

PERFORMANCE OF YOUNG BOARS DEPENDING ON THE LITTER SIZE

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Abstract. The material consisted of 60 hybrid boars, from line 990 (♀) and Pietrain breeds (♂), divided into two groups depending on the litter size in which they were born and reared – group: 7–10 piglets (average 8.8) per litter; group: 11–17 piglets (average 12.5) per litter. The mean body weight of 21 day of live piglets born and reared in larger litters was significantly ($P \leq 0.05$) lower than among boars reared in smaller litters. This difference gradually diminished and at day 63 of life both groups had the same average body weight. In the period from 63 to 180 day of life, the boars from smaller litters had a slightly lower rate of growth (statistically insignificant). Boars reared in larger litters at 180 day of life were on average 3 kg heavier. There were no significant differences in fat thickness, lean meat and testicular volume between the assessed groups of young boars. From boars reared in smaller litters ejaculates had a significantly higher ($P \leq 0.05$) sperm concentration and total sperm volume.

Key words: litter size, semen, slaughter traits, testicular size, young boars

INTRODUCTION

In recent years there has been an increased interest in improving reproduction characteristics. The possibility of improving these traits by selection are limited, mainly due to the low rate of heritability. Many studies have highlighted fertility rates are poorly improved by indirect selection for ovulation rate, high fertility line formation or direct selection for litter size [Alsing et al. 1980, Rutledge 1980,

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Vangen 1980, Robison 1981, Steen 1984]. The reason for the lack of improvement may be a negative influence of litter size in which pigs are reared on their development and somatic growth, the development of sexual organs, the course of oogenesis and spermatogenesis, sexual maturation, and the number of born and reared piglets. Offspring derived from large litters are raised in less favorable environmental conditions, both in pre- and post-natal periods [Nelson and Robison 1976, Klein 2005, Kawęcka et al. 2006, Rekiel et al. 2010].

Despite the positive effects of selection by testicular size (which determines the volume of semen production), environmental factors such as malnutrition and season (due to the high variability and unpredictability) may also have a significant impact on the quality of semen [Klein 2005]. The number of developing fetuses and then the number of piglets fed by a sow can have a significant impact on their growth and thus their fertility. In the first three weeks after birth and before reaching sexual maturity at 3 to 4 months of age, boars experience an intense increase in cell nuclei and gonads. During both of these periods the number of Sertoli cells increases significantly [França et al. 2005].

The aim of this study was to compare the growth of young boars, their slaughter quality, testicular size and semen traits in relation to the size of the litter size in which they were born and reared.

MATERIAL AND METHODS

The study was carried out at the Institute of Animal Production of the National Research Institute in Balice, Experimental Station Pawłowice. The studied material consisted of 60 hybrid boars of line 990 breed (♀) and Pietrain breed (♂), divided into two groups depending on the litter size in which they were born and reared (group: 7–10 piglets per litter – 30 individuals, group: 11–16 piglets litter – 30 individuals).

The period of suckling lasted 30 days. After weaning, piglets were kept in the same pens until the 63rd day of life. Lactating sows, and piglets during suckling and after weaning, were fed with pelleted mixtures in accordance with the standards of nutrition. On the 63rd day of age, 2 boars were selected from each litter for further evaluation, which was carried out until the 180th day of life. During that period, the young boars were kept individually in standardized environmental factors (pen size 1 x 2 m) and fed with a mixture depending on the age, containing 13 MJEM, 187 g total protein, 10.5 g lysine, 6.7 g methionine with cystine (per kilo), and mineral and vitamin supplements.

Young boars were weighed at 21, 30 and 63 days of life. In 180 day of life boars were performance tested (according to the methodology of the Institute of Animal Production) using a Piglog 105 ultrasound device. The percentage of meat

in the carcass was calculated from two measurements of backfat (3 and 8 cm from the midline of the back behind the last rib) and measuring the loin eye high (8 cm from the midline of the back behind the last rib). Measurement of body weight at 180 days was the basis for evaluation of daily weight gains (body weight at birth = 0). Measurement also concerned feed consumption per 1 kg of weight gain during the period from 63 to 180 days of age. At 63 and 180 days of age, testes were measured (width and height with epididymis). Skinfold thickness was also measured. The volume of both testicles was estimated using the formula given by Young et al. [1986].

After performance tested the boars remained in the individual pens. After being taught how to mount a phantom, three ejaculates were collected, one per week. A detailed evaluation of the semen was carried out according with indicators established by Bielański [1978]. The tests included measurement of the total ejaculate volume, sperm concentration (in a Bürker chamber), the total number of spermatozoa in the ejaculate, and the % of motile spermatozoa.

Statistical analysis was performed using one-way analysis of variance using Statistica® PL software.

RESULTS AND DISCUSSION

The mean of body weight in 21 day of life boars born and reared in larger litters was significantly ($P \leq 0.05$) lower (about 0.7 kg) than boars reared in smaller litters (Table 1).

This difference diminishes over the course of their growth and at 63 days of life boars were the same average body weight in both groups. In the period from 63 to 180 days of life the boars from smaller litters had a slightly lower growth rate, although the difference was not statistically significant. Although the boars reared in larger litters were on average 3 kg lighter at 180 days than those from smaller litters, there were no significant differences in fat thickness and meatiness between the examined groups of young boars (Table 2).

It is well known that the growth of piglets depends on their body weight at birth and access to sow's milk in the first weeks of life. The negative impact of the litter size on the body weight of piglets at birth has long been acknowledged [Kerr and Cameron 1995]. According to Hoya et al. [1994] piglets with lower weight at birth have a weaker vitality, later access to the first colostrum intake and a reduced ability to compete with stronger siblings. With a limited supply of nutrients in an excessively litter size, there is also strong competition for nutrition between the internal organs.

Table 1. Growth of young boars depending on the litter size

Tabela 1. Wzrost knurków w zależności od wielkości miotu, w którym się odchowywały

Specification Wyszczególnienie	Group/ litter size Grupa/ liczebność miotu			
	7–10		11–16	
	\bar{x}	$\pm s$	\bar{x}	$\pm s$
Average number of piglets in litter, in which young boars were derived: Średnia liczba prosiąt w miocie, z którego pochodziły knurki:				
– born alive – żywo urodzonych	8.8	1.1	12.5	1.7
– at 21 days of age – w 21. dniu życia	8.0	1.6	11.6	2.5
Body weight of young boars, kg: Masa ciała knurków, kg:				
– at 21 days of age – w 21. dniu życia	6.3 ^a	1.2	5.6 ^a	1.2
– at 30 days of age – w 30. dniu życia	9.3	2.1	8.8	1.6
– at 63 days of age – w 63. dniu życia	22.0	2.8	22.0	3.7
– at 180 days of age – w 180. dniu życia	112.5	9.7	109.4	11.2
Average daily gain, g/day: Przyrosty masy ciała, g/dzień:				
– from 1 to 180 days of age – od 1. do 180. dnia życia	620	60	605	50
– from 63 to 180 days of age – od 63. do 180. dnia życia	801	82	787	60
Feed intake per weight gain from 63 to 180 days, kg Zużycie paszy od 63. do 180. dnia (kg/1 kg przyrostu) 11.2	3.0	0.3	3.0	0.2

a – means marked with the same letters differ significantly at $P \leq 0.05$.

a – średnie oznaczone tymi samymi literami różnią się istotnie przy $P \leq 0,05$.

According to Fandrejewski [1998] organs such as the heart, liver and kidneys are selectively better supplied than the reproductive system, which slows down its development and may adversely affect future reproductive performance. It has also been shown that weight gain of young boars and gilts reared in smaller litters was significantly higher in comparison with their peers reared in larger litters. [Kawęcka et al. 2006, Owsiany et al. 1993]. In smaller litters differences between

sexes was more pronounced. Inferior rearing during suckling has been observed to result in young boars with lower body weight. Boars with more favorable conditions of rearing gain significantly more weight than gilts which indicates a higher sensitivity of young boars to less favorable rearing condition, which are related to the litter size [Kawęcka et al. 2006]. Similarly, Larriestra et al. [2002] revealed worse rearing in suckling period of young boars with lower body weight and increased losses compared to gilts. Results obtained in the present study on the characteristics of growth of boars to some extent confirms the results obtained in that work.

Table 2. Backfat thickness and meatiness of young boars depending on the litter size which were derived

Tabela 2. Grubość słoniny i mięsność knurków, w zależności od wielkości miotu, z którego pochodziły

Specification Wyszczególnienie	Group/ litter size Grupa/ liczebność miotu			
	7–10		11–16	
	\bar{x}	$\pm s$	\bar{x}	$\pm s$
Backfat thickness, mm Średnia grubość słoniny, mm	10.8	2.1	10.9	6.6
Height of the longissimus muscle, mm Wysokość mięśnia najdłuższego grzbietu, mm	53.5	4.9	52.1	5.5
Percentage of meat in carcass Procent mięsa w tuszy	58.2	2.8	57.8	2.4

Taking into account the possibilities of improving pig reproductive performance through inclusion of maternal effects in selection, the standardization of litters of highly fertile sows has been employed in many experiments [Rutledge 1980, Steen 1984]. It was confirmed that gilts in smaller litters (less than 12 piglets) can produce a greater number of ovulated oocytes, more embryos at the 28th day of pregnancy and an increased number of born piglets per litter. Research on males has not confirmed the beneficial effects of a smaller litter size on the size of the testicles or on semen characteristics [Eden et al. 1978, Klein 2005]. Klein [2005] concluded that there is no need for rearing boars in smaller litters, because there are no significant differences in semen characteristics between boars reared in small and large litters. However, studies by other authors [Pietruszka 2009, Flowers 2001, Owsiany et al. 1993] show that the boars reared in smaller litters had larger testes and a better quality of semen compared to boars reared in larger litters. This suggests that animals in smaller litters are not exposed to high competition and uptake a lot more milk, which not only may increase weight gain but also intensify the production of supporting Sertoli cells in testicular tubu-

les. Consequently, after reaching sexual maturity these boars may produce more sperm. According to Flowers [2001], the first three months of life, often ignored during rearing, are an important period that influence semen production in mature individuals.

Table 3. Testes size and traits semen of young boars depending on the litter size derived

Tabela 3. Wielkość jąder i cechy nasienia młodych knurów w zależności od wielkości miotu, z którego pochodziły

Specification Wyszczególnienie	Group/litter size Grupa/ liczebność miotu			
	7–10		11–16	
	\bar{x}	$\pm s$	\bar{x}	$\pm s$
Volume of both testes, cm ³ : Objętość jąder, cm ³ :				
– at 63 days of age – w 63. dniu życia	12.8	5.8	12.6	5.9
– at 180 days of age – w 180. dniu życia	698	135	664	91
Ejaculate volume, cm ³ Ogólna objętość ejakulatu, cm ³	193.4	82.0	183.6	61.1
Concentration of spermatozoa in cm ³ x 10 ⁶ Koncentracja plemników w cm ³ x 10 ⁶	190.3 ^a	94.5	148.5 ^a	56.0
Total number of spermatozoa x 10 ⁹ Ogólna liczba plemników w ejakulacie x 10 ⁹	31.7 ^a	10.6	23.8 ^a	12.5
Motile spermatozoa, % % plemników o ruchu prawidłowym	76.4	6.8	74.1	11.5

a – means marked with the same letters differ significantly at $P \leq 0.05$.

a – średnie oznaczone tymi samymi literami różnią się istotnie przy $P \leq 0,05$.

Our measurements of testicular volume and characteristics of boar semen (Table 3) confirm the results and conclusions obtained by other authors. Boars reared in smaller litters had slightly larger testes and their ejaculates had a significantly higher sperm concentration and total sperm volume ($P \leq 0.05$).

Recently, pig producers have been observing an increasingly frequent reproductive disorder among boars. Due to their low reproduction value (low libido, poor sperm quality, leg weakness), almost half of the breeding boars in Poland are culled of use [Knecht et al. 2004]. Falkowski and Kozera [1994] have shown that on an industrial farm as many as 77% of breeders are culled within two years of use. The use of insemination gives economic benefits, primarily due to the optimization of the use of semen from boars of high genetic value. A boar used for artificial insemination can replace about 20–60 similar boars used for copulation [Kondracki 2010]. From the point of view of insemination efficiency, the choice of a boar significantly depends on the number of motile spermatozoa in the ejaculate,

which decides the number of possible insemination doses [Kondracki 2010, Klein 2005]. Therefore, achieving success in reproduction requires careful analysis and knowledge of the many factors that may condition the results of reproductive performance. A thorough understanding of the entire process of reproduction is the basis for the optimum use of the traits of pigs.

CONCLUSION

The obtained results in the present study suggest the possibility of improving the traits of boar semen by rearing breeders in small litters. It also seems appropriate to carry out further research on the impact of the maternal environment on libido and semen traits of mature boars.

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OCENA UŻYTKOWOŚCI MŁODYCH KNURÓW MIESZAŃCÓW W ZALEŻNOŚCI OD WIELKOŚCI MIOTU

Streszczenie. Materiał badawczy stanowiło 60 knurków mieszańców linii 990 (♀) i rasy pietrain (♂), podzielonych na dwie grupy w zależności od wielkości miotu, w którym się urodziły i odchowywały, grupa: (średnio 8,8 prosiąt w miocie); grupa: (średnio 12,5 prosiąt w miocie). Średnia masa ciała w 21. dniu życia knurków, urodzonych i odchowywanych w miotach większych była istotnie ($P \leq 0,05$) mniejsza od knurków odchowywanych w miotach mniejszych. Ta różnica zmniejszała się w trakcie ich wzrostu i w 63. dniu życia knurki osiągnęły taką samą średnią masę ciała w obu grupach. W okresie od 63. do 180. dnia życia knurki pochodzące z mniej licznych miotów charakteryzowały się nieco niższym ale statystycznie nieistotnym tempem wzrostu. Knurki odchowywane w miotach większych w 180. dniu życia ważyły średnio 3 kg więcej. Nie wykazano istotnych różnic w zakresie grubości słoniny, mięsności oraz wielkości jąder pomiędzy ocenianymi grupami knurków. Od knurów odchowywanych w miotach mniejszych uzyskiwano jednak ejakulatory o istotnie wyższej ($P \leq 0,05$) koncentracji nasienia i ogólnej liczbie plemników.

Słowa kluczowe: cechy tuczne i rzeźne, knurki, nasienie, wielkość jąder, wielkość miotu

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