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Mob: +92 300 3008585, Fax: +92 41 8815544
E-mail: editorpjn@gmail.com

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Gradient Replacement of Fish Meal with Poultry By-Products Meal in Broiler Rations Supplemented by Amino Acid

M.M. Manzoor[1], M.Z. Alam[1], Z.I. Chauhan[2], S.A.H. Gilani[1], S.T.H. Shah[1], A. Ali[3] and J. Muhammad[4]
[1]Faculty of Animal Husbandry, University of Agriculture, Faisalabad, Pakistan
[2]Livestock and Dairy Development Department, Punjab, Pakistan
[3]Poultry Food, Gojra, Pakistan
[4]University Diagnostic Lab, University of Veterinary and Animal Sciences, Lahore, Pakistan

Abstract: The present study was conducted to evaluate the effect of different levels of poultry byproducts meal (PBM) on the performance of broiler chicks. One hundred and fifty day old (male and female mixed) Hubbard broiler chicks were reared on the five experimental rations up to 42 days of age using control rations containing 8% fish meal. In the experimental rations both in starter and finisher fish meal was replaced by the poultry byproducts meal (PBM) at 2, 4, 6 and 8% levels keeping control rations without PBM. The starter rations were fed up to 28 days of age and remaining 14 days the finisher rations were fed. The crude protein (%) and metabolized energy (Kcal/Kg) content of the starter rations A, B, C, D and E were 21.52, 2937; 21.71, 2916; 21.89, 2983; 22.0, 83007 and 22.29, 3032, respectively, while for finisher rations were 18.73, 3042; 18.92, 3070; 19.10, 3097; 19.29, 3125 and 19.47, 3152.28, respectively. The result showed that the rations containing PBM at the level of 2, 4 and 6% were the best for growth as compared to 8% consumed. There was a non-significant ($p<0.05$) difference in feed efficiency among different rations. The varying level of PBM used in rations did not significantly ($p<0.05$) influence the dressing percentage of broiler chicks. It was also concluded that PBM can be used in broiler rations up to 8% of the total diet. It is concluded that PBM supplemented with amino acids may be suggested to be suitable and replace with fish meal in poultry diet.

Key words: Fish meal, poultry by products, replacement, ration feed, poultry

INTRODUCTION

There are several feed ingredients like whey, blood meal, fish meal, spray dried plasma protein and poultry byproduct meal (PBM) but PBM is one of the lower cost and mogestric diets especially for pet animals and poultry (Murray *et al*., 1997; Boling and Firman, 1997; Keegan *et al*., 2004). It has been reported that PBM is deficient in essential amino acids like lysine, methionine and histidine. However, it has similarity in quality of protein to fish meal and can be replaced up to 100% (Nengas *et al*., 1999; Takagi *et al*., 2000; Gaylord *et al*., 2005). Animal byproduct like meal and bone and poultry byproduct contain about 45 to 65% crude protein and behave like a good source of essential amino acids (Tzachi *et al*., 2004). An attempt was therefore made to replace fish meal with poultry byproducts meal at different levels. Supplementation of limiting amino acids was also done. The effect of such rations was observed on the growth performance of broiler chicks.

MATERIALS AND METHODS

Experimental birds: One hundred and fifty day old Hubbard chicks were divided into fifteen experimental units of 10 chicks each. These experimental unites were allocated randomly into five experimental rations each comprising of 3 units (replicates) and were placed into growing pens while keeping the temperature 35°C during first week of brooding. Each week temperature was keeping in decline by 3°C till a temperature of 27°C. All chicks were vaccinated against Newcastle disease at 5 and 28th day ad libitum. The birds were kept under continuous light regime throughout the experimental period.

Experimental rations: Five starter rations were prepared and designed as A, B, C, D and E. Fish meal in the ration was replaced gradually with poultry byproduct meal at 0, 2, 4, 6 and 8%, respectively. Rations were isocaloric and isonitrogneous containing CP 22% and M.E 3000 kcal/kg and were fed to all birds from day old to 28th day. Composition of starter rations is shown in Table 1 and 2. Similarly, five experimental finisher rations were prepared and designed as A1, B1, C1, D1 and E1 and were supplemented with isocaloric and isonitrogenous containing CP 20% and M.E 3200 kcl/kg. The composition of broiler finisher rations is shown in table 3 and 4. These rations were fed from day 28 to 42 day ad libitum. Fresh and clean water was made available round the clock throughout the experiment. After every 6 days, body weight of each chick and feed

Corresponding Author: Z.I. Chauhan, Department of Livestock and Dairy Development, Punjab, Pakistan

Table 1: Composition of experimental starter rations

	Rations				
Description	A	B	C	D	E
Maize	25.00	25.00	25.00	25.00	25.00
Rice	10.70	10.30	9.85	9.35	9.35
Wheat	15.00	15.00	15.00	15.00	15.00
Rice polishing	6.50	6.50	6.50	6.50	6.50
Cotton seed meal	8.00	8.00	8.00	8.00	8.00
Soybean meal	6.00	6.00	6.00	6.00	6.00
Corn gluten 30%	5.00	5.00	5.00	5.00	5.00
Corn gluten 60%	6.00	6.00	6.00	6.00	6.00
Fish meal	8.00	6.00			
Poultry by-product meal	0.00	2.00	4.00	6.00	8.00
Di-calcium phosphate	1.00	1.20	1.20	1.40	1.40
Limestone	0.50	0.50	0.75	0.75	0.75
Molasses	1.00	1.00	1.00	1.00	1.00
Soybean oil	1.80	2.00	2.20	2.40	2.50
Rape seed meal	5.00	5.00	5.00	5.00	5.00
Pre-mix	0.50	0.50	0.50	0.50	0.50
Total	100.00	100.00	100.00	100.00	100.00

Table 2: Nutrient composition of starter rations

	Rations				
Description	A	B	C	D	E
M.E. (k.cal/kg)	2937.6	2961.5	2983.8	3007.7	3032.4
Calcium (%)	1.01	1.02	1.08	1.08	1.05
Av. Phosphorus (%)	0.48	0.49	0.46	0.47	0.45
Crude fiber (%)	4.37	4.39	4.42	4.44	4.47
Lysine (%)	0.93	0.91	0.89	0.87	0.85
Methionine (%)	0.44	0.43	0.43	0.42	0.41
Meth+Cys. (%)	0.80	0.81	0.83	0.84	0.85
Cost/kg (Rs)	5.24	5.21	5.17	5.14	5.09
CP: Energy ration	136.53	136.53	136.44	136.22	136.03

Ration was supplemented with lysine, methionine and both lysine+methionine, respectively

consumption per experimental unit was calculated. Proximate analysis including moisture, crude protein, ether extracts, crude fiber, ash, nitrogen free extract of ingredients used to prepare the experimental rations along with the prepared rations was done suing AOAC (2010) method.

Statistical analysis: Three birds from each replicates were picked up randomly and slaughtered for recording dressing percentage. The data including total body weight gain, feed consumption, feed efficiency and dressing percentage values were analyzed though ANOVA by using DMR test (Amtul and Amna, 2012).

RESULTS AND DISCUSSION

Weight gain: Average weight gains of chicks from 0 to 28 days fed on starter rations A, B, C, D and E were 815.97, 863.97, 785.40, 747.97 and 706.20 g, respectively. The highest weight gain was obtained of chicks fed on ration B containing 6% fish meal (FM) and 2% PBM while lowest weight gain was obtained with ration E containing 8% PBM. A significant difference ($p<0.5$) in weight gain was found overall while a non-significant difference was noted in A and C group as shown in Table 6. A non significant difference ($p<0.05$) in average weight gain was noted onward from 28 days in chicks fed with finisher ration in A1, B1, C1, D1 and E1 was examined as 691.52, 692.00, 661.33, 643.66 and 616.33, respectively as shown in Table 7. Total weight gain from 0 to 42 days was calculated as 1507.49, 1555.97, 1446.73, 1391.63 and 1322.53 g in A-A1, B-B1, C-C1, D-D1 and E-E1, respectively. Results of total weight depicted a heigh weight 1555.7 in B-B1 containing FM and 2% PBM while lowest weight 1322.53g was achieved in E-E1 containing 8% PBM. Non-significant difference ($p<0.05$) was found in group A-A1 and B-B1 and similar non-significant difference was observed in D-D1 and E-E1 as shown Table 8. Similar results were found by Mehran *et al.* (2013) and Nasir *et al.* (2000) that by replacing fish meal with poultry byproducts up to 50% was able to enhance weight gain rainbow trout but increasing the amount at 75 and 100 percent has decreased in total weight gain. In another study conducted by Amtul and Amna (2012) indicates that by increasing in percentage of PBM from 0 to 25 in diet with fish meal had augmented weight gain in grass carp fry and further increasing in amount had decreased weight gain.

Feed consumption: The chicks fed on rations A, B, C, D and E showed average feed consumption of 1473.83, 1505.60, 1461.03, 1427.87 and 1377.90 g, respectively. A significant result ($p<0.05$) with highest feed (1505.60 g) consumption by chicks on ration B (having 6% FM and

Table 3: Composition of broiler finisher rations

	Rations				
Description	A	B	C	D	E
Rice	15.00	15.00	15.00	15.00	15.00
Wheat	4.50	4.20	3.90	3.60	3.30
Rice polishing	8.00	8.00	8.00	8.00	8.00
Cotton seed meal	6.00	6.00	6.00	6.00	6.00
Soybean meal	4.00	4.00	4.00	4.00	4.00
Corn gluten 30%	6.00	6.00	6.00	6.00	6.00
Corn gluten 60%	4.50	4.50	4.50	4.50	4.50
Fish meal	8.00	6.00	4.00	2.00	0.00
Poultry by-product meal	0.00	2.00	4.00	6.00	8.00
Di-calcium phosphate	1.50	1.60	1.70	1.80	1.90
Limestone	0.50	0.50	0.50	0.50	0.55
Soybean oil	2.50	2.70	2.90	3.10	3.00
Pre-mix	0.50	0.50	0.50	0.50	0.50
Molasses	1.00	1.00	1.00	1.00	1.00
Rape seed meal	3.00	3.00	3.00	3.00	3.00
Total	100.00	100.00	100.00	100.00	100.00

Table 4: Nutrient composition of finisher rations

	Rations				
Description	A	B	C	D	E
M.E. (k.cal/kg)	1042.5	3070.0	3097.5	3125.1	3152.5
Calcium (%)	1.12	1.11	1.10	1.09	1.08
Av. Phosphorus (%)	0.54	0.53	0.52	0.51	0.51
Crude fiber (%)	3.99	4.01	4.40	4.06	4.09
Lysine (%)	0.84	0.85	0.85	0.85	0.85
Methionine (%)	0.39	0.39	0.38	0.38	0.38
Meth+Cys. (%)	0.70	0.71	0.73	0.75	0.76
Cost/kg (Rs)	5.36	5.32	5.29	5.26	5.23
CP: Energy ratio	162.42	162.28	162.14	162.01	162.88

Ration was supplemented with lysine, methionine and both lysine+methionine, respectively

Table 5: Chemical composition of feed ingredients

Feed stuff	CP (%)	ME K.cal	Ca (%)	Phos (%)	Av.phos (%)	CF (%)	Lysine (%)	Methionine (%)
Maize	9.0	3320	0.01	0.25	0.25	2.00	2.26	0.19
Rice	7.7	3200	0.04	0.26	0.10	1.00	0.29	0.15
Wheat	11.5	3060	0.05	0.33	0.18	2.00	0.33	0.18
R.polishing	11.6	3100	0.06	1.30	0.19	12.00	0.60	0.25
C.S.M (solv)	40.4	2100	0.17	1.00	0.10	13.50	1.52	0.60
S.B.M (44%)	43.5	2210	0.20	2.60	0.10	7.50	2.74	0.60
C.G.M (30%)	27.0	2300	0.15	0.43	0.14	8.00	0.62	0.67
C.G.M (60%)	58.0	3500	0.02	0.40	0.13	2.00	1.00	1.41
Fish meal	50.7	2645	5.50	3.30	2.81	1.00	3.36	1.13
P.B.M	52.06	3600	3.50	2.00	1.70	2.50	2.41	0.87
D.C.P	0.00	0.0	28.00	0.00	0.00	15.00	0.00	0.00
Limestone	0.00	0.00	38.00	0.00	0.00	0.00	0.00	0.00
Molasses 3.01	960	0.88	0.08	0.04	0.00	0.00	0.00	0.00
Soybean oil	0.00	8800	0.00	0.00	0.00	0.00	0.00	0.00
R.S.M	34.30	1760	0.60	0.00	0.30	11.00	2.07	0.70

Table 6: Average weight gain per chick fed starter rations (0-28 day of age)

Ration	Initial weight (g)	Final weight at 28 day (g)	Weight gain at 28 day (g)
A	40.40	856.30	815.97^{b}
B	41.20	905.17	863.97^{a}
C	41.00	826.40	785.40^{b}
D	40.60	788.57	747.97^{c}
E	40.50	746.70	706.20^{d}

Wg (gr): Final body weight-initial body weight

2% PBM) while lowest feed (1377.90 g was consumed by the chicks on ration E. On other hand results onward from 28 to 42 days described the highest feed (1594.67 g) having 6% FM and 2% PBM was consumed by chicks on finisher ration B1. A non significant difference in feed consumption was found between A1 and B1 as well as in D1 and E1. Overall total feed consumed from 0 to 42 days was highlighted a significant results ($p<0.05$) with maximum and minimum feed 3100.27 g and 2750.90 g by chicks fed on ration B-B1 and E-E1, respectively as shown in table 9. Study of Zhang *et al*. (2003) showed that feed consumption was increased from 521.5 to

Table 7: Average weight gain per chick fed starter rations (29-42 day of age)

Ration	Initial weight at 29 days (g)	Final weight at 42 day (g)	Weight gain at 42 day (g)
A1	856.37	1547.89	691.52[a]
B1	905.17	1597.16	692.00[a]
C1	826.40	1487.73	661.33[a]
D1	788.57	1432.23	643.66[a]
E1	746.70	1363.03	616.33[a]

Wg (gr): Final body weight-initial body weight

Table 8: Average weight gain (total) of experimental chicks (0-42 days of age)

Ration	Av weight day old (g)	Av weight at 42 day (g)	Av total at 42 day (g)
A-A1	40.40	1547.89	691.52[a]
B-B1	41.20	1597.16	692.00[a]
C-C1	41.00	1487.73	661.33[a]
D-D1	40.60	1432.23	643.66[a]
E-E1	40.50	1363.03	616.33[a]

Wg (gr): Final body weight-initial body weight

Table 9: Average feed consumption per chick on different experimental rations

	Av total feed consumed/chick starter rations (g)	Av total feed consumed/chick finisher ration (g)	Av total feed consumed/Ration chick upto 42 days (g)
A+A1	1473.83[ab]	1573.33[a]	3047.17[a]
B+B1	1505.60[a]	1594.67[a]	3100.27[a]
C+C1	1461.03[ab]	1457. 67[b]	2918.70[b]
D+D1	1427.87[bc]	1402.00[bc]	2892.87[c]
E+E1	1377.90[c]	1373.00[c]	2750.90[d]

Table 10: Feed conversion ratio of chicks fed starter rations up to 42nd day of age

Ration per chick	Av. Total feed consumed per chick (g)	Av. Final wt. gain per chick (g)	Av. Amount of feed req/unit weight gain (g)
A	1473.83	815.97	1.81[bc]
B	1505.60	863.97	1.74[c]
C	1461.03	785.40	1.86[ab]
D	1427.87	747.97	1.90[ab]
E	1377.90	706.20	1.95[a]

FER: Weight gain (g)/feed consumed (g/dry weight)

Table 11: Feed Conversion Ratio at 42nd day of age

Ration	Av total feed consumed per chick (g)	Av total wt gain per chick (g)	Av amount of feed required per unit of weight gain (g)
A+A1	3047.17	1507.49	2.02[a]
B1+B1	3100.27	1555.97	1.99[a]
C1+C1	2918.70	1446.73	2.01[a]
D1+D1	2829.87	1391.63	2.03[a]
E1+E1	2750.90	1322.53	2.08[a]

FER: Weight gain (g)/feed consumed (g/dry weight)

Table 12: Data of dressing percentage at the age of 42nd day

Ration no.	Av. Live weight per chick (g)	Av. Dressed wt. per chick (g)	Dressing percentage (%)
A	1620.00	973.00	60.00[a]
B	1613.00	985.00	61.00[a]
C	1553.00	946.00	60.91[a]
D	1646.00	1001.00	60.81[a]
E	1540.00	920.00	59.74[a]

Same superscripts on average weight gain show non-significant differences

686.3 g/day by replacing of fish meal with PBM. Similar findings were observed by Zier *et al.* (2004) that in presentence of 3% PBM total 351 gram per day feed consumed by poultry while having 6% PBM feed intake was found a total of 338 in 21 days.

Feed conversion ratio: Average feed conversion ratio (FCR) from 0 to 28 days in case of chicks reared on rations A, B, C, D and E were 1.81, 1.74, 1.86, 1.90 and 1.95, respectively. Apparently the birds fed on ration B containing 6% FM and 2% PBM were more efficient in feed utilization. Overall a significant ($p<0.05$) difference was found in FCR in case of chicks reared on rations A to B, C and E while non-significant difference exists between C and D as shown in Table 10. Rate of average FCR depicted a non-significant difference ($p<0.05$) from 29 to 42 days in chicks reared on A, B, C, D and E with ratio 2.27, 2.30, 2.20, 2.18 and 2.22, respectively. Overall a non significant difference was observed in FCR with average values of 2.02, 1.99, 2.01, 2.03 and 2.08, respectively as shown in Table 11. Similar finding were observed by Mehran *et al.* (2013) that by increasing

amount of PBM replaced FM from 0 to 75% resulted in boost up FCR from 1.12 to 1.56 and a non significant increase in FCR was found in presence of 75 and 100% PBM.

Dressing percentage: A non-significant difference in dressing percentage was found with average values of 60.00, 61.00, 60.91, 60.80 and 59.74 for ration A, B, C, D and E, respectively as shown in Table 12. Approximate results were found by Tariq *et al.* (1995) that in presence of 3% PBM and 2.5 percent fish meal, dressing percentage was 60.50.

Conclusion: In conclusion, poultry by products can be used as an animal source protein supplemented with amino acids to enhance growth performance of broilers. In this way it will also be possible to use PBM due to easily available and economical as compared to fish meal and will help in protection of environment.

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