# The effect of feeding technologies on the economics of fattening pigs

*Vliv techniky krmení prasat na ekonomiku výkrmu*

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**Abstract:** The aim of the experiment in test station was to evaluate productive performance with respect to feeding-technologies through the test for LWs × (LW×L) genotype in pigs. The productive performance as growth capacity, feeding intake and quantitative traits of slaughter value was examined for 144 hybrid pigs divided in two identical groups, where the 1st group was fed ad-libitum and the 2nd one semi-ad-libitum. On the base of profit formula, the ad-libitum system of feeding in pigs is better in all economic features.

**Key words:** pig, feeding, performance, testing, economics, profit formula

**Abstrakt:** Účelem testu bylo zhodnocení dvou krmných technik na produkční užitkovost hybridní kombinace prasat matka-otec (BU×L) × BO. Produkční užitkovost 144 prasat (rozdělených do dvou stejných skupin, kde první skupina byla krmena ad-libitně a druhá skupina semiadlibitně) byla hodnocena na podkladě růstové intenzity, denního příjmu krmiva a kvantitativní stránky jatečné hodnoty. Na podkladě ziskové funkce bylo zjištěno, že ad-libitní technika krmení vykazuje ve všech ekonomických ukazatelích lepší výsledky, než způsob krmení pomocí restringované krmné dávky.

**Klíčová slova:** prase, krmení, užitkovost, testace, ekonomika, zisková funkce

## INTRODUCTION

Pig breeding has undergone great qualitative changes especially in the last twenty years of the past century. This branch of animal farming belongs among the most developed in our country. After transformation of our agriculture, genotypes of pigs have changed significantly, particularly in respect of the fattening capacity and carcass value which are undoubtedly very important factors in slaughter pig production with regard to profitability, due to the existence of many local as well as foreign company hybridisation programs. New genotypes require realisation of changes in the field of feeding technologies as well as the feeding-methods with an objective to allow full manifestation of the animals' growing potential while saving feeds as their consumption within the fattening determines the overall economy of the carcass pig production.

## REVIEW OF LITERATURE

Based upon many works (Webb, Curran 1986; De Vriese, Kainse 1992), it may be stated that the present pig populations show approximately the same phenotype manifestation of annual improvement of the production features fluctuating about 1%. It means that:

– non-genetic factors play a more significant role in improvements of the hog production yield capacity,

– the genetic progress achieved in the area of breeding improvement is not completely transmitted into the sphere of the yield capacity (Jakubec 1990).

Existence of reciprocal interaction of the genotype and the environmental factors is an obstacle for simple evaluation of the level of improvement of various pig genotypes. This interaction is especially obvious in hog breeding (Webb, Curran 1986; Mc Phee et al. 1991).

Comparability of the yield features among each other obtained upon the tests, which may be performed by application of the specified conditions, together with the selection of appropriate biometrical methods, is principal for verification of effectiveness of the applied breeding measures (Jakubec 1990).

A great attention is paid to the issues of the technique of feeding at present that belongs among the environmental factors. As Stern et al. (1990); Bereskin et al. (1990), Mc Phee et al (1991) proved, genetic correlations were, among other of the indicators of fattening efficiency and meat value, highly impacted by the composition and technique of feeding.

Experiments were realized in the frame of the research plan MSM 412 100 003.

Based upon the above-presented facts, the importance of tests carried out both in the stations as well as in the field in the area of utility breeding is significant. Also Raoo, McCracken (1990, 1992) confirm their significance, who proved importance of the interaction genotype x nutrition in relation to a higher demand of the present pig genotypes in relation to the maintenance ration.

Besides the differences in nutrition among the testing and commercial breeding, also differences in the housing system, microclimate, organisation of breeding, health of the pigs etc. (Nossaman et al. 1991; Krick et al. 1992) shall be taken into account. Interaction of these factors with a genotype may also decrease effectiveness of the breeding progress (De Hear, 1990; De Hear, De Vries 1993).

Range and size of the presented interactions among the production traits have not been quite clear so far. A small genetic impact of a genotype among the production traits in different conditions has been proved on one side (Bampton et al. 1977; Standal 1977; Merks 1988, 1989), and the works of Van Diepen, Kennedy (1989) on the other side, however, there is the evidence of the opposite. So it is not quite clear whether the difference in opinions is caused by selection of the monitoring method or by other effects (Dempfle, Merks 1991).

## METHODS

Verification and comparison of the production performance, i.e. fattening capacity, carcass value and the overall economy of pig production with regard to different feeding technologies, were the objectives of the carried out test.

It included the comparison of the hybrid pig genotype LWs × (LW×L), when the first group was fed ad-libitum and the second one was fed with a feeding mixture and a feeding curve designed for achievement of a high growth intensity in demand of the best pork profitability.

144 hybrid pigs were brought in the test-station at the average age of 83 days (since their birth) and the average live weight 28.28 kg. The tested animals were sorted out into the following two groups:

Group 1: 72 barrows and gilts of the average live weight 27.94 kg fed ad-libitum,

Group 2: 72 barrows and gilts of the average live weight 28.64 kg fed restrictively.

All pigs were penned in pairs (barrow/gilt) according to the testing methodology of pure and hybrid-bred pigs. Also feeding was carried out ad-libitum/semi-ad-libitum by the help of Duräumat self-feeders in the smooth-conversion phases where the feeding-mixtures (CFM) was fattened according the followed receptures and figures (Table 1–3).

Table 1. Feeding-mixture composition (CFM 1) of Group 1

| Component (%) | Feeding period | | |
|---|---|---|---|
| | up to 35 kg | 35–65 kg | over 65kg |
| Wheat | 45.0 | 38.8 | 36.2 |
| Barley | 26.8 | 38.4 | 50.0 |
| Maize | 0.0 | 0.0 | 0.0 |
| Soya meal | 25.0 | 20.0 | 11.0 |
| Makro P1 | 3.2 | 2.8 | 0.0 |
| Makro P2 | 0.0 | 0.0 | 2.8 |
| Total | 100.0 | 100.0 | 100 |

Table 2. Feeding-mixture composition (CFM 2) of Group 2

| Component (%) | Feeding period (days) | | | | | | |
|---|---|---|---|---|---|---|---|
| | 84–90 | 91–97 | 98–104 | 105–111 | 112–118 | 119–125 | |
| Wheat | 53.0 | 52.9 | 52.9 | 52.8 | 52.7 | 52.6 | |
| Barley | 17.2 | 17.8 | 18.6 | 19.3 | 20.2 | 21.0 | |
| Maize | 0.1 | 0.4 | 0.9 | 1.3 | 1.7 | 2.2 | |
| Soya meal | 26.5 | 25.7 | 24.5 | 23.5 | 22.3 | 21.1 | |
| Makro P1 | 3.1 | 3.0 | 2.7 | 2.5 | 2.2 | 2.0 | |
| Makro P2 | 0.1 | 0.2 | 0.4 | 0.6 | 0.9 | 1.1 | |
| Total | 100 | 100 | 100 | 100 | 100 | 100 | |
| | 126–132 | 133–139 | 140–146 | 147–153 | 154–160 | 161–167 | 168–174 |
| Wheat | 52.5 | 52.5 | 52.4 | 52.3 | 52.3 | 52.2 | 52.2 |
| Barley | 21.9 | 22.6 | 23.4 | 24.1 | 24.5 | 25.1 | 25.6 |
| Maize | 2.7 | 3.1 | 3.5 | 3.8 | 4.1 | 4.4 | 4.7 |
| Soya meal | 19.9 | 18.8 | 17.7 | 16.8 | 16.1 | 15.3 | 14.6 |
| Makro P1 | 1.7 | 1.5 | 1.3 | 1.1 | 0.9 | 0.8 | 0.6 |
| Makro P2 | 1.3 | 1.5 | 1.7 | 1.9 | 2.1 | 2.2 | 2.3 |
| Total | 100 | 100 | 100 | 100 | 100 | 100 | 100 |

Table 3. Feeding technology in the test

| Days | Group 1 = CFM 1 | Group 2 = CFM 2 (kg) |
|---|---|---|
| 84–90 | ad-libitum | 1.29 |
| 91–97 | ad-libitum | 1.48 |
| 98–104 | ad-libitum | 1.66 |
| 105–111 | ad-libitum | 1.83 |
| 112–118 | ad-libitum | 1.98 |
| 119–125 | ad-libitum | 2.40 |
| 126–132 | ad-libitum | 2.69 |
| 133–139 | ad-libitum | 2.85 |
| 140–146 | ad-libitum | 2.95 |
| 147–153 | ad-libitum | 3.06 |
| 154–160 | ad-libitum | 3.01 |
| 161–167 | ad-libitum | 2.87 |
| 168–174 | ad-libitum | 2.73 |

For evaluation of fattening and growing performance, all pigs were weighted regularly weekly where the following traits were monitored:
– average live weight (ALW) in kg
– feeding conversion ratio (FCR ) in kg
– daily feed intake (DFI) in kg
– average daily weight gain (ADG) in g.

When achieving the average live weight of approximately 106,09 kg, pigs were slaughtered and realised within the SEUROP system by the ZP method (Vrchlabský, Palásek 1992; Pulkrábek 2001, etc.).

For carcass value determination, the following traits were monitored in each animal:
– live weight (kg)
– carcass weight ( kg)
– weight of the right half carcass (kg)
– backfat thickness of the last rib (mm)
– average backfat thickness (mm)
– lean meat share (%).

All obtained data were processed by common mathematical and statistic methods and expressed in tables and figures. By the conclusion, the profitability of the test was evaluated with respect to the group by help of the profit-formula (Poděbradský 1980, Župka 1992)

$$Zc = \{c_1 y_1 - [n_1 x_1 + n_2 x_2 + (n_3 : x_3) + A]\}\ xr, \text{ while}$$

$$r = 365 : (x_2 + k)$$

$$x_2 = (y'_1 - y'_0) : x'_2$$

$$Zc = Z \times r$$

where:
$Z_c$ = annual profit per capacity unit,
$Z$ = profit per head,
$r$ = annual speed of turnover,
$c_1$ – average sales price per unit of production,
$n_1$ – unit cost of compound feed,
$n_2$ – fixed costs per feeding day (in growing and finishing phase),
$n_3$ – costs per sow and litter,
$A$ – costs of piglet treatment and feeding,
$y_1$ – carcass weight,
$y'_1$ – live weight of slaughter pig,
$y'_0$ – initial live weight of fattened pig,
$x_1$ – quantity of consumed compound feed,
$x_2$ – duration of fattening,
$x'_2$ – ADG from live weight $y_0$ to live weight $y_1$ of the slaughter pig,
$x_3$ – number of reared piglets per sow and litter,
$k$ – number of days between two rounds of fattening.

## RESULTS AND DISCUSSION

The obtained results of the growth intensity of the tested pig-groups are presented in Tables 4 and 5.

As it is obvious from the Table 4, the initial live weight of animals coming into the tests was balanced both in respect of their weight and age. Pigs fattened ad-libitum achieved 108.73 kg for 14 weeks in average daily gain equal to 888 grams while the second group of pigs with the average daily gain equal to 826 grams were practically lighter by 5 kilograms in average while receiving probably ($P \leq 0.01$) a lower daily feed intake (2.25 kg) and also feed conversion (2.74 kg). Therefore, the results of the test confirm that ad-libidum technique of feeding allows for full realisation of the genotype growth intensity, which is evidenced by the probable differences between the fattening efficiency indicators listed above, in particular for the whole period of the test, and during the individual wee-intervals. It is also obvious (Table 4) that the growth intensity of "ad-libitum pigs" gets the maximum growth intensity at 85 kg of live weight i.e.146 days of age.

Table 5 shows evaluation of the carcass value of the tested groups of animals. Considering the fact that the achieved average weights of the monitored groups are not statistically significant, it may be assessed that the results achieved in the groups are not influenced by each other and thereby may be compared. Because the non-significant differences have been registered in other carcass traits, it is obvious that ad-libitum technique of feeding brings not only higher carcass weight (ca 4 kg) but also a higher rate of fat and a lower rate of lean meat share than the restricted feeding, which negatively influences pig classification within the SEUROP system.

Table 6 documents that the feeding technique significantly influences classification of the carcass of pigs, i.e. sales or realisation price/1 kilogram of carcass weight. Ad-libitum feeding caused a higher percentage of pigs in the E, U classes, semi-ad-libitum feeding causing a lower percentage of fat in the carcass and then advance to the required classes S, E. These results as well as the conclusions mentioned above reflect in the overall evaluation of economics.

For the determination of profit per production unit, it is necessary to determine the average carcass-cost-price and test expenditure that in this case includes only the cost of weaners and feeds except of fix-cost of the test,

Table 4. Fattening performance with respect to type of feeding in groups of pigs ($n$ = 144)

| Age (days) | Group 1 ($n$ = 72) – ad-libitum | | | | | | |
|---|---|---|---|---|---|---|---|
| | ALW (kg) | | CFR (kg) | | DFI (kg) | | ADG (g) |
| | $\bar{x} \pm s_x$ | $s$ | $\bar{x} \pm s_x$ | $s$ | $\bar{x} \pm s_x$ | $s$ | $\bar{x}$ |
| 83 | 27.94 ± 0.87 | 4.26 | . | . | . | . | . |
| 90 | 34.13 ± 1.08 | 5.29 | 2.09 ± 0.23 | 1.12 | 1.62** ± 0.07 | 0.35 | 773 |
| 97 | 39.44 ± 1.25 | 6.12 | 2.97*± 0.64 | 3.16 | 1.74** ± 0.06 | 0.30 | 759** |
| 104 | 46.27 ± 1.49 | 7.29 | 2.17 ± 0.11 | 0.51 | 2.13** ± 0.10 | 0.49 | 976* |
| 111 | 53.15 ± 1.59 | 7.80 | 2.46 ± 0.13 | 0.62 | 2.34** ± 0.09 | 0.45 | 982 |
| 118 | 59.40 ± 1.64 | 8.05 | 2.79*± 0.16 | 0.76 | 2.42** ± 0.09 | 0.44 | 893 |
| 125 | 64.73 ± 1.62 | 7.95 | 3.41*± 0.15 | 0.75 | 2.50 ± 0.09 | 0.43 | 762 |
| 132 | 71.67 ± 1.86 | 9.10 | 2.82 ± 0.16 | 0.78 | 2.65 ± 0.08 | 0.40 | 991 |
| 139 | 77.94 ± 1.90 | 9.31 | 3.15*± 0.14 | 0.66 | 2.74* ± 0.09 | 0.46 | 896 |
| 146 | 85.46 ± 2.01 | 9.85 | 2.81* ± 0.11 | 0.55 | 2.93* ± 0.09 | 0.42 | 1 074 |
| 153 | 91.71 ± 1.97 | 9.63 | 3.59 *± 0.21 | 1.04 | 3.00 ± 0.09 | 0.44 | 893 |
| 160 | 97.02 ± 2.06 | 10.08 | 4.10 ± 0.21 | 1.03 | 2.93 ± 0.08 | 0.39 | 759 |
| 167 | 103.58 ± 2.12 | 10.39 | 3.54 ± 0.18 | 0.90 | 3.17** ± 0.07 | 0.36 | 938** |
| 174 | 108.73 ± 2.00 | 9.80 | 5.29* ± 0.65 | 3.16 | 3.16** ± 0.06 | 0.31 | 735 |
| Total | 108.73 ± 2.00 | 9.80 | 2.90**± 0.07 | 0.33 | 2.56** ± 0.07 | 0.32 | 888* |
| | Group 2 ($n$ = 72) – semi-ad-libitum | | | | | | |
| Age (days) | ALW (kg) | | CFR (kg) | | DFI (kg) | | ADG (g) |
| | $\bar{x} \pm s_x$ | $s$ | $\bar{x} \pm s_x$ | $s$ | $\bar{x} \pm s_x$ | $s$ | $\bar{x}$ |
| 83 | 28.64 ± 0.89 | 4.16 | . | . | . | . | . |
| 90 | 33.82 ± 1.17 | 5.48 | 2.70 ± 0.64 | 3.02 | 1.38** ± 0.05 | 0.23 | 648 |
| 97 | 37.20 ± 1.41 | 6.63 | 4.04*± 1.06 | 4.72 | 1.36** ± 0.08 | 0.37 | 484** |
| 104 | 42.57 ± 1.78 | 8.35 | 3.05 ± 0.81 | 3.70 | 1.63** ± 0.04 | 0.21 | 766* |
| 111 | 49.82 ± 2.06 | 9.65 | 2.70 ± 0.86 | 4.02 | 1.89** ± 0.07 | 0.32 | 1 036 |
| 118 | 55.77 ± 1.91 | 8.96 | 2.50*± 0.19 | 0.88 | 1.94** ± 0.04 | 0.20 | 851 |
| 125 | 61.18 ± 2.12 | 9.95 | 4.58*± 1.08 | 5.09 | 2.27 ± 0.09 | 0.44 | 773 |
| 132 | 67.91 ± 2.12 | 9.95 | 2.68 ± 0.16 | 0.75 | 2.47 ± 0.08 | 0.39 | 961 |
| 139 | 74.23 ± 2.09 | 9.78 | 2.89*± 0.17 | 0.81 | 2.49* ± 0.09 | 0.41 | 903 |
| 146 | 81.14 ± 2.12 | 9.93 | 2.91*± 0.24 | 1.12 | 2.60* ± 0.07 | 0.32 | 987 |
| 153 | 87.84 ± 2.13 | 10.01 | 3.18*± 0.20 | 0.92 | 2.87 ± 0.08 | 0.36 | 958 |
| 160 | 92.98 ± 2.03 | 9.51 | 4.45 ± 0.66 | 3.07 | 2.75 ± 0.07 | 0.33 | 734 |
| 167 | 98.45 ± 1.99 | 9.35 | 4.02 ± 0.35 | 1.66 | 2.82** ± 0.04 | 0.17 | 782 ** |
| 174 | 103.80 ± 1.95 | 9.14 | 3.87*± 0.28 | 1.29 | 2.73** ± 0.02 | 0.09 | 763 |
| Total | 103.80 ± 1.95 | 9.14 | 2.74**± 0.07 | 0.31 | 2.25** ± 0.04 | 0.21 | 826 * |

Differences indicated by same type are statistically significant. For $P \leq 0.01$ is used **; for $P \leq 0.05$ then *

Table 5. Carcass value of tested pigs with respect to type of feeding ($n$ = 144 )

| Indicator | Group 1 ($n$ = 72) | | Group 2 ($n$ = 72) | |
|---|---|---|---|---|
| | $\bar{x} \pm s_x$ | $s$ | $\bar{x} \pm s_x$ | $s$ |
| Carcass weight (kg) | 93.13 ± 1.728 | 8.47 | 89.09 ± 1.782 | 8.36 |
| Weight of the right half carcass (kg) | 46.00 ± 0.893 | 4.37 | 43.95 ± 0.901 | 4.23 |
| Carcass length (cm) | 87.63 ± 0.570 | 2.79 | 87.00 ± 0.712 | 3.34 |
| Backfat thickness at the last rib (mm) | 19.04 ± 0.781 | 3.83 | 18.50 ± 0.816 | 3.83 |
| Average backfat thickness (mm) | 26.88 ± 0.609 | 2.98 | 26.00 ± 0.790 | 3.70 |
| Lean meat share (%) | 55.88 ± 0.675 | 3.31 | 56.33 ± 0.956 | 4.48 |

Table 6. Carcass-realization in SEUROP system with respect to type of feeding in pigs ($n$ = 144 )

| Class | Group 1 ($n$ = 72) | | | Group 2 ($n$ = 72) | | |
|---|---|---|---|---|---|---|
| | $n$ | carcass weight (kg) $\bar{x}$ | % | $n$ | carcass weight (kg) $\bar{x}$ | % |
| S | 6 | 91 | 8.33 | 17 | 88 | 23.61 |
| E | 33 | 91 | 45.83 | 30 | 90 | 41.67 |
| U | 30 | 97 | 41.67 | 20 | 89 | 27.78 |
| R | 3 | 84 | 4.17 | 5 | 88 | 6.94 |

which are different for various companies and therefore the profitability per pig is too high.

A difference in profit per pig at the amount of CZK 103.87 for the benefit of ad-libitum feeding was discovered in the Table 7. Pigs in the second group were classified better in groups, though their lower weight at slaughter was not sufficient for positive influencing the final sales of the realised pigs although the realised carcass-price of 1 kg of meat on bone in this group was more favourable by CZK 0.50.

Table 7. The economic evaluation with respect to type of feeding in tested groups of pigs

| Indicator | Group 1 | Group 2 |
|---|---|---|
| Number of pigs/group | 72 | 72 |
| Costs in CZK | | |
| per 1 weaner | 1 676.40 | 1 718.40 |
| for feeds/1 pig in the test | 1 210.68 | 1 147.80 |
| overall costs/1 pig | 2 887.08 | 2866.20 |
| per 1 feeding day | 13.30 | 12.61 |
| per 1 kg of weight gain in test | 14.98 | 15.27 |
| Sales in CZK | | |
| per 1 pig | 3 835.08 | 3 710.33 |
| Realized carcass-price | 41.14 | 41.64 |
| Profit per 1 pig | 948.00 | 844.13 |
| Profitability per 1 pig (%) | 32.84 | 29.45 |

Costs = includes only the price for a weaners and feed per pig in the test

Note: Profitability of the tested groups of pigs is based on the previously defined costs of CFM components and realization sales of slaughter pigs

## CONCLUSION

The test was carried out in the test-station of the Pig and Poultry Science Department, where the influence of ad-libitum and semi-ad-libitum technique of feeding in 144 hybrid pigs of LWs × (LW×L) genotype was tested. Production performance, i.e. fattening capacity and carcass value of these pigs were monitored. Results were evaluated by means of the profit formula at the end of the test. It is definitely obvious that ad-libitum technique of pig feeding results in a better growth of pigs that positively reflects in the general economics of fattening, which represents, with a view to the tested combination of cross-breeding, a difference in profit per 1 fattened pig equal to CZK 103.87.

In the turnover of large-scale production realising, the fattening period equals to 91 days like in the test, i.e. 4.01 and the anticipated capacity of herd production of 5 000 places, this difference represents a significant item leading to improvements in competitiveness of our pig keeping.

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