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EVALUATION OF CHEMICAL COMPOSITIONS OF SIXTEEN CULTIVARS OF OKRA (*Abelmoschus esculentus* L. Moench) IN UNWANA

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Abstract
The field experiment was conducted at the research farm of Department of Horticulture and Landscape Technology, Akanu Ibiam Federal Polytechnic, Unwana during 2024 planting season with the aim of evaluating the nutritional composition of sixteen cultivars of okra collected from five States of Nigeria. The experiment was laid out in Randomized Complete Block Design with four blocks. Data were collected on freshly harvested fruit samples which were taken to laboratory for chemical analysis on mucilage, carbohydrate, protein, fiber, ash and moisture contents. The results of the analysis on the chemical contents showed that apart from crude protein every other chemical trait like carbohydrate, fiber, ash, moisture and mucilage revealed significant differences. Otukwuru omia had the highest mucilage contents of 296.6cp which differed significantly from other cultivars studied. The population means of the cultivars on percentage protein, carbohydrate, moisture, ash and fiber were 2.91, 4.26, 89.72, 0.90 and 2.07, respectively. Also, the population mean of the cultivars on mucilage content in centipoises was 214.57 with a range of 181.10. The cultivars showed minimum variability in percentage protein, moisture, ash and mucilage contents as shown in their coefficients of variation (C.V %) of 6.50%, 1.20%, 3.40% and 1.70%, respectively. There are more variabilities in percentage carbohydrate and fiber with C.V. % of 28.9% and 15.30%, respectively. However, in a breeding program for higher nutrient content and mucilage, cultivars from Ebonyi State is recommended.
Keywords: Cultivars, Mucilage, Okra and Nutrient Contents

Introduction

The crop okra originated from Africa (Sanjeet *et al.,* 2010) and also, an important crop in Central and Southern America. In Nigeria, okra is found in all the political zones (Schipper, 2000). There are two distinct species of okra, namely common okra (*Abelmoschus esculentus* L. Moench) and West African okra (*Abelmoschus caillei*) (Osawaru *et al.* 2014). Okra adapted to a wide variety of soil with good drainage and a soil pH of about 6.0 to 6.8 is optimum (Eke *et al.,* 2008). The crop fortified humans with nutrient like carbohydrates, vitamins and minerals. Minerals of special importance like sodium, magnesium and calcium were found to be the major elements in okra. Other minerals such as iron, zinc, manganese and nitrogen can equally be seen (Arapitsas, 2008). Okra have high content of carbohydrate, protein and other dietary elements and so enhance the importance of this in our diet (Arapitsas, 2008).

Fresh okra fruits are the most important vegetable source of viscous fiber and so many important in lowering cholesterol levels in our body (Kendall and Jenkins, 2004). He argued that okra as a nutritious vegetable that contain 86.1% water, 2.2% protein, 0.2% fat, 9.7g carbohydrate, 1.0% fiber and 0.8% ash can best be exploited at seven days after flowering. This is the time when we can have highest concentration of nutrients (Agbo *et al.,* 2008). Okra seed could be a better alternative rich source of protein, fat, fiber and sugar (Deters *et al.,* 2005). Fresh pods of okra contain low calories of about 20 per 100g.

Okra mucilage is an acidic polysaccharide that is made up of galacturonic acid, glucose and rhamnose in the ratio (1.3:0.1:1.0). The immature pods, barks, seeds, stems, leaves, flowers, roots and even the cell walls of

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the okra fruits contains a considerable amount of mucilage in them (Sengkhamparn *et al.,* 2009). According to Ndjouenkeu *et al.* (1996), mucilage in okra contains significant levels of nutrient and minerals like protein, carbohydrate, neutral sugar, minerals and as well other complex polysaccharides that enrich our diet. Mucilage that is seen in okra can be used as a replacement for plasma (Siemonsima and Koume, 2004) and responsible for washing away toxic substances and bad cholesterol which loads the liver.

Okra is cultivated and consumed widely among the rural dwellers in South eastern Nigeria where the fruits serves as food in our daily diet. It offers numerous nutritional benefits to human (Oppong-sekyere *et al.,* 2011). This crop is cultivated without looking at the nutritional values. Research efforts are therefore required to recommend cultivars of okra that have good nutritional value.

Material and Methods

Experimental Site: The experiment was conducted at the teaching and research farm of the Department of Horticulture and Landscape Technology, Akanu Ibiam Federal Polytechnic, Unwana, Ebonyi State during 2024 cropping season. Unwana is located on Latitude $06^0 05'$N and Longitude $08^0 03'$E with an elevation of 300m above sea level (NIMET, 2014). The study area is located in a humid tropical climate with annual rainfall greater than 2,500mm and temperature ranging from 32^0C – 38^0C (Njoku *et al.,* 2006).

Collection of Okra Cultivars: Sixteen cultivars of okra (*Abelmoschus* spp) were collected from five States in Nigeria (Anambra, Cross-River, Ebonyi, Enugu and Oyo States). After the collection, the cultivars were first characterized according to local names, sources/market, town, Local Government Area (L.G.A), and State (Table 1)

Table 1. Description of 16 okra germplasm collections by local names, source/market, town, L.G.A and States

S/N	Local Names	Source/Market	Town	Local Government Area	States
1	Ajouwaero	Eke	Ishiagu	Ivo	Ebonyi
2	Anom Ivam	Utanga	Obanliku	Obanliku	Cross-River
3	Awgu Early	Federal Ministry of Agriculture	Enugu	Enugu North	Enugu
4	Idu	Nkwo	Adani	Uzouwani	Enugu
5	Ifutu	Eke	Ishiagu	Ivo	Ebonyi
6	Meyaa	Orie	Ifite ogwari	Ayamelum	Anambra
7	Nnta	Kpirikpiri	Abakaliki	Ebonyi	Ebonyi
8	Okwuru Ojiri	Eke	Ishiagu	Ivo	Ebonyi
9	Ologoji ojo	Ojaegbe	Iseyin	Iseyin	Oyo
10	Opele	Eke	Ugwuoba	Oji-River	Enugu
11	Otukwuru Omia	Nwofe	Nwofe	Ebonyi	Ebonyi
12	Pusa Swani	Ogbete	Enugu	Enugu North	Enugu
13	Torfam	Utanga	Obanliku	Obanliku	Cross-River
14	Udu	Okwo	Ngbo	Ohaukwu	Ebonyi
15	Yorlis	Afor	Omasi-Agu	Ayamelum	Anambra
16	Yoroba	Nkwo	Omor	Ayamelum	Anambra

Source: Germplasm Collections (2024)

Field Experiment: The research field was measured 41.5m long and 13m wide (0.0540ha). The marked area of land was cleared. Soil samples was collected at random from twelve representative locations of the experimental site with soil auger at a depth of 20cm and samples bulked into d composite sample from which sub samples were taken for laboratory analysis for physic chemical properties of the soil. The experiment was laid out in a randomized Complete Block Design (RCBD). Each treatment was replicated four times and the treatment was compose of sixteen cultivars of okra. The research field was divided into four equal blocks and each block contains of sixteen plots, giving a total of sixty four plots. Okra seeds were extracted from healthy pods collected from five states of Nigeria. The 16 okra cultivars were sown in twenty four rows per plot at spacing of 0.6m x 0.45m. NPK 15-15-15 fertilizer were applied at the rate of 250kg/ha as a blanket treatment. It was applied at four week after planting. Weeds were controlled manually using hoe about three times to minimize the effect of weed on the plant. Zap insecticide was used to control insects and pest attack at fourteen days interval from seed emergence until the plant is eight weeks old. Harvesting of okra commenced when the tip of the fruit/peduncle can easily be broken using a snap of hand or knife.

Laboratory Analysis: The chemical analysis of the 16 cultivars of okra for percentage carbohydrate, protein, dietary fiber, ash moisture and mucilage contents were determined at the laboratory unit of National Root Crop Research Institute, Umudike, Abia State. The 16 cultivars of okra fruits were harvested and the desirable parts washed with water. 3.5g of the okra fruits were thoroughly sliced and chopped. 900ml of distilled water was added to the mixture and then filtered using a muslin cloth to extract the mucilage. This filtrate was centrifuged at 6000rpm for 15 mins. Three volumes of acetone was added to the resulting clear greenish viscous solution to precipitate the mucilage. Determination of mucilage content from the extracted mucilage was analyzed using viscometer as outlined by Ahiakpa *et al.* (2014). Carbohydrate determination on the fruit was by the method described by AOAC (2005). Crude protein determination on the fruit by micro kjedahl method as described by Pearson (1976). Dietary fiber, moisture contents on the fruit was determined by using soxhlets extractor as described by AOAC (1995).

Data Analysis: Data collected on chemical constituents were subjected to analysis of variance (ANOVA) for Completely Randomized Design (CRD) using Genstat software (GENSTAT, 2018). The chemical constituents, carbohydrate, crude protein, dietary fiber, ash moisture and mucilage contents means were compared using Fishers Least Significant Difference (F-LSD) as outlined by Obi (2012).

Results

The result of the chemical and physical properties of the experimental plots is presented in Table 2. It showed that the surface soil was slightly acid with pH value of 5.80, low in organic carbon, nitrogen, phosphorus and exchangeable bases which could be as a resulted in the loss of basic cation from the soil.

Table 2. Pre-planting Soil physic Chemical properties of the Experimental Site

Soil properties	Values
pH	5.80
Total N (mg/kg)	1.50
Available P (mg/kg)	7.80
Organic carbon (g/kg)	14.30
Organic matter (g/kg)	24.90
Ca^{2+} (Cmol/kg)	3.00
Mg^{2+}(Cmol/kg)	1.00
Na^{+}(Cmol/kg)	0.02
K^{+}(Cmol/kg)	0.32

ECEC (Cmol/kg)	7.16
Exchangeable	2.82
BS (%)	60.11
Sand (g/kg)	380
Silt (g/kg)	140
Clay (g/kg)	480

Carbohydrate Content (%)

Seven cultivars, Pusa swani, Yoroba, Idu, Otukwuru omia, Ajouwaero, Ifutu and Meyaa had statistically the same percentage carbohydrate contents, which ranged from 2.25% to 3.92% and differed significantly (P=0.05) from Yorlis, Awgu early, Okwuru ojiri, Nnta, Opele, Ologoji ojo, Udu Anam Ivam and Torfam which ranged from 4.37% to 6.05%. The population mean percentage carbohydrate was 4.26% whereas, the range and C.V% were 3.80% and 28.90%, respectively (Table 3).

Crude Protein Content (%)

The results of the analysis of variance (ANOVA) showed that the 16 cultivars of okra had the same protein content. However, Otukwuru omia and Meyaa recorded highest and lowest protein content of 3.14% and 2.60%, respectively (Table 3). The population mean percentage protein content of the 16 cultivars of okra were 2.91% with a range of 0.50% and coefficient of variation of 6.50%.

Dietary Fiber Content (%)

The cultivar Nnta, Yoroba and Idu had statistically the same mean percentage dietary fiber of 2.55%, 2.73% and 2.87%, respectively. Similarly, the cultivars, Torfam, Udu, Opele, Anom Ivam, Otukwuru omia and Pusa swani had statistically the same % mean dietary fiber ranging from 1.40% to 1.98%. Also, cultivars Awgu early, Ifutu, Okwuru ojiri, Ologoji ojo, Meyaa, Ajouwaero and Yorlis had statistically the same % dietary fiber ranging from 2.05% to 2.13%. the population mean % fiber content was 2.07% and range and C.V% of 1.49% and 15.30%, respectively (Table 3).

Ash Content (%)

The cultivar Ajouwaero had the least % ash content of 0.79% which was statistically the same with ash content of Yoroba and Awgu early cultivars with % ash content of 0.81% each. The cultivars Okwuru ojiri, Pusa swani and Otukwuru omia had the highest % ash content of 1%, 1.02% aand 1.07%, respectively. The range of % ash content was 0.79% (Ajouwaero) to 1.07% (Otukwuru omia). The population mean was 0.90% and the range and C.V% were 0.26% and 3.40%, respectively (Table 3)

Moisture Content (%)

The 16 cultivars of okra belonging to two groups of % moisture content. The cultivars, Ologoji ojiri, Nnta, Torfam, Yorlis, Opele, Anom ivam, Okwuru ojiri, Idu, Udu and Awgu early had % moisture range from 88.50% to 89.76%. on the other hand, the cultivars, Meyaa, Ifutu, Otukwuru omia, Yoroba, Ajouwaero and Pusa swani belong to another group with % moisture content ranging from 90.22% to 91.92%. The population mean is 89.72% with a range and C.V% of 3.43% and 1.20%, respectively (Table 3).

Mucilage Content in Centipoise (cp)

The cultivars, Otukwuru omia and Okwuru ojiri, had the highest mean mucilage content of 296.6cp and 277.55cp, respectively, which were statistical equal. The cultivars, Opele, Anomivan, Torfam, Udu, Nnta, Idu and Ajouwaero, had mean mucilage content which ranged from 203.4cp to 265.35cp. On the other hand, the cultivars, Ifutu, Awgu early, Ologoji ojo, Pusa swani, Yorlis and Meyaa could be described as low mucilage content of okra, ranging from 114.50cp to 197.90cp. The population mean mucilage was 214.57cp and with range and C.V% of 163.05% and 1.70%, respectively (Table 3).

Table 3. Proximate Analysis of 16 Cultivars of Okra for carbohydrate, Crude Protein, Dietary Fiber, Ash, Moisture and Mucilage Contents in Centipoise

Cultivars	CHO (%)	CP (%)	DF (%)	A (%)	M (%)	M (cp)
Ajouwaero	3.33	2.99	2.11	0.79	90.77	265.35
Anom Ivam	5.38	2.69	1.92	0.87	88.93	207.50
Awgu Early	4.56	2.82	2.03	0.81	89.11	151.20
Idu	2.83	3.05	2.87	0.90	89.60	259.90
Ifutu	3.76	2.83	2.05	0.94	90.41	114.50
Meyaa	3.92	2.60	2.10	0.94	90.22	197.90
Nnta	5.18	2.78	2.55	0.82	88.70	252.00
Okwuru Ojiri	4.81	3.02	2.05	1.00	89.13	277.55
Ologoji Ojo	5.45	3.01	2.06	0.97	88.50	173.55
Opele	5.24	3.03	1.82	0.97	88.92	203.40
Otukwuru Omia	3.00	3.14	1.96	1.07	90.56	296.60
Pusa Swani	2.23	2.83	1.98	1.02	91.92	182.10
Torfam	6.05	2.98	1.40	0.82	88.77	230.90
Udu	5.00	3.10	1.43	0.87	89.70	288.20
Yorlis	4.37	2.88	2.13	0.89	88.92	190.75
Yoroba	2.71	2.94	2.75	0.81	90.76	191.80
Mean	4.26	2.91	2.07	0.90	89.72	214.57
$LSD_{0.05}$	2.045	N.S	0.527	0.025	1.795	6.245
Range	3.80	0.50	1.47	0.28	3.43	181.10
C.V (%)	28.90	6.50	15.30	3.40	1.20	1.70

CHO (%) = Percentage Carbohydrate, CP (%) = Percentage Crude Protein, DF (%) = Percentage Dietary Fiber, A (%) = Percentage Ash, M (%) = Percentage Moisture and M (cp) = Mucilage in Centipoise, N.S = Non Significant at the preliminary F-test, cp = Centipoise; 1p = $0.1kg.m^{-1}.S^{-1}$ = $1gm.Cm^{-1}.S^{-1}$

Discussion

The results of chemical and physical properties of the experimental plots showed that the surface soils were slightly acidic with pH values of 5.80. This is in line with the report of Azu et al. (2017) who reported high acidity in most soils of Ebonyi State. Mucilage contents of 16 cultivars of okra were observed be significant (P=0.05) from the F-test. Otukwuru omia produced the highest mucilage content of 296.60cp, while Ifutu had the least Mucilage content of 114.5cp. This shows that those cultivars that have significant values would be used to provide slimming ability of okra fruit. The higher the mucilage content of okra fruit, the higher the slimming ability. This work in agreement with the earlier report of Woolfe *et al.* (1977) who carried out a research on okra and reported that higher concentration of mucilage will lead to higher viscosity. Thantcha and Prance (2011) that worked on divergence in the mucilage content reported significant difference among the various accessions studied. National Academic Press (2006) revealed that cultivars belonging to West African taxon callei are significantly higher in mucilage content.

The nutritional constituents of okra seen to vary in crude protein, carbohydrate, dietary fiber, ash, moisture and mucilage contents. The non-significant nature of okra fruit in terms of crude protein composition may be because of the seed constituent protein that is embedded in all the cultivars under study. The nutritional constituents of okra in this study have the following overall (grand) means as summarized in Table 3; crude protein (2.91%), carbohydrate (4.26%, moisture (89.92%), ash (0.90%), fiber (2.07%) and mucilage (214.57cp). The findings of this study are in support of the work by Osawaru *et al.* (2014), Saifullah and Rabbani (2009),

who reported that okra is a nutritious vegetable containing 86.1% water, 2.2% protein, 0.2% fat, 9.7% carbohydrate, 1% fiber and 0.8% ash.

Conclusion

We conclude that cultivars of okra varied in the chemical constituents. Qualitatively, Otukwuru omia can be chosen in terms of its protein and ash. Torfam can be chosen for its carbohydrate. Pusa swani for its moisture. Idu for its fiber and finally Otukwuru omia and Okwuru ojiri for its mucilage contents.

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