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Research Article

Comparative Effect of Fish Meal, Acetic Acid and Enzymes on Meat Yield and Economics of Broiler Chickens

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Abstract

An experiment was conducted to compare the dietary effect of fishmeal, acetic acid and enzyme complex on carcass, internal organs and economics of broiler chickens. A total of 150 Anak broiler chickens were used and grouped into five dietary treatments. Each treatment was replicated three times with ten birds per replicate. The experiment was arranged in completely randomized design (CRD). Treatment one (TI) which was the control was a soya bean meal based diet without fish meal. Treatment two (T2) was a diet with fishmeal and soya bean meal. An enzyme complex containing phytase, xylanase, pectinase, glucanase, and hemicellulase was added to the basal diet at 0.5% to form treatment three (T3). Treatment four (T4) was the control feed plus 0.5% acetic acid, while treatment five (T5) was the basal diet plus 0.5% acetic acid and 0.5% enzyme complex. All the test ingredients were added at both starter and finisher diets. Birds were fed and watered *ad libitum* for 49 days the experiment lasted (4weeks for starter phase and 3 weeks for finisher phase). There were no significant differences (P>0.05) in dressed percentage, breast weight, thigh and drumstick. Acetic acid significantly increased (P<0.05) abdominal fat, gizzard weight and bile volume compared to fishmeal and enzyme. Revenue and gross margin were higher in fishmeal treated group followed by enzyme. Economically, fishmeal followed by enzyme proved to be the best, but in terms of dressed percentage, the enzyme complex could be used in fishmeal-free-diet.

Keywords: Acetic acid; Broiler chickens; Economics; Enzyme complex; Fish meal; Meat yield

Introduction

Feed has a major economic impact on broiler production as it contributes 60-70% of total production cost [1]. Broiler production may become a more profitable enterprise by obtaining efficient growth and improved feed conversion ratio (FCR). Better growth of broilers is achieved by inclusion of fish meal in their feed because of its high quality protein content and its digestibility compared to those of plant proteins such as soya bean meal protein [2-4]. Soya bean meal protein is adjudged to be the best plant protein because it contains higher lysine and it is more digestible compared to others such as groundnut cake [5]. The quality of any feedstuff is judged by its nutrient content and its ability to release the nutrients for the benefit of the animal. Recently, efficiency of feed utilization of broilers has been improved by the application of different feed additives such as enzymes, probiotics and prebiotics and organic acids even when fishmeal was used. This is an indication that feed utilization by broilers goes beyond nutrient degradation by endogenous enzymes. According to Samik [6] health of the gut (that is the gastro intestinal tract) is one of the major factors governing the performances of birds and thus, the economics of poultry production. Plant feedstuffs contain some organic compounds such as fibre which broilers cannot digest effectively. Nutritionists have overcome this by identifying these indigestible compounds and are corrected by feeding a suitable feed additive such as enzymes. Hence addition of feed grade enzymes in diets to take care of fibre, non-starch polysaccharides and phytate has been reported to improve the availability of nutrients to broilers [7].

Considering the fact that fishmeal is being phased out in chicken feeds in many countries it is necessary to find alternative ways of improving broiler performance using fishmeal-free-diets. The first products that could come to mind are enzymes and organic acids which have proved suitable in poultry diets. However, according to Ndelekwute EK [8] improved growth due to addition of organic acids or any other feed additives should translate into better dressed weight and economic benefit in other to attract the interest of the farmer whose target is input minimization and profit maximization. Therefore, the objective of this study was to compare the effects of fishmeal, enzymes and acetic acid on carcass, internal organs and economics of broiler chicken production.

Material and Methods

Site of experiment

The experiment was conducted at the Teaching and Research Farm of Department of Animal Science, University of Uyo, Nigeria, located at latitude $5^0 32^0$N and longitude $7^0 54^0$E and with average rainfall of 1500mm. The average relative humidity during the experiment was 75% and average ambient temperature of 28 ^{0}C.

Experimental design and management of experimental birds

One hundred and fifty day old of Anak strain were used. They were divided into five dietary treatments. Each treatment was replicated thrice with ten birds per replicate. The experiment was arranged in completely randomized design (CRD). Treatment one (TI) which was the control (basal diet) was a soya bean meal based diet without fish meal. Treatment two (T2) was a diet with fishmeal and soya bean meal. An enzyme complex containing phytase, xylanase, pectinase, glucanase, and hemicellulase was added to the basal diet at 0.5% to form treatment three (T3). Treatment four (T4) was the basal diet plus 0.5% acetic acid, while treatment five (T5) was the basal diet plus 0.5% acetic acid and 0.5% enzyme complex. The control/basal diet was formulated in such a way that the quantity of protein supplied by the fishmeal in the fishmeal diet was supplied by adding quantity of soya bean meal that will supply the same amount of protein supplied by the fish meal. This was maintained at both the starter and finisher phases (Table 1). The experiment started from day old and lasted for 49 days. Four weeks for the starter phase and three weeks for finisher phase. Feed and water were offered *ad libitum*. Extra warmth was supplied to the birds using kerosene stove for 21 days. Conventional management practices and all vaccinations were observed and the birds were raised in a deep litter open sided house.

Table 1: Ingredient and nutrient composition of experimental diets.

Phases	Starter Diets		Finisher Diets	
Ingredients (%)	Basal diet	Fishmeal diet	Basal Diet	Fishmeal Diet
Maize	53.00	53.00	51.00	51.00
Soybean meal	34.80	30.00	31.20	28.00
Fishmeal	-	3.00	-	2.00
Palm kernel cake	8.40	10.20	14.10	15.30
Bone meal	3.00	3.00	3.00	3.00
Salt	0.25	0.25	0.25	0.25
Lysine	0.20	0.20	0.10	0.10
Methionine	0.10	0.10	0.10	0.10
Premix*	0.25	0.25	0.25	0.25
Total	100	100	100	100
Calculated Nutrient Composition				
Crude protein	21.91	21.94	20.25	20.25
Crude fibre	4.04	4.20	5.25	5.25
Ether extract	3.36	3.60	4.50	4.64
Lysine	1.15	1.20	0.85	0.85
Methionine	0.45	0.46	0.37	0.39
Calcium	1.15	1.20	1.00	1.04
Phosphorus	0.98	1.00	0.41	0.40
Energy	2865	2949	2851	2859

Starter premix supplied per kg diet: vitamin A 15000I.U, vitamin D_3 13000I.U, thiamin 2mg, riboflavin 6mg, pyridoxine 4mg, Niacin 40mg, cobalamine 0.05g, Biotin 0.08mg, Choline chloride 0.05g, Manganese 0.096g, Zinc 0.06g, Iron 0.024g, Copper 0.006g, Iodine 0.014g, Selenium 0.24mg, Cobalt 0.024mg and Antioxidant 0.125g. Finisher Premix supplied per kg diet: vitamin A 10,000 I.U., Vitamin D. 12,000 I. U., Vitamin E 20 I.U., Vitamin K 2.5mg. Thiamine 20mg. Riboflavin 3.0mg, Pyridoxine 4.0mg, Niacin 20mg, Cobalamin 0.05mg, Pantothenic acid 5.0mg, Folic acid 0.5mg, Biotin 0.08mg, Choline chlorine 0.2mg, Manganese 0.006g, Zinc 0.03g, Copper 0.006g, iodine 0.0014g, Selenium 0.24g, Cobalt 0.25g and Antioxidant 0.125g

Data collection

Carcass, internal organs and economic analyses: At maturity, 30 birds, two from each replicate of a treatment were selected and used for carcass and internal organs analyses according to Ndelekwute EK [9]. Dressed carcass was cut into parts of breast, thigh, drumstick, back-cut and wing. Dressed weight, internal organs and abdominal fat were expressed as percentage live weight while weights of cut-parts were expressed as percentage of dressed carcass weight according to Abaza MI [10]. Economic analysis was carried out according to the report of Ndelekwute EK [11].

Data transformation and statistical analysis: Data collected were expressed in percentages and were transformed using Arc Sine. All data were then subjected to analysis of variance (ANOVA). Significant means were separated using Duncan New Multiple Range Test according to Steel and [12].

Results and Discussion

Carcass yield

Table 2 shows the effect of fishmeal, enzyme complex and acetic acid plus enzyme complex on carcass of broiler chickens. Dressed

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weight, breast, drumstick, thigh and wing were not significantly (P>0.05) influenced. The result of the dressed percentage was in line with the report of Kahraman R [13] but in contrast with the works of [4]. The back cut and abdominal fat were significantly (P<0.05) influenced by dietary treatments. Control diet significantly (P<0.05) produced smaller back-cut weight compared to fishmeal and the other treatments. This result is in agreement with the works of [14] but in contrast with the report of Fickler J [2]. Control diet produced higher abdominal fat (P<0.05) followed by acetic acid diet compared to fishmeal, enzyme complex and acetic acid plus enzyme complex.

Table 2: Effect of diets on carcass quality.

Parameter	T1	T2	T3	T4	T5	SEM
Dressed %	72.45	74.24	72.24	75.92	76.17	7.11
Breast weight %	27.73	29.11	27.53	28.05	28.58	4.08
Thigh %	13.55	12.96	13.23	12.59	13.01	3.80
Drumstick %	12.71	11.90	13.58	13.21	13.30	3.75
Back cut %	16.89^{b}	18.22^{a}	19.88^{a}	19.12^{a}	18.85^{a}	3.99
Wing %	11.29	9.92	12.21	12.49	10.79	3.31
Abdominal fat %	4.13^{a}	1.46^{c}	2.23^{c}	2.36^{b}	1.60^{c}	1.12

abc means along the same column with different superscripts are significant (P<0.05).

T1: Control; T2: Fishmeal; T3: Enzyme Complex; T4: Acetic Acid; T5: Acetic Acid Plus Enzyme Complex

Internal organs

Dietary treatments with fishmeal, acetic acid plus enzyme complex and control showed a significant effect (P<0.05) on the gizzard, spleen, bile volume and intestine, but no significant effect on heart, liver, pancreas and *cecum.* However, the non-significant results are in contrast with the reports of [15-18] and [19]. Acetic acid supplemented diets showed (P<0.05) increase in gizzard weight compared to control, fishmeal and enzyme complex diets Table 3. This could be an advantage to the chicken and the farmer. Bigger gizzard could mean better ability to accommodate more feed and more pulse to grind the feed which invariability could aid digestion. The farmer could make more profit because gizzard is a premium part which attracts good price. This result was in contrast with [20]. The spleen of control was the smallest (P<0.05) followed by the enzyme supplemented diet but no significant difference was observed between fishmeal, acetic acid and acetic acid plus enzyme diets. Spleen is known to take part in iron synthesis and fish meal and acetic acid could improve its activity. This result is in agreement with the report of Vukic VM [21]. A significant increase (P<0.05) was observed in the bile volume of acetic acid supplemented diets compared to control, fishmeal and diet supplemented with only enzymes. The report of Chaveerach P [22] concurred with this current result that organic acids promoted endogenous secretions such as bile. The weight of the intestine was smaller in acetic acid diets. The significant difference observed in the intestinal weight of the birds that consumed acetic acid containing diets could be due to the antibacterial action of organic acids as reported by [22] and [23], but in contrast with [24].

Table 3: Effect of diet on internal organs quality.

Parameter	T1	T2	T3	T4	T5	SEM
Gizzard %	2.93^{b}	2.90^{b}	2.78^{b}	3.49^{a}	2.87^{b}	1.67
Spleen %	0.86^{c}	3.22^{a}	1.44^{b}	3.57^{a}	3.75^{a}	0.56
Heart %	4.01	4.64	4.77	3.75	3.63	0.60
Liver %	2.16	2.31	2.76	2.38	2.06	0.83
Kidney %	6.24	6.33	6.07	6.00	5.61	0.75
Bile volume (ml)	1.07^{b}	1.13^{b}	1.00^{b}	1.64^{a}	1.09^{b}	0.42
Pancreas %	2.96	2.73	2.82	2.66	2.76	0.70
Intestine %	4.09^{a}	4.10^{a}	4.30^{a}	2.83^{a}	2.90^{b}	0.83
Caecum %	4.38	4.48	4.53	4.48	4.80	0.70

abc means along the same column with different superscripts are significant (P<0.05).

T1: Control; T2: Fishmeal; T3: Enzyme Complex; T4: Acetic Acid; T5: Acetic Acid Plus Enzyme Complex

Economic benefit

Economic implication of adding fishmeal, enzymes and acetic acid in diets (Table 4) indicates that cost/kg feed was lower in control diet because additional cost was not incurred. Acetic acid and enzyme complex diets had the highest feed cost/bird, because of additional cost of acetic acid and enzyme. Also this has been attributed to higher feed intake [9]. Fishmeal supplemented diet had the highest gross margin/bird followed by enzyme supplemented diet. This underlines the importance of fish meal and enzyme in the diets for broiler chickens.

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Table 4: Effect of fishmeal, enzymes and acetic acid on economics of broilers.

Parameters	T1	T2	T3	T4	T5
Cost/kg (N)	109.42	114.52	121.03	205.67	217.28
Feed cost/bird (N)	422.36	451.21	468.39	791.83	860.43
Feed cost/grain (N)	262.61	278.28	292.89	518.29	562.76
Revenue/bird (N)	1717	1950	1819	1733	1767
Gross margin/bird(N)	1294.64	1498.79	1350.61	941.17	906.57

T1: Control; T2: Fishmeal; T3: Enzyme complex; T4: Acetic Acid; T5: Acetic Acid Plus Enzyme Complex; N = Naira: Nigeria Currency

Conclusion

The result of this research showed that addition of broiler diets with fishmeal, and supplementation of enzymes and acetic acid did not improve dressed percentage of the carcass significantly. There was no economic advantage derived by adding the feed acetic acid due to its high cost. It is therefore concluded that in economic terms, addition of fish meal or enzymes to broiler diets resulted to profit maximization and should be encouraged. Secondly the glamour for inclusion of organic acids in economic terms is not supported by the current result.

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