Reproductive Problems in Commercial Pig Farms

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Bulletin UASVM Veterinary Medicine 73(1) / 2016,

Print ISSN 1843-5270; Electronic ISSN 1843-5378

DOI:10.15835/buasvmcn-vm: 11619

Abstract

The main goal of commercial pig production is to produce as much fattened pigs per sow per year as possible. Artificial insemination serves to enable maximum utilization of animal genetic potential. That is possible to achieve by applying adequate and controlled conditions of housing, care, feeding and health monitoring along with implementation of modern management. Expected production results on healthy farms implies farrowing rate of over 90% with 18 born piglets, 16 weaned piglets per litter, 37 piglets per sow per year and 31 fattened pigs per sow per year. Such results are achieved on modern farms in countries which invest a lot in pig production, but in Serbia are rarities. By analyzing of all factors which may cause reproductive problems on farms, we concluded that reproduction results can be improved by modern solutions from the domain of boar exploitation and technology of semen production. Motility and viability of spermatozoa to a large extent determine the quality parameters of sperm. Spermatozoa should be moved from the place of ejaculation through the reproductive tract of sows to the site of fertilization and to be capable to fertilize the oocytes at the right moment. Percentage of dead and deformed spermatozoa is an important factor which influences fertilization ability of boars. Besides routine macroscopic assessment and microscopic examination of semen, it is recommended to do smears and determine pathological forms of spermatozoa. It allows that bad quality semen can be excluded timely. Implementation of proper hygienic measures with the use of disposable equipment is required. By applying of all this specified measures during 12 months, we achieved improving of sows' conception rate for 7% and the number of weaned piglets per litter increased for 0.6.

Keywords: *artificial insemination, boar, hygiene, semen control.*

INTRODUCTION

The concept of modern pig farming on commercial farms depends on many factors such as technology of animal breeding, care, nutrition, farm management and organization, staff as well as the systematic implementation of health care. Good health status of herd is a prerequisite for good reproduction and successful and profitable production in pig farming. Nowadays, there are a lot of diseases of bacterial, viral or parasitic etiology which may endanger health status and reproduction of animals and therefore complete pig production in intensive rearing. By applying of

prophylactic and therapeutic measures along with increased supervision of professional services, it is possible to keep under control all these diseases (Bojkovski *et al.*, 2014).

The largest number of embryonic losses occurred during the first few days after fertilization (Bray *et al.*, 2004) and during the process of implantation (Sargus-Patino, 2013). Infectious and non-infectious factors may cause miscarriages, premature farrowing and a large number of stillborn piglets, which greatly affected reproductive parameters in breeding sows.

Although infectious causes occupy more attention, non-infectious treats are the main cause of miscarriage and stillbirths, with more than 70% of all cases (Stojanac *et al.*, 2011). Specific causative agents, like bacteria, viruses and/or protozoa, reach fetuses through blood or from the outside, via vagina. Non-specific factors, for example some bacteria, may cause multisystem infections and by its effect on uterus (endometritis) or via direct cytolytic effect on fetuses, results in miscarriage and/or stillbirths. Non-infective factors which may lead to these unwanted consequences are: chromosomal aberrations in spermatozoa, external factors (high ambient temperature, feeding disorders, etc.) and maternal factors (hormonal imbalance, parity, etc.). As it can be seen, these factors are numerous and often it is very difficult to make accurate diagnose. By ultrasound examination between 23rd and 30th day after artificial insemination (AI), it is possible to recognize non-gravid individuals and repeat insemination in that cases or exclude them from the herd.

Breeding boars are the first factor for successful reproduction on the farm. The health status of the boars, their proper introduction into exploitation, proper exploitation dynamics, properly techniques for semen collection, professional examination and processing of semen determine quality of doses made for AI. High quality semen doses require proper storage conditions and usage. If all that is accomplished, it can be expected high conception rate in inseminated animals.

After insemination, inserted spermatozoa strive to reach *ampulla tubae uterinae*, after passing through the uterus and uterine horns. On uterotubal junction, mature spermatozoa meet oocytes; penetrate through their *zona pellucida* which results in fertilization. Insemination dose volume and number of spermatozoa rapidly decrease on this way inside the female genital tract and only a small fraction of spermatozoa finally reached *ampulla tubae uterinae* (Overstreet *et.al.* 1999). Polymorphonuclear cells engulf a large part of the population of spermatozoa, up to 60% within 30 minutes after insemination (Woelders and Matthijs, 2001). Furthermore, the limitation of the number of sperm cells which were supposed to reach ampulla of fallopian tubes happened due to adhesion to endometrium epithelial cells and because of migration in uterine glands (Hadjisavas

et al. 1994). This means that more than 90% of spermatozoa from semen dose were eliminated from the female reproductive tract during a period of 2-3 hours after insemination (Roca *et al.* 2006).

As already mentioned, the conception rate of artificial insemination largely depends on the quality of semen doses. Examination of semen quality using available methods can greatly affect the reproductive performance of the farm. Nowadays, there are many modern tests for semen examination: acrosomal reaction test, hypo osmotic swelling test, a test of penetration into the hamster egg (without the zona pellucida), a test of penetration through cervical mucus and computer-assisted sperm analysis (CASA). In this way, it significantly increases the possibility of an objective assessment of the quality and fertilization potential of boar sperm, which provides great opportunities for high-quality reproduction management on farms. The application of these methods on the farm itself is impossible, and therefore it is required a reliable and simple technique that is easy to learn and implement in farm conditions, that is inexpensive and does not require too much time. Technique that meets all of these requirements is staining of sperm smears. Therefore, it should be recommended as a routine method for basic analysis of sperm, when assessing the vitality of spermatozoa. Different dyes could be used for staining, such as eosin-nigrosine, aniline-eosin or eosin-fast green. The stained smears, examined under light microscope with immersion oil, can distinguish live from dead spermatozoa. Alive spermatozoa have intact plasma membrane that is impermeable for dye, as opposed to dead sperm, in which dye penetrates by passive diffusion into the cell. On this way, very simple and fast, it is possible to determine the percentage of vital, properly formed sperm, dead and partially damaged sperm. Based on the findings, it shall be declared if its sperm is usable for AI or not.

The aim of our study was that with improved control of semen of boars influenced the increase conception inseminated sows and gilts. The main tasks were to perform a full review cytomorphologically sperm taken temporarily excluded from breeding boars who gave a bad seeds, their treatment and the permanent shutdown in case you do not achieve satisfactory results after one month of treatment.

MATERIAL AND METHODS

The research has been carried out on the pig farm with intensive production which capacity is 800 sows and which has its own reproduction center for the production of semen dosages used for AI. For semen collection, assessment and processing as well as for dilution and filling of doses and finally, artificial insemination of gilts and sows, disposable equipment and accessories was used which altogether raised hygiene level. Farm was positive to PRRS infection.

After semen collection, each ejaculate was examined. After macroscopic examination of semen (color, smell, pH, ejaculate volume) and microscopic examination (motility, viability, agglutination, determination of the semen concentration), smears of diluted semen was used in order to determine the percentage of live and damaged/dead spermatozoa.

For smear staining it dye solution was used which contained 0.67% yellowish eosin (eosin Y yellow, CI 45380, VWR No 115935) and 10% nigrosine (CI 50420, VWR No 115924; VWR International TM) which was dissolved in 0.9% sodium-chloride solution made from distilled water. Dye solution was made according to Mortimer (1985, 1994), Jovičín *et al.* (2012). Procedure for making of solution started with dissolving of 0.9 g of table salt and 0.67 g of eosin in 100 mL distilled water, along with gentle heating. Then 10 g of nigrosine was slowly added. Before it was used, the solution was warmed to room temperature.

Staining was performed as following: One drop (50 µL) of undiluted and well homogenized semen should have been taken with automatic pipette and mixed with equal drop (50 µL) of

eosin-nigrosine dye solution. Next step was incubation of this suspension for 30 seconds at room temperature (20 °C). Then, small drop (12 µL) of suspension was taken and transferred by pipette to microscopic slides. Finally, smear was made by pushing the drop by another slide, in one shot. From each sample 2 smears should have been made. After smears were air-dried, they were accessed with the assistance of a microscope with a clear field (without phase contrast) and high-resolution of 100x. The specimen was examined under immersion and magnification of 1000x. After microscopic examination of stained smears, we recorded all malformations of spermatozoa, such as acrosome damage, protoplasmic droplets (proximal and distal) and tail abnormalities. Based on the percentage of the above mentioned anomalies, class of semen was determined as it is shown in Tab. 1. One boar could be ranked in 1st, 2nd class or be out of class. Boar sperm which was classified as „out of class” was not used for making of the insemination doses intended for artificial insemination before boar was recovered and his sperm was increased in quality. If even after 30 days of therapy boar did not have improved results, that boar was excluded from breeding and send to slaughterhouse.

Insemination of breeding sows and gilts was done with the previous manual stimulation in the presence of sexually mature boars applying method head-to-head, for 2-4 minutes. Biostatistical analysis was performed by the statistical SPSS package, version 18.0 for Windows (SPSS Inc., Chicago, IL, USA). Chi-square (x²) test was used for the comparison of particular groups of animals. Differences were considered significant when $P < 0.05$.

Tab. 1. Technological norms on which basis was done semen classification

Tested characteristics	Permissible value in the semen and technological norms			
	Finding of certain subpopulations	1st class	2nd class	Out of class
Alive spermatozoa	Alive in total/unstained	≥ 70%	50-60%	< 60%
Normal forms of alive spermatozoa	Alive with intact acrosome	≥ 60%	45-50%	< 50%
	Alive with damaged acrosome	≤ 5%	5-10%	> 10%
	Total with damaged acrosome	≤ 10%	5-15%	> 15%
Pathological forms of spermatozoa (total, alive and dead)	Protoplasmic drop	≤ 12%	25%	> 25%
	Primary abnormalities	≤ 5%	5-15%	> 15%
	Secondary abnormalities	≤ 5%	5-25%	> 25%
	Pathological forms total	≤ 15%	15-30%	> 30%

RESULTS AND DISCUSSION

As a source of data for this study we used official records of the farm, as well as cytomorphologically examination of sperm intended for AI.

During 2013 and 2014 the farm achieved following results (Table 2.):

It is important to mention that farm had some losses of gravid sows and gilts. During 2013 year, 45 of them was sold or died, and during 2014 that number was 51. That has influenced final calculation of conception, because in 2013 it was 2156 inseminated sows and gilts and conception and rate was 73.5%, contrary to 2014 when farm had 2222 inseminated animals and conception was 80.85%. This means that improvement in conception rate was 7.35%.

During 2014 better results were achieved in terms of the number of piglets obtained. Thanks

to the improvement of hygienic and technological procedures in the process of A.I., gilts and sows farrowed more piglets per litter (10.63 and 11:58). As one of the biggest benefits that were achieved by application of those measures an increase in the total number of piglets per litter annually was achieved. In 2013 it would have been 10:57 and in 2014. This number was as high as 11.10. For farm production, an improvement of 0.6 piglets per litter, in the course of just one year, is considered a very good result.

During 12 months of 2014, preparing of smears was done once per month in each boar which was classified in 1st class. In boars who were rated as 2nd class or "out of class", staining was done weekly. In this period, 5 boars were excluded from breeding because they showed bad results of semen longer than one month.

Tab. 2. Farm results during 2 years

Pig farm "MZ"	2013	2014	Pig farm "MZ"	2013	2014
Inseminated gilts	1047	1040	Live born piglets (in total)	21171	22532
Inseminated sows	1886	1708	Piglets farrowed by gilts	7448	8682
Farrowed gilts	751	816	Live born piglets farrowed by gilts	7124	8180
Conception rate in gilts	71.7	78.5	Piglets farrowed by sows	14876	15435
Farrowed sows	1360	1332	Live born piglets farrowed by sows	14047	14352
Conception rate in sows	72.1	78	Piglets per litter (in total)	10.57	11.10
Inseminated animals in total	2933	2748	Live born piglets per litter	10.02	10.38
Farrowed animals in total	2111	2171	Piglets per litter (gilts)	9.91	10.63
Conception rate in total	71.97	79	Live piglets per litter (gilts)	9.48	10.02
Piglets (in total)	22324	24117	Piglets per litter (sows)	10.94	11.58
Live born piglets (in total)	21171	22532	Live born piglets per litter (sows)	10.33	10.77

Farm had 20 boars (9 Yorkshire, 5 Landrace, 4 Pietrain, 2 Duroc) within reproductive center. Sperm collection was done twice a week. Table 3 shows classification of all boars from center at the end of 2014 year.

In eosin-nigrosine stained smears, under microscope live spermatozoa can be seen as white, non-colored cells. Dead and damaged spermatozoa, because of permeable cell membrane and passive diffusion of dye into cell, can be seen as red or dark pink. Spermatozoa with a little pink or red limited to the region of the neck (with "porous, leaky necks"), were considered as alive (Fig. 1).

Statistical analysis of the results implied calculation of descriptive statistics indicators. On this occasion were calculated relative indicators of the structure. Testing of significant differences was performed using the chi-square test (Chi-Square test). Statistical significance was determined at

the level of 0.05 and 0.01. All results are presented in tables and graphs.

Pig farm "MZ"	2013	2014
Inseminated gilts	1047	1040
Farrowed gilts	751	816
Conception rate in gilts	71.7	78.5

The statistical analysis of the percentage of pollinated gilts in 2013 and 2014, although in 2014 was a higher percentage of 6.80%, has not been established statistically significant difference $p > 0.05$ ($p = 0.1797$).

Pig farm "MZ"	2013	2014
Inseminated sows	1886	1708
Farrowed sows	1360	1332
Conception rate in sows	72.1	78

Tab.3. Boars from AI center classified according to sperm quality

Boar ID	Class	Boar ID	Class
Yorkshire 1182/31	1	Landrace 9310/46	1
Yorkshire 1182/28	2	Landrace 9445/53	Out of class
Yorkshire 845835/1	2	Landrace 1211/23	2
Yorkshire 9197/31	Out of class	Landrace 1404/10	Out of class
Yorkshire 9326/72	2	Pietrain 9280/7	2
Yorkshire 9451/22	Out of class	Pietrain 8750/30	1
Yorkshire 9607/19	1	Pietrain 9267/19	Out of class
Yorkshire 9776/34	1	Pietrain 845381/22	1
Yorkshire 1127/24	1	Duroc 11729/31	1
Landrace 9233/29	2	Duroc 9585/21	2

Fig 1. Eosin-nigrosine stained smear: 1) Alive, normal spermatozoa 2) Dead, normal spermatozoa 3) Alive, normal spermatozoa with protoplasmic droplet 4) Alive spermatozoa with and tail deformation 5) Dead spermatozoa with tail deformation

The statistical analysis of the percentage of inseminated sows in 2013 and 2014, although in 2014 was a higher percentage of 5.90%, has not been established statistically significant difference $p > 0.05$ ($p = 0.1246$).

Pig farm "MZ"	2013	2014
Inseminated gilts	1047	1040
Inseminated animals in total	2933	2748
Farrowed animals in total	2111	2171
Conception rate in total	71.97	79

The statistical analysis of the percentage of inseminated sows in 2013 and 2014, although in 2014 was a higher percentage of 5.90%, has not been established statistically significant difference $p > 0.05$ ($p = 0.1246$).

CONCLUSION

The systematic application of certain technological processing AI on farm, farrowing rate and the number of live born piglets has been improved. It raised farm productivity on higher level. Obtained results showed that implementation of semen staining technique along with better hygienic measures and modern AI technology can result in much higher productivity rate on pig farms, even if they are burdened with PRRS infection, like in our case.

Acknowledgments. This study was financially supported by Ministry of Education, Science and Technological Development, Serbia, grant TR 37015.

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