# DIFFERENT BEEF BREED CATTLE FATTENING RESULTS ANALYSIS

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**Abstract**
In Latvia, different breeds of beef cattle are grown; therefore, it is important to explain their suitability to organic farming systems, because most Latvian beef cattle breeders work with organic farming methods. The aim of this research was to compare fattening of different beef breed bulls (*Bos Taurus)* in organic farming system at similar housing and feeding conditions. In the research, there were included Blonde d'Aquitaine (BA), Hereford (HE), Simmental (SI) and crossbred (CB) bulls. Fattening period started after calf weaning from suckler cows at 7 – 8 months of age. Fattening results were significantly affected by factors like breed, live weight and age before fattening, but slaughter results were significantly affected by breed, live weight and age before slaughter. During the fattening period the biggest daily weight gain was showed for SI breed bulls (849 g), but the biggest live weight increase was recognized for BA breed bulls (295 kg). The required slaughter weight the fastest was reached for XG bulls, which average slaughter age was 532 days ($p<0.05$). The greatest slaughter weight – 342 kg ($p<0.05$) and dressing percentage (58% ($p<0.05$)) was recognized for BA breed bulls; also, carcass conformation score in muscle development was the highest for BA bulls (2.0 points ($p<0.05$)). The greatest economic benefit was from CB bulls, income calculated per one rearing day from CB bulls was - EUR 1.80.
**Key words:** beef cattle breeds, bulls, growth and fattening.

## Introduction

The branch of cattle meet production takes a significant role in the structure of agriculture production in the developed countries of the world and EU countries. Similar development can also be seen in the new countries of the EU. During the last ten years a number of suckler cows has grown in Latvia. On 1st January 2006, 6955 of suckler cows were registered in the Agricultural data centre of the Republic of Latvia, but on 1st January 2016 – already 38878 suckler cows. This tendency shows that beef cattle branch has been developing, but still the main production of this branch is weaned calves which are sold for export. Only a small part of weaned calves has been left on the farms for further fattening. In Latvia, there is necessary to arrange an internal beef meat market and develop the payment system of fattened beef cattle according to the carcass classification of SEUROP, which is used in other EU countries in order to facilitate farmers' interest in young cattle fattening and sale in Latvia. Also, EU countries meat procesor and marketing company interest about Latvia farmed beef purchase options is growing every year. Considering of our country's potential to produce high qulity biological products which is equivalent to the production of other EU countries, Latvia has the objective to increase the competitiveness of local beef cattle breeders in the common market in all areas, in terms of the quality of the weaned calves and carcases (Gaļas šķirņu govju ciltsdarba programma, 2013).

In order to develop the branch of beef cattle successfully, it is very important to know, how to grow up high quality beef cattle, thus ensuring the high quality of the carcass assessment and meat. As researchers, Lujane, Oshmane, & Jansons (2013) have recognized the quality of beef at the present genetic material could be much higher in Latvia, but we have to improve the conditions of animal nutrition. It is important to take into account that in order to obtain high – quality meat, there should be adequate nutrition at all stages of animal development.

Intensive farming is not possible in many places of Latvia, but in the branch of beef cattle there is also possibility to farm extensively using natural pastures, bushes, overgrown places and so on. Comparing beef cattle with typical dairy cattle, beef cattle gives greater live weight, increases daily live weight, the outcome of the slaughter and gets higher class of a meat market (Lujane, Oshmane, & Jansons, 2013).

In Latvia, different breeds of beef cattle are grown. According to the information of Agricultural data centre of the Republic of Latvia the biggest populations are: Charolais (19570), Limousin (6424) and Hereford (5347). A smaller number of the beef cattle population are breeds: Angus (2867), Simmental (1941), Highland (885), Galloway (525) and Blonde d'Aquitaine (132). There is also a great number of different beef cattle crossbreed (18471). It is important to explain their suitability to organic farming systems because most of Latvian beef cattle breeders work with organic farming methods.

Up to now in Latvia, separate studies on beef cattle fattening have been carried out. Though there is a lack of studies on the appropriate choice of beef cattle breed for fattening and the most effective model for profitable fattening, so the beef cattle breeders who choose to fatten weaned calves, they often should carry out experiments by themselves (Lujane, Oshmane, & Jansons, 2013).

Many foreign authors researched differences between individual beef breeds in growth performance, fattening and carcass traits (Polach *et al*., 2004; Barton

*et al*., 2006; Hollo *et al*., 2012; Pesonen & Huuskonen, 2015), however these studies can not fully apply to the conditions of Latvia.

The aim of this research was to compare the breed of Blonde d'Aquitaine, Hereford, Simmental and crossbred bulls fattening in organic farming system at similar housing and feeding conditions.

**Materials and Methods**

The research was carried out in the certified organic cattle farm 'Bētas' (56.901566, 22.241868) during the period from November 2014 till December 2015 at similar housing and feeding conditions at the barn. During the whole fattening period rations contained hay, grass silage, grains (oats, barley, triticale) and mineral feed, in summer period also green forage. The winter period forage was with the following indicators: hay – dry matter 92.73%, protein 7.30%, *net energy* for l*actation* (NEL) 6.06 MJ $kg^{-1}$, *neutral detergent fiber (*NDF) 56.5%, acid *detergent fiber(*ADF) 32.0%; grass silage – dry matter 46.19%, protein 10.50%, NEL 5.67 MJ $kg^{-1}$, NDF 54.33, ADF 36.87%. Cereal meal mix dry matter content was 89.87%, protein content 13.22%, NEL content 7.86 MJ $kg^{-1}$, NDF content 20.11 MJ $kg^{-1}$ un ADF content 9.36 MJ $kg^{-1}$.

Forage was fed *ad libitum*, but grain portion was 4 kg per day. At the beginning of fattening, bulls were partially adapted to grain portion until the portion reached maximum – 4 kg per day. Water was supplied with heated watering place. The specific type of fattening is considered as medium intensive because fattening was carried out in the organic farming system. To assess growth performance, each month starting from January 2015 all of the bulls were weighted with electronic cattle scales with accuracy of 0.100 kg.

The research included 21 fattening bulls and depended on their breed type. Four research groups were created:

1st group: Blonde d'Aquitaine (BA) – 4 bulls;
2nd group: Hereford (HE) – 6 bulls;
3rd group: Simmental (SI) – 6 bulls;
4th group: beef cattle crossbreed – 5 bulls.

Bull fattening started after calf weaning from suckler cows 7 – 8 months of age, but fattening finished when bulls reached live weight at least 500 kg.

Using the growth rates of the bulls, average daily gain during fattening period was calculated (1):

$$a = \frac{Wt - W0}{t} \quad (1)$$

where Wt - live weight before slaughter, kg
W0 – live weight before fattening, kg
t – fattening duration, days.

All bulls were slaughtered in certificated slaughterhouses where carcases were wheighed and the carcass SEUROP conformation score was determined (Classification of bovine animal carcasses). Conformation score was marked with the letters EUROP with the following meaning: E – excellent (the numeric designation – 1), U – very

Table 1

**Bulls fattening results**

| Indice | Breed | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| | BA (n=4) | | HE (n=6) | | SI (n=6) | | XG (n=5) | |
| | x ±Sx | V,% | x ±Sx | V,% | x ±Sx | V,% | x ±Sx | V,% |
| Age before fattening | 222±10.3[a] | 9.3 | 226±4.9[a] | 5.3 | 237±1.5[a] | 1.6 | 237±11.9[a] | 11.3 |
| Live weight before fattening, kg | 299±22.1[a] | 14.8 | 269±8.2[a] | 7.4 | 366±7.3[b] | 4.9 | 376±12.5[b] | 7.4 |
| Live weight before slaughter, kg | 594±32.6[ab] | 11.0 | 558±14.3[a] | 6.3 | 630±17.9[b] | 7.0 | 626±23.5[b] | 8.4 |
| Fattening period lenght, days | 352±20.4[ab] | 11.6 | 389±8.0[a] | 5.1 | 307±13.1[b] | 10.4 | 296±19.8[b] | 15.0 |
| Live weight gain, g per $day^{-1}$ | 844±60.0[a] | 14.2 | 745±57.9[a] | 19.0 | 849±40.9[a] | 11.8 | 828±70.5[a] | 19.0 |

[a b] – indices is significantly different between groups, $p<0.05$.

Table 2

**Bulls fattening affecting factors**

| Traits | Factors | | |
|---|---|---|---|
| | breed | live weight before fattening, kg | age before fattening, days |
| | p-value | | |
| Live weight before fattening, kg | *** | ... | *** |
| Live weight increase during the fattening period, kg | *** | *** | *** |
| Fattening period duration, days | *** | ... | *** |
| Live weight gain, gper day$^{-1}$ | *** | *** | *** |

***p<0.001.

good (2), R – good (3), O – medium (4), P – poor (5) developed muscularity.

For preparation income analysis, slaughter houses prices per carcass and bulls age at a slaughter moment were used.

MS Excel software was used for data mathematical processing. Average values, standard error and coefficient of variation results were calculated. T–test for average values was used for significance determination. Different letters (a, b, c) on figures and tables mark significant differences at p<0.05. To analyze factors influencing fattening and slaughter traits one–way analysis of variance (ANOVA) was performed. The following factors were analysed: breed, live weight and age before fatening and live weight and age before slaughter.

For traits relationship correlation analysis determination, which was established between the fattening and slaughter traits was used.

**Results and Discussion**

At the beginning of fattening bulls average age was from 222 to 237 days, among groups there were no significant differences (Table 1). The biggest live weight at the beginning of the fattening was for CB and SI breed bulls, respectively – 377 kg and 366 kg, whereas BA and HE breed bulls live weight was significantly lower – 299 kg and 269 kg (p<0.05) respectively.

Fattening period with the biggest live weight – 630 kg was completed by SI breed bulls which during the fattening period reached also the biggest live weight gain – 849 g. In several foreign studies (Chambaz *et al*., 2003; Barton *et al*., 2006; Hollo *et al*., 2012) the SI breed bulls live weight gains have been greater than in our study due to the fact that bulls were fattened with intensive methods. In the study, which was carried out by a Dannenberger *et al.* (2006) SI breed bulls were fattened in two different systems and it was established that with intensive fattening system bulls live weight gain was on average 1.40 kg, but in system where forage was used, but concentrates only in the finishing phase, live weight gain was on average 0.90 kg.

HE breed bulls live weight gain during the fattening period was on average 745 g what is lower than in a study carried out by the Barton*et al*., (2006) who found live weight gain for this breed bulls during the fattening period on average 1.315 kg. These diferences between live weight gain can be explained with the use of different feeding system because in Barton*et al.* (2006) study bulls were fattened with Total mixed ration (TMR) which consisted of maize (*Zea mays*) and lucerne (*Medicago*) silage, as well as concentrates.

The shortest fattening period in our study was for CB group bulls, which is 296 days, when they achieved average live weight 626 kg. These indicators were significantly different from HE breed bulls, which was 389 days and average live weight 558 kg (p<0.05).

Throughout the period of fattening the largest live weight increase was obtained for BA breed bulls –average 295 kg, but for CB group bulls live weight increase during the fattening period was the least – 250 kg, the diference was 45 kg, which can be explained not only with the shortest fattening period but also with the highest live weight before fattening. Live weight increase for HE breed bulls was 289 kg, but for SI breed bulls – 265 kg.

The bulls fattening affected factors results analysis show that all analyzed factors significantly affect traits of live weight and growth rate (Table 2).

CB group bulls were slaughtered younger than the other group bulls, average 532 days of age, which was 13 days earlier than SI breed bulls, 43 days earlier than BA breed bulls and 83 days earlier than HE breed bulls (p<0.05) (Table 3). Studies in Finland compared to our study show differences in age at slaughter. In these studies BA breed bulls were slaughtered in 570 days of age which is 5 days earlier, HE breed bulls at 561 – 572 days of age which is 43 – 45 days earlier, but SI breed bulls were slaughtered at 565 – 566 days of age which is 20 – 21 days later

Table 3

**Bulls slaughter results**

| Indices | Breed | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| | BA (n=4) | | HE (n=6) | | SI (n=6) | | XG (n=5) | |
| | x ±Sx | V,% | x ±Sx | V,% | x ±Sx | V,% | x ±Sx | V,% |
| Age before slaughter, days | 575±18.2$^{ab}$ | 6.4 | 615±10.5$^{a}$ | 4.2 | 545±13.3$^{b}$ | 6.0 | 532±14.3$^{b}$ | 6.0 |
| Slaughter weight, kg | 342±18.4$^{ab}$ | 10.8 | 298±8.4$^{a}$ | 6.9 | 323±7.5$^{b}$ | 5.7 | 319±3.4$^{b}$ | 2.4 |
| Conformation score (1-5) | 2.0±0.00$^{a}$ | 0.0 | 3.2±0.17$^{bc}$ | 12.9 | 2.3±0.21$^{a}$ | 22.1 | 2.6±0.24$^{ac}$ | 21.1 |
| Income per carcass | 1,048.81± 55.211$^{a}$ | 10.8 | 887.61± 33.657$^{b}$ | 9.3 | 963.09± 26.574$^{ab}$ | 6.8 | 957.73± 10.088$^{ab}$ | 2.4 |
| Income in one breeding day | 1.78±0.065$^{a}$ | 7.3 | 1.45±0.067$^{b}$ | 11.3 | 1.77± 0.021$^{a}$ | 3.0 | 1.80±0.032$^{a}$ | 3.9 |

$^{a\,b}$ – indices is significantly different between groups, $p<0.05$.

(Pesonen, Honkavaar, & Huuskonen, 2013; Pesonen & Huuskonen, 2015).

Slaughter age of HE breed bulls was significantly different from SI breed and CB bulls, but for BA breed bulls significant difference was not recognized.

The biggest slaughter weight was obtained from BA breed bulls – 342 kg, but slaughter weight indicator was not significantly different between the research groups. Conformation score was from 2.0 to 3.2 points. Muscularity was the best for BA breed bulls – 2.0 points. All breed group bulls carcases were scored as class U. HE breed bulls carcasses were scored in 83% of cases as class R, but 33% of cases as class O, whereas 67% of cases SI bred bulls carcasses were scored as class U, but 33% of cases as class R. CB bulls carcasses were scored in 33% of cases as class U, but in 67% – as class R. Several foreign scientific studies observed a similar trend conformation scoring for BA, HE and SI breed bulls, which found that BA breed bulls muscularity scoring is higher than other beef breeds (Pesonen & Huuskonen, 2015). In the study which included SI and HE breeds, bulls carcases score was not significantly different though (Urgakovic, Ivankovic, & Konjacic, 2013).

The comparison of income which was received from bulls sales shows that the greatest economic benefit was from BA breed bulls – EUR 1048.81 per carcass which was significantly more in comparison to the benefit from HE bulls carcases ($p<0.05$).

Income per carcass must be analyzed together with the number of days used for bulls rearing until the slaughter weight was achieved because each rearing day raises costs. The number of days for each research group was different; as a result, the biggest income calculated per one rearing day was from CB bulls – EUR 1.80, which was EUR 0.02 more than BA, EUR 0.03 more than SI and EUR 0.35 ($p<0.35$) more than HE breed bulls.

The highest dressing percentage – 57.6% showed BA breed bulls, whereas the smallest – 51.3% SI breed and 51.2% CB bulls. HE breed bulls dressing percentage was 53.5% which is by 2.5% lower than in Barton *et al*. (2006) study where HE breed bulls showed dressing percentage 56%. SI breed bulls dressing percentage in our study was lower than in other authors' studies where this breed bulls dressing percentage was from 54 to 58% (Chambaz *et al*., 2003; Barton *et al*., 2006; Link *et al*., 2007; Hollo *et al*., 2012). BA breed bulls dressing percentage results were significantly different from the other research groups' bulls dressing percentage results ($p<0.05$).

The factor analysis results allows concluding (Table 4) that breed, live weight before slaughter and age before slaughter are factors which have significant effect on slaughter results – age before slaughter, slaughter weight, dressing percentage and conformation score.

To find out relationship of the slaughter traits, correlation analysis was performed (Table 5). By analyzing the study groups, it was found that between traits age before slaughter and live weight before slaughter exists significant correlation for SI (0.99) and CB (0.90) groups, there was the same significant correlation between traits live weight before slaughter and slaughter weight for SI (0.94) and CB (0.93) groups.

Between traits age before slaughter and dressing percentage, a significant correlation for HE (0.83) and SI (-0.86) groups exists.

Table 4

**Bulls slaughter results affecting factors**

| Trait | Factors | | |
|---|---|---|---|
| | breed | live weight before slaughter, kg | age before slaughter, days |
| | p-value | | |
| Age before slaughter, days | *** | ... | ... |
| Slaughter weight, kg | *** | *** | *** |
| Dressing percentage, % | *** | *** | *** |
| Conformation score (1-5) | *** | *** | *** |

***p<0.001

Table 5

**Slaughter traits correlation analysis**

| Traits BA (n=4) | | Group | | | |
|---|---|---|---|---|---|
| | | HE (n=6) | SI (n=6) | CB (n=5) | |
| Age before slaughter, days | live weight before slaughter, kg | 0.55 | -0.45 | 0.99* | 0.90* |
| | slaughter weight, kg | 0.79 | 0.30 | 0.94* | 0.93* |
| | dressing percentage, % | 0.56 | 0.83* | -0.86* | -0.78 |
| Live weight before slaughter, kg | slaughter weight, kg | 0.92 | 0.59 | 0.98* | 0.69 |
| | dressing percentage, % | -0.27 | -0.34 | -0.77 | -0.97* |
| Slaughter weight, kg | dressing percentage, % | 0.13 | 0.56 | -0.62 | -0.50 |

*p<0.05

For traits live weight before slaughter and slaughter weight a significant correlation for SI group (0.98) was observed, but for traits live weight before slaughter and dressing percentage significant correlation was for CB group (0.97).

For traits slaughter weight and dressing percentage correlation was not significant.

**Conclusions**

1. The shortest fattening period was for crossbreedgroup bulls – 296 days, which achieved average live weight gain 828 g. The fattening period with the biggest live weight finished Simmentalbreed bulls– 630 kg whose average live weight gain during the fattening period was 849 g.
2. The best slaughter results showed *Blonde* d'*Aquitaine* breed bulls whose slaughter weight was average 342 kg with dressing perecentage 58% (p<0.05). This breed bull's carcass conformation score was 2.0 points which was the highest among the groups.
3. Bulls fattening and slaughter results significantly affected breed, live weight and age start or end fattening.
4. Between traits age before slaughter and live weight before slaughter and traits age before slaughter and slaughter weight, a significant correlation for SI and CB groups exists, but between traits age before slaughter and dressing percentage a significant correlation for HE and SI groups exists.
5. For traits live weight before slaughter and slaughter weight, a significant correlation for SI group was observed, but for traits live weight before slaughter and dressing percentage a significant correlation was for CB group.

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