Abstract W35

Factors affecting plasma cholesterol, lipoproteins, and triglyceride in growing pigs of various breed compositions raised under Thai tropical conditions

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SUMMARY

Growing pigs (hogs and gilts) with the same age (85 d) and similar weight (30.03 ± 7.07 kg) from Pietrain (**P**), Large White (**W**), **WP**, Landrace-Pietrain (**LP**), and **WLP** were assigned randomly to each cell of a 5 x 2 factorial design (5 breed groups x 2 sexes). All pigs were raised in open barns, and received the same nutrition, management, and health care. Weights, ultrasound backfat thickness, and lean percent were measured at 3 ages (89 d, 136 d and 178 d). Blood samples were drawn from the 3 fastest and the 3 slowest growing pigs within each factorial group at each age. Plasma was analyzed for concentration of cholesterol (**CHOL**), high density lipoproteins (**HDL**), low density lipoproteins (**LDL**), and triglycerides (**TRIG**) by an enzymatic-colorimetric method. The statistical model considered breed group, sex, and age, the interactions breed group x sex, breed group x age, and sex x age, and the covariates ultrasound backfat thickness and lean percent, and residual. Computations were performed using the mixed procedure of SAS. Breed group was important for CHOL, HDL, and LDL (P < 0.001), but not for TRIG. Pietrain had the lowest least squares means (LSM) for CHOL (71.21 ± 3.04 mg/dL) and LDL (40.61 ± 2.45 mg/dL), WLP had the lowest LSM for TRIG (45.18 ± 4.24 mg/dL), and LP had the largest LSM for HDL (40.78 ± 1.29 mg/dL). Ultrasound backfat and ultrasound lean percent were negatively associated with LDL (P < 0.01).

INTRODUCTION

High concentrations of plasma cholesterol (**CHOL**), low density lipoproteins (**LDL**), and triglycerides (**TRIG**) increase the risk of cardiovascular disease in humans, whereas high concentrations of high density lipoproteins (**HDL**) decrease this risk. Pigs with different breed or breed composition might have different plasma cholesterol (CHOL), high density lipoproteins (HDL), low density lipoproteins (LDL), and triglycerides (TRIG). Selection of pigs for low plasma CHOL, LDL, and TRIG, and high HDL could be beneficial for their health and human consumption. ***The objective of this research was to evaluate factors that may affect plasma CHOL, HDL, LDL, and TRIG in growing pigs from 5 breed groups: Pietrain (P), Large White (W), WP, Landrace-Pietrain (LP), and WLP, under tropical conditions in Thailand.***

MATERIALS AND METHODS

Animal, Nutrition, and Management. Animals were Pietrain (**P**), Large White (**W**), **WP**, Landrace-Pietrain (**LP**), and **WLP** hogs and gilts that had the same age (85 d) and similar weight (30.03 ± 7.07 kg). Forty pigs from each breed group (20 hogs and 20 gilts) were assigned randomly to each cell of a 5 x 2 factorial design (5 breed groups x 2 sexes) and were kept in a 4.5 m by 7.5 m pen in the same open barn. All pigs received the same nutrition, management, and health care throughout the 90-d trial. Feed ration were: 1) starter feed (20% protein; 4,860 Kcal DE) 2) grower feed (16% protein; 4,380 Kcal DE), and 3) finisher feed (14% protein; 4,040 Kcal DE). Pigs had free access to feed and water throughout the 90-d trial. Weather temperature ranged from 16 to 36 ºCelsius (25.7ºCelsius in average), and relative humidity ranged from 54 to 89% (69% in average) during the study.

Measurements and Plasma Analyses. Weight, backfat thickness, and lean percent measurements were taken at ages 89 d, 136 d and 178 d in all pigs. An ultrasound machine (Piglog 105®, SFK, Denmark) was used to measure backfat thickness and lean percent. Blood samples were drawn via the anterior vena cava from the 3 fastest and the 3 slowest growing pigs in each of the factorial groups (10 breed group x 2 sex combinations; 60 animals) at each age. Plasma was analyzed for concentration of cholesterol (**CHOL**), high density lipoproteins (**HDL**), low density lipoproteins (**LDL**), and triglycerides (**TRIG**) by an enzymatic-colorimetric method using COBAS INTEGRA® 400 plus (Roche Diagnostics, IN).

Data analysis. The statistical model considered breed group, sex, and age, the interactions breed group x sex, breed group x age, and sex x age, and the covariates ultrasound backfat thickness and lean percent, and residual. Least square means (LSM) were computed for each factor and then were compared. Correlations among plasma concentration of CHOL, HDL, LDL, and TRIG were also estimated. All computations were performed using procedures in SAS.

Table 1. Significance of effects on plasma cholesterol (CHOL), high density lipoproteins (HDL), low density lipoproteins (LDL), and triglycerides (TRIG)

Factor	DF	CHOL (mg/dL)	HDL (mg/dL)	LDL (mg/dL)	TRIG (mg/dL)
Breed Group	4	0.0001	0.0001	0.0002	0.6469
Sex	1	0.3876	0.0002	0.2979	0.9155
Age	2	0.2023	0.0010	0.4344	0.0032
Breed Group x Sex	4	0.3613	0.0474	0.3077	0.4974
Breed Group x Age	8	0.1211	0.0497	0.4782	0.3879
Sex x Age	2	0.5731	0.1758	0.9258	0.0108
Backfat Thickness	1	0.5523	0.0150	0.0077	0.3560
Lean Percent	1	0.2355	0.3379	0.0061	0.6018

RESULTS AND DISCUSSION

The significance of effects on plasma CHOL, HDL, LDL, and TRIG is shown in **Table 1**. Plasma HDL was affected by breed group, sex, age, and the interactions of breed group x sex and breed group x age. Plasma LDL and CHOL were only affected by breed group, whereas plasma TRIG was affected by age and sex x age interaction. Sex was not important for CHOL, LDL, and TRIG. Age was irrelevant for CHOL and LDL. Significant associations existed between HDL and ultrasound backfat and LDL and ultrasound backfat and percent lean.

Breed Group. Breed group influenced plasma concentration of CHOL, HDL, and LDL (P < 0.001), but not TRIG (**Table 2**). **Pietrain** had the ***lowest*** least square means for CHOL (71.21 ± 3.04 mg/dL), HDL (31.49 ± 1.29 mg/dL), and LDL (40.61 ± 2.45 mg/dL), and **WLP** had the ***lowest*** LSM for TRIG (45.18 ± 4.24 mg/dL). In contrast, **LP** had the ***highest*** least square means for CHOL (96.65 ± 3.04 mg/dL), HDL (40.78 ± 1.29 mg/dL), and LDL (55.82 ± 2.45 mg/dL), but they were not different from those of **W** and **WP**. Furthermore, **WP** had higher CHOL (8.16 mg/dL; 10.01%), HDL (3.22 mg/dL; 9.08%), LDL (4.64 mg/dL; 9.84%), and TRIG (7.78 mg/dL; 9.88%) than the average of **W** and **P**. Contrarily, **WLP** had lower CHOL (-3.84 mg/dL; -4.58%), HDL (-0.25 mg/dL; -0.68%), LDL (-1.26 mg/dL; -2.62%) and TRIG (-4.85 mg/dL; -9.69%) than the average of **W** and **LP**.

Sex. Sex differences existed only for HDL. ***Hogs*** had ***lower*** levels of HDL (35.01 ± 0.82 mg/dL) than ***gilts*** (39.57 ± 0.82 mg/dL). ***Differences*** in HDL between hogs and gilts for ***purebreds*** (0.57 ± 2.56 mg/dL for P, and 0.22 ± 2.57 mg/dL for W) were ***negligible***, but differences for ***crossbred pigs ranged from*** 5.52 ± 2.56 mg/dL for LP to 9.02 ± 2.57 mg/dL for WP. These sex differences may be associated to nonadditive genetic effects presented in crossbred, but not in purebred pigs.

Age. ***Younger*** pigs had ***higher*** levels of HDL (41.23 ± 1.21 mg/dL for 89 d vs. 35.05 ± 1.26 mg/dL for 178 d) and TRIG (61.15 ± 4.02 mg/dL for 89 d vs. 37.92 ± 4.19 mg/dL for 178 d). ***Gilts*** had ***higher*** concentrations of TRIG than ***hogs*** at 89 d (69.09 ± 5.38 mg/dL vs. 53.21 ± 5.02 mg/dL), but ***lower*** concentrations at 178 d (34.40 ± 5.02 mg/dL vs. 41.44 ± 5.75 mg/dL). The difference between plasma TRIG in hogs and gilts decreased from 15.87 ± 6.60 mg/dL at 89 d to 7.04 ± 6.79 mg/dL at 178 d.

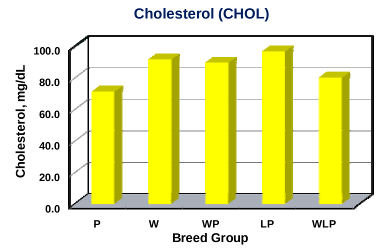


Table 2. Least square means and standard errors for cholesterol, high density lipoproteins, low density lipoproteins, and triglycerides by breed groups[1]

Breed Group	Cholesterol (mg/dL)	HDL (mg/dL)	LDL (mg/dL)	Triglycerides (mg/dL)
Pietrain	71.21 ± 3.04^{c}	31.49 ± 1.29^{c}	40.61 ± 2.45^{c}	47.41 ± 4.27
Large White	91.66 ± 3.02^{a}	39.54 ± 1.28^{a}	53.74 ± 2.43^{a}	49.33 ± 4.25
Large White x Pietrain	89.59 ± 3.01^{a}	38.74 ± 1.28^{ab}	51.82 ± 2.43^{ab}	53.15 ± 4.24
Landrace x Pietrain	96.65 ± 3.04^{a}	40.78 ± 1.29^{a}	55.82 ± 2.45^{a}	52.65 ± 4.28
Large White x Landrace-Pietrain	80.09 ± 3.01^{b}	35.89 ± 1.28^{b}	46.85 ± 2.43^{bc}	45.18 ± 4.24

[1]Different superscripts indicate P < 0.05

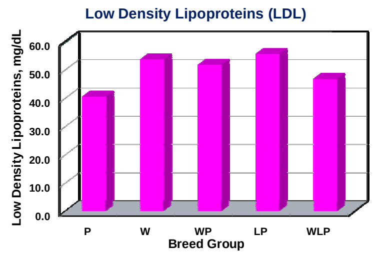
Table 3. Estimate regression coefficients of backfat and lean percentage related to cholesterol, high density lipoproteins, low density lipoproteins, and triglycerides

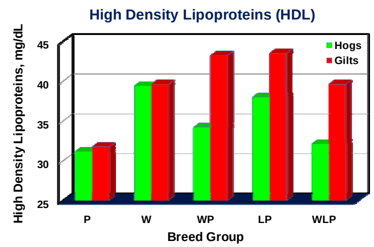
Trait	Backfat (mm)		Lean (%)	
	Estimate	P-value	Estimate	P-value
Cholesterol (mg/dL)	-0.76 ± 1.27	0.5523	-1.44 ± 1.20	0.2355
High density lipoproteins (mg/dL)	1.32 ± 0.54	0.0150	0.49 ± 0.51	0.3379
Low density lipoproteins (mg/dL)	-2.77 ± 1.02	0.0077	-2.70 ± 0.97	0.0061
Triglycerides (mg/dL)	-1.65 ± 1.79	0.3560	-0.89 ± 1.69	0.6018

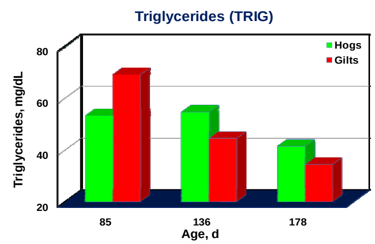
Backfat Thickness. Plasma concentration of HDL and LDL showed significant associations with backfat thickness, but CHOL and TRIG did not (**Table 3**). An increment of 1 mm of backfat thickness was associated with an increment of 1.32 ± 0.54 mg/dL of HDL (P < 0.02), and a decrement of -2.77 ± 1.02 mg/dL of LDL (P < 0.01). ***These associations may be a favorable from a pig health perspective and they may help increase the stayability of reproductively sound sows in the farm.***

Lean Percent. Only plasma concentration of LDL was associated with lean percent, whereas CHOL, HDL and TRIG were not (**Table 3**). For each percent increment of lean, plasma LDL decreased -2.70 ± 0.97 mg/dL (P < 0.01). ***This association suggests that if the goal of producers were to select pigs for higher lean percent, selected pigs would have lower LDL, perhaps increasing the longevity of lean sows. Considering this selection goal, P would be the breed of choice among the 5 breed groups here because they had the lowest CHOL and LDL.***

Phenotypic Correlations. Correlations among plasma concentration of CHOL, HDL, LDL, and TRIG were positive. Significant phenotypic correlations existed between CHOL and HDL (0.59; P < 0.01), LDL (0.80; P < 0.01), and TRIG (0.21; P < 0.01), and between HDL and LDL was 0.26 (P < 0.01). However, correlations between HDL and TRIG, and LDL and TRIG were not significant.







FINAL REMARKS

- Breed group had effect on CHOL, HDL, and LDL, but not on TRIG
- Pietrain had the lowest CHOL and LDL plasma concentrations
- Differences in HDL between hogs and gilts were larger in crossbreds (WP, LP, and WLP) than in purebreds (P and W)
- Younger pigs had higher HDL and TRIG than older pigs
- Ultrasound backfat and lean % were negatively associated with LDL