Shrimp waste and marine waste as substitutes of fish meal in broiler diet

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Abstract

A total of 192, 14 days old as hatched broilers were fed *ad libitum* up to 56 days of age, on a control diet with 12% fish meal (FM) and 3 test diets; shrimp waste (SW) and/or marine waste (MW) and equal mixture of SW and MW completely replace dietary FM to have their effects on performance. Live weight and feed conversion improved and feed intake depleted on test diets than that on control. The test diets did not affect survivability of broilers. Complete replacement of FM by SW and/or MW reduced feed cost and production cost with increased profitability of raising broilers. Meat yield decreased on test SM and MW diets, but equal mixture of SM and MW, gave similar meat yield to that on control. It was concluded that equal mixture of SM and MW might be better, economic and efficient substitute of FM.

Key words: Fish meal, shrimp waste, marine waste, broiler, profitability

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Introduction

Poultry meat and egg contribute 37% of total animal protein supplied in Bangladesh (Ahmed and Islam, 1990). Commercial broiler production has become a specialized sector of modern poultry production in the developing countries. However, quality feeds are inadequate to meet up the requirements of animal protein source in Bangladesh. Cost of feed incurred 60-65% and protein feed cost incurred about 13% of the total feed cost of poultry production (Singh, 1990 and Banerjee 1992). Fish meal (FM) is the conventional but most expensive animal protein source feed ingredient.

Approximately 40,000 metric tons of shrimp are harvested annually from the Bay of Bengal and 18,000 to 20,000 metric tons of SW is available annually, with an extraction but only 30% are extracted (Howlider 1999). Shrimp waste (SW) is a by-product of the shrimp processing industry, composed mainly of heads, tails and shells of shrimp, which are sun-dried or oven dried and ground to a powder. In 1991, the availability of SW estimated to be 60,000 tons per year in Bangladesh (Haque 1993). At present, SW is abundantly used as poultry feed in this country.

Marine waste (MW) consist of the unutilized portion of sea animal other than fish are simply wasted and created environmental pollution (Islam et al. 1993). The MW consist of grill fines, viscera and trash e.g. Sharks, Cat fish, Fatra, Kukurijib and Phasa. The MW is rich in lysine (Ly), methionine (Met), tryptophan (Try), arginine, phenylalanine, CP, calcium (Ca), available phosphorus (Av. P), manganese etc. (Islam et al. 1993). The MW contains 47% CP, 2650 metabolizable energy (ME) Kcal/kg, 4.5% Ca, 18% Av. P, 8.1% lysine, 3.9% methionine and 1.4% tryptophan (Scott et al. 1989 and Islam et al. 1993). Use of MW as a substitute of FM increased profitability of broiler rearing and did not affect growth performance when 19% MW was used in lieu of FM (Islam 1993).

To reduce feed cost, it is imperative to find out cheaper source of protein for poultry to formulate economic diet with unconventional feed like SW and MW. Islam et al. (1994) suggested 50% replacement of FM by MW gave slightly better performance than that of control diet. Some researchers used SW and MW alone as a partial substitute of FM, but no researchers replaced FM totally by SW and MW together. So, it is still unknown whether mixer of SW and MW could be a better substitute of FM than either of SW and MW alone. The present research was undertaken to assess the effect of FM of conventional broiler diet completely by SM or MW or equal mixture of SM and MW on performance and profitability.

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Materials and Methods

The experiment was conducted at Bangladesh Agricultural University (BAU) Poultry Farm with 14 days old straight run broilers and continued up to 56 days. A total of 192 broilers were divided into 4 dietary groups having 4 replications in each and 12 broilers in each replication. The 4 dietary groups were D_1 (control diet with 12% FM), D_2 (test diet FM replaced 12% MW), D_3 (Control FM diet replaced 12 % SW) and D_4 (Control FM diet replaced 6% MW and 6% SW).

Fresh and dried sawdust was used as litter at a depth of 5cm. Initially, the broilers were exposed to a continuous lighting of 23:30 hours and dark period of 30 minutes in each 24 hours. During night, electric bulbs were used to provide necessary light. Two experimental diets (broiler starter and broiler finisher) were formulated with locally available feed ingredients and the chemical composition of feed ingredients is shown in Table 1. Starter diet was fed from 14-28 days and finisher diet was fed from 29-56 days of age. Feed and water were supplied *ad libitum* to the broilers throughout the experimental period. The area of each pen was 120cm x 90cm and was allotted for 12 broilers. Therefore, floor space for each broiler was $900cm^{2.}$ Cost of production included expense on chick, feed, litter and medicine. Broiler cost was calculated from the purchasing cost. Litter and feed cost was calculated on the basis of market price.

All recorded and calculated data were statistically analyzed using analysis of variance technique by an MSTAT Statistical Computer Package Program in accordance with the principle of Completely Randomized Design (Steel and Torrie 1960). Least significant differences (LSD) were calculated to compare variations among diets where ANOVA showed significant differences.

Results and Discussion

Chemical composition of MW, SW and FM is shown in Table 2. Initial live weight of broilers were similar on all diets (P>0.05). At 28 days of age live weight was similar and lower in D_1, D_3 and D_4 than on D_2. At 42 days of age live weight was similar and higher in D_2 and D_4 than those in D_1 and D_2 (P<0.01). The final live weight at 56 days of age was highest in D_4, intermediate on D_2 and D_3 and lowest on D_1. Feed consumption of broilers at 28 days of age was similar in all experimental diets (P>0.05).

Table 1. Ingredients (%) and chemical composition of broiler starter and finisher diets

Ingredient (%)	D_1		D_2		D_3		D_4	
	Starter	Finisher	Starter	Finisher	Starter	Finisher	Starter	Finisher
Maize	27.00	49.00	29.00	45.00	29.00	47.00	29.00	47.00
Wheat	18.00	-	16.00	-	18.00	-	18.00	-
Rice polish	18.00	16.00	18.00	18.00	20.00	20.00	18.00	18.00
Soybean meal	13.50	13.50	13.50	13.50	11.50	11.50	15.50	15.50
Full Fat soybean	-	-	-	-	8.00	8.00	-	-
Sesame oil cake	10.00	8.00	10.00	10.00	-	-	6.00	6.00
Fishmeal	12.00	12.00	-	-	-	-	-	-
Marine waste	-	-	12.00	12.00	-	-	6.00	6.00
Shrimp waste	-	-	-	-	12.00	12.00	6.00	6.00
Bone meal	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Common salt	0.50	0.50	0.50	0.50	0.50	0.50	0.50	0.50
Vit. Min. premix	+	+	+	+	+	+	+	+
Total	100.00	100.00	100.00	100.00	100.00	100.00	100.00	100.00
Chemical composition (%)								
Crude protein	22.74	21.45	23.71	23.25	21.74	21.37	22.88	22.36
ME (Kcal/ kg)	3043	3137	3065	3125	3052	3119	3065	3129
Calcium	1.19	1.16	1.05	0.99	0.71	0.93	1.10	1.10
Available P	0.59	0.87	0.41	0.63	0.43	0.67	0.53	0.77
Lysine	1.19	1.25	1.53	1.52	1.54	1.60	1.79	1.80
Methionine	0.43	0.42	0.68	0.68	0.51	0.51	0.64	0.64

Vit. Min. (Vitamin-mineral) premix was mixed @ 2.5g/kg mixed feed.

Table 2. Chemical composition (%) of marine waste, shrimp waste and fish meal

Item	Chemical Composition									
	DM	CP	ME Kcal/kg	CF	EE	Ca	Av. P	Ly	Met	Try
MW	90	53.60	2650	6.50	6.25	4.30	1.00	8.10	3.90	1.40
SW	86	48.30	1870	12.90	5.75	3.50	1.00	7.42	2.86	1.10
FM	83	50.00	2640	3.30	5.50	4.00	2.80	5.20	1.80	0.80

Source: Scott et al. (1969) Nutrition of the chicken Ithaca, New York; Hosain et al. (1989) Analysis was done at Bangladesh Agricultural University, Mymensingh

Table 3. Growth performance of broilers in control diet (12% FM) and their replacement of FM by 12% MW, 12% SW and 6% MW and 6% SW between 14-56 days of age

Parameters	Age (day)	Different dietary treatment					Significance
		D_1	D_2	D_3	D_4	Mean	
Live weight (g/broiler)	14	106.25	107.79	105.91	104.09	106.01	NS
	28	336^b	419^a	346^b	362.68^b	366.19	**
	42	994^b	1107^a	1002^b	1120^a	1056	**
	56	1075^c	1144^b	1170^{ab}	1198^a	1147	**
Feed intake (g/broiler)	28	1507	1571	1463	1503	1511	NS
	42	2788^a	2496^b	2724^{ab}	2203^c	2553	**
	56	3789^a	3496^b	3708^{ab}	3203^c	3549	**
Feed conversion Ratio	28	4.12	3.74	4.23	4.14	4.13	NS
	42	2.81^a	2.25^b	2.72^a	1.97^b	2.42	**
	56	3.52^a	3.06^b	3.17^b	2.67^c	3.10	**
Survivability (%)	28	95.84	95.84	95.84	95.84	95.84	NS
	42	93.75	93.56	93.75	93.75	93.71	NS
	56	89.39	93.37	93.56	91.67	92.00	NS

*abc, **, P<0.01;values having dissimilar superscript are significantly different; D_1, control diet with 12% FM; D_2, test diet FM replaced 12% MW; D_3, Control FM diet replaced 12 % SW and D_4, Control FM diet replaced 6% MW and 6% SW*

At 42 and 56 days of age, highest feed intake was observed (Table 3) in D_I and lowest on D_4 ($P<0.01$). Feed conversion did not differ among diets at 28 days of age ($P>0.05$). At 42 days of age, feed conversion (FC) was higher (Table 3) in D_2 and D_4 than on D_I and D_3. At 56 days of age, FC was highest on D_4 and lowest on D_1 ($P<0.01$). Survivability did not differ among diets at all ages ($P>0.05$).

Costs of producing broilers on different diets are shown in Table 4. Feed cost was found lower in D_2 and D_4 but highest in D_1 ($P<0.01$). Mortality adjusted chick cost was similar and lower on D_2, D_3 and D_4 than on D_1 ($P<0.01$). Other cost did not differ among the diets ($P>0.05$). Total cost was lowest on D_2, intermediate on D_3 and D_4 but highest on D_1 ($P<0.01$). Profit per kg broiler produced was similar and higher on D_2, D_3 and D_4 than on D_1 ($P<0.01$) shown in Table 4.

Dressed yield, total meat, breast meat, thigh meat and drumstick meat (Table 5) of male and female broilers were similar and highest on diet D_1 and D_4 and lowest on D_3 ($P<0.01$). The percentage of wing meat weight was highest on D_4, intermediate on D_1 and lowest on D_2 and D_3 ($P<0.01$). Other meat yield characteristics were not influenced by diet ($P>0.05$).

The data on live weight, feed intake and FC showed that replacement of FM by SW and MW improved growth performance of broilers (Table 3). However, equal mixture of SW and MW seemed to be a better substitute of FM than either of SW or MW alone. It is also evident that along with improved growth rate, ingested feed was better utilized on test diets. Moreover, D_4 diet was most efficient in terms of feed utilization. The data signify that both 42 and 56 days of age, feed intake was highest on D_1 intermediate in diets D_2 or D_3 and lowest in D_4. Reduced feed intake on test diet in the current study coincides with previous findings of different diets (Gu et al. 1988; Islam 1993 and Fanimo et al. 1996)

Table 4. Total cost of Production and Profit per kg broilers on different diet where FM was replaced by SW and MW

Parameters	Dietary treatment groups				Sig.
	D1	D2	D3	D4	
Live weight (g/bird)	1076^{c}	1144^{b}	1170^{ab}	1198^{a}	**
Feed cost (Tk/kg bird)	28.5^{a}	25.23^{b}	27.42^{ab}	26.09^{b}	**
Chick cost (Tk/kg bird)	18.16^{a}	15.53^{b}	15.80^{b}	16.10^{b}	**
Other cost (Tk kg/bird)	7.15	6.03	6.68	6.38	NS
Total cost (Tk/kg bird)	54.98^{a}	47.57^{c}	51.70^{b}	49.89^{bc}	**
Market price (Tk/kg bird)	70.00	70.00	70.00	70.00	
Profit (Tk/kg bird)	15.54^{b}	26.07^{a}	24.57^{a}	26.40^{a}	**

*Values with different superscript are significantly different; **, P<0.01; D_1, control diet with 12% FM; D_2, test diet FM replaced 12% MW; D_3, Control FM diet replaced 12 % SW and D_4, Control FM diet replaced 6% MW and 6% SW.*

The present study showed that survivability was not affected by different dietary treatments. The results were agreed with the findings of Islam (1993). In Islam's (1993) study, survivability were similar on control FM diet and test diets in which 50% dietary FM was replaced SW. However, survivability was reduced on diet in which 75% dietary FM was replaced by SW. It was reported that survivability was highest when 6% dietary FM was replaced by SW. The results obtained however, contradict Jarquin (1972) and Fanimo (1996). Jarquin (1972) found higher mortality on diet where shrimp by-product replaced FM of control diet. Fanimo (1990) reported increased mortality on SW based diet in comparison with that on control FM diet. Reduced feed cost and therefore, increased profitability on test diets (D_2, D_3 and D_4) obtained in the present investigation contradict Menachery et al. (1978). They stated that cost per kg broiler was higher when shrimp shell powder partially replaced dietary FM. But the results are in agreement with the findings of Islam et al. (1994). They reported reduced production costs when FM of control diet was replaced by SW or MW.

Table 5. Meat yield characteristics (%) of broiler on diets where FM was replaced by SW and MW at various levels

Item*	Different dietary treatment groups				Sig.
	D_1	D_2	D_3	D_4	
DY	57.79^{a}	54.90^{ab}	51.35^{b}	58.21^{a}	**
TMW	27.62^{a}	24.94^{ab}	23.43^{b}	28.41^{a}	**
BMW	10.08^{a}	8.48^{ab}	7.33^{b}	9.82^{a}	**
TMW	8.05^{a}	7.95^{ab}	6.93^{b}	8.38^{a}	**
DMW	6.08^{a}	5.69^{ab}	4.90	6.48^{a}	**
WMW	3.49^{ab}	2.94^{b}	3.03^{b}	3.87^{a}	**

[*]DY, dressed yield; TMW, total meat weight; BMW, breast meat weight; TMW, thigh meat weight; DMW, drumstick meat weight; WMW, wing meat weight

Similar meat yield on D_1 and D_4 indicate that equal mixture of SW and MW perhaps gave similar amino acid balancing and gave similar nitrogen retention and consequently supported similar meat yield. The results indicated that the meat yield among different diets were not differed (P<0.01).

Conclusion

Resulted scenario indicates that mixture of unconventional 6% shrimp waste and 6% marine waste might be an efficient replacer of fish meal to formulate economic diets.

References

Ahmed S and Islam N (1990). Backyard poultry development project in 100 villages. Proc. 1st Conf. Bang. Anim. Husbandry Assoc. February, 23-24, Mymensingh.

AOAC (1990). An Official Methods of Analysis, 13th Edition, Association of Official Analytical Chemists, Washington D.C.

Banerjee GC (1992). In: Poultry. 3rd Edn. Oxford and IBH Publishing Co Pvt. Ltd. New Delhi, Bombay, Calcutta.

Fanimo AO, Mudama E, Umukoro TO, and Oduguwa OO (1996). Substitution of shrimp waste meal for fish meal in broilers. Chinese J. Anim. Sci. 3: 12-14.

Haque QME and Rahman MM (1993). Annual Research Report of Bangladesh Livestock Research Institute, Savar, Dhaka 1341.

Hossain MD, Bulbul SM and Howlider MAR (1989). The composition of some unconventopnal feeds. Poult. Advi. 22: 37-40.

Gu HY, Liu YG and Shu ZZ (1988). Nutrient composition of marine algae and their feeding effects on broilers. Chinese J. Anim. Sci. 3: 12-14.

Howlider MAR (1999). 1st International poultry show and Seminar, April 24-26, Worl. Poult. Sci. Assoc. Bang. Branch.

Islam MA (1993). Use of marine and shrimp waste in broiler diet. M. Sc. Poultry Science thesis, Department of Poultry Science, Bangladesh Agricultural University, Mymensingh.

Islam MA, Bulbul SM and Howlider MAR (1994). Substitution of dietary fish protein by marine or shrimp wastes for broiler. Bang. J. Anim. Sci. 27: 7-12.

Jarquin R, Braham JE, Gonzalez JM and Bressani R (1972). Nutritive value of by products of shrimps for feeding poultry. Turrialba. 22: 160-167.

Menacherv N, Anathasubramanvm CR and Nair AMC (1978). Feeding values of shrimp shell powder (Prawn waste) for broiler chickens. Ind. J. Nutri. Dietetics, 15: 381-388.

Scott ML, Nesheim M, Robert C and Young J (1969). In: Nutrition of the Chicken, Second Edition, M. L. Scott and Associates, Ithaea, New York

Singh RA (1990). In: Poultry Production. 3rd edition. halyany Publishers, New Delhi, Ludhiana.

Steel RGD and Torrie JH (1960). In: Principles and Procedures of statistics, McGraw Hlill Book Company INC, New York, Toronto, London.