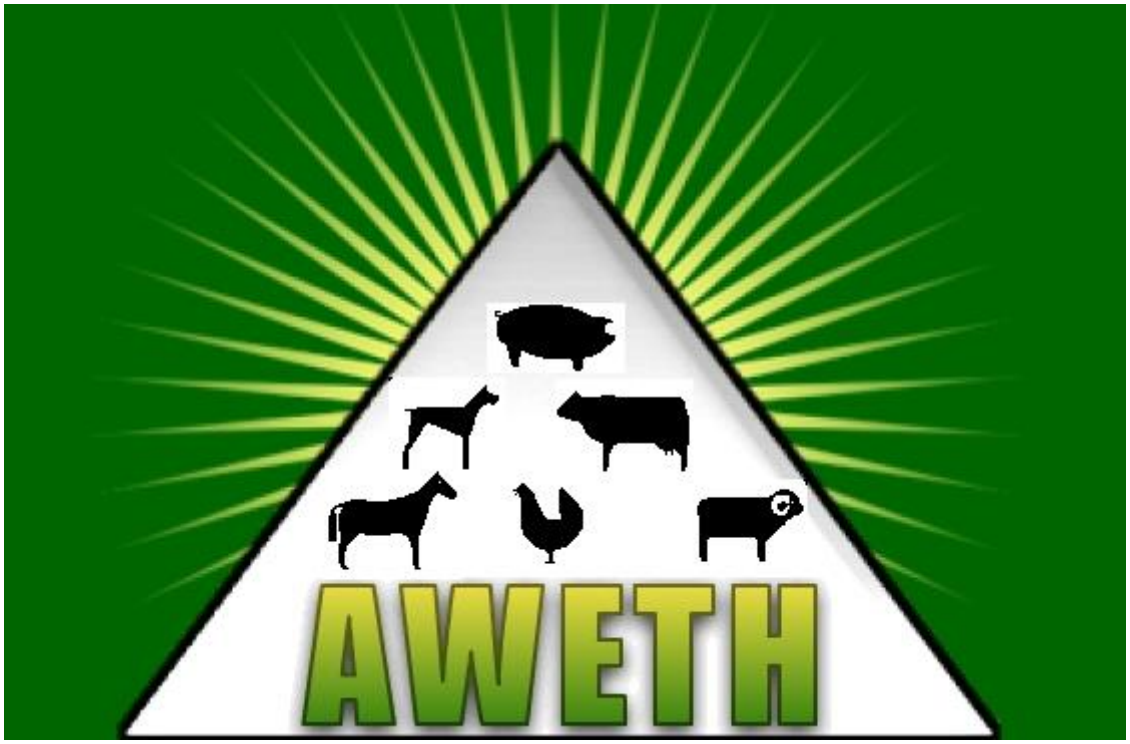
Animal welfare, etológia és tartástechnológia



Animal welfare, ethology and housing systems

Volume 18 Issue 1

Gödöllő
2022

EVALUATION THE BODY CONFORMATION OF LIMOUSIN CANDIDATE BULLS IN FARM PERFORMANCE TEST

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Received – Érkezett: 16.03.2022.
Accepted – Elfogadva: 12.05.2022.

Summary

Authors studied the conformation of Limousin candidate bulls (n=311, farms=30) in 2021. Six body measures – height at withers, cm, rump / tail height, cm, length of back, cm, width of shoulders, cm, width at hip bone, cm, pin width, cm – and two conformation traits (muscularity, score, leg, score) and live weight were analysed.
Live weight of bulls taking part in the study (mean: 455 kg, age: 420±30 days) was in concordance with previous French and Hungarian data. Tail height (132 cm) being higher than wither's height (123 cm) suggest young bulls still maturing, their height is going to grow. Minimum (63 cm) and maximum (94 cm) values of back length mean that animals are well developed according to their age. Current data of hip and pin width of candidate bulls prove a good base for maintaining cow's calving ease in the breed when going to be used for stud. Mean conformation score for muscularity and feet was around 7. Feet score 6 was accompanied with muscularity scores 6 and 7, with at least 440 kg average live weight. Animals scored 8 for feet got scores 7 or 8 for muscularity, with 460 kg live weight. Mean score 8 was paired with more advantageous, lower SE value.
Evaluating live weight by wither's height categories, taking into consideration muscularity and feet scores suggests that live weight increased by increasing wither's height in all categories. Positive, moderate correlations of live weight with wither's height (r=0,613) and tail height (r=0,593) are in concordance with literature data. The correlations of conformation scores with live weight and body measures were different direction and loose.
Maturity, body measure data, muscularity and feed structure of animals studied give a chance significantly improving the production of the consecutive if the best ones are going to be used for stud.
Keywords: Limousin candidate bulls, body measures, conformation

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Limousin tenyészbika-jelöltek testalakulásának értékelése üzemi sajátteljesítmény-vizsgálatban

Összefoglalás

A Szerzők a 2021-ben végezték vizsgálatunkat az üzemi sajátteljesítmény-vizsgálatban limousin tenyészbik-jelöltek (n=311, tenyészet= 30) küllemének értékelése tárgyában. Az élősúly mellett hat testméretet (marmagasság, cm), farbúbmagasság, cm, hát hosszúság, cm, marszélesség, cm, csípőszélesség, cm, ülőgumók szélessége, cm) és két küllemi jellemzőt (izmoltság, pont láb, pont) értékeltek.

A teljesítményvizsgálatban szereplő bikák súlya (átlag: 455 kg, életkor: 420±30 nap) megegyezett korábbi francia és hazai adatokkal. Az, hogy a farbúbmagasság (132 cm) nagyobb volt, mint a marmagasság (123 cm) arra utal, hogy a növendék bikák még fejlődésben vannak és még nőni fog a magasságuk. A háthossz minimum és maximum értéke 63 cm., ill. 94 cm volt, amely az életkornak megfelelő fejlettséget jelent. A csípőszelességnek és az ülőgumók szélességének jelenlegi adatai jó alapot nyújthatnak arra, hogy ezek aztenyészbika-jelöltek továbbra is fenntartsák majd a fajta teheneinél a könnyű ellést. A küllemi bírálati pontszámok (izmoltság és láb) tekintetében a 7 pont körüli átlagérték volt a jellemző. A hatos lábpontszámhoz 6-os és 7-es izmoltság tartozott, legalább 440 kg-os átlagsúllyal. A 8-as lábpontszámmal rendelkező egyedek izmoltsági értéke 7 vagy 8 pontnak adódott, 460 kg-os élősúllyal. A 8 pontos átlagértékhez kedvezőbb, kisebb SE érték társult.

Ha az élősúly adatokat az izmoltság és a láb pontszámának figyelembe vételével értékeljük, a marmagasság kategóriái szerint, akkor megállapíthatjuk azt, hogy a marmagasság növekedésével – minden relációban – az élősúly is emelkedett. Az élősúly és a marmagasság, ill. a farbúbmagasság között számított pozitív irányú és közepes szorosságú összefüggések (r=0,613, ill. r=0,593) egybevágnak az irodalmi adatokkal. A küllemi bírálati pontszámok összefüggése az élősúllyal és a testméretekkel eltérő irányúak és laza szorosságúak voltak.

A vizsgált egyedek fejlettsége, testméret adatai, valamint az izmoltságuk és jó lábszerkezetük minden esélyt megadnak arra, hogy ezek közül a legjobbak érdemben javíthassák majd a következő generáció küllemét.

Kulcs szavak: limousin tenyészbika jelöltek, testméretek, küllemi pontszámok,

Introduction

Origin and standard of the breed

Limousin cattle's roots can be dated back to the origin of Europe, according to a common view, as cattle carvings found in Lascau cave, near Montignac, France surprisingly resemble to the Limousine today.

The place of origin of the breed is the west of French Highlands, between Middle and Southwest France, in a rainy region with disadvantageous climate and bad granite soil. (*http-1*).

These environmental factors led to the development of a tough, resistant breed with a surprisingly fine, but steady physiology, possibly due to the mineral content of the soil. The local, reddish colour variant was getting widespread mostly around the hills of Limoges, which countryside is nowadays called *„Limousin public administration unit"*. Formation of the landrace connected to the county was about in the XVIIIth century, when representative cattle from that

region started to be called as Limousin. The conformation of the population was quite homogenous already that time, animals were horned, large framed, with a bit more rough bones than nowadays. They were mainly used for draught for a long time, so choosing the most powerful and biggest animals was the first aim of selection, which led to upmostly large framed, well-muscled phenotype. Bulls were mostly used for crosses with local dairy breeds, resulting calves showing good beef type (*Dohy*, 1985; *Szabó,* 1998).

The skeleton of Limousin is well-developed, fine and strong. Average live weight of cows is 650 kg, of bulls 1000 kg. Its head is small and short, with wide forehead, neck is short, back and loin are wide, well-muscled, easy calving, its slaughter value excellent is every age group, also due to its light bone structure (*Dervillé et al*, 2009).

Not only its fattening ability, but also the breed's beef quality is excellent. Its beef is fine fibered, because of its low fat content, but being marbled at the same time. The breed won first price in 1991 and in 1992 in the *Trophy of Quality by Blind Taste*. The carcass ratio 62-65%, in which lean meat content is 75%. That excellent yield is also a result of light bones and low tallow production. Based on market tradition in France, the country of origin the most marketing types exist in Limousin breed, as its production values are excellent and weight gain, maturing almost even, so can be sold (*Table 1, htpp-2,* 2020).

Table 1: **Types of marketing beef cattle in the breed in France**

Type of the beef cattle (1)	Slaughter age (month)(2)	Live weight (kg)(3)	Carcass weight (kg)(4)
Milk-fed calf / bobby calf (5)	3–4	180–230	120-150
Aveyron calf beef (6)	8-10	350–450	230 – 290
Fattening cattle younger than a year (7)	11–12	510–520	320
Lyon calf (8)	13-16	500-600	320-380
Young bull (9)	16–17	615-650	380–400
Saint-Etienne heifer (10)	12-15	315–400	200–260
Lyon heifer (11)	18–24	425-500	270-320
Fattened heifer (12)	26–36	more than 600	more than 350
Reform cow (13)	more than 36	more than 600	more than 350

1. táblázat: A vágóállatok forgalmazásának különféle formái a limousin fajtánál Franciországban
állat típusa (1), vágási életkor (hónap)(2), élősúly, kg (3), hasított test súlya, kg (4), tejes borjú (5), Aveyron-i borjúhús (6), egy évnél fiatalabb növendék (7), Lyon-i borjú (8), fiatal szarvasmarha (9), Saint-Etienne-i üsző (10), Lyoni üsző (11), hízlalt üsző (12), Reform tehén (13)

Adapting ability

Karamfilov et al. (2019) studied the conformation of Limousin cows born in Austria, France and Bulgaria. Animals were deep in body, wide, had well-muscled chest and rump, and relatively thin bones. They've shown origin being significant to phenotype, as cattle imported from Austria were the biggest. There weren't significant differences between conformation parameters of cattle

originating from France and Austria. Limousine calves were maturing well in Bulgaria, as at one year old already had reached 93-95% of the fully grown height, 90% of cross body length and 95% of chest circumference.

Significance of body measures and body proportions

Oskaya et al. (2015) found 61.5% R^2 when analysing regression between body surface and live weight in Limousine cattle. Regression equation including all conformation traits had 88.7% reliability. These results suggest digital imaging being serviceable in predicting body measures and live weight of Limousin cattle accurately. Other authors (*Ulutas et al*, 2001, *Bozkurt et al*, 2007) also proved this, with similar results.

Bene et al. (2007) studied body measures of cows belonging to nine beef cattle breeds kept in Hungary (n=100). According to their results, Limousin is longer and wider (e.g. rump length and pin width) compared to other breeds. They have calculated strong positive correlations between live weight and body measures (r=0.4 – 0.83).

Body measures of qualified breeding bulls used to be measured abroad (*Pflaum*, 1989, *Dubois és Huneault*, 1990, *Boonen* (1991). Recording body measures of bulls wasn't a practice in Hungary before 2021. Breeding programme of the breed organisation was changed then, and recording body measures of weaned claves, heifers before insemination and candidate bulls. Next to it muscularity and feet are also scored.

The main points in Hungarian literature and practice in performance tests

- The first study in Hungary according breeding value prediction and improving traits of economical importance in beef cattle is by Nagy (1974). This paper deals in details with the traits and their measures: fertility, calf rearing ability, feed conversion, early maturing and conformation. This study was gap filling in case of breeding value prediction that time, and made the bases of the system applied nowadays in Hungary with the detailed description of the parts of the performance control system already used in practice abroad. Self-performance test for purebred Limousin breeding bulls started in 1972, at the experimental farm of the Department of Animal Breeding, Gödöllő, Hungary. The foundation of that work were the studies and their results made in the stock breeding farm of the State Farm Hajdúszoboszló, Hungary, which enlights the importance of the connectedness of theory and practice.
- *Nagy et al.* (1985) analysed the results of the Hungarian central performance tests per breeds, in comparison to the breed standards set in Great Britain (Meat and Livestock Commission, MLC). The paper analysed the performance of Hereford, Limousine, Charolais and Hungarian Fleckvieh feeders/yearlings in the Performance Control Station Borópuszta, belonging to the Animal Breeding Company Szekszárd between 1980-1984. They concluded that all four breeds are below the MLC standard in case of the corrected live weight at 200 days. Worst performance was measured in Charolais, which was 50 kg (83.3%) under the standard value. Limousin approached closest the MLC value, was only 21 kg (91.8%) bellow it. Hungarian Fleckvieh and Hereford showed 85.5% and 87.5% performance, respectively. Difference among the four breeds was lower in case of live weight at 300 days of age, and all were closer to the standard, with performance over 90%. Limousin breed was closer to the comparative value (97.3%, 10 kg). At 400 days of age all four breeds already exceeded the MLC values, with the following extents: Limousin, 103.4%, Hereford 103.2%, Hungarian Fleckvieh 102.7% and Charolais 101.9%. Authors concluded, that the performance of these breeds in Hungary is

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under the MLC breed standard at younger age, but they can compensate it during rearing, and even exceed the standard.

- There were significant differences between the same Charolais sire lines in growth capacity and growth intensity, when tested in central and farm performance tests (central performance test, 8 breeding line, n = 74, farm performance test, 6 breeding line, n = 122), with individuals tested in central station being better, according to (*Nagy et al.,* 1989).
- Studying Charolais (n = 95), Hereford (n = 55) and Limousin (n = 120) candidate bulls in a central station in Boród, Hungary showed that – under same keeping and feeding circumstances – French breeds had higher weight gain and better feed conversion ratio than the Hereford. The measured values during the performance test were in weigh gain Ch: 1809 g/day, He: 1648 g/day, Li: 1676 g/day, while in feed conversion ratio Ch: 13.0 NEg Mj/kg, He: 15.3 NEg Mj/kg, Li: 13.3 NEg Mj/kg (*Tőzsér et al.,* 1987).
- When performance is measured in farm environment not always show the productive ability of the breeds, especially in case of growth intensity, due to different feeding. Therefore central performance tests have a great importance. In Hungary the breeding association for Hereford, Angus, Hungarian Fleckvieh, Charolais and Limousin frequently send the young candidate bulls to central stations for performance tests.
- The heritability values (h^2) estimated based on 548 candidate bulls from two breeding stations between 1992-1999 were the following: live weight corrected to 365 days 0.28, conformation traits in connection with life productivity (0.13), length measures 0.23, width measures 0.17, muscularity 0.13 (*Tőzsér* 2006).
- It's advised to measure the progeny of the bulls who performed well in farm tests in central stations in case if there's a genotype-environment interaction in a trait with great importance in the given breed and in the breeding aim. That kind of studies can be accompanied with testing the siblings born from embryo splitting in farm and in central station in parallel.
- Measuring the circumfence of *m. longissimus dorsi* by ultrasound scanner *in vivo* is already applied in the practice of beef cattle husbandry in Hungary, in case of several breeds, in concordance with international experiments.
- Ultrasound machines with different wavelength (3.5-7.5 MHz) sensors are suitable for studying reproduction status in cows (ovaries, fallopian tube, uterus, etc.) and in bulls (testicle measures, tissue structure, etc.) *in vivo*, without causing tissue damage, according to the review *Griffin and Ginther*, 1992.
- Based on international experiences, selection for beef production in candidate bulls can be highly more effective by measuring feed consumption and feed conversion performances, using so called electric gates (*INRA*, 1995).
- *Gáspárdy et al*, (1998) used two types of animal models for estimating the weaning weight corrected to 205 days of bull calves. That study showed the importance of utilizing animal model in self-performance tests. As applying animal model is getting widespread, the role and importance of performance tests is increasing, because breeding value of the individual can be accurately estimated based on its own performance and the performance of its relatives.
- Furthermore, it's important to continue estimating the genomic breeding values of the candidate bulls based on central performance tests for the more efficient selection.

It's well-known, that the aim of farm self-performance tests is to let only pre-selected candidate bulls – based on weight gain and conformation traits relevant in their type - to start offspring performance test according to their utilization type. Therefore pre-selection of candidate

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bulls must be as precise and as reliable as possible, for giving a chance to objective, accurate and sound comparative analysis.

Aim of our study was to evaluate the conformation of candidate bulls finishing farm self-performance test in 2021.

Material and methods

We studied the conformation performance of 311 Limousin candidate bulls in farm self-performance test (herds=30), in 2021

The main characteristics of farm self-performance test are the following.

Criteria for taking part in self-performance test

- Only those purebred male young animals can start a farm self-performance test, which are registered in „A" pedigree (at least 93,75% Limousin gene proportion) and are according to the parameters set for breeding animals by the organisation
- Only those young bulls can start, whose ancestry is known at least back to two generations, and whose sire has a self- or offspring performance test result
- Animals starting must meet the actual veterinary criteria
- Weaning weight of animals to be started must be known
- Minimum 2 young bulls must be started in one group

Test procedure

- Animals have to start the test at approx. 210-270 days of age; there can be maximum 30 days difference among those in the same group.
- Duration of farm self-performance test is 150-180 days, minimum 150 days.
- Animals in the test must be kept separately, in groups and have to be fed *ad libitum.*
- Finishing self-performance test and qualification is at about 390-420 days of age, not later than 450 days of age.
- DNA test has to be required by the breeder, and it must be available by the time of qualification. The breed organisation and breeding authority is not finishing self-performance test in case DNA results are not available.

Compulsory measures

- Live weight with 1 kg precision in an authenticated scale and age at the start of farm self-performance test must be recorded, in a presence of an inspector of the breeding authority.
- Breeding association advises 20-30 days difference between weaning and start, as calves get used to new housing and feeding conditions meanwhile, so these won't affect weight gain measured during the performance test.
- Finishing live weight with 1 kg precision in an authenticated scale and age at that time must be recorded, in a presence of the chief inspector of the breeding authority.
- Technicians of the breeding organisation record body measures summarized in *Table 2*. Muscularity and feet conformation is qualified on a 1 to 9 point scale according to the Breeding Programme (*LBBA*, 2018) of the organisation.

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Qualification of the animals

- Qualification is accomplished by the organisation. Base of qualification is weight gain during self-performance test, daily weight gain and the conformation judgement done by the organisation at the finish of the performance test.
- Age difference between individuals can't be more than 30 days at the time of qualification.
- Breeders must provide a suitable place for qualification, where conformation judgement of animals could be done individually or at least in pairs.
- The threshold value for qualification is 1200 g/day daily weight gain (without deducting the live weight at birth). A further requirement is correct conformation, without eliminating faults. In case there're less than 5 individuals satisfying the requirements at the breeder, than all parameters of the qualification threshold values must reach at least the Hungarian population average of the previous year.
- Professional Committee of the organisation sets the components of requirements for candidate bulls and the selection threshold values.

Table 2: **Methods of body measures**

Body measure (1)	Measuring points (2)	Equipment (3)
Withers height (4)	horizontal distance between the ground and the withers (10)	measuring stick (16)
Tail height (5)	horizontal distance between the ground and the hip bone (11)	measuring stick
Length of back (6)	distance between the withers and the loin (12)	tape measure (17)
Width of shoulders (7)	width at the widest point of the withers (13)	measuring stick
Width at hip bone (8)	distance between the two points of hip (14)	measuring stick
Pin width (9)	distance between the two ischium (15)	measuring stick

2. táblázat: Testméretek felvételének módja
testméret (1), méretfelvétel módja (2), eszköz (3), marmagasság, cm (4), farbúbmagasság, cm (5), hát hosszúság, cm (6), marszélesség, cm (7), csípőszélesség, cm (8), ülőgumók szélessége, cm (9), vízszintes talaj-mar közötti távolság (10), vízszintes talaj- farbúb közötti távolság (11), a mar és az ágyék közti távolság (12), szélesség a mar testtájának legszélesebb részén (13), a külső csípőszögletek közti távolság (14), ülőgumók közti távolság (15), mérőbot (16), szalag (17)

Statistical analysis

Statistical analysis was made by SPSS 24.0. Boxplot, error and regression diagrams were used to illustrate our data during the analysis.

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Results and discussion

Table 3 summarizes the live weight, body measures and conformation scores of candidate bulls studied. Animals in the test – as visible – weight approximately 45% of the matured breeding bulls (terminal live weight: 1000 kg, according to *Dervillé et al,* 2009), so have the potential to grow and build muscle in the future.

Table 3: **Live weight, body measurements and appearance scores of the Limousin bulls at performance test**

Traits (1)	**Mean** (2)	**Std. Deviation** (3)	**Minimum** (4)	**Maximum** (5)
Live weight, LW, kg (6)	455.4	42.54	400	632
Withers height, WH, cm (7)	123.2	5.38	105	136
Tail height, TH, cm (8)	132.1	6.19	105	147
Length of back, LB, cm (9)	78.9	6.20	63	94
Width of shoulders, WS, cm (10)	26.8	4.86	17	38
Width at hip bone, WHB, cm (11)	41.4	2.84	35	48
Pin width, PW, cm (12)	16.0	1.09	14	21
Muscularity, MS, score, (13)	6.9	0.72	5	8
Legs, score, LS, (14)	7.1	0.44	6	8

3. Táblázat: Limousin bikák élősúlya, testméretei és küllemi pontszámértékei a teljesítményvizsgálatban

tulajdonságok (1), átlag (2), szórás (3), minimum (4), maximum (5), élősúly, kg (6), marmagasság, cm (7), farbúbmagasság, cm (8), hát hosszúság, cm (9), marszélesség, cm (10), csípőszélesség, cm (11), ülögumók szélessége, cm (12), izmoltság, pont (13), lábak, pont (14)

Live weight of the bulls studied was the similar (mean: 455 kg, age=420±30 days) as data published in previous French (440 kg, *Anonim* 1992) and Hungarian (n=194, 446 kg *Tőzsér* 2006) literature. *Tőzsér* (2006) also reported similar values (n=548, 474 kg) in the country in a later study. *Török* (2009) suggest to keep fattening bulls until they reach 655 kg, based on fattening results, *in vivo* ultrasound measures and slaughter parameters.

Tail height (132 cm) being higher than wither's height suggest young bulls are still in growing, so their height at withers is going to get larger.

Height at withers was almost similar to the data (122 cm) published by *Holleville* (1985). *Rose et al.* (1988) reported lower mean value in tail height (128 cm), measured on 53 individuals, than our data (123 cm).

Minimum value in back length was 63 cm, while the maximum 94 cm, which mean appropriate maturity according age. Present values of hip bone and pin width serve a good base for preserving calving ease in the breed when these bulls are going to be used for stud. Mean in conformation scores in case of muscularity and leg were around 7, with score 5 as minimum and 8 as maximum, which also highlight the value of the population.

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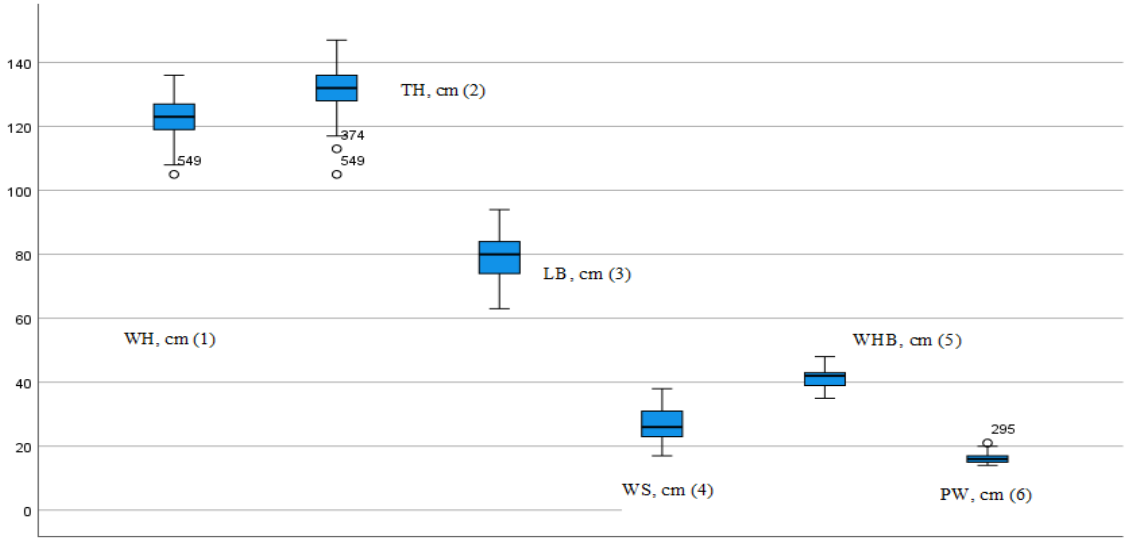
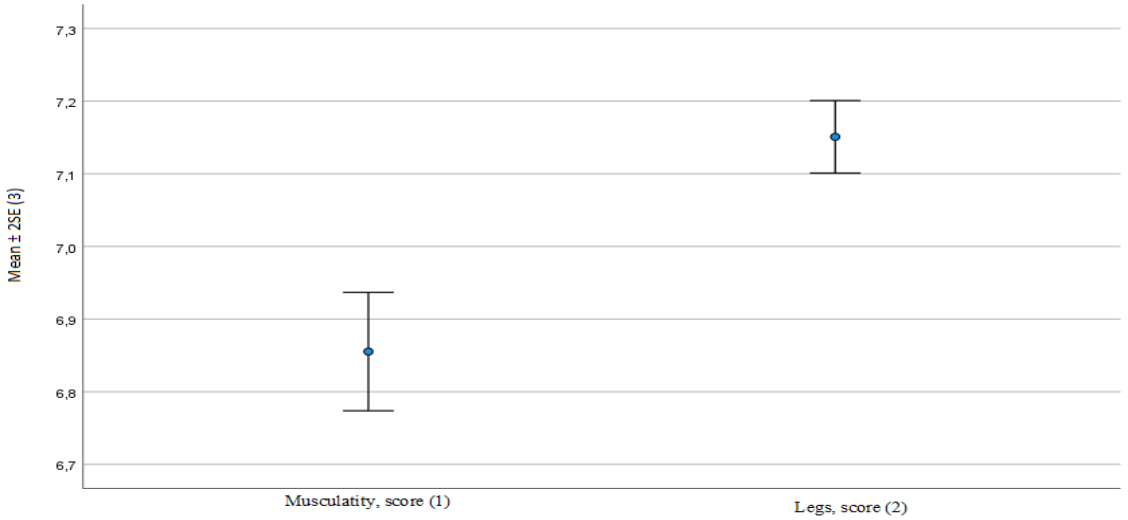
Figure 1: **Results of body measurements in Limousin bulls**



1. ábra: Limousin bikák testméretei
marmagasság, cm (1), farbúbmagasság, cm (2), hát hosszúság, cm (3), marszélesség, cm (4), csípőszélesség, cm (5), ülőgumók szélessége, cm (6)

Figure 1 shows the boxplot charts of body measures studied. Only some outstanding values were measured (height at withers: 1 animal, tail height: 2 animals, pin width: 1 animal), so these don't affect further analysis significantly.

Figure 2: **Scores for muscularity and legs**



2. ábra: Izmoltsági és láb pontszámok
izmoltság, pont (1), láb, pont (2), átlag ±2SE

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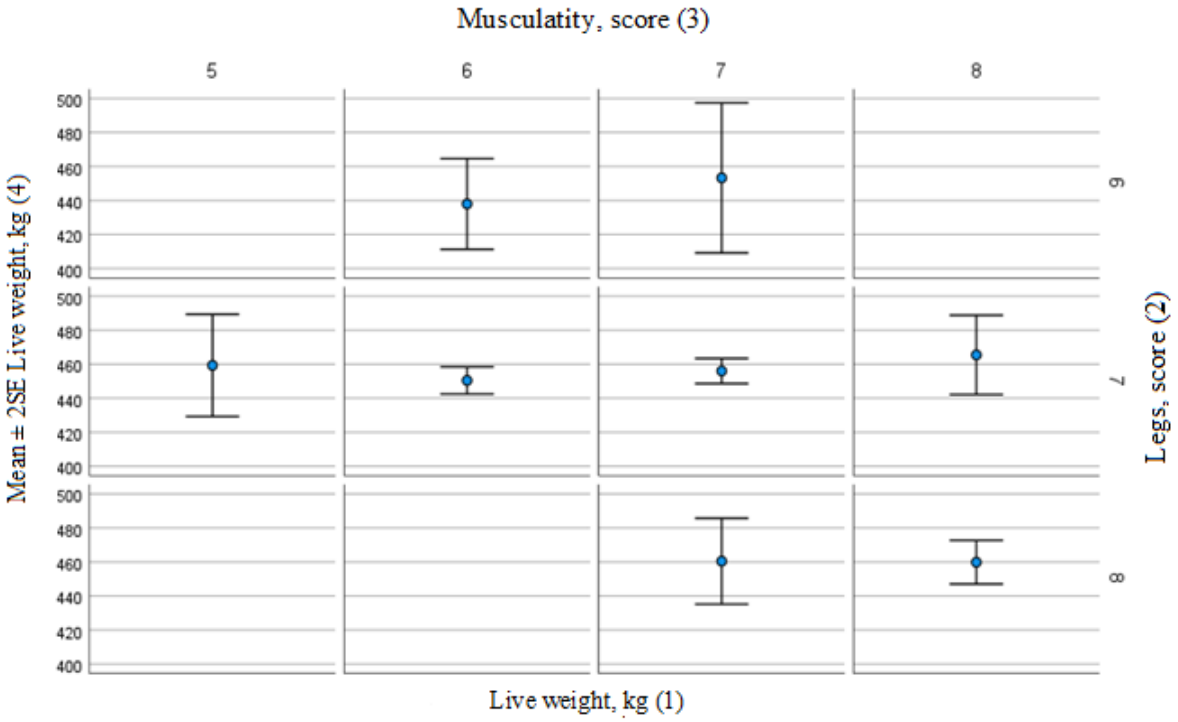
Figure 2 shows the mean and the standard error of mean in conformation scores for muscularity and leg. Legs being good enough is not only shown by high mean value (score 7.1), but also by low error (SE). Error of the mean was higher in muscularity than in leg score.

Figure 3: **Muscularity and leg scores as a function of live weight**



3. ábra: Az izmoltság és a láb pontszámok az élősúly függvényében
élősúly, kg (1), lábak, pont (2), izmoltság, pont (3), átlag ±2 SE, élősúly

Muscularity and leg scores as a function of live weight are summarized in *Figure 3*. As shown on figure, leg score 6 was accompanied with muscularity 6 and 7, with at least 440 kg mean live weight. Standard error of mean was higher in case of muscularity score 7, than in 6.
5, 6, 7 and 8 muscularity scores were next to leg score 7, with different SE values. Error data for score 6 and 7 were much lower, than for score 5 and 8.
Animals scored 8 for leg had muscularity scores 7 or 8, with mean live weight 460 kg. SE value was lower, so more advantageous for score 8.

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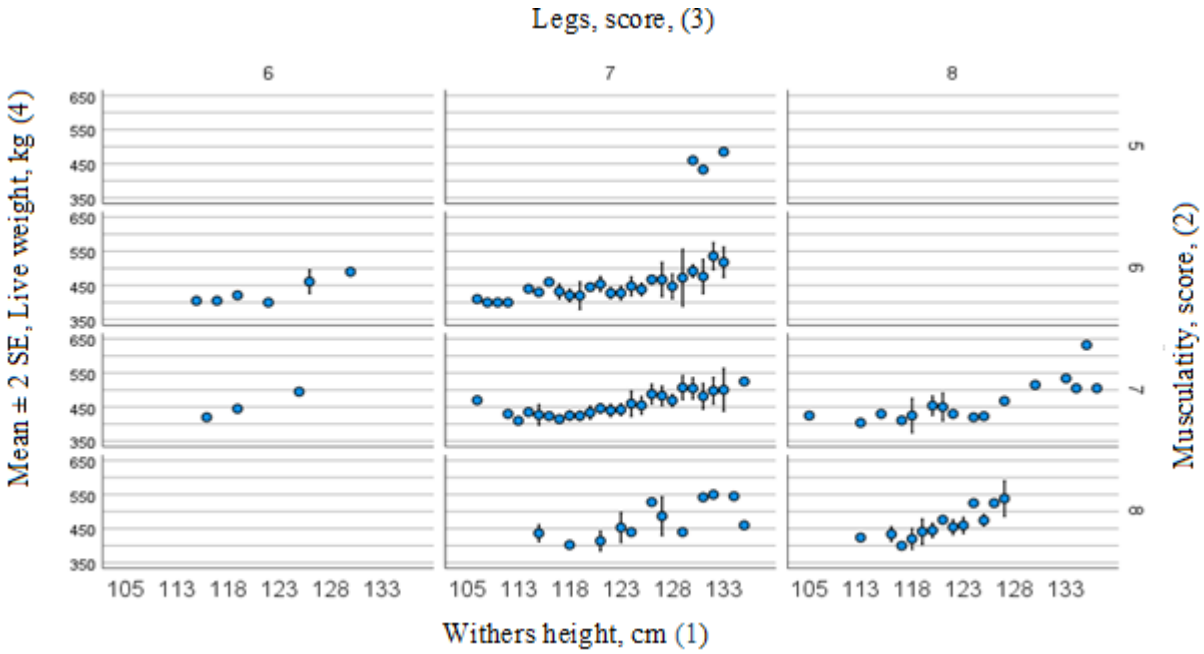
Figure 4: **Development of live weight, muscularity and legs according to height at withers**



4. ábra: Az élősúly az izomzat és a láb alakulása a marmagasság szerint
marmagasság (1), izmoltság, pont (2), átlagos élősúly, kg (3)

Figure 4 shows live weight, muscularity and leg as a function of height at withers. Analysing live weight data according to wither's height categories, taking into consideration muscularity and leg scores shows that live weight increased as wither's height increased in all relations. As an example, 440 kg live weight accompanied 113 cm wither's height, while 650 kg 133 cm wither's height in muscularity score category 7. This chart also shows, that score 7 was the most common value in leg, while 7 and 8 in muscularity.

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Table 4: **Relationships between live weight, body measurements and appearance scores**

Traits (1)	**Live weight, LW (2), kg**	**WH, cm**	**TH, cm**	**LB, cm**	**WS, cm**	**WHB, cm**	**PW, cm**	**MU, score**
Withers height, WH, cm (3)	0,613**	-						
Tail height, TH, cm (4)	0,593**	0,914**	-					
Length of back, LB, cm (5)	0,266**	0,116*	0,063	-				
Width of shoulders, WS, cm (6)	0,141*	0,147**	0,196**	-0,453**	-			
Width at hip bon, WHB, cm (7)	0,213**	0,150**	0,119*	0,425**	-0,189**	-		
Pin with, PW, cm (8)	0,371**	0,288**	0,269**	0,254**	0,047	0,215**	-	
Muscularity, MU, score, (9)	0,099	-0,107	-0,180**	0,331**	-0,285**	0,302**	0,161**	-
Legs LE, score, (10)	0,070	-0,089	-0,159**	0,254**	-0,104	0,176**	0,131*	0,526**

**. Correlation is significant at the 0.01 level (2-tailed).

*. Correlation is significant at the 0.05 level (2-tailed).

4. táblázat: Limousin bikák élősúlya, testméretei és küllemi pontszámértékei közötti összefüggések tulajdonságok (1), testsúly, kg (2), marmagasság, cm (3), farbúbmagasság, cm (4), hát hosszúság, cm (5), marszélesség, cm (6), csípőszélesség, cm (7), ülőgumók szélessége, cm (8), izmoltság, pont (9), lábak, pont (10)

Direction and strength of correlations between parameters studied can be seen in *Table 4*. Positive, moderate correlations between live weight and wither's height (r=0.613), tail height (r=0.593) are in concordance with previous studies. Live weight showed really loose correlations with other body measures in this analysis. Others reported closer relationships, e.g. *Bene et al.* (2007). Many papers showed height at withers being more strongly correlated to live weight than to age, like *Tőzsér et al.* (2001) in weaned calves in Charolais breed, and *Tőzsér and Domokos* (2001) in cows. Correlations of conformation scores with live weight and body scores were of different directions and loose. Correlation between the two scores achieved during judgement was positive, but moderate (r=0,526).

Figures 5-8 show the regression relationships. It's visible from them that regression of live weight with wither's height and tail height is much stronger, than with other body measures studied. That suggests taking live weight and the two height measures emphasized in breeding work for separating types within the breed.

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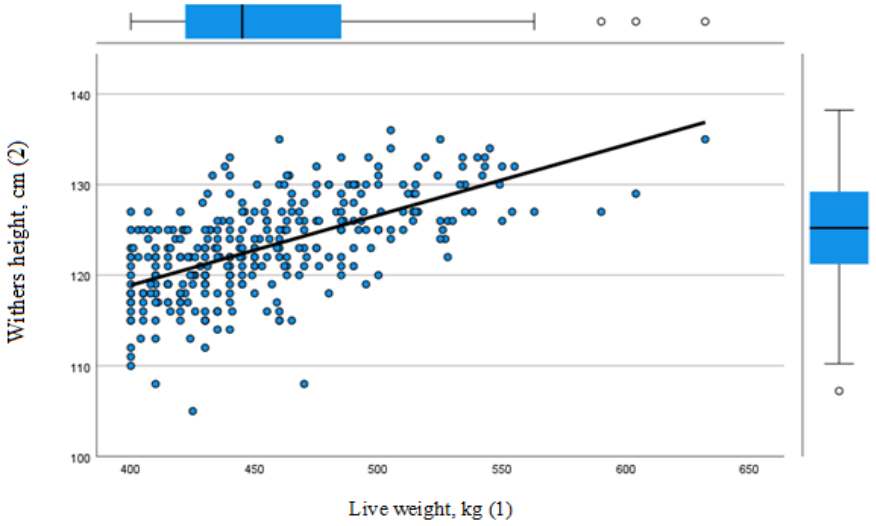
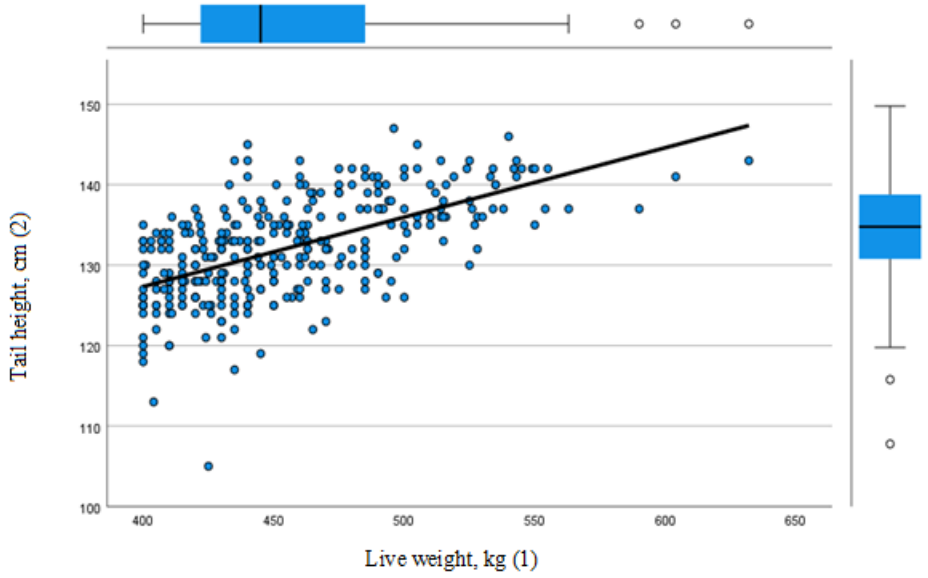
Figure 5: **Regression between live weight and withers height**



5.ábra: Regresszió az élősúly és a marmagasság között
élősúly, kg (1), marmagasság, cm (2)

Figure 6: Regression between live weight and tail height



6. ábra: Regresszió az élősúly és a farbúbmagasság között
élősúly, kg (1), farbúbmagasság, cm (2)

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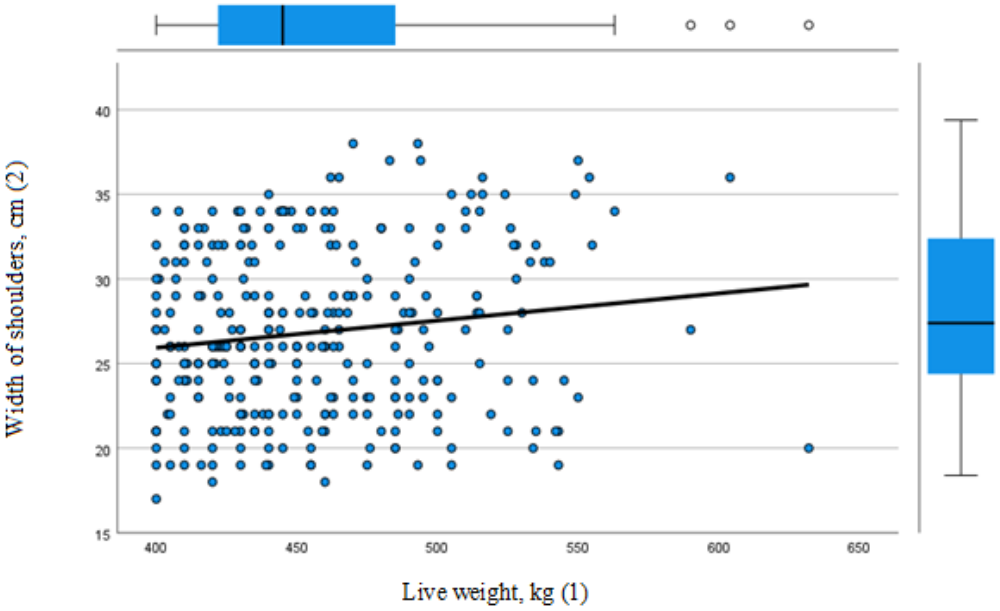
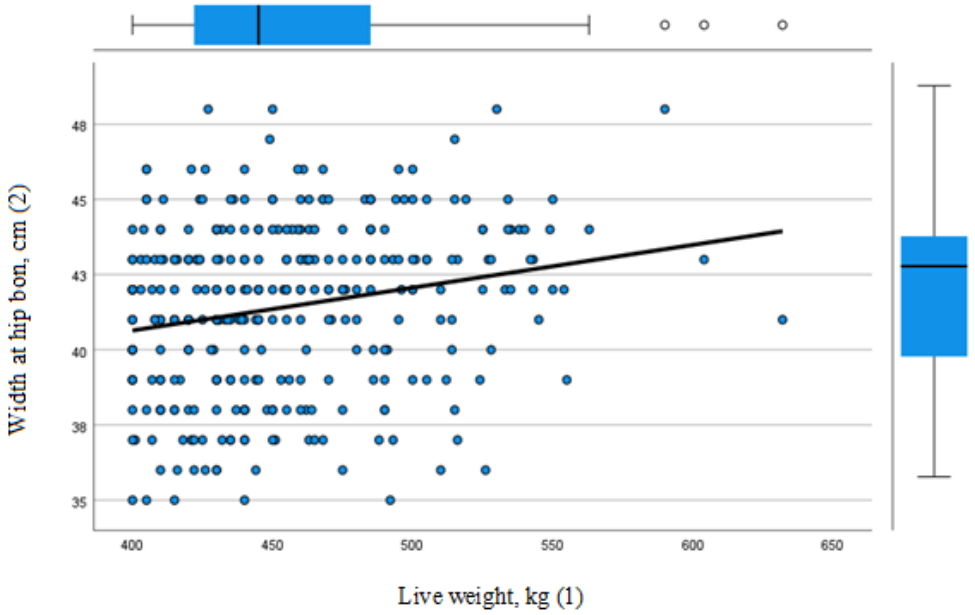
Figure 7: **Regression between live weight and width of shoulders**



7. ábra: Regresszió az élősúly és a marszélesség között
élősúly, kg (1), marszélesség, cm (2)

Figure 8: **Regression between live weight and width at hip bon**



8. ábra: Regresszió az élősúly és a csípőszélesség között
élősúly, kg (1), csípőszélesség, cm (2)

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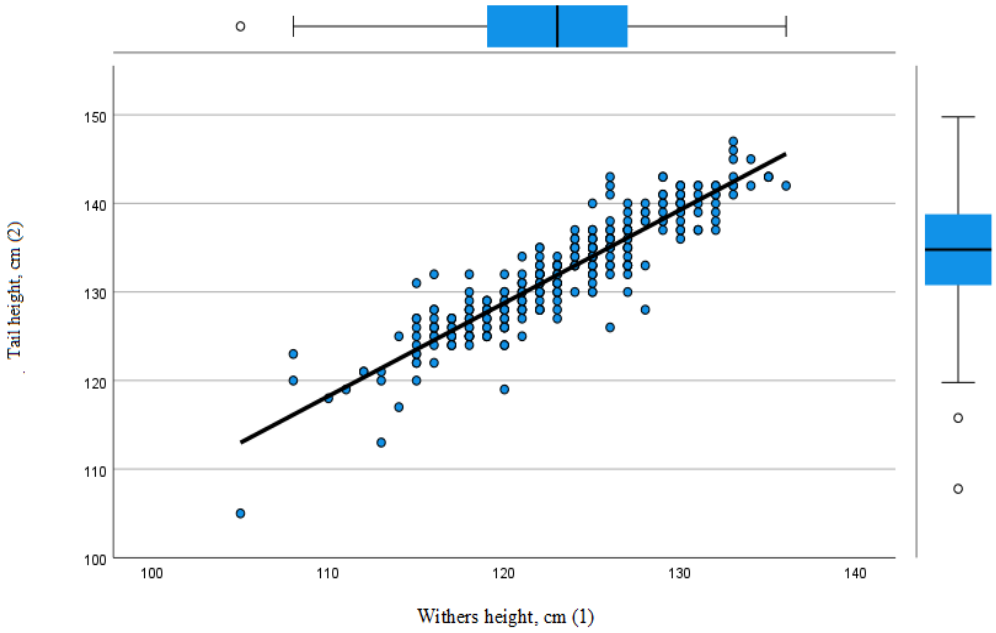
Figure 9 shows the regression between the two height measures. The strong positive correlation (r=0,914) and regression between the two traits would offer the possibility to estimate one from the other with a regression equation. However, have to stress, that both height measures are necessary in the practice for professional target mating.

Figure 9: **Regression between withers height and tail height**



9. ábra: Regresszió a marmagasság és a farbúbmagasság között
marmagasság, kg (1), farbúbmagasság, cm (2)

Conclusion

Analysing production data (live weight, body measures, conformation scores) of young Limousin bulls in self-performance test gave a good opportunity to evaluate the breed. Maturity, body measure data ad muscularity of the animals studied provide a good base for improving next generations when these young bulls start their breeding career as sires in the farms.

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Literature

Anonim, (1992): Résultats du contrôle des performances des bovins allaitants. Institut de l' Élevage, Paris, 1-56.

Bene, S., Nagy, B., Nagy, L., Kiss, B., Polgár, J. P., and Szabó, F.: Comparison of body measurements of beef cows of different breeds, Arch. Anim. Breed., 50, 363–373, https://doi.org/10.5194/aab-50-363-2007, 2007.

Boonen F. (1991): Centre de Sélection Bovine, Rapport d' Activité, Ciney, Belgique, 1-66.

Bozkurt Y, Aktan S, Ozkaya S (2007) Body weight prediction using digital image analysis for slaughtering beef cattle. *Journal of Applied Animal Research* 32, 195–198. https://doi.org/10.1080/09712119.2007.9706877

de Rose E.P.- Wilton, J.W.- Schaeffer, L.R. (1988): Estimation of variance components for traits measured on station-tested beef bulls. J. Anim. Sci. 66., 3., 626-634. https://doi.org/10.2527/jas1988.663626x

Dervillé M., Patin S., Avon L. (2009). Races bovines de France: origine, standard, sélection (in French). Paris: Éditions France Agricole. ISBN 9782855571515

Dohy J. (Ed.)(1985): Húsmarhatenyésztés, Mezőgazda Kiadó, Budapest 349.

Dubois M. - Huneault G.(1990): Évaluation génétique des taurillons de boucherie en station, Rapport des Tests, Hiver 1988-1989, Québec, Canada, 1-21.

Gáspárdy A., Szabára L., Sváb L., Bodó I. (1998): Modern evaluation of the weaning weight in a Charolais herd by using individual animal model. Hungarian Journal of Animal Production, 47: 6. 503-513.

Griffin P.G., Ginher, O. J. (1992)**:** Research application of ultrasonic imaging in reproductive biology, J. Anim. Sci. 70, 3: 953-972. https://doi.org/10.2527/1992.703953x

Holleville, P. (1985): La contribution du Charolais à l' amélioration économique de la production de viande. Revue Trimestrielle, 20, 76., 17-28.

INRA (1995): Répertoire francais des méthodes et des procédures de controle d' évaluation génétique des reproducteurs ovins et bovins de races allaitantes, 1-40.

Karamfilov, S., Nikolov, V., & Malinova, R. (2019). Study on the exterior of cow Limousin cattle breed, bred in Bulgaria. Bulgarian Journal of Agricultural Science, 25(6), 1254–1260

Limousin and Blonde d 'aquitaine Breeders Association (2018): Breeding program. Budapest, 1-30.

Nagy N. (1974): Breeding value estimation and development of charachteristics for beef cattle. Hungarian Journal of Animal Production,. 23.3. 37-46.

Nagy N., Hajas P., Lipcseiné Z. (1985): Real value of the domestic Charolais, Limousin and Hereford herds compering to the English breeds averages. Vágóállat és Hústermelés, 8. 1-7.

Nagy N., Tőzsér J., Kisgergelyné K. A. (1989): Data on the performance and significance of beef cattle breeding lines. Hungarian Journal of Animal Production, 37: 4. 306-313.

Pflaum J. (1989): Bayerische Landesanstalt für Tierzucht Grub. Jahresbericht, 48.

Ozkaya S., Neja W., Krezel-Czopek S., Oler A.(2015): Estimation of bodyweight from body measurements and determination of body measurements on Limousin cattle using digital image analysis. *Animal Production Science* 56(12) 2060-2063 https://doi.org/10.1071/AN14943

Szabó, F. (Ed.)(1998): Húsmarhatenyésztés, Mezőgazda Kiadó, Budapest 374.

Török M. (2009): In vivo ultrasonic measurements in beef cattle breeding towards developing breeding value estimation. Pannon University. Állat- és Agrárkörnyezet-tudományi *Doktori* Iskola, Keszthely, https://konyvtar.uni-pannon.hu/doktori/2010/Torok_Marton_dissertation.pdf

Tőzsér J. (2006): Research for type differentiation in cattle breeding. Doctoral Dissertation of the Hungarian Academy of Sciences, Gödöllő, 173. http://real-d.mtak.hu/224/1/Tozser_Janos.pdf

Tőzsér J., Domokos Z. (2001): Vizsgálatok charolais választott bikaborjak küllemi bírálatának megalapozására. Állattenyésztés és Takarmányozás, 50., 4. 299-309.

Tőzsér J., Donokos Z., Alföldi L., Holló G. Rusznák J. (2001): Különböző génarányú charolais tenyészet teheneinek testméretei. 50., 1. 15-22.

Tőzsér J., Ravasz T.-né, Nagy, N. (1987): Feeding efficiency of beef breeding bulls. Hungarian Agriculture, 41. 46. 14-15.

Ulutas Z, Saatci M, Ozluturk A (2001) Prediction of body weight from body measurements in East Anatolian Red Calves. *Journal of the Faculty of Agriculture. Erzurum University* 32, 61–65. https://dergipark.org.tr/tr/download/article-file/34478

https-1 (2022): www.thecattlesite.com/breeds/beef/39/limousin/

htpp-2 (2020): www.limousine.org

10.17205/SZIE.AWETH.2022.1.064