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Effect of Sex-linked Feathering Genes on Body Weight, Age At Sexual Maturity, Feed Intake and Subsequent Laying Performance of Baladi Chickens

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تأثير جينات التريش المرتبطة بالجنس على وزن الجسم وعمر النضج وإستهلاك العلف وكفاءة إنتاج البيض في الدجاج البلدي *ع. أ. السبيل و ع. ع. الملحم*

خلاصة: أجريت هذه الدراسة على عدد ٣٢٠ من بداري الدجاج البلدي بطيئة وسريعة التريش عند عمر عشرين أسبوعا وذلك لتقييم تأثير مورثات التريش المرتبطة بالجنس على وزن الجسم وعمر النضج واستهلاك العلف وكفاءة الإنتاج في الدجاج البلدي بالإضافة إلى ذلك استخدم عدد مماثل من دجاج اللجهورن سريع التريش في الدراسة بغرض المقارنة. قسمت الطيور في كل مجموعة وراثية عشوائيا إلى أربع مكررات وربيت حسب نظم الرعاية المألوفة. وقد دلت النتائج على أن البلدي بطئ التريش كان أعلى معنويا (P<0.05) من نظيره سريع التريش في وزن الجسم ومعدل النفوق واستهلاك العلف وأقل معنويا (P<0.05) فيما يتعلق بإنتاج البيض وكفاءة تحويل العلف لكنه لا توجد فروق معنوية بينهما بالنسبة لعمر النضج. دجاج اللجهورن سريع التريش كان أعلى معنويا (P<0.05) من البلدي بنوعيه في وزن الجسم وعمر النضج وإنتاج البيض اليومي (HD) ومعدل الهلاكات واستهلاك العلف لكل كيلو جرام من البيض. كذلك تشير النتائج إلى أنه لا توجد فروق معنوية بين البلدي سريع التريش واللجهورن فيما يخص إنتاج البيض حسب عدد الطيور الإبتدائي (HH) وكمية العلف المستهلك لكل دزينة بيض وكانا أفضل معنويا (P<0.05) من البلدي البطئ التريش فيما يتعلق بهاتين الصفتين.

ABSTRACT : A total of 320 twenty week-old slow and rapid feathering Saudi Arabian Baladi pullets were used to assess the effect of sex-linked feathering genes on body weight, age at sexual maturity, feed intake and subsequent laying performance. Similar numbers of rapid feathering Leghorns pullets were included in the study for the purpose of comparison. The experimental birds of each genotypic group were randomly divided into four replicates and subjected to standard management practices. Slow feathering Baladi pullets had higher ($P<0.05$) adult body weight, rate of mortality, and feed intake and a similar age at sexual maturity but showed lower ($P<0.05$) hen-day, and hen-housed egg production and feed conversion compared with rapid feathering Baladi pullets. Rapid feathering Leghorns had higher ($P<0.05$) adult body weight, age at sexual maturity, hen-day egg production, rate of mortality and feed intake and lower feed intake/kg eggs than rapid and slow feathering Baladi. However, rapid feathering Baladi and Leghorns had similar hen-housed egg production and feed intake per dozen eggs and had better ($P<0.05$) performance than slow feathering Baladi.

The relationship of sex-linked feathering genes (k and K) alleles with adult body weight, age at sexual maturity and subsequent laying performance have been studied. Adult body weight seems not to be affected by these genes as reported (Hays and Sanborn, 1929; Lowe and Garwood, 1981; Dunnington and Siegel, 1986; Al-Abdulatiff, 1994; and Buss *et al.* 1994). An exception was the finding of Katanbaf *et al.* (1989a) who reported higher body weight for slow feathering compared with rapid feathering hens of 446 days of age. With respect to other traits, several researchers revealed no significant feathering genotype effect upon age at sexual maturity (Hays and Spear, 1951; Lowe and Garwood, 1981; Kotaiaht 1981; Dunnington and Siegel, 1986), egg production (Hays and Sanborn, 1929; Merat, 1967; Lowe and Garwood, 1981; Kotaiaht 1981; Dunnington and Siegel, 1986, and Buss *et al.* 1994) and laying house mortality (Lowe and Garwood, 1981; Kotaiaht *et al.* 1981; Harris, *et al.* 1984) and consumed less feed (Kotaiaht, 1981). Information on the effect of feathering genes on feed conversion are lacking and those obtained with respect to other traits are not consistent.

This study was conducted to assess the effect of sex-linked feathering genes on adult body weight, age at sexual maturity and subsequent laying performance of Saudi Arabian Baladi chickens. This breed is native to Saudi Arabia and little is known about its performance. Therefore, it is worthwhile to compare its performance with that of the well known rapid feathering Leghorn breed.

Materials and Methods

Slow (SB) and rapid (RB) feathering Saudi Baladi Pullets were obtained from the Baladi population which

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was randomly bred for several years in the Experimental Poultry and Livestock Farm of the Animal Production Department, College of Agriculture, King Saud University. One hundred sixty 20 week-old pullets of each genotypic group were used in this study. The birds in each genotypic group were leg-banded and randomly allotted to four floor pens, 40 birds in each pen in an environmentally controlled house. Each floor pen was considered a replicate. Similar numbers of early feathering Leghorns (RL) which had been bred under similar conditions for many years, were included in the study for the purpose of comparison. The birds received water and a commercial laying ration (Table 1) ad-libitum throughout the experimental period. One day old chicks received 24 h light for the first three days, thereafter 10 h light and 14 h dark. The trial lasted for nine 28-day production periods. Individual body weights were measured to the nearest gram at the start (20 wk), 30, 40 and 50 wk of age and at the end of the experimental period (60 wk). Egg production was recorded daily to calculate hen-day and hen-housed egg production. Eggs of each replicate were collected for three consecutive days during the last week of each production period and individually weighed to the nearest 0.01 gram. Feed intake on a per pen basis was obtained bi-weekly to calculate feed intake per hen per day (F/B•D) and feed conversion (kg feed/dozen eggs, F/DE;and kg feed/kg eggs F/KgE). House temperature and mortality were recorded daily and feed lost was taken into consideration during the whole experimental period. Weekly averages of maximum and minimum house temperature are presented in Figure 1.

TABLE 1

Chemical composition of commercial diets used in the experiment[1]

Nutrients	%
Crude Protein (Min.)	17.00
Crude Fat (Min.)	3.00
Crude Fiber (Max.)	5.50
Calcium (Max.)	3.60
Phosporus (Min.)	0.60
Salt (Max.)	0.35
Metabolizable Energy	2.70 Mcal/kg

Ingredients : Yellow Corn, Wheat, Millfeed Soybean Meal, Meat and Bone Meal, Alfalfa Meal, Animal Fat, Molasses, Oyster Shell, Calcium Carbonate, Phosphate, Salt, Methionine, Manganese, Iron, Iodine, Copper, cobalt, Zinc, Vitamins. A, D3, K, B12, Riboflavin, Panthothenic Acid, Niacin, Choline, Chloride, Ethoxyquin, Fermentation producer.
[1]Manufactured by Grain Silos and Flour Mills Organization, Riyadh, Saudi Arabia.

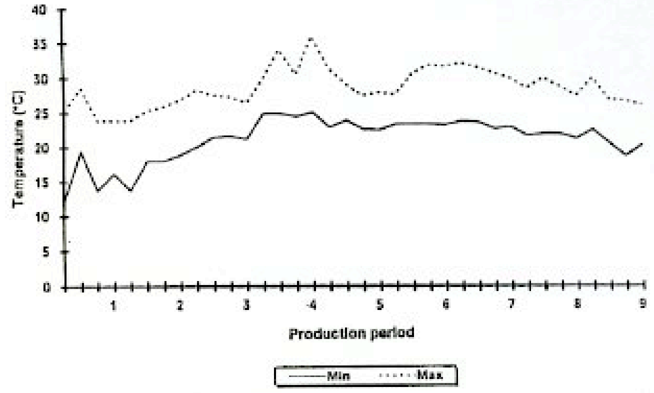

Figure 1. Average weekly house temperature during the entire experimental period

Data collection were subjected to statistical analysis using the SAS general linear model (GLM) procedure, according to the following statistical model:

$$Y_{ijk} = U + G_i + P_j + (GP)_{ij} + e_{ijk}$$

Where Y_{ijk} is the kth observation of the ith genotype (G) and jth production period (P). $(GP)_{ij}$ is the interaction between genotype (G) and production period (P). U is the general mean and e_{ijk} is the random error (SAS, 1986).

Results

BODY WEIGHT (BW): As it is indicated in Table 2 genotype (G) and age (A) effects were highly significant ($P<0.01$) and that of their interaction (G x A) was significant ($P<0.05$). Rapid feathering Baladi had significantly ($P<0.05$) lower BW than their slow feathering Baladi counterparts. However, rapid feathering Leghorns had the highest ($P<0.05$) BW (Table 2). BW increased with age and reached its highest value at 50 wk of age (Table 2). With respect to G x A effect, rapid feathering Baladi had the lowest ($P<0.05$) BW at all age periods, whereas rapid feathering Leghorns and slow feathering Baladi had the highest ($P<0.05$) BW at the four last age periods. At the first period, slow feathering Baladi had lower ($P<0.05$) weight than rapid feathering Leghorns (Figure 2).

AGE AT SEXUAL MATURITY (SM): Table 2 shows that G effect was significant ($P<0.01$) upon age at sexual maturity (SM). However, there was no significant difference between early and late feathering Baladi with respect to SM whereas rapid feathering Leghorns had the highest ($P<0.05$) SM (Table 2).

HEN-DAY (HD) AND HEN-HOUSED (HH) EGG PRODUCTION: Genotype (G), production period (P) and

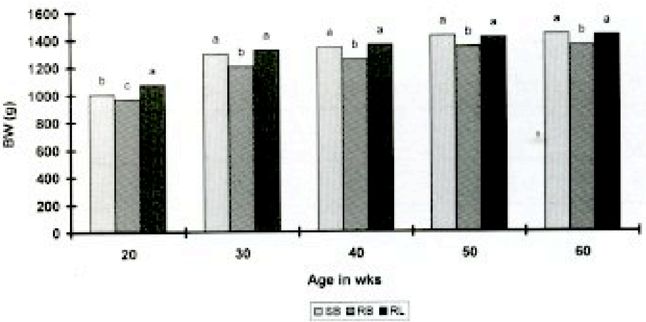

Figure 2 . Effect of genotype and age on body weight (BW) [abc] Columns within each period with different superscripts differ (P <0.05).

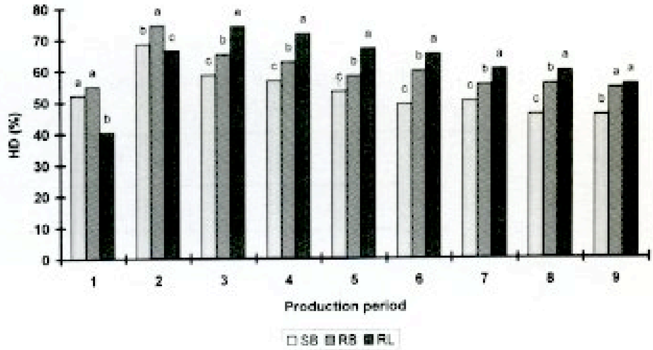

Figure 3. Effect of genotype and age on hen-day egg production (HD) [abc] Columns within each period with different superscripts differ (P<0.05).

their interaction (G x P) effects were significant (P<0.01) for hen-day and hen-housed egg production (Table 3). Slow feathering Baladi had lower (P<0.01) HD than rapid feathering Baladi whereas rapid feathering Leghorns had the highest (P<0.01) HD (Table 3). With respect to HH, slow feathering Baladi had lower (P<0.01) HH than rapid feathering Baladi, whereas there was no difference between rapid feathering Baladi and Leghorns. Table 3 also illustrated that HD and HH increased (P<0.05) up to the end of the second production period and thereafter gradually decreased and reached its lowest value at the last production period. However, the rate of increase and decrease were similar for HD and HH. Figure 3 and 4 show that slow feathering Baladi and rapid

TABLE 2

Effect of genotype (G) and age in weeks (A) on body weight (BW) and that of feathering genotype on age at sexual maturity (SM)

	Parameters	
	BW, g	SM, day
Genotype[1]		
SB	1301[b]	143[b]
RB	1224[c]	144[b]
RL	1317[a]	160[a]
SE	6	1
Age		
20	1014[d]	
30	1273[c]	
40	1319[b]	
50	1394[a]	
60	1405[a]	
SE	7	

[1] SB,Slow Feathering Baladi; RB, Rapid Feathering Baladi; RL, Rapid Feathering Leghorns.

[abcd] Means in the same column with different superscripts differ (P<0.05).

feathering Leghorns had the lowest (P<0.05) and highest (P<0.05) HD and HH values in most of the production periods. However, rapid feathering Baladi had the highest (P<0.05) HH at the first and second and the highest HD only at the second production periods.

MORTALITY (M). As stated in Table 3 G, P and (G x P) effects were significant (P<0.01). Rapid feathering Baladi had lower (P<0.01) mortality than their slow feathering peers whereas rapid feathering Leghorns had the highest mortality (Table 3). Mortality sharply increased (P<0.05) at the four first production periods, thereafter the rate of increase declined until the last production period (Table 3). Figure 5 indicates that rapid feathering Baladi had the lowest (P<0.05) mortality rates during most of the production periods whereas rapid feathering Leghorns had the highest rate during the first and second production periods. However, mortality rates of slow feathering Baladi and Leghorns were statistically similar most of the production periods (Figure 5).

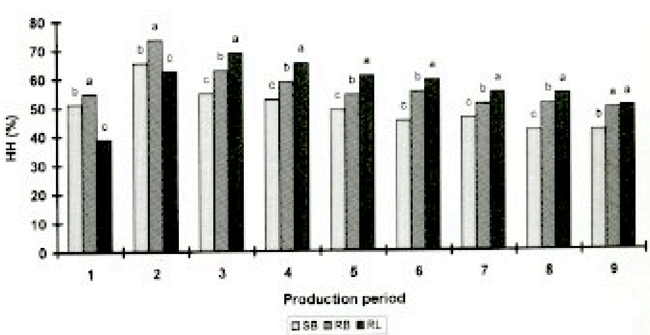

Figure 4. Effect of genotype and age on hen-housed egg productions (HH) [abc] Columns within each period with different superscripts differ (P<0.05).

TABLE 3

Effect of genotype and production period on hen-day(HD) hen-housed(HH) egg production, mortality(M), subsequent feed intake per bird per day(F/B/D/), feed per dozen eggs (F/DE) and feed per kilogram eggs (F/KgE)

	Parameters					
	HD, %	HH, %	M, %	F(B x D), g	F/DE, kg	F/KgE, kg
Genotype[1]						
SB	53.39^{c}	49.56^{b}	7.56^{b}	84.84^{b}	1.97^{a}	3.58^{a}
RB	60.06^{b}	56.52^{a}	5.96^{c}	83.01^{c}	1.69^{b}	3.09^{b}
RL	62.28^{a}	57.04^{a}	8.15^{a}	87.57^{a}	1.76^{b}	2.80^{c}
SE	0.36	0.35	0.13	0.37	0.04	0.06
Production Period						
1	49.16^{f}	48.14^{fg}	2.08^{h}	81.68^{cd}	2.06^{ab}	3.86^{a}
2	69.83^{a}	67.03^{a}	4.09^{g}	82.68^{cd}	1.44^{e}	2.69^{e}
3	65.98^{b}	61.99^{b}	5.92^{f}	83.38^{c}	1.54^{e}	2.84^{de}
4	63.73^{c}	58.81^{c}	7.67^{e}	80.92^{d}	1.55^{e}	2.79^{de}
5	59.46^{d}	54.57^{d}	8.09^{de}	86.24^{b}	1.76^{d}	3.06^{cd}
6	58.02^{d}	53.01^{d}	8.63^{cd}	86.40^{b}	1.82^{cd}	3.09^{cd}
7	55.37^{e}	50.32^{e}	9.12^{bc}	86.60^{b}	1.91^{bcd}	3.25^{bc}
8	53.80^{e}	48.75^{ef}	9.49^{ab}	87.72^{b}	2.00^{abc}	3.34^{b}
9	51.83^{f}	46.72^{g}	9.95^{a}	90.68^{a}	2.15^{a}	3.51^{b}
SE	0.63	0.60	0.23	0.64	0.64	0.11

[1]SB, Slow Feathering Baladi; RB, Rapid Feathering Baladi; RL, Rapid Feathering Leghorns;
[abcdefgh] : Means with columns with different superscripts differ (P<0.05)

FEED INTAKE F(B x D). Genotype G, P and G x P effects were significant (P<0.01). Slow feathering Baladi had higher (P<0.05) feed intake than their rapid feathering counterparts whereas rapid feathering Leghorns consumed the highest amount of feed (Table 3). Feed intake was similar during the 5th and 8th production periods and was higher (P<0.05) than that of the first four and lower than that of the last production periods. Feed intake was lower (P<0.05) at the fourth than at the third production period. This was mainly due to the unexpected rise in house temperature (Figure 1). As can be observed from Figure 6 rapid feathering Leghorns showed the highest feed intake during most of the production periods, whereas slow and rapid feathering Baladi had statistically similar feed intake during the production periods.

FEED CONVERSION (F/DE, F/KgE): Genotype and P effects were significant (P<0.01) and the effects of their interaction were also significant (P<0.05), (Table 3). Slow feathering Baladi had the worst (P<0.05) F/DE and F/KgE values compared with those of rapid feathering Baladi, which lagged behind Leghorns only in F/KgE (Table 3). The F/DE reached its best value

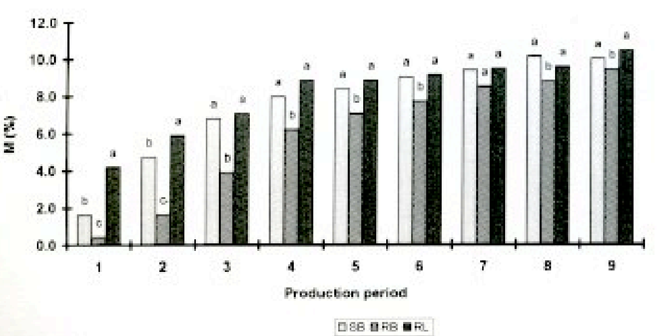

Figure 5. Effect of genotype and production period interaction on total mortality (M) [abc] Columns within each period with different superscripts differ(P <0.05).

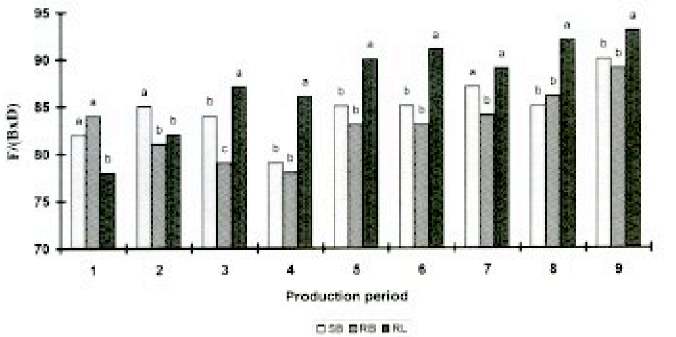

Figure 6. Effect of genotype and production period interaction on feed intake per bird/day [abc] Columns within each period with different superscripts differ (P <0.05).

at the 2nd, 3rd and 4th production periods for all genotypes and rapid feathering Leghorns at the first production period had the highest F/DE (Figure 7). The F/KgE was similar in different genotypes at the first two production periods but slow feathering Baladi had the worst ($P<0.05$) F/KgE during the last four production periods whereas rapid feathering Baladi and Leghorns had similar values in most of the production periods (Figure 8).

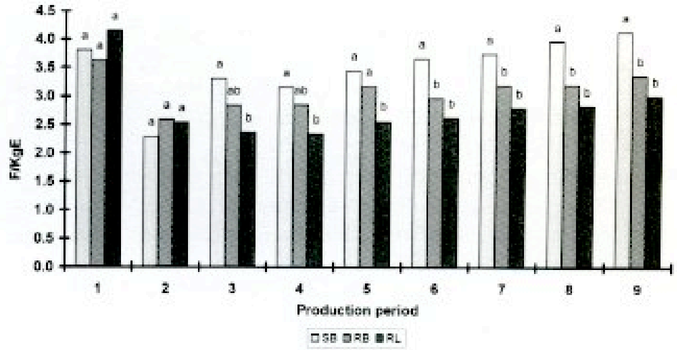

Figure 8. Effect of genotype and production period interaction on feed intake per kilogram eggs (F/KgE) [abc] Columns within each period without common superscripts differ significantly ($P < 0.05$).

Discussion

Slow feathering Baladi had higher adult body weight than their rapid feathering counterparts. These results disagree with those of Hays and Sanborn, 1929; Lowe and Garwood, 1981; Dunnington and Siegel, 1986. Al-Abdulatiff, 1994 and Buss *et. al.* 1994 who observed no significant body weight difference between the two genotypes but were similar to that stated by Katanbaf *et al.* (1989 a) who noticed higher body weight for slow feathering compared with rapid feathering hens at 446 days of age. Rapid and slow feathering Baladi were similar in age at sexual maturity. Comparable results were reported by several investigators (Hays and Spear, 1951; Lowe and Garwood, 1981; Kotaiaht, 1981; Dunnington and Siegel, 1986). However, our results disagree with those of Hays and Sanborn, 1929; Merat, 1967; Lowe and Garwood 1981; Kotaiaht 1981, Dunnington and Siegel; 1986 and Buss *et al.* 1994 who showed no significant feathering genotype effect upon egg production. Rapid feathering Baladi had lower laying house mortality than their slow feathering peers. Comparable results were reported by Lowe and Garwood, 1981; Kotaiaht et al, 1981 and Harris *et al.* 1984. Our results, though, disagree with those of Hays and Sanborn, 1929, Havenstein *et al.* 1989 and Buss *et al.* 1994 who found similar mortality rates for rapid and slow feathering birds. Slow feathering Baladi had higher feed intake per bird per day than their rapid feathering counterparts. Similar results were reported by Kotaiaht (1981) who observed higher feed intake per bird per day for slow than rapid feathering hens. These inconsistent results might be attributed to either the pleiotropic effect of K alleles in different genetic background, maternal origin or inadequate numbers of birds used in the sexual experiments for assessment of quantitative traits. The detrimental effect of K on performance of rapid feathering Leghorns was found to be related to congenital transmission of a putative avian leukosis virus (Harris et al, 1984, and Havenstein *et al.* 1989). More recently, Bacon et al (1988) reported that the sex-linked late feathering gene (K) is either a consequence of or is very closely linked with the presence of an endogenous virus (ev 21).

The literature lacks information on the relationship between feathering genotype and feed conversion. Our study shows that rapid feathering had better feed conversion compared with slow feathering Baladi. On the other hand, slow and rapid feathering Baladi lagged behind rapid feathering Leghorns with respect to most studied traits. From the results of this investigation it seems that sex-linked feathering genes influence most of the studied traits.

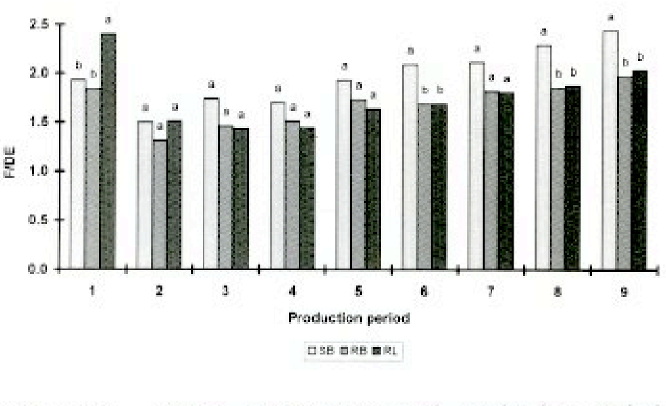

Figure 7. Effect of genotype and production period interaction on feed intake per dozen eggs [abc] Columns within each period with different superscripts differ ($P < 0.05$).

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