Evaluation of Slaughter Weights and Carcass Traits of Bulls Marketed in South Marmara Region of Turkey

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Abstract: In this study, the slaughter weights and carcass traits of bulls which slaughtered in three abattoirs located in the South Marmara Region of Turkey were evaluated. For this aim, data from a total of 1002 bulls including 812 purebred Holstein-Friesian, 135 purebred Simmental, 29 Holstein crossbred and 26 Turkish Grey Steppe bulls were used. Additionaly, slaughter weights and carcass traits were compared between 693 Turkey-born Holstein bulls and 119 Holstein bulls imported from Hungary. Bulls were slaughtered according to standard commercial procedures. Hot and chilled carcass weights, dressing percentage and chilling loss were determined. The data were analysed using the one-way analysis of variance (ANOVA) and Student's t-test. The effect of breed was statistically significant on all the traits analysed (P<0.001). The greater slaughter weights, hot and chilled carcass weights, dressing percentage and chilling loss were observed in Simmental bulls. Moreover, imported Holstein bulls had higher dressing percentage compared to Turkey-born Holstein bulls (P<0.001). The present results may be useful for meat industry and for evaluation of carcass traits in market of Turkey.
Keywords: *Cattle, Holstein, Simmental, Turkish grey cattle.*

Türkiye'nin Güney Marmara Bölgesinde Pazara Sunulan Erkek Sığırların Kesim Ağırlığı ve Karkas Özelliklerinin Değerlendirilmesi

Özet: Bu çalışmada, Türkiye'nin Güney Marmara Bölgesinde bulunan üç mezbahada kesimi yapılan Erkek sığırların kesim ağırlıkları ve karkas özellikleri değerlendirilmiştir. Bu amaçla, 812 baş saf Holştayn-Frizyan, 135 baş saf Simental, 29 baş Holştayn melezi ve 26 baş Boz ırkından oluşan toplam 1002 baş boğaya ait veriler kullanılmıştır. Bunun yanı sıra, 693 baş Türkiye-doğumlu Holştayn boğalar ile 119 baş Macaristan'dan ithal edilen Holştayn boğalara ait kesim ağırlıkları ve karkas özellikleri karşılaştırılmıştır. Erkek sığırların kesimi standart kesim prosedürlerine göre gerçekleştirilmiştir. Sıcak ve soğuk karkas ağırlıkları, karkas randımanı ve soğutma firesi belirlenmiştir. Verilerin değerlendirilmesinde tek yönlü varyans analizi ve Student t-testi kullanılmıştır. Irk etkisi incelenen tüm özellikler üzerine istatistiksel düzeyde etkilidir (P<0,001). Kesim ağırlıkları, sıcak ve soğuk karkas ağırlıkları, karkas randımanı ve soğutma firesinin Simental boğalarda daha yüksek olduğu görülmüştür. Ayrıca, ithal Holştayn Erkek sığırların karkas randımanlarının Türkiye-doğumlu Holştayn sığırlara göre daha yüksek olduğu belirlenmiştir (P<0,001). Elde edilen sonuçların Türkiye'deki et endüstrisi ve pazara sunulan karkas özelliklerinin değerlendirilmesinde yararlı olacağı düşünülmektedir.
Anahtar Kelimeler: *Sığır, Holştayn, Simental, Boz ırk sığır.*

Introduction

The importance of carcass traits for the beef cattle industry is increasing, especially with the determination of more detailed carcass evaluation procedures. To maintain or increase production and to reach a potential of self-sufficient country with respect to red meat production, Turkey must continue to improve the process of carcass assessment. In 2016, 1,173,042 tonnes of red meat was produced from 9,741,786 animals slaughtered, including 3,900,307 cattle, 4,083,620 sheep, 1,756,360 goats and 1,499 water buffaloes in Turkey. Of this production, 1,059,195 tonnes (approximately 91% of total) was compiled of beef (Turkish Statistical Institute: TSI, 2017). However, demand for red meat has gradually increased with the population growth rate and the economic dynamics. The total number of Turkish cattle population was 14,080,155 in 2016. Among this population, Holstein breed comprises by far the most common cattle breed in Turkey, with 5.5 millions purebreds and 856 thousand crossbreeds and hence beef derived from Holstein breed is a very important source of Turkey beef supply (Turkvet-Turkish Ministry of Food, 2016). Holstein cattle, which are bred mainly for dairy purposes, carry a potential for improvement of beef production due to their genetic variability for beef traits (Ardicli et al., 2017). On the other hand,

possibilities of utilizing from dual-purpose cattle breeds for improving beef production should be considered as an important constituent when evaluating the countrys' meat industry. Simmental, as a versatile breed, is one of the oldest and also the most widely distributed breed in the world. The importance of Simmental breed, besides its high milk yield and reproduction performance, is also seen in achieving high fattening performance and disease resistance (Koc, 2016). Turkish Grey Steppe cattle is one of the important domestic livestock resources of Turkey (Soysal and Kok, 2006). This breed probably originated from the Iskar or Bulgarian Grey Steppe and in addition the Turkish variety can be evaluated as a dual purpose cattle breed. It is well adapted to harsh environmental conditions and able to survive on low-quality feed (Yilmaz et al., 2012).

There are evident differences between breeds and crossbreeds and between sires within a breed affecting the genetic variation in both quantity and quality of beef (Burrow et al., 2001). Estimating carcass traits for different cattle breeds is a way of achieving better sustainability and outcomes in cattle breeding and, thus, has economic importance at the selection process through meat yield. Turkey's beef production reached 1,014,926 tons in 2015 and 1,059,195 tons in 2016 (Turkish Statistical Institute: TSI, 2017). However, there is still a strong need for studies regarding ways to improve red meat production in Turkey with respect to high prices of beef and red meat deficit in the sector. In the literature, there are studies about the evaluation of carcass traits in Turkey's meat market, but these studies were mostly conducted on limited sample sizes. Therefore, the objective of the present study was to determine and to compare the slaughter weights and carcass traits of large number of bulls slaughtered in the abattoirs of South Marmara Region of Turkey. An additional aim was to evaluate the differences in mentioned traits between Holsteins raised in Turkey and Holsteins imported from Hungary.

Materials and Methods

Animals: Data from a total of 1002 bulls slaughtered in three abattoirs, located in South Marmara region of Turkey was used in the present study. The analysis included 812 purebred Holstein-Friesian, 135 purebred Simmental, 29 Holstein crossbred (Holstein X Turkish native cattle breeds) and 26 Turkish Grey Steppe bulls. Of the Holsteins included to analysis, 693 bulls were born and raised in Turkey; whereas 119 bulls were imported from Hungary. All animals were recorded for the Pedigree Project of the Turkish Ministry of Food, Agriculture and Livestock, and Cattle Breeders Association. Only animals with relevant data of slaughter and carcass weights were used in subsequent analyses. Moreover, the native Turkish breeds (except Turkish Greys), which were few in number, were excluded from the anaylsis.

Slaughter Procedures: The duration of transport from farm to abattoirs was approximately 1–2 h. Slaughter weight (SW) was determined as live weight prior to slaughter process and was recorded immediately before slaughter by precision scale (100 g sensitivity). Bulls were slaughtered by means of exsanguination according to standard commercial procedures, after being kept for 24 h in paddocks and deprived of feed but with full access to water. Following slaughter, all of the carcasses were electrically stimulated for a duration of 30 s (60 V). The hot carcass weight (HCW) was defined as the carcass weight of the slaughtered animal's body after being skinned, bled, and eviscerated, and removal of the external genitalia, the limbs at the carpus and tarsus, the head, the tail, the kidneys and kidney fats, and the scrotum (Pfuhl et al., 2007). After non-carcass components were removed; HCW was taken approximately 1 h postmortem. HCW was measured without removing the subcutaneous fat and keeping the kidney and pelvic fat. Carcasses were suspended through the achilles tendons and were chilled overnight at 4°C in a ventilated room. After chilling for at least 24 h, the carcasses were weighed, so that, chilled carcass weight (CCW) was determined. The dressing percentage (DP) was calculated based on both HCW and CCW. Chilling loss (CL) were determined after 24 h at 4°C and calculated as weight loss between hot and chilled carcasses (Journaux, 2007; Pfuhl et al., 2007).

Statistical Analysis: In the present study, all **s**tatistical analyses were performed using Minitab software (MINITAB®, USA, v17.1.0). Data were expressed as means and standard errors. In order to determine differences in slaughter weights and carcass traits in Holstein, Simmental, Holstein crossbred and Turkish Grey Steppe bulls, a one-way analysis of variance (ANOVA) was performed and when significant differences were identified, the mean values for group were contrasted using Tukey's test. In addition, comparisons between the two groups including Holsteins raised in Turkey and Holsteins imported from Hungary were performed with Student's t-test. For statistical comparisons a probability level of $P<0.05$ was accepted as statistically significant.

Results

The means, their respective standard errors and levels of significance obtained for the SW and carcass traits in Holstein, Simmental, Holstein crossbred and Turkish Grey Steppe bulls established are shown in Table 1. As expected, highly significant differences in SW, HCW, DP, CCW and CL are evident between all breed groups (P<0.001). Results revealed that Simmental bulls had higher means for all traits compared to other breeds included in this study. The mean for SW in Simmental bulls was 594.95±6.04 as shown in Table 1. Following Simmentals, the SW means were in Holstein (489.81±2.46), Holstein crosses (485.80±13.00) and Turkish Greys (472.55±14.20) order. Overall, the SW showed a significant effect of breed (P<0.001), with +105.14 kg, +109.15 kg and +122.40 kg higher weights in the case of Simmental bulls compared with the values of Holstein, Holstein crosses and Turkish Grey Steppe bulls, respectively. Further, HCW was also higher (P<0.001) for Simmental bulls (327.95±3.44 kg) in comparison to Holstein bulls (263.33±1.40 kg), Holstein crosses (259.54±7.43 kg) and Turkish Grey Steppe bulls (254.50±8.45 kg). Moreover, HCD was greatest (P<0.01) in Simmental bulls (54.98 %), intermediate for Holstein bulls (53.78 %) and Holstein crosses (53.46 %), and lowest for Turkish Grey (52.20 %) breed. According to the current results, Simmentals displayed + 64.62 kg, 68.41 kg and 73.45 kg greater HCW and 1.2 %, 1.52 % and 2.78 % greater HCD compared to Holstein, Holstein crosses and Turkish Grey Steppe bulls, respectively. In the present study, the breed was significantly effective on CCW and CCD (P<0.001) and results indicated that, the greatest CCW and CCD were observed in Simmental bulls. Accordingly, the mean CCW was 320.74±3.36 kg and the mean CCD was for 53.78±0.22 % for Simmentals which was an estimated +62.86 kg, + 65.05 kg and + 70.51 kg CCW and + 1.11 %, + 1.12 % and + 1.92 % compared to Holstein, Holstein crosses and Turkish Grey Steppe bulls, respectively. Results revealed that CCD, in accordance with the HCD results, was similar for purebred Holstein and Holstein crosses and the lowest dressing percentage was determined in Turkish Grey Steppe bulls. The effect of breed on CL was found to be statistically significant among the cattle breeds analysed. Markedly the highest value for the CL was observed in Simmental bulls. Mean CL was 0.07±0.02 % for Simmentals which was an estimated + 0.01 % and 0.03 % higher compared to Holstein, Holstein crosses and Turkish Grey Steppe bulls, respectively. Besides, Holstein crosses and Turkish Grey bulls had the same means for CL (0.04±0.01 %) as shown in Table 1. In the current study, apart from the comparison of SW and carcass traits among the breeds analysed, we also targeted to determine the differences in mentioned traits between purebred Holsteins born and raised in Turkey and purebred Holsteins imported from Hungary. However, results revealed that, few differences existed between two groups. Imported Holsteins had higher + 1.59 % HCD and + 1.61 % CCD compared to Turkey- born Holsteins as shown in Table 2. There was no significant difference in SW, HCW, CCW and CL between the two groups.

Table 1. The means, their respective standard errors and levels of significance obtained for the slaughter weights and carcass traits in Holstein, Simmental, Holstein crossbred and Turkish Grey Steppe bulls.

Trait	Holstein (n=812)	Simmental (n=135)	Holstein Crosses (n=29)	Turkish Grey (n=26)	Significance
Slaughter weight (kg)	489.81±2.46^{b}	594.95±6.04^{a}	485.80±13.00^{b}	472.55±14.20^{b}	P<0.001
Hot carcass weight (kg)	263.33±1.40^{b}	327.95±3.44^{a}	259.54±7.43^{b}	254.50±8.45^{b}	P<0.001
Hot carcass dressing (%)	53.78±0.09^{b}	54.98±0.21^{a}	53.46±0.46^{bc}	52.20±0.61^{c}	P<0.001
Chilled carcass weight (kg)	257.88±1.37^{b}	320.74±3.36^{a}	255.69±7.25^{b}	250.23±8.25^{b}	P<0.001
Chilled carcass dressing (%)	52.67±0.09^{b}	53.78±0.22^{a}	52.66±0.48^{b}	51.86±0.56^{c}	P<0.001
Chilling loss (%)	0.06±0.02^{b}	0.07±0.01^{a}	0.04±0.01^{b}	0.04±0.01^{b}	P<0.001

^{a,b,c} Different superscripts within a row indicate significant difference.

Table 2. The means, their respective standard errors and levels of significance obtained for the slaughter weights and carcass traits in Holsteins born and raised in Turkey and Holsteins imported from Hungary.

Trait	Holsteins Imported (n=119)	Holsteins Turkey (n=693)	Significance
Slaughter weight (kg)	483.10±6.70	490.96±2.78	NS
Hot carcass weight (kg)	266.66±3.74	262.76±1.55	NS
Hot carcass dressing (%)	55.13±0.22	53.54±0.09	P<0.001
Chilled carcass weight	261.37±3.64	257.28±1.51	NS
Chilled carcass dressing (%)	54.04±0.22	52.43±0.09	P<0.001
Chilling loss	0.05±0.01	0.05±0.01	NS

NS: non-significant.

Discussion

The primary objective of the current study was to evaluate the live weights prior to slaughter and carcass traits including HCW, HCD, CCW, CCD, and CL of bulls regarding the market in the South Marmara Region of Turkey and to determine the current situation in carcass assessment. The greater SW, HCW, HCD, CCW and CCD observed in Simmental bulls and this result could be attributed to the dual-purpose ability and the higher fattening performance of Simmentals. SW and carcass traits may vary due to the genetic background, age and sex of the animal, nutritional and environmental effects (Dannenberger et al., 2006). Accordingly, different, and sometimes, conflicting results of the studies conducted on various cattle breeds exist in the literature. Sochor et al. (2005) reported higher means of carcass weight (389.0±58.64 kg) and DP (55.90±2.39 %) in Simmental bulls compared to results of the present study. Similarly, Ustuner et al. (2017) determined higher HCW, CCW and DP in both young and old groups (according to initial fattening ages) of Simmental bulls. In addition, the results of studies performed by Chambaz et al. (2003), Sami et al. (2004), Dannenberger et al. (2006) and Alberti et al. (2008) revealed higher means for carcass weights. Conversely, Catikkas and Atakan (2017) reported lower HCW (309.25±3.45 kg) and CCW (303.99±3.37) but higher DP (54.29±0.60 %) in Simmental bulls. HCW and CCW found in this study for Holstein bulls were lower than earlier reports by Akman and Koc (2003), Barton et al. (2003), Dannenberger et al. (2006), Pfuhl et al. (2007), Alberti et al. (2008), and McNamee et al. (2015) but higher than Rotta et al. (2009). Zaujec et al. (2009) evaluated the carcass traits of young Holstein bulls from the viewpoint of qualitative classes for conformation and fattiness by means of SEUROP system and the carcass weights they determined that the carcass weights of U, R and O conformation classes were 289.0±39.72 kg, 251.56±30.01 kg and 226.64±30.88 kg, respectively. According to this classification, the HCW found in the present study were lower than U class but higher than R and O class. Similar result was also determined for the DP. Ogan et al. (2000) reported higher values of HCW, CCW and DP (including HCD and CCD) for Limousin X Holstein crossbred bulls than those obtained from the present study. It has traditionally been assumed that the rise in DP, as growth proceeds, is a direct result of increasing fatness (Simoes et al., 2005). Hence, evaluation of DP may present indicative results for both meat quantity and quality. DP found in this study for Holstein and Holstein crossbred bulls was higher than the results of the studies performed by Rotta et al. (2009) and Chladek and Falta (2014) but lower than that reported by Barton et al. (2003), Pfuhl et al. (2007), Alberti et al. (2008), Nogalski et al. (2014a) and Nogalski et al. (2014b).

Turkish Grey Steppe Cattle is one the most important national animal genetic resources of Turkey and is well adapted to harsh environmental conditions and able to survive on low-quality feed (Yilmaz et al., 2012). However, the information about this breed in the literature, especially carcass traits, is rather limited. In this study, we have evaluated carcass traits of Turkish Grey Steppe Cattle. Not surprisingly, the lower carcass weights (HCW and CCW), HCD and CCD for Turkish Greys compared to remaining breeds analysed. Although Turkish Greys have low production performance, this breed is characterized by high resistance to diseases or external parasites and very fast recovery when infected (Soysal and Kok, 2006). Hence, studies conducted on such native breeds should be performed to classify and conserve for sustainable development of animal genetic resources.

In the present study, only HCD and CCD were different between Holsteins born and raised in Turkey and purebred Holsteins imported from Hungary. Holstein-Friesian which are bred mainly for superiority in milk production have the capacity not only to produce beef but also a potential for improvement in beef production as indicated by their genetic variability for beef traits (Calo et al., 1973). Therefore, the dual capacity of the Holstein breed should be considered when evaluating the ways to meet the meat deficit in Turkey.

Carcass characteristics of beef cattle vary due to many factors including breed, genetic background, and environmental effects (Cross et al., 1984; Dannenberger et al., 2006). In addition, DP may differ substantially with increasing slaughter weights of bulls (Litwinczuk et al., 2006). Hence, unsteady results of carcass traits obtained from various cattle breeds can be evaluated as a common condition. Beef production trend has gradually changed from meat yield to meat quality in many countries (Ardicli et al., 2017). However, evaluating the ways to increase meat yield may be the crucial point to achieve significant economic benefits and to maintain sustainable production systems, especially in countries with meat production deficit.

Conclusion

This study focused on the evaluation of slaughter weights and carcass traits in Holstein, Simmental, Holstein crossbred and Turkish Grey Steppe Bulls slaughtered in the South Marmara region of Turkey. The present results confirm that

the lower carcass weights (HCW and CCW) for the Holstein crosses and Turkish Greys were determined by the lower SW and low carcass dressing in animals from this breed group. Greater SW, HCW, HCD, CCW, and CCD were observed in Simmental bulls. In addition, HCD and CCD were different between Holsteins born and raised in Turkey and Holsteins imported from Hungary. To achieve a sustainable meat production system, detailed assessment of carcass traits should be conducted and efficient databases should be established in Turkey. Therefore, the results of the current study may be useful and indicative for future studies on meat production traits in livestock.

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