

EFFECT OF FAT SOURCES ON CARCASS CHARACTERISTICS AND FATTY ACID DEPOSITON IN LONGISSIMUS DORSI MUSCLE OF GOATS

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ABSTRACT-The objective of present experiment was aimed to investigate the effect of fat sources on carcass characteristics and fatty acid deposition in longissimus dorsi muscle. Twenty-four male crossbred Anglonubian goats were used in randomized complete block design. Treatments were tallow, soybean oil, sunflower oil and linseed oil supplementation in total mixed ration. The experiment lasted for 90 days. It was demonstrated that final body weight was not significantly different among treatments. Percentage of hot carcass was 46.02, 44.80, 45.60 and 48.29 in meat of goats fed tallow, soybean oil, sunflower oil and linseed oil, respectively. The hot carcass weight was 11.86, 9.97, 10.16 and 10.06 kg meat of goats fed tallow, soybean oil, sunflower oil and linseed oil, respectively. Chemical composition of meat such as dry matter, crude protein, total fat, calcium and phosphorus contents were not significantly different among treatments. The shear force value of longissimus dorsi muscle was 63.33, 66.18, 70.13 and 66.90 N in

meat of goats fed tallow, soybean oil, sunflower oil and linseed oil, respectively. Loin eye area (LEA) of longissimus dorsi muscle was 5.89, 6.88, 9.59 and 7.36 cm² in meat of goats fed tallow, soybean oil, sunflower oil and linseed oil, respectively ($P < 0.05$). There were no significant difference in brightness (L^*) and yellowness (b^*). It is clearly shown that inclusion of unsaturated fats reduced redness (a^*) when compared with saturated fat (tallow). Supplementation of soybean oil, sunflower oil and linseed oil were increased PUFAs content and C18:2c9,t11 in longissimus dorsi muscle. In conclusion, supplementation of unsaturated fats can be increased PUFAs content and C18:2c9,t11 in the muscle of goats.

Key words- Oil, Carcass characteristic, fatty acid deposition, longissimus dorsi muscle

I. INTRODUCTION

There is increasing interest in supplementation of unsaturated fats in ruminant diets owing to the attempt to increase the content of cis-9, trans-11 conjugated fatty acid (c9,t11-CLA) in meat and milk. Vegetable oils such as soybean oil, sunflower oil and linseed oil are introduced in ruminant diets which aim to increase the content of polyunsaturated fatty acid in ruminant products. However, the polyunsaturated fatty acids in those oils are pass into the process of biohydrogenation, which modify the unsaturated form to saturated form particular C18:0. Casutt et al. [1] compared three oils (sunflower oil, rapeseed oil and linseed oil) found that CLA in subcutaneous fat were 7.8, 5.5, 4.6 and 5.6 mg/d FAME in sunflower oil, linseed oil, rapeseed oil and control, respectively. In addition, Santos-Silva et al. [2] who reported that lamb fed fresh grass with sunflower seed increases CLA in longissimus thoracis from 4.1 to 7.0 mg/g fatty acids. Furthermore, supplementation of soybean oil slightly increased

CLA proportion in the intramuscular fat and subcutaneous fat of sheep [3]. The objective of present experiment was to investigate the effect of fat sources (tallow, soybean oil, sunflower oil and linseed oil) on carcass characteristics and fatty acid deposition in longissimus dorsi and adipose tissue of goats.

II. MATERIALS AND METHODS

GOAT, DIET AND MANAGEMENT

Twenty-four male crossbred Anglonubian, BW 13 ± 1.5 kg and age 4-5 months, were used in a randomized complete block design. Treatments were tallow, soybean oil, sunflower oil and linseed oil at 5.0% in total mixed ration (TMR). TMR was fed ad libitum and water was freely accessed. Goats were housed in individual pens. The goats were weighed weekly until the end of the experiment which lasted 90 days.

SAMPLE COLLECTION AND ANALYSIS

Feed intake was daily measured and feed refusal was recorded. Feed samples were collected weekly and pooled per week. At the end of experiment (90 days), four goats from each treatment were slaughtered at body weight of 20-25 kg in a local slaughterhouse. The goats were fasted for 12 hours before slaughtering. Immediately after killing the internal organ were removed.

CARCASS CHARACTERISTICS

Hot carcass weight was measured after removing all internal organs including kidney. The right of longissimus dorsi muscle was used for shear force measurement. The diet and meat samples were freeze dried and then were analyzed for crude protein, crude fiber, and ash [4]. The dried meat samples were quantified for the percentage of moisture and fat contents according to standard chemical analyses [4].

FATTY ACID COMPOSITION

Samples of longissimus dorsi muscle and diets were extracted for total lipids according to a procedure described previously [5]. In the total lipid fraction the fatty composition was determined. Total lipids were saponified and methylated according to the procedure of Metcalfe et al. [6] followed by gas liquid chromatography using a flame ionisation detector, a Chrompack column (Fused silica, no.7485, CP.FFAPCB 25mx0.32mm, Chrompack, Middelburg, The Netherlands) and H₂ as carrier gas. The individual fatty acids are expressed as weight percentage of total methyl esters.

III. STATISTICAL ANALYSIS

All data was subjected to analysis of variance by general liner model according to a randomized complete block design (RCBD). Means were tested for significant by Duncan's new multiple range test [8].

IV. RESULTS AND DISCUSSION

The fatty acid profiles of tallow, soybean oil, sunflower oil and linseed oil are shown in Table 3. Tallow is high in stearic acid (C18:0) and oleic acid (C18:1). Soybean and sunflower oils are rich in linoleic acid (C18:2) while linseed oil is rich in linolenic acid (C18:3). Similar results with Wongsuthavas et al. [8] and Mitchaothai et al. [5] who reported that soybean oil is rich in linoleic acid while sunflower oil is rich in linolenic acid.

It was demonstrated that final body weight was not significantly different among treatments. Percentage of hot carcass was 46.02, 44.80, 45.60 and 48.29 in meat of goats fed tallow, soybean oil, sunflower oil and linseed oil, respectively (Table 2). The hot carcass weight was 11.86, 9.97, 10.16 and 10.06 kg meat of goats fed tallow, soybean oil, sunflower oil and linseed oil, respectively (Table 2). Similar result with Khaokhaikaw et al. [9] showed the hot carcass weight was 11.89 kg for crossbred Anglonubian at 25 kg of body weight at slaughtering. Chemical composition of meat such as dry matter, crude protein, total fat, calcium and phosphorus contents were not significantly different among treatments. The shear force value of longissimus dorsi muscle was 63.33, 66.18, 70.13 and 66.90 N in meat of goats fed tallow, soybean oil, sunflower oil and linseed oil, respectively (Table 2). Loin eye area (LEA) of longissimus dorsi muscle was 5.89, 6.88, 9.59 and 7.36 cm² in meat of goats fed tallow, soybean oil, sunflower oil and linseed oil, respectively ($P < 0.05$). The value of LEA was similar to Khaokhaikaw et al. [9] reported that LEA of crossbred Anglonubian at 25 kg of body weight was 8.64 cm². The color parameters of meat are shown in Table 2. There were no significant difference in brightness (L*) and yellowness (b*). It is clearly shown that inclusion of unsaturated fats reduced redness (a*) when compared with saturated fat (tallow).

Supplementation of unsaturated fats increased C18:2c9,t11 when compared with tallow. It was demonstrated that soybean oil, sunflower oil and linseed oil contains C18:2 and C18:3 which they are a precursor for C18:2c9,t11 synthesis during the process of biohydrogenation in the rumen. Similarly with Ivan et al. [10] showed that sheep fed on sunflower oil (6.0%DM) increased c9,t11-CLA content in various tissues. Furthermore, Choi et al. [3] reported that supplementation of soybean oil slightly increased cis9,trans11-CLA in the intramuscular fat and subcutaneous fat. Supplementation of unsaturated fats increased total polyunsaturated fatty acids (PUFAs) in longissimus dorsi muscle.

In conclusion, it can be concluded that supplementation of unsaturated fats can be increased PUFAs content and C18:2c9,t11 in the muscle of goats.

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Table 1 Fatty acid profiles of fat sources

Fatty acid profiles, mg/g	Tallow	SBO	SFO	LO
C14:0	4.23	0.1	0.07	0.09
C16:0	31.87	10.26	6.09	4.92
C18:0	28.63	3.75	2.79	4.13
C18:1 n-9	29.17	20.31	33.67	24.74
C18:2 n-6	0.88	57.27	55.87	15.53
C18:3 n-3	0.32	6.23	0.43	49.86
C20:0	0.01	0.69	0.04	0.18
C24:0	0.04	0.15	0.07	0.05
ΣSFA	65.37	15.05	9.07	9.40
ΣMUFA	31.66	20.5	33.76	24.77
ΣPUFA	1.20	63.52	56.3	65.39

¹ T = Tallow; SO = Soybean oil; SFO = Sunflower oil; LO = Linseed oil

Table 2 Chemical composition and quality of *Longissimus dorsi* muscle

Items	Fat sources				SEM
	¹ Tallow	SBO	SFO	LO	
Live wt., kg	25.44	22.75	22.23	20.65	1.99
Hot carcass wt., kg	11.86	9.97	10.16	10.06	0.99
% Hot carcass weight	46.02	44.80	45.60	48.29	1.41
Chemical composition of meat, %					
Dry matter	23.85	24.87	24.21	24.72	0.18
Crude protein	69.20	73.31	71.72	72.97	1.11
Total fat	20.72	16.42	16.73	17.43	0.89
Calcium	0.17	0.17	0.21	0.18	0.02
Phosphorus	4.01	4.17	3.01	3.01	0.67
Shear force, N	63.33	66.18	70.13	66.90	2.27
Loin eye area, cm ²	5.89 ^b	6.88 ^{ab}	9.59 ^a	7.36 ^{ab}	0.12
Color parameter					
L* (brightness)	33.12	34.08	33.81	31.23	1.39
a* (redness)	13.09 ^a	10.97 ^{ab}	9.92 ^b	11.57 ^{ab}	0.44
b* (yellowness)	13.53	12.24	12.26	11.59	0.31

¹ T = Tallow; SO = Soybean oil; SFO = Sunflower oil; LO = Linseed oil. Hot carcass (%) = carcass weight*100/ live weight;

^{ab} Means in the same row with different superscript letters are significantly different: P<0.05

Table 3 Fatty acid profiles in *longissimus dorsi* muscle

Items	Fat sources				SEM
	Tallow	SBO	SFO	LO	
Total EE, %	18.44	14.76	15.09	15.50	0.79
C14:0	1.95 ^a	1.50 ^b	2.22 ^a	1.62 ^b	0.04
C16:0	21.65	18.57	21.36	20.81	0.46
C18:0	22.71	19.39	19.12	18.48	0.68
C18:1n9c	43.33	41.98	46.28	44.52	0.81
C18:2n6t	0.05	0.06	0.25	0.05	0.00
C18:2c9t11	0.03 ^c	0.103 ^a	0.07 ^b	0.09 ^a _b	0.00
C18:2n6c	3.30 ^c	6.10 ^a	2.34 ^c	4.61 ^b	0.16
C18:2c11c13	0.42 ^{bc}	0.90 ^a	0.23 ^c	0.69 ^b	0.04
C18:3n3	0.03	0.03	0.04	0.04	0.00
C18:3n6	0.20	0.28	0.16	0.24	0.01
C20:4n6	0.05 ^b	0.12 ^a	0.04 ^b	0.05 ^b	0.01
C20:5n3	0.02	0.07	0.04	0.03	0.01
C22:2	0.06 ^b	0.16 ^a	0.03 ^b	0.11 ^a _b	0.01
C22:6n3	0.02	0.03	0.02	0.03	0.01
C24:0	0.06 ^{bc}	0.14 ^a	0.03 ^c	0.11 ^a _b	0.01
C24:1	0.13 ^{ab}	0.30 ^a	0.09 ^b	0.28 ^a	0.03
Σ SFA	47.46	41.71	43.85	41.71	0.93
Σ MUFA	47.81	48.78	52.38	51.68	1.06
Σ PUFA	2.73 ^c	9.49 ^a	3.79 ^b	7.18 ^a _b	0.45
Σ SFA: Σ PUFA	11.00 ^a	5.20 ^b	12.35 ^a	6.21 ^b	0.60

¹ T = Tallow; SO = Soybean oil; SFO = Sunflower oil; LO = Linseed oil

^{abc} Means in the same row with different superscript letters are significantly different: P<0.05