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Research Article

Benefits of the Applications of Advanced Method in Food Inspection

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Abstract

This study was conducted to evaluate the growth performance and nutrient digestibility of weaned rabbit fed pawpaw seed oil-based diets in an eight weeks trial. Thirty-six weaned rabbits of an initial body weight of 517.0 ± 0.26 grams were randomly divided into four treatments with nine replicates consisting of one rabbit each in a completely randomized design. Experimental (basal) diet was adequate in all nutrients. Rabbits in treatment 1 were fed basal diet without pawpaw seed oil; treatment 2, 3 and 4 was fed same diet with pawpaw seed oil at 0.1 mL, 0.2 mL and 0.3 mL per kg diet correspondingly. Feed and clean water were supplied unrestricted and other management practices were strictly adhered to. Phyto-constituents in pawpaw seed oil revealed the presence of flavonoids (7.72 %), phenols (3.70 %), terpenoids (2.40 %), alkaloids (2.18 %), tannins (1.83 %) and steroids (0.06 %). Average daily weight gain was highest among rabbits fed treatment 3 (21.74 g) and 4 (22.12 g), intermediate in treatment 2 (17.55 g) and lower in treatment 1 (14.75 g) ($P<0.05$). Average daily feed intake was influenced ($P<0.05$). Mortality was recorded only in treatment 1 (2.00 %), none was recorded in the other treatment ($P<0.05$). Dry matter, crude protein, crude fibre and ether extract digestibility were significantly ($P<0.05$) different among the treatment. In conclusion, rabbits in treatment 3 and 4 had better performance and this could be attributed to the activities of bioactive components in pawpaw seed oil. These active components have been proven to have the ability to stimulate digestive enzymes such as lipase, amylase, or protease which can improve intestinal morphology and in turn facilitate growth.

Key Words: antioxidants; growth; oil; phyto-constituents; rabbits

Introduction

Growing antibiotic resistance is leading to a continuous need for discovering new drugs and alternative treatments against diseases. Essential oils have been receiving attention from a wide variety of research groups in search for antimicrobial activity because of the absence of toxic substance, effectiveness and without withdrawal periods (1, 2, 3). Among the potential alternatives to antibiotics is pawpaw seed oil which is rich in antioxidant vitamins and minerals such as phosphorous, iron, potassium, calcium and magnesium (4, 5).

Pawpaw **(**Carica papaya**),** is a succulent fruit that belongs to a large plant of the family Caricaceae (6). It is cultivated throughout the tropical world and into the warmest parts of the subtropics. The papaya plant is considered a tree, though its palm like trunk up to of about 26 feet tall is not as woody as the description generally implies. The plant is crowned with deeply lobed leaves, borne on hollow petioles (leaf stalks) 60 cm long. The fruit is melon-like, round or long, and may contain more than 1000 seeds. The skin is smooth and green, but turns yellow or orange when ripe.

Papaya seeds contain oil and fatty acids such as oleic acid, palmitic acid, stearic acid and some triacylgycerols (7). They are rich in polyphenols, flavonoids, alkaloids, tannins and saponins which are strong antioxidants that prevent the body from damage by free radicals (8). Papaya seeds contain carpaine which is known for its anti-bacteria properties, hence, capable of killing unwanted bacteria and parasites in the intestines and thus keep the digestive system healthy.

Field trials have shown the great benefit of essential oils in improving growth performance, reducing the activities of pathogenic organisms and promoting the immune system of animals due to the presence of bioactive compounds

in them (1, 9, 10). (11) also reported that pawpaw seed oil can be supplemented up to 2 mL in the diet of broilers without compromising their health status. However, there is little or no report on the use of pawpaw seed oil on the performance of rabbits. This research is timely, because there is rapid increase in cases of antimicrobial resistance, exploring the use of phyto-constituents in pawpaw seed oil will help to improve animal performances in order to boost production of animal protein to meet the increasing demands, bearing in mind that these phytogenic materials must be used with caution.

This study was conducted to see how much pawpaw seed oil and all its components can improve performance in rabbits.

Materials and Methods

Experimental Site

This experiment was conducted at the Animal science section of the Teaching and Research Farm, University of Abuja, Abuja, Nigeria. The site lies between latitude 80 5629 North, 70 5 31 East, and longitude 0070 20 North and 0070 51 East. It covers a total land mass of 65 sq. km (6,500 hectare), it is 282m above sea level.

Source and extraction of Pawpaw seed oil

Ripe pawpaw fruits were harvested from University of Abuja, Teaching and Research Farm and taken to the Department of Biological Sciences for identification and authentication by a certified taxonomist and assigned a voucher number (AD/021/007). Seeds were collected from the ripe fruits, air dried for 10 days and milled using an electronic blender. 200 grams of grinded sample was placed in a sealed filter paper and set in a Soxhlet apparatus for the extraction of oil. Collected oil sample was sent to the laboratory for further examination.

Experimental animals, management and design

A total of thirty-six weaned rabbits (Chinchilla × Newzealand white) with an initial body weight of 517.0 ± 0.26 grams were used for this experiment. The rabbits purchased from a reputable source, placed on two weeks quarantine period, fed basal diet which was adequate in all nutrients according to Nutritional Research Councils recommendation in 2007 and also treated against parasites using Albendazole® (1 tablet to 500 grams body weight). The experimental animals were housed individually in wired hutches measuring 100 cm by 80 cm by 40 cm (length × width × height) raised above the floor. All experimental animals were subjected to the same housing and management conditions. The rabbits were balanced for weights and assigned to four treatment groups in a completely randomized design (CRD) in a feeding trial that lasted for (8) weeks. Rabbits in treatment 1 were fed basal diet without pawpaw seed oil while treatment 2, 3 and 4 were fed same diet supplemented with pawpaw seed oil at 0.1 mL, 0.2 mL and 0.3 mL per kilogram respectively.

Performance evaluation

Daily feed intake was obtained by subtracting the left over from the feed served expressed in grams. Body weight gain was estimated by subtracting initial body weight from final body weight. Average daily weight gain and average daily feed intake was calculated by dividing body weight gain and total feed intake by the duration of experiment (56 days). The feed conversion ratio was determined by dividing average daily feed intake by the average daily weight gain.

Digestibility trial

Digestibility study was carried out at the end of the experiment. Five rabbits were selected from each of the treatment weighed, isolated and subjected to digestibility trial for seven days in a metabolic cage. Within the seven days, two days were used as an acclimatization period while five days were used for data collection. Total droppings voided from each treatment were weighed and recorded. Collected wet droppings were oven dried at 80°C for 48 hours and dry matter content determined by subtracting the moisture content from 100. Droppings from the same treatment were thoroughly pooled before they were sent to the laboratory for further analysis. Record of feed consumed was also recorded. The nutrient digestibility was estimated using the formula:

Nutrient Digestibility = Nutrient intake Nutrient in droppings × 100

Nutrient intake

Proximate analysis of experimental diet and faecal droppings

Near infra-red kit (Model: TNOP NIRS^{TM}, Netherlands) was used to analyze experimental diet and faecal droppings. 100 grams of each sample was placed in a collection tray after putting on the start button and kit was operated according to the manufacturer's recommendation. Result was obtained within 60 seconds and printed out from the visual display unit. To ensure precision in results, optical band, data resolution and wavelength was maintained at 9.00 nm, 0.6 nm and 2600 nm respectively.

Phytochemical evaluation of pawpaw seed oil

Concentrations of alkaloids, tannins, flavonoids, terpenoids, saponins, steroids and phenolic compounds were computed at different optical density using Lans® (model DF-008UD, China) gas chromatography and mass spectrometry. All other machine configuration was carried out according to the manufacturer's recommendation following (12) procedure.

Statistical analysis

Data obtained (growth performance and nutrient digestibility) were subjected to analysis of variance (ANOVA) using the computer software package (SPSS version 21.0) differences among treatment means was compared with Duncan's multiple range test.

Results and Discussion

Materials	Quantity (kilogram)
Maize	25.00
Wheat bran	15.00
Soybean meal	20.05
Maize offal	7.00
Rice husk	29.00
Fish meal (72 percent)	1.00
Dicalcium posphate	2.00
Lysine	0.05
Vit/Min premix*	0.45
Salt	0.50

Total	100.00

Table 1: Ingredients and experimental diets

Phyto-constituents in pawpaw seed oil

Phyto-constituents in pawpaw seed oil as presented in Table 2 revealed that flavonoids had the highest concentration (7.72 %) followed by phenolic compound (3.70 %), terpenoids (2.40 %), alkaloids (2.18 %), tannins (1.83 %), saponins (1.40 %) and steroids (0.06 %) correspondingly. The presence of these phyto-constituents suggests that pawpaw seed oil had numerous medicinal value or pharmacological properties such as, antimicrobial, antifungal, hepato-protective, immune-stimulatory, antiviral, cytotoxic, antioxidant, antibacterial, anti-cancer, anti-diuretic, amongst others (13, 14). Oils with medicinal value are generally regarded as safe and have no withdrawal period (15, 16). They have also been proposed as natural alternatives that can curb the increasing cases of antimicrobial resistance (17). For instance, flavonoid and phenols have been recognized to possess antioxidant properties and showed a broad spectrum against pathogenic organisms such as *Escherichia coli*, *Staphyllococcus spp*, *Streptococcus spp*, *Pseudomonas spp*, *Aspergillus spp*, *Candida albicans*, *Bacillus spp* amongst others (18, 19). Alkaloids have been suggested to possess antidiabetic, analgesics and antimicrobial properties (20, 21). Tannins have been suggested to possess antibacterial properties (22, 23). Terpenoids and steroids also show antimicrobial and anti-diarrhoeal effects by membrane disruption and inhibit release of autacoids and prostaglandins (24, 25). The result on phyto-constituents in pawpaw seed oil recorded in this study is contrary to the reports in another research. This discrepancy could be due to processing or extraction method, species, age of plant and geographical location (26, 1).

Variables	% composition
Alkaloids	2.18
Flavonoids	7.72
Saponins	1.40
Steroids	0.06
Tannins	1.83
Terpenoids	2.40
Phenols	3.70

Table 2: Phyto-constituents in pawpaw seed oil

Performance characteristics of weaned rabbits fed pawpaw seed oil

Performance characteristics of weaned rabbits fed pawpaw seed oil presented in Table 3. Average daily body weight, average daily feed intake and feed conversion ratio took the form of 14.75 – 22.12 grams, 70.42 – 74.78 grams and 3.40 – 4.00 correspondingly. Body weight gain and total feed intake follows similar trend. Rabbits fed diet supplemented with 0.2 mL pawpaw seed oil/ kg diet (treatment 3) were similar (P>0.05) to those fed 0.3 mL pawpaw seed oil/ kg diet (treatment 4) but significantly (P<0.05) higher than those fed treatment 2 (0.1 mL pawpaw seed oil/ kg diet and control diet (without pawpaw seed oil; treatment 1). Higher average daily weight gain recorded in treatment 3 and 4 suggests that the presence of phyto-constituents in pawpaw seed oil can promote the production of digestive secretions and nutrient absorption encouraging balanced microbiota, and supporting a good immune status (2, 11). This also explains reasons why mortality was not recorded in this treatment implying that supplementing pawpaw seed oil at 0.2 mL and 0.3 mL/kg diet can improve the health status of rabbits. The result obtained in this study is in agreement with the findings of (10 and 9) when diet containing *Alchornea cordifolia* leaf was fed to growing rabbits. Similar result was recorded by (27) who recorded a higher body weight in animals fed diets supplemented with quercertin. Average daily feed intake was higher (P<0.05) in pawpaw seed oil supplemented treatment compared to the control. This indicates that it possesses flavoring properties which can improve the palatability. Results obtained is in agreement with the reports of (28) when dried garlic was fed to broilers.

Parameters	T_1	T_2	T_3	T_4	SEM
IBW (g)	517.03	517.00	516.86	516.74	26.11
FBW (g)	1411.11^c	1500.00^b	1734.55^a	1755.55^a	25.02
BWG (g)	894.08^c	983.00^b	1217.69^a	1238.81^a	26.60
ADWG (g)	14.75^c	17.55^b	21.74^a	22.12^a	0.47
FI (g)	3743.48^c	3955.19^b	4172.57^a	4187.42^a	18.36
ADFI (g)	68.42^c	70.63^b	74.51^a	74.78^a	0.65
FCR	4.00^a	3.91^b	3.41^c	3.40^c	0.05
Mortality (%)	0.27	-	-	-	0.55

Table 3: Performance characteristics of weaned rabbits fed pawpaw seed oil

Means in the same row with different superscripts differ significantly (P<0.05); IBW: initial body weight; FBW: final body weight; BWG: body weight gain; ADWG: average daily weight gain; FI: feed intake; ADFI: average daily feed intake; FCR: feed conversion ratio; T_1: basal diet without pawpaw seed oil; T_2: Basal diet with 0.1 mL pawpaw seed oil; T_3: Basal diet with 0.2 mL pawpaw seed oil; T_4: Basal diet with 0.3 mL pawpaw seed oil

Effect of pawpaw seed oil on the nutrient digestibility of weaned rabbits

Effect of pawpaw seed oil on the nutrient digestibility of weaned rabbits is presented in Table 4. Dry matter, crude protein, crude fibre and ether extract values took the form of 79.82 – 87.06 %, 58.32 – 70.99 %, 41.81%, 50.80 % and 30.91 – 40.58 % in that order. Dry matter, crude protein, crude fibre and ether extract values were higher in treatment 3 and 4, intermediate in treatment 2 and lower in treatment 1 (P<0.05). The result obtained suggests that pawpaw seed oil supplementation at 0.2 mL and 0.3 mL per kg diet in treatment 3 and 4 may promote feed efficiency with the regulation of the gastro intestinal tract due to the presence of biologically active compounds

in pawpaw seed oil (29). The result obtained in this study is in agreement with the reports of (30) who recorded a positive result when thyme extract was fed to rabbits.

Variables (%)	T_1	T_2	T_3	T_4	SEM
Dry matter	79.82[c]	83.00[b]	85.00[a]	87.06[a]	0.42
Crude protein	58.32[c]	60.69[b]	70.76[a]	70.99[a]	0.04
Crude fibre	41.81[c]	46.92[b]	50.85[a]	50.80[a]	0.67
Ether extract	30.91[c]	37.07[b]	40.35[a]	40.58[a]	0.30

Table 4: Effect of pawpaw seed oil on the nutrient digestibility of weaned rabbits

Means in the same row with different superscripts differ significantly (P<0.05) DM: dry matter; CP: crude protein; CF: crude fibre; EE: ether extract; T_1: basal diet without pawpaw seed oil; T_2: Basal diet with 0.1 mL pawpaw seed oil; T_3: Basal diet with 0.2 mL pawpaw seed oil; T_4: Basal diet with 0.3 mL pawpaw seed oil

Conclusions

In conclusion, pawpaw seed oil contains several phyto-constituents with pharmacological properties, including antimicrobial, antifungal, hepato-protective, immune-modulatory, antioxidant activities amongst others. Pawpaw seed oil has proven to be potent at 0.2 mL and 0.3 mL per kg of feed, thus improving the growth performance of rabbits without compromising their health status. Pawpaw seed oil can be used in future to safeguard antibiotics for future use in animal production.

References

1. Shittu, M.D., Alagbe, J.O., Adejumo, D.O., Ademola, S.G., Abiola, A.O., Samson, B.O and Ushie, F.T. (2021). Productive Performance, Caeca Microbial Population and Immune-Modulatory Activity of Broiler Chicks Fed Different Levels *Sida Acuta* Leaf Extract in Replacement of Antibiotics. *Bioinformatics and Proteomics Open Access Journal* 5(1), 000143.
2. JOHN, A.O. (2024). Clerodendron splendens leaf extract supplementation in weaner rabbits: impact on growth performance, haematology and intestinal microbial population. *Cerrado: Agricultural and Biological Research*, 1(1), 21-31.
3. AGUBOSI, O.C.P., ALEXANDER, JAMES AND ALAGBE, J.O. (2022). Influence of dietary inclusion of Sunflower (*Helianthus annus*) oil on growth performance and oxidative status of broiler chicks. *Central Asian Journal of Medical and Natural Sciences*, 2(7), 187-195.
4. ALMORA K, PINO J A, HERNÁNDES M, DUARTE C, GONZÁLEZ J AND RONCAL E (2004) Evaluation of volatiles from ripening papaya Carica papaya L. var. Maradolroja. Food Chem. 86, 127-13
5. ONYEYIRICHI I, MOHAMMED G, BALA M M, BALA S AND ALIYU N (2015) Chemical Composition of chloroform extract of Carica papaya seed oil. Intl. J. Mod. Biochem. 4(1), 15-22.
6. ADEJUWON, A.A (2014). Toxicological Survey of African Medicinal Plants
7. YOGIRAJ V, GOYAL P K, CHAUHAN C S, GOYAL A AND VYAS B (2014). Carica papaya Linn: An overview. Intl. J. Herbal Med. 2(5), 01-08.
8. YANTY N A, MARIKKAR J M, NUSANTORO B P, LONG K AND GHAZALI H M (2014) Physico-chemical characteristics of papaya (Carica papaya L.) seed oil of the Hong Kong/Sekaki variety. *J. Oleo. Sci.* 63(9), 885-892.
9. OLORUNTOLA, O. D., AYODELE, S. O., AGBEDE, J. O., OLORUNTOLA, D. A., OGUNSIPE, M. H. & OMONIYI, I. S. (2016). Effect of Alchornea cordifolia leaf meal and enzyme supplementation on growth, haematological, immunostimulatory and serum biochemical response of rabbits. *Asian Journal of Biological and Life Sciences*, 5(2), 190−195.
10. AYODELE, S. O., OLORUNTOLA, O. D. & AGBEDE, J. O. (2016). Effect of diet containing Alchornea cordifolia leaf meal on performance and digestibility of Weaner rabbits. *World Rabbit Science*, 24, 201−206.
11. DANIEL N. A, FRIDAY U. & ALAGBE O. J (2023). Investigating the effects of pawpaw (*Carica papaya*) essential oil dietary supplementation on the growth performance and carcass characteristics of broilers. Research in: *Agricultural and Veterinary Sciences*, 7(3), 164 - 174.
12. ALAGBE O. J (2024). Novel phytogenics' impact on weaned pigs' growth performance, haematology and serum biochemical indicators. *Black Sea Journal of Agriculture*, 7(2), 82-89.
13. ALIYU K. I AND ADEYINA A. O (2022). Phytochemical, vitamin compositions and antioxidant potential of kigelia africana fruit and leaf meals. Asian Journal of Advances in Research 5(1): 664-667
14. SINGH SHARMA., ALAGBE OLUJIMI JOHN., LIU XING., SHARMA RAM AND KUMAR AMITA (2022). Comparative analysis of ethanolic *Juniperus thurifera* leaf, stem bark and root extract using gas chromatography and mass spectroemetry. *International Journal of Agriculture and Animal Production*, 2(6), 18-27.
15. OJEDIRAN, T.K., EMIOLA, I.A., DUROJAYE, V AND JOHN ALAGBE (2024). Proximate, vitamin and GC-MS profiling of Kigella africana powder. *Cerrado: Agricultural and Biological Research*, 1(1): 13-20.
16. MANILAL, A., SUJITH, S., SABARATHNAM, B., KIRAN, G.S., SELVIN, J., SHAKIR, C. & LIPTON, A. (2011). Biological activity of the red algae Laurencia brandenii. Acta Botanica Croatica, 70 (1), 81-90
17. MUSA, B., ALAGBE, J.O., ADEGBITE MOTUNRADE BETTY & OMOKORE, E.A. (2020). Growth performance, caeca microbial population and immune response of broiler chicks fed aqueous extract of *Balanites aegyptiaca* and *Alchornea cordifolia* stem bark mixture. *United Journal for Research and Technology*, 2(2), 13-21.
18. OFOKANSI, C., ESIMONE, C.O. & ANELE, C.R. (2005). Evaluation of the invitro Combined Antibacterial Effect of the Leaf Extracts of Bryophillum pinnatum (Fam. RASSULACEAE) and Ocimum gratissum (FAM: LABIATAE*). Plant Product Research Journal*, 9, 23-27.
19. DOUGHARI, J.H. (2012). Phytochemicals: Extraction Methods, Basic Structures and Mode of Action as Potential Chemmotherapeutic Agents- A Global Perspective of Their Role in Nutrition and Health. Dr. Venketeshwer Rao. Ed). ISBN: 978-953-51-0296-0. Intech.
20. AJIBOYE, A.A., AGBOOLA, D.A., FADIMU, O.Y. & AFOLABI, A.O. (2013). Antibacterial, Phytochemical and Proximate Analysis of Prosopis africana (LINN) Seed and Pod Extracts. *FUTA Journal of Research in Sciences*, 9 (1), 101-109.
21. ODOZI, B.E., IBEH I N., ODOZI P.I., OSAKWE, A.A & OTOIKHIAN, C.S.O. (2014). Antimicrobial activity of aqueous

and methanol extract of Prosopis africana on selected bacteria isolates. *Indo-American Journal of Life Science and Biotechnology*, 2 (2), 10-14.

22. EDEOGA, H.O., OKWU, D.E. & MBAEBIE, B.O. (2005). Phytochemical constituents of some Nigerian medicinal plants. African Journal of Biotechnology, 4 (7), 685-688.
23. LIMA, A.L., PARIAL, R., DAS, M AND DAS, A.K. (2010). Phytochemical and Pharmacological studies of ethanolic extact from the leaf of mangrove plant Phoenix paludosa Roxb. Malaysian Journal of Pharmaceutical Sciences, 8 (2), 59-69.
24. TIWARI, P., KUMAR., B., KAUR, M., KAUR, G. & KAUR, H. (2011). Phytochemical screening and Extraction: A Review: *International pharmaceutica sciencia*, 1 (1), 98-106.
25. SIMLAI, A. & ROY A. (2012). Analysis of and correlation between phytochemical and antimicrobial constituents of Ceriops decandra, a medicinal mangrove plant, from Indian Sundarban estuary. *Journal of Medicinal Plants Research*, 6 (32), 4755-4765
26. OJEDIRAN, T.K., EMIOLA, I.A., DUROJAYE, V AND JOHN ALAGBE (2024). Analysis of Kigellia africana fruit' s powder antioxidant and phytochemical properties. *Brazilian Journal of Science*, 3(7): 38-49.
27. GOLIOMYTIS, M., TSOUREKI, D., SIMITZIS, P. E., CHARISMIADOU, M. A., HAGER-THEODORIDES, A. L. & DELIGEORGIS, S. G. (2014). The effects of quercetin dietary supplementation on broiler growth performance, meat quality, and oxidative stability. *Poultry Science*, 93, 1957−1962.
28. ONYIMONYI, A. E., CHUKWUMA, P. C. & IGBOKWE C. (2012). Growth and hypocholesterolemic properties of dry garlic powder (Allium sativura) on broilers. *African Journal of Biotechnology*, 11(11), 2666−2671.
29. MOJCA, O.M. (2021). Full natural phytogenic support for intestinal integrity in Poultry. International Poultry Magazine, 1(8), 2-4.
30. ALIPOUR, F., HASSANABADI, A., GOLIAN, A. & NASSIRI-MOGHADDAM, H. (2015). Effect of plant extracts derived from thyme on male broiler performance. *Poultry Science*, 94(11), 2630−2634.

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