Abstract T170

Factors affecting carcass weight, dressing percent, and marbling score of crossbred beef cattle in tropical Thailand

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SUMMARY

The objective of this study was to characterize factors affecting carcass weight (**CWT**), dressing percent (**DP**), and marbling score (**MBS**; 1 = low to 5 = high) of crossbred beef cattle raised under Thai tropical conditions. Data came from 40,107 bulls and heifers, fattened in 3,939 farms, and collected at the slaughter house of the Pon Yang Khram Livestock Breeding Cooperative National Security Command Ltd. from January 2004 to December 2010. Crossbred cattle groups were ½ Charolais ½ Brahman (**CB**), ½ Limousin ½ Brahman (**LB**), and ½ Simmental ½ Brahman (**SB**). Seasons were winter (November to February), summer (March to June), and rainy (July to October). The model included the fixed subclass effects of year-season, breed group, and sex, covariates for slaughter age and slaughter weight, and a random residual. Least squares means (LSM) for subclass effects were compared using Bonferroni t-tests. All subclass effects influenced (P < 0.05) **CWT**, **DP**, and **MBS**, except for sex that had no effect on **MBS**. Crossbred CB and LB animals had similar **CWT** and **DP**, but **CB** had higher (P < 0.0001) **MBS** (3.11 ± 0.01) than **LB** (3.06 ± 0.01). Crossbred **SB** had similar **MBS** to **LB**, but lower (P < 0.0001) **CWT** (**SB**: 336.84 ± 0.42 kg; **CB**: 341.08 ± 0.16 kg; **LB**: 341.81 ± 0.45 kg) and **DP** (**SB**: 55.66 ± 0.07 %; **CB**: 56.32 ± 0.03 %; **LB**: 56.49 ± 0.07 %) than **CB** and **LB**. Bulls had higher **CWT** (343.18 ± 0.20 kg vs. 336.64 ± 0.37 kg) and **DP** (56.74 ± 0.03 % vs. 55.57 ± 0.06 %) than heifers. ***Results suggested that CB and LB would be the most advantageous to increase carcass quantity and quality of beef cattle under Thai tropical conditions***.

INTRODUCTION

Thailand is a tropical country in South East Asia. Climate in this country is hot (17° to 36° Celsius) and humid (66 to 81%). In 2010, the number of beef cattle raised in Thailand was 6,426,853 in 998,150 farms (mean = 6 animals per farm). The largest beef production region is North Eastern Thailand, with 3,325,794 cattle raised in 649,184 farms (mean = 5 animals per farm). Most beef cattle in Thailand are indigenous Thai (4,610,395 animals; 72% of the population), and the rest are crossbreds between Thai indigenous and other *Bos taurus* (e.g., Charolais, Limousin, Simmental, and Angus) and *Bos indicus* cattle (e.g., Brahman, InduBrazil; Department of Livestock Development, 2010).

Commercial beef production for high quality beef market has been steadily increasing in recent years. However, because most beef producers are small holders, the Thai government has enticed Thai beef producers to organize themselves into cooperatives as a way to increase the efficiency and cost-effectiveness of their beef operations. One of the most successful beef cooperatives is the Pon Yang Khram Livestock Breeding Cooperative National Security Command Ltd. This cooperative was established in 1980 by the governments of Thailand and France, and they had 4,702 member farms in 2009. Although this cooperative has collected information on carcass quantity and quality traits in electronic form since 2004, research on factors influencing these traits has not been done. ***Thus, the objective of this study was to characterize factors affecting carcass weight, dressing percent, and marbling score of crossbred beef cattle raised under Thai tropical conditions.*** Results from this study would help beef producers develop suitable mating, nutrition, and management strategies for fattening beef cattle in Thailand.

MATERIALS AND METHODS

Data, Farms, Feeding, and Management

The dataset came from 40,107 bulls (38,096) and heifers (2,011), fattened in 3,939 farms, which most of them (92%) were located in Northeastern Thailand (e.g., Sakon Nakhon, Nakhon Phanom, and Mukdahan provinces). These data were collected at the slaughter house of the Pon Yang Khram Livestock Breeding Cooperative National Security Command Ltd. from January 2004 to December 2010. Traits were carcass weight (**CWT**), dressing percent (**DP**), and marbling score (**MBS**; 1 = low to 5 = high; The National Bureau of agricultural Commodity and Food Standards, 2004). Breed groups were ½ Charolais ½ Brahman (**CB**), ½ Limousin ½ Brahman (**LB**), and ½ Simmental ½ Brahman (**SB**). Seasons were winter (November to February), summer (March to June), and rainy (July to October).

The vast majority of farms in this study were small holders (96% of farms), and they produced an average of 3.73 (SD = 2.57) fattened cattle at a time. The majority of farmers had primary school education (69% of farms). Most farms (81% of farms) bought cattle from outside for fattening. The average initial weight was 387.46 kg (SD = 47.67 kg), the average fattening period was 382 d (SD = 121 d), and the average slaughter weight was 604.62 kg (SD = 78.84 kg). Most farms (94% of farms) feed their cattle with concentrate bought from the cooperative, the others either mixed their own concentrate (3% of farms) or purchased concentrate from commercial companies (3% of farms). Supplement feed ingredients were mainly rice bran (89% of farms), broken rice (9% of farms), and cassava (2% of farms). Cattle were fed approximately 5.40 kg/d (SD = 2.59 kg/d). Preferable roughages of the farmers were rice straw (74% of farms), grasses (64% of farms), hay (63% of farms), grass silage (37% of farms), corn silage (35% of farms), and legumes (35% of farms). Most farms produced roughage themselves (58% of farms), some of them purchased it (28% of farms), and others both produced and purchased roughage (14% of farms). Mineral supplement was provided in most farms (81% of farms). Cattle were fattened separately in 2 x 3 m^2 individual pens, vaccinated against Foot and Mouth Disease, and treated with antihelmintics.

Data Analysis

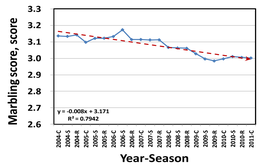
The model included the fixed subclass effects of fattening year-season (2004-winter to 2011-winter), breed group (**CB**, **LB**, and **SB**), and sex (male and female), covariates for slaughter age (2 to 5 years) and slaughter weight (304 to 1,035 kg), and a random residual. Least squares means (LSM) for subclass effects were compared using Bonferroni t-tests. Phenotypic trends were drawn for **CWT**, **DP**, and **MBS** using year-season subclass LSM. Computations were carried out with the MIXED procedure of SAS (SAS Institute, Inc., Cary, NC, USA).

RESULTS AND DISCUSSION

Fattening Year-Season

Fattening year-season affected **CWT**, **DP** and **MBS** (P < 0.0001). The LSM ranged from 332.85 ± 0.40 kg (2007-Summer) to 346.98 ± 0.38 kg (2006-Winter) for **CWT**, form 54.89 ± 0.07 % (2007-Summer) to 57.30 ± 0.06 % (2006-Winter), and from 2.98 ± 0.01 score (2009-Rainy) to 3.17 ± 0.01 score (2006-Summer) for **MBS**. The regression coefficient estimate was -0.30 ± 0.11 kg/year-season (P = 0.0130) for **CWT**, -0.05 ± 0.02 %/year-season (P = 0.0188) for **DP**, and -0.007 ± 0.001 score/year-season (P < 0.0001) for **MBS**.

Nearly all farmers in this study were small holders, thus the quality of cattle feeding and management across year-seasons may have been highly dependent on their ability to cope with increasing prices of feed ingredients, concentrate, and fuel during the period of the study, as well as variation in weather conditions. A reduction in the amount and quality of feed provided over time may have been one of factors accounting for the decreasing trends across year-seasons for all traits. All fattened cattle in this study were crossbred (i.e., **CB**, **LB**, and **SB**) and most farms purchased cattle from outside sources. Thus, it is also possible that the quality of purchased crossbred cattle decreased over time, perhaps due to use of semen from cheaper Charolais, Limousin, and Simmental sires in multiplier farms. However, it is more likely that under the current highly competitive economic environment for beef in Thailand, farmers may have had little alternative but to reduce the cost of fattening cattle. Cost reduction strategies may have included reductions in quality and quantity of concentrate ingredients and lower quality roughage, which resulted in the observed decreasing trends for **CWT**, **DP** and **MBS** between 2004 and 2010 in this population.



Breed Group

Breed group had an effect on **CWT**, **DP** and **MBS** (P < 0.0001; Table 1). The LSM for **CWT** and **DP** were similar for **CB** (341.08 ± 0.16 kg and 56.32 ± 0.03 %) and **LB** (341.81 ± 0.45 kg and 56.49 ± 0.07 %), and they were larger (P < 0.0001) than those for **SB** (336.84 ± 0.42 kg and 55.66 ± 0.07 %). In addition, **CB** had higher **MBS** (3.11 ± 0.01; P < 0.0001) than **LB** (3.06 ± 0.01) and **SB** (3.07 ± 0.01). Thus, the performance of **CB** for **CWT**, **DP**, and **MBS** was either comparable or superior to that of **LB** and **SB**. Waritthitham et al. (2009) reported that crossbred Charolais x Thai native had better **CWT** and **DP** than crossbred Brahman x Thai native. The superiority of CB over LB and SB suggested that Charolais would be the sire breed of choice to produce crossbred progeny with Brahman dams for fattening under Thai environmental conditions and beef market based on marbling.

Table 1 Least squares means of carcass weight, dressing percent and marbling score of crossbred fattened beef cattle separated by breed group

Breed Group	Carcass Weight (kg)	Dressing Percent (%)	Marbling Score (score)
½ Charolais ½ Brahman	341.08 ± 0.16[a]	56.32 ± 0.03[a]	3.11 ± 0.01[a]
½ Limousin ½ Brahman	341.81 ± 0.45[a]	56.49 ± 0.07[a]	3.06 ± 0.01[b]
½ Simmental ½ Brahman	336.84 ± 0.42[b]	55.66 ± 0.07[b]	3.07 ± 0.01[b]

Sex

Sex had an effect on **CWT** and **DP**, but not on **MBS** (Table 2). Bulls had larger (P < 0.0001) **CWT** and **DP** (343.18 ± 0.20 kg and 56.74 ± 0.03%) than heifers (336.64 ± 0.37 kg and 55.57 ± 0.06 %). Similar **MBS** were found for bulls (3.08 ± 0.01) and heifers (3.07 ± 0.01). The significance of differences between bulls and heifers for **CWT**, **DP** and **MBS** found in this study were similar those reported by Owens and Gardner (2000), however bulls had lower **MBS** than heifers. The similarity of **MBS** found in bulls and heifers here suggests that animals of both sexes were slaughtered at similar degrees of maturity.

Table 2 Least squares means of carcass weight, dressing percent and marbling score of crossbred fattened beef cattle separated by sex

Sex	Carcass Weight (kg)	Dressing Percent (%)	Marbling Score (score)
Bulls	343.18 ± 0.20[a]	56.74 ± 0.03[a]	3.08 ± 0.01
Heifers	336.64 ± 0.37[b]	55.57 ± 0.06[b]	3.07 ± 0.01

Slaughter Age and Slaughter Weight

Regression coefficient estimates of slaughter age and slaughter weight on **CWT**, **DP**, and **MBS** are shown in **Table 3**. Older cattle at slaughter had lower **CWT** (-0.202 ± 0.089 kg; P = 0.0231) and **DP** (-0.033 ± 0.015 %; P = 0.0248), but larger **MBS** (0.019 ± 0.002; P = 0.0001) than younger cattle. This beef cooperative determined carcass prices based on **CWT**, **MBS**, and others incentives (e.g., feeding, cleaning, housing, management; Pon Yang Khram Livestock Breeding Cooperative NSC Ltd., 2009). Thus, farmers whose cattle were slaughtered at older ages would need to consider a reduction in the age at slaughter of their cattle in order to receive a higher price from this cooperative.

Positive associations existed between slaughter weight and **CWT**, **DP**, and **MBS**. Fattened cattle with higher slaughter weights had larger **CWT** (0.576 ± 0.001; P = 0.0001), **DP** (0.001 ± 0.001; P = 0.0001), and **MBS** (0.001 ± 0.001; P = 0.0001) than those with lighter weights. These results agreed with Park et al. (2002), who studied Hanwoo (Korean native cattle) and reported that carcass quantity and quality of fattened cattle could be improved with heavier slaughter weights. However, to increase the profitability of beef operations under Thai economic conditions, farmers will need to improve not only economically important carcass traits, but also growth rate and feed conversion efficiency. In addition, particularly small farmers will need to utilize low cost feeding regimes of appropriate nutritional value, if they are to remain competitive.

Table 3 Regression coefficient estimates of slaughter age and slaughter weight on carcass weight, dressing percent, and marbling score of crossbred fattened beef cattle

Traits	Slaughter Age (year)	P-value	Slaughter Weight (kg)	P-value
Carcass weight (kg)	-0.202 ± 0.089	0.0231	0.576 ± 0.001	0.0001
Dressing percent (%)	-0.033 ± 0.015	0.0248	0.001 ± 0.001	0.0001
Marbling score (Score)	0.019 ± 0.002	0.0001	0.001 ± 0.001	0.0001

FINAL REMARKS

- ***Year-season, breed group, sex, slaughter age, and slaughter weight affected carcass weight, dressing percent, and marbling score***
- ***Least squares means for all traits tended to decrease across year-seasons from 2004 to 2010***
- ***Charolais-Brahman crossbreds performed better for all traits than Limousin-Brahman and Simmental-Brahman crossbreds***
- ***Bulls had larger carcass weights and dressing percent than but similar marbling scores to heifers***
- ***Older cattle had lower carcass weight and dressing percent, but higher marbling score than younger cattle***
- ***Higher slaughter weights were associated with higher values for all traits***

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