Growth performance and nutrient digestibility of Thai native compared with Lowline Angus crossbred beef cattle fed with regional feedstuffs

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Abstract Cassava starch residue and oil palm meal are massive industrial by-products which can be used as animal diet in Thailand. The aim of this study was to investigate voluntary feed intake, nutrient digestibility, and growth performance of Thai native cattle compared with Lowline Angus x Thai native crossbred beef cattle fed with those two local feedstuffs as supplement. Yeast fermented cassava starch residue mixed with oil palm meal prior fed to beef cattle at 1.50% BW, while rice straw was given in *ad libitum* during 6 months of experimental period. It was found that total intake and intakes of roughage and supplement did not different among breed of beef cattle. Growth rate and final body weight of Thai native cattle were greater than the crossbred but that caused by differences in initial body weight (covariate effect), then growth performance was similar between cattle group. Feed per gain of Thai native cattle (11.6 g/g) did not different from the crossbred (12.1 g/g). Moreover, Thai native cattle and Lowline Angus x Thai native crossbred beef cattle had similar in nutrient digestibility including dry matter, organic matter, crude protein, crude fat, and fiber fractions. Therefore, Lowline Angus x Thai native crossbred beef had similar ability of local feed resources utilization and growth performance as Thai indigenous cattle.

Keywords: cassava starch residue, oil palm meal, nutrient digestibility, growth performance, Thai native cattle

Introduction

In Thailand, indigenous cattle and their crossbred with Brahman distributed more than 60% of total population (Department of Livestock Development, 2017) since they are suited to Thai raising conditions. These cattle have high lean percentage and tenderness with lower fat percentage which good for local dish such as Goy and Lap (raw or cooked beef with specific condiments and herbs). However, due to inferior of growth rate, carcass percentage, and marbling score (required for steak cooking or modern dish) of indigenous and Brahman crossbred (Opatpatanakit *et al*., 2010), *Bos taurus* was improted for crossbreeding to improve their production traits. Kampangsan beef, Tak beef, Kabinburi beef, and Thai black are example of crossbred beef strains in Thailand. The crossbred especially with Charolais >50% play importance role in beef production of Thailand particularly feedlot cattle to produce high quality meat (Bunmee *et al*., 2018). However, large type breed like Thai native x Brahman with Charolais or other Europe breed may not suitable for smallholder farmer cuased high production cost. Thai native x Lowline Angus crossbred cattle, medium size, has been develop by Sawasdipan since 2003 to be another choice for farmer. These cattle had adapted and then present similar heat tolerance but with higher growth rate than Thai native cattle under condition (Pakdeerat, 2010; Pilajun *et al*., 2019).

Deficiency of high quality roughage during dry season is a large problem especially in the Northeast of Thailand. Consequently, supplementation of concentrate with low quality roughage such as rice straw are strategy often conduct. Utilization of several local low-cost feedstuffs particularly by-product or residue of rice, cassava, sugarcane, and oil palm have been interpreted (Wanapat, 1999). Cassava pulp is the residue from cassava starch production. Farmers accepted to use dried cassava pulp as feed ingredient to reduce the production cost when the price of other carbohydrate sources was high (Yimmongkol, 2009). However, due to low nutritive value with high moisture content therefore improving their nutritive value by fermentation with several additives have been conduct. Khampa *et al*. (2014) is primary work about improving nutritive value of cassava starch residue with yeast (*Saccharomyces cerevisiae*) fermentation then wildly use as animal diet in Thailand. Fermented cassava starch residue with yeast and enzyme improved nutrient component and digestibility has been reported in our previous work (Pilajun and Wanapat, 2016). In term of oil palm industry by-products, crude oil palm meal had lower crude protein content with high proportions of fiber, ash, and lignin from seed shell (Chanjula *et al*., 2018). However, they reported the optimal level of palm kernel cake in concentrate for goat should be lower than 35% to reduce production cost. In addition, not exceed 20% of oil palm meal inclusion in concentrate for milking cow has been endorse (Lunsin, 2018).

The objective of this study was to investigate growth performance and feed utilization of Lowline Angus x Thai native crossbred beef compared with Thai native purebred cattle fed with usefully local feed resources.

Materials and methods

The experiment was conducted under the control and advice of the Office of Laboratory and Farming Center, Faculty of Agriculture, Ubon Ratchathani University by followed EU standards for the protection of animals used for scientific purposes.

Experimental design, Animals and Feeds

Growth performance and nutrient digestibility of Thai native cattle (TN) was compared with Lowline Angus x Thai native crossbred beef (LAC) in Completely Randomized design. Five, 2-year-old castrated male with 148±4.20 kg and 139±3.54 kg initial BW of TN and LAC, respectively, were receive rice straw in *ad libitum* while yeast fermented cassava starch residue mixed with oil palm meal was supplemented at 1.5% BW on dry matter basis. Fermented cassava starch residue was prepared by the method of Pilajun *et al*. (2018). In brif, cassava starch residue from the industrial factory for cassava manufacture was ferment with yeast (*Saccharomyces cerevisiae*), urea, and molasses (0.33 g, 3.3 kg, and 4.2 kg per 100 kg DM, respectively) at least 21 days before use. Crude oil palm meal (COPM) bought from crude palm oil factoty. Chemical composition of experimental diet was showed in Table 1. Three portion of yeast fermented cassava starch residue (YFCSR) was mixed with COPM prior feeding in each meal. Animals were raised in individual pen with appropriate feeding and watering spaces, and free access to mineral block.

Data collection, Samples and Analysis

After 15 days of adaptation period, the experiment was conducted for 6 months. Feed and refusal were recorded daily while body weight was determined in every month for feeding adjustment and growth rate assessment. Feed samples was sampled every month while cattle's feces was collected by rectal grab sampling in five consecutive days of 3rd and 6th months. Samples were dried at 60ºC for 72 h, ground and analyzed for dry matter (930.15), total ash (942.05), nitrogen (968.06) and ether extract (920.39) according to AOAC (1995), while fiber fractions including neutral detergent fiber and acid detergent fiber were followed Van Soest *et al*. (1991). Acid insoluble ash was analyses and used as internal indicator for nutrient digestibility estimation (Van Keulen and Young, 1977).

Statistical analysis

All data were statistically analyzed by using ANCOVA procedures of SAS (2006) by using initial body weight as covariance. Differences among means were analyzed by t-test with $P<0.05$ level of significance.

Table 1. Chemical composition of experimental diets (Mean±SD, g/Kg DM)

Chemical composition	RS	YFCSR	COPM
Dry matter	921±34	163±16	876±65
Organic matter	893±55	951±52	917±77
Crude protein	26.5±2.3	123±9.2	70.2±3.9
Ether extract	6.42±0.6	13.1±1.5	35.4±2.2
Neutral detergent fiber	726±61	411±42	741±58
Acid detergent fiber	543±27	217±26	562±39
Acid detergent lignin	112±18	30.3±4.2	106±24

RS, rice straw; YFCSR, yeast fermented cassava starch residue; COPM, crude oil palm meal

Results

Production performance

Total feed intake and intakes of roughage and supplement were comparable among group of beef cattle ($P>0.05$). Body weight, average daily gain, as well as feed per gain of Lowline Angus crossbred did similar with Thai native cattle as shown in Table 2 ($P>0.05$).

Nutrient digestibility

Digestibility of dry matter, organic matter, crude protein, ether extract and fiber fractions did not different between beef cattle ($P>0.05$; Table 3). Dry matter digestibility presented a little bit low, 62.3% vs 63.1%, due to type of roughage (rice straw) as low digestibility of NDF and ADF presented.

Table 2 Growth performance of Thai native compared with Lowline Angus crossbred beef cattle (Mean±SD)

Items	Thai native	Lowline Angus crossbred	P-value
Total intake (kg/d)[1]	5.59±0.22	5.28±0.34	0.323
Rice straw intake (kg/d)[1]	1.95±0.31	1.86±0.28	0.199
YFCSR+COPM intake (kg/d)[1]	3.64±0.29	3.42±0.38	0.241
Body weight (BW, kg)			
Initial BW	148±4.20	139±3.54	0.247
3 month BW[1]	181±6.41	167±5.74	0.163
6 month BW[1]	227±5.19	213±6.24	0.371
Average daily gain (ADG, g/d)			
3 month ADG	362±26.6	341±24.8	0.546
6 month ADG	516±23.1	484±30.2	0.683
Feed per gain (FCG)			
3 month FCG	14.3±1.28	15.7±2.46	0.433
6 month FCG	11.6±1.04	12.1±1.84	0.567

[1] Covariate effect from initial body weight

Table 3 Nutrient digestibility of Thai native compared with Lowline Angus crossbred beef cattle (Mean, SE)

Digestibility, %	Thai native	Lowline Angus crossbred	P-value
Dry matter	62.3±1.41	63.1±1.22	0.561
Organic matter	65.7±0.97	67.8±0.85	0.631
Crude protein	68.1±0.56	70.2±0.71	0.785
Ether extract	72.4±2.89	70.7±2.44	0.432
Neutral detergent fiber	53.6±1.28	55.6±1.45	0.324
Acid detergent fiber	46.8±1.82	45.2±1.36	0.399

Discussion

Crude protein of rice straw and yeast fermented cassava starch residue were in ranged of previous report. Although several agriculture by-products in Thailand are capable to use as ruminant diet, low nutritive value of them lead to limit of utilization (Wanapat, 1999). Chemical composition of cassava starch can be enriching by fermented with microorganism especially yeast (*Saccharomyces cerevisiae*) with some additives (Khampa *et al*., 2012; Pilajun *et al*., 2018). Crude palm oil meal contained high proportion of lignin from seed shell as reported by Wan Zahari *et al*. (2012). Simple or fermented cassava starch residue are accepted to use as ruminant feed with a few restrictions (Yimmongkol, 2009); in contrast, crude oil palm meal still has queries. Comprising of seed shell, hard with lignin and ash, which almost undigestible resulted in low

digestibility (Chanjula *et al*., 2018). In addition, using of COPM as ruminant diet have to consider the development of teeth of animal

These agreed with our previous study (Pilajun *et al*., 2020) which found grazing Lowline Angus x Thai native crossbred beef cattle and Thai native cattle with fermented cassava pulp supplementation had similar growth rate. However, several study about crossbred beef cattle reported higher growth rate when compared with indigenous cattle. Widiati *et al*. (2019) reported that the Simmental and Limousin crossbred with the local cows in Yogyakarta-Indonesia showed greater performance than indigenouse purebred. Moreover, Crossbreeding using both taurine and zebu breeds is recommended to increase beef cattle performance in southern Brazil (Leal *et al*., 2018), from maternal breed additive and heterosis effects. Absent of superior performance of Lowline Angus crossbred in the present study may related poor quality of all diet. The high fiber, silica and lignin contents of straw resulted poor nutrient (dry matter and protein) digestibility (<50%) has been reported in review article of Aquino *et al*. (2020). Non-protein nitrogen (urea) remain in fermented cassava starch residue may indue nutrient imbalance in the rumen of crossbred beef cattle (Pilajun and Wanapat, 2018), lead to low feed efficiency in this study. Hard and high lignin content of palm seed shell in crude oil palm meal may affected voluntary intake and digestibility of animal. Lowline Angus crossbred beef has been developed in farm of Ubon Ratchathani University since 2003 (Sawasdipan, 2003), long period adaptation of this cattle under tropical area should improve their existence.

Our previouse study (Pilajun *et al*., 2016) also found Thai native cattle and Lowline Angus crossbred beef had similar nutrient digestibity when fed with rice straw, rice straw with concentrate supplement, or Pangola hay. Agreed with Silvestre *et al*. (2021) who reported dairy heifer purebred Gyr and Holstein x Gyr crossbred (F1) had similar feed digestibility but higher CP digestibility than purebred Holstein. This indicated that F1 capable adapt to local environment may be by moternal effect. Apparent total tract digestibility of organic matter, gross energy, and fiber fractions were not affect by breed type, Angus vs Hereford × Angus cross, although the crossbred had greater body condition score than purebred (Andresen *et al*., 2020). In contrast, Nouala *et al*. (2009) reported N'Dama x Jersey crossbred cattle had significantly lower organic matter and NDF digestibilities than pure N'Dama, The Gambia indigenous cattle. Warm-season perennial C4 grasses are the dominant forages in tropical and subtropical regions. The resilience of C4 grasses under adverse conditions caused reduced nutritive value compared with forages from temperate climates (Cooke *et al*., 2020) may related with the different of digestibility of *Bos indicus* and *Bos taurus*.

Based on the results it could be concluded that Lowline Angus x Thai native crossbred beef had similar ability of local feed resources utilization resulted unexcess growth performance as Thai indigenous cattle. Production performance of the crossbred trial with high quality feed based on local resource should be conducted.

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