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Replacement of Fish Meal by Broiler Offal in Broiler Diet

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Abstract: A total of 144 day old straight run starbro broiler chicks were fed *ad libitum* up to 42 days of age on 3 different iso-nitrogenous and iso-energetic diets formulated by replacing dietary fish meal (FM) partially to completely by broiler offal (BO). In 3 diets 0, 4 and 8% BO replaced equal amount of FM to compare growth performance, profitability and meat yield among 3 diets. At 42 day of age, live weight increased almost linearly with increasing levels of dietary BO (P<0.01). Feed consumption was also positively correlated with BO concentration in diet. Feed conversion also improved on increasing levels of dietary BO (P<0.01). But survivability had little relation with dietary BO. Profitability of broiler rearing increased at increasing concentration of BO in diet. Meat yield also increased as BO replaced the dietary FM. It was concluded that replacement of costly conventional dietary FM by unconventional BO could increase performance of broilers with increased profitability and meat yield.

Key words: Profitability, feed consumption, unconventional, broiler offal, fish meal

Introduction

Commercial broiler production has become a specialized and speedy poultry operation during the recent years all over the world. Total consumption of poultry meat and eggs has increased dramatically during the past five decades and continues to increase ahead of human population growth. The broiler industry demands a fast growing chicks and good quality feed with high level of energy, protein, vitamins and essential minerals to support maximum growth before the birds are ready to sale. For the survivability of broiler industry, the production cost should be kept as minimum as possible. Cost of feed incurs about 60-65% of the total cost of poultry production and protein costs about 13% of the total feed cost (Banerjee, 1992). Clearly all of the feed resources are not available in every environment, or in every developing country. Some developing countries have problems with the supply and quality of feed for their intensive poultry industry and very limited number of feed ingredients are available to choose for the formulation of balanced diet. Moreover, there is a constant competition amongst human and animals for the same. So, higher feed cost hardly supports profitable poultry production. Poultry Production may not be remunerative if costly conventional feeds can not be replaced by the cheaper unconventional feeds in the poultry diets. It is therefore, a recent trend among the poultry nutritionist to explore the unconventional cheaper ingredients towards reducing feed cost to maximize profit from poultry farming. Increased concerned of the producer regarding the quality and cost of feed have changed the approach of using conventional feed and therefore, invoked the prospects of unconventional or nontraditional feeds in broiler ration formulation.

Fish meal is a conventional animal protein source and costly feed item when added to the diet increases poultry production cost (Islam, 1993) too much. Moreover, poultry is a competitor of human being in respect of dry fish consumption. So, the price of quality FM is increasing at an alarming rate and its quantitative supply is not steady in the local market throughout the year. The quality of fishmeal is often questioned and blamed due mostly to adulteration with other ingredients such as fish bone, sand, stone, soil, fine sawdust etc. Inclusion level, fluctuation of price, variable quality, contamination with objectionable organisms; *salmonella* and use of insecticide as preservative the major limiting factors for the use of fishmeal in diet. In addition, the supply of FM is often affected by natural calamities. For the above reason, it is very important to find out the possibilities of using alternative source of low cost animal protein to substitute expensive FM. Broiler industry is growing rapidly with an increasing trend of dressed broiler consumption in some big cities of the world. Bulbul and Islam (1991) suggested broiler offal as a high quality animal protein. Therefore, BO, a by-product of the broiler processing plant, is now available to be recycled as poultry feed as well as favorable for reducing environmental pollution. Hossain *et al.* (1989) reported that BO contained reasonable amount of proximate components, essential amino acids and important minerals. It may be an important addition in the list of

Table 1: Layout of the experiment showing allocation of broilers to diet with variable levels of dietary fish meal (FM) and broiler offal (BO)

Dietary FM%/BO%	Number of birds/replication				Total
8/0	12	12	12	12	48
4/4	12	12	12	12	48
0/8	12	12	12	12	48
Total	36	36	36	36	144

Table 2: Chemical composition of ingredients used in diet formulation

Ingredient	DM %	ME kcal/ kg	CP %	EE %	CF %	Ash %	Ca %	P. %	Lys. %	Meth. %	Tryp. %
Wheat	89.00	3250[a]	10.60	2.40	3.00	3.00	1.12	0.42	0.47[b]	0.21[b]	0.12[b]
Rice polish	91.00	2860[a]	11.00	9.50	5.00	6.00	0.04	0.19	0.44[b]	0.24[b]	0.09[b]
Til oil cake	90.50	1910[a]	27.00	4.50	4.00	10.00	0.17	0.46	1.14[b]	1.23[b]	0.78[b]
soybean meal	89.50	2240[a]	34.00	1.50	2.50	4.48	1.15	0.17	2.25[b]	0.76[b]	0.57[b]
Fish meal	86.00	2640[a]	38.25	5.00	3.00	16.00	0.95	1.25	3.17[b]	1.12[b]	0.80[b]
Bone meal	95.00	-	-	-	-	67.00	18.60	8.34	-	-	-
Broiler offal	85.00	2910[a]	58.35	18.00	3.00	5.50	2.45	1.78	2.60[c]	0.46[c]	0.42[c]

Source: [a]Metabolizable energy (ME) using Wiseman (1987) formula: ME (kcal/kg) = 35.2 CP + 78.5 EE + 40.0 Starch + 35.5 Sugar. [b]Singh and Panda (1992). [c]Analyzed at Nutrition Laboratory, Directorate of Livestock Services, Dhaka.

Table 3: Experimental ration for broilers having different levels of broiler offal (BO) with chemical composition

Ingredients (%)	Starter			Finisher		
	0%BO	4%BO	8%BO	0%BO	4%BO	8%BO
Wheat	38.00	39.00	40.00	44.00	44.00	44.00
Rice polish	18.00	20.00	22.00	20.00	22.00	22.00
Soybean meal	24.00	20.00	18.00	18.00	16.00	15.00
Til oil cake	10.00	11.00	10.00	8.00	8.00	9.00
Fish meal	8.00	4.00	-	8.00	4.00	-
BO	-	4.00	8.00	-	4.00	8.00
Bone meal	1.25	1.25	1.25	1.25	1.25	1.25
Common salt	0.05	0.05	0.05	0.05	0.05	0.05
Premix*	0.25	0.25	0.25	0.25	0.25	0.25
Calculated chemical composition						
DM%	89.50	89.46	89.42	89.50	89.46	89.42
ME kcal/kg	3005.00	3039.84	3082.21	3094.67	3100.00	3121.00
CP%	22.26	22.27	22.32	20.33	20.44	20.54
Ca%	1.21	1.26	1.30	1.19	1.23	1.26
P%	0.45	0.51	0.43	0.46	0.48	0.42
Lys%	1.30	1.27	1.25	1.16	1.14	1.12
Meth%	0.57	0.55	0.52	0.52	0.48	0.45
Tryp%	0.36	0.34	0.32	0.32	0.30	0.28

*Embavit-B (Rhone Poulene Agrovet Bangladesh Ltd.) was added 250 g per 100 kg of mixed feed. Each 2.5 kg of premix contained: Vit A, 12,500 IU; Vit D_3, 2,500,000 IU; Vit E, 20 g; Vit K_3, 4 g; Vit B_2 5 g; Vit. B_6, 4 g; Nicotinic acid, 40 g; Pantothenic acid, 12.5 g; Vit B_{12}, 12 g; Folie acid, 0.8g; Biotin, 100 mg; cobalt, 0.4 g; copper, 10 g; Iron, 60 g; Iodine, 0.4g; Manganese, 60g; Zinc, 50 g; Selenium, 150 mg; DL-methionine, 100 g; Choline chloride, 300 g; L-lysine, 60 g.

unconventional ingredient to be used for broiler to minimize feed cost and increase broiler performance.

With those ideas in view, the current study was aimed at the following objectives:

1. To study the effect of replacing FM partially or completely by BO on the performance of broilers.
2. To assess the economic feasibility of BO to broilers.
3. To recommend the level of inclusion of BO to formulate economic broiler diet.

Materials and Methods

The experiment was conducted at Bangladesh Agricultural University Poultry Farm, Mymensingh to investigate the feeding value of BO for broiler. The experiment was conducted from day old to 49 days of age. Birds were reared in 12 separate pens and were given a floor space of $900cm^2$ / bird. Rice husk was used as litter at a depth of 7.5cm. All birds were exposed to a continuous light of 23: 30 h/day. A total of 144-day-old unsexed Starbro broiler chicks were used for this experiment and they reared up to 49 days of age. Collected broiler offal were cleaned with fresh water, boiled at 100 ^0C for 10-15 minutes, chopped and sun dried, ground by feed grinder and stored in airtight bags for 25 days prior to use in diet. Chicks were equally and randomly divided and distributed in 3 dietary treatment groups having 4 replication in each group (Table 1).

All ingredients including BO for diet formulation were subjected to proximate analysis and important minerals; Ca and P (AOAC, 1990) (Table 2). The formulation of diets has been shown in Table 3.

During the experimental period initial and weekly body weight, weekly feed intake and survivability were

Table 4: Performance of broiler on different dietary level of BO at different ages

Parameters	Age in days	Dietary levels of BO (%)			Level of Significance[+]
		0	4	8	
Body weight (g/broiler)	Day old	44.994	45.06	45.12	NS
	7	112.9[b]	113.6[b]	129.4[a]	*
	14	242.4[c]	260.7[b]	283.2[a]	**
	21	432.5[c]	472.9[b]	522.0[a]	**
	28	[abc]698.4[c]	758.0[b]	822.5[a]	**
	35	950.0[c]	1051.0[b]	1137[a]	**
	42	1316.0[c]	1461.0[b]	1603[a]	**
Feed consumption (g/broiler)	7	110.0[b]	112.5[b]	142.1[a]	*
	14	490.0[b]	504.9[b]	545.8[a]	*
	21	[abc]701.3[c]	1002.0	1035.0[a]	NS
	28	1483.0[c]	1578.0[b]	1685.0[a]	**
	35	2126.89	2021.90	2354.18	NS
	42	3114.0[c]	3396.0[b]	3628.0[a]	**
Feed conversion ratio	7	1.60	1.64	1.69	NS
	14	2.48[a]	2.34[b]	2.29[b]	**
	21	[abc]2.39[a]	2.33[a]	2.18[b]	*
	28	2.27[a]	2.21[b]	2.17[b]	*
	35	2.35[a]	2.26[ab]	2.17[b]	*
	42	2.50[a]	2.40[a]	2.32[c]	**
Survivability	7	95.83	100	100	NS
	14	100	97.92	100	NS
	21	100	100	95.83	NS
	28	100	97.92	100	NS
	35	97.92	100	95.83	NS
	42	100	100	100	NS

[+] NS, P>0.05; * P<0.05; **P<0.01. [abc] Values in the same row bearing different superscripts are significantly different.

Table 5: Cost of production and profit of broiler on different diets where fishmeal (FM) was replaced by broiler offal

Variable	Dietary levels of BO (%)			SED (LSD) values and level of significance [+]
	0	4	8	
Live weight (g/broiler)	1316[b]	1411 [b]	1616 [a]	149.81**
Total feed cost (Tk/b)	39.92 [c]	41.72 [b]	43.69 [a]	2.41**
Chick cost	23.00	23.00	23.00	NS
# Other cost (Tk/b)	7.28	7.28	7.28	NS
Total cost (Tk/b)	70.02	72.00	73.97	1.520 [NS]
Total cost (Tk/kg)	53.21[b]	51.03[b]	45.77[a]	5.95*
Market price	65.00	65.00	65.00	NS
Profit (Tk/kg)	11.79[b]	13.97[b]	19.23[a]	4.27*
Profit (Tk/kg live broiler)	18.11 [b]	22.80 [a]	25.31 [a]	4.542*[+]

NS, P>0.05; * P<0.05; **P<0.01.

Other cost included vaccine, litter, labor, disinfectants, electricity and transport cost etc.

recorded for each replication. House temperature (^{o}F) and relative humidity (%) were recorded every 6 hours using thermometer and dry and wet bulb thermometer respectively. Replication wise feed conversion was calculated from feed intake and live weight gain. Cost of production/replication was calculated considering expense on chicks, feed, litter and medicine on the basis of market price. At the end of the experiment one male and one female from each replication weighing average of the pen weight were randomly selected to establish meat yield in carcass. They were fasted for 12 hours, slaughtered, eviscerated, dressed and dissected (Jones, 1984) at 42 days of age.

Results

Chemical composition of broiler offal (BO) is shown in Table 2. The live weight (Table 4) of broilers significantly and almost linearly increased at all ages for increasing

Table 6: Dressing parameter of male (M) and female (F) broilers on different levels of broiler offal (BO) in diet at 42 day of age

Variable	Sex (S)	BO% in diet			(LSD) SED and level of significance⁺		
		0	4	8	D	S	D×S
Dressing %	M	65.32	66.96	67.59	(0.349)**	(0.285)*	(0.492)*
	F	63.94	66.02	64.56			
	Mean	64.53	64.49	66.03			
Breast meat %	M	6.91	8.94	9.83	(0.610)**	(0.169)*	(0.622)*
	F	7.69	8.64	9.44			
	Mean	7.30	8.79	9.66			
Thigh meat%	M	7.07	7.49	8.85	(0.725)*	(0.592)*	0.348^NS
	F	6.04	7.64	7.44			
	Mean	6.57	7.57	8.15			
Drumstick meat%	M	4.91	5.02	6.27	(0.448)*	0.124^NS	0.214^NS
	F	5.08	5.25	6.14			
	Mean	4.99	5.14	6.21			
Giblet %	M	5.80	6.07	6.38	(0.407)*	(0.332)*	0.270^NS
	F	5.81	6.88	5.78			
	Mean	5.80	6.48	6.06			
Viscera %	M	9.06	8.75	9.18	0.331^NS	0.270^NS	0.469^NS
	F	8.77	8.72	8.73			
	Mean	8.91	8.61	8.95			

⁺NS, P>0.05; * P<0.05; **P<0.01.

dietary BO. Overall feed intake during experimental period increased almost linearly on increasing dietary BO concentration although there was similar (p>0.05) feed intake among the treatments at 21 and 35 days of age. However, feed conversion improved at all ages for the increasing level of BO in diet in lieu of FM. Dietary BO had little relation with survivability of birds at all ages.

Total cost of production per broiler (Table 5) was similar at different levels of BO in diet (P<0.05). However, production cost/kg live broiler decreased and profit per kg live broiler increased almost linearly on increasing rate of inclusion of BO in diet. Dressing yield (Table 6) was lowest on 4% BO + 4% FM, intermediate on 0% BO + 8% FM and highest on 8% BO + 0% FM in diet (P<0.01).

Discussion

In chemical composition, BO had higher CP, ME, Ca, P. Similar CF and lower Ash, Lys, Meth in comparison with fishmeal (FM). Ether extract (EE) in BO was much higher in BO than that in FM (Table 2). The chemical composition of BO determined in the present study are almost similar with Nazneen (1995) and also partially agree with McNaughton *et al.* (1977). Nazneen (1995) reported that BO had 90% DM, 59% CP, 20% EE, 6020 ash, 3060% Ca and 2020% P. McNaughton *et al.* (1977) showed that poultry meat meal contained 9.98-11.20% moisture, 53.1-54.0% CP, 24.70-25.30% EE, 5.52-6.06% ash, 4.00-5.255 CF, 1.46-1.78% Ca and 1.00-1.10% P. In the present study, data on body weight, feed consumption, feed conversion impress (Table 4) that replacement of FM by BO partially or completely improved performances of broilers in terms of growth, feed intake and feed conversion. However, highest performance on D_3 (0% FM + 8% BO) indicates that complete replacement of FM by BO is possible with increased growth performance of broilers. As FM with comparatively lower CP content was replaced by BO of higher CP concentration, that might have increased animal protein proportion in diet improving biological value of protein. Such increased biological value of protein in diet may be responsible of improved performance of broilers on BO diets. Increased broiler for using BO in lieu of FM is supported by many previous workers Fraga *et al.,* 1989; Dafwang *et al.,* 1986; Orga *et al.,* 1964. Contradicting present findings, Pesti, 1987 found no significant differences in gain, feed intake and feed conversion attributable to dietary BO.

Improved feed conversion on BO diet is supported by Salmon (1977); Fraga *et al.* (1989); Dafwang *et al.* (1986) who recorded better feed conversion for substitution dietary FM by BO.

In the present study, dietary levels of BO had no influence on survivability of broilers. Reduced production cost and increasing profitability per broiler on increasing level of BO in diet observed in current study coincided with Hamid (1968); Bulbul and Islam (1991). They reported lowest feed cost per kg broiler by replacing FM by BO in diet. Result suggests that lower cost of BO compared to that of FM could advantageously be used in formulating low cost and nutritionally well balanced diet for broilers with improved performance and profitability. Increased dressing yield on increasing BO level in diet may be related to heavier live weights of broilers on BO diets. Such an assumption is supported by who found increasing dressing with the increase of live weight in broilers.

Conclusions: Inedible cheaper poultry by-products; Broiler Offal (BO) could replace costly fishmeal of conventional diet completely for the formulation of economic broiler ration. Use of BO in diet may increase broiler performance and profitability. The rate of inclusion of BO in diet may be 8 percent or even at a higher rate.

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References

AOAC, 1990. Official Methods of Analysis, 15th edn. Association of Official Analytical Chemists. Washington, D. C.

Banerjee, G. C., 1992. Poultry. 3rd edn, Oxford and IBH Publishing Co., Pvt. Ltd., New Delhi, Bombay, Calcatta.

Bulbul, S. M. and M. A. Islam, 1991. Feasibility of using unconventional feed in the poultry diet and formulation of economic ration with the inclusion of the unconventional sources. A report of a research project, sponsored by Bangladesh Agricultural Research Council (BARC). Research done in the Dept. of Poultry Science, Bangladesh Agricultural University, Mymensingh.

Dafwang, I. I., M. E. Cook, D. J. Pringle and M. L. Sunde, 1986. Nutritional value of aerobically fermented poultry manure and offal (Fermway) for broiler chicks. Poult. Sci., 65: 1965-1770.

Fraga, L. M., L. Lon-Wo and A. Palma, 1989. Utilization of offal fat for broiler feeding. *Revista Cubana de Ciencia Avicola* (Cuba), 16: 111-116. In: Poult. Abst., 1991, 17: 1420.

Hamid, M. A., 1968. A comparative study of fishmeal, meat offals, vegetable protein and teramycin (TM-S) on the growth rate of growing chicks. M. Sc. Thesis, Department of Poultry Science, Bangladesh Agricultural University, Mymensingh-2002.

Hossain M. D., S. M. Bulbul and M. A. R. Howlider, 1989. The composition of some Unconventional feeds. Poult. Adv., 22 : 37-40.

Islam, M. A., 1993. Use of Marine and shrimp wastes in the Broiler diet. M. Sc. thesis, Department of Poultry Science, Bangladesh Agricultural University, Mymensingh.

Jones, R., 1984. A standard method of dissection of poultry for carcass analysis. The West of Scotland Agricultural College Technical Note. No. 222.

McNaughton, J. L., J. D. May and A. C. Strickland, 1977. Composition of Poultry Offal Meals from Various Procession Plants. Poult. Sci., 56: 1659-1661.

Nazneen. T, 1995. Economic Feasibility of Feeding Broiler offals as a replacement of fishmeal on the performance of growing pullets up to sexual maturity M. Sc. Thesis, Dept. of Poultry Science. Bangladesh Agricultural University, Mymensingh-2202.

Orga, M. S., G. S. Sidhu and H. Singh, 1964. Systematic study for the evolvement of economic poultry ration. Analysis of common poultry feeds for proximate principles and preliminary feeding trails. Nutr. Abst. and Rev. (Series B), 34: 884.

Pesti, G. M., 1987. The nutritional value of poultry by-product meal. Department of Poultry Science, University of Georgia, Athens, U.S.A., In: Nutrition Abstracts and Reviews (Series B) 1988, 58: 1891.

Salmon, E. E., 1977. Fishmeal, meat meal and bone meal and fermented by-products and ingredient combinations in diets of young turkey. Canadian J. Anim. Sci., 57: 751-754.

Singh, R. A. and B. Panda, 1992. Poultry Nutrition, 2nd edn., Kalyani publishers, 1/1, Rajinder Nagar, Ludhiana-141008. New Delhi, India.

Wiseman, J., 1987. Feeding of non-ruminant livestock. Butter worth Co. Ltd., London.