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Article Title (within 20 words without abbreviations)	Effects of Energy Levels on Growth Performance, Carcass Characteristics, and Fatty Acid Composition of Holstein Steers at Different Slaughter Ages
Running Title (within 10 words)	Energy levels affect productivity of Holstein steers
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Abstract

We investigated the effect of energy levels on growth performance, carcass characteristics, and fatty acid composition of Holstein steers at different slaughter ages. Forty Holstein steers with an average body weight (BW) of 234.21 kg ± 7.42 and 7.78 ± 0.22 months were randomly allocated to two experimental groups; a 22-month-old experimental group and a 24-month-old experimental group. Total digestible nutrients (TDN) for each group were set to 70% (T1) and 72% (T2) during fattening phase and 74% (T3) and 76% (T4) for the finishing phase, respectively. No difference was observed in the final BW between the experimental groups during the fattening phase. However, in the finishing phase, the final BW of T4 (820.31 kg) group was significantly higher than that of T1 (745.57 kg; $p < 0.05$). The average daily gain (ADG) of T2 group in the finishing phase and overall period were 1.27 kg and 1.26 kg, respectively, which were significantly higher than those of T1 (1.11 kg and 1.12 kg; $p < 0.05$). The feed conversion ratio (FCR) and TDN conversion ratio of T2 group in the finishing phase also decreased by 10.23% and 7.73%, respectively, compared to those of T1. The cold carcass weight of T4 group was significantly higher ($p < 0.05$) than that of T1, whereas back fat thickness, longissimus area, and marbling score were not significantly different among groups. No differences were observed in physicochemical characteristics of the carcass including moisture, crude protein, and crude fat content among groups. However, the composition of fatty acids differed significantly between the groups. The content of C18:0 was significantly lower ($p < 0.05$) in T4 than in T1 group, and the content of C18:2 was higher in T4 than in T1 and T3 ($p < 0.05$). Therefore, feeding Holstein steers at a high-energy feeding level during the fattening and finishing phases improves ADG and reduces the slaughter age from 24 months to 22 months.

Keywords: Holstein steer, Average daily gain, Feed conversion ratio, Fatty acid composition

Introduction

Holstein steers are s suitable breed for the beef cattle industry due to their relatively short fattening period and improved feed efficiency. They have a very high average daily gain (ADG) of 1.30–1.50 kg during the fattening period[1]. In addition, their uniform bloodline allows for better prediction and management of feed intake and ADG[2]. In recent years, many large-scale farmers have specialized in fattening Holstein cattle due to the low capital required for this breed. However, factors such as sex, castration, and nutrient feeding level considerably affect the growth performance and meat quality of beef cattle[3] [4].

Previous studies have shown that increasing the energy feeding level by 10%–15% during the fattening period improves the growth performance of Holstein cattle [5]. Another study found that high-energy feed for 12 months increased intramuscular fat twice as much as in the 6-month experimental group[6]. However, little research has been conducted on improving the growth performance and meat quality of Holstein compared to other beef cattle, and previous studies have only focused on extending the fattening periods after castration[7] . Therefore, this study aimed to determine the most efficient energy feeding level for different slaughter ages of Holstein steers by adjusting the energy feeding level for different phases during the fattening period. This will help farmers reduce production costs and improve feed conversion ratio.

Materials and Methods

Experimental animals and design

Experimental protocol was approved by the Institutional Animal Committee of Yeungnam University, Korea (approval #: YUH-12-0340-016). Forty Holstein steers with an average age of 7.78 ± 0.22 months (average weight of 234.21 kg ± 7.42) were classified into 22-month and 24-month groups depending on their age on slaughter. The energy feeding level for each group by slaughter age was set to 70% and 72% of TDN for the fattening phase and 74% and 76% for the finishing phase, respectively. Considering their weight and age, the test animals were randomly allocated to four groups (10 steers in each) depending on their slaughter age and energy feeding level (Table 1). The specification measurements were taken after 449 days (shipping date for the 22-month group) and 502 days (shipping date for the 24-month group).

Experimental diets

Concentrates of the test feeds were produced by order at a feed factory in Incheon (South Korea). These were divided into two stages for the fattening (7.7 to 10-month) and finishing (11 to 24 months) phases; rice straw was used as forage. Chemical composition for the experimental diets and formula of the feed ingredients are shown in Table 2 and 3, respectively. Concentrate and roughage feeding amounts were designed considering the nutritional level of Holstein steer by growth stage. (Table 4).

Feeding management

Steers were accommodated in eight pens of 5.0 m × 10.0 m in size, with five heads each, and were fed twice a day (morning and afternoon). Steers were fed fattening phase diets until they were 10 months old, and then switched to finishing phase diets until slaughter. Experimental animals were managed according to the traditional Korean farm regulation and given ad libitum access to water. Throughout the experiment, feed intake was recorded every day. Body weights of experimental animals were weighed every month.

Carcass evaluation

At the end of the experimental period, animals were fasted for 24 h, weighed, and slaughtered at a commercial abattoir located in Deagu, Korea. Carcass was chilled for 24 h at 4℃ followed by characterizing the carcass including carcass yield and meat quality. Carcass was given appropriate meat grades by meat judgement according to the criteria provided by Livestock Quality Assessment [8].

Analysis of chemical composition of carcass

2.5.1 Sampling

Musculus longissimus lumborum muscles were obtained from the 12th and 13th rib section. Muscle samples were then placed in cooler at 0–5 ℃ for further analysis. Fat was removed from the samples and was pulverized with a Hanil Mini Cooking Cutter (HMC-150T, Hanil Electric Co., Ltd., Seoul, Korea). Samples were stored at −80 ℃ for fatty acid analysis.

Chemical composition

Contents of crude protein, crude fat, moisture, and ash of carcass was analyzed based on the protocol provided by AOAC [9]. First, 2 g of muscle samples were homogenized and dried at 105 ℃ and moisture content (%) was determined by weight loss upon drying in an oven. Next, a muffle furnace was used to determine ash content according to the AOAC method. Total fat content was determined using the Soxhlet extraction method after completing the measurement of moisture content. Finally, crude protein content was measured using the Kjeldahl nitrogen analysis. Briefly, longissimus dorsi muscle samples (0.5 g) were digested at 450 ℃ for 5 h, distilled, and neutralized by the addition of 50% sodium hydroxide (NaOH) and titrated with hydrochloric acid (HCl). Content of crude protein was determined by the equation as follows [10]: Crude protein (CP) = % nitrogen (N) × 6.25.

Meat color

Meat colors were displayed as CIE L* [lightness], a* [redness], and b* [yellowness] using a Chroma Meter (CR-10, Minolta Corporation, LTD, Japan). The standard color used in this study was set to Y = 94.5, x = 0.3132, and y = 0.3203 according to the manual, and three parts per sample were measured and expressed as an average value.

Fatty acid composition of longissimus lumborum muscle

Fat extraction for fatty acid composition analysis of longissimus dorsi muscle fat was performed by extracting fat according to Folch et al., (1957) [11], followed by methylation of fatty acids in keeping with the method of Lepage and Roy (1986) [12], and analyzed by gas chromatography[13]. Briefly, we took approximately 3 g of the sample pulverized at −80 ℃ (in liquid nitrogen), thawed it slightly, placed it in a glass tube, and added 5 ml of chloroform:methanol (2:1). Then, we ground it for 2–3 min at 11,000 rpm using a homogenizer (Polytron PT-MR-2100, Switzerland) and filtered it using an aspirator (Tokyo

Rikaikai Co. Ltd., Japan) after 30 min. Subsequently, 8 ml of 0.74% KCl was added, and the sample was left in a cold chamber for approximately 2 h. Next, the supernatant was separated, lower layer was transferred to a scintillating vial, and solvent was volatilized for approximately 2 h using nitrogen in a 70 ℃ water bath. Extracted FAMEs were mixed with 2 mL methanol:benzene (4:1, v/v), 200 μL acetyl chloride, 1 mL isooctane, and 8 mL 6% potassium carbonate (K_2CO_3), followed by centrifuged at 1,200 × *g* for 10 min. The supernatant was analyzed by a gas chromatograph (Clarus 500, Perkin Elmer, Waltham, MA, USA) equipped with a fused silica capillary column (Supleco SP-2560, 100 m × 0.25 mm). Experimental samples (1 μL) were then injected into the vials (split ratio 100:1 at 250 ℃) with nitrogen as a carrier gas and flame ionization detector (FID) at 270 ℃. The oven temperature was set at 170 ℃ for 5 min, increased 2 ℃ per min up-to 220 ℃, and finally held for 40 min.

Statistical analysis

The data obtained from this study were analyzed using the generalized linear model (GLM) method in SAS [14]. In addition, the significance of each experimental group was tested using Duncan's multiple-range test; significance was considered at $p < 0.05$.

Results and Discussion

Growth performance

The growth performance of Holstein steers considering the energy feeding level is shown in Table 4. During the fattening phase, there were no significant differences in average daily gain (ADG) and body weight (BW) among the experimental groups. However, the final BW of T4 experimental group at the end of the finishing phase was higher than that of T1 experimental group (820.31 and 745.57 kg, respectively; $p < 0.05$). The average daily gain (ADG) of the finishing phase was significantly higher in T2 experimental group than in T1experimental group (1.27 and 1.11 kg, respectively; $p < 0.05$) in the 22-month group. However, there was no difference among the experimental groups in the 24-month group.

The average daily gain (ADG) of the overall period was also higher in T2 experimental group than in T1 experimental group (1.26 and 1.12 kg, respectively; $p < 0.05$).

No difference was observed in feed intake (Table 6) and TDN intake (Table 7) between the experimental groups. However, compared to T1 experimental group, T2 experimental group showed decreases in the FCR and TDN conversion ratio by 10.23% and 7.73%, respectively, in the finishing phase. Holstein cattle generally show higher ADG when fed high-energy feeds during all fattening periods except when they were calves [15]. In particular, a higher energy feeding level during the finishing phase is reported to significantly increase the body weight gain [16]. Studies have reported that raising the energy feeding level of beef cattle increases the feed efficiency rather than the feed intake[17, 18], and our study showed similar results. The results of our study showed that 22-month group (T2) with higher energy feeding levels showed a significant improvement in the ADG and FCR over the 24-month group (T4). This could be attributed to the feeding program used in this study (Table 4) which maximized feed intake during the finishing phase to induce rapid growth. In addition, the average daily gain (ADG) of the 24-month slaughter age group decreased as the finishing phase got relatively longer. In addition, it has been reported that the ADG and feed efficiency of Holstein steers considerably decreases after the 22-month slaughter age [2].

Carcass characteristics

The cold carcass weight of T4 experimental group was higher than that of T1 experimental group (458.72 and 417.13 kg, respectively; $p < 0.05$), as shown in Table 8. However, there was no significant differences in the back fat thickness and longissimus area between the experimental groups. Regarding the marbling score, T2 and T4 experimental groups, which were fed at a higher energy feeding level, showed increases of 13.40% and 7.11% compared to T1 and T3 experimental groups, respectively. Difference, however, was not statistically significant. The experimental groups did not differ in other meat qualities such as meat color, fat color, or texture. Holstein steers generally have thinner back fat and lower marbling score than other beef cattle breeds, such as Hanwoo and Wagyu[7, 19]. A study has reported that 24 Holstein steers slaughtered at 22 months of age had an average marbling score of 2.10 -

3.60, similar to the present study[20]. However, as shown in the results of our study, there was no significant difference in the back fat thickness and marbling score in the experimental groups with high-energy feeding levels. These results are because Holstein steers accumulate body fat at a lower rate than other beef cattle breeds.

Physicochemical characteristics of carcass

Among the physicochemical characteristics of the carcass, the moisture and crude protein content did not differ by experimental groups (Table 9). The crude fat content increased to 12.74% in T2 experimental group compared to T1 experimental group, but there was no significant difference. The meat CIE values also showed no difference among the experimental groups. In general, the physicochemical characteristics of the carcass are reported to be significantly affected by the marbling score, and Holstein steers, which do not have a high marbling score, are known to have a slight variance in the physicochemical characteristics [21]. Studies have reported that among the physicochemical characteristics of the beef carcass, the crude fat content increases, and the moisture and crude protein content decrease as the meat quality grade increases[22]. In the recent specification test results of Holstein steers between the slaughter age of 20 to 24 months, it was reported that there was no significant difference in the physicochemical characteristics of carcass between the experimental groups [2], which is similar to the results of our study.

Fatty acid composition

Among the fatty acid compositions of longissimus lumborum muscle, the contents of saturated fatty acids (SFA) C14:0 and C16:0 did not differ between the experimental groups. However, the C18:0 content was significantly lower in the T4 experimental group than in the T1experimental group ($p < 0.05$) (Table 10). Similarly, the content of C18:1, the major unsaturated fatty acid (UFA) of beef, did not differ by experimental groups, but the content of C18:2 for T4 experimental group was higher than those of the experimental groups that had lower energy feeding levels (T1 and T3; $p < 0.05$). However, the contents of SFA, UFA, and monounsaturated fatty acid (MUFA) did not differ between the experimental groups. In general, it has been reported that in the fatty acid composition of beef cattle, the contents of C16:0 and C18:0 decrease, and the contents of C18:1 and UFA increase as the meat quality grade increases[23-25]. Similarly, in line with our study, studies have reported that there were no significant differences in the contents of SFA, UFA, and MUFA between the carcasses of different experimental groups of Holstein steers slaughtered at 18, 21, and 24 months of age [26, 27].

Conclusion

It is crucial to optimize the factors such as energy levels included in feed and the fattening period to maximize the profit of cattle production. Results from our study indicate that Holstein steers fed a high energy level diet for 22 month showed greater ADG as well as increase in fat content of cold carcass. Furthermore, a high energy level diet for 24 months produced a greater cold carcass weight with higher linoleic acid content, which is a polyunsaturated omega 6 fatty acid. These results warrant further studies on the effect of different energy levels and fattening periods on meat quality and consumers preference.

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Tables and Figures

Table 1. Experimental design of Holstein steers

Treatment	No. of steers	22 month		24 month	
		Concentrate		Concentrate	
		Fattening	Finishing	Fattening	Finishing
		TDN, %			
T1	10	70	74	-	-
T2	10	72	76	-	-
T3	10	-	-	70	74
T4	10	-	-	72	76

Table 2. Chemical composition of concentrate and roughage diets for experimental groups.

Composition	Concentrate				Roughage	SEM[1]
	Fattening		Finishing		Rice straw	
	T1	T2	T3	T4		
Moisture	12.45	12.13	12.22	12.88	9.42	0.13
Crude protein	15.21	15.34	11.88	11.62	3.55	0.16
Crude fat	2.52	2.48	3.87	3.52	0.91	0.04
Crude fiber	9.75	9.81	10.59	10.14	32.01	0.07
Crude ash	4.36	4.12	3.51	3.30	9.12	0.08
NFE[2]	55.71	56.12	57.93	58.54	55.01	0.30
Ca	0.45	0.43	0.32	0.37	0.18	0.07
P	0.30	0.31	0.30	0.30	0.16	0.01
TDN[3]	70.00	72.00	74.00	76.00	37.57	

[1] Standard error of the mean
[2] Nitrogen-free extract
[3] Calculated

Table 3. Formula of concentrate diet for experimental groups

Item	Concentrate			
	Fattening		Finishing	
	T1	T2	T3	T4
	%, as-fed			
Ingredient				
Corn grain	31.50	33.50	30.00	31.50
Wheat	1.00	3.00	4.00	5.00
Wheat bran	17.50	15.50	18.00	16.50
Corn gluten feed	12.00	9.00	13.00	11.00
Soybean meal	7.50	7.50	4.50	4.50
Palm kernel meal	7.00	8.00	9.00	10.00
Coconut meal	11.00	11.00	8.00	8.00
Cotton seeds meal	3.50	3.50	4.50	4.50
Molasses	5.00	5.00	5.00	5.00
Salt dehydrated	0.50	0.50	0.50	0.50
Limestone	1.50	1.50	1.50	1.50
Vitamin premix[1)]	1.00	1.00	1.00	1.00
Mineral premix[2)]	1.00	1.00	1.00	1.00
Total	100	100	100	100

[1)] Supplied per kg concentrate feed: 13,000 U vitamin A, 2500 U vitamin D3, 15 mg vitamin E, 1 mg vitamin B1, 0.56 mg vitamin B2, 0.5 mg vitamin B6, 0.01 mg vitamin B12, 12.5 mg vitamin niacin, 1.9 mg pantothenic acid, 0.15 mg folic acid

[2)] Supplied per kg feed; 100 mg Zn, 50 mg Fe. 100 mg, 50 mg Mn, 6 mg Cu, 0.6 mg Co, 3 mg I, 0.3 mg Se

Table 4. Feeding program for Holstein steers in the experiment

Fattening phase	Age in month	Body Weight range (kg)	Feeding level (Body wt, %)	Concentrate fed (kg/hd/day, as-fed basis)		Roughage fed (kg/hd/day, as-fed basis)
				Fattening	Finishing	Rice straw
	%, as-fed					
Fattening	7	230~300	2.13	6.4		2.0
	8	300~345	2.13	7.2		2.0
	9	345~390	2.18	8.5		2.0
	10	390~435	2.18	9.5		2.0
Finishing	11	435~475	2.11		10.0	1.5
	12	475~515	2.14		11.0	1.2
	13	515~550	2.00		11.0	1.2
	14	550~585	1.88		11.0	1.2
	15	585~620	1.77		11.0	1.1
	16	620~650	1.69		11.0	1.1
	17	650~680	1.62		11.0	1.1
	18	680~710	1.55		11.0	1.0
	19	710~735	1.43		10.5	1.0
	20	735~760	1.38		10.5	1.0
	21	760~785	1.27		10.0	1.0
	22	785~810	1.23		10.0	1.0
	23	810~830	1.23		10.0	1.0
	24	830~840	1.20		10.0	1.0

Table 5. Effect of energy feeding levels on performance Holstein steers

Item	22 month		24 month		SEM[1)]	P-value[2)]
	T1	T2	T3	T4		
No. of heads	10	10	10	10		
Body weight(kg)						
Initial (7.7 month)	240.54	231.02	233.23	232.03	3.82	0.6816
Fattening (11 month)	372.27	370.02	363.12	369.01	12.87	0.2247
Finishing (22–24 month)	745.57[b]	797.64[ab]	810.52[ab]	820.31[a]	20.15	0.0923
Average daily gain(kg)						
Fattening phase	1.18	1.24	1.16	1.22	0.04	0.1230
Finishing phase	1.11[b]	1.27[a]	1.15[ab]	1.16[ab]	0.05	0.0812
Overall period	1.12[b]	1.26[a]	1.15[ab]	1.17[ab]	0.06	0.0913

[1)] Standard error of the mean
[2)] Probability of the F test
[a, b] Means in the same row with different superscripts are significantly ($p < 0.05$) different

Table 6. Feed intake and feed conversion in Holstein steers

Item	22 mon		24 mon		P-value[1)]
	T1	T2	T3	T4	
Fattening phase					
Feed intake (kg/head/day)					
Concentrate	6.65	6.67	6.64	6.61	0.8724
Rice straw	2.10	2.21	2.09	2.02	0.6816
Sub-total	8.75	8.88	8.73	8.63	
Feed conversion ratio, kg/kg	7.42	7.16	7.46	7.02	
Finishing phase					
Feed intake (kg/head/day)					
Concentrate	11.98	11.94	11.24	11.01	0.8156
Rice straw	1.42	1.49	1.21	1.29	0.6487
Sub-total	13.40	13.43	12.45	12.30	
Feed conversion ratio, kg/kg	11.75	10.66	10.73	10.25	
Overall period					
Feed intake (kg/head/day)					
Concentrate	9.32	9.31	10.40	10.28	0.2748
Rice straw	1.86	1.85	1.57	1.65	0.3487
Sub-total	11.18	11.16	11.98	11.93	
Feed conversion ratio, kg/kg	9.72	8.93	10.49	9.67	

Table 7. TDN intake and TDN conversion in Holstein steers

Item	22 mon		24 mon		P-value[1)]
	T1	T2	T3	T4	
Fattening phase					
TDN intake (kg/head/day)					
Concentrate	4.66	4.80	4.65	4.76	0.6287
Rice straw	0.79	0.83	0.78	0.76	0.7854
Sub-total	5.45	5.63	5.43	5.52	
TDN conversion ratio, kg/kg	5.32	4.54	4.64	4.49	
Finishing phase					
TDN intake (kg/head/day)					
Concentrate	8.86	9.07	8.31	8.37	0.5932
Rice straw	0.53	0.56	0.45	0.48	0.6271
Sub-total	9.39	9.63	8.76	8.85	
TDN conversion ratio, kg/kg	8.23	7.64	7.55	7.38	
Overall period					
TDN intake (kg/head/day)					
Concentrate	7.77	7.97	7.51	7.57	0.2748
Rice straw	0.60	0.63	0.53	0.54	0.3487
Sub-total	8.37	8.60	8.04	8.12	
TDN conversion ratio, kg/kg	7.28	6.88	6.93	6.70	

Table 8. Effect of energy feeding levels on carcass characteristics in Holstein steers

Item	22 month		24 month		SEM[1)]	P-value[2)]
	T1	T2	T3	T4		
Body weight						
Market wt., kg	754.57^{b}	794.64^{ab}	803.52^{ab}	820.31^{a}	20.15	0.0923
Cold carcass wt., kg	417.13^{b}	444.12^{ab}	442.90^{ab}	458.72^{a}	8.57	0.0865
Carcass percentage, %	55.28	55.89	55.12	55.92		
Yield traits						
Backfat thickness, mm	6.87	7.72	7.31	8.01	0.83	0.1015
Longissimus muscle area, cm^2	78.21	80.21	81.14	82.12	2.88	0.6949
Yield grade, %[)]						
A	10.00(1)	10.00(1)	ND	ND		
B	80.00	70.00(7)	90.00(9)	90.00(9)		
C	10.00(1)	20.00(2)	10.00(1)	10.00(1)		
Quality traits						
Marbling score[3)]	2.61	2.96	2.81	3.01	0.44	0.1174
Meat color[4)]	4.34	4.47	4.67	5.01	0.19	0.1869
Fat color[5)]	2.51	2.51	2.56	2.53	0.03	0.1038
Texture[6)]	1.94	1.87	1.90	2.01	0.05	0.3872
Maturity[7)]	2.00	2.00	2.00	2.00	0.00	1.0000
Quality grade, %						
1^{+}	ND	10.00(1)	ND	10.00(1)		
1	10.00(1)	10.00(1)	20.00(2)	10.00(1)		
2	60.00(6)	60.00(6)	60.00(6)	70.00(7)		
3	30.00(3)	20.00(2)	20.00(2)	10.00(1)		

[1)] Standard error of the mean, [2)] Probability of the F test,
[3)] 9 = the most abundant, 1 = devoid, [4)] 7 = dark red, 1 =b right red,
[5)] 7 = yellowish, 1 = white, [6)] 3 = coarse, 1 = fine, [7)] 9 = mature, 1 = youthful.
[a, b] Means in the same row with different superscripts are significantly ($p < 0.05$) different.

Table 9. Effect of energy feeding levels on physicochemical characteristics of longissimus dorsi muscle in Holstein steers

Item	22 month		24 month		SEM[1)]	P-value[2)]
	T1	T2	T3	T4		
Moisture, %	66.79	66.32	66.20	66.12	0.74	0.4513
Crude fat, %	10.52	11.86	11.02	11.96	0.85	0.1952
Crude protein, %	21.03	20.03	20.77	20.11	0.31	0.2398
CIE value						
L^*	39.77	41.35	40.72	40.12	1.17	0.1289
a^*	21.07	20.98	20.88	20.34	0.73	0.4215
b^*	9.52	9.02	9.52	8.99	0.38	0.2187
Chroma	22.37	23.01	23.52	23.77	0.89	0.4874
hue	24.44	25.01	24.33	24.77	0.67	0.1528

[1)] Standard error of the mean
[2)] Probability of the F test
[a, b] Means in the same row with different superscripts are significantly ($p < 0.05$) different

Table 10. Effect of energy feeding levels on fatty acid of longissimus lumborum muscle in Holstein steers

Item	22 month		24 month		SEM[1)]	P-value[2)]
Fatty acid, %	T1	T2	T3	T4		
$C_{14:0}$	3.42	3.32	3.23	3.11	0.14	0.1534
$C_{14:1}$	0.81	1.11	0.93	0.97	0.13	0.5112
$C_{15:0}$	0.31	0.3	0.29	0.27	0.02	0.8123
$C_{15:1}$	0.07	0.08	0.08	0.08	0.01	0.8452
$C_{16:0}$	27.01	26.11	27.34	26.81	1.12	0.2125
$C_{16:1}$	4.99	5.23	4.98	4.6	0.28	0.3879
$C_{17:0}$	0.74	0.87	0.79	0.78	0.05	0.4321
$C_{17:1}$	0.07	0.08	0.08	0.07	0.01	0.8491
$C_{18:0}$	12.92	11.87	11.1	9.41	0.89	0.0842
$C_{18:1}$	47.71	49.14	47.67	50.02	1.52	0.1854
$C_{18:2}$	2.17[b]	2.88[ab]	2.23[b]	3.27[a]	0.22	0.0977
$C_{18:3}$	0.06	0.07	0.07	0.07	0.01	0.2717
$C_{20:0}$	0.18	0.15	0.14	0.15	0.02	0.7813
$C_{20:3}$	0.15	0.14	0.12	0.13	0.02	0.5218
$C_{20:4}$	0.2	0.21	0.21	0.22	0.05	0.2987
SFA[3)]	44.58	42.62	42.89	40.53	2.14	0.1432
MUFA[4)]	53.65	55.64	53.74	55.74	1.21	0.5157
UFA[5)]	56.23	58.94	56.37	59.43	1.87	0.1021

[1)] Standard error of the mean,
[2)] Probability of the F test, [3)] Saturated fatty acid,
[4)] Monounsaturated fatty acid,
[5)] Unsaturated fatty acid.
[a, b] Means in the same row with different superscripts are significantly ($p < 0.05$) different.