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COMPARATIVE GROWTH, MEAT YIELD AND BLOOD LIPID PROFILES OF ARBOR ACRES, COBB 500 AND LOHMANN BROILER STRAINS

Shesher Das and Mohammad Aminul Islam*
Department of Dairy and Poultry Science at Bangabandhu Sheikh Mujibur Rahman Agricultural University, Gazipur-1706, Bangladesh

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ABSTRACT

A total of 8883, day-old broiler chicks of Arbor Acres (S1- 2706), Cobb 500 (S2- 3308) and Lohmann (S3- 2869) were assigned to 3 treatment groups having 3 replications in each strain for 28 days of the age of the bird to identify a suitable strain for profitable broiler production. The birds were fed the starter diet (0-14 days) containing 22% CP and 2900 Kcal ME/kg and the finisher diet (15-28 days) containing 20% CP and 3000 Kcal ME/kg. The birds were reared on a littered floor management system providing standard management given by the breeder. The body weight, feed intake, mortality, production cost, and net profit did not differ among the strains ($p>0.05$), except for the feed conversion ratio (FCR) ($p<0.01$). The lowest FCR was observed in S3, followed by S1 and S3, respectively. However, strain S2 tended to have higher body weight and feed intake compared to S1 and S3. Evidently but not significantly, Strain S3 had the highest production cost and lowest net profit among the strains. The strain S1 was comparable to S2 in terms of net profit. There was a tendency to increase meat yield traits and a decrease in blood lipid profiles in S2 compared to S1 or S3. Therefore, strains S2 and S1 performed better than S3 in terms of growth, net profit, meat yield, and lipid profile content of the blood. Hence, Cobb 500 (S2) was found to be superior to Arbor Acres (S1) considering the overall performance.

Keywords: Broiler Strain, Growth Performance, Lipid Profiles, Meat Yield Traits, Net Profit.

1. INTRODUCTION

The poultry industry is the most important sub-sector of Agriculture, which plays a vital role in human nutrition, economic growth, and employment opportunities. Meanwhile, the poultry sector in Bangladesh has gained remarkable development as per the current market demand for meat and egg (DLS 2020). As the population is increasing day-by-day need to increase meat production to nourish the people properly. Broiler farming is the easiest and cheapest source of valuable animal protein (Rahman et al. 2021), which is used in homes, restaurants, social occasions, and in every part of the country. In addition, irrespective of religion and age, everybody prefers broiler meat to fulfill the protein requirement. It is also advantageous to be easily digestible, minimizes the risks of blood pressure, heart disease, and diabetes, and prevents cancer in the body of human beings (Islam et al, 2023).

There are several broiler strains such as Cobb 500, Arbor Acres, Ross 308, Indian River, Arian, Hubbard Classic, Hubbard Flex, Lohmann, Tiger Sasso, Vedette, ISA, Starbro, MPK, Hybro G, Hybro N, etc. are rearing in Bangladesh (Pica-Ciamarra et al. 2010). Production performance of these strains are varying because of the genetic resources, environment, feeds, and feeding (FAO

2014). Hossain et al. (2011) found the highest live weight, feed intake, net profit, and lowest FCR in Cobb 500 compared with the Hubbard classic and MPK broiler strains. Udeh et al. (2015) observed the highest growth performance in Arbor Acres compared with the Marshal and Ross broiler strain. Rahimi et al. (2006) and Skrbic et al. (2007) reported improved growth performance in Cobb 500 broiler strain compared to that of Arbor Acres, Arian, Hubbard, Lohmann and Ross 508 strains. Al-Marzooqi et al. (2019) and Konpechr et al. (2020) showed that Cobb 500 broiler had the highest body weight, carcass yield and breast meat weight compared to the Ross 308, Arbor Acres, Hubbard and local Omani strain.

Abdullah et al. (2010) found the highest carcass weight and dressing percentage in Hubbard Classic followed by Lohmann and Ross, respectively. They also found the highest breast meat, leg cut and abdominal fat percentage in Hubbard Classic among the strains. Musa et al. (2007) found a higher level of total cholesterol, triglycerides, HDL and a lower level of LDL in the Cobb 500 strain than the Hubbard strain. Whereas, Osorio et al. (2012) found a higher level of total cholesterol, triglycerides, HDL and a lower LDL in the Ross broiler than in the Cobb 500 broiler strain. Nasoetion et al. (2019) observed higher total cholesterol, LDL and lower HDL in the Lohmann broiler strain compared to the Ross. Therefore, it has been found that Arbor Acre, Cobb 500 and Lohmann are very common, potential and preferable for producing profitable broilers. Therefore, among the 3 strains necessary to identify the most suitable broiler strain for producing a safe and cost-effective broiler.

Considering the above points, the present study was planned to assess the growth performance, meat yield traits and lipid profiles of Arbor Acre, Cobb 500 and Lohmann broiler strains to identify the broiler strain suitable for producing a safe and cost-effective broiler.

2. MATERIALS AND METHODS

2.1 Growth performance of Arbor Acres, Cobb 500 and Lohmann broiler strains

The experiments were carried out at the commercial poultry farm, Nourish Poultry and Hatchery Ltd., Ghatail Upazila, Tangail and at the laboratory of the Department of Dairy and Poultry Science at Bangabandhu Sheikh Mujibur Rahman Agricultural University, Gazipur-1706, Bangladesh.

2.2 Feeding trial

A total of 8883, day-old broiler chicks of Arbor Acres (S_1- 2706), Cobb 500 (S_2- 3308) and Lohmann (S_3- 2869) were assigned to 3 treatment groups having 3 replications in each. The birds were reared on a sawdust based littered floor management system for 28 days of the age of the bird. The birds were fed a commercial starter diet containing 22% CP and 2900 Kcal ME/kg for 0-14 days (A_1) and a finisher diet containing 20% CP and 3000 Kcal ME/kg for 15-28 days (A_2) (Table 1). Clean and fresh water was provided ad-libitum during the experimental period. The standard management practices as per the standard of the breeder were provided to the birds during the investigation.

Table 1: Composition of diet used in the experiment

Ingredients	Amount (Kg)	
	Starter diet (0-2 weeks)	Finisher diet (2-4 weeks)
Maize	56.60	63.50
Soybean meal	25.50	18.50
Rice polish	8.00	8.50
Protein concentrate	7.50	7.00
Limestone	2.00	1.50
Oil	-	0.50
Salt	0.50	0.50
Total	100.00	100.00
Calculated composition:		
ME (kcal/kg)	2900.00	3000.00
Crude Protein (CP) (%)	22.00	20.00
Crude Fiber (CF) (%)	5.00	5.00
Calcium (Ca) (%)	1.00	0.95
Phosphorus (P) (%)	0.45	0.45
Lysine (%)	1.15	1.05
Methionine (%)	0.40	0.45

*Vitamin and mineral premix: 1g/liter of water

The initial body weight of the chick was recorded replication wise, body weight and feed intake were recorded bi-weekly replication wise and dead birds when occurred.

The following parameters were calculated using the formula given by Onunkwo and Okoro (2015):

FCR (Feed conversion ratio) was calculated from feed intake and live weight.

Production cost (Taka/kg live weight) was calculated considering the chick cost, feed cost, labor cost and vaccine cost, etc.

Net profit (Taka/kg live weight) was calculated from the price per kg live weight and production cost per kg live weight of the bird.

2.3 Meat yield traits of Arbor Acres, Cobb 500 and Lohmann broiler strains

Six (6) birds having 2 birds in each strain were taken randomly and then slaughtered in order to process (stunning, bleeding, scalding, de-feathering, evisceration, washing) as cut-up parts. The following data were recorded:

Live weight (g), blood weight (g), feather weight (g), head weight (g), shank weight (g), dressed meat yield (%), breast meat weight (g), dark meat weight (g), wing weight (g), thigh weight (g), drumstick weight (g), heart weight (g), gizzard weight (g), liver weight (g), giblet weight (g) and skin weight (g).

2.4 Blood lipid profiles of Arbor Acres, Cobb 500 and Lohmann broiler strains

At the end of the experiment, a total of 6 blood samples per replication were taken from the bloodstream during the slaughter of the birds. Thereafter, the serum of the blood was separated from the blood samples using a centrifuge machine (4000 rpm for 10 minutes). The supernatant of blood serum was transferred into Eppendorf tubes and then measured the lipid profiles (total cholesterol, triglyceride, HDL and LDL) using a lipid profiles kit (Crescent Diagnostic Lab) in the spectrophotometric method.

2.5 Statistical analysis

The collected data were analyzed in 3 strains × 2 age groups Factorial Design using the Statistix10 computer package program for the growth performance of the bird. The data of production cost, net profit, meat yield traits and blood lipid profiles were analyzed in a Completely Randomized Design (CRD) using the Statistix10 computer package program.

2.6 Statistical model

The following statistical model was used for the analysis of data on growth performance.

$Y_{ijk} = \mu + S_i + A_j + (S \times A)_{ij} + e_{ijk}$

Where Y_{ijk} is the observation of the kth replication of the ith strain and the jth age group

μ is the overall mean

S_i is the fixed effect of the ith strain (i= 1, 2, 3)

A_j is the effect of the jth age group (j=1, 2)

$(S \times A)_{ij}$ is the interaction effect of the ith strain and the jth age group

e_{ijk} is the random error

The following statistical model was used for the analysis of data on production cost, net profit, meat yield traits and blood lipid profiles.

$Y_{ij} = \mu + S_i + e_{ij}$

Where Y_{ij} is the observation of the jth replication of the ith strain

μ is the overall mean

S_i is the fixed effect of the ith strain (i= 1, 2, 3)

e_{ij} is the random error

3. RESULTS AND DISCUSSION

3.1 Growth performance of Arbor Acres, Cobb 500 and Lohmann broiler strains

There was no significant difference among the strains for body weight, feed intake and mortality ($p>0.05$) except for FCR ($p<0.01$) (Table 2). The feed conversion ratio differed significantly among the strains ($p<0.01$). The body weight and feed intake tended to be the highest in strain S_2, followed by S_3 and S_1, respectively. Statistically, the mortality was almost similar among the strains. The lowest FCR was observed in S_3, moderate in S_1 and the highest in the S_2 strain.

Age affected growth performance; body weight, feed intake, FCR ($p<0.001$) and mortality ($p<0.05$). Body weight, feed intake, FCR and mortality increased with the increase in the bird's age. There was no interaction of strain and age on the growth performance traits ($p>0.05$).

The strains were almost similar for body weight, feed intake and mortality, however, strain S_3 showed the lowest FCR followed by S_1 and S_2, respectively Therefore, strain S_3 performed better than strain S_1 or S_2, which contradicted the finding of Rahimi et al. (2006). They found the highest body weight and feed intake in Cobb 500, followed by Lohmann, Hubbard, Arian, Ross

308 and Arbor Acres, respectively. The mortality was very poor in this study, however, the mortality tended to be the lowest in Arbor Acres, followed by Cobb 500 and Lohmann, respectively which was consistent with the findings of Sarkar et al. (2001) because they found more survivability in Arbor Acres compared to the ISA Vedette or Hybro broiler strain. Production cost and net profit did not differ statistically among the strains (p>0.05) (Table 2). Evidently, but not significantly, the highest production cost was observed in strain S_3, followed by S_1 and S_2, respectively. The net profit tended to be the lowest in S_3 and the highest in S_1 or S_2. However, the strain S_1 or S_2 was almost similar in terms of net profit. Therefore, strains S_1 and S_2 performed better than S_3 in terms of net profit, which was supported by the findings of Hossain et al. (2011) and Sarkar et al. (2002). They found the highest net profit and the lowest production cost in the Cobb 500 compared to the other broiler strains. Islam et al. (2018) showed a better net profit in Cobb 500 than in the Hubbard Classic broiler strain which also supported the present findings.

Table 2: Growth performance of Arbor Acres, Cobb 500 and Lohmann broiler strains at different ages of the bird

Traits	**Age (A)**	**Strain (S)**				**LSD value and level of significance+**		
		S_1	**S_2**	**S_3**	**Mean**	**S**	**A**	**S x A**
Body weight (g/bird)	A_1	473.30	470.00	470.00	471.10	58.554^{NS}	47.809***	82.808^{NS}
	A_2	1480.00	1516.70	1483.30	1493.30			
	Mean	976.67	993.33	976.67	982.22			
Feed intake (g/bird)	A_1	514.00	543.70	501.30	519.70	131.980^{NS}	107.760***	186.650^{NS}
	A_2	2143.00	2301.00	2075.30	2173.10			
	Mean	1328.50	1422.30	1288.30	1346.40			
FCR (Feed intake/live weight)	A_1	1.08	1.15	1.07	1.10	0.061**		0.0498***
	A_2	1.45	1.52	1.40	1.45	0.086^{NS}		
	Mean	1.26	1.34	1.24	1.28			
Mortality (%)	A_1	0.54	1.14	1.17	0.95	1.106^{NS}	0.903*	1.564^{NS}
	A_2	1.90	2.32	1.80	2.01			
	Mean	1.22	1.73	1.49	1.48			
Production Cost (Tk/kg live bird)		82.00	80.33	84.33	82.22	5.244^{NS}		
Net profit (Tk/kg live bird)		11.33	11.00	8.33	10.22	11.282^{NS}		

+NS, p> 0.05; *, p<0.05; **, p<0.01; ***, p<0.001; S_1=Arbor Acres, S_2= Cobb 500, S_3=Lohmann; A_1= 14 days of age; A_2= 28 days of age; selling price/kg live bird: 93.33 taka (Arbor Acres), 91.33 taka (Cobb 500), 92.66 taka (Lohmann)

3.2 Meat yield traits of Arbor Acres, Cobb 500 and Lohmann broiler strains

There was no significant difference among the strains for live weight, blood weight, feather weight, head weight, shank weight, dressed meat yield, dark meat weight, wing weight, thigh weight, drumstick weight, heart weight, gizzard weight, skin weight ($p>0.05$) except for breast meat weight, liver weight and giblet weight ($p<0.01$) (Table 3). The strains were significantly different for breast meat weight, liver weight and giblet weight ($p<0.01$). The strain S_2 showed the highest breast meat, liver weight, and giblet weight, followed by S_3 and S_1, respectively. Dressed meat yield (%) and dark meat weight were tended to the highest in S_2, followed by S_1 and S_3, respectively. Therefore, the strain S_2 showed the highest meat yield traits among the strains.

The strain S_2 performed better than S_3 or S_1 in terms of meat yield traits, consistent with the finding of Al-Marzooqi et al. (2019), Santos et al. (2004) and Konpechr et al. (2020). They showed the highest meat yield in Cobb 500 compared to the other strains (Omani, ISA Label, Lohmann, Ross 308, Arbor Acres, and Hubbard). Rahimi et al. (2006) reported the highest carcass yield, breast meat, abdominal fat in Hubbard strains, followed by Arbor Acres, Cobb 500, Arian, Ross 508 and Lohmann broiler strains, respectively, which contradicted the findings of the present study. Konpechr and Sohsuebngam (2020) reported the highest carcass yield in Hubbard Classic broiler strain, followed by Cobb 500, Ross 308 and Arbore Acre, respectively, which partially supported the present findings.

Table 3: Meat yield traits of Arbor Acres, Cobb 500 and Lohmann broiler strains at 28 days of the age of the bird

Traits	Strains (S)			LSD value and level of significance+
	S_1	S_2	S_3	
Live weight (g)	1441.00	1553.00	1495.00	95.878^{NS}
Blood weight (g)	42.00	40.00	33.00	11.908^{NS}
Feather weight (g)	32.00	43.00	42.00	11.908^{NS}
Head weight (g)	38.00	45.00	42.00	9.369^{NS}
Shank weight (g)	61.00	68.50	60.00	20.666^{NS}
Dressed meat yield (%)	69.43	70.84	68.90	1.979^{NS}
Breast meat weight (g)	272.00	332.00	324.00	15.591^{**}
Dark meat weight (g)	678.00	690.50	671.00	73.461^{NS}
Wing weight (g)	86.00	97.50	89.00	22.239^{NS}
Thigh weight (g)	139.50	160.00	159.00	23.132^{NS}
Drumstick weight (g)	128.00	140.00	132.00	22.749^{NS}
Heart weight (g)	16.00	15.50	14.00	8.319^{NS}
Gizzard weight (g)	22.00	25.50	22.00	7.464^{NS}
Liver weight (g)	42.00	62.00	55.00	2.598^{**}
Giblet weight (g)	80.00	103.00	91.00	8.217^{**}
Skin weight (g)	101.00	112.00	108.00	36.471^{NS}

+NS, p> 0.05; *, p<0.05; **, p<0.01; ***, p<0.001; S_1=Arbor Acres, S_2= Cobb 500, S_3=Lohmann

3.3 Lipid profiles of the blood of Arbor Acres, Cobb 500 and Lohmann broiler strains

There was no significant difference among the strains for total cholesterol (TC), triglycerides (TG), high-density lipoprotein (HDL) and low-density lipoprotein (LDL) (p>0.05) (Table 4). The TC and LDL tended to lower in strain S_2, followed by S_3 and S_1, respectively. The value of HDL was almost similar among the strains (p>0.05).

Considering the lipid profile content of the blood of strains, strain S_2 performed better than strain S_3 or S_1. Of the two strains, the S_3 was found to be better than the S_1 in terms of the lipid profile content of the blood of broiler strains. The present findings partially supported the findings of Osorio et al. (2012) and Musa et al. (2007). Osorio et al. (2012) found higher total cholesterol, triglycerides, HDL and lower LDL in the Ross broiler strain compared to the Cobb 500 broiler strain. Musa et al. (2007) showed a higher level of total cholesterol, triglycerides, and HDL with a lower level of LDL in the Cobb 500 broiler strain compared to the Hubbard broiler strain.

Table 4: Blood Lipid profiles of Arbor Acres, Cobb 500 and Lohmann broiler strains at 28 days of age of the bird

Traits	**Strains (S)**			**LSD value and level of significance+**
	S_1	**S_2**	**S_3**	
Total cholesterol	227.69	186.15	201.54	63.208^{NS}
Tri-glycerides	144.16	159.39	147.21	29.494^{NS}
HDL	77.13	68.50	74.39	54.056^{NS}
LDL	121.73	85.78	97.71	65.621^{NS}

+NS, p> 0.05; *, p<0.05; **, p<0.01; ***, p<0.001; S_1=Arbor Acres; S_2= Cobb 500; S_3=Lohmann; HDL= High-density lipoprotein, LDL = Low-density lipoprotein

4. CONCLUSIONS

The present study reveals that Strain S_2 (Cobb 500) performed better than S_1 (Arbor Acres) and S_3 (Lohmann) in terms of production cost, net profit, meat yield traits and lipid profile content of the blood of broiler chickens. However, S_1 was superior to S_3 in terms of meat yield traits and lipid profile content of the blood of broiler chickens. Hence, strain S_2 may be superior to S_1 or S_3 strain in terms of the overall performance; growth performance, meat yield traits and lipid profile content of the blood of broiler chickens. Therefore, the strain Cobb 500 (S_2) may be considered for producing a safe and profitable broiler. However, more studies are needed involving more broiler strains to confirm the present findings before making a final comment to use a broiler strain for producing a safe and cost-effective broiler.

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