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Original article

Nutritional and Medicinal Potentials of *Polyalthia Longifolia* Leaf Extracts in Animal Production

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Abstract

Introduction: The clamour for organic agriculture necessitated the use of phytogenics in animal production. This study evaluates the nutritional and medicinal properties of *P. longifolia* leaf extracts, focusing on proximate composition, amino acid profile, mineral content, vitamin composition, phytochemical constituents, antioxidant capacity, and antimicrobial activity.

Methods: The fresh leaves were carefully separated from the stem, washed with clean water to remove any form of sand or debris and then drained in a clean basket. 100g of the fresh leaves were blended with 500ml of water using a blender for 3 minutes after which the blended samples were properly filtered using standard filter papers (Whatman paper No. 1). The filtrate was then analyzed for proximate, phytochemical, mineral, vitamin, antioxidants, antimicrobial and amino acid composition. Analyses were done in triplicates and analyzed for means and standard deviations.

Results: The proximate analysis revealed a high carbohydrate content (66.47%), along with notable levels of crude fiber (10.01%), crude fat (7.61%), and crude protein (5.24%). Amino acid profiling identified glutamic acid as the most abundant amino acid (23.98 mg/100g), with essential amino acids such as leucine, phenylalanine, and valine present in significant quantities. Mineral analysis highlighted the presence of essential elements including iron (87.52 mg/100g), zinc (50.62 mg/100g), potassium (40.9 mg/100g), and phosphorus (44.92 mg/100g). Phytochemical screening confirmed the presence of flavonoids, alkaloids, tannins, and saponins. The antioxidant assay demonstrated a concentration-dependent increase in radical scavenging activity, with the highest inhibition observed at 100 μg/ml. Antimicrobial tests showed significant inhibition of bacterial strains such as *Escherichia coli*, *Klebsiella pneumoniae*, and *Pseudomonas aeruginosa*, suggesting the potential of *P. longifolia* as a natural antimicrobial agent. These findings indicate that *P. longifolia* leaf extracts possess valuable nutritional and medicinal properties that could be harnessed for applications in animal production, particularly in enhancing growth performance and disease resistance.

Keywords: Antioxidant, Ethno-Medicinal, Immune Booster, Phytogenics, *Polyalthia longifolia* Leaf Extracts

Introduction

The increasing global demand for sustainable and eco-friendly alternatives in animal production has led to the exploration of various plant-based feed additives and bioactive compounds (Makkar et al., 2007; Wang et al., 2024; Akinola et al., 2025). One such plant of interest is *Polyalthia longifolia* (Masquerade Tree), a member of the Annonaceae family, which has been traditionally used in ethnomedicine due to its diverse pharmacological properties (Katkar et al., 2010; Nma & Ayisa, 2024). The plant is native to India and widely cultivated across tropical regions, including Africa, where it is valued for its medicinal and ornamental uses (Vishala et al., 2021).

Phytogenic feed additives, such as medicinal plants, have gained considerable attention due to their potential to improve growth performance, enhance nutrient utilization, and serve as antimicrobial and immunostimulant agents (Ivanova et al., 2024; Akintunde et al., 2024a,b). Several studies have highlighted the beneficial effects of medicinal plant extracts on poultry and livestock growth performance. Mahfuz et al. (2021) demonstrated that the inclusion of plant-derived polyphenols in poultry and swine diets improved weight gain and feed efficiency. Similarly, Akintunde et al. (2021) and Oloruntola et al. (2024) reported that dietary supplementation with *Moringa oleifera* leaf extract enhanced feed conversion ratio (FCR) and reduced mortality in broiler chickens. Phytogenics like turmeric (Abd Al-Jaleel, 2012; Adebisi et al., 2021; Ayodele et al., 2021, 2022), negro pepper (Azodo et al., 2021), scent leaf (Olumide and Akintola, 2018; Olumide et al., 2022a), Ginger (Khan et al., 2012), Garlic (Odunowo & Olumide, 2019), Moringa (Akintunde et al., 2019; Akintunde & Toye, 2014), Soursop (Abdul-Wahab et al., 2018), Pawpaw leaves (Olumide et al., 2022a), Clove (Adebisi et al., 2021; Ayodele et al., 2021, 2022), Beetroot Juice (Tayo et al., 2020), *Parquetina nigrescens* (Akintunde et al., 2023, 2024c; Olumide et al., 2022b), *Centella asiatica* (Ajayi et al., 2020; Ajibade et al., 2023), *Phyllanthus niruiri* (Tayo et al., 2022) amongst others have been used to replace antibiotics in livestock production with reasonable results.

Phytogenic feed additives have been shown to improve digestive enzyme activity, nutrient absorption, and gut health in poultry (Syed et al., 2021; Abdelli et al., 2021). *Polyalthia longifolia* belongs to the Annonaceae family and is widely distributed in tropical and subtropical regions (Lavanya et al., 2018; Chen et al., 2021). *Polyalthia longifolia* contains bioactive compounds such as flavonoids, alkaloids, and tannins that may enhance feed efficiency and nutrient metabolism (Chen et al., 2021) but there is dearth of information on the chemical composition of *Polyalthia longifolia* leaf extracts and its potentials in animal production.

Despite the promising pharmacological attributes of *P. longifolia*, limited research has been conducted on its nutritional and medicinal potentials in animal production. The present study aims to evaluate the nutritional composition and bioactive properties of *P. longifolia* leaf extracts and their implications for livestock health and productivity. The study will assess the proximate composition, phytochemical profile, and in vitro antioxidant and antimicrobial activities of the leaf extracts, providing insights into their potential benefits as natural growth promoters and disease management agents in animal husbandry.

Materials and Methods

Collection and Preparation of Plant Materials

Reasonable quantities of *Polyalthia longifolia* fresh leaves were harvested from Babcock University environment around Illishan community and identified by a recognized botanist from the Basic Science Department, Babcock University, Ilishan-Remo, Ogun State, Nigeria. The fresh leaves were carefully separated from the stem, washed with clean water to remove any form of sand or debris and then drained in a clean basket. 100g of the fresh leaves were blended with 500ml of water using a blender for 3 minutes after which the blended samples were properly filtered using standard filter papers (Whatman paper No. 1).

Determination of Proximate Composition

The *Polyalthia longifolia* leaf extract was analyzed for proximate composition (dry matter, ash, crude fat, crude fibre and crude protein contents) using the methods of Association of Official Analytical Chemists (AOAC, 2010).

Determination of Amino Acids Profile

The amino acid profile of *Polyalthia longifolia* leaf extract was determined by standard method described by Sparkman et al. (1958). The samples were dried to constant weight, defatted, hydrolysed, evaporated in a rotatory evaporator and loaded into the Technicon Sequential Multi-Sample Amino Acid Analyzer (TSM).

Determination of Minerals

Sodium and potassium contents were determined using the method described by (Oshodi, 1992). Phosphorus was determined by vanadomolybdate method (AOAC, 1995). The other mineral contents (elements) were determined using an atomic absorption spectrophotometer as described by the Association of Official Analytical Chemists (AOAC, 1990) for calcium (Ca), magnesium (Mg), potassium (K), sodium (Na), iron (Fe), zinc (Zn), manganese (Mn) and copper (Cu).

Determination of Vitamins Contents

Standard spectrophotometric methods of AOAC (2000) and Okwu (2004) were used in the determination of all the vitamin contents of the extracts except vitamin C that was determined using titrimetric method (Okwu, 2004).

Phytochemical Analysis

Phytochemical analysis was done to determine the presence of phytate, saponin, flavonoid, tannin and alkaloid. Standard spectrophotometic and titrimetric methods were used in the determination of phytochemical contents of the Extracts. Flavonoids were determined using the methods of Boham and Kocipai, (1994), saponins, phenols and glycosides (Obadoni and Ochuko, 2001), alkaloids by Harbone (1973). All the analyses were done using triplicate samples.

Antioxidant Assay

The antioxidant activity of *P. longifolia* leaf extracts was evaluated using the 2,2-diphenyl-1-picrylhydrazyl (DPPH) radical scavenging assay as described by Brand-Williams et al. (1995). The absorbance was measured at 517 nm using a UV-visible spectrophotometer (Shimadzu UV-1800, Japan), and the percentage inhibition of DPPH radicals was calculated.

Antimicrobial Assay

The antimicrobial activity of the extracts was assessed against selected bacterial strains (*Escherichia coli*, *Salmonella spp*., and *Staphylococcus aureus*) using the agar well diffusion method (CLSI, 2015). The zones of inhibition were measured, and the minimum inhibitory concentration (MIC) was determined by the broth dilution method.

Data Analysis

All experiments were conducted in triplicates, and the data were expressed as mean ± standard deviation (SD).

Results and Discussion

Table 1 presents the proximate analysis of *Polyalthia longifolia* leaf extracts. The results indicate that carbohydrates constitute the highest proportion of the extract (66.47%), followed by crude fiber (10.01%), crude fat (7.61%), crude protein (5.24%), moisture content (9.31%), and ash content (1.46%).

Table 1. Proximate Analysis of *Polyalthia longifolia* Leaf Extracts

Parameter	
Moisture Content (%)	9.31 ± 0.01
Ash Content (%)	1.46 ± 0.02
Crude Fat (%)	7.61 ± 0.02
Crude Protein (%)	5.24 ± 0.05
Crude Fibre (%)	10.01 ± 0.01
Carbohydrate (%)	66.47 ± 0.12

The amino acid profile of *Polyalthia longifolia* leaf extracts (Table 2) reveals a diverse range of essential and non-essential amino acids. Glutamic acid (23.98 mg/100g) is the most abundant, followed by alanine (7.69 mg/100g) and arginine (7.03 mg/100g). Essential amino acids such as leucine (6.38 mg/100g), phenylalanine (5.46 mg/100g), and valine (5.00 mg/100g) are also present in significant amounts.

Table 2. Amino Acids Composition of *Polyalthia lonngifolia* Leaf Extracts

Compound Detected	Peak Area %	Comp (mg/100g)
Aspartic Acid*	2.15	10.84 ± 0.02
Threonine	7.17	4.96 ± 0.02
Serine*	2.87	3.93 ± 0.14
Glycine*	3.59	4.91 ± 0.03
Alanine*	12.19	7.69 ± 0.02
Phenylalanine	5.73	5.46 ± 0.02
Proline*	8.96	3.98 ± 0.01
Leucine	6.45	6.38 ± 0.02
Methionine	11.11	2.9 ± 0.03
Isoleucine	1.79	3.89 ± 0.02
Tyrosine*	14.34	3.62 ± 0.03
Valine*	1.43	5 ± 0.03
Glutamic Acid*	4.3	23.98 ± 0.02
Histidine	7.89	2.34 ± 0.05
Arginine	6.09	7.03 ± 0.09
Lysine*	3.94	9.04 ± 0.06

The mineral analysis of Polyalthia longifolia leaf extracts (Table 3) reveals the presence of essential macro- and microelements required for various physiological functions. The results highlight significant concentrations of iron (Fe), zinc (Zn), phosphorus (P), potassium (K), and calcium (Ca), which are crucial for metabolic and biochemical processes in both plants and animals.

Table 3. Mineral Composition of *Polyalthia lonngifolia* Leaf Extracts

Mineral	**Concentration (mg/Kg)**
Calcium (Ca)	32.52 ± 0.02
Chlorine (Cl)	21.28 ± 0.04
Iron (Fe)	87.52 ± 0.22
Lead (Pb)	0.03 ± 0.01
Selenium (Se)	18.74 ± 0.03
Manganese (Mn)	0.08 ± 0.02
Zinc (Zn)	50.62 ± 0.02
Magnesium (Mg)	25.34 ± 0.03
Potassium (K)	40.9 ± 0.55
Phosphorus (P)	44.92 ± 0.02
Sodium (Na)	27.82 ± 0.02

The antioxidant potential of *Polyalthia longifolia* leaf extracts was assessed using two standard assays: DPPH (2,2-diphenyl-1-picrylhydrazyl) and FRAP (Ferric Reducing Antioxidant Power). The results (Table 4) demonstrate a concentration-dependent increase in antioxidant activity across both assays, with maximum activity observed at 100 µg/ml.

Table 4. Antioxidant Properties of *Polyalthia longifolia* Leaf Extracts

Conc. (µg/ml)	**Antioxidant**	
	DPPH	**FRAP**
20	42.33 ± 0.03	33.12 ± 0.03
40	48.71 ± 0.01	38.62 ± 0.02
60	55.7 ± 0.03	47.9 ± 0.01
80	71.01 ± 0.02	58.22 ± 0.02
100	82.31 ± 0.04	66.32 ± 0.02
IC50	38.23 ± 0.02	30.03 ± 0.03

The antimicrobial activity of *P. longifolia* leaf extracts was evaluated against five pathogenic bacterial strains. The results revealed that the extract exhibited significant inhibitory effects against *Escherichia coli* (18.72 ± 0.03 mm), *Klebsiella pneumoniae* (15.00 ± 0 mm), and *Pseudomonas aeruginosa* (15.22 ± 0.03 mm). These findings suggest a broad-spectrum antibacterial potential of the extract, comparable to the standard antibiotic streptomycin, which exhibited inhibition zones of 17.98 ± 0.02 mm, 13.99 ± 0.02 mm, and 15.22 ± 0.02 mm, respectively. However, the extract demonstrated relatively lower activity against *Bacillus subtilis* (13.18 ± 0.02 mm) and was completely ineffective against *Staphylococcus aureus* (*0 ± 0 mm*), whereas streptomycin was effective against all tested bacteria.

Table 5. Antimicrobial Potentials of *Polyalthia lonngifolia* Leaf Extracts

Microorganisms	**Zone of inhibition (Dia. in mm)**		
	Sample	**Streptomycin Positive control**	**DMSO Negative control**
Escherichia coli MTCC 585	18.72 ± 0.03	17.98 ± 0.02	0 ± 0
Klebsiella pneumoniae MTCC 3040	15 ± 0	13.99 ± 0.02	0 ± 0
Pseudomonas aeruginosa MTCC 424	15.22 ± 0.03	15.22 ± 0.02	0 ± 0
Bacillus subtilis MTCC 441	13.18 ± 0.02	14.03 ± 0.03	0 ± 0
Staphylococcus aureus MTCC 3160	0 ± 0	16.41 ± 0.02	0 ± 0

The phytochemical analysis of *Polyalthia longifolia* leaf extracts revealed the presence of various bioactive compounds, including alkaloids, flavonoids, glycosides, saponins, steroids, phenols, terpenoids, tannins, and anthraquinones (Table 6). Among these, tannins (8.30 ± 0.05) and alkaloids (6.40 ± 0.05) were the most abundant, followed by saponins (3.30 ± 0.02) and flavonoids (2.36 ± 0.02).

Table 6. Phytochemical Composition of *Polyalthia lonngifolia* Leaf Extracts

Parameter	**Concentration (mg/100g)**	**Observation**
Alkaloids	6.40± 0.05	+++
Flavonoids	2.36± 0.02	+
Glycosides	0.08 ±0.01	+
Saponin	3.30± 0.02	++
Steroids	0.24± 0.00	+
Phenols	0.80 ±0.01	+
Terpenoides	0.44± 0.02	+
Tannin	8.30± 0.05	+++
Antraquinones	1.60 ±0.02	+

The vitamin content of *Polyalthia longifolia* leaf extracts, as presented in Table 7, reveals significant concentrations of essential vitamins. Notably, the extract contained high levels of Vitamin B2 (862.30 ± 0.05 mg/100g), Vitamin B3 (355.20 ± 0.10 mg/100g), and Vitamin B1 (272.20 ± 0.15 mg/100g). Moderate levels of Vitamin C (15.20 ± 2.0 mg/100g) and Vitamin A (3.50 ± 0.02 mg/100g) were also detected, while Vitamin E was found in trace amounts (0.010 ± 0.01 mg/100g).

Table 7. Concentration of Vitamins in *Polyalthia lonngifolia* Leaf Extracts

Vitamins	Concentration (mg/l00g)
Vitamin A	3.50+ 0.02
Vitamin B1	272.20+ 0.15
Vitamin B2	862.30 +0.05
Vitamin B3	355.20+ 0.10
Vitamin C	15.20+ 2.0
Vitamin E	0.010 +0.01

Discussion

The moisture content of 9.31% is relatively low, indicating good shelf stability and reduced susceptibility to microbial spoilage. This is comparable to the moisture content of aqeoues extracts of *Parquetina nigrescens* leaves, which has been reported at 7.80% (Akintunde et al., 2024c). Low moisture content is advantageous for storage and preservation, making *Polyalthia longifolia* a viable candidate for herbal formulations and pharmaceutical preparations. The ash content of 1.46% is an indicator of the total mineral composition of the leaves. Compared to *Moringa oleifera* leaves, which have an ash content ranging from 6.0% to 9.5% (Moyo et al., 2011; Akintunde & Toye, 2014), *Polyalthia longifolia* contains a lower concentration of minerals. However, this does not diminish its medicinal potential, as bioactive compounds rather than mineral content primarily define its pharmacological effects. With a crude fat content of 7.61%, *Polyalthia longifolia* leaves contain a moderate amount of lipids. This value is higher than that reported for *Ocimum gratissimum* (African basil), which has a crude fat content of approximately 4.23% (Ijeh et al., 2004). The presence of lipophilic compounds suggests potential antioxidant and anti-inflammatory properties, as essential fatty acids and phytochemicals play critical roles in cellular metabolism and immune responses (Rarison et al., 2023). The protein content of 5.24% is lower than 14.35% found in *Ocimum gratissimum* leaves (Olumide et al. 2019) and 9.02% and 10.05% reported for young and mature leaves of Polyalthia logifolia respectively (Ojewuyi et al., 2014). While *Polyalthia longifolia* is not a high-protein plant, the presence of proteins and peptides may contribute to its therapeutic effects, including antimicrobial activity and tissue repair. A crude fiber content of 10.01% suggests potential digestive health benefits, as fiber aids in bowel movement regulation and cholesterol metabolism. This is slightly higher than the fiber content of Vernonia amygdalina (8.90%) (Olumide et al., 2019), indicating that *Polyalthia longifolia* could be useful in dietary interventions for conditions such as constipation and cardiovascular diseases. Carbohydrates make up the majority (66.47%) of *Polyalthia longifolia* leaves, indicating their potential as an energy source. This value is comparable to that of aqueous extracts of *Parquetina nigrescens* leaves, which contains approximately 62.30% carbohydrates (Akintunde et al., 2024c). The high carbohydrate content may be attributed to the presence of soluble sugars and polysaccharides, which have been linked to immunomodulatory and anticancer activities (Li et al., 2021). The moderate levels of protein and fiber indicate that the plant may serve as a supplementary dietary component, particularly in fiber-rich formulations. The lipid content suggests the presence of essential fatty acids, which may enhance antioxidant activity and cardiovascular protection.

Amino acids play critical roles in metabolic processes, protein synthesis, immune function, and neurotransmitter activity. The presence of both essential and non-essential amino acids suggests potential applications of *Polyalthia longifolia* in nutritional and pharmaceutical formulations. Essential amino acids are those that the human body cannot synthesize and must be obtained through diet. The presence of these amino acids in *Polyalthia longifolia* highlights its potential as a nutritional supplement. Leucine (6.38 mg/100g) is vital for protein synthesis, muscle repair, and metabolic regulation. Its level in *Polyalthia longifolia* is comparable to that of aqueous extracts of *Parquetina nigrescens* leaves, which contains approximately 6.90% (Akintunde et al., 2024c). Phenylalanine (5.46 mg/100g) is a precursor for neurotransmitters such as dopamine and norepinephrine. It plays a crucial role in cognitive function and mental health. Valine (5.00 mg/100g) is a branched-chain amino acid (BCAA), valine supports muscle metabolism and tissue repair. Lysine (9.04 mg/100g) is essential for calcium absorption, immune function, and collagen synthesis, lysine levels in *Polyalthia longifolia* are higher than those in aqueous extracts of

Parquetina nigrescens leaves, which contains about 6.60% (Akintunde et al., 2024c). Histidine (2.34 mg/100g) is important for growth, tissue repair, and the production of histamine, which plays a role in immune response and digestion (Brosnan & Brosnan, 2020).

Non-essential amino acids can be synthesized by the body but still play key roles in health and metabolism. Glutamic Acid (23.98 mg/100g) is the most abundant amino acid detected, glutamic acid serves as a neurotransmitter and precursor for gamma-aminobutyric acid (GABA). Its high content suggests cognitive and metabolic benefits. This is comparable to the glutamic acid levels found in aqueous extracts of *Parquetina nigrescens* leaves (20.23%) (Akintunde et al., 2024c). Alanine (7.69 mg/100g) is a key player in glucose metabolism and immune function, alanine supports energy production. Proline (3.98 mg/100g) is important for collagen formation, skin health, and wound healing, proline content in *Polyalthia longifolia* is similar to that found in aqueous extracts of *Parquetina nigrescens* leaves (Akintunde et al., 2024c). Aspartic Acid (10.84 mg/100g) is essential for DNA and RNA synthesis, aspartic acid plays a crucial role in energy production and neurotransmitter function. Glycine (4.91 mg/100g) supports muscle growth, tissue repair, and cognitive function. It is also a precursor for glutathione, a powerful antioxidant (McCarty et al., 2018).

The amino acid composition of *Polyalthia longifolia* is comparable to that of other medicinal plants, indicating its potential as a dietary supplement and medicinal resource.

The high levels of glutamic acid, lysine, and aspartic acid suggest that *Polyalthia longifolia* has potential cognitive, metabolic, and immune-boosting properties similar to those of *Moringa oleifera*, which is widely used in functional foods and supplements. The amino acid composition of *Polyalthia longifolia* has several important implications: The presence of essential amino acids indicates potential use as a dietary supplement, especially in protein-deficient diets. The high glutamic acid and aspartic acid content suggest potential roles in enhancing cognitive function and neurotransmitter activity. Amino acids such as arginine and alanine support metabolism, immune response, and muscle recovery, making *Polyalthia longifolia* a valuable phytoadditive for overall health. Given the balanced amino acid composition, *Polyalthia longifolia* may have applications in developing functional foods, nutraceuticals, and phyto medicines aimed at improving metabolic and immune health.

The mineral composition of *Polyalthia longifolia* leaves highlights its potential as a nutritionally and pharmacologically valuable plant. The presence of essential minerals such as calcium, iron, zinc, and magnesium underscores its potential applications in health and disease management. The calcium content of *P. longifolia* leaves (32.52 mg/100g) indicates its potential in supporting bone formation and muscular function. Calcium is essential for enzymatic activities and plays a key role in preventing osteoporosis (Martiniakova et al., 2022). Compared to some other medicinal plants like *Moringa oleifera* leaves, which contain about 3.65% calcium (Moyo et al., 2011), *P. longifolia* has lower levels. However, its calcium content is comparable to that of *Telfairia occidentalis* (fluted pumpkin) leaves (40.5 mg/100g), which is widely consumed as a nutritious vegetable in Africa (Akwaowo et al., 2000).

The high iron content (87.52 mg/100g) in *P. longifolia* suggests its potential role in managing anemia and improving blood health. Iron is crucial for hemoglobin formation and oxygen transport in the body (Abbaspour et al., 2014). This concentration is significantly higher than that found in commonly consumed leafy vegetables such as *Amaranthus hybridus* (13.58 mg/100g) (Akubugwo et al., 2007). The high iron content suggests that *P. longifolia* could serve as a supplementary source for individuals at risk of iron-deficiency anemia. The zinc concentration (50.62 mg/100g) in *P. longifolia* is notable, as zinc plays a crucial role in immune function, wound healing, and enzymatic activities (Lin et al., 2017). This level is higher than what is found in *Moringa oleifera* (39 mg/Kg) (Oluwaniyi et al., 2020) and *Azadirachta indica* (Neem), which contains around 32.6 μg/g (Rathore & Mohit, 2013). The adequate zinc content makes *P. longifolia* a potential functional food ingredient for supporting immune health.

With a magnesium content of 25.34 mg/100g, *P. longifolia* can contribute to muscle function, nerve transmission, and blood pressure regulation (Dharmarajan & Gunturu, 2020). This value is lower than *Moringa oleifera* leaves (38.75 g/Kg) (Akintunde et al., 2024d) but higher to *Telfairia occidentalis* (8.69

mg/100g) (Akwaowo et al., 2000). The presence of magnesium in *P. longifolia* suggests its possible use in maintaining cardiovascular health. The potassium content (40.9 mg/100g) is crucial for electrolyte balance and cardiovascular function, while sodium (27.82 mg/100g) supports nerve signaling and fluid regulation (Fhadil & Wright, 2015). The potassium-to-sodium ratio in *P. longifolia* is favorable, making it suitable for individuals requiring a balanced diet for hypertension management. The potassium content is higher than that of *Moringa oleifera* (17.62 mg/100g) (Oluwaniyi et al., 2020).

Phosphorus (44.92 mg/100g) is essential for bone mineralization and energy metabolism (Serna & Bergwitz, 2020). The phosphorus content in *P. longifolia* is comparable to that of *Hibiscus sabdariffa* leaves, which contain around 5% (Balarabe, 2019). Selenium (18.74 mg/100g) plays a vital role in antioxidant defense and immune function, while manganese (0.08 mg/100g) is required for enzyme activation and bone development (Golara et al., 2023). The presence of lead (0.03 mg/100g) is a concern since excessive exposure to lead is toxic and can cause neurological damage (Collin et al., 2022). However, the detected levels in *P. longifolia* are below the FAO/WHO permissible limits of 0.3 mg/kg for plant materials (FAO/WHO, 2001). This suggests that *P. longifolia* is safe for consumption but should be monitored to prevent heavy metal accumulation from environmental contamination.

Compared to other phytogenic plants, *P. longifolia* has a well-balanced mineral composition. Its high iron and zinc content make it nutritionally valuable, similar to *Moringa oleifera* and *Telfairia occidentalis*, both known for their rich micronutrient profiles (Akintunde et al., 2024d; Akwaowo et al., 2000). However, it has a lower calcium and potassium content than *Moringa*, suggesting that it may not be as effective for bone-strengthening applications.The rich iron and zinc content in *P. longifolia* supports its potential as a natural supplement as blood and immune boosters. The high selenium content suggests potential antioxidant and immune-boosting properties, making *P. longifolia* useful in disease prevention. With significant levels of potassium and magnesium, *P. longifolia* could be incorporated into functional foods aimed at cardiovascular health management. The low lead content suggests minimal toxicity risk.

The DPPH assay is widely used to evaluate the free radical scavenging potential of plant extracts. The results indicate that *P. longifolia* exhibited notable DPPH radical inhibition, increasing from 42.33 ± 0.03% at 20 μg/ml to 82.31 ± 0.04% at 100 μg/ml, with an IC_{50} value of 38.23 ± 0.02 μg/ml. This suggests a strong free radical scavenging ability, which may be attributed to the presence of bioactive phytochemicals such as flavonoids, phenolics, and alkaloids (So et al., 2023). When compared with other medicinal plants, *P. longifolia* demonstrates comparable or even superior antioxidant potential. *Moringa oleifera* leaf extracts have shown a DPPH inhibition at 100 μg/ml, with an IC_{50} value of 53.95 μg/ml (Aziz et al., 2021). Similarly, *Azadirachta indica* (Neem) exhibits DPPH scavenging activity of 86.03% at 100 μg/ml had an IC_{50} value of 13.81 μg/ml (Hossain et al., 2014), indicating that *P. longifolia* possesses stronger radical scavenging properties than some commonly used phytogenics.

The FRAP assay measures the ability of antioxidants to reduce ferric (Fe^{3+}) to ferrous (Fe^{2+}) ions, reflecting electron-donating capacity (Benzie & Strain, 1996). The FRAP activity of *P. longifolia* leaf extracts increased from 33.12 ± 0.03% at 20 μg/ml to 66.32 ± 0.02% at 100 μg/ml, with an IC_{50} value of 30.03 ± 0.03 μg/ml. This significant reducing power suggests that the extract contains high levels of reducing agents such as polyphenols and flavonoids (Hossain et al., 2014). Compared to other phytogenics, the FRAP activity of P. longifolia is relatively high. For example, *Ocimum gratissimum* (African basil) exhibited a maximum FRAP value of ferric reducing antioxidant potential (FRAP) (110.0 and 85.0 mg Fe2+/g extract) 54.7% at 100 μg/ml, which is lower than the 66.32% observed for *P. longifolia* (Oriakhi et al., 2014).

The significant antioxidant properties of *P. longifolia* suggest its potential application in health and disease prevention. Oxidative stress is implicated in aging, cardiovascular diseases, cancer, and neurodegenerative disorders (Liguori et al., 2018). The strong radical scavenging activity of *P. longifolia* suggests that it could be beneficial in neutralizing oxidative damage. The high antioxidant potential makes *P. longifolia* a promising natural preservative and a potential candidate for nutraceutical formulations (Gengatharan & Abd Rahim, 2023).). The ability of *P. longifolia* to reduce ferric ions suggests that it can help prevent lipid peroxidation and inflammation, supporting its traditional use in herbal medicine for managing inflammatory conditions and chronic diseases.

The antioxidant activity of *P. longifolia* can be compared to synthetic antioxidants such as ascorbic acid and butylated hydroxytoluene (BHT). Ascorbic acid typically exhibits DPPH inhibition of 90-95% at 100 µg/ml (Hamid et al., 2016). This suggests that while *P. longifolia* is highly effective, it may require combination with other natural antioxidants to achieve comparable potency to synthetic antioxidants. The antioxidant analysis of *Polyalthia longifolia* leaf extracts confirms its strong radical scavenging ability and reducing power. The observed activity is comparable to or superior to many commonly used phytogenic antioxidants, highlighting its potential for use in nutraceuticals, functional foods, and therapeutic applications.

Previous studies have highlighted the antimicrobial efficacy of *P. longifolia* extracts due to their phytochemical constituents, including alkaloids, flavonoids, and glycosides, which exhibit bactericidal effects (Savu et al., 2022; Umar et al., 2024). The significant inhibition of *E. coli* and *K. pneumoniae* is particularly noteworthy as these Gram-negative bacteria are commonly associated with multidrug resistance, making plant-derived antimicrobials a promising alternative (Vaou et al., 2021). The inability of the extract to inhibit *S. aureus* suggests a potential variation in the mechanism of action of its bioactive compounds, necessitating further investigation into its spectrum of activity.

The negative control (DMSO) exhibited no antimicrobial activity, confirming that the observed antibacterial effects were solely due to the active components of the extract. These findings underscore the potential of *P. longifolia* leaf extracts as a natural source of antimicrobial agents, particularly for combating Gram-negative bacterial infections. The results indicate that *Polyalthia longifolia* leaf extracts possess notable antioxidant and antimicrobial activities, supporting their traditional use in herbal medicine. The strong DPPH and FRAP activities suggest potential applications in oxidative stress-related disorders, while the antibacterial effects highlight the extract's potential as an alternative to conventional antibiotics, especially against Gram-negative bacteria.

The findings on phytochemicals align with previous studies that have reported on *P. longifolia* as a rich source of secondary metabolites, contributing to its medicinal and therapeutic potential (Vishala et al., 2021; Shamwil et al., 2025). Phytochemicals play a crucial role in the pharmacological activities of medicinal plants. The high alkaloid content observed in *P. longifolia* is consistent with findings in other medicinal plants such as *Moringa oleifera* and *Azadirachta indica*, which have been reported to possess antimicrobial, analgesic, and anti-inflammatory properties (Emran et al., 2015; Akintunde et al., 2024d). Alkaloids have been extensively studied for their therapeutic significance, particularly in the treatment of bacterial infections and neurological disorders (Heinrich et al., 2021).

Flavonoids, though present in lower concentrations, are well-known for their strong antioxidant properties. Similar phytogenics, including *Ocimum sanctum* and *Parquetina nigrescens*, have demonstrated high flavonoid content, contributing to their free radical scavenging and anti-inflammatory activities (Olumide et al., 2019; Akintunde et al., 2024c). Flavonoids function by neutralizing reactive oxygen species (ROS), thereby reducing oxidative stress and inflammation-related diseases (Zahra et al., 2024). Tannins (8.30 ± 0.05 mg/100g) were the most abundant phytochemical in *P. longifolia*, which is consistent with findings in other polyphenol-rich plants such as *Moringa oleifera* seeds (Akintunde & Toye, 2014). Tannins exhibit significant antimicrobial activity by inhibiting bacterial growth and enzyme activity, making them valuable in wound healing and gastrointestinal treatments (Jing et al., 2022).

Saponins (3.30 ± 0.02 mg/100g) were present in moderate amounts in *P. longifolia* extracts, which aligns with reports on *Allium sativum* (garlic) where saponins contribute to immune-boosting and cholesterol-lowering effects (El-Saadony et al., 2024). The presence of glycosides, steroids, and terpenoids further suggests potential applications in cardiovascular and anti-inflammatory treatments (Pliego et al., 2022).

The bioactive compounds detected in *P. longifolia* are responsible for its diverse pharmacological effects, including antimicrobial, antioxidant, and anti-inflammatory properties. Alkaloids and tannins, in particular, contribute to its antibacterial activity, while flavonoids and phenols enhance its antioxidant potential (Cavazos et al., 2021). Terpenoids and steroids, although present in smaller quantities, are known for their role in immune modulation and hormone regulation (Leite et al., 2022; Pawase et al., 2024).

The phytochemical profile of *Polyalthia longifolia* leaf extracts highlights its potential as a rich source of medicinal compounds. The high concentration of tannins and alkaloids suggests significant antibacterial and antioxidant activities, making it a promising candidate for pharmaceutical applications.

The presence of significant quantities of B-complex vitamins aligns with previous studies on medicinal plants with strong antioxidant and metabolic functions. The high Vitamin B2 (riboflavin) content in *P. longifolia* is comparable to that found in *Moringa oleifera*, which has been recognized for its metabolic and energy-yielding properties (Akintunde et al., 2024d). Riboflavin is crucial for cellular respiration and redox reactions, making its abundance in *P. longifolia* significant for potential nutraceutical applications (Chu et al., 2022).

Similarly, the concentration of Vitamin B3 (niacin) is relatively high in *P. longifolia*, which is consistent with findings in aquoues extracts of *Parquetina nigrescens* leaf which have been studied for their ability to support nervous system function and lipid metabolism (Akintunde et al., 2024c). Niacin plays an essential role in DNA repair and anti-inflammatory processes, supporting its inclusion in natural remedies for metabolic disorders (Marques et al., 2024).

Vitamin C was present at a moderate concentration (15.20 ± 2.0 mg/100g), suggesting a notable antioxidant capacity. This level is lower than that found in citrus fruits but is comparable to leafy medicinal plants like *Vernonia amygdalina* which is used in traditional medicine for immune-boosting and anti-inflammatory purposes (Ndubuisi-Ogbonna et al., 2021; Degu et al., 2024). Vitamin C is known to enhance collagen synthesis, improve immune function, and act as a potent antioxidant by scavenging free radicals (See et al., 2024).

The detection of Vitamin A (3.50 ± 0.02 mg/100g) is consistent with findings in other tropical medicinal plants, such as *Carica papaya* and *Telfairia occidentalis*, which are valued for their role in vision enhancement and immune function (Kolu et al., 2021; Singh & Kumar, 2024). Vitamin A is an essential fat-soluble vitamin that supports epithelial integrity and immune defense against infections (Tanumihardjo, 2025).

However, the concentration of Vitamin E (0.010 ± 0.01 mg/100g) was found to be minimal. This is relatively lower than in oil-rich plants like *Elaeis guineensis* (palm oil) and *Helianthus annuus* (sunflower), which are known for their abundant Vitamin E content (Nagendran et al., 2000). Despite its low levels, Vitamin E plays an essential role in membrane stability and antioxidant defense mechanisms (Traber & Atkinson, 2007).

The rich composition of B-complex vitamins in *P. longifolia* supports its potential as a functional food ingredient for boosting energy metabolism and nervous system function. The presence of Vitamin C and Vitamin A further enhances its role in immune support and antioxidant defense, suggesting potential applications in preventing oxidative stress-related diseases. Although the Vitamin E content is low, the cumulative effect of the other vitamins may contribute to the overall health benefits of the plant extract.

Conclusions

The findings of this study highlight the potential of *Polyalthia longifolia* leaf extracts as a beneficial additive in animal production, given their rich nutritional composition and bioactive properties. The high carbohydrate, protein, and mineral content suggests that the extracts could serve as a valuable dietary supplement, while the presence of essential amino acids further enhances their nutritional significance. The strong antioxidant activity of the extracts indicates their potential role in reducing oxidative stress in animals, thereby improving overall health and productivity. Additionally, the antimicrobial efficacy of the extracts against various bacterial strains suggests their potential usefulness in controlling pathogenic infections in livestock.

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Conflict of interest

Authors declare no conflict of interest in the production of this work.

Authors' contributions

Oladeji Joseph Obatayo (OJA), Martha Dupe Olumide (MDO), Lois Chidinma Ndubuisi-Ogbonna (LCN) and Adeyinka Oye Akintunde (AOA)

This work was carried out in collaboration among all authors.

1. Conceptualization	OJA and AOA
2. Methodology	OJA and AOA
3. Software	AOA
4. Validation	MDO and LCN
5. Formal analysis	AOA
6. Investigation	OJA and AOA
7. Resources	OJA
8. Data Curation	AOA
9. Writing– original draft preparation	OJA
10. Writing – review and editing	MDO, LCN and AOA
11. Visualization	OJA
12. Supervision	MDO, LCN and AOA
13. Project administration	OJA, LCN and AOA

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