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GROWTH AND REPRODUCTION TRAITS OF WHITE IMPROVED PIGS HOUSED IN THREE TYPES OF PEN TECHNOLOGY[1]

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Abstract. The aim of paper was study of growth, reproduction traits of White Improved pigs in three type of pens KNOP l, KNOP 2 and KNOP 3. Better results were obtained in pen KNOP 1. The piglets reached live weight 30.46 kg on the 87th day of life in pen KNOP 1, 28.04 kg in pen KNOP 2 and 18.38 kg in pen KNOP 3 at the same age. The lower number of piglets was found in the KNOP 3, 8.31 piglets at the age of 87 days and the highest in pen KNOP 1, 8.74 one. The lowest losses of piglets were in the period from weaning to rearing in the KNOP 1, only 3.2 %, and the highest losses were found in KNOP 3, 12.9 %. The results showed the necessity of optimization of environmental conditions at piglets growth, and of reproduction traits in sows in pig farming.

Key words: pig breeding, growth and reproduction traits, technology of pig farming.

Introduction

The animal welfare (*Fraser* and *Broom*, 1990, *Novák* and *Novák*, 1999) had in past years a great role in animal production. The ethological investigations are in addition to other methods by which can be measured the degree of welfare conditions in animals, specifically at the reconstruction and modernisation and adaptation of buildings for pig farming (*Paška,* 1997; *Brouček*, 1999). *Ekkel et al.* (1995) discussed about pen size significance of specific stress free housing system on productivity, health and welfare of pigs. *Botto et al*. (1996, 2001) evaluated sows ethological activities in various types of pens. The growth and development of various pig genotypes were studied from biological and genetical aspects by *Fľak* (1990). Live weight and reproduction traits were studied also by *Paška et al.* (1998), *Matoušek et al.* (2001) and *Mlynek et al.* (2002). In our previous paper (*Matta et al.,* 2003) were discussed various ethological activities of White Improved sows and piglets in two types of pens (classical and new constructed KNOP pens), which use welfare of animals.

The main aim of present paper is therefore the study of growth and reproduction of White Improved pigs in three types of KNOP pens.

Material and Methods

The experiment was realized on three farms for pig breeding near Nitra using three types of pens: KNOP 1 pen in farm Čierne Kľačany, KNOP 2 pen in farm Žirany and KNOP 3 in farm Nesvady. In KNOP type of pen was achieved a high intensity of sows usefulness with production 20.6 pigs per sow per year, secured reasonable mortality (12 %), good growth intensity untill the age 87 days (0.323 kg) and live weight of pigs (29.54 kg, *Paška*, 1999). The technological details of KNOP pens were described by *Paška* (1997). Growth of piglets and reprodction traits of sows of White Improved pigs on three farms/pens were analysed by one way and two way nested analysis of variance with fixed effects farms/pens and random effect of sows (*Grofik* and *Fľak,* 1990).

Measurements were evaluated by SPSS for Windows, Release 6.0 (1983-1993) and NESTED Procedure of SAS (1999-2001) Package, with Bonferroni multiple comparisons method of observed means.

Results and Discussion

The basic statistical characteristics of live weight and average daily gain of piglets according to farm are given in table 1. The live weight at birth ranged from 1.40 ± 0.02 kg in farm Nesvady to 1.63 ± 0.02 kg in farm Čierne Kľačany. The corresponding live weight at 87 days of age were 18.38 ± 0.48 or 30.46 ± 0.29 kg. Average daily gain from birth to 21 days ranged from 0.183 ± 0.002 kg in farm Žirany to 0.434 ± 0.005 kg in farm Čierne Kľačany. Average daily gain from birth to 87 days of age ranged from 0.195 ± 0.005 in farm

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Nesvady to 0.331 ± 0.003 kg in farm Čierne Kľačany. The differences between compared farms in all growth traits were highly statistically signigicant (table 4). The correlations between live weights and average daily gains for total experimental material were highly statistically significant, with the lowest values between live weight at birth or at 21st day of age to average daily gain between 42 and 87 days of age.

The basic statistical characteristics of number of piglets in various age in tested pens and reproduction characteristics of White Improved sows are given in table 3. All piglets born ranged from 10.37 ± 0.28 in KNOP 1 pen to 11.92 ± 0.23 in KNOP 2 pen. Corresponding numbers of piglets at 87 days of age were 8.31 ± 0.55 in KNOP 3 pen and 8.74 ± 0.28 in KNOP 1 pen. The lowest losses of piglets were in the period from weaning to rearing in the KNOP 1, only 3.2 %, and the highest losses were found in KNOP 3, 12.9 %. Sows parturition interval was the lowet 171.18 days in KNOP 3 pen and the largest 180.48 days in KNOP 1 pen. Corresponding non-productive days weere 14.32 or 23.70 days. The natality of White Improved sows was 2.15 in KNOP 3 and 2.14 in KNOP 2, but 2.05 in KNOP 1. The highly statistically significant differences were mainly between KNOP 1 and KNOP 2 in number of piglets. The highly statistically significant differences between sows traits were nearly in all compared means of KNOP pens.

Table 1. Basic variational-statistical characteristics of live weight and average daily gain of piglets according to farms/pens

Trait	Age, day	n	$\bar{x}$	s	$s_{\bar{x}}$	v %
Čierne Kľačany - KNOP 1						
Live weight, LW	Birth	377	1.63	0.33	0.02	20.25
kg	21st day	352	5.93	1.23	0.07	20.74
	42nd day	346	10.81	2.24	0.12	20.72
	87th day	338	30.46	5.28	0.29	17.33
Average	0 - 21st day	352	0.203	0.05	0.003	25.00
daily gain, ADG	0 - 42nd day	346	0.218	0.05	0.003	22.73
kg	0 - 87th day	338	0.331	0.06	0.003	18.18
	42 - 87th day	338	0.434	0.09	0.005	20.93
Žirany - KNOP 2						
Live weight, LW	Birth	719	1.55	0.34	0.01	21.94
kg	21st day	673	5.44	1.36	0.05	25.00
	42nd day	648	9.64	2.07	0.08	21.47
	87th day	578	28.04	5.02	0.21	17.90
Average	0 - 21st day	673	0.183	0.05	0.002	27.78
daily gain, ADG	0 - 42nd day	648	0.191	0.05	0.002	26.32
kg	0 - 87th day	578	0.303	0.06	0.002	20.00
	42 - 87th day	578	0.403	0.09	0.004	22.50
Nesvady - KNOP 3						
Live weight, LW	Birth	137	1.40	0.29	0.02	20.71
kg	21st day	0	-	-	-	0
	42nd day	137	7.42	2.44	0.21	32.88
	87th day	115	18.38	5.10	0.48	27.75
Average	0 - 21st day	0	-	-	-	-
daily gain, ADG	0 - 42nd day	137	0.143	0.05	0.005	35.71
kg	0 - 87th day	115	0.195	0.06	0.005	30.00
	42 - 87th day	115	0.235	0.09	0.008	37.50
Total						
Live weight, LW	Birth	1233	1.56	0.34	0.01	21.84
kg	21st day	1025	5.61	1.34	0.04	23.89
	42nd day	1131	9.73	2.39	0.07	24.58
	87th day	1031	27.75	6.20	0.19	22.32
Average	0 - 21st day	1025	0.190	0.05	0.002	27.89
daily gain, ADG	0 - 42nd day	1131	0.194	0.05	0.002	26.80
kg	0 - 87th day	1031	0.300	0.07	0.002	23.33
	42 - 87th day	1031	0.394	0.11	0.003	26.65

Growth and reproduction characteristics obtained in our paper are similar to the results of *Fľak* (1990), *Paška et al.* (1998), *Matoušek et al.* (2001) and *Mlynek et al.* (2002) and confirmed significance of

evaluation of these traits and behavorial activities (*Matta et al.,* 2003) in pig housing as were obtained by *Ekkel et al.* (1995), *Botto et al.* (1996, 2001) and *Brouček* (1999). From our analyses can be concluded that growth and developmet of pigs and reproduction performance of White Improved sows, but also ethological activities in innovated KNOP pens are on the same level as in classical pens and from welfare conditions can be recommended for sow housing.

Table 2. Correlations between live weight and average daily gains for total material

Trait	LW21	LW42	LW87	ADG21	ADG42	ADG87	ADG42-87
Live weight at birth, LWB	.783**	.670**	.438**	.664**	.588**	.398**	.280**
Live weight, 21st day, LW21	1	.819**	.532**	.985**	.774**	.502**	.291**
Live weight, 42nd day, LW42		1	.760**	.811**	.995**	.746**	.525**
Live weight, 87th day, LW87			1	.529**	.761**	.999**	.952**
Average daily gain, 21st day, ADG21				1	.783**	.506**	.290**
Average daily gain, 42nd day, ADG42					1	.751**	.529**
Average daily gain, 87th day, ADG87	$r_{0.05}(1000)$ = 0.062					1	.958**
Average daily gain, 42-87th day, ADG42-87	$r_{0.01}(1000)$ = 0.081						1

Table 3. Basic variational-statistical characteristics of number of piglets at various age in tested pens and reproduction characteristics of White Improved sows

Pen	KNOP 1		n = 38		KNOP 2		n = 66		KNOP 3		n = 13	
Trait	$\bar{x}$	s	$s_{\bar{x}}$	v %	$\bar{x}$	s	$s_{\bar{x}}$	v %	$\bar{x}$	s	$s_{\bar{x}}$	v %
Number of piglets												
All piglets born	10.37	1.70	0.28	16.39	11.92	1.83	0.23	15.35	11.31	1.70	0.47	15.03
Alive piglets born	9.95	1.52	0.25	15.28	11.05	1.84	0.23	16.65	10.77	1.42	0.39	13.18
No. piglets 21st day	9.21	1.73	0.28	18.78	10.23	1.64	0.20	16.03				
No. piglets 42nd day	9.05	1.77	0.29	19.56	9.76	1.53	0.19	15.68	10.62	1.61	0.45	15.16
No. piglets 87th day	8.74	1.72	0.28	19.68	8.67	1.51	0.19	17.42	8.31	1.97	0.55	23.71
Sows traits												
			n = 126				n = 256				n = 82	
Parturition interval days	180.48	24.52	2.18	13.59	173.79	27.96	1.75	16.09	171.18	14.84	1.64	8.67
Non-productive days	23.70	24.27	2.16	102.41	17.41	27.45	1.72	157.67	14.32	14.68	1.62	102.51
Natality	2.05	0.22	0.02	10.73	2.14	0.25	0.02	11.68	2.15	0.16	0.02	7.44

Table 4. Mean squares of one-way analyses of variance of growth and reproduction traits between pens

Trait	MS_A farms/pens	MS_e error	f_a; f_e	Significant comparisons
Growth traits				
Live weight at birth, LWB	2.6042**	0.1114	2; 1230	1: (2.3)** 2: 3**
Live weight, 21st day, LW21	55.3340**	1.7421	1; 1023	1 : 2**
Live weight, 42nd day, LW42	570.0327**	4.7153	2; 1128	1: (2.3)** 2: 3**
Live weight, 87th day, LW87	6316.1963**	26.1519	2; 1027	1: (2.3)** 2: 3**
Average daily gain, 21st day, ADG21	0.0902**	0.0027	1; 1023	1: 2**
Average daily gain, 42nd day, ADG42	0.2770**	0.0022	2; 1126	1: (2.3)** 2: 3**
Average daily gain, 87th day, ADG87	0.7995**	0.0033	2; 1027	1: (2.3)** 2: 3**
Average daily gain, 42-87th day, ADG42-87	1.7379**	0.0077	2; 1026	1: (2.3)** 2: 3**
Number of piglets				
All piglets born	29.2000**	3.1599	2; 114	1 : 2**
Alive piglets born	14.6294**	2.9041	2; 114	1 : 2**
No. piglets 21st day	24.9298**	2.8030	2; 114	1 : 2**
No. piglets 42nd day	13.1801**	2.6236	2; 114	1 : 3**
No. piglets 87th day	0.9141	2.6737	2; 114	-
Sows traits				
	Farms $f_F = 2$	Sows $f_{S:F}=89$	Error $f_e = 372$	
Parturition interval	2676.2087**	505.3506	664.8890	1: (2.3)*
Non-productive days	2577.0060**	499.0190	541.8520	1 : 3*
Natality	0.3615**	0.0383	0.0554	1: (2.3)*

$F_{0.05}(1, 1000) = 3.851$ $F_{0.05}(2, 120) = 3.072$ $F_{0.05}(2, 90) = 3.098$ * $\alpha \le 0.05$
$F_{0.01}(1, 1000) = 6.660$ $F_{0.01}(2, 120) = 4.786$ $F_{0.01}(2, 90) = 4.849$ ** $\alpha \le 0.05$
$F_{0.05}(2, 1000) = 3.005$ $F_{0.05}(90, 400) = 1.296$
$F_{0.01}(2, 1000) = 4.626$ $F_{0.01}(90, 400) = 1.440$

Conclusion

Growth and developmet characteristics and reproduction traits of White Improved pigs studied in three innovated pens showed, that these new pens have not negative influence on pig production. The results obtained from our experiment commonly with nonsignificant differences in ethological activities between classical and innovated pens obtained in our previous experiment showed, that innovated pens can be recommended for sow housing in practice.

PORAST I REPRODUKTIVNE OSOBINE KOD BELE OPLEMENJENE SVINJE U SISTEMU DRŽANJA SA TRI VRSTE BOKSEVA

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Rezime

Statistička analiza osobina porasta kod bele oplemenjene svinje pokazuje da je najbolji porast prasadi od rođenja do 87. dana života bio kod korišćenja tehnologije bokseva KNOP 1 na farmi Čierne Kľačany. Bolji rezultati su dobijeni samo na farmi Žirany tehnologijom bokseva KNOP 2 u poređenju sa tehnologijom KNOP 3 na farmi Nesvady.

Bolji rezultati su registrovani kod prasadi iz bokseva KONP 1. Prasad je dostigla telesnu masu od 30.46 kg 87 dana starosti u boksevima KNOP 1, oko 28.04 kg u boksevima KNOP 2 i samo 18.38 kg u boksevima KNOP 3 u istom uzrastu. Utvrđene su signifikantne razlike između bokseva koji su se poredili.

Visoka plodnost je registrovana na sve tri farme (od 10.37 do 11.92 prasadi). Ograničena karakteristika ekonomičnosti u sektoru odgoja prasadi je broj odbijene prasadi u uzrastu od 87 dana koji je iznosio od 8.31 do 8.74 prasadi. Najmanji gubici prasadi su bili u periodu od odbijanja do odgoja u boksevima KNOP 1, samo 3.2 %, a najveći gubici prasadi kod bokseva KNOP 3, 12.9 %.

Analiza intervala porađanja, neproduktivnih dana i nataliteta pokazuju tendenciju poboljšanja kod posmatranih karakteristika.

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