EFFECTS OF GLYCERIN IN CONCENTRATED FEED ON CARCASS CHARECTERISTICS OF ANGUS CROSSBRED CATTLE

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Abstract – The aim of this study was to evaluate effects of glycerin in concentrated feed on carcass characteristics and meat quality in castrated Angus crossbred steers. Twenty-four steers of 396.71±37.58 kg body weight were randomly assigned to 4 groups. The treatments of replacing dried cassava chips with 99.5 % glycerin to the diet were Gr. 1: without glycerin; Gr. 2: 5% glycerin; Gr. 3: 10% glycerin; and Gr. 4: 15% glycerin in the diets on a DM basis. The steers were kept in a feedlot for 210 days and slaughtered at average weight of 569.44 ± 59.18 kg. Glycerin in the diets did not affected (p>0.05) average daily gain (ADG). In ultrasound evaluation, glycerin in the diets did not (p>0.05) affected rib eye area (UREA) and subcutaneous fat thickness at rump (URMPFT) after 3, 5 and 7 months of treatment. Only 5% glycerin in the diets affected intramuscular fat (IMF) after 3 months of treatment as well as subcutaneous fat thickness over the 12th rib (URIBFT) was affected (p<0.05) after 5 months of 15% glycerin treatment. Carcass traits showed similar results of the ultrasound evaluation. Glycerin in the diets did not (p>0.05) affected CREA, beef marbling score (BMS), CRMPFT and shear force value. Only CRIBFT was affected (p<0.05) by 15% glycerin treatment. Results of meat quality traits showed 10% glycerin in the diets affected significantly (p<0.01) decreasing of meat color in lightness (L*) and significantly (p<0.05) in redness (a*) of rib eye muscle. Thawing loss and drip loss were not affected (p>0.05) by glycerin treatment. The results of this study indicated that 5% glycerin in concentrated feed could increase percent intramuscular fat in fattening Angus crossbred steers.

Key Words – carcass, glycerin, meat quality

I. INTRODUCTION

Crude glycerin is a major co-product of biodiesel production, derived from the agricultural industry, as potential food supply that can meet the need for alternative ingredients sources. The glycerol (synonym: glycerin, 1,2,3-propanetriol) is an organic compound belonging to the alcohol function (C3H8O3), liquid at room temperature (25°C), hygroscopic, odorless, viscous and sweet taste [1], with a net energy concentration of 1.98 – 2.29 Mcal/kg, approximately equal to the energy contained in corn starch [2]. The expansion of the biodiesel industry has led to increased stocks of glycerol with a subsequent price reduction that has provided prospects for the use of glycerol as a feed additive for livestock. Initially, glycerol was used as a treatment for metabolic disorders around parturition, e.g. ketosis [3], in order to increase the supply of glucose and improve the metabolic status, by acting as a substrate for gluconeogenesis [4]. In recent years, glycerin is widely reported to be a viable energy source for cattle [5; 6; 7]. Our hypothesis is that glycerin improves carcass characteristics and the meat quality without compromising. The aim of this study was to evaluate the effects of glycerin in concentrated feed on carcass characteristics and meat quality of castrated Angus crossbred cattle in a feedlot with different levels of glycerin in the diets.

II. MATERIALS AND METHODS

Animals

Twenty-four of castrated 75% Angus x native crossbred steers (396.7 ± 37.6 kg) were grouped by body weight. Four groups (6 steers per group) were fed 0, 5, 10 and 15% of glycerin in diet, respectively and kept in finishing feedlot.

Animal feeds

Replacing cassava chips with 0, 5, 10, or 15 % of 99.5 % glycerin (Table 1) were formulated to meet or exceed the requirements of a finishing cattle. Based on these data, soybean, wheat bran as the primary CP source were formulated to meet 14.34 % of CP requirements.

Table 1 Composition of animal feeds (kg) and percentage of glycerin replacement in cassava chips using in this study

Ingredients (kg)	Glycerin replacement (%)			
	0	5	10	15
Soybean	130	130	130	130
Cassava chips	530	480	430	380
Glycerin	0	50	100	150
Wheat bran	100	100	100	100
Palm kernel cake	100	100	100	100
Leucaena leaf meal	50	50	50	50
Molasses	60	60	60	60
Urea	15	15	15	15
Sea salt	3	3	3	3
Sulfur powders	1.25	1.25	1.25	1.25
Dicalcium phosphate	5	5	5	5
Premix	5	5	5	5

The animals were fed with 2 % BW of concentrated diets. Pangola (*Digitaria eriantha*) hay were given for ad libitum consumption, twice daily at 0800 and 1600 h with free access to water. The duration of fattening was 210 days (September 2013 to March 2014). The average final BW was 569.4 ± 59.2 kg (2.6 ± 0.3 yr.).

Real-time ultrasound measurements for carcass traits

The steers used in this experiment had both ultrasound and carcass data. Steers were scanned according to Ultrasound Guidelines Council (UGC). A Aloka SSD-500 with a 3.5 MHz, 17 cm probe was used to collect images on all animals. The images were analyzed and interpreted by Ultrasound Image Capture System (UICS) software version 2.0.162 developed by Walter & Associates, L.L.C. Ultrasound measurements were ribeye area at 12th rib (UREA), fat thickness at 12th rib (URIBFT), percent intramuscular fat (IMF) and rump fat thickness (URMPFT).

Carcass characteristics

Carcass measurements were performed after 14 days of ageing as carcass ribeye area (CREA), carcass 12th rib fat thickness (CRIBFT), carcass rump fat thickness (URMPFT) and beef marbling scores (BMS). Marbling scores were predicted by a new AUS-MEAT marbling chips (0 – 9). Samples of ribeye steaks at 12th rib were performed shear force measurement by Instron 5565, 100 N tension with gram value.

Meat characteristics

Samples of ribeye steaks at 12th rib were performed meat color in lightness (L*), redness (a*) and yellowness (b*) on the exposed cut surface of the muscle using Minolta Chroma Miter (CR-300, Osaka). Total liquid losses during meat thawing and cooking as thawing loss and drip loss were measured by the method of [8].

Statistical analysis

The different of mean values in each group were performed by analysis of variance (ANOVA) from summary data and post hoc tests using Tukey's honestly significant difference (HSD) via www.statpages.info.

III. RESULTS AND DISCUSSION

Average daily gain (ADG)

Average daily gain in each group were not different (p>0.05) after 1-3 months of treatment (Table 2).

Table 2 Mean ± SD of ADG after 1-3 months of treatment

	Mean ± SD of ADG (kg/d)				
	Gr.1	Gr.2	Gr.3	Gr.4	*p*
1 mt.	1.27±0.47	1.76±0.45	1.76±0.51	1.46±0.58	0.282
2 mt.	0.89±0.36	1.06±0.33	0.63±0.27	0.96±0.32	0.152
3 mt.	1.17±0.27	1.22±0.24	1.29±0.27	0.97±0.40	0.319

In contrast, feeding glycerin to finishing heifers [9], average daily gains increased for cattle fed 2 to 8%

glycerin, but at 12 and 16% glycerin, ADG were also reduced.

Carcass characteristics by real-time ultrasound measurements

In table 3, glycerin in the diets did not (p>0.05) affect ribeye area (UREA) and subcutaneous fat thickness at rump (URMPFT) after 3, 5 and 7 months of treatment. Only subcutaneous fat thickness over the 12th rib (URIBFT) was decreased significantly (p<0.05) after 7 months of 15% glycerin treatment as well as intramuscular fat (IMF) was decreased significantly (p<0.05) after 3 months of 10% glycerin treatment.

Table 3 Mean ± SD of live carcass characteristics by real-time ultrasound measurement after 1-7 months of treatment

Traits	Mean ± SD				*p*
	Gr. 1	Gr. 2	Gr. 3	Gr. 4	
Ribeye area (UREA), inch²					
1 mt	9.82±2.21	9.15±1.57	10.15±1.29	9.16±0.77	0.611
3 mt	11.81±0.86	11.81±.0.86	12.89±.0.68	11.72±0.98	0.084
5 mt	13.24±0.15	13.71±1.35	13.71±1.06	13.73±1.67	0.869
7 mt	12.81±1.70	12.53±0.81	14.56±1.56	13.16±2.28	0.191
Intramuscular fat (IMF), %					
1 mt	3.09±0.62	3.01±0.14	2.82±0.59	2.78±0.94	0.807
3 mt	3.87±0.50	4.22±.0.38ᵃ	3.48±.0.37ᵇ	3.93±0.35	0.038
5 mt	4.46±0.52	4.39±0.95	4.24±0.56	4.02±1.10	0.799
7 mt	3.89±1.40	4.49±0.97	4.05±0.62	4.06±0.67	0.737
Subcutaneous fat thickness over the 12th rib (URIBFT), inch					
1 mt	0.15±0.02	0.14±0.02	0.15±0.01	0.14±0.01	0.508
3 mt	0.22±0.05	0.26±.0.10	0.26±0.10	0.19±0.04	0.352
5 mt	0.48±0.12ᵃ	0.42±0.14ᵃ	0.40±0.07ᵃ	0.29±0.07ᵇ	0.036
7 mt	0.36±0.09	0.37±0.13	0.36±0.10	0.31±0.14	0.809
Subcutaneous fat thickness at rump (URMPFT), inch					
1 mt	0.14±0.05	0.12±0.04	0.11±0.03	0.12±0.03	0.596
3 mt	0.24±0.04	0.31±.0.12	0.22±.0.07	0.23±0.03	0.173
5 mt	0.33±0.12	0.30±0.07	0.30±0.13	0.32±0.07	0.940
7 mt	0.31±0.10	0.30±0.10	0.31±0.09	0.32±0.15	0.992

Remark: Means within a horizontal line followed by different letters differ statistically difference (a, b = p<0.05).

Carcass and meat characteristics

In table 4, glycerin in the diets did not (p>0.05) affect CREA, beef marbling score (BMS), CRMPFT and shear force value. Only CRIBFT was decreased significantly (p<0.01) by 15% glycerin treatment. Results of meat quality traits showed that meat color on rib eye muscle were decreased significantly (p<0.01) on lightness (L*) and significantly (p<0.05) on redness (a*) in 10 % glycerin treatment. Thawing loss and drip loss were not affected (p>0.05) by glycerin treatment.

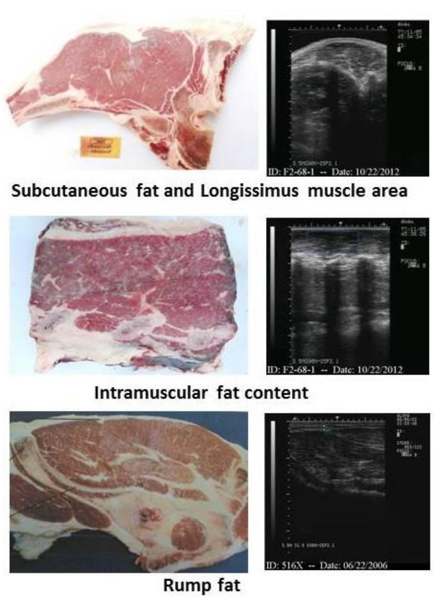
Table 4 Mean ± SD of carcass and meat characteristics

Traits	Mean ± SD				*p*
	Gr. 1	Gr. 2	Gr. 3	Gr. 4	
Ribeye area (CREA), inch²					
	11.85±2.11	10.45±0.71	11.78±1.33	11.81±2.76	0.520
Beef marbling score (BMS), 0-9					
	4.00±0.76	4.17±.0.69	3.41±.1.02	4.00±0.58	0.374
Subcutaneous fat thickness over the 12th rib (CRIBFT), inch					
	0.48±0.09ᵃ	0.52±0.15ᶜ	0.48±0.17ᵃ	0.18±0.18ᵇ,ᵈ	0.003
Subcutaneous fat thickness at rump (CRMPFT), inch					
	0.33±0.20	0.37±0.20	0.46±0.27	0.41±0.28	0.810
Shear force value, gm					
	5293.97 ±1225.80	6858.98 ±1574.59	5586.48 ±778.66	5304.70 ±1658.99	0.177
Color value					
L*	13.94±1.84ᶜ	11.05±2.16	7.71±2.55ᵈ	10.28±3.40	0.004
a*	6.58±1.80ᵃ	5.68±1.01	3.91±1.28ᵇ	5.22±1.70	0.039
b*	4.38±1.80	4.18±1.90	5.57±2.53	7.43±3.38	0.124
Thawing loss, %					
	6.90±1.74	7.04±1.67	6.95±2.87	4.56±1.11	0.112
Drip loss, %					
	2.56±0.98	3.18±1.21	3.93±1.70	3.28±1.46	0.407

Means within a horizontal line followed by different letters differ statistically difference (a, b = p<0.05; c, d = p<0.01).

Because beef muscle color affects consumers purchasing decisions and is a factor in determining meat grades, and has been shown to be useful in sorting carcasses according to palatability, this study was conducted to determine the effects of measurement conditions on L*, a*, and b* values. The main advantage of the L* categorization system over the b* system is that the L* value was less sensitive to bloom time, and the main advantage of the b* categorization system over the L* system is that the b* system was slightly more precise at segregating carcasses based upon corresponding differences in muscle pH. The USDA quality grade characteristics in color system are 38.3±3.2, 9.7±2.3 in L* and b* value, respectively [10]. In this study, the meat color ranged from 7.71 to 13.94 in L* and 3.91 to 6.58 in a*.

Figure 1. Photography showing ribeye muscle (*Longissimus dorsi*) at 12-13th rib and rump muscles for ultrasound image capture



IV. CONCLUSION

Replacement of cassava chips in concentrated feed with 5-15 % of 99.5 % glycerin did not affect REA, BMS, RMPFT and shear force value. However, 5% glycerin in concentrated feed could increase percent intramuscular fat in fattening Angus crossbred steers in 3 months after treatment.

ACKNOWLEDGEMENTS

This research work was supported by government budgets in 2013-2014 fiscal years. The author would to Dr. Amphol Warititham, Director of Livestock Industry Center, Chiangmai for analysis of carcass and meat quality.

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