Comparison of Fatty Acid Composition Between White Lamphun and Brahman Crossbred Cattle Raised with Fresh Pangola Grass

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ABSTRACT

The objective was to compare fatty acid composition of beef Longissimus muscle of White Lamphun and 50% Brahman crossbred raised with fresh Pangola grass. The experiment comprised of each 8 equally White Lamphun and Brahman crossbred steers. The average initial weights were 120-140 kg. They were fed ad libitum with Pangola grass which was cut every 40-50 days. The final slaughter weights were of 275-320 kg, Longissimus dorsi muscle was taken for fatty acid analysis. White Lamphun had a greater fatty acid composition of C15:0, C18:0 and C20:5 n-3 (EPA) (P<0.05) when compared to Brahman crossbred. But polyunsaturated fatty acid (PUFA) : saturated fatty acid (SFA) ratio was not significantly different. It was also found conjugated linoleic acid (CLA) in beef (P>0.05) of both cattle breeds. Therefore, the promotion grass fed beef could be an alternative for customer who have health concerns and moreover reduce production costs for farmers.

Key words: Beef quality, Fatty acid, White Lamphun, Brahman crossbred, Pangola

INTRODUCTION

Currently, there is interested in reducing the amount of grains and increasing the amount of forages fed to beef cattle due to the world need grain for human food. Grass-fed beef tend to be much lower in total fat than grain-fedbeef. Grass-fed animals have more omega-3s than those of grain-fed animals because omega-3s are formed in the green leaves. Previous research has shown that forage-finished cattle produce beef with more CLA and n-3 fatty acids compared with grain-finished beef (French et al., 2000) which has been shown to improve health benefits (Bhattacharya et al., 2006; Huth, 2007). Whereas, some SFA increase serum cholesterol levels (Groff and Gropper, 1999). Each day, animals raised in the feedlot diminish omega-3s (Duckett et al., 1993). There has been increased in demand for natural meat products, such as grass-fed beef, partially as a result of consumer interest in the fat content of foods.

MATERAILS AND METHODS

Experimental pastures

The roughage used was Pangola grass (*Digitaria decumbens*). This grass is excellent in pasture, as it remains green and grows throughout alternate wet-dry seasons in the dry tropical. The test sites were rain-fed in the rainy seasons and irrigated in the dry seasons. The pasture was given 10

kg/rai of urea and 10 kg/rai of 16-16-8 fertilizer, at intervals of 15 days and then repeated the same cycle. Cut and carry forage system was applied for cattle. The fatty acid composition of Pangola grass are shown in Table 1.

Table 1. Fatty acid compositions (as percentage of the total fatty acids) of Pangola grass.

Criteria	Pangola grass
Fatty acid, % of total fatty acids	
C14:0	7.17
C15:0	1.41
C16:0	30.3
C16:1	1.72
C18:0	24.5
C18:1	22.5
C18:2n6c	0.67
C18:2n6t	1.47
C18:3n6	2.23
C18:3n3	6.67
C18:2c9t11(CLA)	0.43
C20:0	1.01
SFA	64.4
MUFA	24.2
PUFA	11.5
PUFA:SFA	0.18
n6	4.36
n3	6.67
n6:n3	0.65

CLA = conjugated linoleic acid (cis 18:2 cis-9, trans-11), SFA = saturated fatty acid, MUFA = monounsaturated fatty acid, PUFA = polyunsaturated fatty acid, n3 = omega-3 fatty acids and n6 = omega-6 fatty acids

Raising and slaughter procedures

Sixteen steer calves were obtained from the Chai Nat Animal Nutrition and Development Center, Department of Livestock Development (DLD), Chai Nat, Thailand. Steers were divided into two equal groups, by breed as White Lamphun and Brahman Crossbred. They were penned individually and fed *ad libitum* with Pangola grass. At average weight of 350 kg, they were slaughtered at the Meat Science Research Center, Kasetsart University, Nakhon Pathom, Thailand, following procedures outlined by Jaturasitha (2004). All experimental procedures were carried out following the animal welfare standards of Department of the Livestock Development, Ministry of Agriculture and Cooperative, Royal Thai Government. *Longissimus* muscle (LD) between the 11^{th} to 12^{th} rib was removed in order to analyze fatty acid composition.

Laboratory analyses

Fatty acids in meat samples were extracted by a mixture of chloroform/methanol (Folch et al., 1957). Fatty acid methyl esters were prepared according to Morrison and Smith (1964). Gas chromatographic analysis was accomplished with model GC-14B of Shimadzu (Kyoto, Japan) equipped with a 0.25 mm × 30 m × 0.25 μm wall-coated fused wax capillary column. The carrier gas was nitrogen. Oven temperature programming was an increase from 50 to 220 °C at a rate of 10 °C/min, held for 35 min, up from 200 to 230 °C at a rate of 5 °C/min and then held at 230 °C for 20 min. The injector and detector temperature was 250 °C. Chromatograms were processed using the Millennium 2010 Chromatography Manager (Millipore Corp., Milford, Massachusetts, USA).

Statistical analysis

The differences of LD fatty acid composition in breed between White Lamphun and Brahman crossbred cattle were studied using means compared the analysis of Student's *t*-tests. Treatment differences were tested for significance at the 5% level. All the calculations were performed with SAS version 6.12 (SAS, 1996)

RESULTS

This experiment was to determine the fatty acid composition and CLA concentration in *Longissimus dorsi* of White Lamphun and Brahman crossbred cattle fed with Pangola grass shown in Table 2. Fatty acid composition was reported including saturated fatty acid (SFA) such as lauric acid (C12:0), myristic acid (C14:0), pentadecanoic acid (C15:0), palmitic acid (C16:0), heptadecanoic acid (C17:0), stearic acid (C18:0) and docosanoic acid (C22:0). For unsaturated fatty acids (UFA) divided into monounsaturated fatty acids (MUFA) including; myristoleic acid (C14:1), palmitoleic acid (C16:1), heptadecenoic acid (C17:1), oleic acid (C18:1 n-9) and polyunsaturated fatty acids (PUFA) comprising omega-3 (n-3 PUFA); α- linolenic acid (C18:3 n-3), eicosapentaenoic acid (C20:5 n-3), docosahexaenoic acid (C22:6 n-3) and omega-6 (n-6 PUFA); linoleic acid (C18:2 n-6), eicosatrienoic acid (C20:3 n-6), arachidonic acid (C20:4 n-6). Furthermore, there was conjugated linoleic acid (CLA; C18:2 cis-9, trans-11) in beef ($P>0.05$) of both cattle breeds. White Lamphun had a higher fatty acid composition of C15:0, C18:0 and C20:5 n-3 (EPA) ($P<0.05$) when compared to Brahman crossbred (0.62 vs. 0.49%, 22.6 vs. 20.2% and 1.62 vs. 1.45%; respectively). But polyunsaturated fatty acid (PUFA): saturated fatty acid (SFA) ratio was not significantly different.

DISSCUSSION

Breed affected the composition of saturated fatty acids. The content of C15:0, C18:0 and C20:5 n-3 (EPA) was significantly higher in White Lamphun' LD. But other fatty acids were not significantly different. This effect resulted from diet found that high fatty acid in C16:0 which related in meat shown in Table 1. Breed differences reported in the literature are often confounded by differences in fatness. Several authors made corrections for the effect of fatness by including it as a covariate in the statistical analyses or compared breeds at similar carcass fat levels however breed has no effects on most fatty acid profile in agreement with a review by De Smet et al. (2004). Choi et al. (2000) reported significantly higher proportions of C18:3n-3 in triacylglycerols and phospholipids and higher proportions of C20:5n-3 and C22:5n-3 in phospholipids of Welsh Black compared with Holstein Friesians, resulting in a lower n-6/n-3 ratio in Welsh Black. The content of C20:5n-3 was also significantly higher in phospholipids of Welsh Blacks, but this study there were no differences in the contents of C18:3n-3 and C22:6n-3. It was probably this study use *Bos indicus* of both cattle breeds. Muchenje et al. (2009) reported that there were no ($P>0.05$) breed effects on levels of most fatty acids. There were significant breed effects on heptadecenoic acid (HA, C17:1n-10) and docosahexaenoic acid (DHA, C22: 6n-3). The cis-9, trans-11 CLA levels among the two breeds were similar ($P>0.05$) and agreed with those reported by Muchenje et al. (2009) beef from three cattle breeds raised on natural pasture. UK Department of Health (1994) recommends the PUFA: SFA ratio of 0.45 for the diet that must be beneficial to health. The PUFA: SFA ratios in this study was lower than that recommendation (0.28 and 0.26 for White Lamphun and Brahman crossbred respectively) which shows that grass-fed beef can contribute to a healthy diet. These were considerably higher than those reported by Ruiz et al. (2005) in bulls (0.25) in comparison to steers (0.16) under grass-based production systems. The n-6: n-3 fatty acid ratio should ideally be below 4.0 according to medical authorities reported by Department of Health (1994). The low ratio of n-6: n-3 fatty acid ratio observed in this study could be due to the fact that the cattle raised with grass. According to Raes et al. (2003) reported that the cattle relied on grass resulted in high levels of C18:3n-3. The n-6:n-3 ratio was consistently below 1.3 in silage-fed steers and from 9 to 16 in those fed concentrate (Warren et al., 2008). The low ratio of n-6: n-3 are desirable for beef

consumers' health reasons (Department of Health, 1994). The ratio of n-6 and n-3 fatty acids have important roles in reducing the risk of coronary heart disease (Wijendran and Hayes, 2004).

Table 2. Fatty acid compositions (as percentage of the total fatty acids) of *Longissimus dorsi* of beef cattle fed with Pangola grass.

Criteria	White Lamphun	Brahman crossbred	SEM[1]	*P*-value
Fatty acid, % of total fatty acids				
C12:0	0.25	0.34	0.168	0.814
C14:0	3.10	3.51	0.256	0.455
C14:1	0.62	0.61	0.058	0.876
C15:0	0.62	0.49	0.030	0.005
C16:0	22.2	23.0	0.691	0.570
C16:1	2.32	2.51	0.198	0.521
C17:0	1.41	1.5	0.137	0.816
C17:1	1.05	1.25	0.130	0.357
C18:0	22.6	20.2	0.656	0.021
C18:1 n-9	31.9	31.4	0.779	0.513
C18:2 n-6	5.44	5.61	0.280	0.697
C18:3 n-3	2.65	2.57	0.069	0.486
CLA	1.09	0.98	0.070	0.276
C20:3 n-6	0.43	0.36	0.034	0.208
C20:4 n-6	1.77	1.68	0.107	0.596
C20:5 n-3 (EPA)	1.62	1.45	0.044	0.010
C22:0	0.66	0.75	0.048	0.192
C22:6 n:3 (DHA)	0.87	0.80	0.045	0.281
SFA	50.2	50.8	0.922	0.286
MUFA	35.9	35.8	0.693	0.538
PUFA	13.9	13.4	0.446	0.220
PUFA:SFA	0.28	0.26	0.013	0.282
Total n-6	7.64	7.65	0.437	0.492
Total n-3	5.14	4.82	0.121	0.071
n-6: n-3	1.49	1.59	0.133	0.751

[1]Standard error of the means

CLA = conjugated linoleic acid (cis 18:2 cis-9, trans-11), SFA = saturated fatty acid, MUFA = monounsaturated fatty acid, PUFA = polyunsaturated fatty acid, n3 = omega-3 fatty acids and n6 = omega-6 fatty acids

CONCLUSION

White Lamphun had a greater fatty acid composition of C15:0, C18:0 and C20:5 n-3 (EPA) ($P<0.05$) when compared to Brahman crossbred. But polyunsaturated fatty acid (PUFA): saturated fatty acid (SFA) ratio was not significantly different. It was also found conjugated linoleic acid (CLA) in beef ($P>0.05$) of both cattle breeds.

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