# Fattening performance and carcass traits of imported Simmental bulls at different initial fattening age

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## SUMMARY

Fattening performance is one of the most important traits in cattle breeding. These traits are closely associated with adequate initial weights and slaughter endpoints. In this context, the aim of this study was to investigate optimum initial fattening age of imported Simmental young bulls and to provide a detailed analysis of initial fattening age effects on fattening performance and carcass characteristics. Seventy five animals were purchased from a single commercial farm where they had been reared under identical production conditions and were allocated into four groups according to age and live-weight as follows: Group I (4 months of age), Group II (6 months of age), Group III (8 months of age), and Group IV (10 months of age). All animals were housed in semi-open pens and were fed *ad libitum* with the same appropriate diet for 12 months. The animals were slaughtered in a commercial abattoir according to standard routines and carcass traits including hot and chilled carcass weights, dressing percentage, and chiling loss were determined. Morever, performance traits including total weight gain, feed conversion rate, average daily weight gain, and dry matter intake were estimated. Results revealed that the initial fattening age of bulls showed significant effects on total weight gain and chilled carcass dressing. In this context, Group I was characterized by the highest total weight gain, whereas, Group IV had the highest values for chilled carcass dressing. During early fattening periods, first three periods, average daily weight gain was significantly different among the treatments. This study pointed out that, concerning importation, younger Simmentals with the initial fattening age of four months may be more suitable and profitable for medium-term fattening. The present results may have a potential to influence adequate management practices in Simmental farms, and moreover, the recent strategies for importation of cattle.

## KEY WORDS

Simmental, fattening age, carcass characteristics, performance traits.

## INTRODUCTION

Evaluation of the quantitative traits in a breeding objective and estimation of their economic values play a crucial role in the development of an adequate breeding program. A wide variety of extrinsic factors including management, environmental, and marketing conditions for beef farming make the evaluation of breeding goals and strategies rather complex and sometimes, almost impossible to define, even within a breed[1]. However, improved breeding methods as well as the application of biotechnology have increased the efficiency of cattle production.

Fattening performance traits are of great economic importance to cattle producers. Variations in these traits can be attributed to differences in genetic composition, breed of the animals, nutrition, season, housing type, concentrate level, sex, and pen cattle population. On the other hand, performance traits are closely associated with adequate initial weights and slaughter endpoints[2,3]. From a broad perspective, young animals have higher feed conversion compared to older cattle. The principal reason for this situation is that increases in the body weight differ between young and older cattle. In this respect, increases for young cattle can be attributed to growth of bones, muscles, and organs. Weight increases of older cattle consist mainly of fat deposits. It is important to note that more feed is required for the formation of fat tissue because it possesses much less water and appreciable more energy when compared to different types of animal tissues. Moreover, consumption feed in proportion to body weight and the maintenance requirements are important points in the evaluation of age affects on economy of gains[4].

Simmental, as a versatile breed, is one of the oldest and most widely spread of all cattle breeds in the world. This breed was included in different selection programs due to his excellence dual-purpose performances. Moreover, the importance of Simmental breed, apart from his high production and reproduction performance, is also seen in achieving improved udder health and disease resistance[5]. The total numbers are estimated between 40 and 60 million Simmental cattle worldwide, with more than half in Europe. Over the last few decades, breeding of Simmentals has gradually increased its importance in many developing countries, also in Turkey. In this respect, one of the most common cattle raised in Turkey (19.57%) is the Simmental breed, with the 3,120,180 purebreds and crosses. Regarding 15,943,586 total cattle count, this breed has a significant impact not only on beef production but also on entire

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Turkish animal husbandry[6].

In 2017, a total of 1,126,403 tonnes of red meat was produced in Turkey and the most significant part of this production was derived from beef with a total of 987,482 tonnes (93.16% of total)[6]. However, the current production has remained insufficient to supply internal demands and the situation resulted in long-term high meat prices. Importation of living animals and carcasses could not regulate supply and demand. In this context, there is still a strong need for studies regarding ways to improve red meat production in Turkey.

Fattening performance traits are quite complex and are affected by many factors. For instance, feed conversion, which is a basic constituent of the evaluation of cattle fattening performance, can be influenced by several biological mechanisms, body composition, protein turnover or tissue metabolisms of animals[3]. Moreover, carcass traits and dry matter intake are effected by age, sex, and feed management[3,7,8]. The genotypic characteristics of animals and related effective genes make the evaluation of performance traits more complex. Feed consumption, energy expenditure, and adipose tissue development can be fairly variable over different time periods of growth[9]. The principal explanation of this association may be related to corresponding biological mechanisms. For instance, it is well known that lipogenic-related genes are expressed significantly different according to the different stages of growth of cattle and these genes seem to be related with overall fat deposition in cattle[8,10]. Moreover, the expression of the effects of calpain-calpastatin system in muscle cell migration and differentiation may differ based on the stages of growth and fattening[11,12]. Concerning the above-mentioned biological interpretations, initial age of fattening may play crucial roles in the evaluation of fattening effectiveness, and thus, the decision on the optimum period to put the animals on feed may influence the net return. In the literature, many comparisons have been performed on the effects of fattening period, slaughter age, and breed on carcass and meat quality characteristics. However, there is limited information about the effects of initial fattening age on these traits, especially for imported cattle. Taken altogether, the objective of this study was to determine the effects of initial fattening age on fattening performance and carcass traits attributes of imported Simmental bulls produced under same management conditions in Turkey.

## MATERIALS AND METHODS

### Animal ethics

All procedures performed were in compliance with worldwide ethical considerations to ensure careful attention to animal welfare[13]. Ethical approval was received from the Ethics Committee of Bursa Uludag University (Approval Number 2012-05-04).

### Animals and management

The study was carried out from the end of January to December under commercial cattle farm conditions. The data from 75 purebred Simmental bulls raised in the same commercial farm, located in South Marmara region of Turkey (Yenisehir/Bursa, 40°15'28.04"N and 29°30'50.18"E) were used in the study. Cattle were imported from Europe to Turkey and were recorded to the Pedigree Project of the Turkish Ministry of Food, Agriculture and Livestock, and Cattle Breeders Association. Before the experimental process had begun, the quarantine procedures and vaccination requirements were conducted on all of the imported cattle. All animals were housed in semi-open pens with straw bedding (two paddocks for each group, approximately 9 bulls in a paddock, 10 $m^2$ per animal). These animals were assigned to four groups (Groups I, II, III, and IV) according to their initial fattening age, as shown in Table 1. Initial live weights of the groups were also shown in Table 1. The experiment was initiated after two weeks of adaptation to ration. All groups were fed *ad libitum* for 12 months with an identical appropriate diet consisting corn silage (28%), wheat straw (27%), pasta pellets (12%), corn bran (11%), corn gluten feed (10.50%), sunflower meal (6.50%), and vitamin and minerals (5%). All feedstuffs were analyzed initially for dry matter and nutrient level nutrient analysis was conducted using standard procedures[14]. All animals had full access to water throughout the experiment.

### Fattening performance and carcass traits

The animals were weighed for nine periods (38±2 day intervals) at the same time of day throughout the experimental period, using an electronic scale (100 g sensitivity). In order to evaluate the data for fattening performance, total weight gain (TWG), average daily weight gain (ADWG), feed conversion ratio (FCR) for each animal were determined. In this context, the ADWG was calculated for the interval between the two subsequent weight measurements. In addition, total ADWG (TADWG) was also calculated as (Final weight, kg - Initial weight, kg) / Fattening period, days. FCR was calculated, dividing the total amount of food consumed (based on dry matter intake) between the weighing days to the TWG[15]. All of the animals were slaughtered in the same commercial abattoir according to standard routines, after being kept for 12 hours in paddocks, deprived of feed, but with full access to water. Prior to slaughter, final weight (FW) was recorded. In the abattoir, hot carcass weight (HCW) was measured, approximate-

**Table 1** - Levels of significance, the means and standard errors of initial live weight, initial fattening age, and slaughter weight of experimental groups.

| Experimental groups | *n* | | Initial weight (kg) | Initial age (days) | Slaughter weight (kg) |
|---|---|---|---|---|---|
| | Paddock I | Paddock II | | | |
| Group I | 10 | 9 | 168.44±8.30$^{b}$ | 119.53±3.56$^{d}$ | 595.72±13.31 |
| Group II | 9 | 9 | 188.23±6.98$^{ab}$ | 183.80±2.55$^{c}$ | 593.66±9.09 |
| Group III | 9 | 10 | 197.21±11.12$^{a}$ | 239.14±3.42$^{b}$ | 602.42±13.71 |
| Group IV | 9 | 10 | 192.00±11.15$^{a}$ | 298.83±4.06$^{a}$ | 600.21±13.70 |
| *P* | | | **0.030** | **0.000** | 0.610 |

$^{a, b, c, d}$ Different superscripts within a column indicate significant difference.

ly 1 hour postmortem, without removing the subcutaneous fat and keeping the kidney and pelvic fat. After slaughter, all of the carcasses were divided down the back-bone to give two sides, suspended through the Achilles tendons, chilled for 24 hours at 4°C in a ventilated room, and weighed again. Thus, chilled carcass weight (CCW) and chilling loss (CL) were determined[16]. The dressing percentage was calculated based on both HCW and CCW, namely hot carcass dressing (HCD) and chilled carcass dressing (CCD)[17].

### Statistical analysis

Using general linear model (GLM) procedure of Minitab software (MINITAB®, Pennsylvania, USA, v17.1.0), analysis of variance (ANOVA) was performed to determine the significance of differences among initial fattening age groups of the population. Data were expressed as means and standard errors. For all statistical comparisons a probability level of $P<0.05$ was accepted as statistically significant. When significant associations were identified, the mean values were submitted to post hoc comparison by the Tukey's test.

## RESULTS

Levels of significance, the means, and their respective standard errors obtained for the ADWG based on different periods of fattening of different age groups are reported in Table 2. Results revealed that statistically significant differences in ADWG were evident between age groups for the first three consecutive periods of fattening. Group IV had significantly higher means of ADWG for the first period of fattening ($P<0.001$), whereas Group II and Group III had higher ADWG regarding the second and the third periods, respectively ($P<0.05$).

Table 3 shows the differences observed in fattening performance traits and carcass traits with respect to four groups of fattening Simmentals. Results revealed that CCD was significantly affected by the initial age ($P<0.05$). In this context, Group IV had higher values of CCW compared to remaining groups of cattle. Moreover, Group I was characterized by the highest TWG ($P<0.05$). There was no significant difference among groups in terms of FCR, TADWG, and DMI. Moreover, no differences were observed in carcass traits including HCW, HCD, CCW, and CL.

## DISCUSSION

Selection of animals with better fattening performance is one of the main objectives for breeders and beef farms because this selection process directly influences the profitability, whether

**Table 2** - Levels of significance, the means, and their respective standard errors obtained for average daily weight gain (ADWG) based on nine different periods of fattening with respect to experimental age groups. The body weight of the animals (kg) at the corresponding periods are presented in parentheses.

| Experimental groups | ADWG1 | ADWG2 | ADWG3 | ADWG4 | ADWG5 | ADWG6 | ADWG7 | ADWG8 | ADWG9 |
|---|---|---|---|---|---|---|---|---|---|
| Group I BW1 | 1.22±0.12$^{c}$ (216.02±9.21) | 1.40±0.31$^{b}$ (272.02±11.22) | 1.27±0.19$^{b}$ (322.83±10.62) | 1.54±0.51 (384.64±6.95) | 0.84±0.18 (417.60±10.82) | 0.84±0.14 (449.59±11.53) | 1.92±0.39 (526.47±8.34) | 0.80±0.62 (558.47±6.91) | 0.94±0.17 (595.72±13.31) |
| Group II BW2 | 1.98±0.08$^{ab}$ (259.45±5.60) | 2.49±0.21$^{a}$ (349.07±6.65) | 1.82±0.13$^{ab}$ (416.32±8.05) | 1.92±0.35 (485.40±9.45) | 0.55±0.12 (505.21±10.82) | 0.42±0.09 (520.34±9.48) | 1.23±0.27 (565.84±7.75) | 0.32±0.42 (577.69±8.55) | 0.40±0.12 (593.66±9.09) |
| Group III BW3 | 2.18±0.12$^{b}$ (280.72±5.25) | 2.18±0.32$^{ab}$ (363.76±7.30) | 2.01±0.19$^{a}$ (440.24±4.34) | 1.47±0.53 (496.21±8.90) | 0.71±0.19 (523.91±9.98) | 0.39±0.15 (538.74±11.27) | 0.45±0.41 (555.94±12.65) | 0.87±0.64 (588.88±9.56) | 0.47±0.18 (602.42±13.71) |
| Group IV BW4 | 2.39±0.12$^{a}$ (282.94±6.70) | 1.86±0.32$^{ab}$ (353.75±8.70) | 1.96±0.19$^{ab}$ (429.23±10.45) | 1.56±0.53 (487.45±11.90) | 1.11±0.19 (530.64±13.60) | 0.38±0.14 (545.20±13.05) | 0.70±0.42 (572.00±14.25) | 0.27±0.64 (582.53±15.80) | 0.45±0.17 (600.21±13.70) |
| *P* | **0.000** | **0.032** | **0.024** | 0.862 | 0.097 | 0.063 | 0.056 | 0.321 | 0.075 |

$^{a, b, c}$ Different superscripts within a column indicate significant difference.
ADWG: Average daily weight gain; BW: Body weight.

**Table 3** - Levels of significance, the means, and their respective standard errors obtained for fattening performance traits and carcass characteristics in experimental age groups.

| Experimental groups | HCW (kg) | HCD (%) | CCW (kg) | CCD (%) | CL (kg) | TWG (kg) | FCR (kg/kg) | TADWG (kg) | TDMI (kg) |
|---|---|---|---|---|---|---|---|---|---|
| Group I | 320.13±8.52 | 53.75±0.06 | 316.48±6.04 | 52.66±0.05$^{b}$ | 6.45±0.28 | 428.79±10.72$^{a}$ | 4.92±0.28 | 1.19±0.08 | 2,067±107 |
| Group II | 319.49±5.84 | 54.59±0.04 | 328.99±5.24 | 54.63±0.04$^{ab}$ | 6.71±0.29 | 401.20±11.91$^{b}$ | 4.99±0.25 | 1.14±0.06 | 1,990±92 |
| Group III | 330.57±8.82 | 54.89±0.06 | 315.56±8.01 | 53.19±0.08$^{ab}$ | 6.44±0.45 | 408.01±18.42$^{b}$ | 5.29±0.38 | 1.19±0.08 | 2,115±144 |
| Group IV | 333.37±8.82 | 55.58±0.05 | 325.64±8.78 | 55.12±0.07$^{a}$ | 6.41±0.36 | 409.78±17.45$^{b}$ | 5.01±0.27 | 1.19±0.08 | 1,908±144 |
| *P* | 0.483 | 0.210 | 0.182 | **0.030** | 0.198 | **0.049** | 0.649 | 0.902 | 0.720 |

$^{a, b}$ Different superscripts within a column indicate significant difference.
HCW: Hot carcass weight; HCD: Hot carcass dressing; CCW: Chilled carcass weight; CCD: Chilled carcass dressing; CL: Chilling loss; TWG: Total weight gain; FCR: Feed conversion rate; TADWG: Total average daily weight gain; TDMI: Total dry matter intake.

in calf-to-finish or fattening farms. In this respect, there are several factors that affect fattening performance traits, for instance, breed and sex, genetic background, season, housing type, size and density of the fattening groups, and nutrition[3,16,18,19]. Moreover, the results of the evaluation of net return may differ depending on feed costs and carcass prices[20]. Accordingly, the current experiment was performed with the aim to evaluate the effect of initial fattening age on animal growth and fattening performance, feed intake, and carcass traits. The animals were purchased from a single commercial farm where they had been reared under identical production conditions and were allocated to four initial ages of fattening groups, namely Group I (~4 months), Group II (~6 months), Group III (~8 months), and Group IV (~10 months). They were slaughtered at a similar average FW (595.64±5.89 kg) with the same fattening period (12 months). During early fattening periods (first 3 periods), ADWG was significantly different among the treatments. Concerning first period of fattening, Group 4 had the highest ADWG (2.39±0.12 kg). During the second period, significant differences were observed between treatments ($P<0.05$), suggesting that Group II was characterized by the higher ADWG values compared to other groups. In addition, Group III had the highest ADWG (2.01±0.19) with respect to the third period of fattening. During the latter fattening periods, ADWG seemed to be rather variable among the initial fattening groups but these differences were not substantiated by statistical analyses ($P>0.05$). The effect of initial age on fattening performance and carcass traits has been documented previously[21,22,23,24], although in most earlier studies the experiments were initiated with older animals. The factors, such as initial age, may be effective on performance traits at different periods of animal's growth and fattening. In this respect, the distinctive aspect of the evaluation presented in this paper, when compared to other cattle fattening performance studies, is the determination of initial fattening age effect based on the comparison of the traits among early fattening periods. Present results indicated that initial fattening age of 4 months was characterized by the highest TWG (428.79±10.72 kg), and accordingly, more profitable fattening process in Simmental breed. In this context, Group I had +27.59 kg, +20.78 kg, and +19.01 kg higher TWG compared to Group II, III, and IV, respectively. Thus, results of this study suggest that selecting or importing Simmentals at early age for fattening may provide relatively higher and rapid weight gain. One possible explanation for the connection between initial fattening age and TWG may be through energy metabolism, especially energy expenditure balances. Concerning the cattle with the equal conditions (when put on feed), TWG necessary to finish decreases slightly with advanced age[4]. Moreover, the expression of the genes which influence the lipogenesis and muscle metabolism may vary depending on different stages of animal's life, and thus, fattening periods[8,9]. Hence, further experiments with molecular aspects should be conducted to provide more reliable results. Although statistically non-significant, total feed intakes per kg weight gain were better for younger animals compared to older ones. The results of this study are comparable with findings of Tuzemen[21], Koc and Akman[22], and Ozluturk et al.[24]. It is worth noting that, there was no significant difference between the DMI values with respect to four age groups considered in this study ($P>0.05$). The differences in FCR between age groups may be related to several biological mechanisms, such as different body composition, protein and tissue metabolism of animals[3,25].

In the present study, initial fattening age was a significant ($P<0.05$) source of variation in CCD. Group IV (initial fattening age: ~10 months) was associated with higher CCD compared to other groups. Animals within this experimental group had 2.46%, 0.49% and 1.93% higher means for CCD compared to Groups I, II, and III, respectively. Litwinczuk et al.[26] reported that dressing percentage increases with an increase in slaughter weight of bulls. However, in this study, the oldest group (Group IV) had the highest CCD, although slaughter weights were similar (Table 1). On the other hand, Group I, which was characterized by the highest TWG had the lowest CCD (52.66±0.05%). The determination of dressing percentage allows a producer to compare the price that would be received on a liveweight basis with the price received on a carcases value basis. Apart from the main factors that affect the live weight of cattle, such as sex and age, this estimation is influenced by many other factors including muscularity, carcass drip, transit and abattoir procedures, and bruising[17]. Here, it should also be noted that, remarkably differences in dressing percentage might be attributed to deposition of internal fat[3]. In this respect, it has traditionally been accepted that the rise in dressing percentage, relevant to growth process, is a direct result of increasing fatness[3,27]. Here, it is important to note that, older animals produce carcasses with lower proportions of high-priced meat and a longer finishing period may result in significantly lower proportions of lean meat[3]. Saleable meat yield from the carcass tends to be lower in fatter cattle due to extra trimming[17]. Taken together, initiation of fattening with younger Simmentals may provide better results with respect to effectiveness and profitability. On the other hand, statistical analyses revealed that, carcass traits including HCW, HCD, CCW, and CL were not significantly different among four initial fattening age groups. As a general interpretation, increased demand and insufficient production may be strongly associated with high meat prices. In many countries, such as Turkey, agricultural policies are inextricably linked with importation of live cattle and/or carcasses to regulate supply and demand. Thus, the characterization of imported animals with respect to import age plays an important role in balance of net return. Results of the present study suggest that young Simmentals may be more suitable and profitable for medium-term fattening because animals with the initial fattening age of four months showed better results for TWG and also for rapid growth. However, here, there is an important issue to be pointed out: bovine species, in general, have a significant predisposition to respiratory diseases[28]. Thus, this situation represents a major problem, which causes considerable economic losses world wide, in intensive cattle breeding, especially for young cattle. It is well known that the severity of infectious respiratory disease with different microbiological agents including bacteria, virus, and mycoplasma is related to the age distribution in the herds[29]. In this context, calves and young cattle are more likely to exhibit higher risk for bovine respiratory diseases which affect health, welfare, and performance status. On the other hand, factors related to the feeding system have been shown to be significantly associated with occurrence of respiratory disorders, especially in the early stage of fattening[30]. Accordingly, it should be emphasized that quarantine procedures, testing for infectious diseases or vaccination requirements of imported cattle have to be managed without any exceptions.

## CONCLUSIONS

Simmental is one of the most common cattle breeds imported to Turkey because of its high production and reproduction performance and also satisfactory adaptability to country conditions. Hence estimation of optimum fattening periods and initial ages plays an important role in achieving profitable and sustainable cattle management. This study provides a detailed analysis of initial fattening age influences on fattening performance in Simmentals. Animals with the initial fattening age of four months (Group I) had the highest TWG. Differences in ADWG were evident among four age groups for the first three consecutive periods of fattening. On the other hand, Group IV (initial fattening age: ~10 months) was associated with higher CCD compared to other groups. Taken together, these results may be useful not only in evaluating the adequate management practices in cattle farms, but may also have potential to influence strategies for importation of cattle.

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