Nutritional Composition and Bioactive Compounds of Some Neglected and Underutilized Food Crops from Udi, Enugu State, Nigeria

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Abstract
The effect of micronutrients in human health has been a continuous study by scientists worldwide. This work aimed at evaluating compounds in some neglected and underutilized food crops in Udi community, Udi Local Government Area, Enugu state, Nigeria. The crops are local varieties of Kidney beans, Cotton milk plant, Yellow yam, Aerial yam Oyster mushroom and blood leaf. Composite samples of each food crops randomly collected from all the villages that make up Udi town, were treated and analyzed in accordance with standard methods as described by Association of official Analytical chemist (AOAC). The mineral contents were done using Atomic absorption spectrophotometer (AAS); and it revealed high mineral potentials in terms of potassium, calcium, iron, copper and zinc. Phytochemical screening of their methanolic extract revealed varying concentrations of beneficial compounds such as phenols, alkaloids, tannins, saponins and flavonoids.
The proximate analysis showed nutrient richness of the food crops: ash, carbohydrate crude fibre, moisture protein and fat. Vitamin contents analysis revealed presence of vitamins B_1, B_2, C, E, Folate and Beta carotene (provitamin A) The findings of this study show the nutritional, medicinal and functional food potentials and benefits of these indigenous food crops. Integrating them into diets could support the prevention of and management of various health conditions and illness, making them valuable for improving the overall public health and wellness, justifying the advocacy for their re-integration into local diets and food security strategies.

Key words: *Micronutrients, Under-utilized, Phytochemicals, Bioactive compounds, Nutritional composition.*

1.0 INTRODUCTION

Neglected and under utilized species (NUS) also called orphan, abandoned, lost, forgotten under-used, local, minor, traditional, underdeveloped crops are part of large portfolio for centuries by users around the world, predominantly local communities (Padulosi, 2017); but currently abandoned or marginalized by farmers and consumers in terms of production and consumption for various reasons. Aboagye et al (2007) described them as crops less expensive, less available, rarely used and marginalized by both farmers and consumers and whose contribution to national economy have not been adequately explored due to decreased attention to their production consumption and utilization probably due to agronomic, genetic, socioeconomic, environmental, cultural and political reasons.

Currently about 7000 plant species out of about 30,000 identified edible plant species have been used in the history of humanity to meet food needs (FAO, 1998). Among these species, just 103 crop species provided 90% of the calories in human diet, while only four of these (rice, wheat, maize, potatoes) account for 60% of the human energy supply world-wide (Tontisrin and Bhattacharjee, 2010; Paludosi et al; 2013). The implication of this obviously, is food insecurity, malnutrition and other associated health related problems.

Underutilized forgotten and neglected food crop species have considerable potential benefits in agriculture, medicine, industry, poverty reduction and hunger. They also contribute significantly to agro biodiversity, food security, nutrition, and household income. Research by (Agulanna, 2020; Madzuivhandila et al, 2016) showed that most of these forgotten food crops have components (minerals, vitamins, proteins) that they posses medicinal values, thus helping to combat malnutrition and other health needs of the local population. Past human societies depended on these forgotten food crops for food, fibre, health security, etc (Williams and Haq, 2022). But recently a lot of these food crops are neglected, not cultivated and not consumed in many parts of the world, giving rise to dependence on foreign and imported foods with the attendant consequences. Consequently, people now consume more of expensive and unhealthy diets, leading to food shortages and low farmers income. Therefore, the current and persistent problems of food scarcity and insecurity, mono-cropping and erosion of indigenous crop genetic resources in Udi community are all part of the problems of underutilization and abandonment of important food crops in the community.

Underutilized (forgotten) food crops have received little or no attention by researchers and scientists, especially in the Nigerian context. They have not been adequately characterized in the literature but were mainly utilized by rural households and isolated traditional communities in the treatment of certain disease and illness (Agulanna, 2020), This means that the potential values of these crops have remained largely unexplored, untapped by both researchers and scientists thereby affecting their availability and security due to ignorance about their nutritional and medicinal properties and benefits. Therefore, the concern of this work is to evaluate the chemical, nutritional and bioactive components of some neglected, underutilized and abandoned food crops in Udi, Enugu State, to show-case their nutritional and medicinal properties. This will facilitate their integrating into the mainstream diets of the people; to address hunger and micro-nutrient deficiencies and most importantly making them valuable candidates for nutraceutical and dietary interventions.

2.0 Materials and Methods

2.1 Materials

2.1.1 Sample Collection and Preparation

Freshly harvested underutilized and neglected food crops from the field were collected. Sample were obtained from most of the villages that made up Udi town, in Udi Local Government Area of Enugu State Nigeria. It was done over a period of six (6) months in 2025 due to seasonal trends and in other to take care of variations in soil and other environmental effects on the mineral concentration and other constituents. They were transported in plastic buckets to the laboratory.

In the laboratory, the samples were washed thoroughly with water first with distilled water and then soaked the blood leaf *(Justicia carnea)* in sodium hypochlotite solution (100ml per litre) for 10mins for surface sanitization and latex removal (Juliana et al; 2016). By means of a sharp stainless steel knife, the back cover were completely removed, sundried for one week and finally

heat dried in an (air-oven method) oven (90°c@72hrs) till complete drying. The dried samples were pulverized using stainless steel blender into composite powder samples of the different food crops under study.
The samples were screened further through 100-50µm mesh to five powder and stored in an air-tight properly labeled analytical sample container as raw samples of the food crops.
In the other hand, fresh leaves of Justicia carnea (blood leaf) for this study was washed with water, sum dried and later on cut into smaller pieces using stainless steel knife. The leaves were re-washed again with distilled water and oven-dried at 40°c for 72 hours. The dried leaves were blended into the powdered sample using stainless steel mechanical blender, screened through 100-50µm mesh and stored in a plastic air-tight analytical container in the laboratory

2.2 Methods

The chemical analysis was performed on the analytical samples of the selected food crops under study. All the analysis was done based on the principles and procedures outlined for examination of physiochemical characteristics of solid samples as described by Association of Official Analytical Chemist (AOAC) official method of analysis (AOAC, 2025).
5g of each crop sample was mixed with 50cm^3 of distilled water and concentrated to 10cm^3 by heating, them digested with a mixture of nitric acid ($HN0_3$) and hydrochloric acid (HCL) in the ratio (1:3) for 1 hour (Okoye et al; 2006). At the end of one hour, the volume was adjusted to 100cm^3 in a volumetric flask and subjected to mineral (elemental) content analysis using Atomic absorption spectrophotometer (Bulk scientific 2004 model) (AAS)proximate analysis was done ion accordance with standard methods (AOAC, 2010), while the phytochemical screening was done based on methods described in previous studies (Trease, G.E, 1998; Edeoga et al; 2005; Raaman, N., 2006; Karthiswaran et al; 2010, Sakanka et al; 2005 and Konate, K. et al; 2012). Vitamins were done in accordance with standard methods as described by Okolodana, F.A; 2005 (Vit C); Pearson, D.A; 1976 (Vit B_1, B_2 and E); Jakkutowicz et al; 1977 (Vit A); Onwquka, G.I., 2005 (Folate).

3.0 Results and Discussion

3.1 Phytochemical study

Table 1: Phytochemical Content

Name	%Phenol	%tannin	%Alkaloid	%Flavonoid	%Saporun
Kidney beans *(Phaseolus vulgaris)*	14.74	0.11	2.00	4.20	1.03
Cotton milk plant(Marsedenia volubilis)	21.58	0.06	2.52	1.06	1.08
Yellow yam(*Diocorea spp)*	2.63	0.10	1.25	1.78	2.50
Aerial yam (*Dioscorea bulbifera*)	6.8	0.01	2.70	2.19	1.07
Mushroom(*Pleurotus ostreatus)*	5.26	0.18	1.65	14.68	2.00
Blood leaf(*Justicia carnea*)	47.89	0.18	1.65	14.68	2.05

The quantitative analysis result in table 1 showed promising phytochemical properties presence in the food crops with phenol, flavoids and alkaloids as the major constituents.

Justicia carnea, Marsdenia volubilis and Phaseolus vulgaris have high content of phenol which have high antioxidant properties and reducing the risk of chronic diseases, including heart disease and cancer. The high phenolic contents of Justicia carnea (47.89%), Marsdenia volubilis (21.58%) and Phaseolus vulgaris (14.4%), suggest their high body defense against free radicals, promoting anti-aging and reduces inflammation. Furthermore, Justicia carnea having high flavonoid (14.64%) content, suggests also the inherent ability to modify the body's reaction to allergies, viruses and carcinogens (Cushrine and bamb, 2005). The phytochemical richness of Dioscorea bulbifera and Marsdenia volubilis showed high contents of alkaloids (2.70 and 2.52%) respectively, indicating their anti-cancer, and anti-micribial and anti-malaria properties (Kurek et al., 2022). Their health promoting potential make them vehicles for neutraceutical and dietary interventions.

3.2 Proximate Analysis Result

Result of proximate analysis of the food crops were presented in table 2.

Table 2: Result of proximate analysis

Name	Ash (%)	Fibre (%)	Fat (%)	Moisture (%)	Protein (%)	Carbohydrate (%)
KidneyBeans variety*(Phaseolus vulgaris)*	2.50	1.25	1.00	17.00	18.02	50.23
Osyter Mushroom(*Pleurotus ostreatus)*	2.0	0.95	1.00	76.00	3.72	16.33
Cottonmilk Plant*(Marsdenia volubilis)*	4.50	2.25	1.00	78.00	5.23	9.03
Aerial Yam*(Dioscorea bulbifera*)	1.97	1.00	0.50	66.00	7.70	22.77
Yellow Yam*(Dioscore specie)*	1.00	0.509	0.50	50.50	5.64	41.86
Blood leaf(*Justicia carnea)*	7.0	4.01	1.00	50.00	1.75	58.00

Proximate analysis revealed basic nutritional composition of the food crops, giving insight into their macro-nutrient contents. The food crops are rich in macro-nutrients with carbohydrate, moisture and protein as the major constituents' carbohydrates in foods primarily provides energy, digestive health support and reduction of risk of certain diseases and illness. Studies (Slavin, J., 2024) have shown that many carbohydrates rich foods Are excellent source of fibre, vitamins and minerals, contributing to the overall well-being of human body system.

Among the examined food crops, Phaseolus vulgaris showed significant high content of protein. Protein is beneficial for muscle development and tissue repair. This makes the crop a good plant-based source of protein for the rural communities (Chandra et al., 2018). Protein rich foods can also support growth, immune booster and muscle repair (Mensik, R.R., 2016).

Moisture content indicates the freshness and storage of the food crop. Moisture affects satiety and digestion. Crops with high moisture content (*Marsdenia volubilis, Dioscorea bulbifera,* and *Pleurotus ostreatus*) may help in hydration, but most often high moisture content shows susceptibility to microbial spoilage if not properly stored or persevered (Alam et al., 2008).

Among the studied underutilized and neglected crops, *Phaseolus vulgaris* and *Marsdenia volubilis* crops stands out for their balanced composition of protein, fibre and Ash contents, while Phaseolus vulgaris, *Dioscorea specie* and *Dioscorea bulbifera* are energy dense. These foods have promising health implications and could serve as affordable alternatives to conventional diets if promoted and processed effectively.

3.3 Mineral Composition Result

The mineral profile revealed significant nutritional benefits and potentials, especially in terms of iron, zinc, phosphorous, calcium, magnesium, manganese and copper as presented in table 3.

Crops Name	Fe mg/100g	Cu mg/100g	Zn mg/100g	P mg/100g	Mn mg/100g	Mg mg/100g	Ca mg/100g
Kidneybeans variety[Phaseolus vulgaris]	4.67	0.73	10.22	40.80	0.013	0.088	0.10
Cottonmilk plant *Marsdenia volubilis)*	5.07	1.69	32.11	20.65	0.061	0.048	0.04
Blood leaf[Justicia carnea]	11.24	3.33	10.95	32.90	0.026	0.077	0.08
Aerial yam[Dioscorea bubifera]	1.92	0.57	21.17	18.48	0.017	0.078	0.14
Yellow Yam[Dioscore specie]	2.33	0.45	18.24	32.61	0.033	0.09	0.05
Oystermush room[Pleurotus ostreatus]	6.13	0.55	0.51	71.13	0.061	0.084	0.04

The mineral profile revealed varying levels of essential micronutrients in the crops studies. These minerals play crucial roles in human metabolism and physiological health (Calvo and Lamberg – Auardi, 2015). Pleurotus ostreatus, Justicia carnea and Phaseolus vulgaris stands out for their balanced overall mineral compositions or mineral rich foods. Pleurotus ostreatus showed highest phosphorus content (71.13mg/100g), signifying its excellent source of bone strength and metabolic energy (Lee, Y. L. et al., 2008) followed by *Phaseolus vulgaris* variety (40,80 mg/100g), *Justicia carnea* 932.90 mg/100g) and *Dioscorea specie* (32.61 mg/100g) reinforcing their importance in supporting muscle and nerve function. *Justicia carnea* showed highest content of iron (11.24 mg/100g), signifying strong contribution to haemoglobin formation and prevention of anemia, while *Dioscorea specie* showed highest content of Zinc (18.24 mg/100g). Zinc plays crucial role in immune function, DNA synthesis, skin repair and growth (Ascher and Acchner, 2005; Odugbemi, T., 2006). The results as shown in table 3, supports the inclusion of *Pleurotus ostreatus, Justicia carnea variety and Phaseolus vulgaris* variety an in health-focused diets because of their balanced mixture of key minerals for overall wellness.

3.4 Result of Vitamin Analysis

The vitamin composition of the food crops examined are presented in table 3.4

Table 3.4: Result of vitamin analysis

S/N	Name	Vit. C mg/100g	Vit. E mg/100g	Beta carotene (IU)	Folate mcg/100g	Vit. B_1 mg/100g	Vit. B_2 mg/100g
1.	Kidney beans variety[Phaseolus vulgaris]	27.95	16.98	326.10	20.65	0.98	7.80
2.	Oyster Mushroom[Pleurotus ostreatus]	367.90	22.03	1835.95	367.90	2.51	3.04
3.	Blood leaf{Justicia carnea]	135.10	14.71	1848.0	265.22	4.71	6.34
4.	Cotton milk plant[Marsdenia volubilis]	14.32	10.50	1236.10	32.61	0.51	0.67
5.	Aerial yam[Dioscorea bulbifera]	12.27	10.43	501.28	23.91	0.43	0.58
6.	Yellow Yam[Diocorea specie]	23.86	10.83	1239.0	32.61	0.83	1.12

Among the food crops examined, *Pleurotus ostreatus* and *Justicia carnea* (blood leaf) stands out for their overall balanced vitamin composition. This was followed by *Phaseolus vulgaris* and yellow yam, underscoring their potentials as nutritionally rich functional foods. The mineral profile revealed that the foods crops are nutritionally rich in pro-vitamin A, folate and vitamin C, suggesting their integration into diets can help address hunger and micro-nutrient deficiencies of the general population.

Pleurotus ostreatus and *Justicia carnea* variety are really exceptional. They combine multiple vitamins that are very essential for immunity, growth, reproduction and disease prevention (Powers, 2003 and WHO, 2009).

Vitamin C is a potential antioxidant essential for immune defence, iron absorption, collagen synthesis and wound healing (Carr and Magini, 2017). Vitamin A is required for vision, immune function, reproduction and cellular communication (WHO, 2009), while folate (Vitamin B_9) Plays key role in DNA synthesis, repair cell division and prevent neural tube defects during pregnancy (Obi et al, 2020).

4.0 Health Benefits

i. Immune Support: The high levels of vitamin c, flavonoids and minerals (iron, zinc, copper) in these neglected and underutilized crops enhances immune function necessary for fighting infections and promoting recovery.

ii. Digestive Health: The fibre content in these crops aid digestion and prevent gastrointestinal problems. In addition, tannins can act as antimicrobial protection for the gut.

iii. Cardiovascular Health: The Anti-oxidant properties (phenols, flavonoids ash, manganese) supports cardiovascular health by covering oxidative stores, lowering blood pressure, thereby improving blood vessel function.

iv. Anti-inflammatory and anticancer properties

The high levels of alkaloids, tannins, phenols and flavonoids indicate the crops anti-inflammatory, anti-cancer, anti-microbial and anti-malaria properties, contributing to overall disease prevention.

v. Iron and folate (Vit B_9) are critical for promoting healthy red blood cell production and efficient oxygen transportation in the body.

Conclusively, the phytochemical, proximate, vitamin and mineral contents of these neglected and underutilized food crops demonstrate their significant nutritional and medicinal properties. They provide wide range of health benefits. Integrating these crops into diets could support prevention and management of various health conditions. Their potential medicinal and nutritional benefits indicate their critical usefulness for improving overall public health and general wellness.

The study also supports further research to identify, isolate, purify and characterize more bioactive constituents from these and other neglected and underutilized indigenous food crop species (NUS) as a lead to preventive medicine and drug development. Continued neglect and under-consumption of these crops could perpetuate poor nutrition and ill-health currently observed in the general populace. Hence, there is urgent need to revive the cultivation and consumption of these crops, not only in the study area, but in all parts of Enugu State Nigeria.

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