ACTA UNIVERSITATIS AGRICULTURAE ET SILVICULTURAE MENDELIANAE BRUNENSIS
SBORNÍK MENDELOVY ZEMĚDĚLSKÉ A LESNICKÉ UNIVERZITY V BRNĚ

Ročník LIV 2 Číslo 4, 2006

BEEF PERFORMANCE OF HOLSTEIN CALVES SLAUGHTERED AT 300 KG OF LIVE WEIGHT

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Received: March 31, 2006

Abstract

CHLÁDEK, G., FALTA, D.: *Beef performance of Holstein calves slaughtered at 300 kg of live weight*. Acta univ. agric. et silvic. Mendel. Brun., 2006, LIV, No. 4, pp. 13–20

The aim of this work was to quantify basic feedlot performance and carcass value characteristics of Holstein bulls slaughtered as "young cattle" at 300 kg of live weight. The observation was carried out in a group of 12 Holstein bulls fattened in identical conditions and fed on a diet consisting of ad libitum amount of crushed grain (barley and wheat) and a limited amount of protein concentrate.
The mean overall values were as follows: age and live weight at slaughter 275.9 days and 299.3 kg, daily weight gain and net weight gain since birth 0.962 kg and 0.527 kg, dressing percentage 48.3%, weight of cold right carcass half 71.0 kg, weight of bones 17.5 kg, weight of muscle 53.0 kg and separable fat 0.54 kg. The mean weight of hide was 21.6 kg. The great majority of calves were classified as O2, one calf graded R2. The forequarter to hindquarter ratio was 1.4 with mean weights 29.1 kg and 41.9 kg. The mean weight of neck was 3.9 kg, chuck 3.6 kg, shoulder 5.9 kg, fore shank 3.4 kg, loin 4.1 kg, filet 1.5 kg, round 18.2 kg and hind shank 1.3 kg. We found highly significant ($P<0.01$) coefficients of correlation between carcass weight and live weight at slaughter ($r=0.963$) or daily weight gain ($r=0.723$). Net weight gain since birth was highly significantly ($P<0.01$) correlated to live weight at slaughter ($r=0.723$) or to daily weight gain ($r=0.982$) and significantly correlated ($P<0.05$) to age at slaughter ($r= –0.665$).
Despite the average or worse-than-average feedlot performance parameters our experimental Holstein bulls had an adequate proportion of muscle (comparable with other literature sources), a high ratio of bones and a very low proportion of fat. Thanks to small meat trim, weights of the main dissection parts of fore-and hindquarters were comparable to those usually found in young Holstein bulls.

calves, Holstein, carcass, disection parameters, meat

Presently, a Holstein cattle population makes up 46.4 % (with 160,000 cows involved in milk recording) of the total dairy cattle population in the Czech Republic. This strictly specialised dairy breed is bred for a high milk yield, however, Holstein bulls, together with bulls of dual-purpose breeds, are still the main source of beef in the Czech Republic (KVAPILÍK et al., 2005). LENGYEL et al. (2003) stated that a great amount of beef consumed worldwide is produced by Holstein bulls.

During the last five years, milk production of Holstein cattle has increased nearly by 1500 kg per cow in the Czech Republic (KVAPILÍK et al., 2005). At the same time, a continuous increase of milk yield has a negative impact on beef production; it causes a reduction of muscle, a lower proportion of valuable parts of the carcass, a higher proportion of bones and, partly, a greater fat deposition (BARTOŇ et al., 2003; URBAN et al., 1997; TESLÍK et al., 1996).

PTÁČEK and SUCHÁNEK (1985) say that the best results of intensive fattening of Holstein bulls were found in bulls with live weights below 500 kg. In animals with higher live weights the proportion of prime quality carcass cuts decreases (KRÁSA et al., 1995). The fattening of young bulls of dairy breeds can make up for the lack of veal on the home market and help increase the importance of beef in human diets (INGR, 2004).

The system of fattening Holstein bulls for veal or meat of young cattle is called baby-beef production. It is the most intensive form of beef production because it uses the growth potential of animals to the maximum production. The fattened animals are bulls of dairy breeds. There are two systems of baby-beef fattening. In the first system the fattening period lasts about 7 to 8 months and the final live weight of bulls is 300 to 350 kg. The advantage of this system is the production of prime quality lean meat with excellent dietetic characteristics; it combines the quality of veal and meat of young cattle. Disadvantages are a low meat yield per animal and a higher proportion of bones in the carcass. In the second system the animals are fattened up to 400–430 kg by 12–13 months of age (KRÁSA et al., 1995).

NOSÁĽ and PAVLIČ (1988) fattened young bulls with a high proportion of Holstein breed in their genotype up to lower slaughter weights. Bulls with a slaughter weight of 350 kg and carcass weight 181.75 kg had a dressing percentage of 54.76%. NOSÁĽ and ČUBOŇ (1994) compared meat performance of Holstein bulls and crossbred bulls with beef breeds. Twelve bulls with 87.5 to 100% of Holstein-Friesian breed were fattened for the production of "young beef" and they averaged at the following: live weight at slaughter 373.3 kg, carcass weight 197.92 kg, dressing percentage 53.82%, daily weight gain 1, 069 g and proportion of fat in the carcass half 5.56%.

CHLÁDEK and INGR (2001a) evaluated beef production of Holstein bulls fattened up to a live weight of 305 to 400 kg. The mean weight before slaughter was 361.9 kg, age at slaughter 367.5 days, daily weight gain and net weight gain were 1 029 g and 543 g respectively, and dressing percentage was 51.8%.

CHLÁDEK et al. (1998) observed meat performance of young Black and White bulls fattened up to lower slaughter weights. They found mean carcass weight 190 kg, slaughter weight 366 kg, age at slaughter 360 days, dressing percentage 51.9%, daily weight gain 1048 g and net weight gain 552 g in a group of 46 bulls.

PINĎÁK and VRCHLABSKÝ (2000) evaluated feedlot performance and carcass value of 10 young Black and White bulls with over 87% of Holstein breed in their genotype fattened for baby-beef. They found live weight 254.7 kg, warm carcass weight 135.2 kg and dressing percentage 55.3% (after a deduction of 4% for alimentary tract content). LENGYEL et al. (2003) fattened 10 young bulls for 7 months up to live weight of 245 kg. Calves were fed ad libitum on a diet consisting of maize silage, dried sugar beet pulp, alfalfa hey and concentrate mixture. Carcass weight was 117.3 kg, proportion of muscle 67.62%, proportion of separable fat 6.88% and proportion of bones 25.5%.

ANDRIHGETTO et al. (1999) fattened young Holstein bulls up to a live weight of 240.1 kg and 242.2 kg, respectively, in two different housing systems. The calves were fed an artificial milk diet and were individually housed in cages or group-housed in pens. Carcass weight was 143.1 kg and 145.6 kg respectively, dressing percentage was 59.6% and 60.1% respectively. Proportions of muscle, separable fat and bones from the left half were 67.7%, 14.2% and 18.1% and 68.0%, 13.6% and 18.4%, respectively.

MATERIAL AND METHODS

The aim of this work was to evaluate meat performance parameters of young Holstein bulls slaughtered at the live weight of 300 kg (in the category "young cattle").

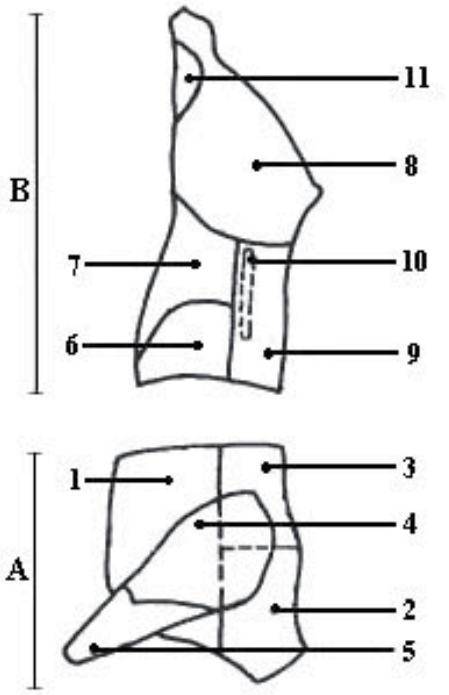
The observation was carried out in a group of 12 young Holstein bulls. The bulls were fattened in identical conditions and the feed ration was based on ad libitum intake of mashed grain (barley and wheat) and a limited amount of protein concentrate. The daily ration was calculated in order to achieve daily weight gain of 1.3 kg, as recommended by Sommer et al. (1994).

At the end of fattening the bulls were slaughtered and the following characteristics were evaluated on the slaughter day: live weight, age at slaughter, daily weight gain, calculated from the live weight at slaughter minus live weight at birth (which was uniformly fixed at 35 kg), net weight gain, carcass weight, dressing percentage and weight of hide.

Twenty four hours after slaughter the right half of the carcass was cut into quarters between the 8^{th} and 9^{th} vertebra, the quarters were cut up and weights of muscle, separable fat and bones were determined. Then the weights and proportions of right half, fore- and hindquarter, weight of round, shoulder, filet, chuck, loin, and hind and fore shank were determined (Fig. 1).

Carcass halves were classified using the SEUROP scale evaluating conformation and fat covering. Conformation was graded from S = 1 (best) to P = 6 (worst) and fat covering (fatness) was graded from 1 (least) to 5 (greatest).

The data were analysed for a mean value ($\bar{x}$), standard deviation (s_x), coefficient of variation (V) and coefficients of correlation between feedlot performance characteristics and carcass value using the computer programme Unistat 5.11.



A = Forequarter; B= Hindquarter

1= brisket and rib; 2= neck ; 3= chuck; 4= shoulder
5= fore shank; 6= flank with rib; 7= flank; 8= round
9= loin; 10= filet; 11= hind shank

1: *The carcass dissection diagram*

RESULTS

Feedlot performance and carcass characteristics of 12 Holstein calves are presented in Table I. The mean weight at slaughter was 299.3 kg, age at slaughter 275.9 days. The mean carcass weight was 144.8 kg with dressing percentage 48.3%, the mean daily weight gain since birth 0.962 g and net weight gain 0.527 kg. The highest variability was found in net weight gain (s_x=63.64 and V=12.07%) and the lowest in weight of bones (s_x=1.39 and V=2.88%).

Carcass evaluation of bull-calves is presented in Table II. The mean weight of cold right half was 71.0 kg. The weight of bones, muscle and separable fat in the right half was 17.5 kg, 53.0 kg and 0.54 kg and proportions 24.6%, 74.6% and 0.76%, respectively. The mean weight of hide 21.6 kg was 7.22% of the live weight before slaughter. The SEUROP classification was carried out by an experienced evaluator in warm carcasses 60 mins post mortem, the great majority of calves were classified as O2, and one calf was graded R2. The mean fore- to hindquarters ratio was 1.44 with variability 3.92%. The highest variability was found in separable fat from the right half of the carcass (s_x=0.15 and V=25.93%); zero variability was found in fat covering grades (fatness).

Dissection parameters of forequarters are described in Table III. The mean weight of the forequarter was 29.1 kg which makes up 40.98% of the right carcass half. The mean weight of neck was 3.9 kg, chuck 3.6 kg, shoulder 5.9 kg and shank 3.4 kg. The weights of bones, muscle and separable fat of forequarter were 7.9 kg, 20.8 kg and 0.44 kg with percentage 27.10%, 71.40% and 1.51%. The highest variability was found in separable fat (s_x=0.14 and V=30.53%) and the lowest in bones (s_x=0.55 and V=6.94%).

Table IV presents dissection parameters of the hindquarters. Hindquarters made up, on average, 59.02% of the right half of the carcass and their mean weight was 41.9 kg. The weight of loin was 4.1 kg, filet 1.5 kg, round 18.2 kg and hind and fore shank 1.3 kg, bone weight averaged at 9.6 kg, muscle 32.2 kg and separable fat 0.10 kg which made up 13.60%, 45.41% and 0.01% of the hindquarter. The variability was greatest for separable fat (s_x=0.12 and V %=120) and least for bones (s_x=0.81 and V%=8.40).

Coefficients of correlation between feedlot characteristics and carcass value are presented in Table V. Highly significant (P<0.01) coefficients of correlation were found between carcass weight (CW) and live weight at slaughter (r=0.963) or daily weight gain (r=0.782). Net weight gain since birth was highly significantly (P<0.01) correlated to live weight at slaughter (r=0.723) or to daily weight gain (r=0.982) and significantly correlated (P<0.05) to age at slaughter (r= –0.665). There was no correlation between weight and proportion of separable fat and other observed characteristics.

I: *Some feedlot performance parameters of Holstein bulls (n = 12)*

Parameter		$\bar{x}$	s_x	V %
Age at slaughter	days	275.9	19.88	7.20
Live weight at slaughter	kg	299.3	24.51	8.19
Daily weight gain since birth	kg	0.962	0.111	11.50
Warm carcass weight	kg	144.8	13.71	9.47
Net weight gain	kg	0.527	63.64	12.07
Dressing percentage	%	48.3	1.39	2.88

II: *Some carcass value characteristics of Holstein bulls (n = 12)*

Parameter		$\bar{x}$	s_x	V %	% [1]
Weight of cold right half	kg	71.0	6.51	9.17	100
Weight of bones of right half	kg	17.5	1.28	7.31	24.6
Weight of muscle of right half	kg	53.0	5.20	9.80	74.6
Weight of separable fat of right half	kg	0.54	0.15	25.93	0.76
Weight of hide	kg	21.6	3.26	15.08	7.22 [2]
Conformation score [3]	grade	4.9	0.29	5.87	
Fat covering score [4]	grade	2.0	0.0	0.0	
Forequarter to hindquarter ratio		1.4	0.06	3.92	

[1] % of cold right half
[2] % of live weight
[3] grade 1=S (best), 6=P (worst)
[4] grade 1=least, 5=greatest

III: *The dissection parameters of forequarters (n = 12)*

Parameter		$\bar{x}$	s_x	V %	% [1]	% [5]
Weight of right forequarter	kg	29.1	2.52	8.67	40.98	100
Neck	kg	3.9	0.37	9.53	5.49	13.40
Chuck (boned)	kg	3.6	0.55	15.21	5.07	12.37
Shoulder (boned)	kg	5.9	0.52	8.80	8.31	20.27
Fore shank	kg	3.4	0.32	9.55	4.79	11.68
Weight of bones of forequarter	kg	7.9	0.55	6.94	11.10	27.10
Weight of muscle of forequarter	kg	20.8	1.91	9.17	29.27	71.40
Weight of separable fat of forequarter	kg	0.44	0.14	30.53	0.61	1.51

[1] % of cold right half
[5] % of forequarter

IV: *The dissection parameters of hindquarters (n = 12)*

Parameter		$\bar{x}$	s_x	V %	% [1)]	% [6)]
Weight of right hindquarter	kg	41.9	4.14	9.86	59.02	100
Loin	kg	4.1	0.64	15.74	5.77	9.79
Filet	kg	1.5	0.15	10.03	2.11	3.58
Round (boned)	kg	18.2	1.83	10.09	25.63	43.64
Hind shank	kg	1.3	0.14	10.76	1.83	3.10
Weight of bones of hindquarter	kg	9.6	0.81	8.40	13.60	22.91
Weight of muscle of hindquarter	kg	32.2	3.46	10.73	45.41	76.85
Weight of separable fat of hindquarter	kg	0.10	0.12	120.0	0.01	0.24

[6)] % of hindquarter

V: *Coefficients of correlation between feedlot performance and carcass value characteristics (n = 12)*

Carcass value	Feedlot performance		
	Live weight at slaughter	Age at slaughter	Daily weight gain
Carcass weight	0.963**	–0.104	0.782**
Dressing percentage	0.342	–0.448	0.509
Net weight gain since birth	0.723**	–0.665*	0.982**
Weight of separable fat of cold right half	0.215	0.254	–0.031
Proportion of separable fat [1)]	–0.145	0.293	–0.322

[1)] % of cold right half

DISCUSSION

Our values of weight and age at slaughter were rather average compared to other literature sources. A higher live weight or age was found by CHLÁDEK et al. (1998), CHLÁDEK and INGR (2001a), CHLÁDEK and INGR (2001b) or NOSÁĽ and ČUBOŇ (1994), whereas lower values were presented by LENGYEL et al. (2003), ANDRIHGETTO et al. (1999) and PINĎÁK and VRCHLABSKÝ (2000). Our values of daily weight gain, net weight gain and dressing percentage were lower than average. They were definitely lower than the values presented by all the above quoted authors. Only ANDRIHGETTO et al. (1999) found a comparable carcass weight. Low values of feedlot performance parameters were probably caused by lower growth rates (compared to the general standard growth rate of this breed).

As for the carcass value, the proportion of muscle of our experimental bulls was comparable to those found by NOSÁĽ and ČUBOŇ (1994) and NOSÁĹ and PAVLIČ (1988) or even greater than values presented by ANDRIHGETTO et al. (1999). On the contrary, the proportion of bones was considerably greater than the values found by the above quoted authors. This is further evidence of a low growth rate of our experimental animals. A small proportion of separable fat (almost zero, considerably smaller than values of CHLÁDEK and INGR, 2001b) supports this hypothesis. The small proportion of fat corresponded with the results of WALDMAN et al. (1972) who claimed that Holstein bulls up to live weight of 227 kg do not grow fat.

CHLÁDEK et al. (1998) evaluated right carcass halves; they found greater weights of fore and hindquarters. In the forequarter, the weights of shoulder and shank were similar but the neck weight was higher. In the hindquarter, comparable values were found in the weight of the round. The shank weight was lower in our experiment. On the contrary, we found greater weights of loin and filet. Although the slaughter weight of their experimental bulls was higher, our bulls showed comparable, or even better values. This was probably due to minimal fatness and no meat trim in our animals, compared to the meat trim in fore and hindquarter (5.3 and 7.0 kg respectively) presented by the above quoted authors.

The proportion of fore to hind quarters was unstable and the values were higher than those presented by NOSÁĹ and PAVLIČ (1988), NOSÁĽ and ČUBOŇ (1994) and PINĎÁK and VRCHLABSKÝ (2000). This was probably due to a lower slaughter weight

in our experiment. This hypothesis was supported by conclusions of NOSÁĽ and PAVLIČ (1988) stating that the forequarter to hindquarter ratio decreases with increasing slaughter weight.

As for the relationship between feedlot performance and carcass value characteristics, the carcass weight was mainly affected by live weight at slaughter and by daily weight gain. Similar coefficients of correlation were found by CHLÁDEK and INGR (2001a) in Holstein bulls fattened up to the live weight of 305–400 kg. They also found a highly significant positive effect of daily weight gain and age at slaughter on net weight gain. On the contrary, they found no effect of live weight at slaughter on net weight gain, where we found highly significant positive effect.

It can be concluded that despite the average or lower-than-average feedlot performance parameters, our experimental Holstein bulls had an adequate proportion of muscle (comparable with other literature sources), a high proportion of bones and a very low proportion of fat. Thanks to small meat trim, weights of the main dissection parts of fore-and hindquarters were comparable to those usually found in young Holstein bulls.

SOUHRN

Masná užitkovost holštýnských telat poražených v živé hmotnosti 300 kg

Holštýnské plemeno je v současné době nejrozšířenějším plemenem skotu v ČR. I když se jedná o čistě mléčné plemeno, holštýnští býci jsou celosvětově využíváni pro produkci masa. Vlivem nedostatku telecího masa na našem trhu se nabízí možnost vykrmovat holštýnské býčky do nižších porážkových hmotností, například v systému baby-beef.

Cílem této práce bylo kvantifikovat základní ukazatele výkrmnosti a jatečné hodnoty holštýnských býčků poražených v kategorii mladého skotu v živé hmotnosti 300 kg. Sledování proběhlo u skupiny 12 kusů holštýnských telat – býčků, kteří byli vykrmováni ve shodných podmínkách a krmná dávka byla založena na adlibitním příjmu mačkaných obilovin (ječmen a pšenice) a limitovaném množství bílkovinného koncentrátu. Zjištěné výsledky jsou uvedeny v Tab. I. až V., kde v tabulce Tab. I jsou uvedeny sledované ukazatele výkrmnosti holštýnských býčků, v tabulce Tab. II. sledované ukazatele jatečné hodnoty. Hodnocení bourárenské výtěžnosti předních čtvrtí uvádí Tab. III., výtěžnost zadních čtvrtí Tab. IV. a koeficienty korelace mezi ukazateli výkrmnosti a jatečné hodnoty jsou uvedeny v Tab. V.

U celého souboru byly zjištěny následující průměrné hodnoty: věk před porážkou a živá hmotnost 275,9 dní a 299,3 kg, denní přírůstek a netto přírůstek od narození 0,962 kg a 0,527 kg při jatečné výtěžnosti 48,3 %, hmotnost vychladlé pravé poloviny byla 71,0 kg při hmotnosti kostí 17,5 kg, hmotnosti masa 53,0 a oddělitelného loje 0,54 kg. Hmotnost kůže byla v průměru 21,6 kg. Téměř všechna telata byla klasifikátorem zařazena do třídy O2, v jednom případě do třídy R2. Poměr hmotností předních a zadních čtvrtí byl 1,4 při průměrné hmotnosti 29,1 kg a 41,9 kg. Průměrná hmotnost byla u krku 3,9 kg, vysokého roštěnce 3,6 kg, plece 5,9 kg kližky přední 3,4 kg, nízkého roštěnce 4,1 kg, svíčkové 1,5 kg, kýty 18,2 kg a kližky zadní 1,3 kg.

Ukazatele jatečné hodnoty byly nejvíce ovlivněny živou hmotností před porážkou (r=0,963) a průměrným denním přírůstkem živé hmotnosti (r=0,782). Dále byl nalezen vysoce průkazný vliv průměrného denního přírůstku a věku před porážkou na netto přírůstek.

Závěrem je možné konstatovat, že přes průměrné či mírně podprůměrné parametry výkrmnosti vykázal námi sledovaný soubor holštýnských býčků literárně deklarovaný podíl masa při vysokém podíl kostí a velmi nízkém podílu loje. Díky nízkým hodnotám ořezu masa byly hmotnosti hlavních bourárenských části přední i zadní čtvrtě srovnatelné s těmi, které jsou v literatuře obvykle uváděny pro mladé býky holštýnského plemene skotu.

telata, holštýn, jatečně upravené tělo, bourárenská výtěžnost, maso

ACKNOWLEDGEMENTS

The study was supported by NAZV QF 4005.

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