

The quality of boar semen of Polish Large White, Polish Landrace, Duroc and Pietrain breeds in different months of the year

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The experimental material consisted of data, concerning 29 578 ejaculates, sampled from 250 purebred boars, including 46 Polish Large White, 163 Polish Landrace, 15 Duroc and 26 Pietrain boars, utilized during the years 1993-2007 in Sow Insemination Centre in Teodorów. The ejaculates were sampled manually, in the intervals of 4-5 days. Each ejaculate was subject to evaluation and the following physical traits were determined: volume of ejaculate, concentration of sperm, percentage of spermatozoa with a progressive motion, total number of spermatozoa in the ejaculate and the number of insemination doses, obtained from one ejaculate. The collected data were classified according to season of the year of sampling the semen; 12 subgroups covering the ejaculated, sampled during the particular months were differentiated. It was found that the most favourable physical characteristics were obtained in case of the ejaculates, collected during the autumn-winter period. The mentioned ejaculates were characterized by the highest volume and the greatest number of spermatozoa. They gave the greatest number of insemination doses. In case of Duroc boars, the run of seasonal changes in physical traits of ejaculate was different as compared to the boars of other examined breeds. The ejaculates of Duroc boars had the lowest volume but the highest concentration of spermatozoa.

KEY WORDS: semen / boar / breed

The effect of artificial insemination boars on the efficiency of pig utilisation in the mass population is much greater than that of sires used in the natural service management scheme. This is possible on condition that the rational selection of boars, optimal maintenance and utilisation, high quality of collected ejaculates, as well as proper ejaculate preservation and distribution are ensured [10]. For this purpose it is of importance not only to provide semen from boars of high breeding value, passing performance traits found preferable by pig producers, but also those guaranteeing high breeding rates and large litter sizes [4].

Production of semen of high biological value depends on many conditions in both the internal and external environment, including breed and age of the boar, nutrition, the mana-

gement system, microclimate in the housing facilities as well as the frequency and season of semen collection [9]. Boars of individual breeds or their crosses may differ in ejaculate volume and motility of spermatozoa [14]. These indexes are least advantageous in the summer period, in which elevated ambient temperatures in combination with the limited thermoregulation capacity of pigs reduce reproduction functions of boars, resulting in decreased sexual drive and deterioration of quantitative and qualitative parameters of their ejaculates [7]. Boars utilised in insemination schemes should be characterised by high sexual activity and produce considerable amounts of high quality semen.

The aim of this study was to determine the quality of ejaculates collected from Polish Large White (PLW), Polish Landrace (PL), Duroc and Pietrain boars in individual months of the year.

Material and methods

The material for analyses comprised data concerning 29 578 ejaculates collected from 250 pure-bred boars, including 46 PLW, 163 PL, 15 Duroc and 26 Pietrain boars, utilised in the years 1993-2007 at the Sow Insemination Station in Teodorów. Ejaculates were collected manually at 4- to 5-day intervals.

Each ejaculate was tested in terms of the following physical parameters:

- Volume of ejaculate (ml),
- Sperm concentration (thousand/mm³),
- Percentage of spermatozoa with progressive motility (%),
- Total number of progressively motile spermatozoa in the ejaculate (billion),
- The number of insemination doses per one ejaculate (pcs.).

The volume of ejaculates was determined after separation of the gel fraction based on the ejaculate mass measured using an electronic balance. Sperm concentration in the ejaculate was determined by photometry using a spectrophotometer. This method consists in the measurement of diffusion of a light beam penetrating through a sperm suspension in a sodium chloride solution isotonic to sperm. The percentage of progressively motile spermatozoa was established in a microscopic examination. At a 200-fold magnification the percentage of spermatozoa with progressive motility was counted in the total number of spermatozoa visible in the microscope field of vision. The total count of progressively motile spermatozoa in the ejaculate and the number of insemination doses which may be obtained from one ejaculate were calculated using the SYSTEM SUL computer software.

Collected data were grouped in terms of the semen collection month, thus distinguishing 12 subgroups (Table).

Table

Number of ejaculates examined in different months of the year

Breed	Month											
	I	II	III	IV	V	VI	VII	VIII	IX	X	XI	XII
WBP	537	487	541	495	520	512	505	494	456	443	481	521
PBZ	1671	1535	1637	1603	1599	1557	1551	1548	1384	1467	1501	1657
Pietrain	275	250	280	289	284	283	265	280	260	272	271	282
Duroc	143	122	141	139	142	125	146	131	111	113	126	146

WBP – Polish Large White; PBZ – Polish Landrace

Variation in the investigated semen parameters was analysed according to the following mathematical model:

$$Y_{ijk} = \mu + a_i + b_j + ab_{ij} + e_{ijk}$$

where:

Y_{ijk} – value of investigated trait,

μ – population mean,

a_i – the effect of boar's breed,

b_j – the effect of the month,

ab_{ij} – effects of interactions of control factors,

e_{ijk} – error.

The significance of intergroup differences was inferred based on Tukey's test.

Results and Discussion

In the artificial insemination practice the total sperm count in the ejaculate is crucial, since it determines the number of insemination doses which may be prepared from the ejaculate, which in turn determines the economic efficiency of sire management. Figure 1 presents data characterising monthly changes in the total sperm count in the ejaculate depending on the boar's breed.

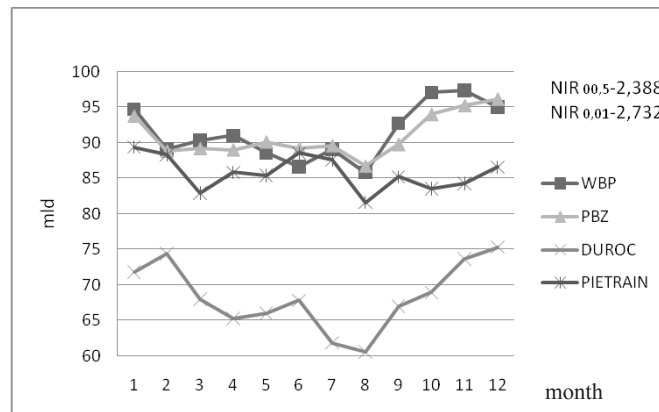


Fig. 1. Total number of spermatozoa in different months of the year

These data show a marked effect of the season of the year on the total number of spermatozoa in the ejaculate. Ejaculates collected from October to January were found to contain the largest sperm numbers. This was followed by a decrease in the total sperm counts in the ejaculate. From April to June an upward trend was observed for sperm counts, while in the successive months the total numbers of spermatozoa decreased. The lowest sperm counts were recorded in ejaculates collected in the summer months (June-August). Duroc and Pietrain were distinguished in terms of seasonal changes in the numbers of sperma-

tozoa in the ejaculate. The lowest sperm counts were recorded in the ejaculates collected from Duroc boars. Additionally, the lowest numbers of insemination doses were prepared from ejaculates from boars of this breed (Fig. 2). On average 17 insemination doses were obtained from ejaculates of Duroc boars collected from July to August, i.e. by almost 4 doses fewer than from ejaculates collected in December. Trends for changes in the number of insemination doses prepared from ejaculates of PL and PLW boars were comparable. The largest numbers of insemination doses were obtained from ejaculates collected in November, December and January. In the next months the numbers of insemination doses obtained from ejaculates of boars of these breeds decreased. Pietrain sires turned out to be more sensitive to the effect of the season of the year than boars of the other breeds, which was clearly evident in the number of insemination doses per ejaculate. Greater numbers of insemination doses were obtained from ejaculates collected in December, January and June than from those collected in the other months of the year.

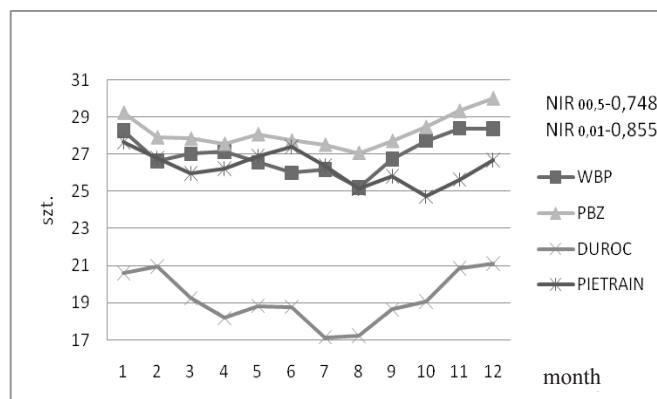


Fig. 2. Number of insemination doses in different months of the year

Seasonal changes in the volume of ejaculates produced by boars of the analysed breeds are presented in Fig. 3. It results from these data that seasonal changes in ejaculate volume in boars of individual breeds are comparable. Ejaculates of greatest volumes were collected in December and January. Next a gradual decrease was observed in ejaculate volume, which lasted until August. In turn, in the period from August to December a gradual increase was found in the volume of collected ejaculates.

Figure 4 presents changes in the concentration of spermatozoa in ejaculates of boars of the analysed breeds depending on the season of the year. Ejaculates with the highest sperm concentrations were collected in the autumn months, mainly in October. In the successive months, i.e. from October to March, a decrease was recorded in sperm concentration by over 55 thousand/mm³ in ejaculates of PLW sires. In contrast, a different trend for sperm counts was observed in ejaculates of Duroc boars. In the period from March to June and from July to October in ejaculates from boars of this breed sperm concentration increased, while in March and July sperm concentration decreased by approx. 31 thousand/mm³.

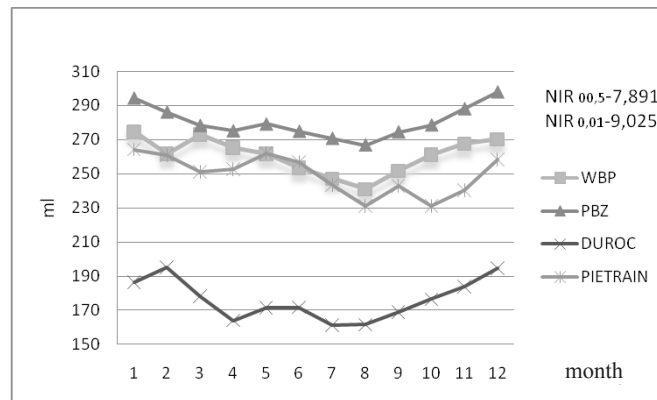


Fig. 3. Volume ejaculate from boars of different breeds with relation to the month of the year

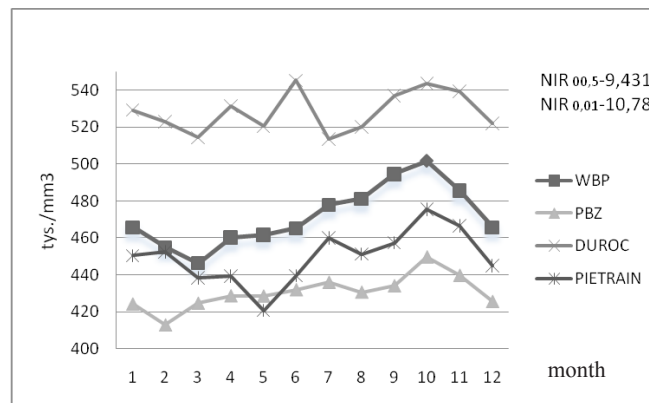


Fig. 4. Sperm concentration in ejaculates from boars of different breeds with relation to the month of the year

Figure 5 presents data concerning sperm motility depending on the month of ejaculate collection. It results from their analysis that seasonal changes in sperm motility in ejaculates of boars from the investigated breeds are slight. In April and December an increase was observed in sperm motility. In ejaculates collected from Duroc boars in the period from November to January a downward trend was recorded for the percentage of progressively motile spermatozoa.

Results presented in this study show that ejaculates of boars utilised in AI programmes vary depending on the season of the year, in which ejaculates were collected. In contrast, it is not clear what are the direct causes for such a situation; their precise clarification is

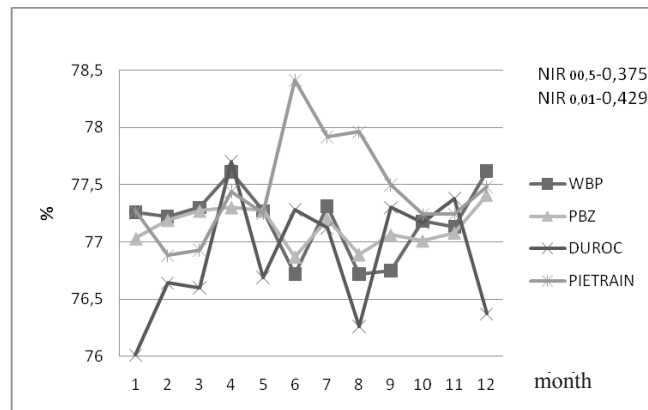


Fig. 5. Percentage of spermatozoa with progressive motility in ejaculate in different months of the year

hindered by the fact that many factors – both physical and biological – are connected with changes occurring in the seasons and they also exhibit considerable seasonal variability [2]. The effect of the seasons on qualitative and quantitative semen parameters may be connected with changes in ambient temperature [11], the length of the photoperiod [8] and lighting intensity [12]. Sancho et al. [8], when investigating the effect of the photoperiod on boar semen quality showed that the quality of collected ejaculates improves with an extension of the natural photoperiod. Improved reproduction performance in pigs coincides with a gradual decrease in the length of the natural photoperiod, i.e. in late summer and autumn, while reduced fertility is observed with an increase in the length of the natural photoperiod during spring and summer. It was shown in this study that the best ejaculates were obtained in the autumn and winter months, i.e. when the natural photoperiod was the shortest. They were ejaculates of the greatest volume, the largest number of spermatozoa and yielding the highest number of insemination doses. In October sperm concentration was observed to increase in ejaculates of boars from the analysed breeds, except for Duroc. Kondracki et al. [5] showed that the best ejaculates are obtained from boars of the domestic pig in the autumn and winter months (November, December). They were ejaculates of the greatest volume and the highest number of spermatozoa. The largest numbers of insemination doses were obtained from ejaculates collected in that period. Also Pokrywka et al. [7] reported greater volumes of ejaculates collected from PL and PLW boars in the autumn and winter seasons. In their study Wysokińska et al. [15] showed that ejaculates with lower numbers of spermatozoa are collected in the summer season than in the autumn-winter period and fewer numbers of insemination doses are then obtained. Other studies reported a deterioration of semen quality in the summer season, manifested in higher percentages of morphologically altered spermatozoa [13]. Similar trends for changes in ejaculate parameters were observed in crosses of the wild boar and the domestic pig [6].

According to Kondracki et al. [3], a significant cause for seasonal variability in boar semen parameters is connected with the atavistic tendency of domestic pigs to greater se-

xual activity in the period of natural mating time in the wild boar and lesser activity in the period adverse to reproduction in wild boars. Seasonality of reproduction observed in wild animals is a physiological adaptation to living in the wild, under natural conditions connected with changes in temperature and food availability. Domestication of some animals has resulted in a partial or complete loss of adaptation to seasonal changes. In the domestic pig the biological reproduction rhythm, typical to its wild ancestor, is manifested in the greatest reproduction activity of sows and boars in the autumn-winter period [15]. Also in crosses of the wild boar and the domestic pig in that period we observe peak reproduction activity, manifested mainly in the production of the greatest semen volume, highest total sperm count and a high percentage of motile spermatozoa [6], as well as maximum blood testosterone concentration [1].

Summing up it needs to be stated that the effect of the season on ejaculate parameters in boars of various breeds is marked and definitely confirmed. In the summer months the quality and quantity of ejaculates are inferior in comparison to the autumn-winter period. The most advantageous physical characteristics are found for ejaculates collected in the autumn-winter period. Ejaculates produced in that season have the greatest volumes and the highest sperm counts, while they also yield the highest number of insemination doses. A different course of seasonal changes in physical ejaculate parameters was found in Duroc boars, as their ejaculates were of the smallest volume, but the highest sperm concentration.

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