

MINERAL, VITAMIN AND MICROBIAL PROPERTIES OF PUDDING PRODUCED FROM RIPE PLANTAIN, MAIZE FLOUR AND DIFFERENT VEGETABLES (PUMPKIN LEAF, WATERLEAF, SCENT LEAF, CURRY LEAF)

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Abstract: This study evaluated the mineral, vitamin, and microbial properties of plantain–maize pudding fortified with pumpkin leaf, water leaf, scent leaf, and curry leaf. A total of five samples were evaluated including the control sample coded PSE prepared without including vegetable. Mineral analysis showed significant enhancement across samples, with iron ranging from 1.24 to 2.05 mg/100 g, calcium 5.25 to 24.60 mg/100 g, magnesium 32.80 to 57.40 mg/100 g, and zinc 0.41 to 0.71 mg/100 g. Curry leaf pudding exhibited the highest values for all minerals. Vitamin A and C contents were also improved, ranging from 0.05 to 0.14 mg/100 g and 12.20 to 21.90 mg/100 g respectively with curry and pumpkin leaf samples recording the greatest increases. Microbial analysis indicated bacterial counts of 2.59×10^5 – 4.17×10^5 CFU/g, fungal counts of 2.37×10^5 – 5.96×10^5 CFU/g, and coliform counts of 0.00 – 1.12×10^5 CFU/g, with pumpkin and curry leaf puddings showing the lowest loads. Overall, vegetable fortification improved both nutritional quality and microbial safety of the puddings. These findings highlight the potential of indigenous vegetables in enhancing staple foods like pudding.

Keywords: Pudding, Plantain, Maize, Vegetables, Flour.

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Introduction

Plantain (*Musa paradisiaca*) and maize (*Zea mays*) are widely consumed staples in many regions due to their affordability and nutritional benefits. Ripe plantain is a rich source of energy, fiber and essential vitamins like A and C, while maize flour provides carbohydrates and minerals such as magnesium and Zinc, making them ideal components for a balanced diet (Adewale *et al.*, 2018). These staples are often combined with vegetables to enhance their nutritional value.

Vegetables like pumpkin leaf, water leaf, scent leaf and curry leaf are integral to local diets, offering numerous health benefits. For instance, pumpkin leaf is an excellent source of iron, calcium and vitamins A and C, which support blood health and immunity (Ekpenyong and Akpan, 2019). Water leaf contains antioxidants, Vitamin C and essential minerals like calcium and iron aiding in overall health and inflammation control (Egbuna *et al.*, 2021). Scent leaf is known for its antimicrobial and anti-inflammatory

properties, promoting gut and respiratory health (Ajibade *et al.*, 2020), and curry leaf is rich in vitamin C, iron and calcium, contributing to better digestion and oxidative stress reduction (Sharma and Patel, 2018). Despite the nutritional benefits of these ingredients, there is limited research on the combination of plantain and maize flour with these vegetables in a pudding format.

Pudding produced from ripe plantain (*Musa spp*) and Maize flour and Traditional puddings in Nigeria, are often packaged in polyethylene packs, cup-like container, aluminum foil or in natural materials like banana leaf or leaf of *Thaumatococcus danielli* (sweet prayer plant, African serendipity berry). The natural packaging materials improves the colour, flavour and enhance the nutritional value by leaching some essential biochemical compounds associated with green leaves into the pudding during cooking. These packaging methods can be influenced by both the culinary traditions of the region and modern economic considerations.

Additionally, the bacteriological safety of such products remains under explored; raising concerns about microbial contamination and shelf stability (Oluwafemi and Adebayo, 2021). This study aims to address these gaps by evaluating the mineral, vitamin and microbial properties of pudding made from these ingredients. Such findings could provide a cost-effective and nutritious solution to malnutrition while ensuring food safety standards are met (Okeke *et al.*, 2023). The research focuses on analyzing the pudding's content of iron, calcium, magnesium, and zinc; vitamins A and C; and its microbial properties, including total viable count and coliform counts. This approach will highlight the potential of these locally sourced ingredients to produce a safe nutrient-dense food product (Ajidabe *et al.*, 2020).

Materials and Methods

The materials used included ripe plantain, maize seed, vegetables (Pumpkin leaf, Water leaf, Scent leaf, Curry leaf) and other ingredients such as palm oil, salt, onions, pepper, seasoning cubes and crayfish used for this study were purchased from the Eke Awka market, Awka South Local Government Area, Anambra state.

Table 1: Experimental Design

Sample Codes	Ripe Plantain (%)	Maize Flour (%)	Vegetables (%)
PSE	90	10	00 (None)
PCC	76.5	13.5	10 (Scent leaf)
PGS	75	15	10 (Pumpkin leaf)
PME	78	12	10 (water leaf)
PMC	75.75	14.25	10 (Curry leaf)

Keyword

PSE – (ripe plantain - 90, maize flour – 10, vegetable – 00)

PCC- (ripe plantain – 76.5, maize flour-13.5, Scent leaf-10)

PGS- (ripe plantain – 75, maize flour – 15, Pumpkin leaf – 10)

PME- (ripe plantain – 78, maize flour – 12, Water leaf – 10)

PMC- (ripe plantain – 75.75, maize flour – 14.25, Curry leaf – 10)

Production of Maize Flour: The maize flour was produced using the method described by Obinna *et al.* (2019). The maize grains were sorted and washed with clean water. Thereafter the washed maize grains were dried in a hot air oven at 60°C for 24 hours. The dried maize grains were cooled, milled using a hammer mill, sieved with 0.2 mm sieve and stored in a well-labelled transparent plastic container until further use.

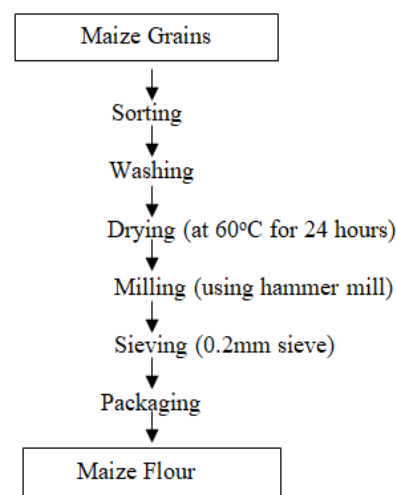


Figure 1: Production of Maize Flour

Source: Obinna *et al.* (2019)

Production of pudding: The vegetables were properly washed to remove dirt and soil, after which it was drained and cut into tiny sizes before adding to the pudding. The pudding was processed using the method described by Abiodun and Adepeju (2011) with a slight modification as shown in figure 3.1. The control ingredient (plantain and maize flour) was made first, in form of a paste then subsequent addition of the vegetables. The maize flour serves as a binder. The ingredients and seasoning were added and whipped until they are blended. The paste was poured into plastic plates and cooked for 45 minutes.

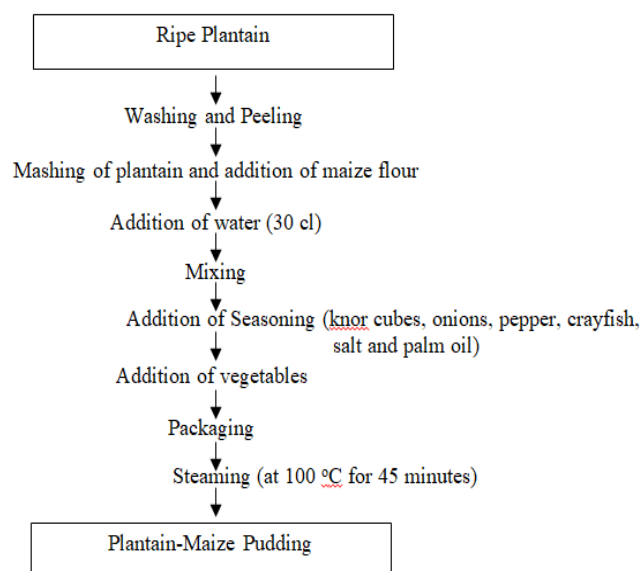


Figure 2: Production of Plantain-Maize Pudding

Source: Abiodun and Adepeju (2011).

Method of Analysis

Mineral Analysis

The mineral content of the samples was determined using the standard methods described by the AOAC (2010).

Digestion of Sample: Twenty (20) grams of the samples were digested for 25 min (as in ash determination) and the resulting ash was dissolved in 100 ml of dilute hydrochloric acid (1 ml HCL) and then diluted to 100 ml volumetric flask using distilled water. The solution was used for various analysis of mineral.

Determination of magnesium: Twenty 20 ml of the sample filtrate was pipetted into a 250 ml conical flask after which 25 ml of ammonia buffer solution added and mixed properly. Then a pinch of Erichrome black T indicator was added and titrated with 0.02 N of EDTA until the colour of the solution changed from wine-red to blue colour.

$$\text{Magnesium (mg/100g)} = \frac{(\text{Tv} \times 0.2432 \times 1000)}{\text{Vol. of sample used}}$$

Determination of calcium: The calcium content of the test samples was determined by the EDTA complex isometric titration. Twenty (20) ml of each extract was dispersed into a conical flask and panels of the masking agents, hydroxytannin, hydrochlorate, and potassium cyanide added, followed by 20 ml of ammonia buffer (pH 10.0). A pinch of the indicator-Ferrochrome black was then added and the mixture was shaken very well. It was titrated against 0.02 N EDTA solution until a permanent blue colour observed, then the reading was taken. The calcium contents were calculated using the formula below.

$$\text{Calcium (mg/100g)} = \frac{(\text{Tv} \times 0.4008 \times 1000)}{\text{Vol. of sample used}}$$

Determination of iron: The concentrations of iron (ppm) were analyzed using atomic absorption spectrophotometer at a wavelength of 243 nm and the concentration in mg/100 g were calculated using the following equation:

$$\text{Iron (Fe) (mg/100 g)} = \frac{\text{Concentration (ppm)} \times \text{Dilution factor}}{\text{Wt. of sample}} \times 1000$$

Determination of zinc: 20 ml sample solution was put in a 100 ml volumetric flask. The solution was neutralized with ammonia and nitric acid solution (1:2). Twenty (20) ml of vanadate molybdate reagent was added and diluted to the mark and then allowed to stand for 10 min and absorbance was read at 470 nm in the ultra violet region and the mineral concentration in mg/100 g was calculated using the following equation:

$$\text{Zinc (mg/100g)} = \frac{\text{Concentration (ppm)} \times \text{Dilution factor}}{\text{Wt. of sample}} \times 100$$

Vitamin Analysis

The vitamins (A and C) in the pudding were determined by the official methods of the Association of Official Analytical Chemists (AOAC, 2010).

Determination of vitamin A (β-Carotene): The sample was prepared by drying the plantain-maize pudding to a constant weight in an oven at 105°C for 2-3 hours. The dried sample was

cooled in a desiccator and then be extracted with hexane or petroleum ether. The extract was filtered through a Whatman No.42 filter paper or equivalent. The vitamin A content was determined using High-Performance Liquid Chromatography (HPLC) with UV-Vis detector at a wavelength of 325nm.

Calculation;

$$\text{Vitamin A (ug/g)} = \frac{(\text{Vitamin A concentration} \times \text{Extraction volume (ml)})}{\text{Sample weight (g)}}$$

Determination of vitamin C (Ascorbic acid): The sample was prepared by taking 5 grams and drying the plantain-maize pudding to a constant weight at 105°C for 2-3 hours. The dried sample was cooled and extracted with metaphosphoric acid (MPA) or oxalic acid. The extract was filtered through a Whatman NO. 42 filter paper or equivalent. The Vitamin C content was determined using a potentiometric titration with a standard solution of iodine (I₂) or 2,6-dichlorophenol indophenol (DCPIP) and absorbance will take place at 15 seconds and 30 seconds interval at 520nm.

Calculation;

$$\text{Vitamin C (ug/g)} = \frac{(\text{Vitamin C concentration} \times \text{Extraction volume (ml)})}{\text{Sample weight (g)}}$$

Microbial Properties

Total viable count and coliform count: Microbial analysis was carried out as reported by Henrietta *et al.*, (2017). Each pudding sample was prepared for microbial analysis in triplicate. A 10-fold serial dilution of each sample was carried out using peptone water as the diluents. 1 ml of appropriate dilutions (10⁻⁵) of the sample were pour plated in sterile plates of nutrient agar (NA), and eosine methylene blue (EMB) agar plates for the culture of bacteria and sabourand dextrose agar (SDA). The culture plates were incubated at 35±3 °C aerobically for 24-48 hours for bacteria and 48-72 hours for the fungi. Developing colonies on nutrient agar and sabourand sextrose agar were counted to obtain total bacterial, total fungi count and total coliform count.

Calculation:

$$\text{TBC/TFC/TCC} = \frac{|\text{N}| \times 100}{\text{V} \times \text{D}}$$

Where:

- TBC = Total bacterial count
- TFC = Total fungal count
- TCC = Total coliform count
- V = Volume plated
- D = Dilution factor
- 10 = Dilution constant

Results and Discussion

The mineral composition of the pudding samples is presented in Table 2. The results showed that the mineral content of the pudding varied with the type and proportion of vegetables used in the formulations. The iron content ranged from 1.24 to 2.05 mg/100 g, calcium content ranged from 5.25 to 24.60 mg/100 g and

magnesium content ranged from 32.80 to 57.40 mg/100 g. These variations could be attributed to differences in the inherent mineral composition of the vegetables incorporated in the pudding blends. The iron content of the pudding samples ranged from 1.24 mg/100 g in PSE (control sample without vegetables) to 2.05 mg/100 g in PMC (formulated with curry leaf). There were significant differences ($p < 0.05$) among all samples. The inclusion of vegetables, particularly curry leaf and pumpkin leaf, led to an increase in iron content. The result is in agreement with the findings of Akindahunsi and Salawu (2005), who reported enhanced iron content in plantain-based dishes supplemented with vegetables. Singh *et al.* (2015) also noted that vegetables are effective carriers of dietary iron, which is essential for oxygen transport and enzymatic reactions. The calcium content ranged

from 5.25 mg/100 g in PSE to 24.60 mg/100 g in PMC, with significant differences ($p < 0.05$) observed among the samples. All the vegetable-fortified samples showed higher calcium levels than the control. This increase is linked to the high calcium content of curry, scent, and pumpkin leaves. Similar results were reported by Fasuyi (2016), who found elevated calcium levels in maize-based porridges enriched with amaranth and other local vegetables. Pravina *et al.* (2013) highlighted that calcium plays a vital role in maintaining bone density, regulating muscle contraction, and supporting nerve signaling. Additionally, Oladele and Aina (2017) confirmed that incorporating indigenous leafy vegetables into traditional foods like moi-moi and yam pottage improved their mineral content, especially calcium.

Table 2: Mineral Composition of Pudding Produced from Ripe Plantain, Maize Flour and Different Vegetables (Pumpkin Leaf, Water Leaf, Scent Leaf, Curry Leaf)

Sample	Iron (mg/100g)	Calcium (mg/100g)	Magnesium (mg/100 g)	Zinc (mg/100g)
PSE	1.24 ^c ±0.05	5.25 ^e ±0.07	32.80 ^c ±1.13	0.41 ^c ±0.01
PCC	1.64 ^b ±0.05	15 ^d ±0.43	49.22 ^c ±1.66	0.61 ^b ±0.02
PGS	1.77 ^b ±0.04	20.75 ^b ±1.06	51.01 ^c ±1.42	0.63 ^b ±0.04
PME	1.67 ^b ±0.07	18.00 ^c ±0.56	48.35 ^c ±1.77	0.57 ^b ±0.01
PMC	2.05 ^a ±0.07	24.60 ^a ±0.84	57.40 ^a ±1.97	0.71 ^a ±0.01

*Results are Means ± SD (n = 20). Mean results with different superscript along the column are significantly ($p < 0.05$) different

Keys:

PSE – (ripe plantain - 90, maize flour – 10, vegetable – 00), PCC- (ripe plantain – 76.5, maize flour-13.5, Scent leaf-10), PGS- (ripe plantain – 75, maize flour – 15, Pumpkin leaf – 10), PME- (ripe plantain – 78, maize flour – 12, Water leaf – 10), PMC- (ripe plantain – 75.75, maize flour – 14.25, Curry leaf – 10)

The vitamin composition of pudding samples produced from ripe plantain, maize flour, and different vegetables is presented in Table 3. The vitamin A content ranged from 0.05 to 0.14 mg/100 g, vitamin C content ranged from 12.20 mg/100 g to 21.90 mg/100g. The results showed that the vitamin A and vitamin C content varied significantly ($p \leq 0.05$) among the samples. These differences are primarily attributed to the nature and quantity of vegetables incorporated into each formulation. The control sample (PSE) contained no vegetables, while other samples were fortified with 10% of various leafy vegetables—scent leaf (PCC), pumpkin leaf (PGS), water leaf (PME), and curry leaf (PMC). The presence of these vegetables substantially improved the vitamin profile of the pudding formulations. The vitamin A content of the pudding samples ranged from 0.05 mg/100 g in PSE to 0.14 mg/100 g in PMC, showing statistically significant increases ($p < 0.05$) across all samples that contained vegetables. Curry leaf (PMC) and pumpkin leaf (PGS) contributed the highest amounts of vitamin A. This increase is expected because these vegetables are known to be rich in carotenoids, particularly beta-carotene, which acts as a precursor to vitamin A in the body. In contrast, the control sample (PSE), which lacked any vegetable addition, recorded the lowest vitamin A content.

The improved vitamin A content in the fortified pudding samples supports the findings of Fasuyi (2006), who reported that green leafy vegetables such as *Telfairia occidentalis* and *Amaranthus*

hybridus significantly improve the vitamin A content of cereal- and tuber-based porridges. Akindahunsi and Salawu (2005) also documented those tropical leafy vegetables are rich sources of provitamin A carotenoids, making them ideal candidates for dietary enrichment. Oladeji *et al.* (2020) further affirmed that curry leaf is an excellent source of carotenoids and polyphenols, and its inclusion in staple foods could improve their micronutrient composition and health-promoting properties. The increase in vitamin A observed in the current study indicates the potential of vegetable-fortified puddings to help address vitamin A deficiency, which is a major public health issue in many parts of sub-Saharan Africa.

The vitamin C content of the pudding samples ranged from 12.20 mg/100 g in PSE to 21.90 mg/100 g in PMC, with significant differences ($p < 0.05$) observed among all formulations. Vitamin C content was lowest in the control sample, which contained no vegetables, and highest in the sample containing curry leaf. Other fortified samples particularly those with water leaf (PME) and pumpkin leaf (PGS) also showed elevated levels of vitamin C compared to the control. The significance of vitamin C in human nutrition cannot be overstated. It functions as an antioxidant, enhances non-heme iron absorption, supports collagen synthesis, and strengthens the immune system (Nworgu *et al.*, 2007) Given the susceptibility of vitamin C to thermal degradation, the relatively high levels retained in these pudding samples may also

suggest that the cooking method was mild enough to minimize nutrient loss. Additionally, the variation in vitamin C content among vegetable-fortified samples may be due to differences in initial ascorbic acid concentrations, bioavailability, and interactions with other food matrix components during cooking.

Table 3: Vitamin Composition of Pudding Produced from Ripe Plantain, Maize Flour and Different Vegetables (Pumpkin Leaf, Water Leaf, Scent Leaf, Curry Leaf)

Sample	Vitamin A (mg/100g)	Vitamin C (mg/100g)
PSE	0.05 ^d ±0.01	12.20 ^d ±0.42
PCC	0.09 ^c ±0.01	17.75 ^c ±0.35
PGS	0.11 ^b ±0.01	19.60 ^b ±0.57
PME	0.11 ^{bc} ±0.01	19.55 ^b ±0.78
PMC	0.14 ^a ±0.01	21.90 ^a ±0.85

*Results are Means ± SD (n = 20). Mean results with different superscript along the column are significantly (p < 0.05) different.

Keys:

PSE – (ripe plantain - 90, maize flour – 10, vegetable – 00), PCC- (ripe plantain – 76.5, maize flour-13.5, Scent leaf-10), PGS- (ripe plantain – 75, maize flour – 15, Pumpkin leaf – 10), PME- (ripe plantain – 78, maize flour – 12, Water leaf – 10), PMC- (ripe plantain – 75.75, maize flour – 14.25, Curry leaf – 10)

The microbial properties of pudding samples produced from ripe plantain, maize flour, and different vegetables are presented in Table 4. The results include bacterial count, fungal count and coliform count, expressed in colony-forming units per gram (CFU/g × 10⁵). Statistically significant differences (p ≤ 0.05) were observed across the samples for all microbial parameters. These differences can be attributed to the nature and antimicrobial properties of the vegetables used, the moisture content of the final product, and the hygienic conditions during processing. The bacterial count of the samples ranged from 2.59 × 10⁵ CFU/g in PGS (sample with pumpkin leaf) to 4.17 × 10⁵ CFU/g in PME (sample with water leaf). These values were significantly different (p < 0.05). The lowest bacterial load recorded in PGS suggests that pumpkin leaf may exhibit antibacterial properties or was better handled during preparation. Conversely, the higher bacterial count in PME could be attributed to the higher moisture content associated with waterleaf, which is known to support bacterial proliferation if not properly cooked or stored.

The fungal count of the samples ranged from 2.37 × 10⁵ CFU/g in PGS to 5.96 × 10⁵ CFU/g in PSE (the control sample with no vegetables). Statistically significant differences (p < 0.05) were observed among the samples. The fungal load was lowest in samples containing vegetables such as pumpkin leaf (PGS), curry leaf (PMC), and scent leaf (PCC), indicating probable antifungal effect from the phytochemicals present in these vegetables. The control sample (PSE), lacking any vegetables, had the highest fungal growth, which may be due to the absence of these naturally occurring antifungal agents. Ekwenye and Elegalam (2005) documented the antifungal activity of leafy vegetables like scent leaf, noting their effectiveness against food spoilage fungi.

Similarly, Ajayi and Fagade (2006) showed that extracts from curry leaf possess potent antifungal properties. Ghosh *et al.* (2013) also reported that phenolic compounds and essential oils present in vegetables act as natural antifungal agents, reducing the fungal load of foods in which they are included. This explains the lower fungal counts in vegetable-fortified samples, which may help improve shelf stability under proper storage. The coliform count ranged from 0.00 × 10⁵ CFU/g in PGS and PMC to 1.12 × 10⁵ CFU/g in PSE. Statistically significant differences (p < 0.05) were found across samples. Coliforms are indicators of fecal contamination and poor hygiene. Their absence in samples containing pumpkin (PGS) and curry leaf (PMC) suggests improved microbial quality, possibly due to better antimicrobial action or more hygienic preparation. On the other hand, the high coliform level in the control sample (PSE) raises concerns about contamination, either during ingredient handling or post-cooking exposure.

Table 4: Microbial Properties of Pudding Produced from Ripe Plantain, Maize Flour and Different Vegetables (Pumpkin Leaf, Water Leaf, Scent Leaf, Curry Leaf) (×10⁻⁵)

Sample	Bacterial count CFU/g	Fungal count CFU/g	Coliform count CFU/g
PSE	3.65 ^c ±0.10	5.96 ^b ±0.56	1.12 ^a ±1.01
PCC	3.09 ^d ±0.04	2.39 ^c ±0.05	1.05 ^{ab} ±0.05
PGS	2.59 ^e ±0.13	2.37 ^c ±0.10	NG ^c ±0.00
PME	4.17 ^a ±0.09	3.55 ^a ±0.10	1.07 ^{ab} ±0.04
PMC	3.86 ^b ±0.13	2.44 ^c ±0.11	NG ^c ±0.00

*Results are Means ± SD (n = 20). Mean results with different superscript along the column are significantly (p < 0.05) different.

Keys:

PSE – (ripe plantain - 90, maize flour – 10, vegetable – 00), PCC- (ripe plantain – 76.5, maize flour-13.5, Scent leaf-10), PGS- (ripe plantain – 75, maize flour – 15, Pumpkin leaf – 10), PME- (ripe plantain – 78, maize flour – 12, Water leaf – 10), PMC- (ripe plantain – 75.75, maize flour – 14.25, Curry leaf – 10)

Conclusion

This study evaluated the mineral, vitamin, and microbial properties of puddings made from ripe plantain and maize flour fortified with various leafy vegetables. The inclusion of vegetables such as curry leaf, pumpkin leaf, and scent leaf significantly improved the nutritional quality of the puddings. Samples fortified with curry leaf showed the highest concentrations of essential minerals like iron, calcium, and magnesium. Vitamin A and C levels were also significantly enhanced in all fortified samples, with the curry leaf pudding recording the highest values. The microbial analysis revealed that puddings containing curry and pumpkin leaves had lower bacterial, fungal, and coliform counts compared to the control, indicating better microbial safety. The control sample without vegetable fortification had the least nutritional content and the highest microbial load. These findings confirm that incorporating indigenous vegetables into traditional pudding

formulations can greatly improve both their nutritional and microbiological quality. Further studies are recommended to investigate the shelf-life stability, packaging conditions, and consumer acceptance of these fortified puddings across different age groups and regions.

References

1. Abiodun, A. and Adepeju, A. (2011). Effect of processing on the chemical, pasting and antinutritional composition of bambara Nut (*Vigna subterranea L. Verdc*) flour. *Advance Journal of Food Science and Technology* 3 (4): 224-227.
2. Adewale, O. A., Adebayo, S. T. and Adeyemi, A. A. (2018). Plantain and maize-based diets: Nutritional evaluation. *African Journal of Nutrition* 12(2): 145–160.
3. Ajayi, A. and Fagade, O. E. (2006). Growth pattern and survival of *Candida albicans* in traditional Nigerian foods. *African Journal of Biotechnology* 5(16): 1385–1389. <https://doi.org/10.5897/AJB2006.000-3210>
4. Ajibade, M. T., Olatunde, S. M. and Okon, F. I. (2020). Nutritional and antimicrobial properties of tropical vegetables. *Journal of Food Science and Technology* 57(3): 201–210 Akindahunsi and Salawu (2005)
5. Akindahunsi, A. A. and Salawu, S. O. (2005). Phytochemical screening and nutrient–antinutrient composition of selected tropical green leafy vegetables. *African Journal of Biotechnology* 4(6): 497–501. <https://doi.org/10.5897/AJB2005.000-3085>
6. Aletor, O., Oshodi, A. A. and Ipinmoroti, I. (2002). Chemical composition of common leafy protein concentrate. *Food Chemistry* 78(32): 63–68.
7. AOAC. (2010). *Official Methods of Analysis* (18th ed.). Association of Official Analytical Chemists, Washington D.C., USA.
8. Egbuna, C., Udedi, S. and Ifemeje, J. (2021). Bioactive compounds in waterleaf and its health implications. *Journal of Nutrition Research* 10(1): 54–63.
9. Ekpenyong, U. and Akpan, E. (2019). Pumpkin leaf as a source of essential vitamins and minerals. *International Journal of Nutrition and Food Science* 8(4): 98–105.
10. Ekwenye, U. N. and Elegalam, N. N. (2005). Antibacterial activity of ginger (*Zingiber officinale*) and garlic (*Allium sativum*) extracts on some enteric bacteria. *Journal of Medicinal Plants Research* 1(4): 194–198.
11. Fasuyi, A. O. (2006). Nutritional potentials of some tropical vegetable leaf meals: Chemical characterization and functional properties. *African Journal of Biotechnology* 5(1): 49–53. <https://doi.org/10.5897/AJB2006.000-3005>
12. Ghosh, S., Naik, D. G. and Kadam, T. A. (2013). Antifungal activity of natural plant extracts against *Fusarium* species. *International Journal of Current Microbiology and Applied Sciences* 2(5): 89–92.
13. Nworgu, F. C., Akinbamijo, O. O. and Fajemisin, A. N. (2007). Enhancing the nutritive value of plantain peels for poultry feeding using leaf meal supplements. *Livestock Research for Rural Development* 19(12). <http://www.lrrd.org/lrrd19/12/nwor191.htm>
14. Obinna, K., Adekunle, T., Chigozie, P. and Yusuf, M. (2019). Maize flour processing: Flowchart, production techniques and quality assessment. *Journal of Food Processing and Technology* 7(4): 150–162.
15. Okeke, C. O., Akinmoladun, O. M. and Eze, E. (2023). Nutritional composition of vegetable-based food products. *Journal of Food Science and Technology* 15(6): 301–310.
16. Oladeji, A. T., Ayodele, B. T. and Lawal, O. I. (2020). Nutritional composition, antioxidant properties and sensory acceptability of dishes prepared with curry leaf (*Murraya koenigii*). *Asian Food Science Journal* 15(4): 14–22. <https://doi.org/10.9734/AFSJ/2020/v15i430158>
17. Oladele, A. K. and Aina, J. O. (2017). Chemical composition and functional properties of flour produced from two varieties of tiger nut (*Cyperus esculentus*). *African Journal of Biotechnology* 6(21): 2473–2476. <https://doi.org/10.5897/AJB2007.000-2385>
18. Oluwafemi, B. E. and Adebayo, O. T. (2021). Microbial safety of vegetable-enhanced food products. *African Journal of Microbiology* 25(7): 312–319.
19. Pravina, P., Sayaji, D. and Avinash, M. (2013). Calcium and its role in human body. *International Journal of Research in Pharmaceutical and Biomedical Sciences* 4(2): 659–668.
20. Sharma, P. and Patel, K. (2018). Health benefits of curry leaf: A review. *Journal of Herbal Medicine* 9(2): 101-109.
21. Singh, A., Prakash, J. and Maheshwari, R. (2015). Iron, calcium, zinc and phytic acid content of selected green leafy vegetables. *Journal of Food Science and Technology* 52(6): 3697–3702. <https://doi.org/10.1007/s13197-014-1450-4>