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Influence of sex, age, slaughter mass and source farm on carcass composition of fattening dairy cattle

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Abstract Sex significantly influenced total tendons mass and percentage of tendons mass ($P<0.01$). The factor had also significantly affected to total mass, total lean meat mass and total bone mass ($P<0.05$). Age influenced total bone mass, total fat mass, percentage of bone and muscle:fat ratio ($P<0.05$) and proportion of fat ($P<0.01$). Chilled carcass mass, total mass of lean meat, bone, fat, and tendons were highly significantly affected by slaughter mass ($P<0.01$), which also significantly influenced percentage of fat ($P<0.05$). Cattle with a slaughter mass more than 650 kg had higher averages of chilled carcass mass, total lean meat, bone, fat, and tendon mass and percentage of fat than lighter animals. The factor of source farm significantly effected chilled carcass mass and total fat mass ($P<0.01$), as well as total mass of lean meat and bone and percentages of bone and of fat ($P<0.05$).

Keywords: Fattening Dairy Cattle, Carcass Composition, Thailand

Introduction

Most milk products in Thailand come from dairy cows. OAE (2018) reported that during 2013 to 2018, the number of dairy cattle was increased by approximately 2.8% per year. Milking cows was increased about 1.5 % (from 267,932 heads in 2017 to 276,321 heads in 2018). At present, more than 90% of dairy cows are Holstein-Fresian (HF, Black and White), while the remainder are Jersey, Guernsey, Brow Swiss, Thai Milking Zebu etc. Due to the geographic location of Thailand, most dairy cows are crossbreeds with a minimum 75 % HF. In a dairy farm, generally, about 20% of dairy cows will be replaced per year, and about 80% of milking cows calve, with 50% male calves, by chance. Cows are culled for several reasons, such as failure in reproduction, milk yield reduction, mastitis etc. To increase farm profit, culled cows and male calves are either sold to beef cattle farmers or intensively reared as growing and finishing dairy cattle for beef production within dairy farms. Currently, an

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estimated 20% of the beef market comes from dairy meat, especially in the mid-level market (Sethakul, 2016). Carcass composition described carcass mass, percentage of fat, muscle, and bone (Irshad *et al*., 2013). Dairy cattle have a lighter carcass and elongated ribeye compared to beef cattle. The lean meat percentage in culled dairy cows is lower than in beef cattle. Many researchers, in Thailand, have discussed fattening dairy cattle, mostly describing carcass traits compared with beef carcasses (Chainam *et al.*, 2019; Tuntivisoottikul and Limsupavanich, 2018; Noidad *et al*., 2014). Unfortunately, only a few reports discuss dairy carcass composition (Tavitchasri *et al*., 2016; Supphakitchanon *et al.*, 2015). Thus, studying factors affecting the carcass composition may be valuable, since results can be fed back to the farmers to improve their dairy cattle carcasses.

Materials and Methods

Data from 146 dairy cattle (min. 75% Holstein Friesian), slaughtered during 04 January to 26 May 2018, was collected: it had two parts. The first part was name of farm, animal identification, type of animal, sex, age, and final live (slaughter) mass. The second part covered the quatering cuts: animals were slaughtered in a commercial slaughterhouse, in Rachaburi Province (13 °49'37.6"N99 °56'14.6"E), Thailand. After slaughter, the clean carcass was halved into left and right sides, weighed (to measure hot carcass mass) and chilled at 2 to 4ºC for 7 days. Each side of carcass was weighed (to record cold or chilled carcass mass). The left side was crosssected between the 12^{th} and 13^{th} ribs to estimate intramuscular fat on the loin muscle (*M. longissimus dorsi*), following the TACFS 6001-2004 Standard (ACFS, 2004). Then both sides were cut into fore- and hind-quarters. All cuts were transported to the Beef Cluster Cooperative Limited, located at Kampeangsaen District, Nakorn Pathom Province (14 °03'12.8"N99 °59'24.2"E). Routine retail cutting process of the cooperative was as follows: The quarters were weighed there, each quarter was deboned and fat was trimmed. The cut was separated into lean meat, bone, fat (subcutaneous fat and trimmed fat) and tendons. Each part was weighed and recorded individually. Chilled carcass mass of the individual was calculated by summing the quarter masses. As with the chilled carcass mass, total masses of lean meat, bone, fat and tendons were calculated. Percentages of lean meat, bone, fat, and tendons were also computed by dividing the mass of each with the chilled carcass mass and multiplying by 100. Proportion between muscle and bone, and between muscle and fat were calculated.

Carcass composition data was analysed using descriptive statistics, as shown in Table 1. Slaughter mass ranged from 442 to 861 kg, with mean

610.77 kg. The average fore-quarters, both left and right sides, were heavier than the hind-quarters: 91.60 and 89.50 kg for left and right fore-quarters and 73.04 and 73.67 kg for left and right hind-quarters. The percentage of lean meat showed the highest average, 76.03%, compared to bone, 13.16%, fat, 9.43% and tendon, 1.38%. The muscle:bone ratio ranged from 4.71 to 7.46 with a mean of 5.8, while the muscle:fat ratio ranged from 4.97 to 26.16, with mean 8.57.

Table 1. Means, standard deviations, minima and maxima of studied traits (n=146)

Carcass composition	**Mean**	**Std Dev**1/	**Minimum**	**Maximum**
Slaughter mass (kg)	610.77	79.69	442.00	861.00
Left fore-quarter mass (kg)	91.60	13.95	59.70	143.10
- Lean meat	68.38	10.57	46.17	114.75
- Bone	13.17	2.19	8.55	22.86
- Fat	9.34	2.92	3.68	18.77
- Tendons	0.73	0.20	0.30	1.41
Left hind-quarter mass (kg)	73.04	10.33	47.60	99.30
- Lean meat	56.66	7.85	38.79	78.49
- Bone	8.60	1.30	5.43	12.70
- Fat	6.28	2.28	2.16	16.29
- Tendons	1.51	0.33	0.82	2.59
Right fore-quarter mass (kg)	89.25	13.77	58.70	138.90
- Lean meat	67.07	10.61	45.00	115.36
- Bone	12.47	1.91	8.41	18.83
- Fat	8.97	2.84	3.54	17.87
- Tendons	0.75	0.22	0.37	2.06
Right hind quarter mass (kg)	73.67	10.55	48.20	102.40
- Lean meat	56.84	8.02	38.50	79.14
- Bone	8.71	1.31	6.02	12.65
- Fat	6.63	2.47	2.53	14.64
- Tendons	1.50	0.31	0.94	2.37
Chilled carcass mass (kg)	327.56	47.33	214.20	473.60
- Total lean meat	248.94	35.79	168.45	387.74
- Total bone	42.94	6.36	29.36	66.07
- Total fat	31.21	9.83	12.26	62.95
- Total tendons	4.48	0.79	2.89	6.79
Lean meat (%)	76.03	1.56	71.65	81.87
Bone (%)	13.16	1.27	9.98	15.78
Fat (%)	9.43	2.14	3.13	14.79
Tendons (%)	1.38	0.21	0.89	1.88
Muscle:Bone	5.83	0.59	4.71	7.46
Muscle:Fat	8.57	2.51	4.97	26.16

1/: Standard deviation

A general linear model was used to determine factors influencing carcass composition, such as chilled carcass mass, total mass of lean meat, bone, fat, tendons, percentages of lean meat, bone, fat, and tendons, proportions of muscle and bone, and muscle and fat. The factors were sex of animals (female and male), age, estimated by counting the number of pairs of permanent incisor teeth (1st pair for 2 yr olds, 2nd pair for 3 yr olds, 3rd pair for 4 yr olds and 4th pair for 5 years or older), slaughter mass groups (<550 kg, 550 to 650 kg and >650 kg), and farm (31 farms). The linear model was:

$$Y_{ijklm} = \mu + S_i + A_j + SWG_k + F_l + e_{ijklm}$$

where Y_{ijklm} is the studied traits; μ is overall mean; S_i is fixed effect of animal's sex (i=1, 2, when 1=male, 2=female); A_j is fixed effect of age (j=1, 2, 3, 4, when 1=2 yrs, 2=3 yrs, 3=4 yrs, 4=≥5 yrs old); SWG_k is fixed effect of slaughter mass group (k=1, 2, 3, when 1=<550 kg, 2=550-650 kg, 3=>650 kg); F_l is fixed effect of source farm (i=1, 2, 3,……., 30, 31); e_{ijklm} is random effect of residual.

If F-test of a trait was significant, then the pdiff option was used to compare the difference of LSmeans (SAS, 1999).

Results

Factors affecting carcass composition

Factors of sex, age, slaughter mass group, and source farm affected carcass composition traits are shown in Table 2. The factor for sex significantly influenced total tendons mass and percentage of tendons mass (P<0.01). Moreover, the factor had significantly affected chilled carcass mass, total lean meat mass, and total bone mass (P<0.05). The muscle:bone ratio, and muscle:fat ratio were not affected by this factor (P>0.05).

The age factor affected total bone mass, total fat mass, and percentage of bone (P<0.05), and on percentage of fat mass (P<0.01). However, this factor did not influence muscle:bone ratio (P>0.05), whereas the muscle:fat ratio was affected (P<0.05).

Most studied traits were significantly affected by slaughter mass (P<0.01), such as chilled carcass mass, total lean meat mass, total bone mass, total fat mass and total tendon mass, but percentage of fat was significantly influenced by the factor (P<0.05). Slaughter mass did not affect both muscle:bone, and muscle:fat ratio (P>0.05).

The source farm significantly affected chilled carcass mass and total fat mass (P<0.01) and had slightly less affect on total lean meat mass, total bone

mass, percentages of bone and of fat (P<0.05) and also both muscle:bone (P=0.06) and muscle:fat proportions (P=0.07).

Table 2. P-values and R^2 for factors influencing carcass composition

Carcass composition	P-values				R^2
	Sex	Age	SWG1/	Source Farm	
Chilled carcass mass (kg)	0.0132	0.2196	<.0001	0.0090	0.8039
Total lean meat mass (kg)	0.0270	0.1616	<.0001	0.0443	0.7661
Total bone mass (kg)	0.0121	0.0224	<.0001	0.0190	0.7275
Total fat mass (kg)	0.5811	0.0173	<.0001	0.0045	0.6517
Total tendons mass (kg)	<.0001	0.3422	<.0001	0.5571	0.6578
Lean meat (%)	0.9841	0.1427	0.3927	0.1947	0.3208
Bone (%)	0.6741	0.0405	0.1112	0.0133	0.5090
Fat (%)	0.5612	0.0072	0.0453	0.0112	0.5186
Tendons (%)	0.0013	0.3405	0.2301	0.0880	0.5322
Muscle:Bone	0.7173	0.1129	0.1666	0.0644	0.4492
Muscle:Fat	0.9545	0.0249	0.6732	0.0686	0.3976

1/: Slaughter mass group

Effect of sex

Sex influenced the studied traits as shown in Table 3. Male cattle had higher chilled carcass mass, total lean meat mass, total bone mass, total tendons mass and percentage of tendons than females. However, percent of lean meat did not significantly differ.

Table 3. Least squares means and standard errors of traits affected by sex

Carcass composition	Female	Male
	LSM ±SE	LSM ±SE
Chilled carcass mass (kg)	315.79 ±5.56$^{b1/}$	341.71 ±7.23^{a}
Total lean meat mass (kg)	240.42 ±4.59^{b}	259.71 ±5.97^{a}
Total bone mass (kg)	42.45 ±0.88^{b}	47.45 ±1.15^{a}
Total tendons mass (kg)	4.24 ±0.12^{b}	6.36 ±5.36^{a}
Total fat mass (kg)	28.69 ±1.54^{a}	30.20 ±2.00^{a}
Lean meat (%)	76.09 ±0.34^{a}	76.10 ±0.44^{a}
Bone (%)	13.49 ±0.24^{a}	13.67 ±0.31^{a}
Fat (%)	9.05 ±0.39^{a}	8.65 ±0.51^{a}
Tendons (%)	1.36 ±0.04^{b}	1.59 ±0.05^{a}
Muscle:Bone	5.68 ±0.12^{a}	5.61 ±0.15^{a}
Muscle:Fat	9.12 ±0.52^{a}	9.07 ±0.67^{a}

1/: Means with different superscript letters differ significantly in the row

Effect of age

Table 4 shows that 3 and 4 yr olds cattle had the highest total bone mass, but did not differ sigificantly from 2 yr olds. The highest percentage of bone was found in 4 yr old cattle, whereas it was lowest in the oldest cattle (≥5 years old). In contrast, total fat mass, and percent of fat mass of the oldest animals were higher than those of the 3 and 4 year olds, but did not differ significantly from the youngest cattle (2 yr olds). The proportion of muscle:fat in the 4 (9.99±0.63) and 3 (9.76±0.59) yrs cattle was higher than in the 5 (8.03±0.44) yrs or older.

Table 4. Least squares means and standard error for traits affected by age

Traits	Age			
	2 yrs old LSM±SE	3 yrs old LSM±SE	4 yrs old LSM±SE	≥5 yrs old LSM±SE
Chilled carcass mass (kg)	323.98±9.72[a1/]	338.51±6.36[a]	323.62±6.72[a]	326.89±4.77[a]
Total lean meat mass (kg)	244.25±8.03[a]	258.97±5.26[a]	247.83±5.55[a]	247.23±3.94[a]
Total bone mass (kg)	44.47±1.54[ab]	45.87±1.01[a]	45.09±1.07[a]	42.37±0.76[b]
Total fat mass (kg)	30.67±2.69[ab]	28.76±1.76[ab]	25.77±1.86[b]	32.59±1.32[a]
Lean meat (%)	75.42±0.60[a]	76.48±0.39[a]	76.67±0.41[a]	75.81±0.29[a]
Bone (%)	13.79±0.41[ab]	13.56±0.27[ab]	13.93±0.29[a]	13.04±0.20[b]
Fat (%)	9.36±0.69[ab]	8.49±0.45[b]	7.85±0.48[b]	9.70±0.34[a]
Tendons (%)	1.44±0.07[a]	1.48±0.05[a]	1.54±0.05[a]	1.45±0.04[a]
Muscle:Bone	5.53±0.20[a]	5.67±0.13[a]	5.51±0.14[a]	5.87±0.10[a]
Muscle:Fat	8.60±0.90[ab]	9.76±0.59[a]	9.99±0.63[a]	8.03±0.44[b]

1/: Means with different superscript letters differ significantly within the row

Table 5. Least squares means and standard errors for traits affected by slaughter mass

Traits	Slaughter mass group (kg)		
	<550 LSM±SE	**550 to 650 LSM±SE**	**>650 LSM±SE**
Chilled carcass mass (kg)	284.85±5.67[c1/]	321.57±5.29[b]	378.33±5.05[a]
Total lean meat mass (kg)	217.07±4.68[c]	244.79±4.37[b]	286.84±4.17[a]
Total bone mass (kg)	39.16±0.90[c]	44.22±0.84[b]	49.96±0.80[a]
Total fat mass (kg)	24.29±1.57[c]	27.88±1.46[b]	36.17±1.40[a]
Total tendons mass (kg)	4.34±0.13[c]	4.69±0.12[b]	5.37±0.11[a]
Lean meat (%)	76.31±0.35[a]	76.18±0.33[a]	75.80±0.31[a]
Bone (%)	13.68±0.24[a]	13.77±0.23[a]	13.28±0.22[a]
Fat (%)	8.50±0.40[b]	8.58±0.38[b]	9.48±0.36[a]
Tendons (%)	1.51±0.04[a]	1.47±0.04[a]	1.44±0.03[a]
Muscle:Bone	5.61±0.12[a]	5.55±0.11[a]	5.77±0.11[a]
Muscle:Fat	9.20±0.53[a]	9.27±0.49[a]	8.82±0.47[a]

1/: Means with different superscript letters differ significantly within the row

Table 6. Least squares means and standard errors for traits affected by source farm

Farm	Chilled carcass mass (kg) LSM ±SE	Total lean meat mass (kg) LSM ±SE	Total bone mass (kg) LSM ±SE	Total fat mass (kg) LSM ±SE	Bone (%) LSM ±SE	Fat (%) LSM ±SE
1	315.12 ±24.97^{bcdef}	240.68 ±20.62$^{bc1/}$	42.90 ±3.96^{bc}	27.32 ±6.91^{bcd}	13.52 ±1.06^{bcd}	8.82 ±1.77^{abcd}
2	327.58 ±10.36^{bcde}	248.60 ±8.56^{abc}	45.42 ±1.64^{bc}	28.68 ±2.87^{bcd}	13.85 ±0.44^{bc}	8.79 ±0.73^{abcd}
3	324.77 ±18.21^{bcde}	242.02 ±15.04^{bc}	45.44 ±2.89^{bc}	32.13 ±5.04^{abc}	14.01 ±0.78^{abc}	10.28 ±1.29^{abc}
4	362.54 ±25.11^{ab}	270.30 ±20.74^{ab}	42.79 ±3.98^{bc}	43.80 ±6.95^{ab}	12.02 ±1.07^{cd}	11.59 ±1.78^{ab}
5	357.15 ±11.99^{abc}	269.49 ±9.90^{ab}	44.67 ±1.90^{bc}	38.38 ±3.32^{ab}	12.67 ±0.51^{cd}	10.34 ±0.85^{ab}
6	337.21 ±11.27^{abcde}	260.19 ±9.31^{abc}	45.12 ±1.79^{bc}	26.86 ±3.12^{cd}	13.37 ±0.48^{bcd}	7.94 ±0.80^{cd}
7	281.34 ±25.11^{ef}	215.96 ±20.74^{bc}	40.54 ±3.98^{c}	20.12 ±6.95^{cd}	14.15 ±1.07^{abc}	7.52 ±1.78^{cd}
8	325.35 ±13.15^{bcde}	254.58 ±10.86^{abc}	41.89 ±2.08^{c}	24.21 ±3.64^{cd}	12.95 ±0.56^{cd}	7.36 ±0.93^{cd}
9	299.91 ±17.93^{def}	228.35 ±14.80^{bc}	42.19 ±2.84^{bc}	24.84 ±4.96^{cd}	13.96 ±0.76^{abc}	8.41 ±1.27^{bcd}
10	360.34 ±25.11^{abc}	265.05 ±20.74^{abc}	45.57 ±3.98^{bc}	45.10 ±6.95^{a}	12.78 ±1.07^{cd}	11.99 ±1.78^{a}
11	340.07 ±8.81^{abcde}	262.07 ±7.27^{abc}	45.99 ±1.40^{bc}	27.27 ±2.44^{cd}	13.60 ±0.38^{bc}	7.98 ±0.62^{cd}
12	315.35 ±8.39^{bcdef}	239.54 ±6.93^{bc}	41.66 ±1.33^{c}	29.47 ±2.32^{bc}	13.26 ±0.36^{cd}	9.26 ±0.59^{abcd}
13	309.67 ±25.47^{bcdef}	233.51 ±21.03^{bc}	44.06 ±4.04^{bc}	27.00 ±7.05^{cd}	14.39 ±1.09^{abc}	8.40 ±1.81^{bcd}
14	345.68 ±18.02^{abcd}	266.00 ±14.88^{abc}	50.83 ±2.86^{ab}	23.18 ±4.99^{cd}	14.91 ±0.77^{ab}	6.55 ±1.28^{d}
15	353.87 ±7.57^{abcd}	267.58 ±6.25^{abc}	45.15 ±1.20^{bc}	36.30 ±2.09^{ab}	12.75 ±0.32^{cd}	10.19 ±0.54^{abc}
16	319.60 ±24.89^{bcdef}	238.81 ±20.55^{bc}	46.32 ±3.94^{abc}	28.82 ±6.89^{bcd}	14.48 ±1.06^{abc}	9.12 ±1.76^{abcd}
17	341.92 ±13.47^{abcde}	262.40 ±11.12^{abc}	52.76 ±2.13^{a}	21.70 ±3.73^{cd}	15.47 ±0.57^{a}	6.15 ±0.95^{d}
18	345.19 ±25.50^{abcde}	267.01 ±21.06^{abc}	39.42 ±4.04^{c}	33.70 ±7.06^{abc}	11.14 ±1.09^{d}	9.62 ±1.81^{abcd}
19	271.42 ±24.97^{f}	212.43 ±20.62^{c}	38.93 ±3.96^{c}	15.02 ±6.91^{d}	14.32 ±1.06^{abc}	5.02 ±1.77^{d}
20	336.44 ±25.11^{abcde}	261.20 ±20.74^{abc}	41.05 ±3.98^{c}	30.00 ±6.95^{bc}	12.33 ±1.07^{cd}	8.81 ±1.78^{abcd}
21	315.69 ±11.14^{bcdef}	239.69 ±9.20^{bc}	44.50 ±1.76^{bc}	26.81 ±3.08^{cd}	14.09 ±0.47^{abc}	8.65 ±0.79^{abcd}
22	333.81 ±12.48^{abcde}	252.50 ±10.31^{abc}	46.06 ±1.98^{bc}	31.13 ±3.45^{abc}	13.88 ±0.53^{abc}	9.39 ±0.88^{abcd}
23	317.12 ±14.52^{bcdef}	236.08 ±11.99^{bc}	41.16 ±2.30^{c}	35.29 ±4.02^{abc}	12.92 ±0.62^{cd}	11.02 ±1.03^{ab}
24	326.11 ±7.72^{bcde}	247.09 ±6.37^{bc}	43.98 ±1.22^{bc}	30.45 ±2.13^{abc}	13.47 ±0.33^{bcd}	9.26 ±0.55^{abcd}
25	357.02 ±25.69^{abcd}	269.35 ±21.21^{abc}	51.01 ±4.07^{ab}	31.54 ±7.11^{abc}	14.24 ±1.09^{abc}	8.81 ±1.82^{abcd}
26	379.84 ±25.11^{a}	288.30 ±20.74^{a}	51.05 ±3.98^{ab}	36.07 ±6.95^{abc}	13.54 ±1.07^{bcd}	9.18 ±1.78^{abcd}
27	308.67 ±9.85^{cdef}	235.40 ±8.13^{bc}	43.96 ±1.56^{bc}	24.79 ±2.72^{cd}	14.24 ±0.42^{abc}	8.14 ±0.70^{bcd}
28	334.45 ±7.65^{abcde}	254.82 ±6.32^{abc}	43.13 ±1.21^{bc}	31.83 ±2.12^{abc}	12.89 ±0.33^{cd}	9.46 ±0.54^{abcd}
29	325.92 ±13.45^{bcde}	244.81 ±11.11^{bc}	45.39 ±2.13^{bc}	31.20 ±3.72^{abc}	13.90 ±0.57^{abc}	9.66 ±0.95^{abc}
30	301.73 ±18.10^{def}	230.85 ±14.95^{bc}	43.59 ±2.87^{bc}	22.62 ±5.0^{cd}	14.33 ±0.77^{abc}	7.70 ±1.28^{cd}
31	304.93 ±12.15^{def}	231.96 ±10.03^{bc}	41.36 ±1.92^{c}	27.23 ±3.36^{cd}	13.55 ±0.52^{bcd}	8.95 ±0.86^{abcd}

1/: Means with different superscript letters differ significantly within the column.

Effect of slaughter mass

The cattle with slaughter mass heavier than 650 kg had higher averages of chilled carcass mass, total of lean meat, bone, fat, and tendon mass and percentage of fat than other groups, as shown in Table 5. This results showed

that increased of slaughter mass, the chilled carcass mass, and total carcass composition (lean meat, bone, fat, and tendons) mass increased.

Effect of source farm

The source farm influenced chilled carcass mass, total masses of lean meat, bone and fat, and percents of bone and fat, as shown in Table 6. Farm 26 had the highest chilled carcass mass (379.84±25.11 kg) and total lean meat mass (288.30±20.74 kg), while farm 19 had the lowest:chilled mass 271.42±24.97 kg and total lean meat 212.43±20.62 kg. Farm 17 had the highest total bone mass (52.76±2.13 kg), but did not differ significantly from farms 25, 26 and 14.

The low average bone mass was found in carcasses from many farms, e.g. 7, 8, 12, 15, 18, 19, 23 and 31. Total fat mass was the highest in carcasses from farm 10 (45.10±6.95 kg), but did not differ significantly from farms 3, 4, 5, 18, 22, 23, 24, 25, 26, 28 and 29. Farm 17 had the highest percent bone (15.47±0.57%), while the lowest was found in farm 18 (11.14±1.09 %). The higest percent fat was detected in farm 10 (11.99±1.78 %), whereas the lowest was in farms 14 (6.55±1.28%), 19 (5.02±1.77 %) and 17 (6.15±0.95%).

Discussion

We found that chilled carcass mass, total mass of lean meat and bone and tendon mass and percent in males were higher than those of females. Our results agreed with Irshad *et al*. (2013) and Guerrero *et al*. (2013), who found that sex had an important influence on fatness and conformation in cattle. All males produce carcasses with more muscle than castrated males. Young bulls produce the leanest carcasses, followed by culled cows and steers, with heifers on average producing the fattest. However, our results showed no significant differences between males and females for total fat mass, percent of lean meat, bone and fat, and proportions of muscle:bone and muscle:fat.

Our results showed that the lowest total bone mass and in percent and the highest total fat mass and percent in dairy cattle 5 years or older. The muscle:fat ratio was similar. Moreover, slaughter mass, chilled carcass mass and total carcass composition (lean meat, bone, fat, and tendons) increased for the 3 to 4 years old cattle. The highest percent fat was found with slaughter masses heavier than 650 kg. These results are consistent with Irshad *et al.* (2013), who observed that the amount of fat in the older and heavier animals increased but the amount of muscles and bone decreased.

The members of Beef Cluster Cooperative Ltd fattened their dairy cattle animals with different management systems, especially different diet formulars

with different kinds of roughage (Supphakitchanon *et al.*, 2015). Our results found that the source farm, an important extrinsic factor, influenced on almost of carcass composition except total tendons mass and percent of lean meat (P>0.05). Moreover, the proportion of both muscle to bone, and muscle to fat trended to be affected by the farm factor (P=0.06 for muscle to bone ratio, and P=0.07 for muscle to fat ratio). The three farms with the highest muscle:bone ratio were farm 18 (6.95±0.53), 20 (6.36±0.52) and 4 (6.31±0.52), whereas farms 17 and 14 had the lowest: 4.94±0.28 and 5.10±0.38, respectively. The ratio muscle:fat is the most important factor in carcass composition. The ratio in culled dairy cows was lower than for beef cattle (Irshad *et al.*, 2013). The three farms which had the highest of muscle:fat ratio were farms 19 (14.68±2.32), 17 (11.98±0.96), 8 (11.73±1.13), whereas lowest were farms 23 (6.40±1.13), 10 (6.67±1.68) and 4 (6.91±1.25).

The intrinsic factors - sex, age, and slaughter mass - affected most of carcass composition. Males had higher chilled carcass mass, total mass of lean meat and bone and tendons mass and percent than females. 3 to 4 yr old animals had the highest of muscle to fat ratio. Increased of slaughter mass group, the chilled carcass mass, and total carcass composition (lean meat, bone, fat, and tendons) in kilograms was increased. The extrinsic factor, source farm, was also an important factor. To improve dairy beef cattle carcass composition, results from present study should be distributed directly to all farms through the cooperative manager.

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