Effect of Dietary Substitution of Maize with Palm Oil Press Fibre on Performance and Cost of Producing Finishing Broiler Chickens

Ikpe, J. N.[*], Mbachu, M. U.[**], Oko, E. C.[*], Abdullahi, J.[*], Ahaotu, E. O.[***] Simeon-Ahaotu, V. C.[****] and Vining-Ogu, I. C[*****].

[*]*Department of Animal Health and Production Technology, Akanu Ibiam Federal Polytechnic, Unwana, Ebonyi State, Nigeria.*

*** Department of Agriculture, Alvan Ikoku Federal University of Education, Owerri, Imo State, Nigeria.*

****Department of Animal Science, University of Agriculture and Environmental Sciences, Umuagwo, Imo State, Nigeria.*

*****Department of Microbiology, Gregory University, Uturu, Abia State, Nigeria.*

******Department of Science Laboratory Technology, Akanu Ibiam Federal Polytechnic, Unwana, Ebonyi State, Nigeria.*

Corresponding author:julianankpe@gmail .com :+2348034958

Abstract

The soaring cost of maize that make up about 60% of broiler feed production has resulted to exorbitant cost of the feed. This situation calls for discovery of alternatives. A research was therefore conducted to investigate the effect of substituting maize with Palm oil Press Fibre (PPF) in finisher broiler diet. One hundred and twenty finishing broilers of 28 days post hatch were randomly assigned to four experimental diets in a complete randomized design arrangement. Diet C_1 which was the control diet contained no PPF while in diets C_2, C_3 and C_4 PPF meal replaced maize at 16.67, 33.33 and 50%, respectively making up 10, 20 and 30% inclusion levels, respectively. The broilers were raised on deep litter system, water and feed were provided ad libitum and proper routine management practices adopted. The feeding period lasted for 28 days. Data was collected on weight gain, feed intake, feed conversion ratio, mortality and cost of producing the broilers. Broilers on the control diet was similar ($P>0.05$) with broilers on C_2 group for weight gain, feed intake and feed conversion ratio but significantly different ($P<0.05$) from C_3 and C_4 groups on these parameters while C_3 and C_4 groups were similar ($P>0.05$) on these parameters. The cost of raising 1Kg chicken was least for broilers in C_2 group, followed by the control and then C_3 while C_4 gave the highest production cost. No mortality was encountered. 16% substitution of maize (10% inclusion) with PPF meal is therefore ideal for finishing broilers production.

Key words: Palm Press Fibre, chicken, growth, production cost

Running title: Performance and cost effectiveness of feeding broiler chickens with Palm Press Fibre meal

Effet de la substitution du maïs par la fibre de pressage de palme dans l'alimentation sur les performances et le cout de production des poulets de chair en finition

Résumé

Le coût élevé du maïs, qui constitue environ 60 % de l'aliment pour poulets de chair, a entraîné un prix exorbitant de cet aliment. Cette situation nécessite la recherche d'alternatives. Une étude a donc été menée pour évaluer l'effet du remplacement du maïs par de la Fibre de Pressage de Palme (FPP) dans l'alimentation des poulets de chair en finition. Cent vingt poulets de chair en finition âgés de 28 jours post-éclosion ont été répartis aléatoirement selon un dispositif complètement randomisé en quatre groupes correspondant à des régimes expérimentaux. Le régime C1, qui était le régime témoin, ne contenait pas de FPP, tandis que dans les régimes C_2, C_3 et C_4, la farine de FPP remplaçait le maïs à des taux de 16,67 %, 33,33 % et 50 %, représentant des niveaux d'incorporation de 10 %, 20 % et 30 %, respectivement. Les

poulets ont été élevés sur litière profonde, l'eau et l'aliment étaient fournis ad libitum et les bonnes pratiques de gestion de routine ont été respectées. La période d'alimentation a duré 28 jours. Les données ont été recueillies sur le gain de poids, la consommation alimentaire, l'indice de conversion alimentaire, la mortalité et le coût de production des poulets. Les performances des poulets du régime témoin étaient similaires (P>0,05) à celles des poulets du groupe C_2 pour le gain de poids, la consommation alimentaire et l'indice de conversion, mais significativement différentes (P<0,05) de celles des groupes C_3 et C_4 pour ces paramètres, tandis que les groupes C_3 et C_4 étaient similaires (P>0,05) pour ces mêmes paramètres. Le coût d'élevage d'un kilogramme de poulet était le plus faible pour les poulets du groupe C_2, suivi du groupe témoin, puis du groupe C_3, tandis que le groupe C_4 présentait le coût de production le plus élevé. Aucune mortalité n'a été enregistrée. Une substitution de 16 % du maïs (soit un niveau d'incorporation de 10 % de FPP) est donc idéale pour la production de poulets de chair en finition.

Mots-clés : Fibre de Pressage de Palme, poulet, croissance, coût de production

Introduction

The current exorbitant rise in the cost of feeding broilers has led to the interest in the sourcing for inexpensive alternate feed ingredients as replacement to the more expensive conventional feed ingredients in poultry feed formulation. Maize makes up 55 to 70% of the finished feed for poultry (Agriculture. Institute, 2023). Presently in Nigeria, maize has become so expensive, which has resulted to high production cost. It is therefore crucial to explore the use of other agricultural wastes which has little or no cost in poultry feed production. An agricultural waste of interest is Palm oil Press fibre (PPF) which is the fibrous material that remains after decanting the palm oil mill effluent. Nigeria is ranked fifth largest producer of palm oil in the world, following Indonesia, Malaysia, Thailand and Colombia, and accounts for 7% of global production (People's voice, 2025: Shahbandeh, 2025). Presently, heaps of PPF are seen around most palm oil producing mills within the areas where palm fruit is processed. This could become an environmental problem since the delayed use of PPF has been reported to result in bioconversion to methane, which directly contributes to greenhouse gas emissions (IEA, 2022). The chemical composition of PPF ranges from 6.50% moisture content, 93.91% dry matter, 3.6 – 7.5% crude protein, 33.18-35.73 % carbohydrate, 5.56 - 40.13% of fat and 14.6% crude fibre depending on the method of the palm oil extraction (Heuzé *et al.*, 2015). This study therefore was designed to evaluate the effect of dietary substitution of maize with PPF meal on the performance and production cost of finishing broilers.

Materials and methods

The research was conducted at the Teaching and Research Farm, Akanu Ibiam Federal Polytechnic, Unwana, Afikpo North, Local Government Area, Ebonyi State. Unwana is in tropical rain forest zone of Nigeria.

Collection and preparation of Palm Press Fibre (PPF)

The PPF was collected from a local palm oil mill at Afikpo South, Local Government Area, Ebonyi State, sun dried to crispiness and was hammer milled to obtain the Palm Press fibre Meal (PPFM). Proximate composition of the PPFM was carried out according to A.O.A.C (2000).

Experimental birds and design

A total of 120 Ross 308 breed of finishing broilers of 28 days post hatch were used for the research following a Completely Randomized Design (CRD). Each treatment group had 30 broiler birds that were replicated three times. The weight of the birds per replicate groups was adjusted to give near uniform initial weights to all the groups. The broiler birds were managed under deep litter adopting strict ethical standards. Water and feed were given *adlibitum.* The feeding period lasted for 28days.

Experimental diets

Four experimental diets were formulated for the research. Diet C_1 which was the control contained 0% PPFM. In C_2, C_3 and C_4 diets, PPFM substituted maize at 16.67% (10% added), 33.33% (20% added) and 50% (30% added), respectively. The palm oil press fibre was added on weight-to-weight basis. The ingredient composition of the diet is represented in table 1.

Table 1. Ingredients and calculated nutrient composition of the experimental diets

Ingredients	Treatment Levels (%)			
	C_1(0.00PPFM)	C_2 (10.00PPFM)	C_3 (20.00PPFM)	C_4 (30.00PPFM)
Maize	60.00	50.00	40.00	30.00
Palm oil press fibre meal	0.00	10.00	20.00	30.00
Ground nut cake	9.00	9.00	9.00	9.00
Soyabean meal	8.00	8.00	8.00	8.00
Brewers dried grains	12.00	12.00	12.00	12.00
Fish meal	3.00	3.00	3.00	3.00
Blood meal	3.00	3.00	3.00	3.00
Bone meal	4.00	4.00	4.00	4.00
**Vit. Premix	0.25	0.25	0.25	0.25
Lysine	0.25	0.25	0.25	0.25
Methionine	0.25	0.25	0.25	0.25
Common salt	0.25	0.25	0.25	0.25
Total	**100**	**100**	**100**	**100**
Calculated nutrient levels of the diets				
Crude protein (%)	20.46	20.88	21.24	21.60
Crude fibre (%)	3.96	4.41	4.86	5.31
Calcium (%)	0.15	0.47	0.79	0.11
Phosphorus (%)	0.42	0.75	0.08	0.41
Fat (%)	4.61	4.53	5.49	4.37
Ash (%)	6.96	7.53	8.07	8.63

*ME (kcal/kg)	2985.63	2957.04	2935.51	2897.45

***To provide the following per kilogram of feed; Vit A 10,000IU; vit D3 1500 IU; Vit. E 2mg; riboflavin 3mg; pantothenic acid 10mg; nicotinic acid 2.5mg; choline 3.5mg; folic acid 1mg; magnesium 56mg; lysine 1mg; iron 20mg; zinc 50mg Cobalt 1.25mg. * M.E of Palm Press Fibre meal was calculated according to (Pauzega, 2007) ME = 35 × % CP + 81.8 × % E.E + 35.5 × % NFE, where, M.E = metabolizable energy, CP = crude protein, EE = ether extract, NFE = nitrogen free extract.*

Data collection and analysis

The broiler chickens were weighed using a digital table scale at the beginning of the research and subsequently weighed on weekly basis till the end of the research to obtain their weight. Feed intake was determined by subtracting the weight of the leftover feed from the weight of feed offered after 24 hours. Feed conversion ratio was obtained by dividing the total feed intake with total weight gain while mortality was monitored during the course of the research. The cost analysis was computed based on prevailing cost of ingredients used for diet formulation. The data obtained were subjected to statistical analysis using one-way analysis of variance procedure at ($P < 0.05$) level of Significance and computed with GenStat 22 edition analytical software.

Results

Proximate composition of PPFM

The result of the proximate analysis of the PPFM is presented in table 2. The result showed that the PPFM contained a crude protein of 12.61%, crude fibre of 7.21%, ether extract of 3.32%, ash of 6.87% and nitrogen free extract of 60.78%.

Table 2. Proximate composition of PPFM

Nutrient	Percentage Levels
Dry Matter	90.76
Crude Protein	12.61
Crude Fibre	7.21
Ether Extract	3.32
Ash	6.87
Nitrogen Free Extract	60.78
Metabolizable energy (Kcal/kg)	2,891.16

Performance of the finisher broilers fed varying levels of PPFM

The performance of the finisher broiler fed different inclusion rates of PPFM as presented in table 3 showed that the final weight of the broilers in the C_2 group (2683.33g) was similar ($P>0.05$) with the broilers in the C_1 (control) group but significantly higher ($P<0.05$) from broilers in C_3 (2180.00) and C_4 (1940.00) groups. The broilers in the C_3 and C_4 groups were similar ($P>0.05$). The weight gain and feed conversion ratio of broilers had the same trend with the final weight, the broilers in control group were similar ($p>0.05$) with C_2 in these parameters but

significantly higher ($p<0.05$) than C_3 and C_4 while C_3 and C_4 did not differ ($P>0.05$). Broilers in the control group had a daily feed intake of 182.79g which was similar ($P>0.05$) with the C_2 (176.17g) and C_3 (175.10g) but significantly ($P<0.05$) lower than the daily feed intake of (190.57g) for broilers in the C_4 group. No mortality was record among the treatment groups during the research period.

Table 3. Performance of finisher broilers fed varying levels of PPFM

Parameters	Treatment levels (%)				SEM
	C_1(0.00PPF)	C_2(10.00PPF)	C_3 (20.00PPF)	C_4(30.00PPF)	
Initial body wt (g)	1193.33	1091.00	1120.00	1030.00	11.55
Final body wt (g)	2843. 33 [a]	2683.33 [a]	2180.00 [b]	1940.00 [b]	181.05
Body wt gain (g)	1650. 00 [a]	1592.00 [a]	1060.00 [b]	910.00 [b]	179.47
Daily wt gain (g)	78.57 [a]	75.77 [a]	50.88 [b]	43.30 [b]	8.58
Daily Feed intake (g)	182.79 [b]	176.17 [b]	175.10 [b]	190.57 [a]	7.26
Feed Conversion ratio	2.35[b]	2.38[b]	3.50 [a]	4.28 [a]	0.39
Mortality (number)	0	0	0	0	0.0

Note: Without superscript = not significant. Means within row with different super script differ significantly ($P<0.05$) SEM = standard error mean. Av = Average, wt = weight.

Cost effectiveness of finisher broiler feed Varying levels of PPFM

The cost effectiveness of the production as presented in table 4 showed reduction in the cost of producing 1kg of feed as inclusion level of PPFM increased. The cost of kg feed was ₦235.80, ₦213.90, ₦190.80 and ₦168.90 for C_1, C_2, C_3 and C_4 respectively. The cost of feed consumed by the broilers within the period of the research was highest for control group which was ₦1207.30 but progressively declined to ₦1054.53, ₦934.92 and ₦901.93 for treatments C_2, C_3 and C_4 respectively. The cost of feed consumed to obtain a kilogram weight gain of the broiler however, was highest for broiler in C_4 (₦991.13) and least (₦662.39) for broilers in C_2 group. The cost per Kg final weight was also highest (₦464.91) for C_4 group and least (₦393.04) for broilers in the C_2 group.

Table 4. Cost effectiveness of finisher broilers fed varying levels of PPFM

Parameters	Treatment level (%)			
	C_1 (0PPF)	C_2 (10PPF)	C_3 (20PPF)	C_4 (30PPF)
Final body wt (g)	2843	2683	2180	1940
Total body wt gain (g)	1650	1592	1060	910

Total feed consumed per bird (kg).	5.12	4.93	4.90	5.34
Feed cost for 100kg (₦)	23578.25	21328.25	19078.25	1682.25
Feed cost per kg (₦)	235.8	213.9	190.8	168.9
Cost of feed consumed per bird (₦)	1207.30	1054.53	934.92	901.93
Cost of feed consumed per bird/kg wt gain (₦)	731.70	662.39	882.00	991.13
Cost of feed consumed per bird per kg final wt (₦)	424.66	393.04	428.86	464.91

Note: wt = weight

Discussion

Proximate composition of PPFM

The chemical composition of the PPFM obtained in the present research had a higher level of crude protein compared to report of (Bamikole and Ikhatua, 2009: Heuzé et al., 2015). The difference in the chemical composition could be as a result of variation in location of the palm fruits and the processing technique adopted during the oil extraction (Rhule, 1996).

Performance of the finisher broilers

The result of the present research is an indication that the broilers in C_2 group utilized PPFM efficiently as maize and that PPFM can substitute maize at 16.67% rate (10% inclusion) without causing any deviation in any of the performance parameters. At higher inclusion rates of 20% and 30% (33 and 50% substitution of maize with PPFM) however, there was a reduction in weight gain which is an indication that PPFM cannot replace maize effectively at such a higher rate. A similar result was reported by Houndonougbo *et al*. (2012) in their work on rabbit. The broilers in C_4 ate the highest quantity of feed. This could be as a result of the low energy level of diet C_4. Broilers eat to satisfy their energy requirement and feed intake increases as energy value of the diet reduces Maharjan *et al.*, 2021. The feed conversion ratio was superior for C_1 and C_2 diets confirming the work the report of Abu Hassan (1996) that PPF has low feeding value. The nil mortality however is an indication that PPfM is not deleterious to broiler chickens.***Cost effectiveness of producing the broilers***

The result of the present research is an indication that 16.67% substitution rate of maize with PPFM will reduce the cost of producing kilogram chicken. There was a progressive drop in the cost of producing feed as the inclusion level of PPFM increases. This is because the PPF is a waste and the price not comparable with maize. The cost per kg weight gain and final weight of the chicken was however highest for C_4 group and then C_3 which further is an indication of the unsuitability of the test ingredient at higher inclusion rate.

Conclusion and recommendation

The finding from the research showed that palm oil pressed fibre can be included up to 10% to replace maize (16.67% substitution rate of maize) in broiler finisher diets without any adverse effect on the performance. The substitution reduced the cost of producing chicken.

It is therefore recommended that Palm press fibre meal can substitute maize at 16.67% in finisher broiler diet.

Acknowledgement

We are grateful to Tertiary Education Trust Fund (TETFund) for providing grant, used for this research.

References

A.O.A.C. 2000 (Association of Official Analytical Chemists). Official methods of analysis (18th ed.). A.O.A.C International Virginia, USA.**Agriculture.Institute, 2023.** Poultry feeds and Feedings Optimal Inclusion Levels of Feed Ingredients for Broilers and Layers. https://agriculture.institute/poultry-feeds-and-feeding/optimal-feed-ingredients-broilers-layers/

Bamikole, M. A. and Ikhatua, U. J. 2009. Variety diversity effect on the Chemical composition and dry matter degradation characteristics of residue and by-products of oil Palm fruits. *Anim. Sci. J.*, 80+3):239-249.

Heuzé, V., Tran, G. and Sauvant, D. 2015. Palm Press Fibre. Feedipedia, a program by INRA, CIRAD, AFZ and FAO. https://www.feedipedia.org/node/15392. *Last updated on May 11, 2015, 14:35*

Houndonougbo, M. F., Chrysostome, C. A. A. M., Attakpa, S. E., Sezan, A. and Dehou, H. B. 2012. Growth Performance of Rabbits Fed Palm-Press Fibres-Based Diets. International Scholarly *Research Network ISRN Veterinary Science* Volume 2012, 5 pages doi:10.5402/2012/915729

IEA, 2022. Global Methane Tracker 2022, IEA, Paris https://www.iea.org/reports/global-methane-tracker-2022, Licence: CC BY 4.0

Maharjan, P., Hilton, K. M., Jordan, W. G. M., Beitia, A.; Suesuttajit, N., Umberson, C., Martinez, D. A., Caldas, J. A., Kalinowski, A., Yacoubi, N.; Naranjo, V., England, J. A., Coon, C. N. 2021. Effects of dietary energy levels on performance and carcass yield of 2 meat-type broiler lines housed in hot and cool ambient temperatures, *Poultry Science*, 2021. Volume 100, Issue 3, https://doi.org/10.1016/j.psj.2020.11.062.

Pauzenga, U. 1985. Feeding parent stock. Zootecnia International, 22-25.

People's Voice, 2025. Top Largest Palm Oil Producing States in Nigeria (2025) https://peoplesvoice.ng/2025/01/10/top-largest-palm-oil-producing-states-in-nigeria-2025/

Rhule, S. W. A. 1996. Growth rate and carcass characteristics of pigs fed on diet containing palm press fibre meal. Animal feed science and Technology. 61:167-172. Response of turkey poultry graded levels of Alphamune. Research opinion in Animal and Veterinary Science, 1996 1:304-308.

Shahbandeh, M. 2025. Palm oil top global producers 2024/25 https://www.statista.com/statistics/856231/palm-oil-top-global-producers/

Date received: 24th July, 2025

Date accepted: 30th October, 2025