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Short communication

Effects influencing boar semen

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Abstract

The aim of this study was to analyze the main influences on the quality and quantity of boar semen. A total of 230,705 records of semen collections were utilised to estimate statistics of semen traits of 2712 boars belonging to the following breeds: Czech Meat Pig, Duroc, Hampshire, Landrace, Large White, Czech Large White and Pietrain, and various crosses of these breeds. The evaluation was based on semen volume (VO), concentration of spermatozoa (CO), progressive motion of spermatozoa (MO), abnormal spermatozoa (AB), total number of spermatozoa (NO_T) and corrected number of spermatozoa (NO_C). The breeds differed significantly for all examined traits. The maximal differences between the breeds were 95 ml for VO, 109×10^3 mm^{-3} for CO, 9% for MO, 1.6% for AB, 24×10^9 for NO_T and 19×10^9 for NO_C. The maximal heterosis effect reached 12% for VO, 17% for CO, 4% for MO, −14% for AB, and 8% for NO_T and NO_C. The results demonstrate that the year-season effect has a clear effect on semen quality. The lowest values of semen traits were observed in summer while the highest values were found in autumn and winter. Age of boar was found to have a strong impact on sperm output. Sperm output tended to increase up to a boars' age of 3.5 years. An acceptable level of semen volume occurred after a sexual pause of 3 days and the pool of spermatozoa was restoring after 5–7 days and fully after 10–11 days.

Keywords: Pig-male reproduction; Semen; Effect of breed; Heterosis; Effect of season; Effect of age; Effect of collection interval

1. Introduction

Monitoring and analyzing the quality and quantity of boar semen has great economic importance for pig breeders. The boar's impact on the herd reproductive performance is high, particularly if the male is mated to many females. According to Robinson and Buhr (2005) the economic return of an AI centre primarily depends on the boar's ability to produce spermatozoa during the period.

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This ability is limited by testicular capacity, libido and physical soundness (feet, legs, back). A lot of studies indicate that the reproductive fitness of boars depends on the following factors: heritability (Pavlík, 1988; Oh et al., 2003), testicular size (Clark et al., 2003), nutrition (Khan et al., 2005), age of the boar (Jankeviciute and Zilinskas, 2002), intensity of sexual exploitation (Frangez et al., 2005), photoperiod (Sancho et al., 2004) and outdoor temperature and social environment (Hemsworth, 1996; Kunavongkrit et al., 2005). The aim of the present study was to analyze the influence of some important effects on the quality and quantity of boar semen.

2. Materials and methods

Data from 22 insemination stations for boars in the Czech Republic were analyzed. The data set consisted of 230,705 records of semen collections from 2712 boars obtained during the period from 2000 to 2005. The collection and processing of semen was standardized using the methods described in the respective standard (ČSN, 1996) in all selected stations. The boars belonged to the following breeds: Czech Meat Pig (CM; 89♂), Duroc (D; 105♂), Hampshire (H; 22♂), Landrace (L; 477♂), Large White (LW; 462♂), Czech Large White (CLW; 389♂), Pietrain (P; 115♂) and to the following crossbred combinations: CM × P (23♂), D × H (88♂), D × LW (123♂), D × P (206♂), H × P (315♂) and LW × P (298♂).

Four basic semen traits were examined: semen volume in milliliter (VO, i.e. volume of sperm rich fraction) measured by graduated cylinder, concentration of spermatozoa (CO) measured by photocolorimetry ($\times 10^3$ mm^{-3}), progressive motion of spermatozoa in percent (MO, i.e. proportion of sperm cells moving straightforward) evaluated microscopically and proportion of abnormal spermatozoa in percent (AB, i.e. sperm cells deformed or otherwise changed) also evaluated microscopically. The total number of spermatozoa (NO_T, in 10^9) and the corrected number of spermatozoa (NO_C, in 10^9) were calculated as follows (Smital et al., 2004):

$$NO_T = \frac{VO \times CO}{1000}$$

$$NO_C = NO_T \times \frac{MO}{100} \times \left(1 - \frac{AB}{100}\right)$$

where VO is the semen volume (ml), CO is the concentration of spermatozoa ($\times 10^3$ mm^{-3}), MO is the progressive motion of spermatozoa (%) and AB is the proportion of abnormal spermatozoa (%).

The procedure GLM of SAS® was used (SAS Institute Inc., 1989). The normal distribution of the data was tested using the procedure UNIVARIATE of SAS®. The data were analyzed using the following linear model:

$$ST_{ijklmn} = \mu + B_i + M_j + Y_{(j)k} + I_l + Bo_{(i)m} + (\beta A + \chi A^2_{ijklmn}) + \varepsilon_{ijklmn}$$

where ST_{ijklmn} is the value of the given semen trait for the nth collection in the mth boar, lth interval of collections, kth year within the jth month and ith breed, μ is the overall mean, B_i is the effect of the ith breed or crossbred combination ($i = 1, \ldots, 13$), M_j is the effect of the jth month ($j = 1, \ldots, 12$), $Y_{(j)k}$ is the effect of the kth year within the jth month ($k = 1, \ldots, 6$), I_l is the effect of the lth interval of collections (l = 1, …, 16), $Bo_{(i)m}$ is the effect of the mth boar within the ith breed, A_{ijklmn} is the age of the boar at collection (in days), β and χ are linear and quadratic regression coefficients and ε_{ijklmn} is the residual effect.