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INFLUENCE OF DIFFERENT FEEDLOT TYPES ON PRODUCTION AND ECONOMIC EFFICIENCY IN CHAROLAIS BREED

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ABSTRACT

The economic weights (EW) of 13 production and function traits for Charolais cattle raised in Slovakia were calculated. Two different fattening systems – intensive feedlot in bind (Type1) and in free technology (Type2) and two different slaughter weights – 550 kg (A) and 650 kg (B) were simulated. EWs for current production system (2006) and for the future production system (2010) were calculated. The economic weights were expressed in Slovak crowns (1 Euro = 33.35 Sk). The lowest total and nutrition costs were obtained for fattening of heifers in Type1B. The economic importance of evaluated traits were little bit higher in all feedlots types for production system in 2010 year, except EW for average daily gain during fattening period. The EW for average daily gain during fattening period were +4.66 ,+7.61, +4.74 ,+7.68 Sk per 1 g for Fed1A, Fed1B, Fed2A, Fed2B in 2006 year, respectively. The highest differences in EW within one trait for different alternatives were found out for EW of conception rate of cows and average daily gain in fattening for 2006 and 2010, respectively. The different influence of feedlot types on EW were observed mainly for functional traits and average daily gain during fattening period.

Keywords: beef cattle, economic weights, fattening, bioeconomical approach, production systems

INTRODUCTION

The main objective of genetic improvement of livestock is increasing of economic efficiency of production (Albera et al., 2004), which is represented by various traits. These traits are included in breeding goals, which are carried out by breeding programs. Choice of traits, included in program is mainly dependent on the proportion of appropriate trait on total production efficiency usually evaluated from economic point of view. Requirements for set up of breeding goal are carrying out in aggregate genotype, which is representation of evaluated breeding values for traits and their relative economic importance. Design of aggregate genotype also should reflect differences between eventual alternatives due to natural conditions or management of herd and marketing strategies. Breeding values accomplished these requirements, when the environmental effects are considered. The differences due to various conditions are little bit less known for calculation of economic weights.

Many papers were dedicated to evolution of production and economic efficiency or to calculation of economic weights (EW) for beef cattle. Comparison of two different beef systems was used for evaluation of economic and production efficiency by Anderson et al. (2005). Phocas et al. (1998) calculated EW for more than 20 most important traits for Limousine cattle. The economic efficiency and weights for functional, growth and carcass traits of Charolais cattle raised in the Czech Republic for middle European conditions were calculated by Wolfová et al. (2005). Krupa et al. (2005a) calculated EW for Slovak Simmental cattle. Studies especially concentrated to fattening systems were also published. Lamb et al. (1992) simulated the feedlot segment of an integrated beef production system. They found out different biological and economical efficiency for two various slaughter end point weights. Hirooka et al. (1998) estimated biological and economic values

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using by deterministic bio-economical model for feedlot production system under alternative circumstances. According their results, increasing of marbling score was the most beneficial in feedlot system. Decreasing of slaughter weight provided negative economic values of daily gains and weaning weight. Kahi and Hirooka (2005) used deterministic simulation to evaluate 10 breeding schemes for genetic gain and profitability. Ibi et al. (2006) investigate the effect of changes in carcass market prices on estimation of genetic parameters and economic weights for carcass traits. Wilton et al. (1996) compared three alternatives of slaughter end point. According their results, if management variables are optimized, economic weights are equivalent regardless of end point considered. This means that economic weights and selection indices can be conveniently calculated for age constant end points even though commercial production may use weight or fat depth constant slaughter end points. When calculating the economic weights for predicted production system, to generation phase of cattle has to be taken into account.

The economic weights for milk production traits were calculated for the Slovak Republic condition by Peškovičová et al., 1996 and by Huba et al., 2004. EW are used for construction of selection (production) indices in genetic evaluation of milk cattle (Candrák et al., 1997), and pigs (Peškovičová et al., 2002) in the Using of EW for genetic evaluation of milk sheep is also assumed (Oravcová et al., 2005) and also for beef cattle (Krupa et al., 2005b).

The goal of this study was compare the economic importance of growth, carcass and functional traits for Charolais breed raised in the Slovak Republic under different alternatives of integrated feedlot types and different slaughter weights for current (2006) and predicted production systems (2010).

MATERIAL AND METHOD

The economic weights (EW) of the following 13 traits for Charolais cattle raised in Slovakia were calculated:

- Growth traits - average daily gain (ADG) of calves from birth to 120 days, from 120 to 210 days, from 210 to 365 days and during fattening period.
- Functional traits - mean class for calving performance (4 classes, 1st – easy calving, 4th- caesarean section), losses of calves: at calving, losses of calves: 48 hours till weaning, conception rate of heifers and cows and average lifetime of cows.
- Carcass traits – dressing percentage, mean class of fleshiness and mean class of fat covering (EUROP system).

The traditional middle European calf-cow system was assumed. The pasture period was assumed to last from May 1 to October 30. The mating season lasted from April 30 to July 5 and covered three oestrus cycles starting with artificial insemination in the first cycle. All calves were weaned at the same date (on September 30).

Two different fattening alternatives – intensive feedlot in bind technology (Type 1) and intensive feedlot in free technology (Type 2), for two various slaughter weights - 550 kg (A) and 650 kg (B) were simulated. Growth and feeding parameters for feedlots are displayed in Table 1. EWs for current production system (2006) and for the future production system (2010) were calculated.

Table 1: Growth and feeding input parameters for different feedlot systems

Parameter	Year 2006		Year 2010	
	Type A	Type B	Type A	Type B
Average daily gain during fattening period – bulls (g)	1400	1300	1500	1400
Average daily gain during fattening period – heifers (g)	1300	1200	1400	1300
Dry matter in feed for bulls in feedlot (%)	48%	47%	49%	48%
Dry matter in feed for heifers in feedlot (%)	50%	49%	50%	49%
Net energy content in dietary for bulls in feedlot (MJ/kg of dry matter)	6.70	6.83	6.80	6.94
Net energy content in dietary for heifers in feedlot (MJ/kg of dry matter)	5.64	5.67	6.13	6.23
Protein content in dietary for bulls in feedlot (g/kg of dry matter)	82.25	77.49	83.31	79.31
Protein content in dietary for heifers in feedlot (g/kg of dry matter)	69.43	69.30	76.84	77.01

A = fattening to 550 kg of male (bulls, castrates) live weight and 500 kg of female (heifers) live weight; B = fattening to 650 kg of male (bulls) live weight and 600 kg of female (heifers) live weight

Costs were related to nutrition (feeding, water and mineral additions), housing, health (veterinary), breeding (inseminations), labour and interest of investments. The main cost components are summarised in Table 2. The average total costs per 1 kg of average daily gain during fattening period were calculated as proportion of total costs during fattening period and total gain during fattening period. Revenues from slaughtered animals depend on the slaughter weight, dressing percentage and payment for carcass body (based on EUROP grading system) were assumed. The 16.4 % growth of costs and prices for predicted system in 2010 was assumed. For the predicted production system in 2010, yearly genetic improvement of average daily gain in fattening, equal genetic standard deviation (120 g) was assumed. The feed ratios for all categories were calculated with use program Feedman (Petrikovič et al., 2003). The total net energy and protein requirement for fattening period are showed in Table 3.

Table 2: Main production costs

Parameter		Year 2006	Year 2010
Fixed costs (SKK/day):	cow and calf in summer	36.00	41.00
	breeding bull in herd	36.40	39.60
	bull in intensive feedlot	39.40	42.00
	heifer in intensive feedlot	39.40	42.00
Veterinary costs (SKK):	cow and calf in summer	1000.00	1200.00
	breeding bull in herd	530.00	650.00
	bull in intensive feedlot	277.00	318.00
	heifer in intensive feedlot	277.00	318.00
Maximum price for carcass bull in carcass weight (SKK/kg)		98.28	112.28
Maximum price for carcass heifer in carcass weight (SKK/kg)		70.00	79.94

Table 3: Calculated feedlot parameters for bind housing technology and year 2006

Parameter	Heifers		Bulls	
	Type A	Type B	Type A	Type B
Length of fattening period (day)	198.6	275.5	191.3	258.0
Average age at the end of fattening (day)	411.0	488.0	404.0	471.0
Net energy requirement (MJ NE/period)	9457.4	14351.3	10103.0	14730.0
Protein requirement (kg PDI/period)	120.1	176.0	144.5	204.7
Amount of fresh feed matter (kg/period)	2823.1	4284.0	3036.1	4426.6

A = fattening to 550 kg of male (bulls, castrates) live weight and 500 kg of female (heifers) live weight; B = fattening to 650 kg of male (bulls) live weight and 600 kg of female (heifers) live weight

The economic weights were expressed in Slovak crowns (1 Euro = 33.35 SKK) per unit of appropriate trait and per standard female unit. The marginal economic value of trait l (ev_l), $l = 1,\dots, L$ was calculated as numeric derivation of the profit function with respect to trait l as follows:

$$ev_l = \frac{profit(\mu_1, \mu_2, \dots, \mu_l + d_l, \dots, \mu_L) - profit(\mu_1, \mu_2, \dots, \mu_l - d_l, \dots \mu_L)}{2d_l} = \frac{\Delta profit_l}{\Delta_l}$$

where μ_l is the mean of trait l and d_l is a small value by which the mean is changed. A value of 0.5 % of μ_l was assumed for d_l. L is the number of traits. Economic weights were calculated using ECOWEIGHT program – module EWBC (Wolf et al., 2003). To express the relative economic importance $ev_l^{[rel]}$ of trait l (l = 1,…, L), the marginal economic value was multiplied by the genetic standard deviation of the trait and expressed as percentage of this value for average daily gain during fattening period:

$$ev_l^{[rel]} = 100 * \frac{ev_l * \sigma_l}{ev_{weaning\ weight} * \sigma_{weaning\ weight}} \quad [\%]$$

The values for the genetic standard deviations were taken from Miesenberger (1997), Koots and Gibson (1998), Coopman et al. (1999), Amer et al. (2002), Hradecká (2002), Brumatti et al. (2002) and Přibyl et al. (2003) because they were not estimated under Slovak Republic conditions.

RESULTS AND DISCUSSION

Comparisons of the economic efficiency and economic weights calculated for various production conditions are not possible because of differences in input parameters consequential from definition of traits and in rearing and marketing strategies. Nevertheless, at least some general conclusions can be drawn from the literature.

Calculated costs and revenues in fattening period for bind housing technology and year 2006 are showed in Table 4. Heifers reached the lowest total costs during fattening period in both alternatives with comparison with fattening of bulls. It is due to lower assumed average daily gains and it followed lower requirements for nutriment in feed ratios and also it due to lower final weight at the end of fattening period like bulls (500 kg, 600 kg, respectively). The lowest proportion of costs for nutrition was obtained for fattening of heifers in alternative B (51.9 % from the total costs during fattening period). The highest proportion of nutrition costs on total costs was found for bulls in both alternatives (58.5, 58.6 for Type A, Type B, respectively). The average costs were lowest for fattening of heifers to 600 kg (79.5 SKK/day for average total daily costs; 41.2 SKK/day for average costs for nutrition during fattening period). The economic efficiency for production system was negative for all alternatives.

Marginal economic weights for production system in 2006 year are shown in Table 5. The highest EW was calculated for average lifetime of cows and for Fed1A alternative (+1605.79 SKK/year). In our previous study (Krupa et al., 2005a) we also found out the highest EW for this trait. Increasing of slaughter weight to 550 or 650 kg resulted in decreasing economic importance for six of studied traits. The situation was different only for carcass traits and ADG in fattening period. Increasing of slaughter weight caused increasing of EW for dressing percentage (+250.82 SKK/%, +291.10 SKK/% for Type1A, Type1B, respectively) and for average daily gain during fattening period. Neither increasing nor decreasing EW for ADG from birth to 120 days, from 120 to 210, from 210 to 365, mean class for flashiness and fat covering were observed with increasing of slaughter weight. The higher EW were found out for animals with highest slaughter weight and the lower EW reached animals with 550 kg slaughter weight. Differences between technologies used in

Table 4: Calculated costs and revenues in feedlot for bind housing technology and year 2006

Parameter	Heifers		Bulls	
	Type A	Type B	Type A	Type B
Total costs during fattening per animal (SKK/period)	16793.4	21889.8	17824.4	23829.8
Costs for nutrition during fattening per animal (SKK/period)	9127.6	11362.5	10430.9	13956.3
Average total daily costs during fattening per animal (SKK/day)	84.6	79.5	93.2	92.4
Average daily costs for nutrition during fattening per animal (SKK/day)	46.0	41.2	54.5	54.1
Average total costs on 1 kg of gain per animal (SKK/kg)	65.0	61.1	62.1	61.6
Total revenues from realized fattened animals (SKK/animal)	17507.8	21009.4	29594.3	34975.1

A = fattening to 550 kg of male (bulls, castrates) live weight and 500 kg of female (heifers) live weight; B = fattening to 650 kg of male (bulls) live weight and 600 kg of female (heifers) live weight

Table 5: Economic weights (marginal economic values) of traits under different fattening types for current production system (2006 year)

Trait	Bind (1)		Free (2)	
	Type 1A	Type 1B	Type 2A	Type 2B
Mean class for calving performance (SKK/0.01 class)	-12.56	-8.95	-12.40	-8.57
Losses of calves at calving (SKK/ %)	-80.80	-60.69	-80.12	-59.20
Losses of calves from 48 hours till weaning (SKK/%)	-69.92	-50.42	-69.14	-48.60
ADG of calves from birth to 120 days (SKK/1g)	+1.84	+2.06	+1.81	+2.07
ADG of calves from 120 to 210 days (SKK/1g)	+1.52	+1.69	+1.45	+1.70
ADG of calves from 210 to 365 days (SKK/1g)	+1.45	+1.41	+1.45	+1.40
ADG in fattening (SKK/1g)	+4.66	+7.61	+4.74	+7.68
Dressing percentage (SKK/%)	+250.82	+291.10	+250.82	+291.10
Conception rate of heifers (SKK/%)	+11.71	+7.79	+11.45	+7.15
Conception rate of cows (SKK/%)	+30.25	+0.64	+28.24	-4.10
Mean class of fleshiness (SKK/0.01 class)	+11.49	+12.83	+11.49	+12.83
Mean class of fat covering (SKK/0.01 class)	+7.48	+8.32	+7.48	+8.32
Average lifetime of cows (SKK/year)	+1605.79	+1372.83	+1589.72	+1334.27

A = fattening to 550 kg of male (bulls, castrates) live weight and 500 kg of female (heifers) live weight; B = fattening to 650 kg of male (bulls) live weight and 600 kg of female (heifers) live weight; 1 = bind housing technology; 2 = free housing technology

feedlots were low in 2006-year production system. Most of the EWs were higher in bind technology. Breeding technology alternatives did not influence EW of carcass traits.

Economic weights of traits for predicted production system (year 2010) are shown in Table 6. Similarly to 2006, the highest economic importance was found for average lifetime of cows (from +1851.59 SKK/year for Type2B to +2050.01 SKK/year for Type1A). The same situation when different slaughter weights were taken into account was observed for predicted production system. Increasing of importance was observed for same trait like for current system. Differences between using technologies in feedlot were conformable like in 2006 year. The economic importance of traits was stronger in current production system for average daily gain during fattening period and slightly for average daily gain from birth to 120 days. All other traits reached higher EW in current production system. Lifetime of cows was the first or the second most important trait under Slovak as well as Czech conditions (Wolfová et al., 2005) for all marketing strategies.

Table 4 include relative economic weights multiplied by standard genetic deviations and expressed as relative deviation on economic weight for average daily gain during fattening period. The highest relative economic importance was obtained for average lifetime of cows and for all alternatives (from 217.17 % for Type1A to 338.12 % for Type1B). The relative high economic weights reached dressing percentage, but other carcass traits (mean class for flashiness and fat covering) achieve lowest relative economic importance. The results of our study did not support result of Albera et al. (2002) who found out relatively high economic importance of carcass quality traits in comparison with growth traits. Probably low price differences between the individual classes of the EUROP grading system in the Slovak Republic are responsible for this situation.

CONCLUSIONS

Fattening of heifers to 600 kg and bulls to 650 kg seems to be most economicaly effective. Economic weights were sensitive on different feedlot types. Differences due to various alternatives of feedlot were stronger for current production system in major part of traits studied. As there are substantial differences in the economic importance of traits for different alternatives of feedlot, it will be beneficial to construct different production indices for Charolais cattle (in pure-breeding systems) that will allow farmers to choose the best breeding animals according their breeding goal and marketing strategy.

Table 6: Economic weights (marginal economic values) of traits under different fattening types for predicted production system (2010 year)

Trait	Bind (1)		Free (2)	
	Type 1A	Type 1B	Type 2A	Type 2B
Mean class for calving performance (SKK/0.01 class)	-17.10	-14.60	-16.93	-14.25
Losses of calves at calving (SKK/ %)	-106.27	-92.35	-105.56	-90.96
Losses of calves from 48 hours till weaning (SKK/%)	-94.01	-80.53	-93.16	-78.84
ADG of calves from birth to 120 days (SKK/1g)	+1.82	+1.99	+1.79	+2.00
ADG of calves from 120 to 210 days (SKK/1g)	+1.51	+1.65	+1.49	+1.65
ADG of calves from 210 to 365 days (SKK/1g)	+1.74	+1.71	+1.73	+1.70
ADG in fattening (SKK/1g)	+4.26	+6.97	+4.31	+7.03
Dressing percentage (SKK/%)	+284.16	+332.90	+284.16	+332.90
Conception rate of heifers (SKK/%)	+17.23	+14.51	+16.96	+13.94
Conception rate of cows (SKK/%)	+63.86	+43.31	+61.76	+39.01
Mean class of fleshiness (SKK/0.01 class)	+13.04	+14.66	+13.04	+14.66
Mean class of fat covering (SKK/0.01 class)	+8.45	+9.51	+8.45	+9.51
Average lifetime of cows (SKK/year)	+2050.01	+1885.33	+2033.94	+1851.59

A = fattening to 550 kg of male (bulls, castrates) live weight and 500 kg of female (heifers) live weight; B = fattening to 650 kg of male (bulls) live weight and 600 kg of female (heifers) live weight; 1 = bind housing technology; 2 = free housing technology

Table 7: Relative economic weights of traits under different fattening type and production systems

Traits in (%)	GSD	2006		2010	
		Type 1A	Type B	Type 2A	Type 2B
Average lifetime of cows	0.50	225.50	217.17	338.12	329.23
ADG in fattening	40.00	100.00	100.00	100.00	100.00
Dressing percentage	0.80	76.50	75.81	95.52	94.71
ADG of calves from 210 to 365 days	60.00	27.79	27.34	36.80	36.27
ADG of calves from 120 to 210 days	45.00	24.98	24.90	26.63	26.40
ADG of calves from birth to 120 days	30.00	20.30	20.21	21.41	21.34
Losses of calves at calving	0.95	18.94	18.31	31.47	30.73
Losses of calves from 48 hours till weaning	0.60	9.94	9.49	17.33	16.82
Conception rate of heifers	2.10	5.37	4.89	10.93	10.41
Mean class for calving performance	0.32	0.93	0.88	1.65	1.60
Conception rate of cows	2.50	0.53	3.34	38.84	34.68
Mean class of fleshiness	0.02	0.06	0.06	0.08	0.08
Mean class of fat covering	0.01	0.04	0.04	0.05	0.05

GSD = Genetic Standard Deviation; 1 = bind housing technology; 2 = free housing technology; A = fattening to 550 kg of male (bulls, castrates) live weight and 500 kg of female (heifers) live weight; B = fattening to 650 kg of male (bulls, castrates) live weight and 600 kg of female (heifers) live weight

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