

**BODY WEIGHT, SELECTED BLOOD PARAMETERS
AND SEMEN QUALITY IN TWO AGE GROUPS
OF POLISH LANDRACE ARTIFICIAL INSEMINATION
BOARS**

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Key words: pigs, artificial insemination boars, Polish Landrace.

Abstract

Polish Landrace (PL) boars are most widely used for artificial insemination (AI) in Poland. The objective of this study was to determine the body weights, the values of selected hematological and biochemical blood parameters and semen quality of PL boars used in two AI Stations. The experimental materials comprised 32 boars, 16 from each Station. The boars were divided into two equal subgroups, younger boars – aged up to two years, and older boars – aged above two years.

The average age of younger boars was 414 days, and their average body weight was 237 kg. The average age of older boars was 1167 days, and their average body weight was 344 kg. Both age and age-related body weight positively influenced the total number of spermatozoa in the ejaculate and the number of insemination doses that could be obtained from a boar. The analyzed group of AI boars included five mature boars, aged 1309 to 1571 days and weighing 352 – 375 kg, that produced high-quality ejaculates.

**MASA CIAŁA, WYBRANE WSKAŹNIKI KRWI I JAKOŚĆ NASIENIA KNURÓW
INSEMINACYJNYCH RASY POLSKIEJ BIAŁEJ ZWISŁOCHEJ**

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Słowa kluczowe: świnie, knury inseminacyjne, rasa polska biała zwisłoucha.

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Abstrakt

Knury rasy polskiej białej zwisłouchej (pbz) są najczęściej wykorzystywane w inseminacji świń w Polsce. W badaniach analizowano masę ciała, wartość niektórych wskaźników hematologicznych i biochemicznych krwi oraz jakość nasienia knurów rasy pbz użytkowanych w dwóch stacjach unasienniania loch (SUL). Badaniami objęto łącznie 32 knury, po 16 szt. z każdej stacji. Knury podzielono na 2 równe pod względem liczebności podgrupy: knury młodsze, w wieku do 2 lat, i knury starsze, w wieku powyżej 2 lat.

Średni wiek knurów młodszych wynosił 414 dni i średnia masa ciała 237 kg, natomiast średni wiek knurów starszych – 1167 dni, a średnia masa ciała odpowiednio 344 kg. Wiek i związana z nim masa ciała korzystnie wpływają na liczbę plemników w ejakulacie i liczbę dawek inseminacyjnych możliwych do uzyskania.

W analizowanej grupie znajdowało się 5 dojrzałych knurów w wieku od 1309 do 1571 dni o masie ciała wynoszącej 352-375 kg, których ejakulatory bardzo dobrze oceniono pod względem analizowanych cech.

Introduction

In the process of improving pig performance traits, the growing popularity of artificial insemination is a highly desirable and inevitable phenomenon because biotechnology techniques are essential in modern pig breeding (MERKS 2000). The most popular pedigree breeds in Poland are Polish Landrace (PL) and Polish Large White (PLW). The majority of inseminations are performed with the use of semen obtained from PL and PLW boars (MUCHA and TYRA 2013). Artificial insemination (AI) boars are selected for improved growth and meatiness, whereas ejaculate traits that determine their reproductive value are analyzed only in the AI station. According to numerous authors (KAWĘCKA 2002, KOKETSU and SASAKI 2009, MILEWSKA 2007, MILEWSKA 2008, ROBINSON and BUHR 2005), the high fattening performance and slaughter value (in particular high meatiness) of boars are negatively correlated with semen quality. Semen traits are also determined by breed, and in crossbreeds – by crossbreeding variant, as well as by the boar's age and the season during which ejaculates are obtained (CIERESZKO et al. 2000, KOĆWIN-PODSIADŁA et al. 1990, MILEWSKA 2008). The breeding suitability of boars is also evaluated based on the weight and size of the testes and enzyme activity levels (GA CZARZEWICZ et al. 2000, GLOGOWSKI et al. 1997, KAPELAŃSKI 1995, RATHJE et al. 1995). In addition to age, body weight is a key determinant of growth and development in pigs. Breeding farms perform general in vivo evaluations of animals, but the body weights of AI boars are rarely monitored. Recent publications offer scant information about the body weights of purebred and crossbred pigs (SULABO et al.).

The objective of this study was to determine the body weights, selected blood parameters and semen quality of Polish Landrace artificial insemination boars from different age groups.

Materials and Methods

The experiment was performed in two Artificial Insemination Stations – AIS₁ and AIS₂. It involved 32 Polish Landrace (PL) boars, 16 from each station. The animals were divided into two subgroups: group I of 16 young boars (aged up to 2 years and weighing less than 300 kg) and group II of 16 mature boars (older than 2 years and weighing more than 300 kg). The animals' performance traits, ejaculate traits, blood morphology and biochemistry profiles were determined. The evaluated performance traits were: age, body weight, lifetime daily gains, standardized daily gains at 180 days, meat content, selection index and number of teats. The evaluation was performed during the rearing period in pig farms. Semen traits were analyzed in 3108 ejaculates based on ejaculate volume, sperm concentrations, number and percentage of live spermatozoa and number of insemination doses per ejaculate. Influence of the season of the year on semen quality was also studied. Blood for morphology and biochemistry tests was sampled from the vena cava cranialis. The following morphological blood parameters were determined: white blood cell counts (Leu), red blood cell counts (Ery), mean corpuscular volume (MCV), hematocrit values (Ht), hemoglobin concentrations (Hb) and thrombocytes (Tro). The serum biochemistry profile involved the determination of total protein, glucose and urea concentrations, as well as the activity levels of the following enzymes: alkaline phosphatase (ALP), alanine aminotransferase (ALT) and aspartate aminotransferase (ASP). Blood tests were performed with the use of the end-point assay in the Veterinary Diagnostics Laboratory in Gietrzwałd.

The results were processed by one-way ANOVA for orthogonal designs, and the significance of differences between groups was verified by Tukey's test. Statistical calculations were performed in the Statistica 10.0 application.

Results and Discussion

The performance traits of boars are presented in Table 1. On the day of the test, the age of boars was determined at 279 to 667 days in group I and 820 to 1571 days in group II. The average age was 414 and 1167 days in groups I and II, respectively, and the difference was statistically significant ($P \leq 0.01$). Significant differences in average body weight were also noted between groups ($P \leq 0.01$). In group I, the average body weight was 237 kg (in the range of 190 to 299 kg), and in group II – 344 kg (310–379 kg). As a result, significant differences between groups were also reported in lifetime daily gains that reached 598 g in group I and 304 g in group II ($P \leq 0.01$).

Table 1

Performance traits of boars

Traits	Statistics	Groups	
		I	II
Standardized daily gains [g]	$\bar{x} \pm s$	845 ± 47	830 ± 49
Meat content [%]	$\bar{x} \pm s$	61.7 ^a ± 0.7	60.9 ^a ± 1.1
Selection index [points]	$\bar{x} \pm s$	144 ± 7	138 ± 8
Number of teats	$\bar{x} \pm s$	15.2 ± 0.7	15.2 ± 1.1
Age [days]	$\bar{x} \pm s$	414 ^B ± 130	1167 ^A ± 233
	min-max	279–667	820–1571
Body weight [kg]	$\bar{x} \pm s$	237 ^B ± 36	344 ^A ± 23
	min-max	190–299	310–379
Lifetime daily gains [g]	$\bar{x} \pm s$	598 ^A ± 84	304 ^B ± 49

^{A,B} – differences significant at $P \leq 0.01$

^{a,b} – differences significant at $P \leq 0.05$

The age and body weights of AI boars before maturity have been scantily researched. In a study by KAPELAŃSKI (1995), the average weight of 24-month-old PL boars was 275 kg. In a feeding trial involving F1 crossbreeds (♀ PL x ♂ PLW) aged 4 months to 2 years, average daily gains were estimated at 411–425 g. The average body weights were determined at 208 kg for one-year-old boars and 295 kg for two-year-old animals (FALKOWSKI et al. 1997). In a US study of 214 crossbred boars from various age groups, average daily gains reached 363 g in younger animals (aged 220–620 days) and 227 g in older boars (aged 620–1000 days) (SULABO et al. 2006).

In the present experiment, boars were characterized by a high breeding value, as demonstrated by the selection index that reached 138 to 144 points (Table 1). The above trait is highly correlated with daily weight gains that ranged from 830 to 845 g. Both groups of animals were characterized by a high meat content in excess of 60%. Meatiness values were significantly higher in young boars ($P \leq 0.05$) than in older animals. In this experiment, standardized daily gains and meat content were significantly higher than those reported by BLICHARSKI et al. (2014) in a study of young PL boars, which indicates that the evaluated animals were characterized by a high breeding value. KONDRACKI et al. (2002), who analyzed AI boars characterized by high fattening performance and slaughter value, demonstrated that the highest-quality semen was obtained from boars with average values of the performance index in the range of 121 to 140 points.

The number of teats is an important consideration in pig breeding, and it is one of the key criteria in the selection for reproductive performance. In our study, the average number of teats was 15.18 (Table 1). The results reported by

GRUDNIEWSKA et al. (1999) indicate that the number of teats in the evaluated breed has remained high for many years.

In the work of MILEWSKA (2008), PL boars produced ejaculates of higher quality than PLW animals, which partially explains the leading role of the PL breed in artificial insemination. The high quality of ejaculates obtained from PL boars was validated by the results of this study. The ejaculates of group II boars were characterized by a highly significantly higher volume in comparison with group I boars (Table 2). As a result, the number of insemination doses per ejaculate was also higher in group II ($P \leq 0.01$). A total of 26.97 and 28.07 insemination doses per ejaculate were reported in young and older boars, respectively, and similar results were noted by WYSOKIŃSKA and KONDRACKI (2002), and BRUCKA-JASTRZEBSKA et al. (2008). The number of insemination doses per ejaculate significantly determines the economic efficiency of boar semen production. Ejaculates containing more insemination doses can be used to inseminate more sows, which increases the breeding efficiency of the boar.

Table 2

Ejaculate traits ($\bar{x} \pm s$)

Traits	Groups	
	I	II
Volume [ml]	288 ^B ± 82	318 ^A ± 94
Sperm concentration [ths/mm ³]	380 ^A ± 131	358 ^B ± 145
Percentage of live spermatozoa	72.5 ^A ± 4.3	71.3 ^B ± 3.4
Number of spermatozoa in ejaculate [mld]	77.4 ± 27.6	78.7 ± 31.1
Number of insemination doses	26.9 ^B ± 8.8	28.1 ^A ± 9.0

^{A,B} – differences significant at $P \leq 0.01$

According to PATTERSON et al. (2002), POPWELL and FLOWERS (2002), KOZDROWSKI and DUBIEL (2004), the individual traits of boars can also affect semen quality. The traits of ejaculates obtained from five boars with the longest insemination history are presented in Table 3. Each of those boars produced ejaculates with the most desirable characteristics for artificial insemination. The volume of ejaculates obtained from three boars reached 620–650 ml. Similarly to ejaculate volume, significant fluctuations were noted in sperm concentrations (10,000–1 million/mm³), and the highest sperm concentrations were determined in the ejaculates of F2 (911,000–985,000/mm³), G2 (781,000–799,000/mm³) and A4 (732,000/mm³) boars. The highest number of spermatozoa was reported in ejaculates from boar G2 (204–275 billion), whereas the highest number of insemination doses was obtained from the ejaculates of A4 (62 doses) and G2 (60 doses) boars. The analyzed animals included brothers, boars G2 and G3, but the ejaculates

obtained from G2 were characterized by a significantly higher number of spermatozoa and yielded more than 33 insemination doses per ejaculate on average. The above results indicate that G2 was individually predisposed to produce high-quality semen. In a Japanese study of 108 pig herds, boars were used for insemination purposes for 781 to 984 days on average, but the best performers were used until 1200 days of age (KOKETSU and SASAKI 2009). In a study by SZOSTAK and PRZYKAZA (2011), boars older than 36 months were characterized by a significantly shorter time between phantom mounting and the beginning of ejaculation than younger males. Sperm quality traits should be regularly monitored – MAZEIKA et al. (2012) reported high coefficients of correlation between pathological changes in the testes and semen quality in boars culled at 34.9 ± 10.7 months of age.

Table 3

Ejaculate traits of oldest boars

Boars	Statistics	Volume [ml]	Sperm concentration [ths/mm ³]	Number of spermatozoa in ejaculate [mld]	Number of insemination doses
A4	$\bar{x}+s$ min-max	332 ^{BC} ± 82 110–620	349.1 ^{BDE} ± 116.8 102–732	79.2 ^{BC} ± 31.4 9.4–183	28.1 ^{BCE} ± 8.9 8–62
F2	$\bar{x}+s$ min-max	288 ^{BD} ± 73 90–650	401.0 ^{BC} ± 129.2 124–985	76.5 ^{BC} ± 21.8 11.3–153.4	26.8 ^{BCF} ± 6.7 12–45
G2	$\bar{x}+s$ min-max	362 ^A ± 81 150–570	408.0 ^{BC} ± 122.0 111–799	102.4 ^A ± 37.3 12.7–275.6	33.6 ^A ± 8.3 10–60
G3	$\bar{x}+s$ min-max	359 ^A ± 92 130–650	252.1 ^{BD} ± 106.2 80–608	60.1 ^{BD} ± 23.6 19.5–145.8	22.2 ^{BD} ± 7.5 10–49
M1	$\bar{x}+s$ min-max	226 ^{BD} ± 64 100–420	449.0 ^A ± 63.0 280–590	79.59 ^{BC} ± 25.9 27.3–161.3	29.9 ^{BCE} ± 9.3 10–61

^{A,B} – differences significant at $P < 0.01$

Significant differences were also noted between the traits of ejaculates obtained in successive seasons of the study, which corroborates the findings of other authors (CIERESZKO et al. 2000, KOZDROWSKI and DUBIEL 2004, MILEWSKA and FALKOWSKI 2004). Higher-quality ejaculates were obtained in the fall and winter, and they were characterized by the highest number of insemination doses (28–30 on average) per ejaculate ($P < 0.01$) – Table 4. FLOWERS (2008) observed that boars can also be selected for heat tolerance, but according to HUANG et al. (2010), this trait is reduced with age.

Blood morphological parameters were similar in both groups (Table 5). Biochemical tests revealed highly significant differences in total protein levels, glucose concentrations and ALP activity between the groups. Group I boars were characterized by lower protein levels, higher glucose concentrations and

higher ALP activity. In both groups, total protein levels and ALT activity were somewhat above the reference ranges (WINNICKA 2011). Lower serum glucose levels in group II boars could be attributed to higher ejaculate volume.

Table 4

Ejaculate traits in consecutive seasons ($\bar{x} \pm s$)

Season	Volume [ml]	Sperm concentration [ths/mm ³]	Number of spermatozoa in ejaculate [mld]	Number of insemination doses
Spring	306 ^B ± 76	355 ± 147	72.88 ^B ± 27.03	26.4 ^B ± 7.7
Summer	312 ^B ± 81	355 ± 123	72.74 ^B ± 28.23	25.9 ^B ± 8.5
Fall	344 ^A ± 100	360 ± 128	85.76 ^A ± 39.00	28.6 ^A ± 9.5
Winter	349 ^A ± 85	367 ± 123	87.71 ^A ± 31.74	30.6 ^A ± 9.1

^{A,B} – differences significant at $P \leq 0.01$

Table 5

Hematological and biochemical blood parameters of boars ($\bar{x} \pm s$)

Specification	Reference ranges [acc. to 29]	Groups	
		I	II
Leu [m/mm ³]	10–20	18.7 ± 3.2	17.1 ± 3.1
Ery [M/mm ³]	5–8	6.7 ± 0.6	6.7 ± 0.7
MCV [FL]	50–68	63.7 ± 2.6	65.9 ± 5.3
Ht [%]	23–50	42.9 ± 3.7	43.9 ± 3.2
Hb [g/dl]	10–16	14.6 ± 1.1	14.7 ± 1.1
Tro [m/mm ³]	120–450	272.7 ± 87.6	197.7 ± 25.5
Total protein [g/dl]	5.9–7.4	7.5 ^B ± 5.5	7.9 ^A ± 4.7
Glucose [mg/dl]	45–100	85.7 ^A ± 0.4	75.2 ^B ± 0.3
Urea [mg/dl]	20–40	32.1 ± 9.5	33.6 ± 5.6
ALT [U/l]	9–43	66.2 ± 17.9	58.6 ± 2.5
ASP [U/l]	16–65	33.2 ± 7.7	45.4 ± 34.4
ALP [U/l]	92–294	111.8 ^A ± 34.5	71.8 ^B ± 45.3

^{A,B} – differences significant at $P \leq 0.01$

In the current study, the average age of younger boars was 414 days, and their average body weight was 237 kg. The average age of older boars was 1167 days, and their average body weight was 344 kg. The heaviest animal weighed 379 kg. Blood morphological parameters were within the reference ranges. Biochemistry tests revealed that serum protein concentrations and ALT activity were somewhat above the reference values. Both age and age-related body weight positively influenced the total number of spermatozoa in the ejaculate and the number of insemination doses that could be obtained from a boar. The analyzed group of AI boars included five mature boars, aged 1309 to 1571 days and weighing 352–375 kg, that produced high-quality ejaculates.

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