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# The quality of boar ejaculates collected at different times of the day

Jakość ejakulatów knurów pobieranych w różnych porach dnia

**Summary.**The purpose of the research was to determine the value of ejaculates collected from breeding boars at different times of the day. The materials used for the study were gathered during the process of breeding boars. There were 60 boars of Polish Large White, Polish Landrace, Duroc, Pietrain breeds and their crossbreeds (Duroc × Pietrain and Pietrain × Duroc) as well as a synthetic line Hypor. 9953 of boar ejaculates were examined between 2011–2013. The studies showed that the time of day when the collection takes place affects the volume of the ejaculate. More semen was obtained during collections in the morning. The time of collection during the day did not significantly affect other semen parameters; it showed only a trend toward a higher concentration of sperm in specimens collected in the afternoon. Differences in the parameters of specimens collected at different times of the day had a small effect on the number of insemination doses produced and the value of the obtained doses from a single ejaculate.

**Key words:** boars, ejaculates, collection time

## INTRODUCTION

The insemination effectiveness of breeding boars' depends on the quantity and quality of sperm produced. The previous publications [Sonderman and Luebbe 2008, Muczyńska *et al.* 2010, Szostak and Przykaza 2010, Pokrywka and Tereszkiewicz 2011, Wilczyńska *et al.* 2013, Knecht *et al.* 2014, Pokrywka *et al.* 2014, Udała *et al.* 2014] indicate that despite the genetic progress and improvement of environmental conditions,

specimens collected from boars at semen collection stations still show considerable discrepancies, both in terms of physical parameters as well as the quality. The differences can be caused by external and internal factors [Borowiecka de Martin *et al.* 2005]. Internal factors include: the value of genetic and physical aptitude of boar, its reproductive usefulness, age and libido. The external factors include: nutrition, environmental parameters, the state of hygiene of premises and the way of sperm collection. In the group of external factors we are increasingly looking for the impact of unique conditions, which have not been the subject of research before (not in the circle of research). Orlicki and Migdał [2006] found that the mountain wind has an impacton boar semen parameters. In studies [Strzeżek 2000, Borowiecka de Martin *et al.* 2005, Gasiński and Pędziwiatr 2012, Bajena *et al.* 2013, Borowicz 2013, Kondracki *et al.* 2013] more attention is also drawn to the influence of human factor; the person who is directly involved in the collection of biological materials.

In the group of external factors more attention is also drawn to the organization of work in collection stations, including elements directly related to the process of semen collection. According to Kunowska-Ślósarz and Ignaczak [2010] the optimization of the factors related to the proper organization and management of the herd might increase the efficiency of the use of breeding boars by as much as nearly 50%. Due to the relatively short life span of boar semen that is used for artificial insemination, and thus the need for rapid delivery of fresh one to insemination stations for recipient sows, semen from boars is collected twice a day. According to Gasiński and Pędziwiatr [2012] the time of day in which the semen is collected, is a factor that is to be significantly associated with sexual behaviour and characteristics of the ejaculates of boars. In the morning before feeding boars willingly climb the phantom and give ejaculates with better characteristics. It is believed that the poor quality of semen collected in the afternoon might be related to earlier sexual arousal of boars associated with the morning session of semen collection. Although the organization of insemination stations, where two times a day semen collection process is involved, belongs to the extrinsic factors, cannot be analyzed without taking into account of animal genetics.

The aim of this study was to evaluate the quality of ejaculates collected from boarsof different genotypes at diverse times of the day.

## MATERIALS AND METHODS

Materials used for the study were collected during the process of breeding boars. There were 60 boars of breeds Polish Large White (PLW), Polish Landrace (PL), Duroc, Pietrain and their crossbreeds (Duroc × Pietrain – Duroc × Pietrain and Pietrain × Duroc – Pietrain × Duroc,) and synthetic line Hypor. The 9953 of boars' ejaculates were examined between 2011–2013 in the Małopolska Biotechnology Centre – Examinations Station of Boars in Czermin. Semen was manually collected from boars and then tested in accordance with the rules operating in Insemination Stations. Ejaculates were evaluated basing on: the volume of spermatozoid fractions, the percentage of progressive spermatozoids, spermatozoid concentration, total count of progressive spermatozoids and the total number of insemination doses obtained from one ejaculation the calculations were

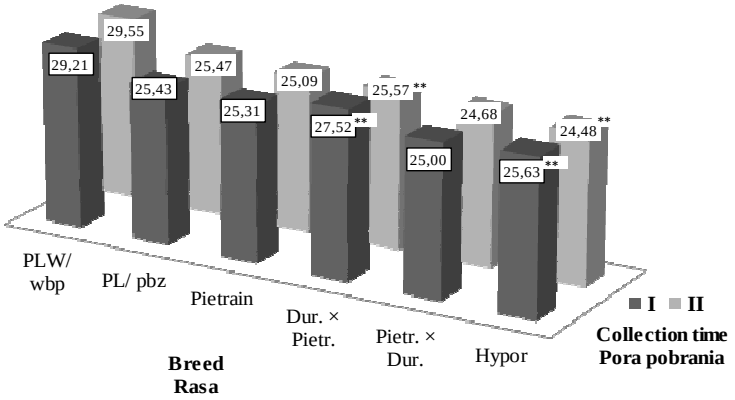
made with use of System SUL software. The value of one of the ejaculate was calculated by multiplying of the number of doses from one ejaculate by the net price per serving of semen from 2013.

The parameters of ejaculates collected from evaluated breeds of boars were analyzed statistically in the times of semen collection; first in the morning between 5 and 9 o'clock a.m. (I), and the afternoon second between 3 to 7 o'clock p.m. (II). The statistical analysis was based on arithmetical calculations and means of standard deviations. The calculations were based on the univariate analysis of variance (ANOVA) and the significance of differences between average arithmetic results was determined with the Tukey's test. The statistical conclusion was carried out at two levels of significance $p \leq 0.1$ and $p \leq 0.05$. All statistical calculations were conducted with use of the program Statistica 9.0.

## RESULTS

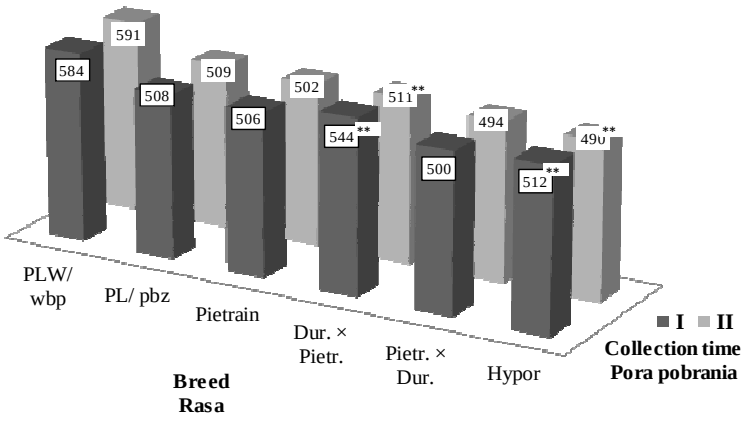
Table 1 shows the average values of quality parameters of semen collected from studied breeds of boars. The figures illustrate that the highest volume of ejaculate was collected in the morning from boars of Polish Large White breed. It was found that the ejaculate volume of boars of this breed was statistically significantly higher when compared to the volume of ejaculates obtained from boars of other breeds and hybrids outside breeds Pietrain × Duroc. Differences in semen volume between races were confirmed in specimens obtained in the afternoon. At the same time it has been shown that the volume of ejaculate obtained during the second collection was lower in all races. However these differences are statistically confirmed in pure breed boars and all analyzed hybrids. It is worth noting that the largest (39.95) difference between the volume of ejaculate between collections was found in boars Pietrain × Duroc. The study shows that the time of collection, to a lesser extent, affects the rest of its parameters. It was noted that changes in the percentage of progressive sperm in the analyzed breeds were irregular. It was stated at the races Pietrain and Duroc and hybrids Pietrain × Duroc that share of progressive sperm in the semen that was collected in the morning was lower than in the other groups. However the sperm concentration is significantly dependent on the breed and the time of collection. Higher sperm concentration was observed in ejaculates from second collection while statistically significant differences were confirmed for semen of boars Duroc and Pietrain (Tab. 1). However, a greater sperm concentration in ejaculates which were obtained in the afternoon was parallel to the total number of progressive sperm which in ejaculates from second collection was lower (except race Duroc). The decrease of total number of progressive spermatozoids in the semen obtained in the afternoon was statistically confirmed in hybrids (Duroc × Pietrain and Hypor). The time of collection slightly shaped production results measured by the number of doses and the value of the seed produced. In the case of hybrids and boars of pure breed Pietrain the decreases were observed in the number and value of doses obtained from ejaculates collected in the afternoon. The ejaculates obtained from Duroc and Pietrain boars in the same period allow for the production of a greater number of doses (Fig. 1).

Demonstrated differences in sperm production efficiency for most evaluated boars of pure breeds and hybrids associated with the analyzed factor were figurative. Only the results for the hybrids Duroc × Pietrain and Hypor indicate that for economic reasons it is preferable to obtain their semen in the morning. In case of other genotypes, time of collection did not influence the production effects (Fig. 2).




** Difference statistically highly significant (P ≤ 0.01) between the collection time
** Różnica statystycznie wysoko istotna (P ≤ 0,01) między porą pobrania

Fig. 1. The number of insemination doses obtained from one boar ejaculate collected at different times of the day
Rys. 1. Liczba dawek inseminacyjnych uzyskanych z jednego ejakulatu knurów w różnej porze dnia




** Difference statistically highly significant (P ≤ 0.01) between the collection time
** Różnica statystycznie wysoko istotna (P ≤ 0,01) między porą pobrania

Fig. 2. The value of one boar ejaculate collected at different times of the day (PLN)
Rys. 2. Wartość jednego ejakulatu knurów pobieranych w różnej porze dnia (PLN)

Table 1. The quality of boar ejaculates collected at different times of the day
Tabela 1. Jakość ejakulatów knurów pobieranych w różnej porze dnia

| Trait<br>Cecha | Collection time<br>Pora pobrania | | Breed/ Rasa | | | | | | Significant of differences<br>Istotność różnic<br>$P \leq 0.01$ |
|---|---|---|---|---|---|---|---|---|---|
| | | | PLW/ wbp<br>(1) | PL/ pbz<br>(2) | Pietrain<br>(3) | Dur. × Pietr.<br>(4) | Pietr. × Dur.<br>(5) | Hypor<br>(6) | |
| Volume ejaculates<br>Objętość ejakulatu ($cm^3$) | I | $\bar{x}$ | 328.82 | 297.89** | 264.67 | 258.31** | 321.46** | 276.25** | 1–2, 3, 4, 6;<br>2–3, 4, 6; 3–5;<br>4–5, 6; 5–6 |
| | | SD | 102.29 | 106.21 | 78.98 | 70.52 | 80.99 | 82.34 | |
| | II | $\bar{x}$ | 323.78 | 286.51** | 257.12 | 242.87** | 281.51** | 267.05** | 1–2, 3, 4, 5, 6;<br>2–3, 4, 6;<br>4–5, 6 |
| | | SD | 101.32 | 99.81 | 89.77 | 70.75 | 77.99 | 78.51 | |
| Percentage<br>of progressively motile<br>spermatozoa<br>Odsetek plemników<br>o ruchu postępowym (%) | I | $\bar{x}$ | 69.59 | 68.95** | 69.66 | 69.51 | 69.49* | 69.78 | 2–6 |
| | | SD | 1.97 | 5.26 | 3.34 | 4.81 | 2.52 | 2.99 | |
| | II | $\bar{x}$ | 69.67 | 69.61** | 69.48 | 69.20 | 69.94* | 69.31 | NS |
| | | SD | 4.16 | 3.76 | 4.86 | 5.97 | 0.76 | 4.86 | |
| Concentration<br>of spermatozoa<br>Koncentracja plemników<br>($\times 10^6/cm^3$) | I | $\bar{x}$ | 411.89 | 385.99** | 426.07 | 474.46 | 331.82** | 413.32 | 1–2, 4, 5;<br>2–3, 4, 5, 6;<br>3–4, 5; 4–5, 6; 5–6 |
| | | SD | 112.20 | 111.76 | 101.23 | 131.23 | 103.03 | 101.23 | |
| | II | $\bar{x}$ | 427.12 | 404.10** | 437.97 | 477.43 | 393.03** | 409.32 | 1–4; 2–3, 4;<br>3–4, 5, 6;<br>4–5, 6 |
| | | SD | 121.09 | 118.60 | 116.54 | 144.80 | 134.51 | 116.54 | |
| Total number<br>of progressively motile<br>spermatozoa<br>Ogólna liczba lemników<br>o ruchu postępowym ($\times 10^9$) | I | $\bar{x}$ | 89.52 | 77.05 | 76.71 | 82.69** | 74.59 | 77.27** | 1–2, 3, 4, 5, 6;<br>2–4; 3–4<br>4–5, 6 |
| | | SD | 20.57 | 19.05 | 19.50 | 20.77 | 18.35 | 19.09 | |
| | II | $\bar{x}$ | 92.23 | 76.93 | 76.00 | 77.78** | 74.42 | 73.49** | 1–2, 3, 4, 5, 6;<br>2–6 |
| | | SD | 24.37 | 22.23 | 21.19 | 23.27 | 22.69 | 20.68 | |

** difference statistically highly significant ($P \leq 0.01$), * statistically significant difference ($P \leq 0.05$) between the collection time columns are marked with asterisks
** różnica statystycznie wysoko istotna ($P \leq 0.01$), * różnica statystycznie istotna ($P \leq 0.05$) między porą pobrania – w kolumnach oznaczono gwiazdkami
1–2, 3, ... – the difference statistically highly significant ($P \leq 0.01$) between the races in the lines are provided with different numbers, NS – not significant difference between the races in rows
1–2, 3, … – różnica statystycznie wysoko istotna ($P \leq 0.01$) między rasami – w wierszach oznaczono różnymi cyframi, NS – różnica nieistotna między rasami w wierszach

## DISCUSSION

In the sow fertilization stations the twice a day rhythm of semen collection is the important element of the organization. Such system allows for the optimal use of potential of breeding animals as well as for preparation of the necessary amount of servings of fresh semen for artificial insemination and distribution. Earlier reports [Gasiński and Pędziwiatr 2012] indicate that the time of collection can form both sexual behaviour of boars and the quality of ejaculates that they produce. In the study, the influence of the time of collection on the semen quality and fertilization efficiency of breeding boars of pure breeds and hybrid was analyzed. The results confirm previous research results of [Brucka-Jastrząbska *et al.* 2008, Szostak and Sarzyńska 2008, Kunowska-Slósarz and Makowska 2011] which point out the significant differences in quality of semen produced by the boars of different races. The own studies indicated that among the pure breeds of boarsthe most positive, were ejaculates collected from boars of breed Polish Large White. These results are consistent with the results obtained by Brucka-Jastrzębska *et al.* [2008]. However, according to Szostak and Sarzyńska [2008] Polish Large White boars have different results when compared to Polish Landrace. According to other studies [Kunowska-Slósarz and Makowska 2011] Polish Large White boars in comparison to Polish Landrace produce ejaculates in lower volumes and lower sperm concentration. The assessment of the quality of semen produced by hybrids have shown that the best results were obtained for boars of Duroc × Pietrain breeds, which ejaculates had the largest volume and highest concentration of sperm. Previous study results [Brucka-Jastrzębska *et al.* 2008] show that among hybrids better results have boars of Pietrain × Duroc in comparison to Duroc × Pietrain in own study, the hybrid boars derived from crosses of the same variants had different results. Better results were obtained in boars Duroc × Pietrain race. In these hybrids there was 27.52 portions of semen in ejaculates collected in the morning, while in hybrids Pietrain × Duroc only 25.00 were obtained. Also from ejaculates collected in the afternoon in hybrids Duroc × Pietrain an average one more serving was obtained. The other studies [Muczyńska *et al.* 2010] have shown that the semen collected from hybrids Duroc × Pietrain produced an average of 25.94 portions while in semen Pietrain × Duroc only 23.39 portions. Both, the results of own studies as well as of the other authors [Smital 2009, Szostak and Przykaza 2011] indicate significant differences in semen quality associated with genotype of males and those differences are observed between pure breed boars and hybrids (Tab. 1). The differences indicate that genetic factor must be taken into account when analyzing the environmental influence on the parameters of insemination boar semen. Taking these conditions into account, the effect of time of collection of the semen on the quantitative and qualitative parameters and the value and count of sperm produced dose was defined. At the same time it should be noted that in the literature there is no information describing the effect of the time of day in which the sample semen is collected. The results indicate that the collection time influenced mainly the volume of ejaculate. It was found that ejaculates collected in the morning from all races and hybrids evaluated characterized with a higher volume, however, these differences were statistically confirmed for boars of Polish Landrace breed and all evaluated variants of hybrids (Tab. 1). The time of collection, however, had lower influence on the specimens in relation to the other analyzed parameters. At the same time it should be noted that ejaculates collected in the afternoon have a higher concentration of sperm, excluding Hypor boars. At the same time it should be empha-

sized that the differences in the analyzed semen parameters associated with time of collection had little effect on the number of doses produced and the value of a single ejaculate. The most noticeable was the difference in the efficiency depending on the time of collection in hybrid boars Duroc × Pietrain – more than 30 PLN.

## CONCLUSIONS

1. Studies have shown that the time of day when collection takes place affects the volume of ejaculate. More semen was obtained during the morning sessions.

2. The time of collection during the day did not significantly affect the other semen parameters, it showed only a trend toward a higher concentration of sperm in specimens collected in the afternoon.

3. The differences in parameters of specimens collected in different times of the day had a little effect on the number of insemination doses produced and the value of the obtained doses from a single ejaculate.

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**Streszczenie.** Celem badań była ocena jakości ejakulatów knurów różnych genotypów pobieranych w różnych porach dnia. Materiał do badań stanowiły wyniki użytkowania rozpłodowego 60 knurów rasy wielka biała polska, polska biała zwisłoucha, pietrain, duroc × pietrain, pietrain × duroc i linia syntetyczna hypor. Ocenie poddano łącznie 9953 ejakulatów knurów użytkowanych w latach 2011–2013. W badaniach wykazano, że pora dnia pobrania nasienia wpływała na objętość ejakulatu. Więcej nasienia uzyskiwano podczas pobrań wykonanych rano. Pora pobrania nasienia w ciągu dnia nie wpływała znacząco na pozostałe parametry nasienia, wykazano jedynie tendencję do wyższej koncentracji plemników w ejakulatach pobranych po południu. Wykazane w badaniach różnice w parametrach nasienia związane z czasem jego pobrania miały niewielki wpływ na liczbę produkowanych dawek inseminacyjnych oraz wartość dawek uzyskiwanych z jednego ejakulatu.

**Słowa kluczowe:** knury, ejakulaty, pora pobrania