

From the State Veterinary Serum Laboratory, Copenhagen, Denmark.

STUDIES ON BOAR SEMEN

III. SPERM CONCENTRATION AND SEMINAL PLASMA TOTAL SOLIDS FOLLOWED IN DANISH AI BOARS THROUGH A 10-YEAR-PERIOD

By

Erik Blom and Poul Thode Jensen

ERIK BLOM & P. THODE JENSEN: *Studies on boar semen. III. Sperm concentration and seminal plasma total solids followed in Danish AI boars through a 10-year-period.* Acta vet. scand. 1984, 25, 107—112. — Semen samples from 1531 young boars eligible for AI service were examined for normality. Sperm concentration (s.c.) was determined by the hemocytometer technique in 1348 of the samples. Seminal plasma total solids (t.s.) were determined on all samples in order to control whether the semen samples originated from complete ejaculates.

The hemocytometer counts showed an arithmetic mean of $370 \times 10^6/\text{ml}$ with a standard deviation of $188 \times 10^6/\text{ml}$. No correlation was found either between s.c. and age or between s.c. and season of the year.

The seminal plasma t.s. showed an arithmetic mean of 4.6 % with a standard deviation of 1.35 %. No correlation was found between t.s. and s.c. or between t.s. and the age of the boars. Neither was there any association between t.s. and the season of the year.

Values of t.s. below 1.6 % combined with aspermia were regarded as the result of incomplete ejaculations and the following retest from such cases gave ejaculates showing normal values concerning s.c. and t.s. A drop in t.s. combined with an admixture of pathological cells to the ejaculate may indicate an inflammatory condition in the vesicular glands.

boar semen; sperm concentration; seminal
plasma total solids.

Rules and regulations for AI in swine, issued by the Danish Veterinary Directorate 1970, prescribe that before a boar is taken into an AI centre, an ejaculate must be collected and examined at this laboratory in order to ensure that the semen is normal with respect to physiological quality and free from pathological admixture.

An examination programme for these boar semen samples included a series of tests which would ensure as far as possible the "normality" of the samples. Two of these routine tests will be dealt with in his paper: First the sperm concentration, which gives very valuable information concerning the function of the testes, and second, the content of total solids in seminal plasma, which will indicate whether the different accessory secretions have been combined in the ejaculate in a proper way.

MATERIALS AND METHODS

During the period 1971 through 1980, a total of 1531 "introductory" boar semen samples were received. Following the rapid progress of AI in the Danish pig industry, the number of samples has been increasing from year to year. As a routine, 2×3 ml of a gel free, but otherwise unprocessed, semen sample from each boar was sent to the laboratory under cooled conditions, and the majority of samples were received within 24 h of dispatch. The great majority of the boars belonged to the Landrace breed. Others were Yorkshires and crossbreeds.

For each boar only 1 sample (the first) has been included in the material. In very rare cases, however, when this first sample was evaluated as the result of an incomplete ejaculation (aspermia and total solids below 1.6 %) the first retest-sample containing sperm cells was chosen.

The sperm concentration was determined by means of the hemocytometer on 1348 of the samples. All of the 1531 samples were examined for seminal plasma total solids by means of the rapid refractometric method ("AO-TS meter", American Optical Co.) described by *Blom* in 1969 for bull semen.

As expected, the age distribution of the material shows a great excess of young boars. The minimum age is 6 months and only a few boars of 6½ months old are registered. The oldest boar examined was 55 months old and rather few were over 36 months. The median age was 8 months, and 90 % of the boars were between 7 and 13.5 months old.

The samples were evenly distributed over the months of the year (Table 1). Data were analysed by a computer statistical package (*Helwig & Council* 1979).

RESULTS

Sperm concentration

Hemocytometer counts performed on 1348 samples showed an arithmetic mean of 370×10^6 /ml with a standard deviation of 188×10^6 /ml. The distribution showed a positive skewness with a median value of 340×10^6 /ml, and with the 5 % and 95 % quantiles represented by 135×10^6 /ml and 750×10^6 /ml, respectively.

No association was demonstrated either between sperm concentration and age ($r=0.02$) or between sperm concentration and season of the year (Table 1).

Table 1. Sperm concentration ($\times 10^6$ /ml) and seminal plasma total solids (%) in boar semen as related to month of the year.

Month	Sperm concentration			Total solids in sperm plasma		
	No. of samples	Arithmetic mean	Standard error	No. of samples	Arithmetic mean	Standard error
Jan.	110	399	20	118	4.5	0.1
Feb.	102	370	20	109	4.1	0.1
Mar.	97	384	20	115	4.1	0.2
Apr.	114	366	17	139	4.4	0.1
May	91	335	17	104	4.2	0.1
Jun.	133	390	18	149	4.3	0.1
Jul.	122	378	18	143	4.5	0.1
Aug.	126	366	15	150	4.4	0.1
Sep.	117	353	16	139	4.5	0.1
Oct.	101	353	14	116	4.1	0.1
Nov.	146	366	16	152	4.6	0.1
Dec.	89	371	22	97	4.3	0.1

Total solids in seminal plasma

As was the case with the s.c. values, the distribution of the values for sperm plasma total solids showed a slight positive skewness with an arithmetic mean of 4.6 %, a standard deviation of 1.35 %, and a median value of 4.3 %. The 5 % and 95 % quantiles were 2.3 % and 6.7 %, respectively.

Total solids and sperm concentration were uncorrelated, and so were total solids and age of the boars ($r < 0.02$). Neither was there any association between total solids in sperm plasma and season of the year (Table 1).

In a sanitary control programme as the one dealt with here, it would be of great interest to follow possible changes in seminal

total solids in cases of inflammatory conditions in the genital organs, especially in the gll. vesiculares. In the case of the bull, experience has shown that acute vesiculitis may cause a clear decrease in seminal total solids (Blom 1979).

Table 2. Boar 1406. Born 24 Nov. 1975.

	Sp. conc.	Total solids	Cell admixture
10 June 1976	430	3.4	0
2 Mar. 1977	250	1.6	+
16 Mar. 1977	160	1.4	0

Tent. diagnosis: Vesiculitis. *P.M.*: Not done.

Table 3. Boar 6390. Born 22 Sept. 1971.

	Sp. conc.	Total solids	Cell admixture
2 June 1972	300	5.0	0
1 Feb. 1974	380	2.4	+
5 Feb. 1974	340	2.0	+

Tent. diagnosis: Vesiculitis. *P.M.*: The genital organs were received, but unfortunately the vesicular glands had been removed at slaughter.

During the period of investigation, abnormal cell admixture to the semen was demonstrated in 2 boars only (Tables 2 and 3). In both cases the semen samples were normal at the introductory examination. Coinciding with the later appearance of abnormal cell admixture to the semen, a drop in total solids occurred. Unfortunately the opportunity of doing a post mortem examination of the vesicular glands was missed, so that the tentative diagnosis of vesiculitis could not be verified.

DISCUSSION

Having regard to the two factors examined, the evaluation of the present material of boar semen samples has yielded results which may prove helpful in future laboratory work.

Already Lagerlöf & Carlquist (1961) examined a large material of young boars and pointed out that a boar will not reach a semen quality with fully normal characteristics before the age of 6 months. This has to some extent been confirmed by the present

investigation, in that no samples were submitted from boars younger than 6 months, and the age group 6—7 months did not show abnormally low sperm concentrations.

Older textbooks give rather low values for sperm concentration in boar semen, and even in a recent treatise the average value for boars is stated to be 100,000 sperms/ μ l (= 100×10^6 /ml) (Mann & Lutwak-Mann 1981) with normal variations from 25,000 to 300,000. Compared to our findings in Danish boars this is too low. Both Lagerlöf & Carlquist who examined 269 boars, and Hartwig who followed 8 boars through a 10-month-period, found higher sperm concentrations, comparable to our results.

A seasonal variation in sperm concentration has not been found in Danish boars. Under tropical conditions concentrations have been found to be significantly lower during the hot season (Mazzarri & Fuentes 1981). Similar observations have also been reported from subtropical Australia (Cameron 1980).

The refractometric determination of seminal total solids is a quick and accurate laboratory test, which by use of only 2 drops of seminal plasma will reveal whether it is a complete or an incomplete ejaculate.

No other rapid test is known which enables one to distinguish incomplete ejaculates (values below 1.6 %) from cases of aspermia caused by serious conditions like testis hypoplasia or testis degeneration, where total solids are usually normal.

The findings in the 2 reported cases of abnormal cell admixture to the semen (Tables 2 and 3) would seem to indicate the value of total solids determination in the diagnosis of vesiculitis. Like in the bull (Blom 1979), an acute inflammation of the vesicular glands in the boar will most probably lead to a marked decrease in the content of total solids.

Since vesiculitis in the boar is obviously of rare occurrence, such cases have to be handled very thoroughly.

REFERENCES

- Blom, E.: Rapid refractometric determination of the content of total solids in bull seminal plasma. *Andrologie* 1969, 1, 71—74.
- Blom, E.: Studies on seminal vesiculitis in the bull. I. Semen examination methods and post mortem findings. *Nord. Vet.-Med.* 1979, 31, 193—205.
- Cameron, R. D. A.: Factors influencing semen production and quality in young boars. *Proc. Int. Pig Vet. Soc. 6. Congr. Copenhagen* 1980, p. 34.

- Hartwig, W.*: Versuche zur Ermittlung der Sexualpotenz bei Besamungsebern. (Estimation of spermatogenic potency in AI boars). Monatsh. Vet.-Med. 1979, 34, 261—265.
- Helwig, J. T. & K. A. Council*: (ed.) SAS User's Guide. SAS Institute Inc. Raleigh, NC 1979.
- Lagerlöf, N. & H. Carlquist*: The semen of boars of the Yorkshire breed between the ages of five and nine months. Proc. 4. Int. Congr. of Reprod. The Hague 1961, 4, 818—821.
- Mann, T. & C. Lutwak-Mann*: Male Reproductive Function and Semen. Springer Verlag, Berlin & New York 1981
- Mazzarri, B. G. & A. Fuentes*: (Semen characters of boars in tropical conditions.) In Spanish. Ciencias Veterinarias, Venezuela 1978, 7, 1113—1139 (1978). Abstract in: Pig News and Information 1981, 2, 84.

SAMMENDRAG

Spermiekoncentration og tørstofindhold i spermplasma undersøgt hos danske AI orner gennem en 10-årig periode.

Sædprøver fra 1531 unge orner, der stod for at skulle anvendes til kunstig sædovertføring, indgik i undersøgelsen. Spermiekoncentrationen (s.k.) blev målt ved hjælp af hæmocytometer på 1348 af prøverne. Tørstofindholdet i spermplasma (t.s.) blev målt med refraktometer på alle prøverne bl. a. for at man kunne sondere mellem fuldstændige og ufuldstændige ejakulater.

Hæmocytometertællingen viste et aritmetisk middeltal på 370×10^6 spermier/ml med en spredning på 188×10^6 /ml. Der blev ikke påvist nogen korrelation mellem s.k. og ornernes alder eller mellem s.k. og årstid.

Tørstofindholdet viste et aritmetisk middeltal på 4,6 % med en spredning på 1,35 %. Der kunne ikke vises nogen korrelation mellem t.s. og s.c. eller mellem t.s. og ornernes alder. Der fandtes heller ingen relation mellem t.s. og årstiden.

De meget sjældne t.s. værdier under 1,6 % fandtes altid sammen med aspermi og blev betragtet som resultater af en ufuldstændig ejakulation. De i disse tilfælde rekvirerede omprøver viste da også ejakulater med normale værdier for s.k. og t.s. En nedgang i t.s. i forbindelse med tilblanding af pusceller til ejakulatet blev tolket som et tegn på betændelsestilstand i gll. vesiculares i lighed med, hvad der er påvist for tyrens vedkommende.

(Received January 25, 1984).

Reprints may be requested from: P. Thode Jensen, the State Veterinary Serum Laboratory, Bülowsvej 27, DK-1870 Copenhagen V, Denmark.