Effects of Dried Cassava Pulp as a Source of Energy on Growth Performance and Carcass Quality in Fattening Beef Cattle

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ABSTRACT

This study was conducted to determine effects of feeding dried cassava pulp (DCP) as a main source of energy on growth performance, carcass composition and economic return of feedlot cattle. Twenty mature Charolais crossbred steers at an average age of 3 years were used in this study. The feedlot cattle were randomly divided into 4 groups of 5 animals and were randomly allotted to receive one of four dietary treatments according to a Completely Randomized Design (CRD). The animals in control (CTRL) and dietary treatment were fed with concentrate at 1 percentage of body weight and supplemented with rice straw to the animals ad libitum. The other 3 treatments were fed with concentrate in which corn and rice bran was replaced by dried cassava pulp (DCP) at 50, 75 and 100% by weight. The results indicated that feedlot performances (ADG, FCR and feed efficiency) were not significantly different. Additionally, carcass compositions (carcass length, carcass weight, dressing percentage, lean percentage, bone percentage, fat percentage and fat thickness) and carcass quality (chemical composition, water holding capacity, marbling score and shear force) were not significantly different. However, meat color values of b* value of control diet and DCP50 were higher than DCP100 (P<0.05). Note that the total feed cost of control group was higher then DCP50, DCP75 and DCP100 (P<0.05). The results from this study suggested that DCP can be used as an energy source for feedlot cattle without any impact on growth performances, carcass compositions and carcass quality.

Key words: Dried cassava pulp, Ethanol process, Growth performance, Carcass composition, Economic return, Feedlot cattle

INTRODUCTION

Over the last 10 years, many studies have looked at optimizing the level and use of distiller's grains in finishing diets. These studies was conducted replacing with a portion of the cereal grain with distillers grains due to higher cost of ingredient such as corn, cassava ships or rice bran. Most of beef farmers in northern Thailand used commercial concentrate feed and supplemented with local feed ingredients. Nowadays many ethanol plants were established in Thailand so a lot of by-product is from ethanol plants could be used as feedstuff. Dry cassava pulp is the residue of ethanol process from cassava fermentation that can be a new choice in Thailand because of low price of by-product. Yimmongkol et al. (2009) showed no different on growth performances, carcass qualities and carcass composition of the feedlot cattle fed with concentrate which replaced cassava meal by dried cassava pulp from starch process at 50 or 100% by weight. Roeber et al. (2005) reported that feeding distiller's grains at up to 50% of the dietary DM did not affect tenderness or sensory traits. Al-Suwaiegh et al. (2002) reported replacement of dry–rolled corn with distillers grains (DG) from sorghum or corn fermentation increased ADG and feed efficiency in steers.

Depenbusch et al. (2009) showed that tenderness of steaks and ratio of PUFA: SFA improved with increasing levels of distiller's grain with soluble. Most researchers works with distiller grain levels between 15 and 40% but very little research has evaluated distillers grains levels above 40% of DM basis (Farlin, 1981) and the effects on growth performance and carcass characteristics (Vander Pol et al., 2006).

The objective of this study was to determine effects of dried cassava pulp supplementation as a source of energy on growth performance, carcass quality and economic return in fattening crossbred Charolais cattle.

MATERIALS AND METHODS

Animal and feeding

The study was conducted on a commercial beef production company in Chiang Mai, Northern Thailand. The 20 experimental animals were mature crossbred Charolais steers at average age of 3 years and initial body weights of 539.56±73.87 kg were used. The animals were randomly divided into 4 groups of 5 animals and were randomly allotted to receive one of four dietary treatments according to a Completely Randomized Design (CRD). A 14-days preliminary period preceded the growth performance studies. The feeding period was 180 days. The control concentrate (CTRL) used corn and rice bran as an energy source. CTRL and dietary treatments were fed with 1 percent of body weight and supplement with rice straw to the animals *ad libitum*. The other 3 treatments were concentrating in which corn and rice bran was replaced by dried cassava pulp (DCP) at 50, 75 and 100% (Table 1). Each animal had access to a molasses lick and clean water at all times.

Table 1. Feed ingredients and chemical composition of the experimental diet.

Ingredient (kg)	CTRL	DCP50	DCP75	DCP100
Concentrate feed 12% CP	22.5	22.5	22.5	22.5
Dried cassava pulp	0	26.25	39.38	52.5
Corn	10	5	2.5	0
Rice bran	42.5	21.25	10.62	0
Molasses	25	25	25	25
Total	100.00	100.00	100.00	100.00
Chemical composition (% of DM)				
Crude protein	7.35	8.31	8.76	9.21
Fat	3.12	212	1.91	1.71
TDN	72.15	79.13	82.66	86.20

Live weight, slaughtering and carcass traits

Each animal was weighed at the beginning and the end of fattening period. Fattening period was recorded and average daily gain during fattening period was calculated. When the animals reached the target slaughter weight, they were transported to a commercial slaughter house in Chiang Mai, where they were fasted for 12 hours and weight afterwards. The animals were slaughtered according to the procedure of the commercial slaughter house by the follow step; stunning by captive bolt stunner, bleeding, heading, shanking, skinning, eviscerate and carcass splitting. Warm carcass weight, hide weight, visceral weight, carcass composition and carcass percentage were recorded. The dressing percentage and meat composition were also determined.

The sample of *Longissimus dorsi* muscle between the 12^{th} and 13^{th} rib was taken from the left carcass. The *LD* sample was cut into 2.5 cm thick, put into polyethylene bags and frozen at 20 °C and kept for meat quality evaluation.

Meat quality

Chemical composition analysis

The samples were thawed at 4 °C for over night prior all chemical analysis. Moisture, crude protein (Kjeldahl; 6.25N) and ether extract were analyzed according to AOAC (2000).

Drip loss

The sample was weighed and suspended by means of a net inside a plastic bag and seal. The sample was held at 4 °C for 24 h. At the end of the measuring period the sample was taken from the bag, dried gently with soft paper and reweighed. Drip loss was expressed as the percentage of initial weight according to Honikel and Hamm (1999).

Boiling loss

Boiling loss was determined in 2.5 cm thick of *LD* Before weighing, the sample surfaces were dried with soft paper. Afterwards, samples were sealed in heat-resistant plastic bags to be boiled in water bath at 100 °C until an internal temperature of 70°C was reached. Thereafter, the samples was taken from the bag, dried gently with soft paper and reweighed. Boiling loss was expressed as the percentage of initial weight.

Color measurement

The 2.54 cm of *LD* samples were bloomed for 1 h at 4 °C prior to measurement using Minolta Chroma Meter (CR-300, Konica Minolta, Japan) determine as lightness (L*), redness (a*) and yellowness (b*). Three replication measures were performed on each sample.

Shear force

After boiling loss, the samples were kept at 4 °C over night. Six round cores (1.27 cm diameter) were removed from the boiled meat for shear force value determination using an Texture Analyzer (TA.XT2, London, UK) using a Warner–Bratzler shear. A cross head speed of 0.83 mm/s when cutting through the round core and recorded the maximum force (N) and Energy (J).

Statistical analysis

The experiment was based on Completely Randomized Design (CRD). Data was subjected to analysis of variance (ANOVA) and mean were compared by Duncan's New Multiple Range Test (Steel and Torrie, 1980) with SAS 8.1 (SAS, 1990)

RESULTS AND DISCUSSION

Growth performance

The effects of treatments on feedlot performance are shown in Table 2. Initial weight, final weight, weight gain, ADG, FCR, feed efficiency were not affected by treatment (P>0.05). Dried cassava pulp (DCP) replacing up to 100% of diet in corn and rice bran had no effect on fattening beef cattle. Erickson et al. (1989) provided up to 28% of a finishing diet as DDG and observed no negative affects on performance. Other reports suggested that dried distillers grains (DDG) could be an effective replacement of concentrate with no affect on livestock performance compared to control diet.

Table 2. Effects of DCP in concentrate on feedlot performance.

Feedlot performance	CTRL	DCP50	DCP75	DCP100	SEM	*P*
No. of animals (heads)	5	5	5	5	-	-
Initial weight (kg)	527.80	552.20	509.00	531.20	16.37	0.85
Final weight (kg)	679.07	678.34	638.34	714.25	11.66	0.14
Weight gain (kg)	149.80	140.60	115.60	183.80	12.97	0.33
ADG (kg/day)	0.72	0.60	0.52	0.81	0.06	0.37
FCR	16.13	18.49	19.68	12.68	1.56	0.43
Feed efficiency	7.05	6.61	5.44	8.74	0.62	0.31

Carcass composition

It was shown that the slaughter weight, carcass length, abdominal length, carcass weight, dressing percentage, bone percentage, fat percentage, fat thickness and drip loss percentage were not significantly differences among the cattle fed with CTRL, DCP50, DCP75 and DCP100 (Table 3.), respectively (P>0.05). Previous studies by Larson et al. (1993) and Lodge et al. (1997) suggest that replacing of distillers grains for cereal grains did not affect carcass characteristics. Depenbusch et al. (2009) reported that yearling heifers fed finishing diets based on steam-flaked corn containing different levels of dried corn distiller's grains with solubles (DGS) provided up to 75% did not affect on dress yield percentage. Yimmongkol et al. (2009) reported that using diets containing DCP from starch process replaced of cassava meal at 50% and up to 100% as energy source did not influence carcass weight, carcass percentage and lean percentage

Table 3. Effects of DCP as a main source of energy in the diets on carcass composition of feedlot cattle.

Item	CTRL	DCP50	DCP75	DCP100	SEM	*P*
No. of animals (heads)	5	5	5	5	-	-
Slaughtering weight (kg)	679.07	678.34	638.34	714.25	11.66	0.14
Carcass length (cm)	140.45	141.50	137.05	144.50	1.64	0.48
Abdominal length (cm)	86.40	86.45	79.55	89.00	2.19	0.49
Carcass weight (kg)	386.00	395.00	357.60	395.00	8.68	0.40
Dressing percentage	55.23	55.42	55.46	53.60	0.43	0.39
Lean percentage (%)	70.54	73.07	73.79	74.52	0.61	0.10
Bone percentage (%)	14.11	14.31	13.74	14.36	0.22	0.77
Fat percentage (%)	7.79	6.27	7.31	7.28	0.37	0.56
Fat thickness (%)	1.16	.98	1.08	1.08	0.04	0.52

Meat quality

The data showed that the chemical composition, water holding capacity, pH at 45 min, pH at 24 h, marbling score and shear force were not significantly differences among the cattle fed with CTRL, DCP50, DCP75 and DCP100 (Table 4), respectively (P>0.05). But meat color values shown b* value of control diet and DCP50 were higher than DCP100 (P<0.05). The higher yellowness may be due to xanthophylls from corn as Ghazvinian et al. (2011) reported that most of the color is from xanthophylls, and partly carotene and cryptoxanthin. Yellow corn, corn gluten meal, etc., are dietary sources of xanthophylls.

Table 4. Effects of DCP as a main source of energy in dietary on meat quality of feedlot cattle.

Item	CTRL	DCP50	DCP75	DCP100	SEM	*P*
No. of animals (heads)	5	5	5	5	-	-
Chemical composition	74.92	71.18	70.06	69.94	0.96	0.22
Moisture	22.16	22.37	22.59	22.80	0.11	0.18
Protein	4.73	4.62	5.40	6.37	0.34	0.24
Fat						
Water holding capacity	4.12	3.53	4.01	4.26	0.26	0.80
Drip loss (%)	22.05	20.43	23.13	20.31	2.70	0.30
Boiling loss (%)						
Meat colour	39.24	37.89	39.23	40.37	0.57	0.50
Lightness (L*)	17.95	18.27	16.97	15.20	0.52	0.15
Redness (a*)	10.13^{b}	9.50^{b}	9.07^{ab}	7.78^{a}	0.27	0.01
Yellowness (b*)						
$pH^{45\ min}$	6.57	6.51	6.38	6.40	0.06	0.69
$pH^{24\ h}$	5.26	5.26	5.26	5.29	0.04	0.99
Marbling score	3.5	3.4	3.6	3.6	0.16	0.97
Shear force, N	54.15	47.87	48.14	49.45	1.15	0.19

^{a,b}Means within rows with different superscripts differ significantly (P<0.05)

Economic return

The production cost of the experimental feedlot cattle was studied to determine the economic return. The feed cost/kg of gain, total production cost and carcass price of the CTRL, DCP50, DCP75 and DCP100 (Table 5), respectively were not significantly differences (P>0.05). But total feed cost indicated control diet were higher then DCP50, DCP75 and DCP100 (P<0.05).

Table 5. Effects of DCP in concentrate on economic return of feedlot cattle.

Item	CTRL	DCP50	DCP75	DCP100	SEM	*P*
No. of animals (heads)	5	5	5	5	-	-
Slaughtering weight (kg)	679.07	678.34	638.34	714.25	11.66	0.14
Carcass weight (kg)	386.00	395.00	357.60	395.00	8.68	0.40
Feed cost (Baht/kg)	7.34	7.05	6.92	6.78	-	-
Feed cost/day (Baht/day)	64.93	64.29	63.84	63.39	-	-
Breed cost (Baht)	29,109.81	29,575.48	28,751.01	29,174.70	312.40	0.85
Total feed cost (Baht)	$15,606.81^{a}$	$14,990.19^{b}$	$14,713.78^{c}$	$14,262.23^{d}$	111.77	0.00
Feed cost/kg of gain (Baht/kg)	118.38	130.35	136.20	85.99	11.08	0.41
Total production cost (Baht)	44,716.61	44,565.67	43,464.78	43,436.93	335.09	0.39
Carcass price (Baht)	52,478.99	52,216.44	50,044.30	55,847.45	1,096.09	0.33
Net income (Baht)	7,762.38	7,650.77	6,579.51	12,410.52	1,208.40	0.35

^{a,b,c,d}Means within rows with different superscripts differ significantly (P<0.05)

CONCLUSION

Growth performances of the feedlot cattle fed with concentrate by using dried cassava pulp to replace cassava meal and rice bran up to 100 percent showed no differences. Accordingly, carcass qualities, carcass composition of feedlot cattle fed with dried cassava pulp to replace cassava meal and rice bran (100%) also showed no differences. Utilization of dried cassava pulp could reduce the feed cost of fattening beef cattle.

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