Journal of Experimental Agriculture International

Volume 44, Issue 12, Page 1-5, 2022; Article no.JEAI.93519
ISSN: 2457-0591
(Past name: American Journal of Experimental Agriculture, Past ISSN: 2231-0606)

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

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Authors' contributions

This work was carried out in collaboration between both authors. Both authors read and approved the final manuscript.

Article Information

DOI: 10.9734/JEAI/2022/v44i122071

Open Peer Review History:
This journal follows the Advanced Open Peer Review policy. Identity of the Reviewers, Editor(s) and additional Reviewers, peer review comments, different versions of the manuscript, comments of the editors, etc are available here: https://www.sdiarticle5.com/review-history/93519

Short Communication

Received: 01/09/2022
Accepted: 05/11/2022
Published: 11/11/2022

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. Quantitative compositions of proximate and detergent fiber fractions were characteristic of roughage. De-oiled African olive pulp residue is relatively fair in protein and a good source of carbohydrate and digestible fiber for animal nutrition.

Keywords: De-oiled African olive residue; proximate; detergent fiber; feedstuff.

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1. INTRODUCTION

Access to qualitative and affordable animal feedstuffs has 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 would 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 the 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]. The residue from Cote d'Ivoire has been reported to contain 7.9% protein, 6.4% crude fat and about 7.0% ash [5]. Despite the appreciable content of nutrients, its potential as an animal feed ingredient leaves much to be explored.

African olive has been described as a multipurpose economic plant with broad utilization cutting across nutritional and medicinal spheres [5]. The fruit is universally consumed by humans after having been soaked in warm water. Among the Ngas ethnic group of Plateau State, Nigeria, the defatted residue is further used to make a traditional soup, and also fed locally to livestock. Much work has been done on the chemical composition of the full-fat pulp, but there is a dearth of information on the nutritive composition of the defatted residue.

The study was carried out in order to determine the proximate and fiber fractions of defatted *Canarium schweinfurthii* residue (pericarp) with a view to appreciating its nutritive potential as a prospective animal feedstuff.

2. MATERIALS AND METHODS

2.1 Collection and Preparation of Sample

Ripe African olive fruits were collected from trees in Pankshin, Plateau State, Nigeria. Traditional oil-extraction method was used to extract oil from the fruit pulp. The fruits 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 floated). The water was drained and the mashed fruit pericarp was squeezed using a porous polyethylene bag to further remove oil, and was sun-dried for five days. A sample was ground and taken to the laboratory for analysis.

2.2 Chemical Analysis

Chemical 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. DISCUSSION

3.1 Proximate 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% reported for a variety of defatted *C. schweinfurthii* residue from Cote d'Ivoire [5]. The difference could be attributed to varietal differences and/or differences in analytical procedures used. [6,9,3] had reported lower crude protein values in the full-fat pulps of *Canarium schweinfurthii.* Extraction of oil from feedstuffs is known to concentrate non-lipid dependent nutrients, thereby increasing their values per unit quantity of the feedstuff. Pulp and skin of a different species (*Canarium odontophyllum*) also had lower protein values, respectively [10]. The protein content of the residue is good relative to other by-product feedstuffs thus, contradicting the report of [5], and useful for feeding livestock. The value obtained was higher than the value for palm kernel cake (14.5 – 18%) [11]. 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 [12].

Crude fiber value obtained (19.99%) is higher than for the pulp of bullet pear (11.44%) [9] and for the whole fruit (16.37%) [6]. Sun-dried cashew pulps [13] had lower values than obtained in this study. 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 [14]. 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.

Crude fat obtained was lower than 6.4% reported by [5] for fat-extracted *C. schweinfurthii* pulp, and also lower than 5 – 8% for palm kernel cake [11]. This may be attributed, in part, to differences in the efficiencies of oil extraction. Higher crude fat values were reported for the full-fat pulps of C. schweinfurthii [6, 3, 9], sun-dried cashew pulp [13] and shea (*Vitellaria paradoxa*) fruit pulp [15, 16]. Defatting reduced crude fat in the residue. 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 [5, 9, 3] had found lower crude fiber values for the pulp and whole seeds, respectively of *C. schweinfurthii*. This implies that the defatted pericarp 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 (NFE) 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 is relatively high making it a potential source of carbohydrate, and energy. The NFE value compares favorably with that of industrial maize offal (49.91%) [17]. and is slightly less than for red and yellow varieties of sun-dried cashew pulps (52.28% and 54.79%) respectively [13].

Crude protein, soluble carbohydrate and crude fiber were higher than in undefatted *C. schweinfurthii* pulps [6, 9, 3], and also higher than in undefatted pulps of another species (*Canarium odontophyllum*) [10]. Oil extraction has concentrated these nutrients thereby raising their values per unit quantity of the defatted pericarp residue.

3.2 Detergent Fiber Composition

Neutral detergent fiber (NDF) (54.74%) is appreciably high. NDF is indicative of an animal's dry matter intake capacity. Higher NDF would generally lower feed consumption. Hence, defatted residue of African olive pericarp may be better appreciated in diets by animals.

Table 1. Proximate composition 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

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

Acid detergent fiber (ADF) value (38.35%) obtained is relatively low compared to some by-product feedstuffs. ADF is inversely correlated to digestibility of feedstuff, implying that defatted *C. schweinfurthii* residue is likely to have a better digestibility among some by-product feedstuffs.

The oil-extracted residue contained 14.37% acid detergent lignin (ADL). This was lower than reported for some lignocellulosic materials for ruminant feeds [18]. 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. Cellulose obtained (23.98%) was higher than in the findings (15.90%) of [5]. 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 [19].

4. CONCLUSION

Values of crude protein, lipid, crude fiber, neutral detergent fiber and acid detergent fiber obtained were characteristic of fibrous feedstuffs, hence, de-oiled African olive residue is a roughage. It is relatively a good source of soluble carbohydrate and protein. Oil-extraction has improved the nutrient contents of the residue over that of undefatted pericarp. Its appreciable nutrient content may complement supply in animal diets.

COMPETING INTERESTS

Authors have declared that no competing interests exist.

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