SPERM MORPHOLOGY AND FERTILITY IN ARTIFICIAL INSEMINATION BOARS

Neringa Sutkevičienė[1], Henrikas Žilinskas[2]
[1] *Lithuanian Veterinary Academy, Tilžės str. 18; 47181 Kaunas, Lithuania; Phone: +370 37 36 33 18; Fax: +370 37 36 24 17; E-mail:* nerija@lva.lt
[2] *Lithuanian Veterinary Academy, Tilzės str. 18; 47181 Kaunas, Lithuania; Phone: +370 37 36 33 18; Fax: +370 37 36 24 17; E-mail:* hezil@lva.lt

Summary. The objective of this study was to investigate quality of semen and to determine the relationships between semen quality and fertility in the different pig breeds. Twelve boars were randomly selected at Joint stock company "Lekėčiai", Lithuania. Quality of 47 ejaculates was assessed and reproductive data from 209 sows were included into the analysis. None of initial semen quality parameters showed significant correlation with non-return rate % or litter size. Only some of semen quality traits (morphological defects) of the spermatozoa - loose abnormal heads, short broad, big head and acrosomal defects correlated significantly wiht non-return rate % and the litter size. Semen quality parameters differed significantly between the breeds. Danish Landrace boars, compared to the boars of Duroc breed, had lower incidence of pathological spermatozoa in their semen ($P < 0.001$), but higher percentage of sows conceived.

Keywords: boar, semen, non-return rate, litter size.

KUILIŲ SPERMOS MORFOLOGIJA IR VAISINGUMAS

Santrauka. Šiame darbe ištirta kuilių spermos kokybė ir nustatytas tarpusavio ryšys tarp spermos kokybės ir kiaulių vaisingumo. Tyrimas atliktas UAB „Lekėčiai", tyrimui panaudota 12 kuilių. Ištirti 47 ejakuliatai. Reprodukcijai įvertinti panaudoti 209 paršavedžių apsivaisinimo duomenys. Tyrimais nustatyta, kad nė vienas iš pagrindinių spermos kokybės parametrų nekoreliavo su vaisingumu. Tik kai kurie iš spermos morfologijos parametrų (trumpos ir plačios, laisvos patologinės ir didelės spermatozoidų galvutės bei akrosomų defektai) teigiamai koreliavo su nesurujojimu ir vados dydžiu. Spermos kokybės parametrai tarp veislių patikimai skyrėsi. Danijos landrasų veislės kuiliai pasižymėjo didesniu patologinių spermatozoidų kiekiu spermoje ($p<0,001$), bet apsivaisinimo rezultatai buvo geresni sėklinant paršavedes Diurokų veislės kuilių sperma.

Raktažodžiai: kuilys, sperma, nesurujojimas, vados dydis.

Introduction. In animal production, an ejaculate is divided into multiple doses for AI (artificial insemination); therefore, it would be economically beneficial to know the functional quality (fertility: non- return rate %, litter size) of the semen before insemination (Tardif, 1999). An accurate prediction of fertility would be of great economic and practical value, becouse low quality ejaculates or doses could be readily discarded. The aim of this study was to determine the relationship between various semen quality parameters and fertility results (non-return rate % and litter size).

In our study, the correlation between different semen quality parameters and non-return rate % within 60 days of first inseminations (NR %) and litter size primiparous (LS. PRIM) and multiparous (LS. MULT) sows were studied.

Materials and methods. Semen from 12 randomly chosen AI boars (8 Danish Landrace (DL) and 4 Duroc (DU)) at Joint stock kompany "Lekeciai" was examined over 6 months period. The average age of animals was 18.79 ± 5.59 months. All boars were used for artificial insemination (AI). Ejaculates were collected 3 times during the two week period. Volume of ejaculate (ml) was recorded and freshly ejaculated semen was extended in the BTS extender.

Subjective motility was estimated at 37° C by using a microscope Olympus BH2 with a prewarmed 37°C table (Olympus Optical Co., Ltd., Japan) using a 400 × magnification. Sperm motility was analyzed by placing a 5-µl aliquot fresh semen on a prewarmed 37°C microscope slide, covered with a coverslip and examinted by microscope. Subjective motile value was recorded.

Morphology was studied by Williams and Formol-saline (Hanckok) solution methods. To determine sperm tail defects Formol-saline solution method was used. Proximal and distal droplets, loose heads, acrosome defects, pouch formations, abnormal midpieces and the incidences of tail abnormalities were determined. Sperm head defects (pear shape, narrow at base, abnormal countour, undeveloped, loose abnormal head, narrow, big, little normal, short – broad and abaxial) were determined in dry preparations, stained according to Williams.

Sperm concentration (density) was determined in blood cell counting (Goriajev) chamber.

Fertility data were obtained from Joinet stock company „Lekeciai". Fertility of the boars was determined by the non-return rate within 60 days of first inseminations (NR%) and by litter size (at primiparous and multiparous farrowing). In total, 209 inseminations were recorded. The average number of litter size in primiparous sows was 11.3 piglets (89 litters) and 10.9 piglets in multiparous sows (120 litters).

Statistical analyses were carried out using the SPSS software (version 7.0 for windows, SPSS Inc., Chicago, IL, USA). Spearman rank correlations were used to calculate the relationships between sperm parameters and fertility. Values are presented as mean ± standard deviations (SD), and were concidered statistically significant when $P<0.05$.

Results. A summary of semen and fertility parameters is shown in Table 1. Not all semen quality parameters (defects) correlated significantly with non-return rate (NR%). Correlations beween morphological defects of spermatozoa and fertility parameters are depicted in Table 2.

None of initial semen quality parameters showed significant correlation with NR% or litter size. Animal age was correlated with ejaculate volume (r=0.588, P<0.001) and sperm motility (r=0.287; P<0.05). Many of the semen quality parameters were strongly intercorrelated.

The boar was found to have a significant effect (P<0.05) on litter size of multiparous sows (LS.MULT). Boar breed and age had no significant effect on non-return rate % and the litter size. There was also a marked difference in semen quality (P <0.001) and non-return rate (P >0.05) between the two breeds. The NR% in Danish Landrace was 79.44 ± 21.98 and 89.85 ± 12.35 in Duroc breed respectively (Fig.1). In total, sperm defects ammounted to 8.84 ± 11.5% in Danish Landrace and in Duroc breed to 25.52 ± 19.6%.

Table 1. **Summary of semen and fertility parameters**

	Mean ± SD	Range (min-max)	
AGE	18.79 ± 5.59	8	28
VOLUM	261.60 ± 134.25	50	590
DENS	0.47 ± 0.11	0.27	0.7
MOTSUBJ	71.49 ± 6.42	60	85
PROX	1.90 ± 2.33	0	9
DIST	7.41 ± 12.59	0	49.5
ACROS	0.01 ± 0.07	0	0.5
LOAH	0.09 ± 0.22	0	1
BIG	0.07 ± 0.13	0	0.4
PEAR	0.57 ± 0.68	0	2.8
SHORT	0.09 ± 0.16	0	0.6
NR%	82.45 ± 20.12	0	100
LS. PRIM	11.31 ± 1.92	8	15.4
LS. MULT	10.94 ± 1.86	5	14.5

Abbreviations : AGE = animal age (months), VOLUM = volume of ejaculate (ml), DENS = sperm density (Goriajev counting chamber, mlrd/ml), MOTSUBJ = subjective motility (%), PROX = proximal droplets (%), DIST = distal droplets (%), ACROS = acrosomal defects (%), LOAH = loose abnormal heads (%), BIG = big head (%), PEAR = pear shape (%), SHORT = short broad (%), NR% = non-return rate within 60 days of first insemination, LS.PRIM = litter size of primiparous sows, LS.MULT = litter size of multiparous sows.

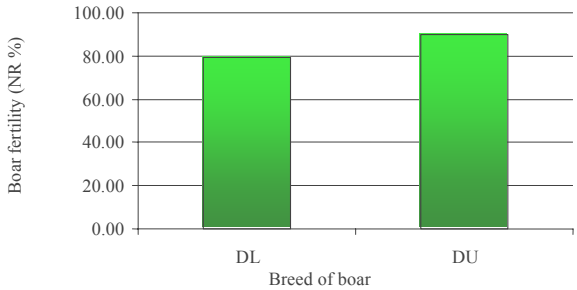

Fig. 1. **Influence of boar breed on fertility results**

Table 2. **Correlation of semen parameters and fertility parameters**

	PROX	DIST	LOAH	PEAR	SHORT	BIG	ACROS
NR%	0.204	0.117	0.125	0.219	0.424**	0.323*	0.625***
LS.PRIM	0.137	-0.041	0.405*	0.079	-0.176	0.042	0.419*
LS.MULT	0.057	0.191	0.150	0.070	-0.087	0.077	-0.173

Abbreviations : PROX = proximal droplets (%), DIST = distal droplets (%), LOAH = loose abnormal heads (%), PEAR = pear shape (%), SHORT = short broad (%), BIG = big head (%), ACROS = acrosomal defects (%), NR% = non-return rate within 60 days of first insemination, LS.PRIM = litter size of primiparous sows, LS.MULT = litter size of multiparous sows. P<0.05 -*; P<0.01-**; P<0.001-***

Discussion. Good correlation between many semen evaluation parameters has been recorded in many studies (Januskauskas, 1995; Juonala, 1998). In our study only loose abnormal heads, and acrosomal defects correlated significantly with litter size of primiparous sows and short, broad, big and abnormal spermatozoa correlated significantly with non-return rate. We found that the litter size should not be used for semen evaluation studies, because there are many more important factors that influence the litter size, such as: age, breed, health and nutritional status of gilts, the number of gilts estrus, genetics factors, etc.

Results of the present study demonstrated that the percentage of total sperm defects of Danish Duroc is higter compared to Danish Landrace. That difference has been also documented in some previous studies (Huang, 2000). We observed that in order to maintain conception at a steady niveau, ejaculates with poor motility must be compensated including higher numbers of spermatozoa to the insemination dose. Simultaneously, some of the characteristics of the spermatozoa, like acrosome defects, cannot be compensated for by increasing the number of spermatozoa, but affect the pregnancy rate and litter size in all insemination doses. Other characteristics (most classical parameters) of the spermatozoa affect their ability to reach and fertilize the oocites, and increasing the number of spermatozoa in the insemination dose can compensate for bad performance with respect to these parameters.

Conclusion. Our results stress out the importance of quality control on semen production. We suggest using of routine morphological examinations of boars intended for AI use at least before taking the boar into the regular collection scheme, and preferably, 4 times a year on a regular basis.

References

1. Huang S. Y., Kuo Y. H., Lee Y. P., Tsou H. L., Lin E. C., Ju C. C., Lee W. C. Association of heat shock protein 70 with semen quality in boars // Animal Reproduction Science- 2000, Vol. 63, p. 231–240.

2. Januskauskas A, Rodrigues - Martinez H. Assessment of sperm viability by measurement of ATP, membrane integrity and motility in frozen/thawed bull semen // Acta Vet. Scand. -1995, Vol. 36, p. 571-574.

3. Juonala T, Lintukangas S., Nurttila T., Andersson M. Relationship between semen quality and fertility in 106 AI-boars // Reprod. Dom. Anim. -1998, Vol. 33, p.155-158.

4. Tardif S., Laforest J.-P., Cornier N., Bailey J.L. The importance of porcine sperm parameters on fertility in vivo // Theriogenology -1999, Vol. 52, p.447-459.