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Replacement of Sesame Oil Cake by Duckweed (*Lemna minor*) in Broiler Diet

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Abstract: An experiment was conducted with 120, seven-day old Vencobb commercial broiler chick feeding *ad libitum* upto 42 days of age on 4 different iso-nitrogenous and iso-energetic diet formulated by replacing dietary sesame oil cake (SOC) by duckweed (DW) to have its effect on performance of broilers. Live weight, feed conversion and profitability increased when sesame oil cake was partially replaced by duck weed. Complete SOC replaced diet significantly reduced live weight gain, feed intake, feed conversion and profitability, as compared with partial replacement of SOC by duckweed and SOC based control diet. Partial replacement of SOC by DW did not affect survivability of broiler. So it might be concluded that replacement of costly SOC partially by cheaper unconventional DW in broiler diet resulted in increased profitability. Therefore, cheaper duckweed could be practiced in formulating economic balanced diet for broiler.

Key words: Profitability, duck weed, sesame oil cake, unconventional

Introduction

Poultry Industry is one of the promising and emerging agro business started particularly during eighties in Bangladesh. Commercial broiler production has become a specialized and speedy poultry operation during the recent year all over the world. Bangladesh is now facing a severe scarcity of poultry feed. Very limited number of feed ingredients is available to chose for the formulation of balanced diet. Non-availability and higher price of feed ingredients are main constrains of broiler production. The profit of poultry farming mainly depends on economic feeding of balanced ration. In poultry rearing, feed cost accounts for 60-70% of the total cost of either egg or poultry meat production and protein accounts 15% of feed cost (Singh, 1990). From the economic point of view, the poultry should be supplied with cheaper feed to get maximum return with minimum cost. Poultry production may not be remunerative if costly conventional feeds are replaced by the cheaper unconventional feeds in the poultry diet. It is therefore, a recent trend among the poultry nutritionists to explore the unconventional cheaper ingredients towards reducing feed cost to maximize profit from poultry farming. So, locally produced available unconventional feed resource like duckweed may reduce feed cost.

Now a days, duckweed is used as a nutritional, aquatic feed ingredient for poultry. The family of duckweed is Lemnacae. Four genera of duckweed namely *Lemna, Spirodela, Wolffia* and *Wolfiella* are available. Among these duckweed is a potential unconventional feed ingredient that can be efficiently used in formulating broiler diet as a protein source. The production cost of duckweed is visually nil and it is grown in marshy land, particularly in ponds, ditches, lakes, canals and low laying paddy fields with stagnant water bodies throughout the year without any agronomic care. Duckweed gives an annual DM yield of 10 to 30 t ha^{-1} (Huque, 1998). Skillikorn *et al.* (1993) reported that the production rate of duckweed was four metric t ha^{-1} /day of fresh plant. Duckweed has high nutritional value and high productivity (Hillman and Culley, 1978). This can easily be collected and used as poultry feed. It contains less cell wall materials than others. The crude protein content of air-dried duckweed ranged from 25-35% (Mbagwu and Adeniji, 1988) and rich in amino acid. So, there is good prospect of using duckweed as protein source ingredient for poultry. Recently, sesame oil cake, a by-product of oil meal is being considered as an ingredient for poultry feed formulation. It is not available round the year in Bangladesh because it is seasonal by product and cost is quite high. Sesame oil meal having high phytic acid content appears to bind dietary calcium depressing growth rate of chicks. It is also deficient in lysine, but apparently contains most of other essential amino acids inadequate level for growing chicks. Sesame oilcake contains anti nutritional factor which can be eliminated by special possessing technique. On the other hand, sesame oil cake is being adulterated by adding coal. Considering the production cost, availability, toxic factor and other nutritional factor duckweed may be better than sesame oil cake.

Considering these themes the proposed research was aimed at to investigate the effect of replacing sesame oil cake by duckweed on the performance of broiler.

Materials and Methods

The experiment was conducted at Bangladesh Agricultural University Poultry Farm, Mymensingh with 7 day old 120 Vencobb commercial broiler chicks and continued upto 42 days old. Broiler chicks were randomly allocated to 4 dietary treatment group having 3 replication in each group (Table 1). All birds were exposed to an ideal uniform management. Collected duckweed was sun dried and stored in plastic bags until feeding broilers.

All feed ingredients used for diet formulation were subjected to proximate analysis for determination of dry matter (DM), ash, crude protein (CP), crude fibre (CF), ether extract (EE) nitrogen free extract (NFE), starch, sugar, calcium and phosphorus (AOAC, 1990) (Table 2). The formulation of diets has been shown in Table 3. Records on live weight, feed intake and feed conversion were kept weekly whereas mortality, temperature and humidity records were kept on daily basis. The experimental data both recorded and calculated was for a Completely Randomized Design (CRD) and analysis of variance (ANOVA) was performed to compare data among treatments.

Table 1: Layout of the experiment showing replication wise distribution of broilers to different diets

	Number of birds per replication			
Dietary treatment	R_1	R_2	R_3	Total number of birds
D_1	10	10	10	30
D_2	10	10	10	30
D_3	10	10	10	30
D_4	10	10	10	30
Total				120

D_1= Control diet (9% SOC+0% DW); D_2= 6% SOC+3% DW); D_3= 3% SOC+6% DW; D_4= 0% SOC+9% DW; where, SOC = Sesame oil cake, DW = Duck weed

Table 2: Chemical composition of feed ingredients used in died formulation

Ingredient	DM%	ME kcalkg^{-1}	CP%	EE%	CF%	Ca%	P%	Lys%	Meth%	Tryp%
Maize	87.70	3309a	8.30	4.60	2.90	0.13	0.21	0.18b	0.09b	0.063b
Rice polish	91.00	2860a	11.00	9.50	5.00	0.04	0.19	0.44b	0.24b	0.09b
Soybean meal	89.50	2240a	34.00	1.50	2.50	1.15	0.17	2.25b	0.76b	0.57b
Sesame oil cake	90.50	2022a	31.46	4.50	4.00	0.17	0.46	1.14c	1.23c	0.78c
Duck weed	89.85	2887a	28.48	4.75	10.35	0.60	0.72	0.91c	0.12c	0.07c
Fish pro-65%	95.40	2900	66.10	9.60	0.13	6.00	3.20	2.99	1.07	-

Source: [a]Metabolizable energy (ME) using Wiseman (1987) formula: ME (kcalkg^{-1} = 35.2 CP+78.5 EE+40.0 Starch+35.5 Sugar. [b]Singh and Panda (1992). [*]Analyzed at Nutrition Laboratory, Directorate of Livestock Services, Dhaka

Table 3: Experimental ration for broilers with calculated chemical composition

	Starter				Finisher			
Feed ingredient	D_1	D_2	D_3	D_4	D_1	D_2	D_3	D_4
Maize	56	55.5	55.5	56	64	64	64	64
Rice polish	3	3	3.0	3	3	3	3	3
Soybean meal	18.5	19	19	19	13.5	13	13.5	14
Sesame oil cake	9	6	3	-	9	6	3	-
Duck weed	-	3	6	9	-	3	6	9
Fish pro-65%	10	10	10	10	8	8	8	8
Soybean oil	2	2	2	2	2	2	2	2
Common salt	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5
Premix *	+	+	+	+	+	+	+	+
Total	100	100	100	100	100	100	100	100
Calculated nutrient composition								
ME (kcalkg^{-1})	3196.00	3200.15	3208.85	3189.89	3194.25	3202.95	3208.40	3210.00
CP%	23.08	23.18	23.06	23.03	20.06	19.97	20.06	20.10
CF%	4.45	4.06	4.25	4.45	3.37	3.87	4.50	4.25
Ca%	1.19	1.17	1.21	1.12	0.95	1.15	1.00	1.10
Av.P.%	0.50	0.56	0.55	0.57	0.47	0.45	0.41	0.40
Lysine%	1.15	1.20	1.25	1.40	1.00	0.96	0.98	0.99
Methionine%	0.55	0.49	0.50	0.52	0.44	0.40	0.37	0.41
Tryptophan%	0.35	0.34	0.25	0.30	0.19	0.80	0.16	0.17

* Premix (Embavit-B) is added @ 0.25% of mixed feed. Each 2.5 kg premix contains: Vit. A-12,500 IU; Vit. D_3-2,500 IU; Vit. E-0.20g; Vit. K_3-4.0 mg; Vit. B_1-2.5 mg; Vit. B_2-5 mg; Vit. B_6-4.0 mg; Nivotinic acid-40.0 mg; Pantothenic acid-12.5 mg; Vit. B_{12}-0.012 mg; Folic acid-0.80 mg; Biotin-0.10 mg; Cobalt-0.40 mg; Copper-10 mg; Iron-60 mg; Iodine-0.40 mg; Manganese-60 mg; Zinc-50 mg; Selenium-0.15 mg; DL-Methionine-100 mg; Choline chloride-300 mg; Lysine-60 mg

Results and Discussion

In chemical composition (Table 2) DW had similar crude protein (28.48%) in comparison with SOC (31.46%). Hanczakowski *et al.* (1995) found 30% protein in DW on DM basis. Van Dyke and Sutton (1977) reported that duckweed contain 34.8% crude protein. CP content of duckweed range from 20 to 40 % when of duckweed is quite variable depending on season, location, environment and nutrient content of water where it is grown (Gerloff *et al.*, 1965). Crude fibre level in our study was 10.35%. Mbagwu and Adeniji (1988) demonstrated that the DW grown under ideal condition and harvested regularly may have fiber content from 5 to 15%.

Ether extract content of DW was 4.75% in our study which is similar with the findings of Culley (1976) ash content of DW determined in present study agrees with the observation of Culley and Epps (1973). They found 26.40% ash in DW.

The live weight of broiler (Table 4) differed significantly ($P<0.01$) at 28, 35 and 42 days of age while was similar in broilers on all diets upto 21 days of age. After 21 days, live weight was increased linearly for increasing dietary duckweed level from 3 to 6%. However, highest performance on diet D_3 (3% SOC + 6% DW) indicated that partial replacement of SOC by DW is possible with increased growth performance of broiler that coincided the result of Haustein *et al.* (1994). They observed higher live weight on diet containing 5% level of DW. Depressed growth of broiler with increasing level of DW as in D_4 (0% SOC+ 9% DW) might be due to the difference in digestible protein content. Digestible protein percent in SOC is 89.9 (NRC, 1994) whereas in DW it is 63.90 (Hossain and Shikha, 1996).

Similar feed intake occurred (Table 4) for broilers on all diets up 21 days of age. From 28-35 days of age, broiler on D_3 diet consumed higher amount of feed than any other dietary treatments but at 42 days of age result of feed intake was reversed. Increasing dietary level of duckweed caused decreasing feed intake at 42 days of age and partial replacement (D_3) of SOC by DW resulted in lowest feed intake. This result agrees with the observation of Islam *et al.* (1995). Feed conversion ratio (Table 4) obtained in different dietary were similar upto 21 days of age. Superior feed conversion was obtained on diet D_3 from 28-42 days of age. However, poorest feed conversion was found on diet D_4 that supports the results of Muztar *et al.* (1977). They reported that higher level of fibre and tannin in aquatic plant may be responsible for lower digestibility and ultimately decreased feed conversion.

Reduced production cost and increased profitability (Table 5) per broiler on increasing level of DW in diet suggest that lower cost (Tk. 4 kg^{-1}) of DW compared to that of SOC (Tk. 9.5 kg^{-1}) could advantageously be used in formulating low cost and nutritionally feasible diet for broiler.

Unconventional cheaper aquatic duck weed (DW) could partially replace costly sesame oil cake (SOC) for the formulation of cost effective broiler diet. Inclusion of DW in partial replacing of SOC (D_3=3% SOC + 6% DW) in diet of broiler may increase performance and profitability and full replacement may not be advisable.

Table 4: Performance of broiler on different dietary level of DW and SOC at different ages

		Diet					
Variables	Age in days	D_1	D_2	D_3	D_4	LSD or (SED)	Level of significance
Live weight	7	129.86	130.66	128.00	130.96	(3.78)	NS
(g/b)	(initial)						
	14	231.66	230.55	231.80	229.94	(1.49)	NS
	21	439.09	438.10	438.70	440.77	(1.69)	NS
	28	680.49b	690.00c	727.65a	628.78c	14.21	**
	35	955.58c	989.35b	1018.87a	907.02d	16.74	**
	42	1265.90c	1315.58a	1350.70b	1192.35a	12.00	**
Feed intake	14	375.98	368.73	369.01	376.48	(4.75)	NS
(g/b)	21	802.65	807.19	807.83	810.86	(4.88)	NS
	28	1347.29b	1274.09c	1374.29a	1298.06c	26.02	**
	35	1965.13c	1996.65b	2010.23a	1945.11d	30.04	**
	42	2745.04a	2732.96a	2719.21b	2728.90a	23.43	*
Feed	14	2.02	2.01	1.97	2.01	(0.04)	NS
conversion	21	2.04	2.05	2.05	2.04	(0.01)	NS
ratio	28	2.11b	2.03c	1.97d	2.21a	0.19	**
	35	2.15b	2.12b	2.10b	2.23a	0.06	**
	42	2.25b	2.14c	2.04d	2.38a	0.06	**

The figures in a row having the similar letters do not significantly. NS = P>0.05; * = P<0.05; ** = P<0.01

D1 = Control diet (9% SOC + 0% DW); D2 = 6% SOC + 3% DW; D3 = 3% SOC + 6% DW;

D4 = 0% SOC + 9% DW; SOC = Sesame oil cake; DW = Duck weed

Table 5: Cost of production and profit of broiler on different diets

Variables	Diet D_1	D_2	D_3	D_4	LSD or (SED)	Level of significance
Chick cost (Tk./chick)	21.50	21.50	21.50	21.50	-	-
Feed cost (Tk./kg broiler)	23.99	22.75	22.53	25.59	0.8523	**
Total cost (Tk./kg broiler)	49.89	47.61	45.76	52.55	0.5435	**
Sale (Tk./kg broiler)	60.00	60.00	60.00	60.00	-	-
Other cost (Tk./kg broiler)	9.45	9.45	9.45	9.45	-	-
Profit (Tk./kg broiler)	10.48	12.39	14.24	7.45	0.9456	**

The figures in a row having the similar superscripts do not differ significantly
$^{+}$NS, P<0.05 *P<0.05 **P<0.01

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