Short communication

Proximate and Detergent Fiber Fractions of de-Oiled African Olive (*Canarium schweinfurthii* Engl.) Residue: A Potential Animal Feedstuff

ABSTRACT
Proximate and detergent fiber composition of de-oiled African olive (*Canarium schweinfurthii*) residue were assessed using standard laboratory analytical procedures. Proximate composition showed 17.58 ± 0.21% crude protein, 4.13 ± 0.06% crude fat, 19.99 ± 0.89% crude fiber, 8.11 ± 0.33% ash and 50.20 ± 1.19% soluble carbohydrate. Detergent fiber components were 54.74±0.0745% NDF, 38.35 ± 0.59% ADF, 14.37 ± 0.68% ADL, 23.98 ± 0.10% cellulose and 16.40 ± 0.13% hemicellulose. The compositions are characteristic of roughage, fair in protein and a potential source of carbohydrate and digestible fiber, essential for non-ruminant digestion, and especially for proper rumen function. This qualifies it to be a possible alternative ingredient in animal feeds.

Key words: de-oiled African olive residue, proximate, detergent fiber, feedstuff

1. INTRODUCTION

Sourcing and affording animal feedstuffs have become very challenging in recent times owing to stricter competition between man and livestock for the conventional feedstuffs. This has narrowed access, and increased cost of the feedstuffs amidst rising human and animal population. The need to create an alternative broad based ingredient profile which should supply nutrients to meet animal requirement has become inevitable. It is against this backdrop that the nutritive potentials of unconventional feedstuffs such as oil-extracted African olive (*Canarium schweinfurthii*) pulp residue is being explored.

Canarium schweinfurthii Linn. commonly known as African elemi, black olive or African olive, belongs to the family Burseraceae and has about 75 species. Among some ethnic groups in Nigeria, where the plant is indigenous, it is referred to as *Lifar* in Afizere, *Paet* in Ngas, *Fwar* in Berom, *Ube mgba* in Igbo, *Atili* in Hausa and *Origbo* in Yoruba.

It is a large perennial evergreen tree with a geographical distribution spreading across tropical West Africa, Cameroon, Sudan, Ethiopia, Uganda, Tanzania and Zambia (1). In Nigeria, it is found mostly in the central states with some varieties which thrive very well in the rocky terrain of the Jos Plateau (2), where large quantities of fruits are produced (3; 4). The plant produces fruits year round, depending on variety (5). The fruits are drupes similar in appearance, morphology and color to olives (*Olea europaeae*); ovoid, purple in color, and red-purple (black) when fully mature (6; 5).

African olive has been described as a multipurpose economic plant with broad utilization cutting across nutritional and medicinal spheres (5). Among the Ngas ethnic group of Plateau State, Nigeria, the defatted residue is used to make a traditional soup, and also fed to livestock. There is, however, a dearth of information on the chemical composition of the oil-extracted residue.

The study was carried out in order to determine the proximate and fiber fractions of de-oiled *Canarium schweinfurthii* residue (pericarp) with a view to utilizing its nutritive potential to meet animal requirements.

2. MATERIALS AND METHODS

2.1 Collection and Preparation of Sample

Ripe African olive fruits were collected from trees in Pankshin, Nigeria. They were washed and placed into a clean clay pot, and soaked in warm water (20℃) for 12 minutes. The softened fruits were mashed in a mortar. The mash was packed into another container where water at room temperature was added to the fill, and sealed. Floated oil was collected on the surface of the water three days after, and for the next five days (until no oil float). The water was drained and the mashed fruit pericarp was squeezed to further remove oil, and sun-dried for five days. A sample was ground and taken to the laboratory analysis.

2.2 Chemical Analysis

Laboratory analyses were carried out at the Livestock Laboratory of the Institute of Agricultural Research and Training, Ibadan, Nigeria. Proximate fractions - moisture, crude protein, fiber, fat and ash contents - were analyzed according to the Association of Official Analytical Chemists (AOAC) official methods (7), and carbohydrate (NFE) was determined by difference as follows:

NFE (%) = 100 – [Moisture content (%) + Crude protein content (%) + Ether extract content (%) + Crude fiber content (%) + Crude ash content (%)] (8).
Detergent fiber fractions were analyzed using procedures described by (8).

3. RESULT AND DISCUSSION

3.1 Proximate and Detergent Fiber Composition

Results of proximate analysis of de-oiled residue of *Canarium schweinfurthii* (Table 1) shows 17.58±0.21% crude protein, 19.99±0.89% crude fiber, 4.13±0.06% crude fat, 8.11% ash, 50.20±1.19% and nitrogen free extract (NFE) on dry matter basis. Crude protein obtained was higher than 7.90% for a variety of defatted *C. schweinfurthii* residue from Cote d'Ivoire (6). This could be attributed to varietal differences and/or differences in analytical procedures used. (9) and (10) had reported lower crude protein in wheat offal (16.85% DM) and maize offal, but higher protein in brewers dried grains (BDG) (20.00 – 22.49%) (11; 12; 13). The value obtained was higher than the value palm kernel cake (14.5 – 18%) (14). The protein content is good relative to other by-product feedstuffs used for feeding livestock, thus contradicting the report of (6). The importance of proteins for biosynthesis and development of cells, enzymes, hormones, antibodies and other substances required for proper function and protection has been highlighted (15).

Crude fiber obtained fell within 13 – 20% for palm kernel cake (14). It is higher than for maize offal (9; 10), sun-dried cashew pulps (16) and wheat offal (11), but lower than in brewers dried grains. Adequate consumption of fiber diets has been known to have beneficial effect on digesta motility, reducing constipation, lowering cholesterol concentrations and reducing blood sugar levels for diabetics (17). However, non-ruminant animals such as poultry can accommodate only a limited amount of crude fiber in their diets, as opposed to ruminants, whose rumen microbial population break down crude fiber to forms that may be digestible.

Table 1: Proximate and detergent fiber fractions of de-oiled African olive residue

Parameters	Percent composition (DM basis)*
Dry matter	90.81 ± 0.46
Crude protein	17.58 ± 0.21
Crude fat	4.13 ± 0.06
Crude fiber	19.99 ± 0.89
Nitrogen free extract (NFE)	50.20 ± 1.19
Ash	8.11 ± 0.33

*Mean ± SD are values of triplicate samples

Crude fat obtained was lower than 6.4% reported by Georges *et al*. (1992) for fat-extracted *C. schweinfurthii* pulp, and also lower than 5 – 8% for palm kernel cake (14, 13). This may be attributed, in part, to differences in the efficiencies of oil extraction. Higher crude fat values were reported for full-fat sun-dried cashew pulp (16) and shea (*Vitellaria paradoxa*) fruit pulp (18). Ether extract represents the major form of stored energy in plant and animal tissues.

Crude ash obtained in this study was higher than 7.0% reported by Georges *et al*. (1992). Palm kernel cake (19), maize offal (9; 10), brewers dried grains and wheat offal (11) have lower ash contents than the fat-extracted residue. This implies that defatted Canarium pulp residue could be a potential source of minerals. Elemental composition in ash of plant origin is known to vary depending on soil chemistry, and this may, in part, account for differences in ash content of plants and plant products. Ash is the quantitative measure of total inorganic elements (minerals) contained in a substance.

Nitrogen free extract is the measure of soluble carbohydrates and other digestible and easily utilizable non-nitrogenous substances in feed. 50.20±1.19% obtained from this study would recommend it to be a relatively important source of energy. It is within the range of 46.7 – 58.8% for palm kernel cake (19), and compared favorably with that of industrial maize offal (49.91%) (10). It was higher than for BDG (35.06%) but lower than for wheat offal (54.11%) (11), red and yellow varieties of sun-dried cashew pulps (52.28% and 54.79%) respectively (16), and local maize offal (76.98%) (9).

Neutral detergent fiber (NDF) (54.74%) obtained in this study is lower than for PKC (68.8 – 78.9%) (19). NDF is indicative of an animal's dry matter intake capacity. Higher NDF would generally lower feed consumption. Hence, defatted residue of *C. schweinfurthii* pericarp has a better tendency of being appreciated in diets by animals over palm kernel cake.
Acid detergent fiber (ADF) (38.35%) was lower than for PKC (52.90%) (20). ADF is inversely correlated to digestibility of feedstuff, implying that defatted *C. schweinfurthii* residue is more digestible than PKC.

The oil-extracted residue contained 14.37% acid detergent lignin (ADL). This was lower than reported for some lignocellulosic materials for ruminant feeds (21). ADL is a phenolic-containing polymer which inhibits the digestibility of the structural carbohydrates of fibrous feedstuffs (8). Low ADL of the sample suggests it to be a viable source of digestible carbohydrate.

Table 2: Detergent fiber fractions of de-oiled African olive residue

Parameters	Percent composition (DM basis)*
Neutral detergent fiber (NDF)	54.74 ± 0.7045
Acid detergent fiber (ADF)	38.35 ± 0.5937
Acid detergent fiber of organic matter (ADFom)	30.98 ± 0.2709
Acid detergent lignin (ADL)	14.37 ± 0.68
Hemicellulose	16.40 ± 0.13
Cellulose	23.98 ± 0.10

*Mean ± SD are values of triplicate samples

Cellulose obtained (23.98%) was higher than in the findings (15.90%) of Georges *et al*. (1992). The relatively high degree of polymerization of cellulose (a polysaccharide) imparts low digestibility, and this has a major effect on carbohydrate utilization. However, Cellulose is well utilized by ruminants but not that much by non-ruminants (poultry), because the molecules are too large to be absorbed through the gastro-intestinal tract of non-ruminants. In the case of ruminants, they are degraded by rumen microbiota before absorption of the metabolites (22).

4. CONCLUSION

Values of crude protein, lipid, crude fiber, neutral detergent fiber and acid detergent fiber obtained were characteristic of fibrous feedstuffs, thus, classifying it to be a roughage. It is relatively a good source of soluble carbohydrate and protein. Its appreciable nutrient content may complement supply in animal diets.

REFERENCES

1. Orwa C, Mutua A, Kindt R, Jamnadass R, Anthony S. Agroforestry Database: a tree reference and selection guide version 4.0. 2009. Available http://www.worldagroforestry.org/sites/treedbs/treedatabases.asp.
2. Nyam MA, Obashola OE, Dawang S. A survey of some varieties of *Canarium schweinfurthii* (Atili) grown in some parts of Jos East LGA, Plateau State, Nigeria, and their antibacterial activities. *J Microbiol Lab Sci*. 2018; 1:102.
3. Maduelosi NJ, Angaye SS. Characterization of African Elemi (*Canarium schweinfurthii)*. *Int. J. Adv. Res. Chem Sci*. 2015; 2(11): 34–36.
4. Ayoade GW, Amoo IA, Jabar JM, Ojo AM, Maduawuchi CO. Proximate, minerals and amino acid profile of (*Canarium schweinfurthii*) seed pulp. *Int J Sci Tech*. 2017; 6(1): 657–66.
5. Georges AN, Olivier CK, Simard RE. *Canarium schweinfurthii* Engl.: Chemical composition of the fruit pulp. *J Am Oil Chem Soc*. 1992; 69(4): 317–320.
6. Nyam MA, Makut MD, Itelima JU, Daniel AM. Nutritional potential of the fruits of Black Olive (*Canarium schweinfurthii* Linn.) from Plateau State, Nigeria. *Pak J Nutri.* 2014; 13(6): 335-339.
7. Horwitz W, editor. Official Method of Analysis. 18th ed. Washington, D. C: Association of Official Analytical Chemists (AOAC); 2006.
8. Galyean ML. Laboratory Procedures in animal Nutrition Research. Department of Animal and Food Sciences, Texas Tech University, Lubbock. 2010. Available: http://www.depts.ttu.edu
9. Vantsawa PA, Ogundipe SO, Dafwang II, Omage JJ. Replacement value of dusa (locally processed maize offal) for maize in diets of egg type chicks (0 – 8 weeks). *Pak J Nutri*. 2007; 6(6):530-533.
10. Ezieshi EV, Obazele OM, Olomu JM. Performance and energy metabolism by broiler chickens fed maize and millet offals at different dietary levels. *J Agric Social Res*. 2011; 11(1): 14–21.
11. Amaefule KU, Abasiekong SF, Ibe SN, Onwudike OC. Digestibility and nutrient utilization of some agro-industrial by-products fed to growing pigs in the humid tropics. *Pak J Nutri*. 2009; 8(4): 355–360.
12. Facenda A, Zambom MA, Avila AS, Fernandes T, Stum M, Garcias J, Tinini RCR. and Dias, A. L. G. Dried brewers grain as a replacement for soybean meal on nutrient digestibility and rumen parameters of cattle. *S Afr J Anim Sci*. 2018; 48(6): 1093–1098.
13. NIAS (2020). National Listing of Feed Ingredients for Commercial Feed Mills in Nigeria. Nigerian Institute of Animal Science. 2020. Ref: NIAS/RA/LFI – 2020. https://www.nias.gov.ng
14. Azizi MN, Loh TC, Foo HL, Chung ELT. Is palm kernel cake a suitable alternative feed ingredient for poultry? *Anim*. 2021; 11(2):338 https://doi.org/10.3390/ani11020338
15. Cheesbrough, M. Medical Lab. Manual for Tropical Countries, 2nd ed. Cambridge Butterworth-Heinmann Ltd, Oxford. 1987; 1:605pp
16. Okpanachi U, Ayoade JA, Tuleun CD. Composition and anti-nutritional factors (phytonutrients) present in both red and yellow varieties of sun-dried cashew pulp. Am *J Food Sci Health*. 2016; 2(4):45–48.

17. Ogunyinka BI, Oyinloye BE, Osunsanmi FO, Kappo AP, Opoku AR. Comparative study on proximate, functional, mineral, and antinutrient composition of fermented, defatted, and protein isolate of *Parkia biglobosa* seed. *Food Sci Nutri*. 2017; 5(1):139–147.
18. Enaberue LO, Obisesan IO, Okolo EC, Ojo A. Proximate and chemical composition of shea (*Vitellaria paradoxa* C.F. Gaertn) fruit pulp in the Guinea Savanna of Nigeria. *World J Agric Sci*. 2014; 2(4): 78–83.
19. Alimon, A. R. The nutritive value of palm kernel for animal feed. 2004. Available https://www.mdpi.com>htm
20. Wan Zahari, M., Mohammed Ariff, O., Mohammed Sukri, I., Oshibe, A. and Hayakawa, H. Oil-palm by-products and urea molasses mineral blocks as fed resources for buffaloes in Malaysia. In: Proceedings of the third Asian Buffalo Congress, Kandy, Sri Lanka. 2000.
21. Srivastava S, Mudgal V, Jain R. K. Lignin – Its role and importance in animal nutrition. *Int J Livestock Res*. 2012; 2(1):7–24.
22. Acamovic T, Brooker JD. Biochemistry of plant secondary metabolites and their effects in animals. Proceedings of the Nutrition Society. 2005; 64: 403 – 412.