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EFFECT OF SEASON ON BOAR SEMEN QUALITY*

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Summary: It was demonstrated that boar sperm production and characteristics significantly decrease in the warmer period of the year. As a result, the boars reproductive exploitation efficiency decrease in the warmer seasons. Therefore, the aim of the present paper was to investigate the influence of cold and warm seasons on the boars semen quality, in the our intensive pig production conditions. The obtained results clearly show that the main semen quality parameters were significantly ($p < 0.05$ or $p < 0.01$) higher in the cold, compared with the warm season (ejaculate volume=274ml, sperm concentration=229×10⁶/ml, total sperm number=60×10⁹, progressive motility=79%, and good ejaculates=96%, vs. 218ml, 208×10⁶/ml, 45×10⁹, 69% and 78%, resp.). In conclusion, keeping boars cool during summer and frequent observation of boars to determine if they are being heat-stressed, can significantly reduce the negative influence of elevated ambient temperature on sperm production and, consequently, improve boars reproductive exploitation efficiency.

Key words: season, semen, quality, boar.

INTRODUCTION

Consistently high-quality ejaculates producing are crucial for successful reproductive exploitation of AI boars in contemporary pig production industry (Grafenau et al., 2003; Stančić and Dragin, 2011). Semen characteristics of boars is influenced by many factors, such as breed, age, nutrition, environmental effects, health status and frequency of ejaculate collection (Cheon et al., 2002; Jankevičiute and Žilinskas, 2002; Stančić et al., 2003; Wilson et al., 2004).

Season is the most important environmental factor that influence the great variations in boar semen characteristics (Ciereszko et al., 2000; Cheon et al., 2002; Stančić et al., 2003) and sows fertility (Rozeboom et al., 2000; Almond and Bilkei, 2005; Stančić et al., 2011). The decreasing fertility in both male and female pig during

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summer is known as “summer or seasonal infertility syndrome” (Okere, 2003; Quesnel et al., 2005). In boars, seasonal changes were influenced by ambient temperature and photoperiod (Corcuera et al., 2002; Sancho et al., 2004; Stančić et al., 2011). High temperature cause germ-cell destruction, which result in a temporary decrease in sperm production and fertility. On the other hand, photoperiod alter androgen synthesis or secretion, by increasing the sensitivity of the boars testes in the longer photoperiod to endogenous LH (It was demonstrated that serum testosterone response to GnRH-mediated LH release was greater in boars exposed to 16 hours of light per day (Kunavongkrit et al., 2005). Therefore, better knowledge of factors influencing seasonal variation on semen quality, may help to improve the efficiency of AI boars reproductive exploitation. So, the aim of this study was to investigate the effect of season on boar semen characteristics variations, in the Serbian intensive pig production conditions.

MATERIAL AND METHODS

The study was conducted on the one industrial pig farm in AP Vojvodina (Serbia), with a capacity of about 1,000 sows. The study included 10 Swedish Landrace boars, aged 12 to 18 month. From each boar was taken 14 ejaculate in a warm and 13 ejaculates in a cold season. The period from May to October was taken as warm season, and period from November to April was taken as cold season.

Using standard laboratory methods, basic parameters of semen quality (volume, sperm concentration, total number of sperm per ejaculate and progressive motility). The number of good ejaculates (volume ≥ 120 ml; sperm concentration $\geq 200 \times 10^6$ /ml of ejaculate; progressive motility $\geq 65\%$) was also determined.

RESULTS

Ejaculates quality parameters of tested boars, in warm and cold season of the year, are shown in Table 1. Ejaculate volume (274ml), sperm concentration (229×10^6 /ml), total sperm number per ejaculate (60×10^9) and the number of good ejaculates (96%) were statistically significantly ($P < 0.01$) higher in cold compared to the warm season of the year (218ml, 208×10^6 /ml, 45×10^9 and 78%, resp.). The average progressive motility was significantly ($P < 0.05$) higher in cold (79%) compared with the warm season (69%).

Table 1. Parameters of boar semen quality within cold and warm season ($\bar{x} \pm SD$)

| Parameter | Season of the year | | Total |
|--|---|---|------------------|
| | Cold ¹ | Warm ² | |
| Boars (n) | 10 | 10 | 20 |
| Ejaculates (n) | 140 | 130 | 270 |
| Ejaculate per boar (n) | 14 | 13 | 13.5 |
| Ejaculate volume (ml) | 274 \pm 88.93 ^A (85-650) | 218 \pm 70.89 ^B (95-370) | 247 (85-650) |
| Sperm concentration ($\times 10^6$ /ml) | 229 \pm 69.81 ^A (103-483) | 208 \pm 39.27 ^B (112-320) | 219 (103-483) |
| Total sperm number per ejaculate ($\times 10^9$) | 60 \pm 23.76 ^A (15-135) | 45 \pm 17.18 ^B (17-90) | 53 (15-135) |
| Progressive motility (%) | 79 \pm 12.02 ^a (40-95) | 69 \pm 11.11 ^b (20-90) | 74 (20-95) |
| Good ejaculates ³ (%) | 96 \pm 25.03 ^A (134/140) | 78 \pm 20.88 ^B (102/130) | 87 (236/270) |

¹November to April; ²May to October. ³Volume ≥ 120 ml; Sperm concentration $\geq 200 \times 10^6$ /ml of ejaculate; Prog. motility $\geq 65\%$. Values with different superscripts, within the same row, differ (^{A,B} $P < 0.01$; ^{a,b} $P < 0.05$). In parenthesis: (min. - max.), or (good ejaculate number/total ejaculate number).

Varying the ejaculate quality parameters by months of year, are shown in Figure 1. The greatest variation was observed in the ejaculate volume, which is the most higher during the period January to April (316ml to 255ml), the lowest in the period May to October (228ml to 201ml), to be re-started growth in the period November to December (256ml). And the other parameters (sperm concentration, progressive motility and number of good ejaculates) show the same trend of variation by month, but with much lower differences between the values.

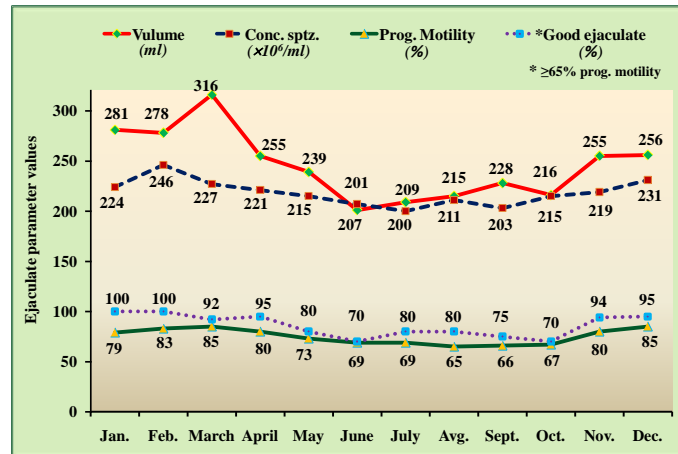


Figure 1. Ejaculate parameters variation by months of year

DISCUSSION

Significant reduction of pigs fertility is evident during the warm summer months. Summer fertility decrease is affected by the interaction of high ambient temperature and extended daily photoperiod in the warm period of the year. The most important aspect of these seasonal fertility decrease is a significant reduction of sperm production and semen characteristics in boars (Ciereszko i sar., 2000; Stančić et al., 2002; Jankevičiute and Žilinskas, 2002; Stančić et al., 2003a; Stančić et al., 2003; Chukwuemeka et al., 2005; Kunavongkrit et al., 2005; Stančić et al., 2006; Lapuste et al., 2011). Long-lasting heat stress (more than 2 weeks with ambient temperature above 30°C) decrease percentage of motile spermatozoa. Percentage of motile spermatozoa did not return to normal values until 5 weeks after the end of exposure to increased ambient temperatures (Stančić, 2006). As a result of heat treatment, normal motile sperm production decreased from control levels (1.28×10^{10} /day) to 0.15×10^{10} /day, 3 weeks after heating ceased (Stone, 1982). Percentage of morphological abnormal spermatozoa in ejaculate significantly increase in the warm season (19%) compared with cold season (25%) (Lipensky et al., 2010). The spermatozoa motility was the lowest in summer (Kozdrowski and Dubiel, 2004; Macchi i sar., 2010). The seasonal variation in sperm production and characteristics is also mediated by the changes in daily photoperiod duration (Stančić, 2006). Namely, photoperiod alter androgen synthesis or secretion, by increasing the sensitivity of the testes of boars in the longer photoperiod to endogenous LH (Kunavongkrit et al., 2005). Season had a significant effect on the intensity of spermatogenesis and qualitative sperm parameters. During the summer–autumn period, the incidence of pathological spermatozoa increased, but sperm motility and viability decreased (Šerniene et al., 2002).

The number of insemination doses per ejaculate significantly decrease in the warmer part of the year, as a result of lower semen characteristic values. Further more, the ability of semen for *in vitro* preservation is influenced by seasonal variation of native ejaculate quality (Johnson et al., 2000; Stančić et al., 2002; Stančić et al., 2003; Stančić et al., 2003; Wolf and Smital, 2009; Stančić et al., 2012). Consequently, seasonal variation in semen quality have grate influence on the efficiency of AI boar exploitation (Glossop, 2000; Singleton, 2001; Stančić et al., 2009; Stančić et al., 2011).

The previous studies on the industrial pig farm in AP Vojvodina (Serbia) (Stančić et al., 2002; Stančić et al., 2003a; Stančić et al., 2003; Stančić et al., 2006) was clear demonstrated the significant seasonal variations of ejaculate volume, total sperm number per ejaculate, sperm concentration in ejaculate and sperm progressive motility. In these studies, average ejaculate volume, sperm concentration and total number of spermatozoa in ejaculate were significant higher and percentage of sperm progressive motility were lower in the period December to May (293 to 283 ml, 319 to 284×10^6 sperm/ml, 93 to 81×10^9 sperm/ejaculate and 85% prog. motility, resp.), compared with the period June to November (213 to 232 ml, 220 to 210×10^6 sperm/ml, 47 to 49×10^9 sperm/ejaculate and 75 to 70% prog. motility, resp.)

Practical implications. Boars exposure to high environmental temperatures reduces their fertility. Boars subjected to heat stress conditions produce ejaculates that have low sperm concentrations, high percentages of abnormal sperm cells (damaged acrosomes, proximal cytoplasmic droplets, etc.) and decreased percentages of progressively motile spermatozoa. Research has indicated that the minimum exposure time and critical air temperature above which production of sperm cells is adversely affected is 29°C and 72 hours, respectively. Keeping

boars cool during summer and frequent observation of boars to determine if they are being heat-stressed, can significantly reduce the negative influence of elevated ambient temperature on sperm production. Producers can get an indication that boars are heat stressed by checking rectal temperatures and/or respiration rates. Normal values for mature boars are 38,4°C and 13 to 18, respiration rate. On this way it is possible to significantly increase the boars reproductive exploitation.

CONCLUSION

In conclusion, seasonal variation in sperm production and characteristics is mediate by changes in ambient temperature and daily photoperiod duration. Bath, while temperature direct affect the spermatogenetic process in testis, photoperiod have indirect influence on the testicular function, by changing the sensitivity of testosterone production to endogenous LH activity.

The results presented in this paper, clearly confirm the strong influence of season on the ejaculate quality parameters. Namely, the values of all parameters (volume, sperm concentration, total number of sperm in the ejaculate, progressive motility, as well as a number of good ejaculate) were significantly higher in coold, compared to the warm season of the year.

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UTICAJ SEZONE NA KVALITET SPERME NERASTA

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Izvod: Ustanovljeno je da su produkcija i osobine sperme nerasta značajno niže tokom toplijeg perioda godine. Posledično, u ovom periodu godine značajno se smanjuje efikasnost reproduktivnog iskorištavanja nerastova. Zbog toga je cilj ovog rada bio da se ustanovi uticaj hladne i tople godišnje sezone na parametre kvaliteta sperme u našim uslovima intenzivne proizvodnje svinja. Dobijeni rezultati jasno pokazuju da su osnovni parametri kvaliteta ejakulata značajno veći ($p < 0.05$ or $p < 0.01$) u hladnoj, nego u toploj godišnjoj sezoni (volumen ejakulata=274ml, koncentracija spermatozoida= 229×10^6 /ml, ukupan broj spermatozoida= 60×10^9 , progresivna pokretljivost=79% i dobrih ejakulata=96%, prema 218ml, 208×10^6 /ml, 45×10^9 , 69% i 78%). Zaključak je da rashlađivanje nerastova tokom leta i češća observacija prisustva toplotnog stresa, može značajno smanjiti negativan uticaj povišene ambijentalne temperature na produkciju sperme i, posledično, povećati efikasnost reproduktivnog iskorištavanja nerastova.

Key words: sezona, sperma, kvalitet, nerast.

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