IMPROVEMENT IN BEEF CATTLE GENETICS SUPPORTED BEEF CATTLE PRODUCTION AND PROTEIN CONSUMPTION IN THAILAND

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Abstract – Theresearch and development (R&D) in beef cattle genetics, biotechnology, climate science and production systems supported profitable and sustainable beef cattle production in Thailand. The Department ofLivestock Development (DLD) undertook R&D to achieve continuous improvement in genetics, production technologies to improve productivity, profitability and sustainability of beef cattle production and of product quality.The objectives of this study were to study production performances and economic potential of various beef cattle genotypes (Thai Native, Thai Brahman, Kabinburi (50% Simmental and 50% Brahman), Tak (62.5% Charolais and 37.5% Brahman), Tajima-Native). Data of growth, carcass performance and economic performances were collected between October 2006 and September 2008. Tak beef cattle had highest ADG, carcass percentage, and loin eye area (0.941 g/d, 59.58%, and 115.88 cm^2). Tak and Kabinburi cattle were higher than Brahman beef cattle in both, production and economic performance. Tajima-Native beef cattle gave the most tender meat with 2.26 kg in average shear force. Tajima-Native beef cattle were higher than Thai Native cattle in carcass and economic performance. The genetic improvement of beef cattle by DLD provided increasing sustainability of beef cattle production and protein consumption in Thailand.

Key Words – Brahman, Tak, cattle

I. INTRODUCTION

Genetic improvement of beef cattle in Thailand has focused on increasing in animals' growth rates. Thai Native and Thai Brahman cattle (*Bos indicus*), were used as based genetics crossing with *Bos taurus*, such as Charolais and Simmental. Calves from this crossed breeding had higher growth rate, body weight, and carcass percentage from *Bos taurus*. They had higher fertility and disease resistant traits from *Bos indicus*, especially Thai native cattle. Researches of breeding system and genetic improvement methods were proposed as tools to develop beef cattle genetics. Department ofLivestock Development (DLD) undertook R&D to achieve continuous improvement in genetics, production technologies to improve productivity, profitability, and meat quality. Beef cattle production was one of agricultural industry that provided food supply chain which is responsive to the needs of consumers. Beef meat consumption of Thai people was less than consumption of American and Australian consumption. It was around 3 kgs per person in 2005, whereas it were 28.60 and 36.70 kgs per person in USA and Australia respectively (Sirisom and Boonyanuwat, 2006).

In 2006, 1,842.53 thousand tons of beef meat was imported (0.41% of all consumption, 120.84 baht/kg) (MOC, 2007). Beef cattle genetic improvement had two purposes,i.e. for medium meat quality production and for high quality meat production. The purpose of DLD programme upgrading Thai Native cattle for medium meat quality production was to produce more meat from Brahman cattle. The purpose of the high quality meat production programme was based on cross breeding systems of *Bos taurus* and *Bos indicus*, such as Tak cattle, Kabinburi cattle, Tajima-Native cattle (Thai synthetic breeds by DLD, Tak = 62.5 Charolais-Brahman, Kabinburi = 50 Simental-Brahman), and crossbred cattle which were in fattening period for 6 to 12 months. Fattening animals were raised for restaurant, hotel, super market, and steak house. Regards with these two genetic improvement purposes, Thai Native and Brahman cattle were used as base genetics. They could give good genetics of heat tolerance, disease resistance traits to the next generations. Calves received high production traits from *Bos taurus*,

such as Charolais, Simmental, and Tajima. The genetic improvement of beef cattle was to maximise the quality of meat from beef cattle. The programs of beef cattle genetic improvement had to identify genes, utilize genetic parameters and process cross-breeding programs that would enable extensive, low input of cow-calf production and fattening system. Genetic improvement of beef cattle was based on quantitative genetics and molecular genetics for selection. For molecular genetics, after completely previous genetic marker development, it could be used for selection with quantitative genetics. Molecular, quantitative genetics and biotechnology tool were being combined in the development of genetic improvement. The objectives of this study were to study production performances and economic potential of various beef cattle (Thai Native, Thai Brahman, Kabinburi (50% Simmental and 50% Brahman), Tak (62.5% Charolais and 37.5% Brahman), Tajima-Native) for Thai beef genetic improvement to provide increasing sustainability of beef cattle production and protein consumption in Thailand.

II. MATERIALS AND METHODS

Animal

Five breeds of cattle were used in this study.

1. Forty Thai Native Cattle(T).
2. Forty Brahman cattle. (B)
3. Forty Kabinburi cattle. (K)
4. Forty Tak cattle.(TK)
5. Sixteen Tajima-Native cattle. (TJ)

These cattle were fattened at DLD (Research and Breeding Center/Station) during October 2006 – September 2008. Animals were fed with grass (*Bachiariaruziziensis* and *Digitariaeriantha*), legume (*Stylosantheshamata*), and concentrates (12% CP). The data of carcass performance were collected at Research and Breeding Center of DLD and Central Laboratory of Chiangmai University. Different types of data were collected: of growth performance [body weight, average daily gain (ADG)], carcass performances (carcass percentage, loin eye area, shear force, fatty acid profile), and economic performance (net income per head). Samples were collected at the 7^{th}–8^{th}ribs for shear force measurement and determination of fatty acid profile. These data were analysed by analysis of variance (ANOVA) (Chantalakhana, 1991).

III. RESULTS AND DISCUSSION

Growth performances and economic potential of Thai beef cattle

Thai Native cattle had the smallest size. The ADG during fattening periods of Thai Native cattle was 0.636 kg per day. It did not significantly differ from ADG of Tajima-Native cattle. Final weight of Tajima-Native was greater than Native cattle (456.38 vs 305.38 kg). Tajima-Native cattle had a greater initial weight (213.90 vs 125.96 kg) (Table 1). The ADG of Tajima-Native did not significantly differ from the one of Native cattle because these two breeds of cattle were similar in frame size. The ADG of Tajima-Native cattle was similar to ADG of F_1Wagyu cross steers from the study of Maki *et al.* (2009), where animals were fed with grass-legume and concentrate (80:20). While the trial of crossbreed Brahman fattening in small holder farms showed that the ADG during fattening periods was 0.787 kg per day (Pruksasri *et al.*, 1990). Thai native cattle in this research had lower ADG than Brahman crossbred. Brahman crossbred cattle received additive genetics and heterosis genetics from Brahman and Thai native cattle. In addition, Brahman crossbred cattle were bigger frame than Thai native. Brahman cattle in this research had similarly ADG with Thai native cattle (0.721 vs 0.636 kg per day, ns). These two breeds of cattle were *Bos indicus.*

For the two breeds improved from Brahman cattle and *Bos tuarus* (Charolais and Simmental), Tak and Kabinburi cattle, they had ADG greater than Brahman (0.941 vs 0.913 vs 0.721 kg/day, $P<0.01$). The ADG of Tak was greater than Kabinburi cattle ($P<0.05$). The higher ADG of Tak and Kabinburi cattle occurred by heterosis effects of cross breeding between *Bos tuarus* and *Bos indicus* (Johnson, 2009). Tak cattle had ADG higher than Kabinburi cattle because of additive and heterosis effects. Tak had Charolais blood at 62.50%. Kabinburi had Simmental blood at 50%. Furthermore, Kabinburi had 50% Simmental and 50% Brahman, Simmental cattle

was dual purpose cattle (milk and meat) (Krublich, 2009).

Tak cattle gave the highest net income (7,335.50 bath/head). Farmers could finish 10 – 20 cattle per year, and they could earned money more than 73,355 bath per year. They could earn from finishing beef cattle while having other occupation, such as government employee, company employee, and other agriculture occupation. Beef cattle finishing was good occupation with good income for farmers and provided protein consumption to consumers.

Table 1 Growth performance and economic potential of Thai beef cattle

	T	B	K	TA	TJ
No.	40	40	40	40	16
W1 (kg)**	125.96^{e} ±41.43	232.78^{c} ±24.62	276.67^{b} ±21.8	290.50^{a} ±21.79	213.90^{d} ±8.66
W2 (kg)**	305.38^{e} ±42.4	405.76^{d} ±36.9	550.57^{b} ±80.3	584.50^{a} ±28.9	456.38^{c} ±66.2
Fage (mo)	21.44 ±12.6	21.33 ±3.5	24.33 ±2.2	23.33 ±2.4	21.33 ±2.2
ADG (Kg/day)**	0.636^{c} ±0.5	0.721^{c} ±0.3	0.913^{b} ±0.3	0.941^{a} ±0.1	0.674^{c} ±0.2
Net income /head (baht/head)**	3275.59^{c} ±2906.3	3216.36^{c} ±1449.9	6012.23^{b} ±3324.0	7335.50^{a} ±1583.0	5625.66^{c} ±2823.7

** Different letter in the same row means highly significant difference of means between genotypes (P<0.01)
T=Thai Native, B=Thai Brahman, K=Kabinburi, TA=Tak, TJ=Tajima-Native, W1=initial weight, W2=final weight, Fage=final age

Carcass performances of Thai beef cattle

Meat quality of Thai Native cattle was the lowest (Table 2). The meat texture of this group is the firmer (shear force = 5.62) (Table 2). It was suitable for Thai food cooking. Meat from this group was used to make meat ball and Thai food. Brahman animals were fattening during 3to 6 months (DLD, 2004). Meat from this group was of medium quality. Farmers fed them with grass, agricultural by-products, and concentrate. They were fattening with grass, legume, and concentrates. Meat from this group was used for general Thai food and steak cooking. Kabinburi and Tak cattle had the highest carcass percentage (59.62 and 59.58%). Tak cattle had the biggest Loin eye area (115.58 cm^2) by heterosis and additive effects (Johnson, 2009). The genetic gains were higher by selection and mating system. Tajima-Native cattle had the most tender meat (shear force = 2.26 kg). This good trait came from Tajima cattle (tender meat) and Native cattle (fine texture). Tajima cattle is one breed of Wagyu cattle. Tajima cattle are genetically predisposed to intense marbling and to produce a high percentage of oleaginous unsaturated fat. The meat from Wagyu cattle is known worldwide for its marbling characteristics, increased eating quality through a naturally enhanced flavor, tenderness and juiciness, and thus a high market value. The result of this study showed Tajima-Native cattle had the highest SFA of (93.24% of total fat). Due to its high marbling potential, Tajima-Native cattle of this study were fed with high concentrate to produce marbling and tender meat, Consequently they had the highest SFA. They were fed higher concentrate, up to 90% of concentrate in the last month of fattening. They were fattening during 6 to 12 months. Native cattle had the highest Omega 3, Omega 6, and PUFA proportions (6.31, 5.54, and 12.12% of total fat). This is good characteristics of Native cattle. They were fed with grass and legume. Due to grass feeding, their meat contained high level of healthy fatty acid.

Table 2 Carcass performances of Thai beef cattle

	T	B	K	TA	TJ
No.	40	40	40	40	16
C (%)**	55.21^{b} ±9.5	57.64^{ab} ±2.7	59.62^{a} ±4.4	59.58^{a} ±2.9	58.08^{a} ±2.7
L (cm^2) **	54.76^{e} ±6.0	76.23^{d} ±16.6	106.70^{b} ±17.4	115.88^{a} ±18.4	83.38^{c} ±16.6
SF (kg) **	5.62^{a} ±0.5	5.34^{a} ±1.7	4.05^{a} ±1.7	4.84^{a} ±2.9	2.26^{b} ±0.9
O3 (%) **	6.31^{a} ±5.1	3.71^{b} ±2.8	3.48^{b} ±2.3	2.13^{b} ±1.9	3.39^{b} ±0.0
O6 (%) **	5.54^{a} ±3.5	4.56^{b} ±3.0	5.34^{a} ±3.0	3.34^{c} ±1.8	0.39^{c} ±0.0
CLA (%) **	0.02 ±0.01	0.02 ±0.02	0.02 ±0.02	0.02 ±0.04	0.01 ±0.01
SFA (%) **	73.32^{b} ±15.1	72.23^{b} ±18.2	69.83^{b} ±18.5	72.76^{b} ±19.5	93.24^{a} ±0.0
MUFA (%) **	14.57^{b} ±4.3	19.24^{a} ±8.0	21.16^{a} ±17.6	21.45^{a} ±20.0	2.87^{c} ±0.0
PUFA (%)**	12.12^{a} ±5.3	8.53^{b} ±4.7	9.01^{b} ±4.0	5.79^{c} ±2.6	3.89^{d} ±0.0

** Different letter in the same row means highly significant difference of means between genotypes (P<0.01)

T=Thai Native, B= Thai Brahman, K=Kabinburi, TA=Tak, TJ= Tajima-Native, C=carcass, L=loin eye area, SF=shear force, O3=Omega3, O6=Omega6, CLA = Conjugated Linoleic Acids, SFA = saturated fatty acid, MUFA = monounsaturated fatty acid, PUFA = polyunsaturated fatty acid

IV. CONCLUSION

Tak cattle ADG (0.941 kg/day) was greater than Kabinburi, Brahman, Tajima-Native, and Native cattle. Tak cattle gave the highest net income (7,335.50 bath/head). Kabinburi and Tak cattle had the highest carcass percentage (59.62 and 59.58%). Tak cattle had the biggest Loin eye area (115.58 cm^2). Tajima-Native cattle had the most tenderness meat (shear force = 2.26 kg). The result of this study showed the highest SFA of Tajima-Native cattle (93.24% of total fat). Native cattle had the highest Omega 3, Omega 6, and PUFA proportions (6.31, 5.54, and 12.12% of total fat). This is good characteristics of Native cattle. They could produce high level of healthy fatty acid. The results of this study showed that each local breed included in programmes of beef cattle genetic improvement, had good characteristics. Whitmore genetic improvement of growth and carcass performance, they have the potential to increase sustainability of beef cattle production and protein consumption in Thailand.

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