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The Effect of Boiled African Pear Seed Meal *(Dacryodes edulis)* on Growth Performance and Nutrient Digestibility of Weaner Rabbits

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Abstract:
This study was carried out to determine the effects of boiled African pear seed meal on the performance and nutrient digestibility coefficient of Weaner rabbits. African pear seeds were washed, chopped into pieces, boiled for one hour, sundried and milled to produce a boiled African pear seed meal (BAPSM). Four diets were formulated and designated T1, T2, T3 and T4. T1 contained maize as the main energy source, and T2, T3, and T4 contained BAPSM at 5, 10 and 15% levels, respectively, replacing maize in the diets. Thirty-two Weaner rabbits aged between 6 – 7 weeks were used for the study. The rabbits were divided into four treatments of eight rabbits, and each treatment was allotted one of the diets in a completely randomized design (CRD). Each group was further divided into four replicates of two rabbits per replicate. The experiment lasted 12 weeks, and the data obtained were statistically analyzed. There were significant differences ($p<0.05$) in feed intake, final body weight, body weight gain and feed conversion ratio values. All investigated nutrient digestibility coefficient parameters were significantly affected ($p<0.05$) by the diets. It was concluded that boiled African pear seed meal could be included in Weaner rabbits' diets up to 15% level to enhance the performance and nutrient digestibility coefficient of the animals.

Keywords: *Weaner rabbits, performance, African pear seed, nutrient digestibility*

1. Introduction

Rabbit production could serve as a better means of alleviating the problem of humans' low animal protein intake, especially in developing countries like Nigeria. Rabbit rearing has attracted a lot of attention in the last few decades because of its various attributes, which include the ability to adapt to a wide range of climates, high reproduction potential, low capital investment, and ability to subsist on forages solely without any negative effect on productive and reproductive performance (Sam *et al*., 2020a; Das *et al.,* 2013).

Rabbit meat has been reported to be tasty, wholesome and rich in protein (22%), low in fat (4%), cholesterol (5%) and sodium, which has contributed significantly to human health by reducing the incidence of heart and heart-related diseases (Aduku and Olukosi, 1990; Elamin, 2013; Sam *et al*. 2020b).

Nutrition is an important aspect of livestock production. Achieving high or maximum productivity in rabbits will require improvement in their nutritional status. Feed constitutes about 70 – 80% of the cost of producing rabbits (Aduku, 2009). The shortage and high cost of feed ingredients have been major challenges to the expansion and development of the rabbit industry in developing countries. Maize, a major energy component in animal feed, has become scarce and expensive because of its multiple uses by animals, humans and industries. The growing demand for maize has intensified the search for an alternative energy source that is cheaper and readily available and can be used in rabbit feed.

African pear seed *(Dacryodes edulis)* is one of the under-utilized feed materials that could serve as a source of dietary energy in rabbit feed. African pear seed is obtained from the fruit of the African pear tree. The African pear tree *(Dacryodes edulis)* is an evergreen, perennial tree that belongs to the family Burseraceae. The African pear tree is mostly abundant in Southern Nigeria. It is locally known as Ube in Igbo and Eben in Ibibio. The tree is cultivated for its fruits, which contain a lot of oil (Orwa *et al.,* 2009). African pear seed is often discarded as waste immediately after the consumption of the pulpy fruit.

Seeds are of nutritional importance as they contain various nutrients that are needed for growth and development in humans and animals (Olufeko *et al.,* 2020). African pear seed has been reported to contain carbohydrates, lipids, protein, crude fibre, potassium, calcium, magnesium, phosphorus and essential amino acids, which include lysine, phenylalanine, leucine and isoleucine. Low amounts of palmitic, oleic and linoleic fatty acids have also been reported to be present in African pear seeds (Leaky, 1990; Hanisen, 2009; Bratte *et al.,* 2010).

However, despite its nutritional potential, African pear seed has been identified with some anti-nutritional substances such as tannin flavonoid, saponin, oxalate, alkaloid, cyanogenic glycoside, and phytate (Uwem & Elechi, 2020), which could limit its use in rabbit feed or as a feed ingredient and, hence, require processing before incorporating it into animal feed.

Processing of feed ingredients has proven to improve the nutritive value of feedstuffs (Udedibie *et al.,* 2005; Essien & Udedibie, 2007; Mathew *et al.,* 2010). Many food processing techniques are employed to improve the feeding value of various feedstuffs and reduce the concentration of anti-nutritional substances to tolerable levels (Akinmutimi & Okwu, 2006). Remarkable improvement in the nutritive value of feedstuff has been achieved through various processing methods such as cooking, toasting, soaking, fermentation, dehulling, etc. Hence, this study was carried out to determine the effect of boiled African pear seed on the performance and nutrient digestibility of Weaner rabbits.

2. Materials and Methods

2.1. Experimental Site

This study was conducted at the Rabbitry Unit of the Department of Animal Science, Teaching and Research Farm, Akwa Ibom State University—Obio Akpa Campus. Obio Akpa is situated between latitude 5^0 17^1N and 5^0 27^1N and longitude 7^0 21^0E and 7^0 58^0E. Its annual rainfall ranges between 3500–5000mm, monthly temperature ranges between 24–26^0C, and relative humidity ranges between 60–90% (AKSG, 2024).

2.2. Source of African Pear Seed and Processing Method

African pear fruits (soft) were sourced from fruit sellers at Itam Market, Itu Local Government Area, Akwa Ibom State. The soft pulps were washed to remove sand particles. The brownish leather coats were later removed with a hand and knife to expose the cotyledon. The cotyledons were separated carefully from the seeds, and the seeds were chopped into tiny pieces and boiled for one hour. After cooking, the water was drained out, and the seeds were sundried for 3–4 days. The sundried seeds were run through a hammer mill with a 2mm sieve to produce a boiled African pear seed meal (BAPSM) and bagged later to be incorporated into the rabbit diet.

2.3. Proximate and Phytochemical Analysis of Boiled African Pear Seed Meal (BAPSM)

A sample of the boiled African seed meal was taken to the laboratory for proximate and phytochemical composition analysis. The proximate composition analysis was conducted to determine crude protein, crude fibre, ash, ether extract and moisture using the method of AOAC (2002). While phytochemical composition analysis for saponin, flavonoid, tannin, alkaloids and phenols were carried out according to the methods of Harborne (1973) and Sofowora (1993).

2.4. Experiment Diets

Four experimental diets were formulated and labeled as T_1, T_2, T_3, and T_4. Treatment one (T_1), the control, did not contain boiled African pear seed meal. T_2, T_3, and T_4 contained boiled African pear seed meal at 5%, 10%, and 15% levels, respectively, partly replacing maize in the diet. The ingredient and nutrient composition of the experimental diets is presented in table 1.

2.5. Experimental Design and Management of Animals

A total of thirty-two (32) rabbits (New Zealand and Chinchilla Cross Bred) aged 6–7 weeks were used for the experiment. The rabbits were purchased from a private rabbit farm in Uyo, Akwa Ibom State, Nigeria. The rabbits were divided into four (4) treatments, and each treatment was randomly allotted to one of the diets in a completely randomized design (CRD). Each of the treatments was further divided into four replicates of two rabbits each and housed individually in double-tier hutches. A feeding trough and a watering trough were provided in each rabbit cell. Anti-stress and deworming drugs were administered to the animals. Prior to the commencement of the experiment, the rabbits were allowed to adapt to the new environment for two weeks while being fed a diet free of boiled African pear seed meal. Feed and drinking water were offered ad libitum. Strict management practices were observed, and the experiment lasted for 12 weeks.

2.6. Data Collection

Rabbits were weighed individually at the beginning of the experiment and on a weekly basis thereafter to determine their weight gain using an electronic scale (SF-400). Feed intake was evaluated as the difference between the weighed amount of feeds given daily and their corresponding leftover the previous day. The feed conversion ratio was calculated as the rate of feed intake to weight gain.

2.7. Nutrient Digestibility Study

The digestibility study was conducted using (4) four rabbits per treatment on the 11^{th} week of the feeding trial. The rabbits were housed in individual metabolic cages, and a known quantity of feed was provided to the animals each day. Five days of acclimatization were observed before the collection of the faecal droppings. Faecal samples were collected daily from each cage in aluminum foil and oven–dried at a temperature of 60 – 80^0C for 24 hours. The study lasted for (5) five days. At the end of the trial, representative samples were bulked and taken to the laboratory for proximate composition analysis according to the methods outlined by AOAC (2002) procedures.

$$Nutrient\ Digestibility = \frac{Nutrient\ in\ Feed - Nutrient\ in\ Faecese}{Nutrient\ in\ Feed} \times 100$$

2.8. Statistical Analysis

All collected data were subjected to analysis of variance (ANOVA) according to Steel and Torrie (1980), and significant means were separated using the Duncan Multiple Range Test (Duncan, 1955).

Ingredients	**T_1**	**T_2**	**T_3**	**T_4**
Maize	40.00	40.00	40.00	40.00
BAPSM	0.00	0.00	0.00	0.00
Groundnut Cake	8.00	8.00	8.00	8.00
Soybean cake	22.00	22.00	22.00	22.00
Wheat offal	16.00	16.00	16.00	16.00
Palm kernel cake	9.00	9.00	9.00	9.00
Bone meal	4.00	4.00	4.00	4.00
Common Salt	0.25	0.25	0.25	0.25
Premix	0.25	0.25	0.25	0.25
L-Lysine	0.25	0.25	0.25	0.25
L-Methionine	0.25	0.25	0.25	0.25
Total	**100**	**100**	**100**	**100**
Calculated Chemical Composition (%Dm)				
Crude Protein	18.51	18.33	17.95	17.58
Ether extract	4.59	4.41	4.36	4.31
Crude fiber	9.76	10.11	10.33	10.53
Ash	3.58	3.47	3.44	3.18
NFE	63.78	63.68	63.92	63.90
ME (Kcal/g)	2671.83	2678.49	2673.58	2697.36

Table 1: Gross Composition of Experimental Diets for Weaner Rabbits Fed Varying Levels of Boiled African Pear Seed Meal

BAPSM – Boiled African Pear Seed Meal

NFE – Nitrogen Free Extra

Me – Metabolizable Energy

3. Results and Discussion

3.1. Proximate and Phytochemical Composition of Boiled African Pear Seed Meal

The result of the proximate and phytochemical composition of boiled African pear seed meal is presented in table 2. The proximate composition revealed that boiled African pear seed meal (BAPSM) contained 4.44%, 8.63%, 3.41%, 11.01%, 72.89%, 11.53% and 88.47% of crude fibre, crude protein, ash, ether extract, nitrogen free extract, moisture and dry matter respectively. The dry matter of BAPSM in this study falls within the range of 85.25 – 87.53, as reported by Leaky (1999). The dry matter content in BAPSM suggests that it is rich in nutrients or feed material that can be utilized in various ways as a feed supplement to promote growth. The crude protein value of 8.63% in this study was higher than the 6.89% reported by Leaky (1999) but lower than the 9.63% and 18.03% reported by Uwem and Elechi (2020); Oneugbu *et al.* (2016).

The values for ash at 3.41% were similar to those of 3.45 and 3.19, as reported by Onuegbu *et al.* (2016) and Leaky (1999). The ether extract value (11.01%) in this study was higher than the 8.98% recorded by Leaky (1999) but lower than the 14.50% and 19.47% reported by Agbalaya *et al.* (2017); Onuegbu *et al.* (2016), respectively. Also, the crude fibre value of 4.44% was lower than the 7.42% reported by Leaky (1999) but higher than 1.06% and 3.17% reported by Onuegbu *et al.* (2016), Uwem and Elechi (2020), respectively. The variations observed in the proximate composition may be due to disparities in soil characteristics, climatic conditions of the area where the plant is cultivated, and differences in the analytical procedure employed. The high nitrogen-free extract value observed in BAPSM showed that African pear seed meal is rich in carbohydrates and could serve as an energy source in animal diets. Ajayi and Oderinde (2002) and Bratte (2007) reported that African pear seed is high in energy in the form of soluble carbohydrates and lipids.

The phytochemical composition showed the presence of tannin, saponin, flavonoid, polyphenol and alkaloid in boiled African pear seed meat at 0.48mg, 0.74, 3.06, 3.15 and 0.38mg/100g, respectively.

Flavonoids are phenolic compounds with a wide range of biochemical activities, including antioxidant, antimutagenic, and anticarcinogenic activities. Antioxidants are hydroxyl radical scavengers; they inhibit lipid peroxidation and superoxide ions (Ikpeamu *et al.,* 2014). Flavonoid content in feedstuffs could indirectly reduce the incidence of cardiovascular disease in humans.

Polyphenols are biologically active molecules with several beneficial effects such as antioxidant and anti-inflammatory. Alkaloids act as medicinal agent due to their analgesic and anti-bacterial properties (Edeoga & Ikem, 2001). Saponins have been reported to have hypocholesterolemic, anticarcinogenic, anti-bacterial and antiprotozoal properties (Koratkar & Rao, 1997). Tannin binds to proteins to form irreversible complexes due to the presence of a phenolic hydroxyl group (Smitha *et al.,* 2013). The presence of these bioactive compounds in boiled African pear seed meal will confer various medicinal effects if included in rabbit feed.

Parameters	Composition (% Dm)
Dry Matter	88.47
Crude Fibre	4.44
Ash	3.41
Ether Extract	11.01
Crude Protein	8.63
Nitrogen Free Extracts	72.89
Anti-nutrient mg/100g	
Alkaloid	0.38
Flavonoid	3.06
Saponin	0.74
Polyphenol	3.15
Tannin	0.48

Table 2: Proximate and Phytochemical Composition of Boiled African Pear Seed Meal

3.2. Performance of Weaner Rabbits-Fed Diet Containing Varying Levels of Boiled African Pear Seed Meal

The performance of Weaner rabbits fed a diet containing varying levels of boiled African pear seed meal is presented in table 3. The varying levels of BAPSM significantly ($p<0.05$) influenced the final body weight and weight gain of the rabbits across treatment. Rabbit-fed 15% BAPSM recorded the highest significant ($p<0.05$) value for final body weight and weight gain, followed by 10% and 5% BAPSM groups, while the lowest values for the two parameters were recorded in the 0% group. An increase in final body weight and weight gain progress significantly as the level of BAPSM increases in the diet. Better performance in animals is linked to feed quality, nutrient adequacy and effective utilization of nutrients in feed. The result of this study could suggest that the diets offered to the animals were of good quality, balanced in nutrients, and also met the recommended energy and protein requirements of Weaner rabbits. This result is similar to the report (Essien & Udedibie, 2007), where improved performances were observed in rabbits fed cracked, cooked, soaked, and cooked jack beans. Moreover, the result could reflect a low level of anti-nutritional substances in the feed.

The feed intake of the rabbits was significantly affected ($p<0.05$) by the diet. The feed intake of rabbits fed BAPSM was significantly higher than that of those fed 0% BAPSM. The high feed intake values in this study by rabbit-fed supplemented diets could be linked to the influence of boiling as an effective method of feed processing, which enhanced the reduction of anti-nutritional levels in BAPSM, thereby increasing palatability and acceptability and also improved the aroma of the diets. African pear seed has been reported to possess a turpentine odour and also contains some anti-nutritional substances that could affect its acceptability by animals (Bratte *et al.,* 2011; Uwem & Elechi, 2020). Nidaullah *et al.* (2010) reported that smell and taste are critical traits in food selection by animals. Moreover, Shaahu *et al.* (2020) opined that feed intake is a function of feed quality and palatability, especially the energy value of the feed. The result is similar to the result of AKintunde *et al.* (2020), who observed an increase in feed intake of broiler chickens fed boiled Bambara nuts.

The feed conversion ratio of the rabbit was significantly influenced ($p<0.05$) by the det. Rabbits fed 15% boiled African pear seed meal had the lowest feed conversion ratio, followed by those fed 10% and 5% BAPSM. The feed conversion ratio was superior with rabbits fed supplemented diets. The result of this study showed that as the feed quality, quantity and utilization increases, the amount of feed required to gain a unit weight by the rabbit decreases. Thus, the better feed conversion ratio obtained in this study portrays a balance of nutrients in feed and effective utilization of nutrients by rabbits fed boiled African pear seed meal.

Parameters	T_1	T_2	T_3	T_4	SEM
Initial Body Weight (g)	764.57	767.41	773.74	765.97	0.04
Total Body Weight (g)	1451.43^{d}	1533.74^{c}	1676.57^{b}	1753.41^{a}	12.41
Daily Weight gain (g)	686.86^{d}	766.33^{c}	902.83^{b}	987.44^{a}	13.47
Total feed intake (g)	$5344,54^{d}$	5873.57^{c}	6136.48^{b}	6556.54^{a}	21.52
Feed conversion ratio	7.78^{d}	7.66^{c}	6.80^{b}	6.64^{a}	1.97
Mortality	0.00	0.00	0.00	0.00	0.00

Table 3: Performance Characteristics of Weaner Rabbits-Fed Diet Containing Varying Levels of Boiled African Pear Seed Meal
ABCD - Means on the Same Row with Different Superscript Is Significantly Different (P<0.05)
SEM – Standard Error of Mean

3.3. Nutrient Digestibility Coefficient of the Weaner Rabbits

The nutrient digestibility coefficient of the Weaner rabbits is shown in table 4. The nutrient digestibility coefficient of the Weaner rabbits was significantly ($p<0.05$) affected by the diets. Rabbits fed a diet supplemented with boiled African pear seed meal depict superior nutrient digestibility coefficient compared to the control. The result showed the efficacy of boiling as an effective method of detoxification of anti-nutritional substances present in African pear seed,

thereby improving the nutritive value of the seed. The higher values of nitrogen-free extract in this study suggest a high content of soluble carbohydrates in African pear seeds (Ajayi & Oderinde, 2002; Bratte, 2007).
Also, crude fibre digestibility improved with higher inclusion levels of boiled African pear seed meal. This could be attributed to the low fibre content of African pear seeds. However, this result showed that boiled African pear seed did not exert any adverse effect on the rabbits' nutrient digestibility.

Parameters	T_1	T_2	T_3	T_4	SEM
Dry matter	81.34^d	83.62^c	86.73^b	89.01^a	0.34
Crude Protein	76.01^d	80.73^c	83.41^b	85.87^a	0.11
Ash	80.43^d	82.51^c	85.67^b	86.79^a	0.25
Ether Extract	70.64^d	73.89^c	75.71^b	79.03^a	0.03
Crude Fibre	74.56^d	77.44^c	79.68^b	82.51^a	0.31
NFE	80.21^d	83.52^c	85.63^b	87.32^a	0.02

Table 4: Nutrient Digestibility Coefficient of Weaner Rabbits-Fed Diet Containing Varying Levels of Boiled African Pear Seed Meal

NFE – Nitrogen-free extract
SEM – Standard Error of Mean
ABCD - Means on the same row with different superscripts is significantly different ($p<0.05$)

4. Conclusion

The study showed that processing African pear seeds through boiling greatly reduced the levels of anti-nutritional substances and also improved the seed's nutritive value. Also, the inclusion of boiled African pear seed meal up to 15% in rabbit feed could improve performance and nutrient digestibility.

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