

Effects of different initial weights on fattening performance, slaughter and carcass characteristics of Holstein Friesian and Brown Swiss young bulls

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ABSTRACT

A total of 27 young bulls [13 Brown Swiss (BS) and 14 Holstein Friesian (HF)] were fed to investigate the effects of initial fattening weights [light weight group (LG= 176.0± 3.5 kg) and heavy weight group (HG= 213.8±3.7 kg)] on the performance, slaughter and carcass traits. With increasing initial fattening weight, final weight ($P<0.01$), cold carcass weight ($P<0.01$), heart weight ($P<0.05$) and front and hind feet weight ($P<0.05$) increased. Final weight, total weight gain, amount of feed consumed per kg weight gain, spleen weight, yield grade and cutability values were in favour of BS compared to HF. All of the carcass measurements were significantly affected by the initial fattening weights in favour of bulls in HG. Average SEUROP conformation score of HG carcasses was one class better than that of LG carcasses. It was concluded that young bulls in HG had better slaughter characteristics, carcass measurements and percentage of kidney, pelvic and heart fat than these in LG, while performance and feed efficiency ratio of the animals in the different weight groups were not statistically different.

Key words: Brown Swiss, Carcass traits, Fattening performance, Holstein Friesian, Initial fattening weights.

INTRODUCTION

In recent years, there is an increasing trend for using pure and crossbred of Brown Swiss (BS) and Holstein Friesian (HF) males with native breeds for fattening purpose as a consequence of demands of consumers for high quality beef in the eastern region of Turkey. Besides of breed, there are other factors affecting beef quality, carcass traits and profitability of the fattening of cattle. The factors are classified as intrinsic factors (gender, age and weights of animals at the beginning of the fattening, as well as age and weight at slaughter) and extrinsic factors (management, stress agents, type of diet, additives, pre-slaughter conditions, post-slaughter conditions etc.) (Guerrero *et al.* 2013). Initial fattening weight is one of the most significant factors influencing fattening performance as well as feed conversion efficiency and profitability in beef cattle production (Demircan, 2008). Although comparison of fattening performance, carcass and slaughter characteristics of BS and HF young bulls were made by several researchers (Tuzemen *et al.* 1990, Akcan *et al.* 1992, Ozdogan 2007), there is no published report on the effect of different initial body weights of BS and HF young bulls reared in Eastern Region of Turkey on fattening performance, carcass and slaughter traits. Therefore, this study was undertaken to determine the effect of various initial fattening weights on the weight gain, feed

efficiency ratio, slaughter and carcass traits of young BS and HF bulls.

MATERIALS AND METHODS

In this study, 13 BS and 14 HF young bulls reared in the Research Farm of College of Agriculture at Ataturk University, Erzurum, Turkey were used. Before initiation of the fattening, all animals were weighted after 12 h starvation on each of 2 consecutive days in order to determine average initial fattening weight. The young bulls were grouped according to the averages of the initial fattening weights. The treatment groups were called as i) light weight group (LG) with 176.0± 3.5 kg of average initial weight or ii) heavy weight group (HG) with 213.8±3.7 kg of average initial weight. The animals were individually fed a ration consisting of 30 % dry hay and 70 % concentrate. They were also adapted to the ration for two weeks. Amount of feed given to the animals were determined according to their weights obtained at two weeks intervals during the fattening period (NRC, 1996).

The fattening animals were kept in a tied stall barn furnished with individual feeders and automatic drinking bowls. Amounts of concentrate and dry hay offered to each animal were recorded daily and the quantities of the feed remained in the feeder were also weighed daily to determine

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feed intake. The feed efficiency ratio was calculated, dividing the dry matter intake by the weight gain. Samples of all feed components were obtained monthly and dry matter, crude protein as Kjeldahl nitrogen, ether extract, crude ash, crude cellulose levels in the feeds were determined (Tyznik, 1992; AOAC, 2000). The chemical compositions of the feeds are presented in Table 1.

TABLE 1: Chemical compositions of the feed used in this study.

Nutrients, %	Concentrate	Dry Hay
Dry Matter	91.0	90.5
Crude Protein	15.1	10.4
Ether Extract	3.4	2.8
Crude Ash	6.1	8.6
Crude Cellulose	6.7	32.4
Nitrogen Free Extract	59.7	36.3

At the end of the fattening period, the bulls were weighed on 2 consecutive days in order to determine final fattening weight after 12 h fast by removing feed and water. The trial lasted for 280 days.

After all cattle were conventionally slaughtered in a commercial slaughterhouse, some of the non-carcass components such as lungs, head, hide, liver, heart, front and hind feet and spleen were removed and weighed. Then, carcass measurements such as carcass length, length of the round, width of the round, thoracic depth and width of the round from medial side were determined from the carcass (Ozluturk *et al.* 2004).

After a chill period at 4 °C for 24 h, cold carcass weight was obtained. Then, the carcasses were ribbed between 12th and 13th ribs, scored and graded by two trained carcass evaluators (USDA, 1989). The depth of the fat at three equally spaced locations over the Longissimus dorsi (LD) muscle, the area of LD muscle, colour score and marbling score were determined at the ribbing site. The scale used for determination of marbling ranged from 1 to 18 (1: slight, 2: slight⁰, 3: slight⁺, 4: small, 5: small⁰, 6: small⁺, 7: modest, 8: modest⁰, 9: modest⁺, 10: moderate, 11: moderate⁰, 12: moderate⁺, 13: slightly abundant, 14: slightly abundant⁰, 15: slightly abundant⁺, 16: abundant, 17: abundant⁰, 18: abundant⁺). Colour scores were obtained from by using Standards for Beef Colour, developed by New Mexico State University Agricultural Experimentation Station, USA (Unlu *et al.* 2008). The scale of colour evaluation ranged from 1 to 8 (1: bleached red, 2: very light cherry red, 3: moderately light cherry red, 4: cherry red, 5: slightly dark red, 6: moderately dark red, 7: dark red; 8: very dark red). Kidney, heart and pelvic fat was also weighed and recorded. All carcasses were evaluated for yield grade and cutability

(the proportion of trimmed, boneless, saleable retail meat cuts from a carcass) was predicted by using a mathematical equation reported by Boggs and Merkel (1984).

Left halves of the carcasses were appraised subjectively for conformation [scale SEUROP, from S: superior (1), E: excellent (2), U: very good (3), R: good (4), O: fair (5) to P: poor (6)] and fatness (scale 1-5, from 1: entire carcass covered with fat) by utilising photographic patterns according to the routinely used by European Union SEUROP classification system (EEC, 1991).

In the statistical analysis, data were analyzed using a general model in order to determine the effect of initial fattening weight, breeds as well as initial fattening weight by breeds interactions (SPSS, 2004). The interaction was excluded from statistical model since it was not statistically significant at the preliminary analysis. The mathematical model used for analysis of variance was as follows:

$$Y_{ijk} = \mu + a_i + b_j + e_{ijk}$$

Where:

Y_{ijk} : Dependent variables (Traits of fattening performance, feed efficiency ratios, slaughter characteristics, amounts of non-carcass components, carcass traits, carcass measurements),

μ : Overall mean,

a_i : Effect of initial fattening weight groups (LG, HG),

b_j : Effect of breeds (BS, HF),

e_{ijk} : Residual error.

RESULTS AND DISCUSSION

Least square means with standard errors for fattening performance and feed efficiency ratio are presented in Table 2. Average final weight of the young bull in HG was 7.7 % heavier than that of animals in LG. The result is in agreement with findings of Elam *et al.* (2003), Koc and Akman (2003), Yerturk *et al.* (2011). Total weight gain of the animals in LG and HG were not significantly affected by the different initial weight groups as already reported by Demircan (2008), Bozkurt and Kaya (2008) and Mundan *et al.* (2012). The significant difference between the final weights could be attributed to different initial weight groups of the young bulls, and similar total weight gains of these weight groups. Even though average total weight gain of the young bulls in LG group was higher than that of animals in HG group, the difference was not statistically significant.

Final weights and total weight gains were also significantly ($P < 0.01$) affected by breeds. BS young bulls had 7.7 % and 15.2 % higher final weight and total weight gain than HF bulls respectively. Higher weight gain of BS

compared with HF was already reported by Ozdogan (2007) and Aydin et al (2013).

Amounts of hay, concentrate, and total feed consumed per kg weight gain were not significantly affected by the initial fattening weight groups. The result is in accordance with findings of Demircan (2008) and Mundan *et al.* (2012). However, the breeds were significant source of variation in the feed efficiency ratios for hay, concentrate and total feed (Table 2). BS bulls had lower quantities of feed per kg weight gain (8.1 vs. 9.4 kg). The finding is in harmony with results of Ozdogan (2007) and Aydin *et al.* (2013) who reported amount of total feed consumed per kg weight gain as 9.95 vs. 11.19 kg and 8.0 vs. 8.8 kg for BS and HF respectively.

Least square means with standard errors for amount of non-carcass components are presented in Table 3. As long

as increasing of the initial weight of the animals, weights of the non-carcass components increased numerically. However, only weights of the heart and feet among the all non-carcass parts were significantly ($P<0.05$) different, and the result could be attributed to the heavier final weight of the young bulls in HG compared with these in LG. Similarly to our findings, Koc and Akman (2003) reported heavier heart weight of the bulls in the low initial fattening weight group than that of animals in the heavy initial weight group. Non-carcass components of BS and HF young bulls were not statistically different except for weight of the spleen. The result is in accordance with the finding of Kizil and Aydogan (2014). Additionally, breed difference in terms of weight of the spleen was statistically significant in favour of BS bulls as already reported by Akcan *et al.* (1992) and Aydin *et al.* (2013).

TABLE 2: Least squares means with standard errors for fattening performance traits and amount of feed consumed per kg weight gain.

	N	Initial Weight (kg)	Final Weight (kg)	Total Weight Gain (kg)	Amount of feed consumed per kg weight gain for		
					Hay (kg)	Concentrate (kg)	Total (kg)
	27	$\bar{X} \pm S_x^-$	$\bar{X} \pm S_x^-$	$\bar{X} \pm S_x^-$	$\bar{X} \pm S_x^-$	$\bar{X} \pm S_x^-$	$\bar{X} \pm S_x^-$
Weight Groups							
Light Group	14	176.0±3.5	445.0±5.7	269.0±5.9	3.2±0.08	5.5±0.1	8.7±0.2
Heavy Group	13	213.8±3.7	479.5±5.9	265.8±6.2	3.2±0.08	5.6±0.1	8.8±0.2
Significance		**	**	NS	NS	NS	NS
Breeds							
Brown Swiss	13	193.1±3.7	479.4±5.9	286.3±6.2	3.0±0.1	5.1±0.1	8.1±0.2
Holstein Friesian	14	196.7±3.5	445.1±5.7	248.4±5.9	3.5±0.1	5.9±0.1	9.4±0.2
Significance		NS	**	**	**	**	**

** : $P<0.01$, NS: Non-Significant

TABLE 3: Least squares means with standard errors for amount of non-carcass components (kg).

	N	Lung (kg)	Head (kg)	Hide (kg)	Liver (kg)	Heart (kg)	Kidney (kg)	Front and Hind Feet (kg)	Spleen (kg)
	27	$\bar{X} \pm S_x^-$	$\bar{X} \pm S_x^-$	$\bar{X} \pm S_x^-$	$\bar{X} \pm S_x^-$	$\bar{X} \pm S_x^-$	$\bar{X} \pm S_x^-$	$\bar{X} \pm S_x^-$	$\bar{X} \pm S_x^-$
Weight Groups									
Light Group	14	5.1±0.2	18.2±0.8	33.0±1.2	6.8±0.2	2.1±0.1	1.2±0.1	9.0±0.2	1.2±0.1
Heavy Group	13	5.7±0.2	18.5±0.8	34.7±1.3	7.1±0.3	2.4±0.1	1.3±0.1	9.7±0.2	1.2±0.1
Significance		NS	NS	NS	NS	*	NS	*	NS
Breeds									
Brown Swiss	13	5.6±0.2	18.1±0.8	35.3±1.3	6.8±0.3	2.4±0.1	1.3±0.1	9.5±0.2	1.3±0.1
Holstein Friesian	14	5.2±0.2	18.6±0.8	32.4±1.2	7.1±0.2	2.1±0.1	1.2±0.1	9.2±0.2	1.1±0.1
Significance		NS	NS	NS	NS	NS	NS	NS	*

** : $P<0.01$, * : $P<0.05$, NS: Non-Significant

Least square means with standard errors for slaughter traits are presented in Table 4. Although cold carcass weight ($P<0.01$) was significantly influenced by the initial fattening weights, the breeds did not result in a significant variation in these slaughter characteristics. Likewise, Demircan (2008) reported a significant ($P<0.05$) increase of carcass weights from 250.71 kg to 328.93 kg by increasing initial body weights of the cattle. Rosati *et al.* (2007) also reported an increase of carcass weight as a consequence of increasing initial fattening weight. Insignificant effects of the breeds on the quantities of the amount of non-carcasses components were also revealed by Kizil and Aydogan (2014).

Means for SEUROP conformation and fatness scores used by countries in European Union for evaluation of the amount of fleshiness and fat in the beef carcasses are presented in Table 4. Carcasses from animals in HG and LG

regarding with carcass conformation scores were evaluated as U (very good shape and muscle development of the carcass) and R (good shape and muscle development of the carcass) respectively, and they were significantly ($P<0.05$) different. On the other hand, SEUROP fatness scores of the both initial weight groups were not statistically different, and they were slightly covered by fat with flesh visible almost everywhere. SEUROP conformation score of BS carcasses was one class ($P<0.01$) better than HF carcasses. Similarly, Monson *et al.* (2004) and Onenc (2004) reported better carcass conformation score of BS compared with HF. However, average SEUROP fatness scores of the BS and HF were not significantly different each other. The result is in accordance with finding of Monson *et al.* (2004).

In Table 5, least square means with standard errors for carcass traits are tabulated. Carcass fat parameters such as marbling score, amounts of kidney, pelvic and heart fat

TABLE 4: Least squares means with standard errors for slaughter characteristics.

	N	Cold Carcass Weight (kg)	Cold Dressing (%)	Conformation (SEUROP) (1-6 scores)	Fatness (SEUROP) (1-5 scores)
	27	$\bar{X} \pm S_x^-$	$\bar{X} \pm S_x^-$	$\bar{X} \pm S_x^-$	$\bar{X} \pm S_x^-$
Weight Groups					
Light Group	14	230.1±5.0	51.6±1.0	4.2±0.2	2.1±0.1
Heavy Group	13	256.0±5.2	53.5±1.0	3.6±0.2	2.2±0.1
Significance		**	NS	*	NS
Breeds					
Brown Swiss	13	248.6±5.2	51.9±1.0	3.4±0.2	2.1±0.1
Holstein Friesian	14	237.4±5.0	53.3±1.0	4.4±0.2	2.2±0.1
Significance		NS	NS	**	NS

**: $P<0.01$, *: $P<0.05$, NS: Non-Significant

TABLE 5: Least squares means with standard errors for carcass traits.

	N	Marbling Score	Kidney, Pelvic and Heart Fat (kg)	Fat Thickness Over LD ² (mm)	KPH ¹ Fat (%)	Yield Grade	Retail Cuts Percentage (%)	Colour Scores
	27	$\bar{X} \pm S_x^-$	$\bar{X} \pm S_x^-$	$\bar{X} \pm S_x^-$	$\bar{X} \pm S_x^-$	$\bar{X} \pm S_x^-$	$\bar{X} \pm S_x^-$	$\bar{X} \pm S_x^-$
Weight Groups								
Light Group	14	2.6±0.4	7.9±0.4	5.5±0.4	3.2±0.01	1.2±0.1	53.9±0.2	5.7±0.2
Heavy Group	13	3.2±0.4	7.6±0.4	5.5±0.5	2.8±0.02	1.1±0.1	54.1±0.2	6.2±0.2
Significance		NS	NS	NS	NS	NS	NS	*
Breeds								
Brown Swiss	13	3.3±0.4	7.9±0.4	6.1±0.5	3.0±0.02	0.9±0.1	54.3±0.2	6.1±0.2
Holstein Friesian	14	2.5±0.4	7.6±0.4	4.9±0.4	3.0±0.01	1.3±0.1	53.7±0.2	5.8±0.2
Significance		NS	NS	NS	NS	*	**	NS

¹KPH: Kidney pelvic heart, ²LD: Longissimus dorsi, **: $P<0.01$, *: $P<0.05$, NS: Non-Significant

TABLE 6: Least squares means with standard errors for carcass measurements (cm).

	N	Carcass Length (cm)	Length of the Round (cm)	Thoracic Depth (cm)	Width of the Round from Medial Side (cm)	Width of the Round (cm)
		$\bar{X} \pm S_x$	$\bar{X} \pm S_x$	$\bar{X} \pm S_x$	$\bar{X} \pm S_x$	$\bar{X} \pm S_x$
Weight Groups						
Light Group	14	138.7±1.0	70.2±0.4	42.9±0.4	40.9±0.5	26.4±0.4
Heavy Group	13	141.3±1.0	72.1±0.4	44.2±0.4	42.3±0.5	27.4±0.4
Significance		*	**	*	*	*
Breeds						
Brown Swiss	13	140.2±1.0	71.2±0.4	43.7±0.4	41.9±0.5	27.0±0.4
Holstein Friesian	14	139.8±1.0	71.1±0.4	43.4±0.4	41.3±0.5	26.8±0.4
Significance		NS	NS	NS	NS	NS

** : P<0.01, * : P<0.05, NS: Non-Significant

(KPH), percentage of KPH as well as fat thickness over LD muscle were not significantly affected by the initial fattening weight and breed groups. In other words, heavier bulls at the beginning of the trial did not result in higher degree of the fatness in their carcasses. The result is in agreement with the finding of Rosati *et al.* (2007) who reported that increased initial feedlot weight did not affect on marbling score and 12 th rib fat thickness of the cattle carcasses. Kizil and Aydogan (2014) also reported insignificant differences between BS and HF cattle concerning marbling, amount and percentage of KPH as well as back fat thickness over LD.

Yield grade (P<0.05) and retail cuts percentage available for consumer (cutability) (P<0.01) values were significantly affected by breeds. The cutability and yield grade of the BS carcasses were superior to HF carcasses. However, the initial fattening weight groups did not have significant influence on these parameters. While initial fattening weight groups was significant (P<0.05) source of variation on the meat colour, breeds did not have significant effect on the beef colour (Table 5). The result is in harmony

with the result of Aydin *et al.* (2013) who reported insignificant effect of HF and BS breeds on the scores of the meat colour.

Least square means with standard errors for carcass measurements are presented in Table 6. While there was an increasing trend in carcass measurements with increasing initial fattening weights of the young bulls, the breed differences were not statistically significant.

In conclusion, increasing initial fattening weight resulted in favourable influence on final weight, cold carcass weight, heart weight, front and hind feet weight and SEUROP conformation score as well as all carcass measurements such as carcass length, length of the round, width of the round, thoracic depth and width of the round from medial side. Even though average weights of the BS and HF young bulls at the beginning of the fattening were not statistically different, total weight gain, final weight, amount of feed consumed per kg weight gain, spleen weight, yield grade and cutability values were in favour of BS breed. BS carcasses also had better SEUROP carcass conformation score than HF bulls.

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