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Concentrate Substituted Cassava Top Fermented Cassava Pulp in Altered Levels on Growth Performance in Thai Native X Lowline Angus Crossbred Cattle

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ABSTRACT: The main objective is to investigate the effect of DCfCaP-substitute concentrate on growth performance and feed efficiency in Thai native x Lowline Angus crossbred cattle. The average initial body weight (IBW) was assigned 97±18.5 kg and 1-year age, 12 females of Thai native x Lowline Angus crossbred cattle. Dietary treatments were designed in a completely randomized design (CRD) to receive three feeding treatments, four replications per treatment with one cow per replicate. The feeding treatments were administered as follows: T1=100% concentrate + 0% DCfCaP (control), T2=67% concentrate + 33% DCfCaP, and T3= 33% concentrate + 67% DCfCaP on dry matter basis (DM). The results indeed showed that the initial body weight (IBW) and final body weight (FBW) were non-significantly different (P>0.05). The average daily gain (ADG) in T1 and T2 was 0.53 kg/day and 0.48 kg/day, and representative superscripts were in the same row, but there were differences in T3 was 0.05 kg/day (P<0.001). T1 used feed intake higher than T2 and T3 (P=0.003). So far, the feed conversion ratio (FCR) in groups T1 and T2 were non-different except T3 (P<0.001). In conclusion, DCfCaP could substitute concentrate up to 33% in the diet without being effective in Thai native x Lowline Angus crossbred cattle. Therefore, DCfCaP is recommended because it is an alternative source of animal feed and could contribute to controlling environmental contamination. So DCfCaP is recommended to supply to cattle.

Keywords: growth performance, nutrient intake, cassava top, cassava pulp

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INTRODUCTION

Cassava is the second main crop in tropical areas, containing a high carbohydrate source (Gunawan et al., 2015). In Africa and Asia, cassava production is an alternative source for improving income (Hawashi et al., 2019). The yield from root compared tops of cassava is approximately 10 tons/ha of dry matter (DM) (Morgan and Choct, 2016), and 10.2 tons/ha according to (Wanapat, 2003). So far, crude protein (CP) in dry cassava leaves contains between 20-44%, according to (Oni et al., 2014; Li et al., 2019; Hawashi et al., 2019; Oresegun et al., 2016). It increased to 20.76-21.55% CP while fermented (Oni et al., 2014; M. Li et al., 2019). Cassava top is an indicator of improving an energy-dense diet (Thang et al., 2010), and it could enrich the nutritional value of animal feedstuffs (Morm et al., 2022). To increase cattle productivity (Faccio-Demarco et al., 2019; Morm et al., 2021), a variety of feed additives are being used, including yeast-derived products such as Saccharomyces cerevisiae, sustained for rumen health (Faccio-Demarco et al., 2019).

Cassava pulp (CaP) is a by-product that contains cassava root approximately 30% (Ghimire et al., 2015). CaP contains low protein (CP), an alternative to high starch that is an energy source (Lounglawan et al., 2011; Norrapoke et al., 2018). To boost feedstuff quality, fermented CaP with additives-enriched nutritional content (Pilajun & Wanapat, 2018; Morm et al.,2023) may reduce feed costs (Morm et al., 2023). Furthermore, used CaP did not affect feed intake, methane production, or nutrient digestibility (Norrapoke et al., 2018; Morm et al., 2023). CaP can digest up to 74.4% of nutrients and 12.9 MJ/kg DM of energy digestion while containing 11.3 MJ/kg DM in Thai natives (Keaokliang et al., 2018). Furthermore, on the other hand, it can improve the feed's nutritional value, increase gas production, and improve the dominant cellulolytic bacterial population while treating urea and molasses in 4% (Norrapoke et al., 2018). Whereas fermented cassava top with Saccharomyces cerevisiae can decline poisoning content, it can be obtained with an enzyme activity of 0.53 units per gram of dry-based substrate (U/gds) (Hawashi et al., 2019). Furthermore, CaP fermented with urea, molasses, and *Lactobacillus casei* TH14 is an indicator to promote CP, lactic acid, acetic acid, and propionic acid (Pongsub et al., 2022).

Based on our knowledge, previous studies have yet to extensively demonstrate the growth performance and nutritional efficiency of dry cassava tops fermented cassava pulp (DCfCaP) and substitute concentrate. The main objective was to investigate the effect of DCfCaP-substitute concentrate on growth performance feed efficiency in Thai native x Lowline Angus crossbred cattle.

MATERIALS AND METHODS

Animals were carried out under Ubon Ratchathani University's Animal Care and Use for Scientific Purpose Committee's guidelines based on the National Research Council of Thailand's ethical principles for using animals in science (NRCT). Approval no. MHESI0604/2565.

Animal, Dietary Treatment, And Experimental Design

The experiment was investigated at the Experimental Field and Central Laboratory (EFCL), Faculty of Agriculture, Ubon Ratchathani University, Thailand. The animals have been carefully maintained to minimize errors from pen, animals, humans, and environmental conditions. The *Manihot esculenta* Kasetsart 50 tops were allocated from a local producer in Ban Hare, Tumbon Khamkwang, Warincharab District, Ubon Ratchathani Province, Thailand. The Magnum Electric Motor (Type ml-90S2-2, Model: GS150, matched power of 3 HP, rotation speed: 2800 rpm, production efficiency ≥1000 kg/hr) was assigned to chop into 2 cm long pieces of fresh cassava top. Thus, cassava tops were sun-dried at an ambient temperature in the dry season for three days. So dry cassava tops (DCT) at 15% was proportioned to 85% of dry cassava pulp (DCS) and fermented for 21 days. 20 g of *Saccharomyces cerevisiae* was stimulated aerobically with oxygen flush and 40 g of sugar in 660 ml of tap water for 30 minutes before fermenting. Solution A. Solution B, 50 ml of molasses, and 3 g of urea were mixed well in 830 ml of tap water. All the solutions were a mixture of A and B at a 1:1 ratio (v/w) and flushed with air for one hour (Solution C), as modified by (Polyorach et al., 2014; Morm et al., 2023).

The average initial body weight (IBW) was assigned 97±18.5 kg and 1-year age, 12 females of Thai native x Lowline Agus crossbred cattle. Dietary treatments were designed in a completely randomized design (CRD) to receive three feeding treatments, four replications per treatment with one cow per replicate. The feeding treatments were administered as follows: T1=100% concentrate + 0% DCfCaP (control), T2=67% concentrate + 33% DCfCaP, and T3= 33% concentrate + 67% DCfCaP on dry matter basis (DM). Table 1 shows the ingredients and chemical composition of the concentrate and DCfCaP. The DCfCaP mixture was well mixed by the JIS C 4004 JP 22 JC machine, kept in plastic tanks in 100-litre dimensions, and placed in the dry zone to use in this study. The DCfCaP was fed 1% dry matter (DM) of body weight (BW) twice daily at 7:00 a.m. and 4:00 p.m. The mineral salt block and clean water were offered *ad libitum* to all cows. The rice straw (RS) was fed *ad libitum* daily to all cows, with 100g kg-1 refusal of total RS offered. RS and feeds were supplied simultaneously, although they were divided into two halves using buckets measuring 60 cm x 40 cm, RS feeding stock and 40 cm x 30 cm for feeding. The cows were placed in individual pens (4 x 2.5 m) equipped with iron walls and a concrete floor. During the adaption, the cows were given Ivermectin at 1% w/v, 1 ml/50 kg BW, and Vitamin AD3E at 1 ml/50 kg.

Growth Performance, Feed Intake And Sample Collection

Growth Performance

The average daily gain (ADG) was determined using the IBW and final weight (FW). According to the Kleiber ratio (Kleiber, 1947), the BW gain for the study was estimated from the ratio of BW gain to mid-point kg $BW^{0.75}$ (Kelly et al., 2011). The feed conversion ratio (FCR) was computed as total DMI proportioned by total WB gain through the trial.

Feed Intake And Sample Collection

Before experimenting, the cows were adapted in their pens for seven days to familiarize them with their living, environmental conditions, feed provider, flavour, and palatability, 21 days of the last experiment with a test feeding regimen for 14 days, and the last seven days for sample collection. At the beginning of the experiment, cows were weighed to adjust feed dry matter intake (DMI) before supplying feed. RS, concentrate, and concentrate mixed DCfCaP were provided separately dietary to all animals. During the last seven days of the 21-day experiment, feed offered and refusal, including RS, concentrate, and concentrate mixed DCfCaP, were recorded daily.

Statical Analysis

The UNIVARIATE was tested on all data for normal distribution. The results were analyzed using a one-way ANOVA in a completely randomized design (CRD) in the Statistical Package for the Social Sciences (SPSS, version 21.0, Chicago, USA. The effects were considered significant at $P<0.05$, and trends or tendencies at $0.05<P<0.10$. The dietary treatment means were compared using the Duncan Multiple Ranging Test (DMRT). All the means were described by the standard error of the mean (means±SEM).

RESULTS AND DISCUSSION

Chemical Composition in Concentrate, DCfCaP, and RS

Table 1 presents the chemical composition content of concentrate, DCfCaP, and RS. The concentrated group contained high soybean meal (SBM) at 14%, 2% urea, 41% cassava chip, 14% palm kernel meal, and 5% molasses. These ingredients provided a high-nutrient and energy-dense diet. Separately, DCFCaP also contained a high proportion of 76.4% CaP, 15% dry cassava top (DCT), 0.2% *S. cerevisiae*, 3% urea, and 5% molasses. These nutrients improve dry matter intake (DMI) and increase growth performance. The chemical contents in the concentrate contain 15.09% CP, 28.52% NDF, 12.47 % ADF, and 4.57% EE. Separately, the DCfCaP diet content is 10.26% CP, 49.26 % NDF, 37.21 % ADF, and 1.13% EE.

Table 1. Chemical composition of concentrate, DCfCaP, and RS

Items	Concentrate	DCfCaP	RS
Ingredients, % DM			
Cassava pulp	-	76.4	-
Dry cassava leaf	-	15.0	-
Cassava chip	41.0	-	-
Soybean meal	14.0	-	-
Palm kernel meal	9.0	-	-
Corn meal	13.5	-	-
S. cervisiae	-	0.2	-
Rice brand	13.0	-	-
Urea	2.0	3.0	-
Molasses	5.0	5.0	-
Sugar	-	0.4	-
Salt	0.5	-	-
Sulfur	1.0	-	-
Monodicalcium phosphate ($Ca \geq 14\%$, $P \geq 21\%$)	0.5	-	-
Mineral premix	0.5	-	-
Chemical composition, % DM			
Dry matter	96.04	38.10	85.42
Ash	5.97	7.21	10.43
Organic matter	94.03	92.78	89.57
Crude protein	15.09	10.26	4.06
Netrual detergen fiber	28.52	49.26	72.34
Acid detergent fiber	12.47	37.21	57.77
Ether extract	4.57	1.13	1.40

Note: RS, rice straw; DCfFCaP= dried cassava top fermented cassava pulp; P, phosphorus; Ca, calcium, G, gram; kg, kilogram; DM, dry matter

Animal Growth Performance Characteristics and Dry Matter Intake of Thai Native x Lowline Angus Crossbred Cattle

The growth performance characteristics of Thai native x Lowline Angus crossbred cattle fed on dietary treatments with T1, T2, and T3 are elucidated in Table 2. The results certainly showed that the initial body weight (IBW) and final body weight (FBW) were non-significantly different ($P>0.05$). The average daily gain (ADG) in T1 and T2 was 0.53 kg/day and 0.48 kg/day, and representative superscripts were in the same row, but there were differences in T3 0.05 kg/day ($P<0.001$). T1 consumed bigger than T2 and ($P=0.003$). So far, the feed conversion ratio (FCR) in groups T1 and T2 were non-different except T3 ($P<0.001$). The DM intake in g/kg WB0.75 was significantly different ($P<0.05$); T1 used a larger feed amount than group T2 and T3.

Table 2. Effect of concentrate proportioned with dry cassava tops fermented cassava pulp (DCfCaP) on growth performance and feed utilization in Thai native x Lowline Angus crossbred cattle.

Variable	T1	T2	T3	SEM	P-value
Initial weight, kg/head	107	94.50	90.25	5.22	0.44
Final weight, kg/head	114.50	101.25	91.00	5.60	0.23
Average daily gain, kg/head	0.53^a	0.48^a	0.05^b	0.06	<0.001
Feed conversion ratio					
FCR	6.71^a	7.39^a	54.03^b	4.73	<0.001
Total intake					
kg/d	3.19^a	2.33^b	2.12^b	0.18	0.003
%BW	2.91^a	2.34^b	2.15^b	0.12	0.005
g/kg $WB^{0.75}$	93.27^a	75.19^b	68.31^b	5.60	0.001
Dry matter intake					
Concentrate: Concentrate with dry fermented cassava pulp					
kg/d	1.18	1.45	1.16	0.07	0.15
%BW	1.06^c	1.49^a	1.30^b	0.05	<0.001
g/kg $WB^{0.75}$	35.35^c	47.94^a	39.94^b	1.65	<0.001
Rice straw					
kg/d	2.01^a	0.80^b	0.79^b	0.18	<0.001
%BW	1.85^a	0.80^b	0.79^b	0.16	<0.001
g/kg $WB^{0.75}$	61.29^a	27.26^b	26.49^b	5.20	<0.001

Note: T1, 100% concentrate + 0% DCfCaP (control); T2, 67% concentrate + 33% DCfCaP; T3, 33% concentrate + 67% DCfCaP; $^{a-c}$ Values on the same row with different superscripts differ (P<0.05); SEM, standard error mean

Chemical Composition And Feed Ingredients

The current study revealed that nutrient contents in DCfCaP contained less, but the concentrated chemical composition was better than (Sommai et al., 2020). The nutrient contents from the concentrate or DCfCaP were altered due to their concentration, time of incubation, practical practices, climatic zone, and type of yeast supplementation or activation (Boonnop et al., 2009).

Animal Growth Performance Characteristics

Current studies for T1, T2, and T3 resulted in DMI of 3.19, 2.33, and 2.12 kg/day, which were a small number of intakes (Desnoyers et al., 2008; Jiang et al., 2022) found that increasing concentration between 30 and 60% could improve DMI by 5.3-5.63 kg/day. High levels of concentrate in the diet of ruminants were affecting fermentation and could be related to the low rumen fill effect of concentrate. A high proportion of concentrates with roughage might contribute to increasing ADG due to increasing feed intake, which can improve ruminant production efficiency (Brown et al., 2006). This current study revealed that group T1 and T2 diet was effective in energy intake and growth performance. Still, this was unsupported by (Keaokliang et al., 2018), which supplied 70.2% concentrate and 29.8% CS in the diet. According to (Khejornsart et al., 2022), CS added to fermented total mixed rations increased tropical sheep's nutrient utilization, rumen ecology, and microbial protein synthesis in 21 days were increased.

Dry Matter Intake

The results agreed (Cherdthong and Supapong, 2019; Sommai et al., 2020) that cows' highly concentrated diet elucidated significantly increased intake. Still, it was not similar to (Dagaew et al., 2022); Roughage 30 and Concentrate 70% can improve bacterial population and nutrient digestibility because they contain more available energy. The high concentration could be obtained effectively because it provided additional nutrients by enhancing rumen fermentation and microbial growth (Phesatcha et al., 2022). Furthermore, activating polysaccharides and glycosidase hydrolase enzymes in yeast can improve the disappearance of ruminants (Chuelong et al., 2011). Whereas the urea contained in the solution might cause a breakdown of the fibre structure in Ca, P, it acts as an alkaline substance (ammonium hydroxide) (Suriyapha et al., 2021). This current study agreed with (Khejornsart et al., 2022), who conducted a 21-day experiment and found that CaP added to fermented mixed total rations in sheep was well intake (Keaokliang et al., 2018).

CONCLUSION

The T1 or T2 was better for dry matter feed intake, growth performance, and FCR than T3. In conclusion, DCfCaP could substitute concentrate up to 33% in the diet without being effective in Thai native x Lowline Angus crossbred cattle. Therefore, CtFCaP is recommended because it is an alternative source of animal feed and could contribute to controlling environmental contamination.

SUGGESTION

Based on the results, the DCfCaP is beneficial for ruminant feedstuffs, so the author suggested that DCfCaP should supply ruminants with a longer time to evaluate feed quality. Whereas DCfCaP could substitute concentrate up to 33% in the diet was recommended.

Conflict of interest

The authors declare that there are no conflicts of interest.

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