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Growth and reproductive fitness of different chicken breed

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ABSTRACT

The present study focused on the growth and reproductive performance of White Plymouth Rock (WPR), Rhode Island Red (RIR), Aseel and Indigenous (*Desi*) chickens in intensive management system. A total 162 day-old chicken (WPR=75, RIR=36, Indigenous (*Desi*)=36 and Aseel=15) were selected for a period of 32 weeks of age. The day old weight of WPR, RIR, Aseel and Indigenous (*Desi*) chickens were 31, 30, 31 and 25g respectively. The body weight at 7, 20 and 32 weeks was highest in Aseel and lowest in *Desi* chicken. The body weight of WPR and RIR had almost similar body weight (P>0.05). The feed consumption was higher in WPR and Aseel followed by RIR and *Desi* chicken in all stages of growth and production. The WPR, RIR and *Desi* chicken attained sexual maturity earlier (P<0.05) than Aseel. The egg weight at 1st lay were 41, 40, 41 and 31g which increased to 55.00, 50.33, 59.00 and 41.00g in WPR, RIR, Aseel and *Desi* chicken at 32 weeks of age (P<0.05). The hen day egg production was 45, 45, 39 and 37% respectively. The livability during laying periods among different breeds was almost similar (WPR=87.33±2.80, RIR=90.66±2.80, Assel=100.00±2.80and *Desi*=100.00±2.80) (P>0.05). The study revealed that the growth performance of Aseel was higher (M=2276.67±54.62 and F=1860.00±42.24 at 32 weeks) (P<0.05) at all stages of growth than those of other breeds. The growth rate of WPR (M=2100.00±54.62 and F=1640.00±42.24) and RIR (M=2156.67±54.62 and F=1450.00±42.24 at 32 weeks) is moderate.

INTRODUCTION

Population growth, urbanization and rising income in many parts of the developing world have caused a growing demand for food of animal origin. Global poultry meat output is expected to amount to 106.4 million tonnes in 2013, according to a forecast made by the Food and Agriculture Organisation (FAO). Chicken meat output accounts for some 88% of world poultry meat production.

World chicken meat production (table birds plus culled layers) is likely exceed 93 million tonnes in 2013 while, according to United States Department of Agriculture (USDA) estimates, broiler meat output is around 84.6 million tones. The proportional contribution of poultry by the year 2020 is believed to increase to 40%, the major increase being in the developing world (Delgado et al., 1999). Poultry are the most commonly kept livestock species and have been reared as an integral part of the mixed agricultural system throughout Bangladesh. When considering livestock species on the basis of their contribution to total farm income, farmers ranked chickens the highest followed by goats and cattle (Muchenje and Sibanda, 1997).

The chicken population is steadily increasing, from about 143 million in 2001 to 195 million birds in 2006 (DLS, 2007). It is increasing at an annual growth rate of 5.9% (Haque et al., 2004). The contribution of poultry is about 21% of the total livestock to the national GDP (Khan and Roy 2003).

According to DLS (2007), beef was the largest single source of meat in 1992 as well as 2007. In 1992, the supply of goat meat was more than poultry meat. Between 1992 and 2007 the goat meat production was stagnated, while beef production has increased by a factor of 2.5.

The Aseel is a local breed reared in backyard and is a vital source of meat and income for small-

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holder. The Aseel has an importance in tribal culture for cock fighting and well known for its pugnacity, high stamina, majestic gait and dogged fighting qualities.

Indigenous (*Desi)* chickens have an inherent scavenging habit. They are more resistant to diseases, less prone to predator attack and can survive under harsh nutrition and environment. Okada et al. (1988) termed them a breed or population, although the chicken differs in size, shape, color and production according to their genetic constitution. The major problem indicated in rearing Indigenous (*Desi*) chicken is their low production performance (Nowsu, 1979). But they have a significant position in the genetic improvement of breeding stock for the tropics (Horst, 1988). There is a need for their genetic improvement in order to improve their productivity within their local environment; make use of the improved Indigenous (*Desi*) chicken in crossing with imported exotic chicken and conserved the desirable genes (e.g. disease resistance, feather color, meat texture) of the Indigenous breed for future breeding. Crossbreeding programmes are more appreciable including upgrading local types with suitable exotic ones. It was found that crossbred progenies were superior in growth rate, meat quality and feed conversion compared to that of respective purebreds (Dubrynia, 1958; Masic and Khalifah, 1965).

In initiating chicken breeding we must know the genetic potentiality of the available resources for meat production at our climatic condition. So the present work was undertaken to evaluate the growth and meat production and reproductive performance of White Plymouth Rock (WPR), Rhode Island Red (RIR), Aseel and Indigenous (*Desi*) chickens in intensive production system.

MATERIALS AND METHODS

The experiment was designated to evaluate the performance of 162 one day-old of White Plymouth Rock (WPR), Rhode Island Red (RIR), Aseel and Indigenous (*Desi*) chicken for a period of 9 months (April, 2010 to December, 2010). The chicks were obtained from Sponsored Public Goods Research (SPGR) project of the Department entitled "Approaches to develop broiler sire and dam lines from available genetic resources" except RIR chicks, which was obtained from poultry farm, Bangladesh Agricultural University, Mymensingh. Chickens were distributed into four (4) treatment groups having three (3) replications each. The chicken was reared in a semi-monitored house on litter floor. The experimental room was divided into 12 separate pens by using wire net and birds were randomly distributed to different breed treatments and replications. The chicks were brooded up to 5 weeks of age. The commercial layer starter crumble, grower and layer mesh diets were fed to all the experimental chicken. The composition of the diets is shown in Table 1. The experimental chickens were vaccinated against Ranikhet, Gumboro, fowl pox and fowl cholera to prevent the diseases. The records of body weight, feed consumption (g/bird) shank length (cm), age at sexual maturity, egg production (hen day), egg weight, mortality were recorded.

Table 1
The composition of experimental diets.

Ingredients (%)	Starter (0-7 weeks)	Grower (8-18 weeks)	Layer (19-32 weeks)
Maize	60	60	60
Rice polish	15	17	19
Soybean meal	20	18	16
Bone meal	2.97	2.97	0.77
$Caco_3$	1.5	1.5	3.70
Salt	0.5	0.5	0.5
Vitamin-mineral premix	*	*	**

Nutrient composition(g/kg)			
CP	190	160	180
ME (kcal/kg)	2900	2750	2750
Ca	11	10	35
P	4.50	3.60	4.20
Lysine	11.2	7.5	8.5
Methionine	5.0	3.30	4.2

*****Embavit WS: 2.50g/kg mixed feed; ** Embavit L: 2.5g/kg mixed feed.

The collected and calculated parameters (body growth, shank length, feed consumption and reproductive and other productive performance such as age at sexual maturity, body weight at sexual maturity, egg weight, egg production and livability at different stages of growth and production) were subjected to analysis of variance by Completely Randomized Design (CRD). Significant differences were identified by Tukeys test.

RESULT AND DISCUSSION

Body growth

The weekly body weight of White Plymouth Rock (WPR), Rhode Island Red (RIR), Aseel and Indigenous (*Desi*) chicken from day old to 32 weeks of age is presented in Table 2 and 3. The chicken grew rapidly with the advancement of age. The body weight was higher ($P<0.01$) in Aseel and WPR then RIR and Indigenous (*Desi*) chickens. While 6-week body weight was 347.33±11.17, 321.66±11.17, 302.00±11.17 and 291.00±11.17g in Aseel, RIR, WPR and Indigenous (*Desi*) respectively ($P<0.05$). The 7 week body weight tended to be in Aseel (429g) followed by RIR (403.33g); WPR (362.33g) and Indigenous (*Desi*) (366.33g) ($P>0.05$). The 8 week body weight of male was highest ($P>0.05$) in WPR and RIR (590g) followed Aseel (551.66g) and Indigenous (*Desi*) (515g). While in female body weight was highest ($P<0.05$) in Aseel (565g) followed by RIR (530g), WPR (496.66g) and Indigenous (*Desi)* (463.33g). The trend in weight was also observed at 9 and 10 weeks of age in Aseel, RIR, WPR and Indigenous (*Desi*) chickens of males and females.

The day old weight of WPR, RIR, Aseel and Indigenous (*Desi*) chickens were 31, 30, 31 and 25g respectively. It is evident that the highest day old weight was in WPR and Aseel and the lowest in Indigenous (*Desi*). The RIR had the medium weight. The difference in day old chick weight was primarily for egg size (meternal effect) variation of the genotypes that ultimately affect the day old weight of the chicks. The chick weight is the function of egg weight (Sharma et al., 1971). The day old body weight of RIR was 30g which is lower than the value reported by Latif (1970) and Chhabara and Sapra (1973) who found 36.36 and 35.58g body weight at hatching time. The day old body weight of Aseel was 31.00g which is lower than the value reported by Chhabara and Sapra (1973). They reported 36.15, 141.17 and 709.00g for Aseel, 35.58, 145.79 and 711.17g for RIR at 1 day, 4 week and 12 weeks of age. The males were heavier than female, while the growth pattern of Assel, RIR, WPR and Indigenous (*Desi*) chickens at 16, 20, 24, 28 and 32 weeks of age follow almost similar growth pattern. The highest body weight was attained in Aseel, followed by WR, RIR and Indigenous (*Desi*) chickens.

The 16 week body weight of Indigenous (*Desi*), RIR, and WPR is comparable with the observation of Hossain and Ahmed (1995). They observed 640, 880 and 950g body weight respectively. The results are partially consistent with Bhuiyan (2005). He reported that mature body weight of Indigenous (*Desi*) chicken varies from 1.00kg to 1.30kg, while the Aseel was heavier than Indigenous (*Desi*) chicken.

Table 2
Body weight (g) of WPR, RIR, Aseel and Indigenous (*Desi*) chickens up to 7 weeks of age (Mean ± SD).

Age (Week)	Sex	WR	RIR	Aseel	Indigenous (*Desi*)	Level of significance
Day old	Mixed	31.00±0.0	30.00±0.0	31.00±0.0	25.00±0.0	**
1	Mixed	52.33±1.58^{b}	47.66±1.58^{b}	49.33±1.58^{b}	43.50±2.12^{ab}	**
2	Mixed	90.00±3.73^{b}	84.00±3.73^{b}	107.66±3.73^{a}	82.33±3.73^{b}	**
3	Mixed	151.00±4.75^{a}	150.00±4.75^{a}	140.00±4.75^{ab}	126.66±4.75^{b}	*
4	Mixed	210.33±4.51^{a}	188.33±4.51^{b}	218.00±4.51^{a}	183.66±4.51^{b}	**
5	Mixed	270.00±6.40^{a}	240.00±6.40^{b}	285.33±6.40^{a}	230.66±6.40^{b}	**
6	Mixed	302.00±11.17^{ab}	321.66±11.17^{ab}	347.33±11.17^{a}	291.00±11.17^{b}	*
7	Mixed	362.33±16.58	403.33±16.58	429.00±16.58	366.33±16.58	NS

Figures superscripts with similar alphabet do not differ significantly.
** Significant (P<0.01); NS=Non significant

Table 3
Body weight (g) of WPR, RIR, Aseel and Indigenous (*Desi*) chickens from 8 to 32 weeks of age (Mean ± SD).

Age (Week)	Sex	WPR	RIR	Aseel	Indigenous (*Desi*)
8	M	590.00±30.45	590.00±30.45	551.66±30.45	515.00±30.45
	F	496.66±7.02^{c}	530.00±7.02^{b}	565.00±7.02^{a}	463.33±7.02^{d}
9	M	636.66±44.40	730.00±44.40	660.00±44.40	614.00±44.40
	F	580.00±8.81^{b}	680.00±8.81^{a}	680.00±8.81^{a}	503.33±8.81^{c}
10	M	688.66±52.53	870.00±52.53	803.33±52.53	655.33±52.53
	F	635.33±7.99^{c}	720.00±7.99^{a}	791.66±7.99^{a}	603.33±7.99^{c}
16	M	1242.67±57.43^{b}	1400.00±57.43^{ab}	1633.33±57.43^{a}	966.67±57.43^{c}
	F	1048.00±21.14^{b}	976.67±21.14^{b}	1421.67±21.14^{a}	653.33±21.14^{c}
20	M	1596.67±58.09^{b}	1673.33±58.09^{b}	2000.00±58.09^{a}	956.67±58.09^{c}
	F	1353.33±59.37^{ab}	1243.33±59.37^{b}	1590.00±59.37^{a}	796.67±59.37^{c}
24	M	1753.33±83.67^{b}	1675.00±83.67^{b}	2163.33±83.67^{a}	1206.67±83.67^{c}
	F	1513.33±60.00^{b}	1336.67±60.00^{b}	1893.33±60.00^{a}	988.33±60.00^{c}
28	M	2096.67±86.74^{a}	2146.67±86.74^{a}	2133.33±86.74^{a}	1560.00±86.74^{b}
	F	1656.67±61.52^{a}	1386.00±61.52^{a}	1586.67±61.52^{a}	1005.00±61.52^{b}
32	M	2100.00±54.62^{a}	2156.67±54.62^{a}	2276.67±54.62^{a}	1533.33±54.62^{b}
	F	1640.00±42.24^{b}	1450.00±42.24^{b}	1860.00±42.24^{a}	1009.00±42.24^{c}

Figures superscripts with dissimilar alphabet differed significantly (p<0.01)

Table 4
Shank length of WPR, RIR, Aseel and Indigenous (*Desi*) chickens at 12, 20 and 32 weeks of age.

Shank length (cm)		WPR	RIR	Aseel	Indigenous (*Desi*)	Level of significance
12	M	7.99±0.19^{ab}	8.81±0.19^{a}	8.82±0.19^{a}	7.41±0.19^{b}	**
	F	7.27±0.20^{bc}	8.10±0.20^{ab}	8.76±0.20^{a}	6.58±0.20^{c}	**
20	M	10.08±0.11^{b}	10.17±0.11^{b}	11.76±0.11^{a}	8.73±0.11^{c}	**
	F	8.38±0.10^{c}	9.12±0.10^{b}	9.69±0.10^{a}	7.79±0.10^{d}	**
32	M	11.22±0.13^{ab}	10.82±0.13^{b}	11.62±0.13^{a}	9.34±0.13^{c}	**
	F	8.77±0.16^{b}	9.21±0.16^{b}	10.36±0.16^{a}	7.80±0.16^{c}	**

Figures superscripts with dissimilar alphabet differed significantly ($p<0.01$).** Significant ($P<0.01$); NS=Non significant.

Table 5
The feed consumption and feed conversion ratio (FCR) of WPR, RIR, Aseel and Indigenous (*Desi*) chickens during growing and laying period.

Daily feed consumption/bird	WPR	RIR	Aseel	Indigenous (*Desi*)
Early growing period(g)	25	25	26	20
Growing period (g)	57	53	57	51
Laying period (g)	107	101	109	77
F. C. R.				
Early growing period (0-7 wks)	3.65	3.26	3.18	2.86
Growing period (8-18 wks)	4.66	4.11	3.62	7.07
Laying period(19-32 wks)	4.08	7.93	6.10	6.50

Shank length

The shank length of White Rock, Rhode Island Red, Aseel and Indigenous (*Desi*) chicken at 12, 20 and 32 weeks of age is presented in Table 4. It is evident (Table 4) that the shank length of Aseel is longer than other breeds at all stages of growth. The shank length of Aseel is ($P<0.05$) longer than Indigenous (*Desi*) chickens in both the sexes. The shank length of Aseel was longer than other breeds at all stages of growth. The results were similar to the observation of Summer et al. (1991) and Indirabai and Surenderen (1983).

Feed consumption

The feed consumption of White Rock, Rhode Island Red, Aseel and Indigenous (*Desi*) chickens during growing and laying period is shown in Table 5. The total feed consumption per bird during early growing period (0-7 weeks) was 1210, 1218, 1250 and 978g in WPR, RIR, Aseel and Indigenous (*Desi*) chickens respectively. It reveals that 25, 25, 26 and 20g feed is needed per bird per day during early growing period (0-7 wks) in WPR, RIR, Aseel and Indigenous (*Desi*) chicken respectively. The feed consumption was more in WPR, RIR and Aseel than Indigenous (*Desi*) chicken. While during growing period (8-18 weeks) the total feed consumption was 4374,

4113, 4411 and 3930g in WPR, RIR, Aseel and Indigenous (*Desi*) chickens which accounted for 57, 53, 57 and 51g feed consumption per bird per day respectively. The per day feed requirement during growing period was more in WPR and Aseel i. e. 57g followed by RIR, 53g and Indigenous (*Desi*), 51g. During laying period (18-32 weeks) total feed consumption was 10.493, 9.851, 10.675 and 7.541kg per bird which accounts 107, 101, 109 and 77g feed requirements per bird per day in WPR, RIR, Aseel and Indigenous (*Desi*) chickens respectively. Daily feed consumption was also more in WPR, 107g and Aseel, 109g per bird followed by RIR, 101g and Indigenous (*Desi*), 77g.

The daily feed consumption and feed efficiency during early growing period (0-7 wks), Late growing period (8-18 wks) and laying period is shown in Table 5. It is evident that feed conversion during early growing period (0-7 wks) was better in Indigenous (*Desi*) and Aseel than RIR and WPR. While during late growing period the feed conversion was better in Aseel, RIR and WPR chicken than Indigenous (*Desi*) chicken. The feed conversion during laying period (g feed/g egg mass production) were 4.08, 7.93, 6.10 and 6.50 in WPR, RIR, Aseel and Indigenous (*Desi*) chicken respectively. The feed conversion in respect of egg mass produced was the best in WPR, followed by Aseel, Indigenous (*Desi*) and RIR chicken.

In this study the feed consumption was in WPR and Aseel followed by RIR and Indigenous (*Desi*) chicken at all stages growth and production period. The results disagree with Yeasmin (2000) who found 35g feed consumption per bird during 5-18 weeks of age in Indigenous (*Desi*) chicken. Probably, this might be for variation in management, nutrient density of diet and season of study. The feed conversion was better in Aseel, RIR and WPR chicken than Indigenous (*Desi*) chicken at all stages of growth except early growing period (0-7 wks). The feed conversion of Indigenous (*Desi*) chicken in the study during laying period was 6.5. While Bhuiyan et al. (2005) reported 8.6-8.8 feed /g of egg mass produced. Probably this might be for variation in management and better production (37.46%) in flock under this study. Bhuiyan et al. reported only 45-50 eggs per year in Indigenous (*Desi*) chicken under scavenging system.

Table 6
Reproductive and other productive performance of WPR, RIR, Aseel and Indigenous (*Desi*) chicken.

Performance	WPR	RIR	Aseel	Indigenous (*Desi*)
Age at sexual maturity	140.00±4.64^{b}	139.66±4.64^{b}	175±4.64^{a}	149.33±4.64^{b}
Body wt. at sexual maturity	1306.67±90.89^{b}	1243.33±90.89^{b}	2233.33±90.89^{a}	953.33±90.89^{b}
Egg wt. (g) (sexual maturity)	41.33±1.35^{a}	39.66±1.35^{a}	40.66±1.35^{a}	31.00±1.35^{b}
24	50.00±1.08^{a}	45.00±1.08^{a}	47.00±1.08^{a}	31.50±1.32^{b}
28	51.33±0.62^{a}	51.00±0.62^{a}	53.33±0.62^{a}	37.00±0.62^{b}
32	55.00±0.60^{b}	50.33±0.60^{c}	59.00±0.60^{a}	41.00±0.60^{d}
Egg production % (Hen day) (Maturity-32 wks.)	44.49±2.19	45.13±2.19	38.76±2.19	37.46±2.19
Livability % (0-7 wks)	95.33±1.57	99.33±1.57	99.00±1.57	100.00±1.57
Livability % (8-18 wks)	99.00±2.95	98.66±2.95	94.33±2.95	100.00±2.95
Livability % (19-32 wks)	87.33±2.80	90.66±2.80	100.00±2.80	100.00±2.80

Figures superscripts with dissimilar alphabet differed significantly. ($p<0.01$). ** Significant ($P<0.01$); NS=Non significant.

Reproductive and other productive performance

Age at sexual maturity, body weight at sexual maturity, egg weight, egg production and livability at different stages of growth and production is presented in Table 6. The age at sexual maturity was 140, 140, 176 and 149 days in WPR, RIR, Aseel and Indigenous (*Desi*) chicken respectively (P<0.01). However, WPR, RIR and Indigenous *(Desi)* chicken came to sexual maturity (P<0.01) earlier than Aseel (175 days). While the difference of age at sexual maturity among WPR, RIR and Indigenous (*Desi*) did not vary (P>0.05). The body weights attained at sexual maturity were 1307, 1243, 2233 and 953g in WPR, RIR, Aseel and Indigenous (*Desi*) chicken respectively (P≤0.01). The egg weight at sexual maturity were 41, 40, 41and 31g in WPR, RIR, Aseel and Indigenous (*Desi)* chicken respectively (P<0.01). The egg size increased to 55, 50, 59 and 41g in WPR, RIR, Aseel and Indingenous (*Desi*) chicken at 32 weeks of age (P<0.01).

The hen=day egg productions from sexual maturity to 32 weeks of age were 44, 45, 39, 37 % in WPR, RIR, Aseel and Indigenous (*Desi)* chicken respectively (P≤0.05).

The livability of WPR, RIR, Aseel and Indigenous (*Desi*) chicken during early growing period (0-7 week) were 95, 99, 99 and 100 %, while during growing period (8-18week) were 99, 99, 94 and 100 % and during laying period were 87, 91, 100 and 100 % respectively (P>0.05).

Reproductive and other productive performance

WPR, RIR and Indigenous *(Desi)* chicken came to sexual maturity (P<0.01) earlier than Aseel (175 days). The age at sexual maturity obtained in Aseel is consistent with the observation of Mohan et al. (2008) but disagree with Bhuiyan et al. (2005). He reported that Aseel come to sexual maturity at 240-300 days. Indigenous (*Desi*) chicken attained sexual maturity at 149 days which was earlier than that reported by Bhuiyan et al. (2005). They found that the Indigenous (*Desi*) chicken come to sexual maturity at 175 days. The body weight attained at sexual maturity was higher in Aseel than in other breeds. While the body weight at sexual maturity in WPR, RIR and Indigenous (*Desi*) chicken was similar. The higher body weight at sexual maturity of Aseel might be for late sexual maturity. The body weight attained at sexual maturity in Indigenous (*Desi*) and Aseel chicken is comparable with the observation of Okada et al. (1988) and Bhuiyan et al. (2005). The egg weight at sexual maturity of Indigenous (*Desi*) chicken was lower (P<0.01) than other breeds. The results are not consistent with the observation of Bhuiyan et al. (2005).They reported that egg weight varied from 35-39g in Indigenous (*Desi*) chicken. While in the present study we found 31g egg weight at sexual maturity in Indigenous (*Desi*) chicken. This might be the Indigenous (*Desi*) chicken in the present study came to sexual maturity earlier i. e. 149 days as against 175 days in their study. The egg size was highest in Aseel, followed by WPR, RIR and Indigenous (*Desi*) chicken.

The hen day egg production was numerically higher in WPR and RIR than Aseel and Indigenous (*Desi*) chicken. The egg production of Aseel in this study was much higher (38.76±2.19%) than that reported Bhuiyan *et al.* (2005). He reported only 33 eggs per year under intensive system. This variation might be due to differences in management and feeding of chicken. Mohan et al. (2008) reported that *Aseel peela* Indigenous (*Desi*) hens give 160 eggs per year of production. The livability of the exotic WPR and RIR and the locally available Aseel and Indigenous (*Desi*) chicken are well adapted in intensive management system. The results partially agree with the observation of Barua and Yashimura, (1998); Khan (1983). They reported that local chickens are more resistance to diseases. But disagree with the observation of Chhabara and Sapra (1973), Islam (1983). They observed much higher mortality of exotic breeds. This variation might be for variation in environment and management as livability is influenced by environment.

CONCLUSION

The growth performance of Aseel is more than Indigenous (*Desi*) chicken while the WPR and RIR have moderate growth. The WPR and RIR

and Indigenous (*Desi*) chicken come to sexual maturity earlier than Aseel, while the egg weight is almost similar in WPR, RIR and Aseel but lower in Indigenous (*Desi*) chicken.

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