



Evaluation of Finger Millet (*Eleusine coracana* (L.) Gaertn) Genotypes for Nutritional Qualities and Yield in Taraba State, Nigeria

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ABSTRACT

Finger millet (*Eleusine coracana* (L.) Gaertn) is an important minor cereal crop with very high nutritional and medicine values, attributed to its high polyphenol, dietary fiber, minerals and essential amino acids. Despite the importance of finger millet, the crop has received less attention in Nigeria. Among associated problems are blast disease causing 10 - 80 % yield loss and low yield of 200 - 400 kg/ha as against potential yield of over 2000 kg/ha. Trials were conducted on 22 germplasm (U 15, P224, ACC 32, ACC14, KNE814, IE 3779, KNE 628, KNE 688, KNE 1149, Etiyo Brown, Gulu E, Kala, RW 127(IE 6613), KNE 392, GBK 029681, ACC 3953, GBK 011136A, KNE 689, KNE 1034, Emiroit, Red local check and Black local check) from ICRISAT and farmers in 3 replicates at Wukari and Takum in 2019, to assess for agronomic/yield parameters and for their nutritional qualities. The results revealed that KNE814, IE 3779, KNE 628, KNE 688, KNE 1149, Gulu E., KNE 392, GBK 029681, ACC 3953, GBK 011136A, KNE 689, KNE 1034, Emiroit and Red (local check) varieties, produced more OTSW (3.80 - 5.03 g) and subsequently highest yield (1565 - 1887 kg/ha), compared to black local variety with the lowest OTSW (3.17 - 3.28 g) and lowest yield (688 - 989 kg/ha), respectively in Wukari and Takum locations. Proximate composition revealed that U15, P224, ACC32, KNE814, ACC 14, IE 3779, KNE 688, KNE 1149, GBK 029681, Kala, Gulu E, KNE392, ACC 3953, GBK 011136A, KNE1034, Emiroit and Red local exhibited high concentration of crude fibre (CF) 365 - 5.08), crude protein (CP) 7.38 - 7.83 %, Ca (345 - 369 mg), Fe (3.60 - 3.90 mg), crude fat (1.60 g - 2.90 g) and ash (2.72 g - 2.90 g) while the least was black local with (3.22 - 3.33 % CF), CA (307 - 317 mg), crude fat (1.13 - 1.18 g) and ash (2.47 - 2.53 g). Therefore, these varieties with good agronomic/yield parameters, good straw weight and nutrient composition could serve as sources of germplasm for genetic improvement and as an alternative source of animal feed.

1.0 INTRODUCTION

Finger millet (*Eleusine coracana* L. Gaertn) is one of the minor cereals known with several health benefits which are attributed to its high level of polyphenol, dietary fibre, minerals and essential amino acids. Epidemiological studies have demonstrated that regular consumption of whole grain and their products can protect against the risk of cardiovascular diseases, type II diabetes, obesity, gastrointestinal cancers, anti-tumorigenic, atherosclerogenic effects, antioxidant and microbial properties and a range of other disorders (Shinggu *et al.*, 2016). The crop contains nutritionally important starch fractions which are slowly digested and absorbed and are favourable in the diet pattern for metabolic disorders such as diabetes, hypertension, and obesity. (Shinggu *et al.*, 2016) reported that finger millet has been found to have high levels of methionine, tryptophan, vitamin B, fibres and minerals such as phosphorus, iron with its calcium level 40 times more than that found in maize (*Zea mays* (L.)) and rice (*Oryza sativa* (L.)), 10 times more than that found in wheat (*Triticum aestivum* (L.)), this makes the crop a good source of balanced diet formulations for diabetic patients, pregnant women, nursing mothers and children. It is also recognized as an important dietary supplement for HIV positive people and help in sustaining malnourished people (Shinggu *et al.*, 2016). The high level of iron and calcium content of finger millet has been found to be relevant to populations inhabiting northern Nigeria where the incidence of iron deficiency causes anemia particularly in pregnant women (Shinggu *et al.*, 2016) and calcium deficiency causes rickets in young children (Shinggu *et al.*, 2016). The ability of the crop to grow in water-deficit regions, the long storability of the seed for consumption and planting estimated to be at least ten years, the resistance of the grain against mould and insects make it a viable emergency food as it fits well in farmers' risk avoidance strategies in drought-prone areas (Shinggu *et al.*, 2016). Among the tropical cereals, finger millet provides the best quality malt for local brewing and is more preferred than maize or sorghum. Finger millet straw is also a valuable livestock feed. It makes good fodder and contains up to 61% of total digestible nutrients better than pearl millet (*Pennisetum americana*), wheat (*Triticum aestivum* (L.)) or sorghum (*Sorghum bicolor* (L) Moench). (Anon. 1996; Upadhyaya *et al.* 2006). The by-product from brewery has been reported to be a good source of fiber, mineral and protein used especially in household poultry feeding and suitable for breeding stock. (Obilana and Manyasa, 2002). The head (panicle) consists of a group of digitally arranged spikes hence the name finger millet (Fig. 1). The spikelets are made up of 4 – 10 florets arranged serially on the finger. All florets are perfect flowers with the exception of the terminal ones which may sometimes be infertile.



Fig. 1: Finger millet plants showing the finger-like heads

In spite of the significant medicinal, nutritional and industrial potential of finger millet, the crop has received little attention in terms of research and development. It has been reported as largely neglected by national and international research organizations and major donors to Agricultural research particularly in sub-Saharan Africa compared to the researches and grants lavished on other cereals in this region (Anon.1996; Mitaru *et al.*,1993; Mgonja, 2005). In Nigeria, finger millet is mostly grown in two states of Kaduna and Plateau in the northern parts of the country and remained unknown and unstudied in the country and threatened by extinction. Considering the nutritional and medicinal importance of finger millet, there is need to introduce the crop to Taraba State for possible consumption and utilization by the local farmers to boost food security in the state.

2.0 METHODOLOGY

2.1 Experiment Sites

The experiments was a one year field experiment conducted in 2018/2019 at two locations namely: Teaching and Research Farm, Federal University Wukari (FUW) in Southern Guinea Savanna (SGS) (Latitude 7^o51'N and 7.85^oN, and longitude 9^o47'E and 9.78^oE) (Tunwari, 2016). It has an elevation of 189 m above sea level, mean annual rainfall of 750-1205 mm and the mean annual temperature of 28 °C (Tunwari, 2016). The second location was at Taraba ADP Zonal Office Takum LGA, at Takum Taraba State in the Derived Savanna (DS) agro-ecological Zone (Latitude 07^o26'N and Longitude 10^o 04'E) with topography of 253 m above sea level. It has an annual average rainfall of 800-1600 mm and annual average temperature of 27 to 29 °C with vegetation similar to that of Derived Savanna (D.S.). Rains Commence as from April/ March and

terminates in October/Mid -November for SGS and DS respectively, while the dry season begins from November to March in both locations (Tunwari, 2016).

2.2 Field Layout and Experimental Design

The field experiment in FUW Wukari (Latitude 07°77'N - 07°82'N and Longitude 09°83'E - 09° 87'E) and Takum (Latitude 07°26'N and Longitude 10° 04'E) were laid out using Randomized Complete Block Design (RCBD) with 20 genotypes from ICRISAT Kenya and 2 local varieties sourced from LCRI and ADPs Plateau/Kaduna totaling up to 22 treatments. These treatments (U 15, P224, ACC 32, ACC14, KNE814, IE 3779, KNE 628, KNE 688, KNE 1149, Etiyo Brown, Gulu E, Kala, RW 127(IE 6613), KNE 392, GBK 029681, ACC 3953, GBK 011136A, KNE 689, KNE 1034, Emiroit, Red local check and Black local check) were used for the two experiments in the two locations and replicated 3 times. Gross plot size was 5 m x 4 m (20m²) and net plot size will be 4m x 3m (12m²) with inter-and intra-row spacing of 75 cm and 20 cm respectively. A total of 120 plots were laid out on the field. About six seeds were sown in each planting hole and at two weeks after sowing, the emerging seedlings thinned to two plants per stand. Pre-emergence herbicide was applied at one day after sowing; supplementary weeding was done at 6 and 9 weeks after sowing. Insecticide application on stem borers and other insects was carried out accordingly. Inorganic fertilizer was applied at the rate of 90 kg N, 60 kg P₂O₅; 60 kg K₂O.

2.3 Data Collection

2.3.1 Agronomic traits: Data were also recorded for agronomic traits, such as days to flowering (DF) (time of full panicle emergence in 50% of the plants in a row) and plant height (measured from the base of the plant to the tip of the panicle at maturity)

2.3.2 Straw weight per 5 plants. Straw weight per 5 plants was determined by weighing 5 randomly selected plants from net plot in g.

2.3.3 Thousand kernel weight (OTSW in g): kernel weight was determined by taking random sample of 1000 kernel weighing per each plot.

2.3.4 Grain Yield (tons ha⁻¹): measured as grain mass was taken from the 40 plants, post harvested and converted to tons ha⁻¹ using the formula:

$$\text{Grain yield (tons ha}^{-1}\text{)} = \frac{333.333 \times \text{yield of the 40 plants (kg)}}{40 \times 1000}$$

2.3.5 Proximate analysis of finger millet (Eleusine. coracana)

Stones, pebbles and stalks were hand picked, and chaff were blown off from the finger millet before being taken to the laboratory for analysis.

2.3.5.1 Determination of finger millet proximate composition

Samples of red and black varieties of finger millet were taken for proximate composition at the Soil Laboratory of the Department of Soil Science and Land Resources Management, Federal University Wukari, Taraba State, Nigeria. The analysis was carried out according to AOAC, (2006).

2.3.5.2 Determination of nitrogen and crude protein

In the micro Kjeldhal method, about 0.5 g part of the sample was weighed and transferred into a Kjeldahl flask. Using a measuring cylinder, about 5 mL concentrated sulphuric acid and one tablet of Kjeldahl catalyst were added to the flask. The flask in an inclined position was gently heated in a fume cupboard, using a heating mantle. When the initial vigorous reaction had died down, the heat was increased and digestion was continued until the liquid was clear and free from black or brown colour. The flask was allowed to cool and the mixture transferred to a 100 mL volumetric flask, diluted with distilled water to the mark. About 10 mL of the sample aliquot and 15 mL of 40 % Sodium Hydroxide solution was transferred into the distillation apparatus consisting of the flask (500 mL capacity), stopper carrying a dropping funnel and a splash head adaptor: a vertical condenser. Ten milliliters (10 mL) of 2% Boric Acid solution was measured into a 250 mL conical flask, and a few drops of screened methyl red indicator were added to the flask and then placed on the receiver so that the end of the delivery tube was below the level of the boric acid. A few pieces of granulated zinc and some anti-dumping granules were added to the distillation flask. The apparatus was shaken gently to ensure mixing of the contents. The flask was boiled vigorously until about 25 mL distillate was obtained. The receiver was removed and titrated against a standard acid 0.025 M H₂SO₄ till a pink colour end point (TV) was reached. $N (\%) = (0.014 \times TV \times 100 \times 0.025) / (W \times 10) \times 100$ Where W is weight of sample taken. % protein = N x F Where F is a factor equal to 5.70 for flour, 6.38 for milk, 5.55 for gelatine and 6.25 for all other foods.

2.3.5.3 Determination of fat content

Filter paper free from fat was weighed (W1). About 1 g of the sample was added into the filter paper, carefully folded and tied to keep the sample intact, the new weight was noted (W2). A 500 mL round bottom flask was filled up to three-quarter with solvent (n-Hexane). The flask was fitted to Soxhlet extraction apparatus with a reflux condenser and placed on an electro-mantle heater. Extraction began as the solvent started refluxing several times. Extraction continued for about 6 hours after which the condenser was detached, the defatted sample removed, and dried to a constant weight in the oven at 105°C for 2 hrs. The difference between the weights of the defatted sample before and after drying

was recorded as the weight of fat (W3). Fat (%) = $(W2 - W1)/W3 \times 100$

2.3.5.4 Determination of crude fibre

About 5 g of the sample were weighed (W1) and defatted by ether extraction with Soxhlet apparatus and dried. The sample was transferred quantitatively by brushing in a 600 mL beaker of the fibre digestion apparatus while 200 mL of 1.25 % sulphuric acid was added. The beaker was placed on digestion apparatus with pre adjusted heater and boiled for exactly 30 minutes. The beaker was removed and the contents were filtered through California Buchner funnel. The beaker was rinsed with 75 mL of boiling water and washed through the funnel. The washing was repeated 3 times with 50 mL portion of water and then sucked dry. The residue was returned to the beaker by blowing back through the funnel; and 200 mL of boiling deionized water and 1.25 % Sodium Hydroxide was added to the beaker and boiled for 30 minutes and the beaker was removed and filtered. The residue was then washed with 25 ml of boiling 1.25 Sulphuric acid, followed by three 50 mL portion of water and 25 ml of alcohol, respectively. The fibre mat and the residue were then dried at 130 ± 2 oC for 2 hours. It's then cooled in a desiccator and was weighed (W2). It was ignited at 600 oC ± 15 for 30 minutes. The dishes were removed and cooled in a desiccator and weighed (W3). The Crude Fibre was calculated as follows: (%) Crude fibre = $(W2 - W3) / (W1) \times 100$ Where: W1 = weight of sample W2 = weight of crucible + sample after drying W3=weight of crucible + sample after ashing

2.3.5.5 Determination of ash content

Crucible was pre-heated in the oven for 30mins at 105°C , cooled in the desiccator for about 1hr and weighed (W1). One gram of the sample was added into crucible, given a new weight (W2) It was then placed in the muffle furnace to ash at 55°C for 3 hours until the content became whitish in colour with no black particles, it was removed and cooled in the desiccator, the weight was noted (W3). % Ash = $(W2 - W3) / (W2 - W1)$ Where W1 = weight of crucible W2 = weight of crucible + sample before ashing W3 = weight of crucible + sample after ashing

2.3.5.6 Determination of mineral concentrations. Mineral concentrations were determined by atomic absorption spectrometer (Perkin-Elmer 560), in anacetylene-air flame at the following wavelengths: 285 nm (Ca), 248 nm (Fe) and 214 (Zn).

2.4 Data Analysis

Data collected from field experiments were subjected to analysis of variance (ANOVA) for RCBD using the generalized linear model (GLM) procedure of SAS Version 9.1 (SAS, 2005). Treatment means separation was carried out with the Duncan's Multiple Range test (DMRT) according to Gomez and Gomez

(1984) at 5 % level of significance. The magnitude and type of relationship between the various parameters (emergence count, plant height, leaf area, number of tillers, days to 50% heading, days to physiological maturity, days to full maturity, productive and unproductive tillers, panicle weight per plant, number of fingers per plant, panicle length per plant, 1000 grain yield, grain yield, straw yield, harvest index, incidence and severity) were determined by simple correlation analysis (Little and Hills, 1978).

3.0 RESULTS AND DISCUSSION

3.1 Means of Agronomic Traits (Plant Height, Days to 50 % flowering and Straw Weight) on 22 Finger Millet Varieties at Wukari and Takum, Taraba State in 2019

Plant height (cm), days to 50 % flowering and straw weight (g) results from the two locations are reported on Table 1. Maximum height (81 - 84 cm) for the trial was recorded on Kala and KNE392 varieties, followed by KNE 1149, KNE 628, ACC 32 (76 - 79 cm) and minimum plant heights (56 - 59 cm) were recorded on Red local and Black local in both Wukari and Takum locations. Results in Table 1 further indicates that Red local is late maturing (80 - 84 days), compared to all other genotypes which are medium maturing with 60 - 79 days to 50 % flowering. Similarly, U15, P224, ACC14, KNE814, IE3779, KNE1149 GULU E and GBK029681 significantly produced more straw weight (345 - 370 g), while the lowest straw weight (308 - 329) was obtained in KNE689 and Emiroit finger millet varieties.

3.2 Means of Yield related Traits on 22 Finger Millet Varieties at Wukari and Takum, Taraba State in 2019

As seen in Tables 2, Kala, KNE814, KNE 689, KNE 1149, Etiyo Brown, KNE 1034, Emiroit and Red (local check) varieties significantly maintained the highest OTSW (3.80 - 5.03 g) and subsequently highest yield (1565 - 1887 kg/ha), compared to Black local, U15, KNE628 and Gulu E of 688 - 989 kg ha^{-1} in both locations. Finger millet is a crop with high tillering ability and this has been found to have a positive effect on crop biomass and yield (Shinggu *et al.*, 2009). Wheat, a crop with similarly high tillering ability, compensated for low population densities by increased production and survival of tillers (Shinggu *et al.*, 2016). The variations in the growth and yield parameters could be due to differences in the reactions of the different genotypes to pathogens (Tunwari *et al.*, 2013) and environmental factors such as soil/edaphic factors, rainfall and build-up of inoculum from previous residues left in the field (Tunwari *et al.*, 2013).

Table 1: Means of the Agronomic Traits taken on the 22 Test Varieties in 2019 at Wukari and Takum, Taraba State

S/N	Accessions	Plant Height (cm)		Days to 50% Flowering		Straw weight per 5 plants (g)	
		Wukari	Takum	Wukari	Takum	Wukari	Takum
1.	U 15	65.67 ^g	78.00 ^{de}	68.00 ^e	69.00 ^{ef}	345.27 ^c	348.20 ^{de}
2.	P 224	69.00 ^f	68.00 ^e	68.00 ^e	70.33 ^{de}	352.86 ^c	352.20 ^d
3.	ACC 32	76.33 ^{cd}	79.00 ^{cde}	71.33 ^d	72.33 ^d	332.37 ^{fg}	348.53 ^{de}
4.	ACC 14	77.00 ^e	77.00 ^e	68.00 ^e	76.00 ^c	352.20 ^b	356.53 ^c
5.	KNE 814	76.33 ^{cd}	78.67 ^{de}	72.00 ^{cd}	76.33 ^c	367.77 ^a	370.20 ^a
6.	I E 3779	76.56 ^{cd}	77.17 ^e	67.33 ^{ef}	68.27 ^{efg}	346.43 ^c	350.20 ^{de}
7.	KNE 628	77.33 ^c	78.83 ^{de}	78.00 ^b	80.00 ^b	366.00 ^{de}	339.03 ^{fg}
8.	KNE 688	75.00 ^d	76.00 ^d	74.00 ^c	76.00 ^c	335.20 ^{ef}	339.87 ^{fg}
9.	KNE 1149	79.50 ^b	80.33 ^{bcd}	68.00 ^e	68.70 ^{efg}	365.20 ^a	363.87 ^b
10.	Etiyo Brown	72.50 ^e	77.00 ^e	65.00 ^{fg}	66.40 ^{Sgh}	327.53 ^h	336.87 ^g
11.	Gulu E	76.57 ^{cd}	79.60 ^{cde}	63.17 ^{gh}	63.77 ^{ij}	341.53 ^c	348.20 ^{de}
12.	Kala	81.23 ^{ab}	83.67 ^{ab}	65.00 ^{fg}	65.17 ^{hi}	329.87 ^{gh}	336.20 ^g
13.	RW127	72.63 ^e	82.17 ^{abc}	67.13 ^{ef}	67.50 ^{fg}	335.67 ^{de}	345.67 ^e
14.	KNE 392	82.30 ^a	83.17 ^{ab}	66.50 ^{fg}	62.50 ⁱ	328.00 ^{gh}	329.93 ^h
15.	GBK 029681	71.50 ^e	73.70 ^{fg}	61.50 ^g	68.70 ^{efg}	355.00 ^b	349.70 ^{de}
16.	ACC 3953	59.57 ^h	65.27 ⁱ	60.85 ^g	62.00 ⁱ	326.33 ^h	336.87 ^g
17.	GBK 011136A	72.33 ^e	76.63 ^{ef}	67.33 ^{ef}	68.33 ^{efg}	339.53 ^{cd}	342.53 ^f
18.	KNE 689	68.23 ^f	72.17 ^{gh}	65.50 ^{ef}	67.17 ^{fgh}	308.20 ^j	318.20 ⁱ
19.	KNE1034	67.53 ^f	70.07 ^h	63.00 ^{gh}	63.77 ^{ij}	328.20 ^h	336.20 ^g
20.	Emiroit	67.27 ^{fg}	69.53 ^h	66.50 ^{ef}	66.93 ^{fgh}	312.20 ⁱ	329.53 ^h
21.	Red local)	56.60 ⁱ	58.77 ^j	82.93 ^a	83.83 ^a	346.20 ^c	346.87 ^e
22.	Black(local)	58.93 ^h	61.13 ^j	63.03 ^{gh}	63.67 ^{ij}	337.53 ^{de}	339.20 ^{tg}
	Mean	71.81	74.81	67.82	66.55	340.20	343.81
	SE	0.51	0.52	0.93	0.70	1.74	2.46

Means in a column follow by the same letter shows that there is no significance difference at P= 5% but when follow by different letters, there is significance difference.

Table 2: Means of OTSW and Grain Yield in kg/ha taken on the 22 Test Varieties in 2019 at Wukari and Takum, Taraba State

S/N	Accessions	One Thousand Seed Weight (OTSW) (g)		Grain Yield in kg/ha	
		Wukari	Takum	Wukari	Takum
1.	U 15	3.57 ^{cd}	3.64 ^{bcdef}	768.50 ^{fg}	773.50 ^{fg}
2.	P 224	4.28 ^b	5.03 ^a	1410.67 ^{abcd} ef	1415.70 ^{ab} cdef
3.	ACC 32	3.43 ^{cd}	3.48 ^{bcdefg}	1323.50 ^{abcd} efg	1328.58 ^{ab} cdefg
4.	ACC 14	3.60 ^{cd}	3.65 ^{bcdef}	1420.33 ^{abcd} ef	1425.40 ^{cd} efg
5.	KNE 814	3.17 ^{ef}	3.42 ^{cdefg}	1048.00 ^{cdef} g	1053.20 ^{cd} efg
6.	I E 3779	3.70 ^{cd}	3.75 ^{bcde}	1565.00 ^{abcd} e	1570.20 ^{ab} cde
7.	KNE 628	3.15 ^{ef}	3.23 ^{fg}	951.67 ^{efg}	956.80 ^{efg}
8.	KNE 688	3.73 ^{cd}	3.77 ^{bcde}	1567.17 ^{abcd} e	1572.30 ^{ab} cde
9.	KNE 1149	3.49 ^{cd}	3.60 ^{bcdefg}	1838.17 ^{ab}	1843.00 ^{ab}
10.	Etiyo Brown	3.75 ^{cd}	3.80 ^{bcd}	1697.83 ^{abc}	1702.90 ^{ab} c
11.	Gulu E	3.03 ^f	3.12 ^g	688.50 ^g	693.58 ^g
12.	Kala	3.87 ^{bc}	3.97 ^{bc}	1882.83 ^a	1887.90 ^a
13.	RW127	3.38 ^{cd}	3.45 ^{bcdefg}	1177.37 ^{bcde} fg	1182.45 ^{bc} defg
14.	KNE 392	3.65 ^{cd}	3.72 ^{bcdef}	1540.77 ^{abcd} e	1545.90 ^{ab} cde
15.	GBK 029681	3.28 ^d	3.35 ^{defg}	1127.75 ^{cdef} g	1132.80 ^{cd} efg
16.	ACC 3953	3.70 ^{cd}	3.75 ^{bcde}	1554.66 ^{abcd} e	1559.87 ^{ab} cde
17.	GBK 011136A	3.62 ^{cd}	3.64 ^{bcdef}	1442.70 ^{abcd} e	1447.90 ^{ab} cde
18.	KNE 689	3.80 ^c	3.85 ^{bcd}	1665.97 ^{abc}	1670.80 ^{ab} c
19.	KNE1034	3.87 ^{bc}	3.88 ^{bc}	1642.97 ^{abcd}	1647.50 ^{ab} cd
20.	Emiroit	3.85 ^{bc}	3.89 ^{bc}	1860.37 ^a	1865.50 ^a
21.	Red local)	4.76 ^a	4.86 ^a	1725.35 ^{abc}	1730.50 ^{ab} c
22.	Black(local)	3.17 ^{ef}	3.28 ^{efg}	983.30 ^{defg}	988.70 ^{defg}
	Mean	3.63	3.73	1403.79	1408.87
	SE	0.26	0.26	278.26	283.50

Means in a column follow by the same letter shows that there is no significance difference at P= 5% but when follow by different letters, there is significance difference.

3.3. Proximate composition of the 22 finger millet (*Eleusine coracana*) varieties at Wukari and Takum, Taraba State in 2019

The proximate composition results for the 22 finger millets are presented in Tables 3 and 4. The result of crude fibre (CF) showed that red local and P224 more CF (4.33 - 5.08), followed by KNE814, KNE 688, KNE 689, KNE 1149, Etiyo Brown, KNE 392, ACC 3953, KNE 1034, Emiroit, GBK 011136A, Kala, IE 3779, ACC 14 and U15 finger millet varieties with 3.65 - 3.93 % CF, while the least was black local (3.22 - 3.33 % CF) across the two localities (Table 3). Crude fibre is nutritionally important as it aids the absorption of trace elements in the gut and elimination of undigested waste through the bowel (Bot *et al.*, 2020). Viscosity promoting potential of CF has also been shown to reduce the overall digestive absorptive efficiency by preventing nutrients from being available at the absorptive sites in the intestinal mucosa (Bot *et al.*, 2020).

The result in Table 3 showed that U15, R127, KNE1149, KNE 392 and P224 finger millet varieties had more crude protein (CP) content of 7.60 - 7.83 % for Wukari and Takum. compared to the other finger millet varieties, which are statistically at par, with CP ranges of CP (7.37 - 7.55 %). The results also

showed slight variations in CP composition between Wukari and Takum locations. These differences in the composition could be due to geographical locations and soil type. The high CP of finger millet makes it a very nutritionally important ingredient for animal feed, since protein is very vital for normal functioning of the entire body system. Pugalenthi *et al.* (2004) reported that proteins are essential components of the diet needed for survival of animals and humans; their basic function in nutrition is to supply adequate amount of required amino acids. The proximate composition results in Table 3 further revealed KNE 814, KNE 1149, ACC 14 and Red local to have significantly higher Ca (345 - 369 mg), while the least CA (307 - 317 mg) was obtained from KNE 689. Furthermore, Fe content (3.60 - 3.90 mg) of U15, P224, ACC32, KNE814, IE 3779, KNE 688, KNE 1149, GBK 029681, Kala, KNE392, ACC 3953, GBK 011136A, KNE1034, Emiroit and Red local were significantly high in the two locations, but not statistically different from the other varieties (Table 4). Finger millet is a nutritious food grain crop with a fair amount of protein (7.3g 100 g⁻¹) (Saritha *et al.*, 2016), dietary fibre (15-20%), (Saritha *et al.*, 2016) and rich source of calcium (344 mg 100g⁻¹) (Saritha *et al.*, 2016).

Table 3: Mean Performance of 22 Finger Millet Genotypes for Grain Nutrient Content (Fibre, Protein and Ca) across two locations in 2019 at Wukari and Takum, Taraba State

S/N	Accessions	Fibre content (%)		Protein (mg/100g seeds)		Calcium Content (mg/100g seeds)	
		Wukari	Takum	Wukari	Takum	Wukari	Takum
1.	U 15	3.62 ^{cd}	3.69 ^{bcdef}	7.63 ^{ab}	7.83 ^a	344.17 ^c	347.00 ^{de}
2.	P 224	4.33 ^b	5.08 ^a	7.60 ^{bc}	7.67 ^{bcd}	351.76 ^c	351.00 ^d
3.	ACC 32	3.48 ^{cd}	3.53 ^{bcdefg}	7.45 ^{bcde}	7.51 ^{fghi}	331.17 ^{fg}	347.33 ^{de}
4.	ACC 14	3.65 ^{cd}	3.70 ^{bcdef}	7.42 ^{bcde}	7.47 ^{hi}	351.00 ^b	355.33 ^c
5.	KNE 814	3.22 ^{ef}	3.47 ^{cdefg}	7.63 ^{ab}	7.71 ^{abc}	366.67 ^a	369.00 ^a
6.	I E 3779	3.75 ^{cd}	3.80 ^{bcde}	7.63 ^{ab}	7.59 ^{cdefg}	345.33 ^c	349.00 ^{de}
7.	KNE 628	3.20 ^{ef}	3.28 ^{fg}	7.37 ^{ef}	7.41 ⁱ	366.00 ^{de}	337.83 ^{fg}
8.	KNE 688	3.78 ^{cd}	3.82 ^{bcde}	7.40 ^{cde}	7.49 ^{fghi}	334.00 ^{ef}	338.67 ^{fg}
9.	KNE 1149	3.54 ^{cd}	3.65 ^{bcdefg}	7.50 ^{bcde}	7.55 ^{defgh}	364.00 ^a	362.67 ^b
10.	Etiyo Brown	3.80 ^{cd}	3.85 ^{bcd}	7.48 ^{bcde}	7.55 ^{defgh}	326.33 ^{ch}	335.67 ^g
11.	Gulu E	3.08 ^f	3.17 ^g	7.57 ^{bcd}	7.57 ^{defgh}	340.33 ^c	347.00 ^{de}
12.	Kala	3.92 ^{bc}	4.02 ^{bc}	7.48 ^{bcde}	7.55 ^{defgh}	328.67 ^{gh}	335.00 ^g
13.	RW127	3.43 ^{cd}	3.50 ^{bcdefg}	7.82 ^a	7.71 ^{abc}	335.67 ^{de}	345.67 ^e
14.	KNE 392	3.70 ^{cd}	3.77 ^{bcdef}	7.63 ^{ab}	7.74 ^{ab}	328.00 ^{gh}	328.73 ^h
15.	GBK 029681	3.33 ^d	3.40 ^{defg}	7.44 ^{bcde}	7.53 ^{efghi}	355.00 ^b	348.50 ^{de}
16.	ACC 3953	3.75 ^{cd}	3.80 ^{bcde}	7.59 ^{bc}	7.62 ^{bcdef}	326.33 ^h	335.867 ^g
17.	GBK 011136A	3.67 ^{cd}	3.69 ^{bcdef}	7.33 ⁱ	7.27 ^j	338.33 ^{cd}	341.33 ⁱ
18.	KNE 689	3.85 ^c	3.90 ^{bcd}	7.45 ^{bcde}	7.49 ^{fghi}	307.00 ^j	317.00 ⁱ
19.	KNE1034	3.92 ^{bc}	3.93 ^{bc}	7.62 ^{ab}	7.65 ^{bcde}	327.00 ^h	335.00 ^g
20.	Emiroit	3.90 ^{bc}	3.94 ^{bc}	7.57 ^{bcd}	7.62 ^{bcdef}	311.00 ⁱ	328.33 ^h
21.	Red local)	4.81 ^a	4.91 ^a	7.54 ^{bcde}	7.45 ^{hi}	344.00 ^c	345.67 ^e
22.	Black(local)	3.22 ^{ef}	3.33 ^{efg}	7.40 ^{cde}	7.43 ^{hi}	336.33 ^{de}	338.00 ^{fg}
	Mean	3.68	3.78	7.53	7.56	339.00	342.71
	SE	0.27	0.28	0.0024	0.0024	1.62	2.34

Means in a column follow by the same letter shows that there is no significance difference at P= 5% but when follow by different letters, there is significance difference.

Table 4: Mean Performance of 22 Finger Millet Genotypes for Grain Nutrient Content (Fe, Fat and Ash across two locations in 2019 at Wukari and Takum, Taraba State

S/N	Accessions	Fe content (mg)		Fat Content (g)		Ash content(g)	
		Wukari	Takum	Wukari	Takum	Wukari	Takum
1.	U 15	3.87 ^a	3.94 ^a	1.33 ^d	1.38 ^{bcdef}	2.80 ^{abcd}	2.90 ^a
2.	P 224	3.63 ^{abcde}	3.70 ^{abcde}	1.52 ^b	1.52 ^{abcd}	2.58 ^{ghij}	2.70 ^{cde}
3.	ACC 32	3.60 ^{abcde}	3.67 ^{abcde}	1.62 ^a	1.70 ^a	2.47 ⁱ	2.53 ^f
4.	ACC 14	3.50 ^{cde}	3.57 ^{cde}	1.43 ^c	1.34 ^{bcdef}	2.56 ^{hij}	2.58 ^{ef}
5.	KNE 814	3.83 ^{ab}	3.90 ^{ab}	1.23 ^{ef}	1.46 ^{bcdef}	2.82 ^{abc}	2.88 ^{ab}
6.	I E 3779	3.73 ^{abcd}	3.80 ^{abcd}	1.15 ^g	1.27 ^{def}	2.67 ^{efgh}	2.75 ^{abcde}
7.	KNE 628	3.50 ^{cde}	3.57 ^{cde}	1.60 ^a	1.56 ^{abc}	2.60 ^{fghi}	2.70 ^{cde}
8.	KNE 688	3.60 ^{abcde}	3.67 ^{abcde}	1.33 ^d	1.23 ^f	2.84 ^{ab}	2.74 ^{abcde}
9.	KNE 1149	3.80 ^{abc}	3.87 ^{abc}	1.23 ^{ef}	1.22 ^f	2.82 ^{abc}	2.85 ^{abcd}
10.	Etiyo Brown	3.40 ^{de}	3.47 ^{cde}	1.43 ^c	1.54 ^{abcde}	2.74 ^{abcde}	2.74 ^{abcde}
11.	Gulu E	3.43 ^{de}	3.50 ^{de}	1.33 ^d	1.42 ^{bcdef}	2.82 ^{abc}	2.85 ^{abcd}
12.	Kala	3.78 ^{abc}	3.85 ^{abc}	1.33 ^d	1.26 ^{ef}	2.66 ^{efgh}	2.73 ^{abcde}
13.	RW127	3.53 ^{bcde}	3.60 ^{bcde}	1.17 ^{fg}	1.46 ^{bcdef}	2.71 ^{cdefg}	2.71 ^{bcde}
14.	KNE 392	3.60 ^{abcde}	3.67 ^{abcde}	1.23 ^{ef}	1.25 ^f	2.87 ^a	2.87 ^{abc}
15.	GBK 029681	3.80 ^{abc}	3.87 ^{abc}	1.28 ^{de}	1.28 ^{def}	2.53 ^{ij}	2.68 ^{ef}
16.	ACC 3953	3.63 ^{abcde}	3.70 ^{abcde}	1.28 ^{de}	1.59 ^{ab}	2.76 ^{abcde}	2.82 ^{abcd}
17.	GBK 011136A	3.87 ^a	3.94 ^a	1.28 ^{de}	1.25 ^f	2.67 ^{efgh}	2.72 ^{bcde}
18.	KNE 689	3.50 ^{cde}	3.50 ^{cde}	1.28 ^{de}	1.28 ^{def}	2.73 ^{bcde}	2.78 ^{abcd}
19.	KNE1034	3.70 ^{abcde}	3.70 ^{abcde}	1.28 ^{de}	1.29 ^{cdef}	2.72 ^{bcdef}	2.73 ^{abcde}
20.	Emiroit	3.80 ^{abc}	3.80 ^{abc}	1.25 ^e	1.25 ^f	2.67 ^{efgh}	2.68 ^{ef}
21.	Red local)	3.70 ^{abcde}	3.77 ^{abcde}	1.33 ^d	1.32 ^{bcdef}	2.72 ^{bcdef}	2.73 ^{abcde}
22.	Black(local)	3.48 ^{cde}	3.55 ^{cde}	1.13 ^g	1.18 [†]	2.65 ^{etgh}	2.53 [†]
	Mean	3.65	3.71	1.32	1.37	2.70	2.74
	SE	0.0052	0.0059	0.00094	0.00095	0.0019	0.0038

Means in a column follow by the same letter shows that there is no significance difference at P= 5% but when follow by different letters, there is significance difference.

Wider adoptability (Saritha *et al.*, 2016) and higher nutritional quality, higher multiplication rate and longer shelf life under ambient conditions (Saritha *et al.*, 2016), makes finger millet an ideal crop for use as a staple food and famine reserve. Hidden hunger due to micronutrients like iron (Fe) and zinc (Zn) deficiency is a major concern in developing countries.

The ether extract or crude fat obtained from the analysis of finger millet in Table 4 revealed that ACC 32 and KNE 628 had significantly higher crude fat (1.60 g - 2.90 g), compared to the least (1.13 - 1.18 g) obtained from Black local variety in Wukari and Takum. Bot *et al.*, 2020, reported crude fat of 3.70 % and 3.10 % from red and black colour varieties respectively. This is higher than 1.214.0±0.01 % reported by Ravishankar *et al.* (2003); 0.83 % by David *et al.* (2014). High fat ingredients are suggested for inclusion in weight gaining diets because of the energy embedded in them. David *et al.* (2014) reported that fats are widely used energy sources in addition to improving the consistency and palatability of mash feed.

The proximate composition in Table 4 further revealed that U15, KNE 814, KNE 1149, Etiyo Brown, Gulu E, KNE 392, ACC 3953 and Red local had significantly higher ash content (2.72 g - 2.90 g), while the least ash content of 2.47 - 2.53 g had been obtained from ACC 32 and Black local varieties in both Wukari and Takum locations. All the remaining varieties had various levels of ash contents that are of the same statistical similarities. This is higher than 2.37 % stated by David *et al.* (2014), 1.7 % by Rao (1994); 2.2 ± 0.02 % by Abubakar *et al.* (2015) and 1.94±0.17 % by (Sanusi *et al.*, 2019). Rotimi (2011) reported 4.22±0.01 %; Banusha and Vasantharuba (2013) reported 2.84±0.13 %; while Fasasi (2009) reported 2.21±0.05 % for finger millet. Singh and Srivastava (2006) recorded a range of 1.4 – 2.58 % for 16 varieties of finger millet, 3.10 % for foxtail millet, but comparable to the findings of Verma *et al.* (2014) as 4.27 % for burnyard millet. The differences recorded may be due to the different types of fertilizer used and the methods of application and their varietal seed coat colours found in those areas. This also suggests that the ash content of a substance or ingredient gives an idea about the inorganic matter or mineral contents of such a substance. This result agreed with the report of Singh and Raghuvanshi (2012) that the ash content in finger millet is higher than what was obtained in the commonly used cereal grains.

4.0 CONCLUSION

The result of the study has in a way provided better information on the twenty-two finger millet varieties in terms of their relative individual adaptation to the climatic conditions prevailing, their yield and nutritional potentials. These varieties thus can serve as test materials on which further work could be done to

improve them in Taraba State. Therefore, it can be concluded that KNE814, IE 3779, KNE 628, KNE 688, KNE 1149, Gulu E., KNE 392, GBK 029681, ACC 3953, GBK 011136A, KNE 689, KNE 1034, Emiroit and Red (local check) which have good agronomic/yield parameters, good straw weight and nutrient composition could serve as sources of germplasm for genetic improvement and as an alternative source of animal feed.

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REFERENCES

- Abubakar, A., Bala, S., Audu, A. E., Mohammad, S., Gero, M. and Lande, L. (2015). Characterization and the antinutritional composition of unprocessed finger millet (*Eleusine coracana*). *International Journal of Food Nutrition and Safety*, 6(3):117- 124.
- Anonymous (1996). Lost crop of Africa. Vol. 1: Grain Board on Science and Technology for International Development. National Research Council National Academy press. Washington D.C. pp: 171.
- Association of Official Analytical Chemists (AOAC) (2006). Official method of analysis (15th edition). Washington D.C. USA.
- Banusha, S. and Vasantharuba, S. (2013). Effect of malting on nutritional contents of finger millet and Mung bean. *American Eurasian Journal of Agricultural and Environmental Science* 13(12): 164-1646.
- Bot, M. H., Bawa, G. S., Omage, J. J., Onimisi, P. A., Bot, D. Y. and Udom, I. E. (2020). Proximate composition of red and black finger millet (*Eleusine coracana*) varieties. *Nigerian Journal of Animal Production* 47(6): 46 - 53
- David, B. M., Michael, A., Doyinsola, O., Patrick, I. and Abayomi, O. (2014). Proximate composition, mineral and phytochemical constituents of finger millet (*Eleusine coracana*). *International Journal of Advanced Chemistry*, 2(2):171-174.
- Fasasi, O. S. (2009). Proximate anti nutritional factors and functional properties of processed pearl millet (*Pennisetum glaucum*). *Journal of Food Technology*, 7(3):92-97.
- Gomez, K.A. and Gomez, A.A. (1984). Statistical Procedure for Agricultural Research 2nd Edition. John Wiley and sons, New York. 680pp.
- Little, J.M. and F.J. Hills, (1978). Agricultural Experimentation: Design and Analysis, John Wiley and Sons, Inc., New York 350 P

- Mgonja M.A. (2005). *Finger Millet Blast Management in East Africa*. Nairobi Kenya (Workshop). Abstract, p.47.
- Mgonja M.A., Lenné J.M., Manyasa E. and Sreenivasaprasad S. (eds.). (2007). *Finger Millet Blast Management in East Africa. Creating opportunities for improving production and utilization of finger millet*. Proceedings of the First International Finger Millet Stakeholder Workshop, Projects R8030 & R8445 UK Department for International Development – Crop Protection Programme held 13-14 September 2005 at Nairobi. Patancheru 502 324, Andhra Pradesh, India: International Crops Research Institute for the Semi-Arid Tropics. 196 pp. ISBN: 978-92-9066-505-2
- Obilana AB & Manyasa V (2002). Finger Millet. Belton, P. and J. Taylor (eds), *Pseudocereals and Less Common Cereals: Grain Properties and Utilization Potential*. Springer-Verlag Berlin Heidelberg, New York, pp. 177-214.
- Pugalenthi, M. Vadivel, U. Gurumoorthi, P. and Jonardhanan, K. (2004). Comparative Nutritional evaluation of little-known legumes, *Tamarindus indica*, *Erythrina indica* and *Sesbania bispinosa*. *Tropical. Subtropical Agroecosystem*. 4(3): 107-123.
- Rao, P. U. (1994). Evaluation of protein quality of brown and white ragi (*Eleusine coracana*) before and after malting. *Journal of Food Chemistry*. 51: pp.433-435.
- Ravishankar, C. R., Prakash, P. and Ramappa, H. K. (2003). Grain yield and nutritional composition in promising finger millet (*Eleusine coracana* Gaertn.) varieties. *Recent Trends in Millet Processing and Utilization*, 1: 121-122.
- Rotimi, T. F. (2011). The effect of processing on the nutritional value of finger millet (*Elusine coracona*) seed. A master thesis of the department of Biochemistry, Ahmadu Bello University, Zaria Nigeria.
- Sanusi, S. N., Sulaiman, S. A. and Bako, H. K. (2019). Comparative of Proximate and Mineral Composition of Commercially-Available Millet Types in Katsina Metropolis, Nigeria. *World Journal of Food Science and Technology*, 3(1): 14-19. Cited on 5/11/2020.
- SAS, (2005). Statistical Analysis Software Package Version 9.SAS Institute Inc., Cary, NC, USA.
- Saritha, H. S., Ravishankar, P. & Aruna, Y. R (2016). Identification of High Yielding, Neck and Finger Blast Resistant and Nutrient Rich White Finger Millet Genotypes. *International Journal of Agricultural Science and Research (IJASR)*. Vol. 6, Issue 3, Jun 2016, 305-314, ISSN(P): 2250-0057; ISSN(E): 2321-0087
- Shinggu, C.P., Tunwari, B.A., and Gani, M. (2016). Finger Millet (*Eleusine coracana*(L.) GAERTN) in Sustainable Food Security in Nigeria: A Review. *FUW Trends in Science and Technology Journal*, 1(2):332-336.
- Singh, P. and Srivastava, S. (2006). Nutritional composition of 16 new varieties of finger millet. *Journal of community mobilization Sustainable\development*. 1(2): pp.81-84.
- Singh, P. and Raghuvanshi, S. (2012). Finger millet for food and nutritional security. *African Journal of Food Science*. 6(4): 77- 84.
- Tunwari, B.A., Nahunnaro, H., and Anaso A.B. (2013). Effects of Cultivar on the development of Gray leaf spot disease and yield of sorghum in the Sudan savanna Agro-ecological zone of Nigeria. *Taraba Journal of Agricultural Research (TAJAR)*, 1(2):109-113.
- Tunwari, B.A. (2016). Control of Sesame *Cercospora* sp. infection by use of Varieties and Plant Extracts in Ardo-kola and Gasso I, Taraba, Nigeria. *FUW Trends in Science and Technology Journal*, 1(1):186-193.
- Upadhyaya HD, Gowda CLL, Buhariwalla HK & Crouch JH 2006. Efficient use of germplasm resources: identifying useful germplasm for crop improvement through core and minicore collections and molecular marker approaches. *Plant*
- Verma, S., Srivastava, S. and Tiwari, N. (2014). Comparative study on nutritional and sensory quality of barnyard and foxtail millet food products with traditional rice products. *Journal of Food Science Technology*: doi 10.1007/s13197- 014-1617-y.