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The relationship between the carcass characteristics and meat composition of young Simmental beef cattle

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Abstract. The objective was to study the relationships between the carcass characteristics and meat composition of young Simmental beef, classified with regard to conformation and degree of fatness scores, and total lipid content, depending on gender. For this purpose, 90 animals (60 male and 30 female Simmental beef cattle) were analysed. The results of the study showed that gender affected carcass measurement scores and chemical composition of meat through its important effect on overall animal fatness. Referring to correlations, male carcass conformation score was negatively related to slaughter weight, total lipid content and fatness score. On the other hand, slaughter weight, hot and cold carcass weight, dressing percentage and carcass conformation was positively related to fatness score, all of them being significant. However, female carcass conformation score was positively related to slaughter weight, total lipid content and fatness score. Hot and cold carcass weights of female Simmental beef cattle were positively correlated to slaughter weight, total lipid content and carcass conformation score. Carcass conformation score and fatness score were affected by gender of young Simmental beef cattle.

1. Introduction

The quality of the beef is affected by many factors, including gender, feeding, animal handling, slaughter of animal, genotype of animals [1-3]. In the European Union, beef carcass classification for conformation and fatness play important point in marketing within and between countries [4]. Nowadays, the food industry prefers to buy steers because they have carcasses with higher fat deposits as indicated by fat thickness and marbling [5,6]. Therefore, meat price in the market is positively related to carcass conformation [7]. Many studies [8-10] have shown the relationships among production factors and beef carcass characteristics. The objectives of this study were to determine the relationship between carcass characteristics and meat composition of young Simmental beef cattle, using the European beef carcass grading system.

2. Materials and Methods

We analysed the carcasses from 60 male and 30 female Simmental beef cattle. Bulls were fasted 18 h before slaughter. Final live weights were recorded. Cattle were slaughtered at a commercial

slaughterhouse. After slaughter, hot and cold carcass weights were obtained. Dressing proportions were calculated as the ratio of cold carcass weight to final live weight.

The carcasses were divided between the 12th and 13th rib interface into forequarters and hindquarters [11]. Carcass were classified using the SEUROP classification scales for conformation (S-superior; E-excellent; U-very good; R-good; O-fair; P-poor) scoring from 18 for S+ to 1 for P-. For the fatness classification (1-low; 2-slight; 3-average; 4-high; 5-very high) the score was 15 for 5+ and 1 of 1-. Moisture content was calibrated by reference to an oven drying method [12], fat content by Soxhlet extraction [13] and protein content according ISO [14]. Total cholesterol (mg/100 g of muscle) was determined according to Maraschiello et al. [15].

Statistical analyses of the results were conducted using software GraphPad Prism version 7.0 for Windows (GraphPad Software, San Diego California USA, www.graphpad.com). All parameters were described by descriptive statistics (mean, standard deviation, minimum and maximum value). Pearson's correlation was used to determine relationships among carcass characteristics and carcass weight, total lipids, conformation score and fatness score.

3. Results and Discussion

Characterization of the experimental population is presented in Table 1. In this study, slaughter weight ranged from 403.8 to 715.6 kg (males) and 417.3 to 662.8 kg (female), which is in accordance with results of other authors [3, 16, 17].

The weights of male yearlings (Domestic Simmental) ranged from 499 kg to 604 kg, while females of the same breed ranged from 430 kg to 481 kg [18]. According to Dokmanovic et al. [19], the average weight of yearlings was 533 kg for male and 421 kg for female animals. The average hot carcass weight and cold carcass weight were similar to those in other studies [20,3]. The dressing percentage was between 53.20% and 61.40% (male), 53.30% and 58.30% (female). Our results for dressing percentages accorded with those of Waritthitham et al. [21] and Sanudoa et al. [22]. Drca [18] reported that male Domestic Simmental cattle in Serbia had dressing percentages between 54.20% and 55.40%, while females achieved between 53% and 55.40%.

Average weights of forequarters and hindquarters of males and females are shown in table 1. Males had higher forequarter and hindquarter weights than female cattle. Carcass conformation score and carcass fatness score were affected by gender. On average, males had leaner carcass than the carcasses of females.

Table 1. Mean, standard deviation (SD), minimum (Min) and maximum (Max) value of carcass characteristics of young Simmental beef cattle (male and female).

	Male				Female			
	Mean	SD	Min	Max	Mean	SD	Min	Max
Slaughter weight (kg)	583.9	70.95	403.8	715.6	541.5	55.76	417.3	662.8
Hot carcass weight (kg)	329.9	50.28	218.0	429.6	305.6	31.82	240.4	385.8
Cold carcass weight (kg)	322.1	50.05	212.8	421.9	296.5	31.28	234.5	374.3
Dressing percentage (%)[a]	56.32	2.32	53.20	61.40	56.42	1.36	53.30	58.30
Forequarter weight (kg)	176.1	28.40	112.0	234.1	161.5	16.08	128.2	202.6
Hindquarter weight (kg)	146.1	22.13	100.8	187.8	135.0	15.53	106.3	171.7
Conformation score[b]	13.91	1.38	12.00	16.00	15.39	0.92	14.00	16.00
Fatness score[c]	9.72	2.17	6.00	15.00	12.88	1.42	10.50	15.00

[a] carcass weight x 100/live weight.
[b] – 1 = P (poorest) to 18 = S+ (best).

[c] – 1= (leanest) to 15 = 5+ (fattest).

The chemical composition in this study is represented by several factors: moisture, ash, crude protein, total lipids and total cholesterol. Chemical composition of the *Longissimus* muscle (table 2) revealed that the differences in moisture and total lipids content were due to gender. Generally, males had lower total lipid content than did females. Minchin et al. [23] suggest that the higher percentage for total lipids in cows is due to their high deposition of fat. The low percentage of total lipids in bulls is explained by testosterone; this hormone is related to the higher capacity for muscle growth in bulls and their lower capacity for fat deposition [24]. Variations in moisture percentage occur when there is a variation in lipid percentage in *Longissimus* muscle [6,25]. Some authors [6,25] reported crude protein percentage in *Longissimus* muscle varying between 21% and 24%. Thus, nutrition and gender can alter crude protein percentage in *Longissimus* muscle of bovines.

Table 2. Chemical composition (mean, standard deviation (SD), minimum (Min) and maximum (Max) values) of *Longissimus* muscle of young Simmental beef (male and female).

	Male				Female			
	Mean	SD	Min	Max	Mean	SD	Min	Max
Moisture (%)	75.72	1.69	71.45	78.78	72.44	0.85	70.66	74.01
Ash (%)	0.93	0.14	0.69	1.64	0.89	0.06	0.79	1.02
Crude protein (%)	21.05	0.75	19.16	22.92	21.01	0.87	18.38	22.26
Total lipids (%)	2.23	1.50	0.50	6.14	5.71	1.47	3.42	9.34
Total cholesterol (mg/100 g of muscle)	49.05	6.12	40.15	62.96	58.83	13.50	43.99	84.12

Correlations between carcass characteristics and slaughter weight, total lipids, conformation score and fatness score of young male Simmental beef cattle are presented in table 3. Slaughter weight was positively correlated to fatness score, but negatively to conformation score. Hot and cold carcass weight had the strongest correlations with slaughter weight. These relationships are consistent with those reported in other studies [26-28]. As carcass weight increased, carcass dimensions (forequarter weight and hindquarter weight) increased. Carcass conformation score was negatively correlated to slaughter weight, total lipid content and carcass fatness score. On the other hand, fatness score was positively correlated to slaughter weight and total lipid content. Not surprisingly, the carcass fatness score most strongly associated with total lipid content. Similar results were presented by Indurain et al. [4].

Table 3. Correlation coefficients (r) between carcass characteristics with slaughter weight, total lipids, conformation score and fatness score of young male Simmental beef.

	SW[c]	TL[d]	CS[b]	FS[e]
Slaughter weight (kg)	-	0.002	-0.087	0.408**
Hot carcass weight (kg)	0.810	0.308	0.014	0.374**
Cold carcass weight (kg)	0.816	0.317	0.008	0.380**
Dressing percentage (%)[a]	0.682***	0.267	-0.018	0.368**
Forequarter weight (kg)	0.819	0.341	-0.001	0.357**
Hindquarter weight (kg)	0.793	0.254	0.022	0.399**
Conformation score[b]	-0.049	-0.123	-	-0.060
Fatness score[c]	0.293*	0.349*	-0.060	-

[a] carcass weight x 100/live weight.
[b] Conformation score – 1 = P (poorest) to 18 = S+ (best).
[c] Slaughter weight (kg).
[d] Total lipids (%).
[e] Fatness score – 1= (leanest) to 15 = 5+ (fattest).
*P<0.05; **P<0.01; ***P<0.001.

Table 4 shows correlations between carcass characteristics with slaughter weight, total lipids, conformation score and fatness score of young female Simmental beef cattle. The female slaughter weight was moderately correlated with total lipid content. Similarly, hot carcass weight and cold carcass weight had moderate correlations with total lipid content. This is because female cattle deposit more fat than males [6]. Males produce higher slaughter weight carcasses than female cattle. This greater growth of male in comparison with female cattle seems to be due to the higher production of anabolic hormones by the testicles [29]. Dressing percentage was negatively correlated to slaughter weight, total lipids, conformation score and fatness score. Carcass fatness score was positively correlated with total lipid content and as a consequence, had a similar relationship with the conformation score. These relationships agree with results reported earlier [26,28].

Table 4. Correlation coefficients (r) between carcass characteristics with slaughter weight, total lipids, conformation score and fatness score of young female Simmental beef cattle.

	SW[d]	TL[e]	CS	FS
Slaughter weight (kg)	-	0.537	-0.002	-0.105
Hot carcass weight (kg)	0.176	0.604	0.109	-0.115
Cold carcass weight (kg)	0.971	0.596	0.097	-0.115
Dressing percentage (%)[a]	-0.071	-0.064	-0.097	-0.234
Forequarter weight (kg)	0.959	0.500	0.055	-0.119
Hindquarter weight (kg)	0.963	0.648	0.139	-0.108
Conformation score[b]	0.185	0.143	-	0.094
Fatness score[c]	-0.054	0.313	0.094	-

[a] carcass weight x 100/live weight.
[b] CS Conformation score – 1 = P (poorest) to 18 = S+ (best).
[c] FS Fatness score – 1= (leanest) to 15 = 5+ (fattest).
[d] SW Slaughter weight (kg).
[e] TL Total lipids (%).
*P<0.05; **P<0.01; ***P<0.001.

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