THE EFFECT OF CONTROLLED NUTRITION ON FATTENING CAPACITY AND CARCASS LEAN MEAT SHARE WITH RESPECT TO SEX IN PIGS*

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The objective of this trial was to assess the influence of controlled feeding on the indicators of fattening capacity and carcass lean meat percentage with respect to sex in pigs. Test included 72 hybrid pigs (36/36 barrows/gilts) of LWs x (LW x L) genotype. The animals in the test were subdivided according to feeding technology and sex into four groups where the first two groups (1, 2) were fed ad libitum and the other two groups (3, 4) were restricted. During test the fattening capacity as well as the lean meat formation in the carcass was monitored. On the basis of obtained results it was confirmed, that ad-libitum system of feeding makes full manifestation of growth potential in tested pigs. Maximum growth peak of barrows was reached at about 75 kg of live weight, after that the growth intensity declined while FCR increased markedly. For gilts the system of ad-libitum feeding may be applied for the whole fattening period although the growth intensity declines from the same weight as well. The influence of feeding technology on FCR was proved mainly in barrows where there exists a statistically significant difference to the detriment of Group 1 (3.05, resp. 2.82 kg/kg of live weight gain). In gilts no such statistically difference was proved. The influence of feeding technology on the lean meat formation in the carcass was demonstrated mainly in barrows. The best results of the lean meat share were achieved in Groups 4 (58.1%), 2 (57.1%), 3 (56.5%), 1 (55.1%). It may be stated that for barrows with body weight up to 90 kg of live weight the controlled feeding system is suitable from the viewpoint of maintenance of positive FCR, growth intensity and lean meat percentage in the carcass, while in gilts ad-libitum feeding may be applied for the whole fattening period. Various feeding in barrows/gilts contributes evidently to a considerable unification of carcass weight as well as the lean meat percentage at the end of the fattening cycle.

pig; sex; growth; lean meat

INTRODUCTION

One of the main aims of slaughter pigs' keepers is to obtain a high growth potential with appropriate carcass lean meat percentage in slaughter pigs. Therefore the problem of different growth ability, feed intake and different lean meat growth in dependence on pig sex is a decisive aspect, influencing breeding technology as well as the total production economy. The preference of optimal feeding with respect to genotype and sex is therefore a rather complicated matter; nevertheless, this problem is being intensively investigated at the present time (Šimeček et al., 2001).

With growing pressure on limiting environmental contamination, with decreasing of animal feedstuffs supply, as well as increasing pressures on improvement of meat quality, it is necessary to introduce in the farms the so-called precise feeding, ensuring the nutrition level fully respecting the needs of pigs as far as the genotype, sex, and body weight of pigs are concerned (Prokop, 1997; Heger, 2001).

The composition of animal body is changing with different intensity in dependence on age. That is why, the nutrition demands are continuously changing as well (Donker et al., 1986; Pulkrábek et al., 1998, 2001). Thus a very important aim is to evaluate the nutrient-amounts necessary for the organism at short-time intervals and to make their prediction of consumption, digestibility and resorption (Campbell et al., 1983; Bastianelli, Sauvant, 1995; Bikker et al., 1996).

An important requirement is to reduce the fat growth. This may be relatively easily influenced by the change of energy value of rations. Increase of energy sources in the diet increases the growth of fat in pig bodies, and vice versa, energy deficit is manifested by reduction of the growth of fat as well as protein (due to limiting of their synthesis), which has negative consequences on the daily weight gain and utilization of growth potential of the animals (McMeekan, 1940; Buchta et al., 1997; Kodeš, Hučko, 2001).

The response of growing pigs on nutrition appears as the share of weight gain related to protein, water, fat and ash content in the hungry body (Kyriazakis, 1995). The target of pig-keepers is therefore to apply such feed consumption necessary for maximum protein deposition in the body.

In relation to the facts stated above there are discussions when, how, and whether at all to apply the technology of proportioned feeding, and how these facts should be taken in account in relation to the sex of animals.

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Pecher (2001) states that particularly, the restriction of feed should be applied at the end of the fattening period in barrows. On the other hand there is no common attitude to this problem in gilts. Some authors prefer partial restriction while others recommend ad-libitum feeding until the end of the fattening period.

MATERIAL AND METHODS

The objective of this trial was to assess the influence of controlled feeding on the indicators of fattening capacity and carcass lean meat percentage with respect to sex in pigs with the aim to provide the corresponding growth and carcass formation with respect to production economy, i.e. to prices of feeding mixtures.

Test included 72 hybrid pigs of LWs x (LW x L) genotype at the age of 83 days (from the birth) of average live weight 28.28 kg. The feeding of the pigs before the test was ad-libitum by feeding mixture used for the weaned category. The animals in the test were subdivided according to feeding technology and sex into four groups. The first two groups included barrows (Group 1) and gilts (Group 2) were fed ad-libitum (FCM I – scheme 1) and the second two groups included barrows (Group 3) and gilts (Group 4) were restricted (FCM II – scheme 2, 3).

Structure of the used feeding mixtures (FCM I, II) were based on wheat, barley, soya meal and feeding supplement. Prior to the beginning of the test analyses of particular feed components were made for fee mixture compilation purpose and their composition with respect to age and live weight of tested pigs.

The feeding of FCM I–II was performed according to the following formulas (Tables 1–3).

The animals were penned according to the methods for tests of thoroughbred and hybrid pigs. The ad-libitum/semi-ad-libitum feeding of FCM was made by help of self-feeders of Duräumat-corporation.

To evaluate fattening and growth performance the animals were regularly weighed in 7-day intervals when the following aspects were investigated:

- average live weight (kg),
- feed conversion ratio – FCR (consumption of CFM (kg) per 1 kg of live weight gain),
- daily feed consumption – DFC (kg),
- average daily weight gain – ADG (g).

From about 70 kg of average live weight of investigated pigs the lean meat percentage (i.e. percentage of lean meat in slaughter carcass) was measured in hybrids at 7-day intervals, using ultrasound equipment Sonomark SM100.

The obtained data were processed using standard mathematical and statistical methods.

Table 1. Nutrients of FCM I (ad libitum) and feeding phases with respect to age

Nutrient	Feeding phase		
	up to 35 kg	35–65 kg	above 60 kg
Crude protein (g/kg)	195.77	178.41	147.79
ME (MJ/kg)	13.24	13.12	12.91
Crude fiber (g/kg)	32.83	34.94	35.65
Lysine (g/kg)	10.89	9.51	7.69
Threonine (g/kg)	6.82	6.27	5.59
Methionine (g/kg)	3.16	2.96	2.48
Ca (g/kg)	7.09	6.21	5.91
P (g/kg)	7.27	6.83	6.56

Table 3. Intake of FCM II with respect to age

Week	Amount of feed	Amount of feed
	barrows	gilts
1	1.40	1.36
2	1.54	1.51
3	1.75	1.60
4	2.00	1.76
5	2.10	1.87
6	2.70	2.10
7	2.83	2.55
8	2.98	2.72
9	3.07	2.84
10	3.16	2.96
11	2.95	3.07
12	2.86	2.89
13	2.76	2.70

Table 2. Nutrients of FCM II (restricted) and feeding phases with respect to age

Nutrient	Feeding phase (week)												
	1	2	3	4	5	6	7	8	9	10	11	12	13
Crude protein (g/kg)	201.5	198.0	194.6	191.1	187.0	182.9	178.9	174.8	171.9	169.0	166.1	163.2	160.3
ME (MJ/kg)	13.36	13.34	13.33	13.32	13.31	13.29	13.27	13.26	13.24	13.23	13.22	13.21	13.20
Crude fiber (g/kg)	30.40	30.37	30.34	30.31	30.27	30.23	30.19	30.15	30.12	30.10	30.07	30.05	30.02
Lysine (g/kg)	11.24	11.00	10.76	10.52	10.25	9.98	9.71	9.44	9.24	9.05	8.85	8.66	8.46
Threonine (g/kg)	7.07	6.87	6.87	6.75	6.68	6.45	6.25	6.10	5.90	5.82	5.51	5.32	5.12
Methionine (g/kg)	5.04	4.88	4.71	4.55	4.36	4.17	3.98	3.79	3.65	3.51	3.38	3.24	3.10
Ca (g/kg)	7.11	7.02	6.94	6.85	6.77	6.69	6.61	6.53	6.47	6.41	6.35	6.29	6.23
P (g/kg)	7.28	7.22	7.16	7.10	7.04	6.98	6.92	6.86	6.81	6.77	6.72	6.68	6.63

RESULTS AND DISCUSSION

Table 4a demonstrates the fattening performance of barrows according to the feeding technology. The results show significantly higher growth ability in barrows fed *ad-libitum* in comparison to barrows fed restricted. The barrows of Group 1 had significantly higher slaughter weight 112.21 kg in comparison to Group 3 with weight 103.83 kg.

The values found out by the test are characterized by excellent weight gain particularly in barrows (Group 1), namely 925 g, which was significantly higher as compared to Group 3 (833 g). Another positive fact is a high growth intensity starting from about 30 kg of live weight. Maximum of growth intensity was reached at about 75, or 70 kg of live weight. Subsequently, the growth intensity started to decline faster in Group 1 as compared to Group 3 (Fig. 1b). From the age of 155 days the growth decline was similar. A considerable variability was recorded between individual monitored weeks in the test. This fact was mentioned by Hovorka (1955, 1956, 1960) who explained this phenomenon as the changes of

Table 4a. Effect of fattening performance with respect to feeding type and sex in pigs – barrows

Group 1 (n = 18) – ad-libitum feeding				
Age	average live weight (kg)	feed conversion (kg CFM/wg)	daily feed consumption (kg CFM/day)	ADG (g/day)
	$\bar{x} \pm s_{\bar{x}}$	$\bar{x} \pm s_{\bar{x}}$	$\bar{x} \pm s_{\bar{x}}$	$\bar{x} \pm s_{\bar{x}}$
84	28.0 ± 1.29			
91	34.5 ± 1.59	2.35 ± 0.44	1.74** ± 0.11	807 ± 87
98	39.9 ± 1.85	3.51 ± 1.27	1.87** ± 0.10	774** ± 76
105	47.5 ± 2.12	2.37 ± 0.17	2.50** ± 0.07	1095* ± 61
112	55.2 ± 2.08	2.45 ± 0.10	2.61** ± 0.05	1089 ± 62
119	61.4 ± 2.03	3.10** ± 0.24	2.66** ± 0.06	893 ± 46
126	67.2 ± 1.95	3.51 ± 0.19	2.81* ± 0.06	827 ± 55
133	74.8 ± 2.26	2.78 ± 0.18	2.90* ± 0.10	1077 ± 65
140	81.4 ± 2.43	3.37 ± 0.19	3.11** ± 0.06	952 ± 51
147	89.3 ± 2.43	2.82 ± 0.15	3.10* ± 0.09	1131 ± 64
154	95.4 ± 2.51	3.95 ± 0.28	3.29* ± 0.11	869 ± 56
161	101.0* ± 2.56	4.33 ± 0.35	3.16** ± 0.08	792 ± 71
168	107.9* ± 2.44	3.51 ± 0.17	3.40** ± 0.07	988** ± 37
175	112.2* ± 2.53	6.90** ± 1.10	3.35** ± 0.06	619* ± 83
Total	112.2** ± 2.53	3.05* ± 0.08	2.81** ± 0.05	925** ± 24
Group 3 (n = 18) – restrictive feeding				
Age	average live weight (kg)	feed conversion (kg CFM/wg)	daily feed consumption (kg CFM/day)	ADG (g/day)
	$\bar{x} \pm s_{\bar{x}}$	$\bar{x} \pm s_{\bar{x}}$	$\bar{x} \pm s_{\bar{x}}$	$\bar{x} \pm s_{\bar{x}}$
84	28.0 ± 1.25			
91	33.1 ± 1.85	3.25 ± 1.16	1.40** ± 0.08	630 ± 93
98	36.2 ± 2.38	3.59 ± 0.92	1.25** ± 0.13	440** ± 126
105	41.9 ± 2.96	3.78 ± 1.39	1.65** ± 0.08	815* ± 109
112	49.5 ± 3.31	1.95 ± 0.16	2.02** ± 0.10	1089 ± 69
119	55.5 ± 3.18	2.45** ± 0.17	2.04** ± 0.06	863 ± 48
126	61.5 ± 3.31	2.99 ± 0.15	2.48* ± 0.10	845 ± 43
133	68.5 ± 3.36	2.70 ± 0.18	2.61* ± 0.09	1006 ± 54
140	74.5 ± 3.27	3.32 ± 0.22	2.70** ± 0.04	851 ± 52
147	81.9 ± 3.50	2.94 ± 0.35	2.80* ± 0.07	1060 ± 94
154	88.0 ± 3.51	3.58 ± 0.27	2.99* ± 0.09	881 ± 62
161	93.0* ± 3.33	4.82 ± 1.15	2.67** ± 0.05	708 ± 69
168	98.3* ± 3.11	4.37 ± 0.60	2.90** ± 0.04	750** ± 64
175	103.8* ± 3.03	3.66** ± 0.29	2.78** ± 0.01	798* ± 48
Total	103.8** ± 3.03	2.82* ± 0.08	2.33** ± 0.05	833** ± 23

** $P \leq 0.01$, * $P \leq 0.05$

CFM – consumption of feed mixture, ADG – average daily gain

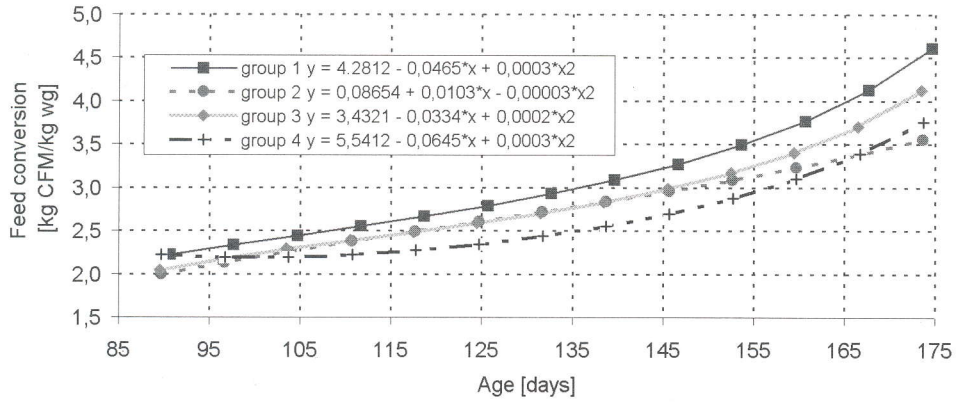

Fig. 1a. Performance with respect to feeding type and sex – average feed conversion (fitted by polynomial curve of the 2nd value)

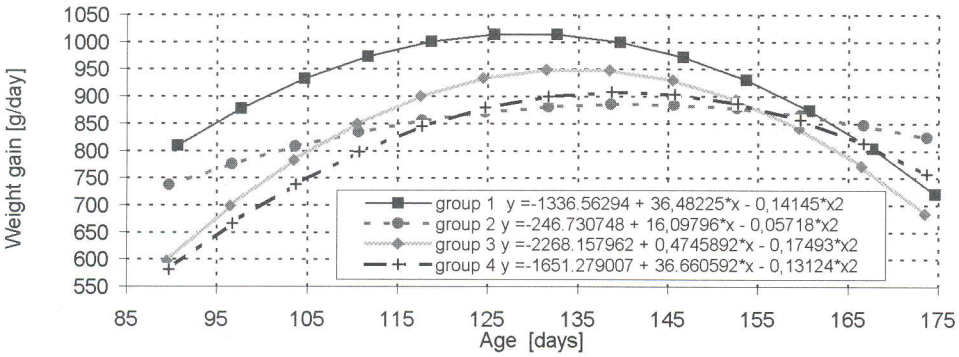

Fig. 1b. Performance with respect to feeding type and sex – average daily weight gain (ADG) (fitted by polynomial curve of the 2nd value)

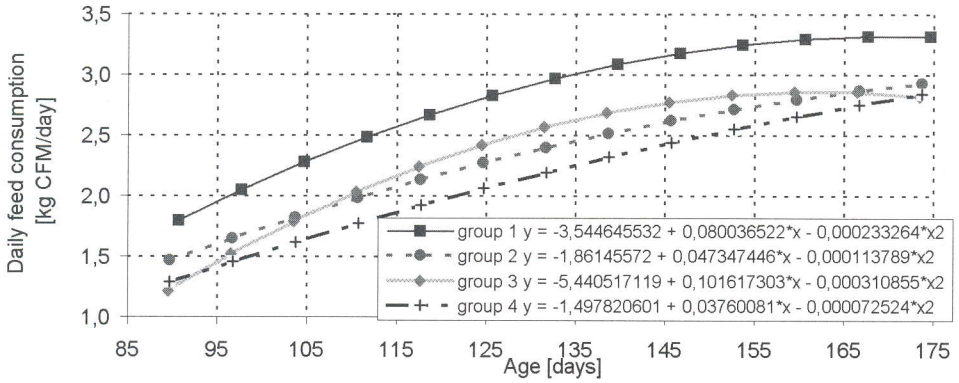

Fig. 1c. Performance with respect to feeding type and sex – average daily feed consumption (fitted by polynomial curve of the 2nd value)

growth depression/acceleration in the process of the growing of pigs.

As far as the FCR is concerned a significant difference was found out to the detriment of Group 1 (3.05 and 2.82 kg/kg of live weight gain). The rapid increase of FCR can be seen from the age of 125 days when especially Group 1 achieved in the last week the highest FCR due to growth depression.

As concerns DFC, there is an evident variability in Group 3 (restricted) especially at the age of 98, 126 and 161 days. This fact can be evidently caused by the existence of animal biorhythm when some animals were not able to eat out the all amount of feed, although it was restricted.

As regards the evaluation of fattening performance in gilts (Table 4b), the results demonstrate the increase of growth intensity in gilts with ad-libitum feeding. The differences in results characterizing growth capacity, however, were not significant between the Groups 2 and 4. Maximum of growth intensity was reached at the age of about 140 days (Fig. 1b) with live weight of approx. 75 kg. Subsequently the decreasing of growth intensity was detected namely in Group, 4 which achieved better parameters of FCR, however, Group 2 did not reflect its higher feed consumption in an appropriate growth.

Table 5 documents the evaluation of lean meat growth in all groups after conversion into the uniform live weight. Higher lean meat share was found out in gilts in comparison with barrows. Gilts fed ad-libitum had the same lean meat share until the body weight about 70 kg in comparison with the group with restricted feeding. After that, the lean meat share was decreasing in bodies of gilts fed ad-libitum and the difference was about 1 per cent of lean meat at 110 kg of live weight. As far as the barrows are concerned, the group fed ad-libitum had higher lean meat share than the Group 3 with restricted

Table 4b. Effect of fattening performance with respect to feeding type and sex in pigs – gilts

Group 2 (n = 18) – ad-libitum feeding				
Age	average live weight (kg)	feed conversion (kg CFM/wg)	daily feed consumption (kg CFM/day)	ADG (g/day)
	$\bar{x} \pm s_{\bar{x}}$	$\bar{x} \pm s_{\bar{x}}$	$\bar{x} \pm s_{\bar{x}}$	$\bar{x} \pm s_{\bar{x}}$
84	27.9 ± 1,22			
91	33.8 ± 1.53	1.83 ± 0.12	1.49 ± 0.07	740 ± 52
98	39.0 ± 1.75	2.43 ± 0.28	1.62 ± 0.07	744 ± 66
105	45.0 ± 2.11	1.94 ± 0.08	1.76 ± 0.11	857 ± 90
112	51.1 ± 2.35	2.48 ± 0.24	2.06* ± 0.14	875 ± 58
119	57.4 ± 2.53	2.49 ± 0.17	2.18* ± 0.14	893 ± 49
126	62.3 ± 2.47	3.31 ± 0.25	2.20 ± 0.11	696 ± 48
133	68.6 ± 2.76	2.86 ± 0.27	2.41 ± 0.09	905 ± 64
140	74.5 ± 2.65	2.93* ± 0.17	2.38 ± 0.09	839 ± 54
147	81.6 ± 2.88	2.80 ± 0.17	2.77** ± 0.13	1018 ± 60
154	88.0 ± 2.71	3.23 ± 0.29	2.72 ± 0.08	917 ± 88
161	93.1 ± 2.89	3.87 ± 0.23	2.69 ± 0.11	726 ± 52
168	99.3 ± 3.08	3.58 ± 0.34	2.93** ± 0.09	887 ± 68
175	105.3 ± 2.85	3.67 ± 0.24	2.97** ± 0.08	851 ± 64
Total	105.3 ± 2.85	2.74 ± 0.09	2.32 ± 0.07	850 ± 23
Group 4 (n = 18) – restrictive feeding				
Age	average live weight (kg)	feed conversion (kg CFM/wg)	daily feed consumption (kg CFM/day)	ADG (g/day)
	$\bar{x} \pm s_{\bar{x}}$	$\bar{x} \pm s_{\bar{x}}$	$\bar{x} \pm s_{\bar{x}}$	$\bar{x} \pm s_{\bar{x}}$
84	29.4 ± 1.28			
91	34.7 ± 1.35	2.03 ± 0.27	1.36 ± 0.07	669 ± 81
98	38.5 ± 1.29	4.58 ± 2.12	1.49 ± 0.05	536 ± 107
105	43.4 ± 1.82	2.09 ± 0.23	1.61 ± 0.04	707 ± 160
112	50.2 ± 2.37	3.60 ± 1.89	1.75* ± 0.07	971 ± 129
119	56.1 ± 1.97	2.57 ± 0.37	1.83* ± 0.03	836 ± 111
126	60.9 ± 2.65	6.48 ± 2.30	2.02 ± 0.13	686 ± 131
133	67.2 ± 2.54	2.65 ± 0.28	2.30 ± 0.14	907 ± 55
140	74.0 ± 2.58	2.38* ± 0.17	2.24 ± 0.16	964 ± 66
147	80.3 ± 2.22	2.87 ± 0.34	2.36** ± 0.07	900 ± 76
154	87.6 ± 2.30	2.69 ± 0.20	2.74 ± 0.12	1050 ± 61
161	93.0 ± 2.21	3.99 ± 0.46	2.85 ± 0.14	764 ± 60
168	98.7 ± 2.48	3.61 ± 0.29	2.72** ± 0.04	821 ± 100
175	103.8 ± 2.45	4.12 ± 0.50	2.66** ± 0.03	721 ± 73
Total	103.8 ± 2.45	2.64 ± 0.11	2.15 ± 0.07	818 ± 26

** $P \leq 0.01$, * $P \leq 0.05$

CFM – consumption of feed mixture, ADG – average daily gain

feed until the weight 95 kg. After that, the lean meat share was decreasing in Group 1 and this trend was even more significant from about 100 kg of live weight up (Fig. 2). At the 110 kg live weight the lean meat share was practically equal in the both groups of pigs.

CONCLUSIONS

- Ad-libitum feeding system allows full manifestation of pig growth potential.
- Maximum of growth peak of barrows fed ad-libitum was reached at about 75 kg of live weight and after that the growth intensity declined while FCR increased markedly.
- In gilts the system of ad-libitum feeding may be applied for the whole fattening period, reaching a higher growth intensity with equal FCR.
- It seems to be advantageous to use the controlled feeding in barrows only, namely from the live weight of 75 kg in dependence on growth intensity decline with a daily feed intake increase.

Table 5. Evaluation of lean meat growth in carcass after conversion into uniform live weight

Weight (kg)	Group 1 (n = 18)	Group 3 (n = 18)	Group 2 (n = 18)	Group 4 (n = 18)
	lean meat percentage	lean meat percentage	lean meat percentage	lean meat percentage
65	60.7	60.2	61.2	60.7
70	60.3	59.7	60.8	60.8
75	59.8	59.1	60.4	60.8
80	59.2	58.5	60.1	60.6
85	58.6	58.0	59.8	60.2
90	57.9	57.5	59.4	59.9
95	57.2	57.1	59.0	59.4
100	56.5	56.8	58.5	59.0
105	55.8	56.6	57.8	58.5
110	55.1	56.5	57.1	58.1

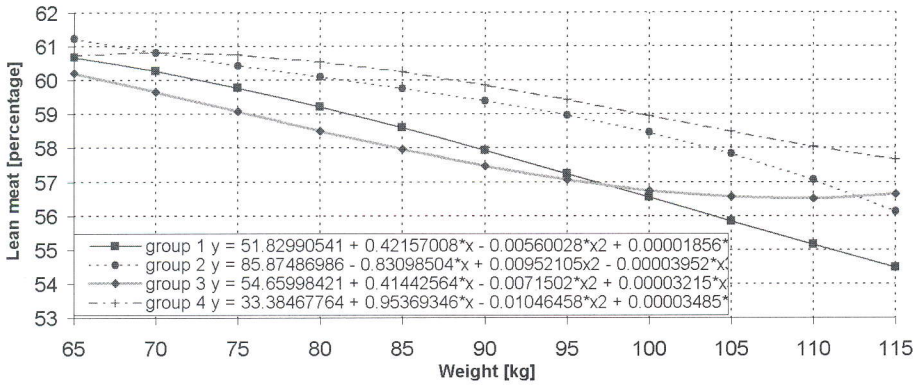

Fig. 2. Evaluation of fattening capacity of investigated groups of pigs – comparison according to feeding type and sex

- As far as the influence of feeding technology on the lean meat percentage in the carcass is concerned, it may be stated that in barrows with body weight of about 90–95 kg, the restriction may be used with the aim of reaching a higher lean meat share in slaughter carcasses. In gilts this trend is not so evident even though the lower proportion of lean meat in the group fed ad libitum was found out also in this sex.
- In the case of ad-libitum/restricted feeding in gilts/barrows there is an evident unification of carcass weight as well as the lean meat percentage at the end of the fattening cycle.

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Vliv řízené výživy na ukazatele výkrmnosti a podíl masa v jatečném těle v závislosti na pohlaví prasat.

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Cílem pokusu bylo posoudit vliv řízené výživy na ukazatele výkrmnosti a podíl masa v jatečných tělech prasat ve vztahu k pohlaví. Pokus proběhl na 72 prasatech s vyrovnaným poměrem pohlaví finálního hybrida (Bu x L) x BO. Prasata byla rozdělena na základě techniky krmení a pohlaví do čtyř skupin, kde první dvě (skupiny 1 a 2) byly krmeny adlibitně a další dvě (skupiny 3 a 4) restringovaně. Byly sledovány ukazatele charakterizující výkrmnost a tvorbu masa v tělech prasat během testu.

Potvrdilo se, že adlibitní systém krmení umožnil plnou manifestaci růstového potenciálu testovaných prasat. Vrchol růstu vepříků byl dosažen v cca 90 kg živé hmotnosti a následně došlo k výraznému nárůstu hodnot konverze krmiva. U prasniček se ukazuje, že po celou dobu lze uplatnit adlibitní systém krmení. Potvrdil se vliv techniky krmení na tvorbu svaloviny, a to především u vepříků.

Závěrem lze říci, že je vhodné uplatnit řízenou výživu u vepříků od 90 kg živé hmotnosti, a to z důvodu dosažení příznivé konverze, udržení odpovídajícího růstu a dosažení odpovídajícího podílu masa. Naproti tomu u prasniček je vhodné během jejich výkrmu používat adlibitní systém krmení.

prase; výživa; pohlaví; růst; svalovina

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