Effect of breeds on growth performance and meat quality in swine

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Abstract:

The objective of this research was to evaluate the effect of different breeds on growth performance and meat quality in swine. Swine is another important economic animal. Growth performance and meat quality traits are economic traits in swine production. If pigs thrive can sell quickly, reduce production costs. The breed is one of the important factors for growth performance and meat quality. This study used growth performance and meat quality data from the commercial farm in different 3 breed pigs (Duroc, Pietrain and Crossbreed). The analysis effect of breeds on growth performance and meat quality using PROC GLM, predicted regression linear model using PROC STEPWISE and correlation among growth performance and meat quality traits using PROC CORR by SAS (1998). The result found that, means of percent lean (PL, %) and average daily gain (ADG, g/d) were 55.92% and 143.58 g/d, respectively. The effect of different breeds on growth performance and meat quality was found for PL, ADG, back fat (BF, cm), loin eye area (LEA, cm^2), live weight (LW; kg), and average daily gain at 104 days (ADG 104 d, g/d) (P<0.01). Breed of Pietrain and Crossbreed pigs were PL, BF and LEA higher more than Duroc pig. Moreover, Pietrain pig was higher ADG (147.91 g/d) more than Duroc (143.26 g/d) and crossbreed (143.24 g/d). The LW and ADG 104 d found that Duroc and Crossbreed pigs were higher than Pietrain pig. The result of regression linear model address that, LW, BF, ADG 104 d and LEA accounted for the greatest amount of variation of PL (R^2 = 0.93). The correlation between ADG 104 d and LW was higher (r = 0.82, P<0.001). Moreover, the correlation of LEA and PL was (r = 0.81, P<0.01). The conclusion of this research showed that crossbreed pig was high growth performance.

Introduction

The swine is another important economic animals. Growth traits and meat quality are the importance economic trait in swine production. If pigs thrive can sell quickly, reduce production costs. The breeds is one of factor important for the growth. Cause crossbreeding is extensively used in pig production to increase the total efficiency of pig production. Accordingly, when choosing the best animal crossbreeding strategy, it is important to recognize that growth and meat quality traits depend on the crossbreed [1, 2, 3]. A number of research has the objective for improving growth performance and meat quality in swine. [2], study carcass and meat quality traits of for commercial pig in China show that the DLY (Duroc x (Landrace x Yorkshire)) and PIC (foreign five-way crossbreed) had heavier live weights more than LM (Landrace x Meishan) and DLM (Duroc x (Landrace x Meishan)). Evaluation of Duroc and Pietrain pigs on carcass and meat quality, the result found that Pietrain progeny had a higher percentage of lean at slaughter more than Duroc pig (52.6 vs. 50.7, $P < 0.05$) [4]. Moreover, Pietrain progeny had more loin muscle area when compared with the crossbreed pig (Duroc x Pietrain) [5]. Duroc boars appropriate with a valuable source of genetic material for improving the carcass and meat quality of finisher pigs [6]. Therefore, our objective of this study was analysis the effect of breed on growth performance and meat quality in swine.

Materials and methods

Animals

For this study, 3,007 pigs (855 Duroc, 217 Pietrain and 1,935 Crossbreed pigs) from the commercial farm in Thailand were used in this study. Pig was standard managed according to commercial conditions until achieved a body weight of approximately 104 kg. All pig was fed and water *ad libitum* until slaughtered at the commercial slaughter house.

Growth performance and meat quality traits

The individual pig (year of birth between 2012 - 2016) was weighted (LW) before slaughter, average daily gain (ADG) and average daily gain at 104 days (ADG 104 d, g/d)

were calculated. Within 45 min post – mortem, back fat thickness (BF, cm) were a measurement of the first rib and percent lean (PL, %). After chilling at 4 °C, loin eye area (LEA, cm^2) were place a plastic grid over the loin eye and count the dots or square the fall within the boundaries of the *longissimus* muscle convert to square inches by dividing the number of dots or squares by the appropriate conversion factor on the grid.

Statistical analysis

The means of growth performance and meat quality traits were analyzed using PROC MEANS [7]. Multiple linear regressions using to predict the equation model by PROC Stepwise. The prediction model selected was the most right best fit model with a maximum R^2 and minimum mean square error (MSE).The correlation among traits used PROC CORR. The effect of breeds on growth performance and meat quality using the GLM procedure [7]. The means between variables were considered significantly different at $p < 0.05$

$$y_{ij} \; = \; \mu + breed_i + e_{ij}$$

where:

y_{ij} *is the Growth preformance and meat quality*
μ *is the mean*
breed   *is the fixed effect of breed* (*Duroc, Pietrain and Crossbreed*)
e *is random residual effect*

Results and discussion

Table 1 shows the means standard deviation (SD) minimum and maximum for growth performance and meat quality in three breeds pig. This study showed the means of PL in three breeds pig (Duroc, Pietrain and Crossbreed) were 55.44%, 56.15% and 56.12%, respectively. Means of ADG in all pig was 143.58 g/d. Moreover, means of BF, LEA, LW and ADG 104 d were 0.88 cm, 35.80 cm^2, 105.15 kg and 736.04 g/d, respectively. Mean of ADG 100 d in Canada Duroc pig was 880 g/d. [8]. [5, 9] report mean of PL of Pietrain and Duroc pig was 55.20% and 56.86 %, which similarly with this study. [10, 11] showed mean of LEA in Duroc pig were 37.00 cm^2 and 36.99 cm^2, respectively. Contradictory [4] report mean of LEA in Pietrain and Duroc pig was 53.2 cm^2, 50.2 cm^2 respectively. The LEM higher more than referent [10, 11] because of pig high LW (150 kg). Moreover [12] report mean of ADG 105d, g/d in Duroc pig was 870 ± 110 g/d. But [13] report mean of BF in Duroc pig was 2.249 cm.

The effect of breeds shown the follows Pietrain and Crossbreed pig were PL, BF and LEA higher than Duroc pig. The Pietrain breed is known for its high of lean meat [14].

Moreover, Pietrain pig was higher ADG more than Duroc and Crossbreed pigs (147.91 g/d, 143.26 g/d and 143.24 g/d, respectively). Duroc and Crossbreed pig were LW and ADG 104 d higher than Pietrain pig (Table2). [9] reported a similar result for carcasses of Pietrain group had significantly higher percent lean than the Duroc ($P<0.001$). Duroc pigs had more back fat than Pietrain pigs. Furthermore, Pietrain had more loin muscle area when compare with Duroc pig, similar to results from this study [4].

Table 1 The descriptive data of growth performance and meat quality in three breeds pig

Breed	Number	Variable	Mean	SD	Minimum	Maximum
Duroc	855	LW; kg	105.28	5.36	92.00	125.00
		ADG, g/d	143.26	8.08	123.28	172.92
		ADG 104 d, g/d	738.02	66.5	531.95	968.03
		BF, cm	0.91	0.14	0.58	1.47
		PL, %	55.44	0.99	52.10	58.46
		LEA, cm^2	34.96	1.84	30.12	42.52
Pietrain	217	LW; kg	103.43	4.49	90.00	118.00
		ADG, g/d	147.92	9.46	125.41	173.20
		ADG 104 d, g/d	702.90	63.81	563.17	887.15
		BF, cm	0.87	0.15	0.52	1.39
		PL, %	56.15	1.03	51.52	59.22
		LEA, cm^2	36.36	2.20	30.12	43.61
Crossbreed	1935	LW, kg	105.29	5.43	90.00	125.00
		ADG, g/d	143.24	8.90	109.92	177.43
		ADG 104 d, g/d	738.89	71.50	525.06	994.93
		BF, cm	0.87	0.14	0.58	1.57
		PL, %	56.12	0.95	52.52	59.60
		LEA, cm^2	36.12	2.04	30.48	43.51
Total	3,007	LW; kg	105.15	5.36	90.00	125.00
		ADG, g/d	143.58	8.79	109.92	177.43
		ADG 104 d, g/d	736.04	70.17	525.06	994.93
		BF, cm	0.88	0.14	0.52	1.57

PL, %	55.92	1.01	51.52	59.60
LEA, cm^2	35.80	2.06	30.12	43.61

Table 2 The effect of breeds on growth performance and meat quality in swine

Traits	Breeds						P- Value
	Duroc		Pietrain		Crossbreed		
	Mean	SE	Mean	SE	Mean	SE	
LW; kg	105.27[a]	0.18	103.43[b]	0.36	105.28[a]	0.12	**
ADG, g/d	143.26[b]	0.29	147.91[a]	0.59	143.24[b]	0.19	**
ADG 104 d, g/d	738.02[a]	2.37	702.90[b]	4.72	738.9[a]	1.58	**
BF, cm	0.91[a]	0.004	0.87[b]	0.00	0.86[b]	0.003	**
PL, %	55.44[b]	0.03	56.14[a]	0.06	56.11[a]	0.02	**
LEA, cm^2	34.95[b]	0.06	36.36[a]	0.13	36.12[a]	0.04	**

[**] significant different the 0.01 level of probability (P<0.01)

[a,b] row means with common superscripts do not differ

Multiple linear regression analysis was performed to predict the PL using the data of growth performance and meat quality in three breeds pig. The highly significant model ($R^2 = 0.94$) were 2 models (model 3 and model 4), could be obtained by a combination of LW, BF, ADG 104 d and LEA. While, model 2 prediction equations of PL were shown as the dependent variable and independent variables were BF and LEA ($R^2 = 0.93$). The lowest R^2 was model 1 and showed the independent variables was LEA (Table3). [15], predicted live and carcass lean weight in pig, the result showed the greatest accountability model length R^2 was 0.844. Moreover, in the presence of [16] investigation multiple regression models using theses parameter resulted showed good predictability of commercial lean cuts weight ($R^2 = 0.62$).

Table 4 shows the correlation of growth performance and meat quality in swine. The correlation on growth performance and meat quality between -0.86 to 0.82. The result showed the correlation between LW and ADG 104 d was found the highest correlation (0.82). The highest correlation of this study showed that, the swine high LW and high ADG 104 d also. In addition, to high relationship correlation between PL and LEA was 0.81. [17], report 10th-rib back fat was negative correlated with loin muscle area (-0.23). Moreover, the correlations between percentage composition in lean and Back fat was negatively relationship (-0.20) [18].

[19], report percentage lean was negatively correlated with back fat depth and positively correlated with loin eye depth.

Table 3 The regression linear model of growth performance and meat quality in swine

Model	Dependent variables	Independent Variables	β	P- Value	R^2	MSE
1	PL, %	Intercept = 41.60			0.66	0.34
		LEA, cm^2	0.39	**		
2		Intercept = 44.52			0.93	0.06
		BF, cm	-3.72	**		
		LEA, cm^2	0.41	**		
3		Intercept = 45.65			0.94	0.06
		LW; kg	-0.008	**		
		BF, cm	-3.76	**		
		LEA, cm^2	0.40	**		
4		Intercept = 45.81			0.94	0.06
		LW; kg	-0.01	**		
		ADG 104 d, g/d	0.0001	**		
		BF, cm	-3.76	**		
		LEA, cm^2	0.40	**		

** Significant different the 0.01 level of probability (P<0.01)

Table 4 The correlation of growth performance and meat quality in swine

Traits	LW; kg	ADG, g/d	ADG 104 d, g/d	BF, cm	PL, %	LEA, cm^2
LW; kg	1.00	-0.43**	0.82**	-0.11**	-0.24**	-0.31**
ADG, g/d		1.00	-0.86**	0.06*	-0.43**	0.01
ADG 104 d, g/d			1.00	-0.10**	-0.12**	-0.17**
BF, cm				1.00	-0.48**	0.04*
PL, %					1.00	0.81**
LEA, cm^2						1.00

* significant different the 0.05 level of probability (P<0.05)

** significant different the 0.01 level of probability (P<0.01)

Conclusions

Results of this study indicate that breed was affected on growth performance and meat quality in swine. Duroc and Crossbreed pig are appropriate for growth performance, such as LW and ADG 104 d. Pietrain and Crossbreed pig were high meat quality (BF, PL and LEA). Crossbreed pigs showed good of the growth performance and meat quality.

Acknowledgements

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