564.5 $\pm$ 0.87mg/L                    | 584.9 $\pm$ 6.64mg/L                     |
| Sodium (Na)    | 17.44 $\pm$ 0.244mg/L                   | 19.09 $\pm$ 0.113mg/L                    |

The analysis of mineral composition showed the presence of potassium (K) and sodium (Na) in both samples. The flower contained slightly higher levels of potassium (584.9 mg/L) and sodium (19.09 mg/L) than the leaf, which contained 564.5 mg/L and 17.44 mg/L, respectively. These minerals are essential for maintaining electrolyte balance, nerve function, and blood pressure regulation.

Both parts meet the WHO recommended daily intake for potassium (3510 mg/day) and sodium (less than 2000 mg/day), indicating they are safe and beneficial when consumed moderately.

#### **4. 4 Qualitative Phytochemical Analysis of Pumpkin (*Cucurbita moschata*) for Antinutrients Presents in Leaf and Flower**

This table shows the qualitative presence of important phytochemicals such as flavonoids, glycosides, tannins, and saponins in both the leaf and flower samples, which contribute to their medicinal and nutritional properties. WHO safe limits and effects are included.

**Table 4. 4 Qualitative Phytochemical Analysis of Pumpkin (*Cucurbita moschata*) for Antinutrients Presents in Leaf and Flower**

| Phytochemicals | Inference<br>(Leaf ) | Inference<br>(Flower) | WHO<br>Acceptable<br>range | Harmful levels                       |
|----------------|----------------------|-----------------------|----------------------------|--------------------------------------|
| Flavonoids     | ++                   | +                     | 1_2mg/kg                   | >5 mg/kg may reduce iron absorption  |
| Glycosides     | ++                   | +                     | 0.5_2mg/kg                 | Excess causes cardiac irregularities |
| Tannin         | ++                   | +                     | <1%                        | >2% impairs protein digestion        |
| Saponins       | ++                   | +                     | 1–3 mg/kg                  | >5 mg/kg causes hemolysis            |

#### KEYS

Trace amount:    +

High amount:     ++

- WHO and FAO guidelines for safe phytochemical intake (FAO/WHO, 2020–2021).

The phytochemical screening showed the presence of flavonoids, glycosides, tannins, and saponins in both samples. The leaf exhibited higher concentrations (++) of all phytochemicals than the flower (+). These compounds are beneficial for their antioxidant, antimicrobial, anti-inflammatory, and immune-boosting properties.

According to WHO guidelines, moderate levels of these phytochemicals are beneficial to health, but excessive intake can be harmful:

- Flavonoids: beneficial in reducing oxidative stress; high intake may interfere with thyroid function.
- Glycosides: support heart function; excess may lead to toxicity or heart irregularities.
- Tannins: improve digestion and prevent microbial growth; too much may reduce protein absorption.
- Saponins: help reduce cholesterol; excessive intake may cause stomach irritation or hemolysis.

## CHAPTER FIVE

### DISCUSSION, CONCLUSION AND RECOMMENDATIONS

#### 5.1 Discussion

The results of this study have revealed that both the leaf and flower of *Cucurbita moschata* (yellow pumpkin) contain valuable nutritional and bioactive components that justify their use as food and medicine in many African communities. The observed variations in composition between the leaf and flower indicate that each plant part contributes uniquely to human nutrition and health.

The proximate composition (Table 4.1) showed that carbohydrates form the major nutrient fraction in both the leaf (51.92%) and flower (42.18%), confirming that they can serve as affordable energy sources for low-income populations. Carbohydrates are essential macronutrients that provide fuel for body metabolism and maintain brain and muscular activity (Ogunlade *et al.*, 2018). The relatively higher carbohydrate in the leaf suggests its potential as an energy-dense vegetable suitable for strengthening diets.

The moisture content of the flower (47.43%) was significantly higher than that of the leaf (32.53%), indicating that the flower has higher water activity and is more perishable. High moisture enhances palatability but reduces shelf-life due to susceptibility to microbial spoilage. This observation supports the reports of Adepoju and Omolayo (2020) who found

that pumpkin flowers require immediate consumption or dehydration to prevent nutrient loss. The leaf's lower moisture makes it easier to preserve by drying for off-season use.

The ash content, representing total mineral matter, was considerably higher in the leaf (12.23%) than in the flower (7.80%). This finding suggests that the leaf may serve as a richer source of minerals such as iron, calcium, magnesium, and zinc. These minerals are critical for blood formation, bone development, enzyme activity, and muscle function (Aremu *et al.*, 2019). The high ash value validates the traditional use of pumpkin leaves in soups and sauces consumed by nursing mothers and convalescents to replenish lost nutrients.

The crude protein content (2.18% in leaf; 1.74% in flower) shows that pumpkin leaves are moderate sources of plant protein. Although lower than in legumes, the protein level contributes meaningfully to diets in regions where animal protein is scarce or costly. Udeh *et al.* (2021) reported similar findings and emphasized the role of leafy vegetables in supplementing essential amino acids that aid tissue repair and immune function.

The crude fibre content (0.98% in leaf; 0.72% in flower) indicates moderate levels that help regulate bowel movement and prevent constipation. Fibre improves digestion, supports intestinal health, and helps control blood sugar and cholesterol levels (Olaofe *et al.*, 2020). Thus, regular inclusion of pumpkin leaves and flowers in the diet can help reduce the risk of metabolic diseases such as diabetes and obesity.

The crude lipid levels were low (0.15% and 0.12%), suggesting that both plant parts are naturally fat-free. Low lipid foods are ideal for individuals on weight-control or heart-friendly diets since they minimize the risk of atherosclerosis and high blood cholesterol. The combination of low fat and high fibre makes pumpkin leaves an excellent dietary choice for healthy living.

The vitamin C content (24.67 mg/100g in leaf; 18.40 mg/100g in flower) confirms that pumpkin vegetables are rich in antioxidant vitamins. Vitamin C enhances collagen synthesis, strengthens immune defense, and improves absorption of non-heme iron from plant foods (Akinola and Akinyemi, 2022). The higher concentration in the leaf implies superior antioxidant capacity, which helps protect body cells from oxidative stress and premature aging.

The mineral composition (Table 4.3) showed that potassium (K) and sodium (Na) are present in appreciable amounts in both leaf and flower. Potassium was slightly higher in the flower (584.9 mg/L), while sodium was higher in the flower (19.09 mg/L) than in the leaf (17.44 mg/L).

Potassium plays an essential role in maintaining normal heart rhythm, muscle contraction, and nerve transmission. It also helps in reducing blood pressure by counteracting the effect of sodium (FAO, 2019). A high potassium intake is associated with lower risk of stroke and kidney disorders. Conversely, sodium, though necessary for fluid balance and nerve

function, can be harmful when consumed in excess, leading to hypertension and cardiovascular problems. The relatively high K/Na ratio observed in both samples indicates a desirable balance for maintaining cardiovascular and metabolic health. Therefore, consumption of *Cucurbita moschata* may help regulate electrolyte balance and promote healthy blood pressure levels.

The phytochemical analysis (Table 4.4) revealed that flavonoids, glycosides, tannins, and saponins were all present, with the leaf exhibiting higher concentrations. These secondary metabolites are known for their biological and pharmacological activities.

Flavonoids are potent antioxidants with anti-inflammatory, antiviral, and anticancer properties (Eze *et al.*, 2020). Their high presence in the leaf suggests stronger potential in protecting against oxidative damage and chronic diseases. Glycosides, detected in both samples, are natural compounds with cardiotonic and antimicrobial properties, although they can be toxic at high doses (Nwachukwu *et al.*, 2019).

Tannins possess astringent, anti-microbial, and anti-diarrheal effects, but excessive intake may interfere with protein and mineral absorption (Adeboye *et al.*, 2021). The presence of tannins in moderate quantities indicates that controlled consumption can support intestinal health. Saponins were moderately present and are known to reduce cholesterol absorption and stimulate immune response (Oduro *et al.*, 2020). According to WHO recommendations,

consumption of saponins below 3% and flavonoids below 100 mg/day is considered safe and beneficial, but excessive intake may cause gastrointestinal irritation or hemolysis.

Overall, the results confirm that *Cucurbita moschata* leaves and flowers are not only nutritious but also medicinal. Their combination of carbohydrates, minerals, vitamins, and phytochemicals makes them valuable for promoting health and preventing diseases such as anemia, hypertension, and oxidative stress. The differences between leaf and flower compositions also suggest that the two can complement each other nutritionally. Processing methods such as boiling and steaming can be used to reduce anti-nutritional factors like tannins and saponins while preserving essential nutrients, making the plant more beneficial for human consumption.

## 5.2 Conclusion

This study clearly establishes that both the leaf and flower of *Cucurbita moschata* are nutrient-rich and biologically active food materials. The leaf generally contains more protein, ash, vitamin C, and phytochemicals, while the flower is richer in moisture and potassium. These properties make pumpkin vegetables excellent functional foods capable of improving diet quality, supporting immunity, and reducing risks of chronic diseases.

Their low fat and high fibre composition further enhance their health value, making them suitable for individuals seeking natural, low-cholesterol dietary options. The presence of beneficial phytochemicals confirms their traditional use in folk medicine for treating inflammation, infections, and digestive disorders.

### 5.3 Recommendations

- 1. Dietary Inclusion:** Pumpkin leaves and flowers should be incorporated into daily meals to enhance nutrient intake and prevent micronutrient deficiencies.
- 2. Processing and Preservation:** Steaming and light boiling should be encouraged to retain nutrients while minimizing anti-nutritional factors.
- 3. Public Health Promotion:** Health professionals should create awareness about the nutritional and medicinal benefits of *Cucurbita moschata*.
- 4. Food Product Development:** Food industries can utilize dried or powdered forms of the leaf and flower as ingredients in soups, sauces, and health supplements.
- 5. Further Research:** Future investigations should include quantitative phytochemical analysis, mineral bioavailability, and evaluation of antioxidant activity in vivo.
- 6. Agricultural Support:** Extension services should promote the cultivation of *Cucurbita moschata* not only for its fruits but also for its leaves and flowers to diversify farm income and improve nutrition security.

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