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THE BODY CONSTITUTION TYPE INFLUENCE ON CHAROLAIS BREEDS CATTLE MEAT PRODUCTION AND QUALITY

V. Jukna, Č. Jukna, N. Pečiulaitienė, E. Meškinytė-Kaušilienė

Lithuanian University of Health Science Veterinary Academy, Laboratory of Meat Characteristics and Quality Assessment, Tilžės 18, Kaunas LT-47181, Lithuania
Corresponding author: vjukna@lva.lt
Invited paper

Abstract: The article presents data the most common body constitution types and their impact on meat production and quality on Charolais breed. Four body constitution types were researched in the breed: large, small, muscular and lightweight (commercial) type. For each type were selected in 15-16 uncastrated bulls, which were reared Control feeding station in identical feeding and storage conditions of up to 500 days age. Feeding control has been carried out from 210 days to 500 days of age. After the fattening from each group were slaughtered in 8 bulls. Investigated types of animals were marked differences in body measurement sizes. At the end research of large body constitution type bulls weighed 622.5 kg, small type 590.5 kg, muscular type 612.0 kg and of lightweight type 606.7 kg ($P<0.05$, $P> 0.05$). The animal of small type for 1 kg of weight gain consumed for 6.1 MJAE or 8.4 percent feed more than a large type animals. Other types of animal feed costs were only 1.2 to 1.7 percent higher than the large type animals. Carcass yield was the highest muscular type animals and was composed 59.8 percent, 58.9 percent of large type, 56.4 percent of lightweight (commercial) type and 54.2 percent was of small type animals ($P<0.01 - > 0.05$). Different types of body constitution animals were unequal of carcase hip thigh part mass and soft parts yield. The type of body constitution animal did not influence on the majority meat quality characteristics. The small type of animals meat was significantly hardness than of other types body constitution animals ($P<0.05$). It was concluded that for meat production purposeful to grow animals it's best to focus on the large and muscular body constitution types by increasing the number of such animal types.

Key words: Charolais cattle, body constitution type, meat production, meat quality, carcase yield

Introduction

Breeds in which is a high number of animals and its prevalence in a large area with different natural conditions, individual characteristics highly vary. Author *Johnson et al.(1963)* observed large individuals differences in the breed and he divided them on the morphological and physiological. These differences are closely correlated, therefore it is not always easy to distinguish. Such indicators attributed to the morphological differences as color of the animal, body type, etc., while attributed to the physiological differences animal's growth rate, feed consumption efficiency and milk production. The selection direction determines of a particular zone of natural-climatic and economic conditions. Therefore, depending on local conditions begin to form groups of animals, which ensures optimum productivity in the specific conditions, as a result the formation of zonal types *(Петрушко, 2004; Смирнов, 2004)*. French beef cattle breeds among beef cattle has a high popularity. In France is mainly Charolais beef cattle breed's, this breed is spread rapidly in recent years in the world. Now Charolais cattle are bred in more than 80 countries *(Амерканов, 2001)*.

In France Charolais cattle were bred of differences productivity land and taking into account the specific objectives of the breeder, formed four different body constitution types of Charolais cattle breed's *(Jukna, 2009)*. Increasingly more popular with large well-developed muscles of animals type. This type cows weigh from 800 to 950 kg and bulls from 1200 to 1350 kg. Cows of large types eat more grass and produce more milk than small type cow's *(Scholz, 2010)*. Calves are born 42 to 50 kg. Therefore, the assessment carried out in accordance of bulls of born calf weight. 12 months bulls weighing 525 kg, heifers 360 kg. Carcass yield was of 64-65 percent.

Less popular, but fairly common widespread muscular type. Animals of this productivity type are the lower legs, shorter, more compact trunk, wide body shapes with well-developed in parts of the body musculature. This cows type weigh from 700 to 800 kg, bulls from 1100 to 1200 kg and calves born weigh- 44-46 kg. Carcass yield was of 62-64 percent. In recent years, more often refused of small animals type with average developed muscles. Animals of this type are smaller than the above mentioned animals types. The animals have weak dorsal and especially the posterior part muscles of body. Their lower weight gain and lower carcass yield. Cows weigh from 600 to 700 kg, bulls from 1000 to 1100 kg and calves born weigh 42-44 kg. Carcass yield of 58-60 percent.

There are also distinguishable of animal light type, sometimes referred to as "commercial" type. Animals light type are quite large, they have a long, narrow and shallow trunk, than beef cattle have long legs. Development of thigh muscle is a moderate or weak, shoulders isn't wide, therefore such cows easy calving. Cows

weigh from 650 to 750 kg and bulls from 1100 to 1200 kg, calves born weigh from 44 to 46 kg, carcass yield composed of 60-62 percent. Cattle of this type reared of farmers who sells weaned calves and not specialize in grow for meat. Lithuanian Charolais cattle have all four types of body constitution *(Jukna, 2009)*. Charolais beef cattle breeding program compose need appropriate knowledge about different body constitution types of cattle in meat production and quality characteristics and for their potential use in the selection process.

The aim of this study was to perform a comparative evaluation of meat production accordance in country existing Charolais breeds cattle body constitution types.

Materials and Methods

For study were sorted Lithuanian Charolais breed the most significant four types of body constitution animals: large, small, muscular and lightweight (commercial) types.

Non-castrated bulls were selected after 15 to 16 animals according each type. For each group was represented two bulls offsprings. Bulls of 200 days age were placed in Company Šilutė breeding control feeding station and animals were reared in equally feeding and storage conditions tethered. Concentrate feed and hay were rationing groups, whereas the silage bulls ate ad libitum. Feed content consumed was determined by weighing put feed and unconsumed residues once too two week consecutive two days. Concentrates in accordance with nutrition composed 43-45 percent, feed consumed records were conducted from 210 to 500 days of age. During this period was conducted and weight of changes supervision, bulls were weighed every two months. Than group reached on average 500 days age was carried out in a visual evaluation of muscularity. The main body dimensions were measured and selected at eight bulls, which most conformity of group average for control slaughter. During the control slaughter was assessed: of warm carcass weight, carcass muscularity and fat class, carcass hip-thigh part mass and of this part morphological composition. At the last rib was assessed longest dorsal muscle (*musculus longissimus dorsi*), cross-sectional area.

The sample for the meat quality determination was taken from the longest dorsal muscle at the last two ribs. The experiment was established by using common accepted methods. The meat pH was measured by a pH-meter Inolab 3, by a contact electrode „Sensative“; dry materials (with automatic instruments' SM-1); meat colour by a Minolta Chroma Meter 410, measuring values L * – for lightness, a * − for redness and b * − for yellowness; water-holding capacity by Grau and Hamm method; cooking loss by Shiling method; drip loss – by sample weight reduction after 24 hours; ash – by organic matter incineration at 700°C; shear force – according to Warner-Bratzler method; fat by an automatic system for

fat extraction Soxterm method; of meat protein full-fledged indicator was determined according to the relationship of amino acids: tryptophan and oxyproline. The amino acids tryptophan and oxyproline ratio determines the meat protein full-fledged indicator.

Statistical analysis. The R statistical package version 2.0.1. (Gentlemen, Ihaka, 1997) was used to estimate data. The difference statistically reliable when $p < 0.05$.

Results and Discussion

Analysing the exterior peculiarities of the experimental bulls individual body measurements were compared with the large type animals (Table 1).

Table 1. Body measurements, cm

Body measurements	Productivity type			
	Large	Small	Muscularity	Lightweight
Height at the ridge	124^{x}	118^{x}	119^{x}	126
Height at the cross	130^{x}	127	125^{x}	132
Diagonal of trunk length (stick)	162^{x}	153^{x}	160	161
Chest size	199^{x}	185^{x}	198	196
Half the rear size (gregory measure)	175^{xx}	161^{xx}	178	172
Spinal ham dimension	169^{xx}	153^{xx}	173	163^{x}
Muscularity	7.2^{x}	5.6^{x}	7.5	6.5

^{x} – $p<0.05$; ^{xx} – $p<0.01$

In the first table of data shows that bigest differences were obtained other cattle types of measurements comparison with of bulls small type body measurements. This type's of bulls height at the withers was 6 cm, diagonal of trunk length 14 cm, chest size 5 cm, half the size of rear 14 cm, spinal ham size 16 cm less than theirs of large type peers ($P < 0.05 - < 0.01$). Muscularity type bulls was 5 cm lower ($p < 0.05$) than of the large-type peers. And their of diagonal of trunk length and of chest size measurements were also slightly lower, half the rear size and spinal of ham size 3-4 cm larger than the large type animals. Lightweight type animals were 2 cm taller. Their chest's size was 3 cm and half rear size 5 cm, and spinal ham size 6 cm was less than large type animals ($P > 0.05 - < 0.05$). Highest muscularity was evaluated of muscle types cattle and the lowest was of small type animals ($p < 0.05$).

In the second table shows that the end of the test (500 days age) the most weighed of large type of bulls.

Table 2. Carcass traits

Indicators	Productivity type			
	Large	Small	Muscularity	Lightweight
Weight 500 days of age, kg	622.5[x]	590.5[x]	612.0	606.0
Overweight per daily from 210 to 500 days of age, g	1180	1080	1160	1120
Feed costs for overweight, MJAE	72.3	78.4	73.2	73.5
Carcass yield, %	58.9[x]	54.2[x]	59.8	56.4
Muscularity class of carcass	E/U	U	E	E/U
Fat class of carcass	2.3	2.0	2.4	2.2
Carcass hip-thigh part yield, %	34.6	33.0	35.2	33.8
The soft parts yield and carcass hip thigh part, %	81.8	80.5	82.3	81.6
Longest dorsal muscle cross-sectional area, cm2	102[x]	91[x]	107	98

[x] – $p<0.05$; [xx] – $p<0.01$

The large type bulls weight were 32 kg or 4.5 percent ($P<0.05$) higher than the small type bulls, 10.5 kg or 1.7 percent than muscularity type and 16.5 kg or 2.5 percent than lightweight the type of animals. Feed inputs per unit of body overweight were smallest large type bulls, while the small type bulls its were largest. The difference was 6.1 or 8.4 percent MJAE. The other types of bulls consumed feed for body overweight compared with large types bulls were slightly more. Body constitution type had influenced for carcass yield. The highest carcass yield was of muscularity types, but the least was of small bulls types. The difference was composed 5.6 ($p<0.01$). Among other types of body constitution of carcass yield differences was lower. The highest muscularity class was assessed carcasses of muscularity type bulls and the lowest muscularity class had of small type bulls carcasses. Carcasses of fat class differed marginally for all productivity types. Carcasses hip-thigh part was the best developed of muscularity and large type cattle, and the worst was of small type animals. Similar situation were obtained and of the soft parts yield from the hip -thigh part. Maximum longest dorsal muscle area was of large and muscularity types and the smallest was of small type cattle.

Meat quality the most distinct differences did not showed among all types of body constitution. Only of small type animals meat was significantly hardness than the other types and its was lesser of protein usefulness indicator ($p<0.05$) (Table 3).

Table 3. Quality of meat (*musculus longissimus dorsi*)

Indicators	Productivity type			
	Large	Small	Muscularity	Lightweight
Chemical composition of meat, %:.				
Dry materials	24.46	23.50	24.09	24.50
Protein	21.71	20.85	21.68	21.79
Fat	1.63	1.51	1.27	1.58
Ash	1.12	1.14	1.14	1.13
pH	5.5	5.6	5.5	5.6
Color:				
L^*	40.04	38.78	38.96	39.82
a^*	17.25	16.55	15.58	16.74
b^*	7.69	7.53	8.66	7.83
Shear force, kg/cm^2	1.7^x	2.6^x	1.9	1.8
Water holding capacity, mg %	60.86	60.90	61.22	60.71
Cooking loss, %	24.23	23.40	23.19	24.15
Tryptophan content, mg %	342.0	337.0	331.5	348.7
Oxyproline content, mg %	58.6	70.3	59.2	63.4
Meat protein full-fledged indicator	5.8^x	4.8^x	5.6	5.5

^{x} – $p<0.05$

In our experiments was obtained data about this, that of the same breed's of different body constitution type animals varies according of meat production and this coincides with other authors' analysis. Authors in their experiments with Hereford has assessed, that body constitution type and growth rapidity determines of the meat production to some of the indicators *(Renand et. al., 2001; Cassar-Maleck et. al., 2003; Culioli et .al. 2003; Sami et al., 2004; Picard et.al., 2006; Micol et. al., 2009; Беляев et al., 2004; Стелькин, 2007; Качетков et al., 2009)*. Author *Roffeis et al. (2002)* found, that between overweight and of carcass yield was of moderate size positive correlation. This statement was confirmed and in our experiments. The lowest overweight and the least carcass yield were obtained of the small body constitution type's.

Conclusion

To sum up the research data can draw the following conclusion, that considering in the Lithuanian natural conditions and feed resources most appropriate for selection the formation of large and muscularity animals type.

Uticaj tipa konstitucije goveda šarole rase na proizvodnju i kvalitet mesa

V. Jukna, Č. Jukna, N. Pečiulaitienė, E. Meškinytė-Kaušilienė

Rezime

U radu su prikazani podaci o uticaju najčešćeg tipa konstitucije trupa na proizvodnju i kvalitet mesa šarole rase. Istraživana su četiri tipa konstitucije: veliki, mali, muskularni i komercijalni tip. Za svaki tip odabrano je 15-16 nekastriranih bikova koji su hranjeni u kontrolnoj ishrandbenoj stanici u identičnim isrhanbenim i ambijentalnim uslovima do 500 dana starosti. Ishranbena kontrola trajala je od 210. dana do 500. dana starosti. Nakon tova iz svake grupe zaklano je po 8 bikova. Kod ispitivanih grupa životinja zabeležene su razlike u težini. Na kraju istraživanja, bikovi velike konstitucije bili su teški 622,5 kg, malog tipa 590,5 kg, muskularnog tipa 590,5 kg i komercijalnog 606,7 kg (P <0,05, P> 0,05). Životinje malog tipa, za formiranje 1 kg mase (težine) pojedu 6,1 MJAE ili 8,4% više hrane nego životinje velikog tipa. Kod drugih tipova životinja troškovi hrane su bili samo od 1,2 do 1,7% veći nego kod životinja velikog tipa. Masa trupa je bila najveća kod muskularnog tipa i činila je 59,8%, zatim kod velikog tipa 58,9%, komercijalnog 56,4% i malog tipa 54,2% (P <0,01 - > 0,05). Različiti tipovi konstitucije životinja razlikuju se u masi trupa, buta i mekih delova. različiti tipovi konstitucije životinja nisu imali uticaja na glavne parametre kvaliteta mesa. Mali tip životinja imao je značajno lošije meso od drugih tipova životinja (P<0,05). Zaključeno je da je za proizvodnju mesa svrsishodnije gajiti životinje velike i maskularne konstitucije.

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