GENETIC ANALYSIS OF SERUM FSH, LH AND PROGESTERONE IN DUROC, HARBIN WHITE AND DUROC x HARBIN WHITE PIGS

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SUMMARY

An experiment was conducted to study the phenotypic and genetic characteristics of serum FSH, LH and progesterone in Duroc (D), Harbin White (H) and DxH pigs. There were no significant differences between sexes for these endocrine traits in these young pigs. The FSH concentration was higher than LH in contrast to sows. The changing patterns of progesterone profiles with age varied with genotypes. The endocrine traits had low to moderate heritabilities and had relatively high genetic correlations among them, indicating the change in any one hormone profile will cause changes in the others. As 120-d progesterone concentration had high positive genetic correlation with 180-d backfat thickness, selection against progesterone concentration at 120 days of age would result in higher lean meat yield. The negative heterosis in progesterone concentrations was also in favour of Duroc x Harbin White for lean meat production.

INTRODUCTION

Every characteristic of an animal is determined by biochemical and physiological pathways occurring in its body. In the processes of these pathways, hormones play an important role. Studies have shown some relationships between sex hormones and traits of economic importance and effective selection on 5α-androstenone in pigs (Willeke and Pirchner, 1980) and LH in sheep (Land, 1981). The objectives of this study was to investigate the phenotypic and genetic characteristics of serum FSH, LH and progesterone in Duroc (D), Harbin White (H) and DxH pigs and their relationships to growth, backfat thickness and live litter size.

MATERIALS AND METHODS

This experiment was conducted on Northeast Agricultural University Experimental Station, Harbin, China. All purebred Duroc (D), purebred Harbin White (H) and DxH were Spring born and under the same feeding and management. Blood samples (8 ml) for determining FSH and LH concentrations were taken from Harbin White piglets 20 min. and 40 min. after intramuscular administration of LRH-A (a synthetic polypeptide substitute of LH-RH, 5μg/kg) at 56 days of age for Radioimmunoassay (RIA). Blood samples (20 ml) for determining progesterone concentration were taken at 120, 150, and 180 days of ages in Harbin White, Duroc and DxH pigs for RIA. Birth weight, 56-d weight, 180-d weight and live litter size of the dam were recorded. Backfat thickness at 180 d was determined on live animals using a probe. Heritability (h^2) was estimated using mixed full- and half-sib analysis (Wu, 1985). Sampling error of h^2 was approximated as a function of mean squares (Kempthorne, 1957; Liu, 1985). Genetic correlation (r_A) was also estimated from the mixed full- and half-sib analysis (Liu, 1987). Sampling error of r_A was according to Robertson (1959). Heterosis expressed as a percentage (RH) was calculated as the deviation of the average of crossed animals from the average of the parent breeds relative to the average of the parent breeds. Sampling error of RH was according to Wu and Zhang (1983). Log

transformation was applied to concentrations of FSH, LH and progesterone for estimating h^2, r, r_A and RH.

RESULTS AND DISCUSSION

Tables 1 and 2 shows that there existed considerable variation in FSH and LH and the differences between sexes were not significant. Log transformation significantly reduced the variation in the new scale. Tables 1 and 2 also shows that the concentration of FSH was higher than that of LH at 56 days of age after LRH-A treatment in Harbin White in contrast to the FSH-LH ratio in sows (Nalbandov, 1964).

Table 1. Means (M), standard deviations (S.D.), coefficients of variation (C.V.) and number of observations (N) for FSH concentrations at 56 days of age in Harbin White pigs (ng/ml, lg(ng/ml))

Sex	M	S.D.	C.V.	M	S.D.	C.V	N
Male	26.76	22.56	0.84	1.33	0.28	0.21	69
Female	28.46	16.17	0.57	1.39	0.24	0.17	58
Pooled	27.54	19.83	0.70	1.36	0.26	0.19	127

Differences between males and females are not significant ($P > 0.05$).

Table 2. Means (M), standard deviations (S.D.), coefficients of variation (C.V.) and number of observations (N) for LH concentrations at 56 days of age in Harbin White pigs (ng/ml, lg(ng/ml))

Sex	M	S.D.	C.V.	M	S.D.	C.V	N
Male	6.98	4.88	0.69	0.75	0.29	0.38	47
Female	6.77	4.69	0.69	0.73	0.28	0.37	43
Pooled	6.88	4.77	0.69	0.75	0.28	0.38	90

Differences between males and females are not significant ($P > 0.05$).

Progesterone concentrations were similar between 120 d and 150 d, and both 120 d and 150 d were significantly higher than 180 d in Harbin White (Table 3). In Duroc, concentrations were similar between 120 d and 150 d, and both of them were lower than 180 d. Progesterone concentrations at three ages were not significant different in DxH pigs. Progesterone concentrations between Duroc and DxH were not significantly different, while they were significantly lower than Harbin White at 120 d and 150 d. At 180 d, progesterone concentrations were similar between Harbin White and DxH, while both were significantly lower than Duroc.

Table 3. Progesterone concentrations by breed groups and ages

Breed group	120 days	150 days	180 days
Harbin White (H)	131.31	139.39	86.29
Duroc (D)	112.00	99.14	168.15
DxH	78.47	69.75	110.77

There are no significant differences between sexes.

In general, heritability estimates of reproductive traits and early developed traits were not significant. The endocrine traits had low to moderate heritabilities. Heritability estimates of 180-d weight and 180-d backfat thickness were significant, but lower than previous reports (Craft, 1958; Fredeen and Jonsson, 1957). Estimate of LH was 0.34 similar to the estimate of LH at 70 days of age in sheep (0.33) reported by Land (1981).

Table 4. Estimates of heritabilities

		Progesterone			Weight				
FSH	LH	120-d	150-d	180-d	birth	56-d	180-d	Backfat	L.L.S.
0.11	0.34*	0.19*	0.31*	0.18	0.04	0.08	0.16*	0.24**	0.39

* $P < 0.05$; ** $P < 0.01$; Backfat: 180-d backfat thickness; L.L.S.: Live litter size.

Table 5. Estimates of genetic (r_A) and phenotypic (r) correlations

Trait		Y1	Y2	Y3	Y4	Y5
FSH	(Y1)		−0.85**	−0.49	−0.14	−0.11
LH	(Y2)	0.01		0.51	0.38	—
120-d P	(Y3)	0.19	−0.04		−0.54	0.01
150-d P	(Y4)	−0.32**	0.24	−0.17		−0.36
180-d P	(Y5)	−0.40**	0.09	−0.05	−0.01	
Birth WT	(Y6)	−0.05	−0.08	−0.01	0.08	−0.07
56-d WT	(Y7)	−0.08	−0.02	−0.02	0.11	−0.14
180-d WT	(Y8)	−0.02	0.12	0.01	0.14	0.07
180-d BF	(Y9)	−0.05	0.13	−0.04	0.12	0.12
L.L.S.	(Y10)	−0.01	0.29	0.19	0.10	−0.09

		Y6	Y7	Y8	Y9	Y10
FSH	(Y1)	−0.15	−0.08	−0.02	−0.23	0.02
LH	(Y2)	−0.05	0.40	−0.05	−0.13	0.55
120-d P	(Y3)	−0.44	−0.55	0.45	0.79**	0.48
150-d P	(Y4)	−0.05	0.19	−0.12	0.05	0.09
180-d P	(Y5)	0.50	−0.37	0.26	0.63	−1.00
Birth WT	(Y6)		0.43	0.92**	0.30	−0.03
56-d WT	(Y7)	0.38**		0.31	0.38	−0.89
180-d WT	(Y8)	0.43**	0.55**		0.77**	−0.15
180-d BF	(Y9)	0.07	0.26**	0.33**		0.11
L.L.S.	(Y10)	0.21	0.21	−0.05	−0.03	

P: Progesterone; Wt: weight; BF: Backfat Thickness; L.L.S.: Live litter size; r_A are above diagonal and r are below diagonal; $P < 0.05$, ** $P < 0.01$.

Phenotypic correlations were low to moderate. Genetic correlations between FSH and LH (-0.85), 120-d progesterone and 180-d backfat thickness (0.79), birth weight and 180-d weight (0.92), 180-d weight and 180-d backfat thickness (0.77), were significant (Table 5). The genetic correlations among the endocrine traits were relatively high. In addition, genetic

correlation between 120-d and 150-d progesterone concentration was higher than genetic correlations between 120-d and 180-d or between 150-d and 180-d progesterone concentrations.

120-d and 150-d progesterone concentrations in the DxH were lower than the average of the parent breeds, resulting in negative heterosis. Heterosis of 180-d progesterone concentration was not significant (Table 6).

Table 6. Heterosis of progesterone concentrations in Duroc x Harbin White pigs (lg(Pg/ml), count, %)

Traits	Mean of Parental breed	Duroc x Harbin White		
		No.	Mean	Heterosis(%)
120-d progesterone	1.93±0.03	39	1.84±0.03	−4.46*
150-d progesterone	1.95±0.03	31	1.65±0.08	−15.20***
180-d progesterone	1.98±0.04	26	1.87±0.08	−0.17

In summary, this study showed that there were no significant differences between sexes for the endocrine traits in these young pigs. The FSH-LH ratio was larger in the young pigs in contrast to the ratio in sows. The changing patterns of progesterone concentrations with age varied with the genotypes of the pigs. The endocrine traits had low to moderate heritabilities and would response to selection. The relatively high genetic correlations among endocrine traits, indicating the change in any one hormone profile will result in the changes in other hormone profiles. The high positive genetic correlation between 120-d progesterone concentration and 180-d backfat thickness indicates that selection against progesterone concentration at 120 d would result in higher percentage of lean meat yield. In addition, the negative heterosis in progesterone concentrations was in favour of Duroc x Harbin White for lean meat production.

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