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Nutritional Properties of African Pear Seed and Performance of Defatted Cake in Poultry Feed Formulations

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Abstract

The proximate composition and anti-nutritional properties of the African pear seed (APS) were determined. The oil was extracted and the physico-chemical properties of the oil were analysed. The cake obtained after oil extraction was utilized in poultry feed production and its performance was evaluated. The results showed that the seed has a high dry matter content of 87.22%, as well as a high fat content (19.47%) indicating usefulness in the edible oil processing industry. The oil characteristics were within the required range of values for edible oils. Among the anti-nutrients analysed, trypsin inhibitors were the highest (7.33%) while polyphenols were lowest (0.35%). The poultry feeding trial revealed that diet 1 with 40:25:15 maize:APScake:soybean showed no significant difference ($p \leq 0.05$) from the control in most of the parameters tested. All the samples diets sustained growth and no mortality was recorded.

Keywords: *Dacryodes edulis*; Poultry feed; African pear seed

Introduction

African pear (Dacryodes edulis) known as ube among the Ibo-speaking people of South-eastern Nigeria is a member of the family Burseraceae. It is an evergreen tropical fruit tree which grows in the humid and sub-humid climate of the West African countries [1]. The African pear (Dacryodes edulis) fruit pulp is well known for its richness in protein, fat, fibre, minerals and essential amino acids. They are consumed during the months of April to September.

They are often softened by heating in hot water or ash and eaten as an accompaniment to roasted or boiled maize. However, the seeds are not eaten and are often discarded as waste or sometimes consumed by domestic animals if discovered before they are rotten. Previous research [2] has revealed that the seed contains 18-34% oil, making it comparable with other oil bearing seeds such as palm kernel (40%), cotton seed oil (30%). However little or no studies have been done on the characterization of the oil, as well as utilization of the cake in feedstuffs.

Investigating the use of nonconventional ingredients in feed production is an easy way of reducing the cost of poultry production since 80% of the cost incurred is from feed purchase. The conventional ingredients (like soybeans) used in animal feeds, are very costly because they are also in high demand for human consumption. The aim of this research therefore is to determine the nutritional and anti-nutritional properties of the African pear seed, determine the physicochemical properties of the oil and the performance of the African pear seed cake in poultry feed formulations.

Material and Methods

The proximate composition of the APS sample was determined using some described methods [3]. The saponins and phenols were determined [3] while the phytates and trypsin inhibitors were determined according to the described methods [4]. The tannins and oxalates were also determined [5].

The oil was extracted using hexane and the acid, iodine and saponification values of the oil were determined as described [6] while the smoke and flash points were determined using the described methods [7]. The melting point was also determined [8].

The cake obtained after oil extraction was sundried and used as substitute for soybean cake in feed formulation at different levels. The maize: APS cake: soybean ratios were as follows; 60:0:20 (control), 40:25:15(Diet 1), 40:27:13 (diet 2), 40:30:10 (diet 3), 60:20:0 (diet 4). The feed samples were formulated according to guidelines from ref. [9]. As the ratio of soybean cake to APS cake increased, the other ingredients (maize, wheat bran etc.) were adjusted to maintain the minimum protein content (18%) according to the requirement for crude protein in feed formulations as described in ref. [10].

A total of fifteen (15) four week old broiler finisher birds (Gallus gallus) were distributed into five treatment groups made up of 3 broilers per group. The different groups were fed with the different sample diets for 7 days prior to commencement of the measurements to allow the birds acclimatize to the environment and the feed. The experimental feeds and water were given ad libitum. The birds were

weighed at the beginning of the experiment and on a weekly basis for 4 weeks. The proximate composition of the diets were determined using methods [7]. The feed intake, weight gain, protein efficiency ratio and feed conversion ratio were determined [9]. The results obtained were subjected to statistical analysis using the Analysis of Variance (ANOVA). When significant difference ($P<0.05$) was observed, the Fischer's Least Significant difference(FLSD) method was used to separate the means in order to determine which samples were different.

Results and Discussions

Proximate composition

The proximate composition is shown in Table 1. The moisture content of the seed was 12.77%, thus giving a dry matter content of 87.22%. This suggests a nutrient dense food material that can actually be utilized in many ways such as in feed supplementation.

The protein content (18.03%), carbohydrate (39.10%), crude fibre (3.17%) and ash (3.45%) contents are quite comparable to those of other nuts and oil seeds [11,12]. A lipid content of 19.47% shows that the seed can be a good source of oil. The value falls within the range of values for most oil producing seeds like soybeans [13].

Table 1: Proximate composition of African pears seed.

Component	Quantity (%)
Moisture	12.77 ± 0.33
Dry matter	87.22 ± 0.02
Crude Protein	18.03 ± 0.11
Crude fibre	3.17 ± 0.01
Ash content	3.45 ± 0.01
Ether Extract	19.47 ± 0.04
Carbohydrates	39.10 ± 0.19
Energy(KJ/100 g)	1689.9

Anti-nutrients in Africa pear seed

The most predominant anti-nutrient (Table 2) are the trypsin inhibitors (7.33%) followed by the saponins (1.14%) and the tannins (1.05%). The polyphenols (0.35%), oxalates (0.64%) and phytates (0.77%) were also present in lesser amounts.

Saponins are characterized by a bitter taste. They also inhibit nutrient transport and exhibit growth depressing action [14]. Dietary levels of 1% phytate or more have been reported to interfere with mineral availability [15]. Chai and Lieman [16] has reported that a daily intake of 450 mg oxalate can interfere with body metabolism.

Table 2: Anti-nutrients in African pear seed. The presence of these anti-nutrients have inhibited the use of the APS as food for humans. However it has been observed in the local communities that they are freely consumed by domestic animals.

Anti-nutrient	Quantity (%)
Polyphenols	0.35 ± 0.31
Oxalates	0.64 ± 0.01
Phytates	0.77 ± 0.02
Tannins	1.05 ± 0.01
Trypsin Inhibitors	7.33 ± 0.66
Saponins	1.14 ± 0.01

Pear seed oil properties

The properties of the APS oil are shown in Table 3. The melting point was 32.35°C while the smoke and flash points were 176.13°C and 210.44°C respectively. These characteristics are essential for a cooking oil. The iodine value was 48.16 ml/g which is comparable with the value for other edible oils [17]. The acid value was 7.31 mgKOH/g. The value is higher than the recommended value (4.0 mgKOH/g) for crude vegetable oils. This may be related to moisture level of the seed, which could induce enzymatic hydrolysis of the oils. However, the peroxide value (14.13 meq/kg) falls within the range of values (10-15 meq/kg) recommended in the Codex standard (1999). The saponification value (213.54 mgKOH/g) falls within the Codex recommended value (188-265 mgKOH/g). Saponification values are highly significant in soap making since it signifies the number of milligrams of potassium hydroxide required to neutralize one gram of the sample during soap making [18].

Table 3: Properties of African pear oil.

Physicochemical parameters	Values
Iodine value (ml/g)	48.16 ± 1.09
Acid Value (mgKOH/g)	7.31 ± 0.39
Saponification value (mgKOH/kg)	213.54 ± 1.63
Peroxide value(meq/kg)	14.13 ± 0.16
Melting Point(°C)	32.35 ± 0.22
Smoke Point (°C)	176.13 ± 0.13
Flash Point(°C)	210.44 ± 0.01

Properties of poultry feed samples

The proximate composition of the formulated feed samples are shown in Table 4. The feed samples compared favourably with the control diet in most of the parameters. No significant

difference (p>0.05) was observed between the control sample and diet 1 for the moisture, protein and fat content. Interestingly, all the protein values for all the sample diets remained above the minimum level (18%) recommended for poultry finisher feeds [10].

Table 4: Proximate composition and growth performance of formulated diets.

Diets	Moisture content %	Crude protein %	Crude fibre %	Ash content %	Ether extract %	Carboh-ydrate %	Feed intake kg/week	Weight gain kg/week	Protein efficiency ratio(PER)
Control	13.03^{a}	21.74^{a}	4.84^{bc}	3.84^{c}	6.38^{a}	50.16b^{c}	1.77^{a}	1.09^{a}	2.87^{a}
Diet 1	13.53^{a}	21.83^{a}	5.25^{ab}	4.16^{c}	6.09^{a}	49.14^{c}	1.46^{b}	0.78^{a}	2.22^{b}
Diet 2	10.23^{b}	20.29^{b}	4.82^{c}	6.55^{a}	5.59^{a}	52,52^{ab}	1.38^{b}	0.65^{b}	2.14^{b}
Diet 3	10.23^{b}	20.23b^{c}	4.68^{c}	6.79^{a}	5.88^{a}	51.68^{b}	1.42^{b}	0.74^{ab}	2.27^{b}
Diet 4	10.73^{b}	18.39^{c}	5.52^{a}	5.34^{b}	6.14^{a}	53.88^{a}	0.66^{c}	0.22^{c}	1.89^{c}
Means on same column with same superscript are not significantly different (p<0.05)									

The feed intake (1.77 kg/week), weight gain (1.09 kg/wk), and protein efficiency ratio (2.87) were highest for the control diet. This was followed by diet 1, 3 and 2 respectively. However, no significant difference (p>0.05) was observed in the weight gain for the control diet, diet 1 and 3. Also, no significant difference (p>0.05) was observed in the feed intake and Protein efficiency ratio for the samples 1, 2 and 3. The significantly lowest (p ≤ 0.05) values were recorded for diet 4 with feed intake of 0.66 kg/wk, weight gain of 0.22 kg/wk and protein efficiency ratio of 1.89. However the mortality rate was zero for all the birds fed on the various diets and the sample diets were able to sustain growth and steady weight gain for all the birds.

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