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THE USE OF SCROTAL CONTRACTIONS/RELAXATIONS VIDEO MONITORING IN EVALUATING BOAR SEMEN PRODUCTION CAPACITY

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Introduction

Visual observation and recording by video cameras are increasingly employed in farm animals' behaviour research. The aim of this feasibility study was to support the prognosis of boar semen production capacity correlating the semen characteristics with the frequency and the intensity of scrotal contractions (SC) during the ejaculation process.

Materials and Methods

Semen collection and dilution

Ten (10) collected ejaculates from 5 adult boars, were extended to a final concentration of 30 × 10^6 spermatozoa/ml, with a commercial medium-term extender.

Sperm assessment

Aliquots of diluted semen were assessed for sperm: a) motility and kinematics by a computer-assisted sperm analyzer (CASA), b) nuclear chromatin integrity by acridine orange, c) viability and morphology (eosin-nigrosin stain assay) and d) biochemical activity of cell membrane (HOS-Test).

Scrotal contraction/relaxations assessment

Ten (10) videos were recorded (two from each of the 5 boars). The video camera was placed at a constant position throughout the sperm collection process in view of the rear part of the boar's body which does not move significantly, ensuring the same angle of each boar scrotum's volume view.

The scrotum size was measured as a percentage of pixels of the whole image. The SC intensity was evaluated as a percentage change in the scrotum volume between the video frames of maximal contraction and relaxation **(Fig. 1)**. The camera was recording the scrotal contractions/relaxations and the video was processed by the Image Processing Toolbox of Matlab (Mathworks Inc., Natick, MA).

More specifically, for the processing, the following steps were followed:

Load and view the video of the process in Movie Player. Tag the frames of maximum contraction and maximum relaxation of the scrotum.

STEP 1

For each frame of interest (contraction/relaxation) export the frame to the Image Tool and, subsequently, to Matlab's Workspace.

STEP 2

Load the image from the Workspace into the Image Segmenter and use the Graph Cut algorithm: Mark the foreground with a scribble (green) and the background with another scribble (dark red). The region is segmented (as cyan pixels).

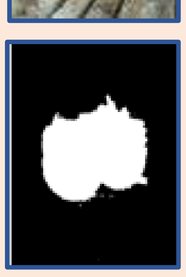
STEP 3

The region is manipulated (fill holes, clear borders, erode mask) to make it smoother. A mask (i.e., a black-and-white image) is created from the region (marked with a yellow color) and exported to Matlab's Workspace.

STEP 4

The mask (black-and-white image) is then loaded from the Workspace into the Image Region Analyzer to find the number of pixels belonging to the area of the mask (the first line in the Table with the regions properties). This number is then divided by the total number of image pixels to give a percentage, which is used a proxy of the scrotum size (volume) in the video frame.

STEP 5



Statistical analysis

The statistical analysis was performed in MATLAB 2021a (Statistics and Machine Learning Toolbox) using linear mixed-effects models. The coefficients of determination (R^2) and linear regression, as well as the 95% confidence interval (CI) for the latter, were derived.

Conclusion

More research is needed on video monitoring of the boar scrotal function during ejaculation to prove its suitability as an additional useful tool for predicting boar semen production capacity.

a) b)

Fig. 1. (a) Relaxation and (b) contraction of boar scrotum.

Results

The results revealed significant linear relation of the SC intensity with the average path velocity - VAP (R^2=0.574, p=0.043), and cytoplasmic droplets (R^2=0.509, p=0.036).

Table 1. Regression analysis results between the scrotum contraction/relaxation and sperm variables.

Dependent/Independent variables		Regression Coefficient	95% Confidence Internal		R^2	p-value
			Lower Coefficient	Upper Coefficient		
Total Motility (%)	Difference scrotum volume (%)	-0.157	-0.509	0.195	0.017	0.333
Progressive (%)		-0.671	-2.132	0.789	0.109	0.320
Non progressive (%)		-0.112	-1.272	1.049	0.643	0.829
Immotile (%)		0.157	-0.195	0.509	0.017	0.333
Rapid (%)		-0279	-2.090	1.531	0.539	0.731
Medium (%)		-0.105	-0.950	0.741	0.328	0.783
Slow (%)		0.822	-0.241	1.886	0.147	0.112
Static (%)		0.157	-0.195	0.509	0.017	0.333
VCL (μm/s)		-0.202	-1.287	0.883	0.784	0.679
VSL (μm/s)		0.154	-0.715	1.124	0.807	0.693
VAP (μm/s)		0.574	0.024	1.024	0.591	0.043
LIN (%)		0.939	0.175	1.702	0.376	0.022
STR (%)		1.111	0.315	1.906	0.448	0.012
WOB (%)		0.538	0.068	1.009	0.337	0.030
ALH (μm)		-0.029	-0.089	0.031	0.565	0.296
BCF (Hz)		0.055	-0.025	1.134	0.983	0.150
Hyperactivation (%)		-0.125	0.269	0.017	0.353	0.077
N. morph (%)		-0.004	0.007	-0.001	0.342	0.029
Abnor. morph (%)		0.004	0.001	0.007	0.342	0.029
Abnor. Head (%)		0.002	-0.001	0.004	0.221	0.135
Abnor. Mid. (%)		0.001	-0.001	0.001	0.071	0.184
Abnor. Tail (%)		0.001	-0.001	0.002	0.642	0.123
C. droplets (%)		0.001	0.001	0.002	0.509	0.036
Viability (%)		-0.004	0.009	0.001	0.201	0.078
Host plus (%)		-0.003	-0.006	0.001	0.121	0.133
Volume (ml)		-1.179	-10.115	7.756	0.912	0.769
Tot. Ejec.Time (sec)		4.404	0.801	8.007	0.373	0.022

Significant and strong correlations (R^2>0.5, p≤0.05)

VCL, curvilinear velocity (μm/s); **VSL**, straight line velocity (μm/s); **VAP**, average path velocity (μm/s); **LIN**, linearity (VSL/VCL × 100); **ALH**, amplitude of lateral head displacement (μm); **BCF**, beat/cross-frequency (Hz); **STR**, straightness (VSL/VAP × 100); **WOB** (VAP/VCL × 100); **N. morph**., normal morphology %; **Abnor. morph.,** abnormal morphology %; **Abnor. Head.,** abnormal head %; **Abnor. Tail**., abnormal tail %; **Abnor. Mid**., abnormal midpiece %; **C.droplets**., cytoplasmic droplets %; **Tot. Ejec. Time**., total ejaculation time (sec).

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