

Evaluation of light parameters in terms of breeding boars

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Abstract: One of the key factors affecting achievement of good reproductive skills within the microclimatic conditions is lighting. The environment in which animals are kept can be defined as an overall influence of external physical, chemical and biological factors, all of them being among those substantially affecting the animal welfare. The lighting parameters play a significant role. Light intensity which is evaluated in this experiment was conducted at weekly intervals at ISK Velké Meziříčí from March 2012 to March 2013. The experiment included such breeds of pigs as Duroc, Danish Duroc and Landrace. Light intensity was evaluated in relation to parameters of sperm quality, namely: sperm motility (%), semen volume (ml), sperm concentration (thousand/mm³) and the percentage of sperm with pathological changes (%). The analysis of collected data showed statistically a significant light effect on the ejaculate quality (P=0.01). With an increase of light intensity (65.7 lx), the volume and portion of pathological changes decreased (to 231.3 ml from 279.7 ml and 8.7 % from 9.6%), while the concentration has risen (426.8 thousand/mm³ from 346.2 thousand/mm³) in opposite to lower level of light intensity (52.3 lx).

Key-Words: Boar, light intensity, light meter, semen quality

Introduction

Stable climate is a key to successful healthy status of animals bred in closed space [1]. The surroundings is defined as an overall influence of external physical (temperature, relative humidity, airflow, light, noise), chemical (gasses) and biological (microorganisms, dust) factors which have impact on animals' health, satisfaction and efficiency [9].

Fluctuation of luminous portion of a day has an impact on breeding animals from middle and higher latitudes, through the influence of photoperiodism and its perception via the organ of sight [7].

Stall lighting significantly affects regulation of the reproduction cycle. If a minimal standard 40 lx for a period of 8 hours a day is not complied, particular changes in animals' behaviour as well as in structure of single tissues and organs occur as a result of physiological processes [3, 8].

The physiological importance of lighting lies in fulfilling vital processes thanks to so-called dual sight function. It involves visual function

(medium for processing the sight stimulus) and non-visual function (medium for providing important biological processes). If the availability of lighting is insufficient, the balance of physiological, biological and mental processes is broken. A long-term lack causes a decrease of organism immunity [6].

In relation to venereal activity, lighting functions through hormones produced by germ cells of gonads during a cycle of oestrus, which means venereal sexual characteristics, temper and managing the oestrus [4].

The whole process of adolescence is led by gonadotrophic hormones which, among others, shape physical features and males' behaviour. Under the influence of such hormonal changes spermiogenesis happens. The venereal adolescence is affected by factors such as heredity, nutrition and external conditions of farming. Axis hypothalamus-hypophysis-gonads or hypothalamus-adenohypophysis-testicle in males' case are extremely important for regulation of endocrine function [5]. Innervation of venereal centres is arranged in two ways – by stimuli of internal and external

backgrounds when such stimuli penetrate and reactions arisen from them are hinged on each other [2].

Material and Methods

Methodology of this experiment was constant for the whole year and measuring took place from 2.3.2012 to 1.3.2013. Intensity of lighting was measured at the same time and the same place (at the level of boar’s eyes) with Luxmeter. The intensity was evaluated in relation to parameters of the ejaculate quality, including motility of sperms (%), volume of ejaculate (ml), concentration of sperms (thousand/mm³) and rate of sperms’ abnormalities (%). Data analysis of the experiment was statistically evaluated.

Results

The results supported by statistical argumentativeness comment, first of all, the effect of stable and light intensity on the value of ejaculate, followed by the effect of light intensity on boars, sorted by breeds (duroc, Danish duroc, landrace), in different seasons of a year. The effect of light intensity at higher average light intensity (65.7 lx against 52.3 lx) caused a decreased volume of ejaculate (from 279.7 ml to 231.3 ml), increased concentration (from 346.2 thousand/mm³ to 426.8 thousand/mm³) and a percentage decrease in pathological changes (from 9.6% to 8.7%).

Concerning the stable aspect, it was detected that it was necessary to unify lighting conditions of different hall units where the decrease was about 20 lx in comparison to the others (47 lx against 68 lx). While the volume of sperm in this particular unit was high (292 ml against 219 ml), there was a fall of sperm concentration (from 432 thousand/mm³ to 354 thousand/mm³), not mentioning nearly double deterioration of percentage abnormality of sperms (up to 12% against 7%).

Furthermore, the influence of breed was compared to the influence of light intensity. Landrace breed in particular was affected by low light intensity (52 lx against 66 lx). Although Landrace breed provided the highest volume (445 ml against 322 ml), it showed the worst percentage value of sperm abnormalities (12.3% against 5.6%) and reduced concentration of sperm (from 289 thousand/mm³ to 220 thousand/mm³). Duroc displayed the highest sperm concentration during high light intensity (from 390 to 473 thousand/mm³) and abnormalities were reduced by 0.3%. Danish

duroc proved also an increase in concentration during higher light intensity (from 377 to 439 thousand/mm³) and abnormalities were lower as well (from 12.1% to 10.6%). It can be stated that in duroc case the concentration during higher light intensity increased nearly by 90 thousand/mm³ and in Danish duroc case it went up by more than 60 thousand/mm³. Having taken the evaluated breeds into account, it can be concluded that the influence of lower light intensity has a negative impact on quality of ejaculate, which varies at different breeds.

Fig. 1 The volume of semen at boars and intensity of lighting in different stables

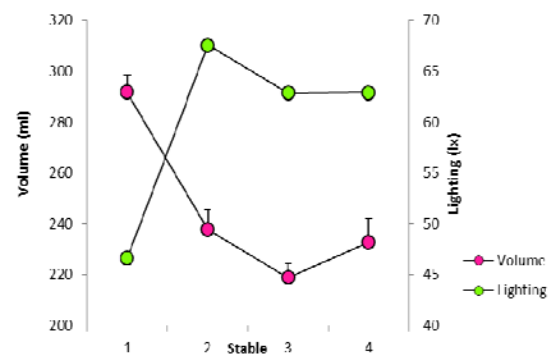


Fig. 2 Sperm concentration at boars and intensity of lighting in different stables

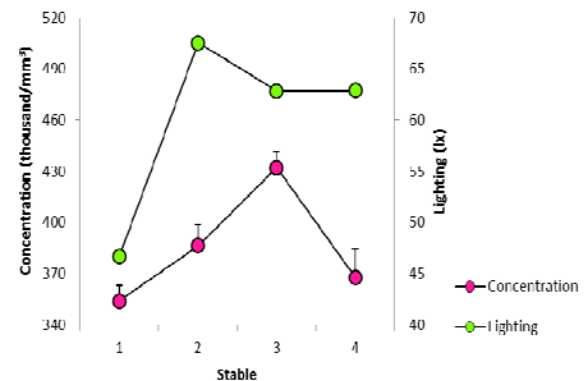
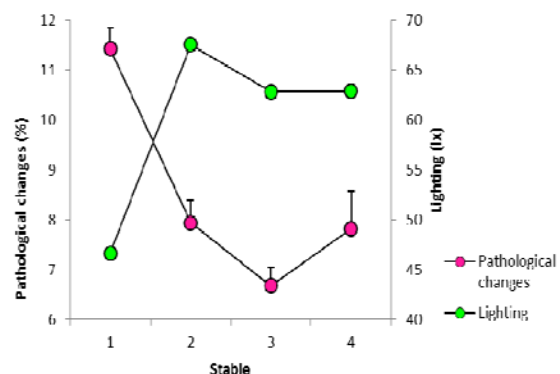


Fig. 3 Pathological changes of sperm at boars and intensity of lighting in different stables



Discussion

Light modes in pigsties are a subject of continuous discussions. The element of seasonality can be noticed in both male and female wild swine species. Domestic pig appears to stem from the wild swine and many experiments have proved that sows tend to acyclicity during summer months. Equally, boars' potency goes down during summer season as well as quality of their semen worsens, which has been affirmed by results of an experiment carried out at ISK Velké Meziříčí.

Fig. 4 Volume of ejaculate at boars of *Landrace* breed and the effect of light intensity in different seasons of a year

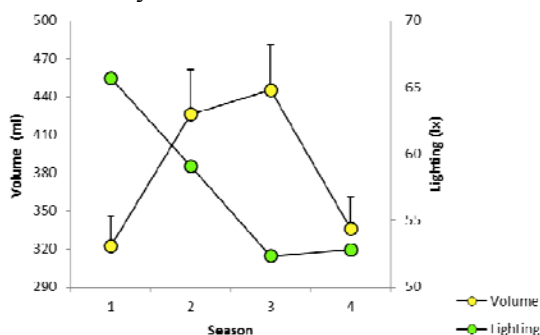


Fig. 5 Concentration of sperm at boars of *Landrace* breed and influence of light intensity in different seasons of a year

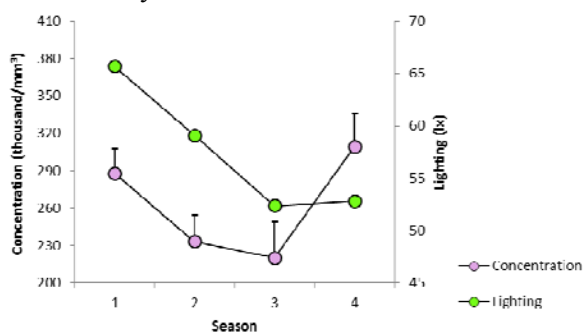
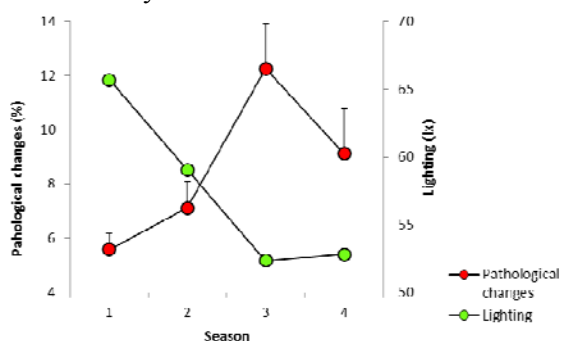


Fig. 6 Pathological changes of sperm at boars of *Landrace* breed and intensity of lighting in different seasons of a year



Some experiments dealt with an assessment of illumination quality as regards sows and boars, focusing on elimination of sexual function deviations controlled by light modes. When it comes to sows, phase light modes evidently appear much more successful than the constant ones. This particular thesis can be applied to boars, too, with the exception that light programs are based on development of young boars' sexual adolescence, which has faster progress during spring and summer, but in contrast to winter season, less sunlight and shorter daytime period, it gets much slower. One of the experiments has also proved that blackout of a pigsty during summer months can lead to a higher sperm production (when compared to a naturally long light day), which is in conformity with the results of my research. It states that lower illumination intensity causes increased volume. Another experiment related to improved indicators of sows' fertility showed that a 3% decrease in elimination of sterile pieces was remarked at 300 lx illumination intensity and litter quantity increased by half a piglet.

More recent studies from Australia, Germany, UK, Hungary and Czech Republic also prove that pigs' sexual function lowering in the course of summer is caused not only by high temperatures, but also by other reasons, such as photoperiod, constant daytime shortening in autumn being the main starter of sexual function activation [7].

Conclusion

Analysis of the experiment proved direct impact of illumination intensity upon quality of boar semen. The average intensity recorded at the beginning of spring and during summer was higher (63 lx) than in the course of autumn and winter season when there is less sunlight and therefore the average intensity reached lower level (53 lx). Increased illumination intensity caused smaller amount in terms of volume. On the contrary, decreased volume made sperm concentration goes up and consequently decreased percentage of pathological modifications was considered a positive feature.

The highest illumination during spring months (66 lx):

- the lowest volume – Danish duroc (170 ml),
- the highest concentration – duroc (473 thousand /mm³),
- the lowest pathological modifications – landrace breed (5.6%).

The lowest illumination intensity during autumn months (52 lx):

- the most obvious impact upon landrace breed – the largest volume (445ml),
- the lowest sperm concentration (220 thousand/mm³),
- the highest (i.e. the worst) percentage of sperm abnormalities (12.3%).

Illumination intensity significantly affects the resulting semen quality which is straightforwardly related to processes and financial aspects of the entire company. Its insufficient level may have fatal consequences as far as insemination dosage quality is concerned.

In conclusion, it can be stated that high illumination intensity causes decrease in the amount of semen volume; however, it positively affects quality of concentration indicators and percentage of pathological modifications of sperms. This thesis confirms a theory about importance of illumination in general to boar insemination stations as well as its impact upon semen quality parameters. Light modes of boars may still be a subject to further questions and research.

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