Comparative Evaluation of Nutrient Contents of Fonio Offals of *Digitatria Exilis* and *Digitariai Burua* Speices

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Abstract: **- This experiment was conducted to compare the nutrient contents of fonio offals of Digitaria exilis and Digitariai burua offals. The results revealed that moisture between D. exilis and D. iburua offals was similar. However, D. iburua offal was higher in crude protein, ether extract and organic matter while D. exilis offal was higher in total ash, crude fibre, nitrogen free extract and dry matter. Calcium, potassium, zinc, copper and manganese were higher in D. exilis offal while D. iburua offal was higher only in phosphorus and iron. Both offals had similar contents of magnesium and sodium. The non-essential amino acids in D. exilis offal were glutamic acid, proline and serine while aspartic acid, cysteine, and glycine were in D. exilis offal. Essential amino acids in D. exilis offal were only alanine and leucine while arginine, histidine, isoleucine, lysine, methionine, phenylalanine, threonine and tyrosine were higher in D. iburua offal. D. exilis offal was higher in acid detergent fibre, acid detergent, phytate, oxalate and tannin while D. iburua offal was higher only in neutral detergent fibre. In conclusion, variation exists between the offal of D. exilis and D. iburua offals. D. iburua offal is predominantly higher in minerals, fibre and phytochemicals while D. iburua offal is higher in protein and essential amino acids. These offals are potential alternative fibre ingredients for livestock.**

Keywords: **Fonio, Digitaria exilis, Digitariai burua, offal, comparative evaluation, nutrients.**

I. INTRODUCTION

Fonio otherwise called Acha in Nigeria has two varieties: *D.exilis* and *D.iburua* (NRC, 1996). *Digitatria exilis* has brown seed coat and is actually called achaand with crude protein content of 8.00% while *Digitariai burua* is called iburu, it has black seed coat and 11.80% crude protein (Ballogou *et al*., 2013; Sudik, 2016). The seed of both species is the smallest seeds of all cerealcrops and 1000 seeds weighed 0.5 – 0.6g (Ballogou *et al*., 2013).Like rice and tamberfonio is an herbaceous annual plant that usually grows to the height of 30-80 cm. the seed of fonio is covered with husk also like rice (Sudik, 2016). Itis cultivated in West Africa across the semi-arid region covering areas from Senegal to chad (Philip and Itodo, 2006). The brown acha is the most commonly cultivated while the iburuis predominantly grown in Plateau and Bauchi states of Nigeria (Gyang and Wuyep, 2005). The objective of this paper was to examine the differences in chemical compositions of fonio offals (*Digitatria exilis* and *Digitariai burua*)in respect to proximate composition, minerals, amino acids, fibre fractions and phytochemicals to decide their usage in animal nutrition.

II. MATERIALS AND METHODS

100kg each of *D. exilis* and *D. iburua* offals were obtained in Jos, Plateau State, Nigeria and cleaned by picking off chaffs. Samples were fetched and milled using laboratory hammer mill, to pass through 0.5mm sieve, properly labeled and stored in screw-capped bottles prior to analysis. Proximate composition (Moisture content, crude fat, crude protein, total Ash and crude fibre) was determined using methods described by AOAC (2000). Nitrogen free extractive was determined by subtracting the percentages of the proximate components from 100 and expressed in percentage. The ash was dissolved in 10 ml HCl and made up to the mark in 50 ml for mineral determination. Na and K contents were determined by flame photometry (Jewnway Ltd, Dunwow, Essex, UK), P by Vanadomolybdate method (AOAC, 2000) while Ca, Mg, Fe, Zn, Fe, Mn and Cu were determined after wet digestion with a nitric, sulphuric and hydrochloric acid, using atomic absorption spectro-photometer (Buck Scientific, 2000 A. USA. Amino acid profile was determined according to (Beniter, 1989). Fibre fractions (neutral-detergent fibre - NDF, acid-detergent fibre - ADF and lignin were determined as described by Van Soest *et al.* (1991). Gross energy was determined against thermocouple grade benzoic acid a Gallenkamp Adiabatic bomb calorimeter (Model CBB-330-01041) U.K. Determination of phytate was carried out by the method of Young and Groove (1990), tannin was determined by the method described by Makkar (2000).

The data generated were reported using descriptive statistics.

III. RESULTS

Table 1 shows proximate compositions of *D. exilis* and *D. iburua* offals. Moisture content in the two offal were the same (10.14% each) as indicated by 0.00% coefficient of variation (CV). However, *D. iburua* was higher in crude protein (14.16%), ether extract (2.17%) and organic matter (98.66%) than *D. exilis* with CV of 5.72%, 1.98% and 0.01% respectively while *D. exilis* was higher in total ash (1.35), crude fibre (12.02%), nitrogen free extract (61.32%) and dry matter (89.86%) with CV of 0.53%, 1.55%, 1.03% and 0.05% respectively.

Table 2 shows mineral contents of *D. exilis* and *D. iburua* offals. The D. exilis offal had higher contents of calcium, zinc, copper and manganese (0.47%, 35.775 and 2.45% respectively) and the variations from D. exilis were 16.84%, 8.71% and 11.55% respectively. Also, *D. exilis* offal was slightly higher in potassium (3.12%) and manganese (5.43%) with CV of 2.07% and 2.65% respectively. While *D. iburua* was higher only in phosphorus (2.21%) and iron (47.11%) with CV of 4.64% and 1.56% respectively. both offals were also the same in magnesium (1.07% each) and sodium (0.02% each).

Table 3 shows the amino acid profile of *D. exilis* and *D. iburua* offals. *D. exilis* offal was higher in alanine (5.44%), glutamic acid (10.77%) proline (7.63%) and serine (2.46%) of the class of NEAA with CV of 1.58%, 7.10%, 3.42% and 0.87% respectively while*D. iburua* offal was higher in aspartic acid (3.91%), cysteine (1.18%), and glycine (3.63%) as NEAA with CV of 17.70%, 3.69% and 4.21% respectively. *D. exilis* was higher in leucine (9.68%) and tyrosine (3.21%) only EAA with CV of 1.63% and 0.89% respectively while *D. iburua* was higher in arginine (4.79%), histidine (3.30%), isoleucine (3.44%), lysine 3.10%), methionine (2.01%), phenylalanine (7.91%) and threonine (3.15%) as EAA with CV of 1.95%, 1.08%, 3.37%, 0.23%, 2.14%, 9.64% and 0.90% respectively.

Table 4 shows the fibre fraction and phytochemicals of *D. exilis* and *D. iburua* offals. *D. exilis* was higher in acid detergent fibre (12.64%) and acid detergent lignin (0.59%) with CV of 26.82% and 7.58% respectively. also *D. exilis* was higher in phytate (43.16), oxalate (6.30) and tannin (11.05) with CV of 0.16%, 1.13% and 6.70% respectively while *D. iburua* was only higher in neutral detergent fibre 42.10%) with 15.05% CV.

Table 1: Proximate composition (%) and calculated valuesof D. *exilis* and *D. iburua* offals

Parameters	***D. exilis***	***D. iburua***	**Mean**	SD	CV%
Moisture	10.14	10.14	10.14	0.00	0.00
Total Ash	1.35	1.34	1.35	0.01	0.53
Crude protein (CP)	13.06	14.16	13.61	0.78	5.72
Ether extract (EE)	2.11	2.17	2.14	0.04	1.98
Crude Fibre (CF)	12.02	11.76	11.89	0.18	1.55
Nitrogen free extract (NFE)	61.32	60.43	60.88	0.63	1.03
Dry matter (DM)	89.86	89.80	89.83	0.04	0.05
Organic matter	98.65	98.66	98.66	0.01	0.01

Values are averages of 3 samples.

Table 2: Macro-elements, micro-elements (mg/100g) and mineral ratio of *D. exilis* and *D. Iburua* offals

Parameters	***D. exilis***	***D. iburua***	**Mean**	**SD**	**CV**
Macro-elements (g/kg)					
Calcium (Ca)	0.47	0.37	0.42	0.07	16.84
Phosphorus (P)	2.21	2.36	2.29	0.11	4.64
Magnesium (Mg)	1.07	1.07	1.07	0.00	0.00
Potassium (K)	3.12	3.03	3.08	0.06	2.07
Sodium (Na)	0.02	0.02	0.02	0.00	0.00
Micro-elements (Mg/kg					
Zinc (Zn)	35.77	31.62	33.7	2.93	8.71
Iron (Fe)	47.11	48.16	47.64	0.74	1.56
Copper (Cu)	2.45	2.08	2.27	0.26	11.55
Manganese (Mn)	5.43	5.23	5.33	0.14	2.65

Values are averages of 3 samples.

Table 3: Amino acid profile (g/16 N) of *D. exilis* and *D. iburua* offals

Parameters	*D. exilis*	*D. iburua*	Mean	SD	CV
Non-essential amino acids					
Alanine	5.44	5.32	5.38	0.08	1.58
Aspartic acid	3.04	3.91	3.48	0.62	17.70
Glutamic acid	10.77	9.74	10.26	0.73	7.10
Serine	2.46	2.43	2.45	0.02	0.87
Cystine	1.12	1.18	1.15	0.04	3.69
Glycine	3.42	3.63	3.53	0.15	4.21
Proline	7.63	7.27	7.45	0.25	3.42
Essential amino acids					
Arginine	4.66	4.79	4.73	0.09	1.95
Histidine	3.25	3.3	3.28	0.04	1.08
Isoleucine	3.28	3.44	3.36	0.11	3.37
Leucine	9.68	9.46	9.57	0.16	1.63
Lysine	3.09	3.10	3.10	0.01	0.23
Methionine	1.95	2.01	1.98	0.04	2.14
Phenylalanine	6.90	7.91	7.41	0.71	9.64
Threonine	3.11	3.15	3.13	0.03	0.90
Tyrosine	3.21	3.17	3.19	0.03	0.89

Values are averages of 3 samples.

Table 4: Dietary fibres (g/100g) and anti-nutrients (mg/100g) of *D. Exilis* and *D. iburua* offals

Parameters	*D. exilis*	*D. iburua*	Mean	SD	CV
Fibre fractions					
Neutral Detergent fibre (NDF)	34.00	42.10	38.05	5.73	15.05
Acid Detergent fibre (ADF)	12.64	8.61	10.63	2.85	26.82
Acid detergent lignin (ADL)	0.59	0.53	0.56	0.04	7.58
Anti-nutritional factors					
Phytate	43.16	43.06	43.11	0.07	0.16
Oxalate	6.30	6.20	6.25	0.07	1.13
Tannin	11.05	10.05	10.55	0.71	6.70

Values are averages of 3 samples.

IV. DISCUSSION

The grains of D exilis and *D. iburua* were reported to differ by coat colour (Jideani, 2012), size (sudik, 2016) and protein levels (NRC, 1994). According to these authors *D. exilis* seed is brown, smallest and has 5% protein while *D. iburua* seed is black, bigger and has 8% protein. However, the offals of *D exilis* and *D. iburua* as analyzed in this experiment are similar in moisture content which is lower than 12-15% the moisture at which grains canbe kept longer with good shelf-life in store (Lasztity, 1984).Also, they have similar contents sodium and magnesium.

But *D. exilis* offal has higher contents of total ash, crude fibre and nitrogen free extract. Also, it is higher in calcium, potassium, manganese zinc and copper. Again, it is higher contents in ADF, ADL, phytate, oxalate and tannin and in most cases also it has higher contents in all the NEAAs while *D. Iburua* offal has higher contents of CP, EE, P, I, NDF, all the EAAs except leucine and also, has lower contents of phytate, oxalate and tannin.

A feed ingredient israted high when the fibre contents and anti-nutritional contents are lower because these are mainly factosr that chelate nutrients and make nutrients unavailable for absorption and utilization particular if it is serve to monogastric animals (Agbede, 2000). In the light of this, the *D. iburua* offal having shown lower contents of ADF, ADL, phatate, oxalate and tannin may be a prefer to *D.exilis* offal.

In terms of average values, both offals have higher crude protein than 11.9% in maize offal, and the *D. iburua* offalin particular has higher crude protein than 14.20% reported in rice bran (Heuzé *et a*l., 2016; Heuzé and Tran, 2015). Both offals also have lower NDF, ADF and lignin than 44.20%, 14.50% and 2.2% of fibre reported in maize bran respectively (Heuzé *et a*l., 2016). They also have lower lignin contents than 3.2% reported in rice bran (Heuzé and Tran, 2015). This analysis further confirmed the wholesomeness of *D. iburua* offal and in some case the *D. exilis* offal. This further presented them as alternative fibre ingredient to monogastric animals.

V. CONCLUSION

Looking at the relative high nutrient density in the *D. exilis* and *D. iburua* in respect to their fibre fraction and anti-nutritional contents worth to be given priority in food and feed formulations: therefore they are suggested for feeding trials to ascertain their effect on the performance of animals.

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