

FOLICULAR ACTIVITY OF OVARIES IN SOWS, CROSSES OF SWEDISH LANDRACE AND LARGE WHITE IN POST PARTUM AND OESTRUS**

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Abstract: Swine breeding production as one of the most perspective branch in livestock farming require particular attention when it is about reproduction of the flock. Final goal of every swine breeding farm is of course to increase reproduction of the animals and ensure healthy progeny. Aim of our research was to on the basis of detailed microscopic analyse of the ovaries in researched periods and results obtained accelerate reproduction in swine breeding production and by that total flock craft. We have culled 36 sows cross breed of Swedish Landrace and Large White whose are breded in farm conditions in the periods of estrous and post partum. Immediately after culling we have separated ovaries from surrounding tissue and using micrometer we have measured length and width of evident follicles. Obtained results showed that the most ideal period for next mating of sows is 21 to 28 days post partum, when the biggest values of examined parameters had been recorded – length and width of follicles, what indicate to increase of ovarial activity.

Keywords: sows, ovaries, folliculogenesis, post partum, estrous

Introduction and literature overview

Organisation of reproduction in every farm, and especially in pig farming is one of the most important processes. In order to process of reproductive flock utilisation be more succesful, one of the conditions is properly selection of male and female reproductive materials, as well as

satisfying percent of pregnant animals, which again is dependant of variety aught outside so as inside factors as accenuate *Heard* (1976) and *Schmiedt* (1967).

Age when sexual maturation of females appear is between 6 and 8 months, and first labor is expected with age of one year as accenuate *Adilović et al.* (1983), *Kovalik et al.* (1982), *Schmiedt* (1967), *Varatanović* (1989), and *Vidović et al.* (1981). Puberty, sexual maturation in sows is manifested with appear of first estrous, maturation and ovulation of tertiar follicules which hold egg station capable for fertilisation.

In our research we have tried to enlighten problematic of pig reproduction namely cross bred of Swedish Landrace and Large White (SL x LW), following ovarial cycle, respectively some histological parameters, number of mature follicules, their dimensions in period of estrous and early puerpery

Materials and methods

We have performed our research on 36 gilts (primiparous) cross breed of SL x LW whose are breded at pig farm Drniš, R Croatia, in early puerpery and estrous, whose are kept in equal zoohygienic conditions and fed with mixture for lactation sows.

After we monitoring gilts from the moment of coitus until the moment of pregnancy detection and labor, we followed precise date of farrow to calculate duration of gestation. Animals are culled from day 1 to day 28 *post partum* and in estrous, then we separated them in 6 groups for more clear monitoring of possible changes in ovaries in: days 1-3 *post partum*, days 5-7 *post partum*, days 10-13 *post partum*, days 16-19 *post partum*, days 21-28 *post partum*, and in estrous.

Immediately after culling of researched animals, we separated ovaries with surrounding tissue in order to manipulation last shorter, to evade possible squeezing. We have described ovaries detailed and appointed number of follicules, specially in right and spesially in left ovaries. Follicules are separated to small (under 2 mm), medium (from 2 to 4 mm) and very perceived, large (over 5 mm). We have performed measurement manually, by micrometer – šubler, and we measured lenght and width of the follicles in left and right ovaries. After we obtained numeral informations by measuring the follicles, same are processed by variation-statistical methods and tested by T-test, and results are presented tabular.

Results of research and discussion

To establish the most proper moment for approach to sows cross breed ŠL x LW in *post partus* period, we have tried to establish number of mature follicles which are visible with bare eye in ovaries, their dimensions, respectively average length and width. We have specifically examined left and right ovaries to establish whose ovaries are more active in which researched period immediately after partus, hoping that received results will directly influence the course and progress of reproduction in pig farming production.

Table 1. Dimensions of the follicles at right ovaries in mm
Tabela 1. Dimenzije folikula na desnim ovarijima u mm

Dimensions of the follicles at right ovaries in mm/ Dimenzije folikula desnih ovarija u mm								
Days/ Dani, pp.	Measure/ Mera	n	x	Sx	S	S%	min.	max.
1. - 3. Days/dan a pp.	Length/ Dužina	15	3.166	0.299	1.199	36.607	2	5
	Width/ Širina	15	2.766	0.270	2.049	37.924	1.5	5
5. - 7. Days/dan a pp.	Length/ Dužina	13	2.423	0.414	0.493	20.346	2	3
	Width/ Širina	13	2.115	0.140	0.506	23.924	2	3
10. - 13. Days/dan a pp.	Length/ Dužina	17	3	0.296	1.224	40.800	1.5	5
	Width/ Širina	17	2.588	0.281	1.162	44.899	1	5
16. - 19. Days/dan a pp.	Length/ Dužina	28	3.928	0.307	1.625	41.369	2	8
	Width/ Širina	28	3.5	0.280	1.484	42.400	1.5	7
21. - 28. Days/dan a pp.	Length/ Dužina	46	5.630	0.342	2.329	41.367	1.5	10
	Width/ Širina	46	4.891	0.305	2.073	42.383	1.5	8
estrous	Length/ Dužina	18	7.777	0.431	1.832	23.556	4	10
	Width/ Širina	18	7.333	0.420	1.782	24.301	3	10

After performed researches, results were more than expected. In fact the highest number of mature follicles we noticed in right ovaries, total 46 in the

period from 21 to 28 days *post partum*, while minimum number of follicles was in period from 5 to 7 days *post partum*, total 13. It is interesting to accentuate that in estrous total number of found follicles at examined ovaries was 18, which is significantly less than in certain periods immediately after labor (Table 1).

The largest recorded average value for length of follicles in right ovaries is in estrous period $7,777 \pm 0,431$ mm, what is for 4,611; 5,354; 3,849 and 2,147 mm longer than in periods 1-3; 5-7; 10-13; 16-19; and 21-28 days *post partum*. Minimal value for length of follicles in right ovaries is recorded from 1,5 mm and maximal 10 mm (Table 1).

By testing variations of average values for length of follicles in right ovaries (Table 2) by T-test, significant difference is recorded at level $P < 0,05$ between days 10-13 and 16-19 *post partum*. High significance at level $P < 0,01$ we recorded between periods of 5-7 and 16-19 days *post partum*. Very high significance at level $P < 0,001$ is recorded between days 1-3 and 21-28 *post partum* and estrous; 16-19 and 21-28 days *post partum* and estrous, and 21-28 days *post partum* and estrous.

Table 2. Testing of variations in average values for length of the follicles in right ovaries/mm
Tabela 2. Testiranje razlika srednjih vrednosti dužina folikula desnih ovarija/mm

Testing of average values for length of the follicles in right ovaries/ Testirane srednje vrednosti dužina folikula desnih ovarija					
Days/ dana p.p.	1. -3.	5. -7.	10. 13.	16. - 19.	21. - 28.
5.- 7.	1.459				
10.- 13.	0.396	1.138			
16.- 19.	1.784	xx 2.928	x 2.183		
21.- 28.	xxx 5.451	xxx 5.994	xxx 5.844	xxx 3.716	
estrous	xxx 8.816	xxx 8.983	xxx 9.168	xxx 7.289	xxx 3.917

Width of follicles in right ovaries (Table 1) by $7,333 \pm 0,420$ mm recorded in estrous is the largest, which is with regard to periods 1-3; 5-7; 10-13; 16-19; and 21-28 days *post partum* wider for 4,567; 5,218; 4,745; 3,833 and 2,442 mm. Minimal value of width for follicles in right ovaries was 1mm, while the maximal value was 10 mm.

By testing variations of average values for width of follicles in right ovaries (Table 3) we obtained significant difference at level $P < 0,05$ between periods 1-3 and 5-7, and period 10-13, 16-19 days *post partum*. High

significance at level $P < 0,01$ is recorded between periods 16-19 and 21-28 days *post partum*. Very high significance at level $P < 0,001$ we had between periods 1-3 and 21-28 days *post partum* and estrous, 10-13 and 21-28 days *post partum* and estrous, between 16-19 days *post partum* and estrous, as between 21-28 days *post partum* and estrous.

Table 3. Testing of average values for width of the follicles in right ovaries/mm
Tabela 3. Testiranje srednjih vrednosti širina folikula desnih ovarija/m

Testing of average values for width of the follicles in right ovaries/ Testirane srednje vrednosti širina folikula desnih ovarija					
Days/ dana p.p.	1. -3.	5. -7.	10. 13.	16. - 19.	21. - 28.
5.- 7.	x 2.162				
10.- 13.	0.459	1.520			
16.- 19.	1.896	xxx 4.453	x 2.314		
21.- 28.	xxx 5.233	xxx 8.311	xxx 5.576	xx 3.368	
estrous	xxx 9.189	xxx 11.832	xxx 9.433	xxx 7.620	xxx 4.714

When we examined left ovaries, we established that the maximal and minimal number of follicles was in same periods like in the right ovaries, but slight smaller compared to right ovaries. Maximum number of mature follicles in left ovaries was from 21 to 28 days after partus, 32, while the minimum number is determined from 5 to 7 days *post partum*, 12. At peak of sexual activity, estrous, total number of found tertial follicles was 17 (Table 4).

The largest average value for width of follicles in left ovaries (Table 4) was in period estrous $7,764 \pm 0,469$ mm, which is longer for 3,608; 5,264; 4,864; 4,086 and 2,264 mm with regard to periods 1-3; 5-7; 10-13; 16-19; and 21-28 days *post partum*. Minimal value for length of follicles in left ovaries was 2 mm, and maximal 10 mm.

By testing obtained variations of average values for length of follicles in left ovaries (Table 5) significant difference at level by $P < 0,05$ we had between periods 1-3 and 5-7 days *post partum*, as well as between 10-13 and 16-19 days *post partum*. High significant difference at level $P < 0,01$ we had between periods 1-3 and 5-7 days *post partum* and estrous, than, between 5-7 and 16-19, 21-28 days *post partum* and estrous. Same level of significance is recorded between periods 10-13 and 21-28 days *post partum* and estrous, as well as between periods 21-28 days *post partum* and estrous.

Table 4. Dimensions of the follicles at left ovaries in mm
Tabela 4. Dimenzije folikula na lijevim ovarijima u mm

Dimensions of the follicles at left ovaries in mm/ Dimenzije folikula levih ovarija u mm								
Days/ Dani, pp.	Measure/ Mera	n	\bar{x}	Sx	S	S%	min.	max.
1. - 3. Days/dan a pp.	Lenght/ Dužina	16	4.156	0.370	1.480	35.611	2	6
	Width/ Širina	16	3.593	0.348	1.393	38.769	2	6
5. - 7. Days/dan a pp.	Lenght/ Dužina	12	2.500	0.194	0.674	26.960	2	4
	Width/ Širina	12	1.875	0.164	0.569	30.346	1	3
10. - 13. Days/dan a pp.	Lenght/ Dužina	15	2.0	0.268	1.038	35.793	2	5
	Width/ Širina	15	2.633	0.264	1.025	38.928	1.5	4.5
16. - 19. Days/dan a pp.	Lenght/ Dužina	28	3.678	0.250	1.327	36.079	2	7
	Width/ Širina	28	3.232	0.237	1.258	38.923	1.5	7
21. - 28. Days/dan a pp.	Lenght/ Dužina	32	5.5	0.393	2.228	40.509	2	10
	Width/ Širina	32	4.843	0.348	1.969	40.656	2	9
estrous	Lenght/ Dužina	17	7.764	0.496	2.047	26.365	2	10
	Width/ Širina	17	7.058	0.457	1.886	26.721	2	9

When it is about width of follicles in left ovaries, the largest average value in width (Table 4) we recorded in estrous period $7,085 \pm 0,457$ mm, which is with regard to periods 1-3; 5-7; 10-13; 16-19 and 21-28 days *post partum* wider for 3,465; 5,183; 4,425; 3,826 and 2,215 mm. Minimal value for width of follicles in left ovaries was 1 mm and maximal 9 mm.

By testing of obtained variations of average values for width of follicles in left ovaries (Table 6) we obtained significant variation at level $P < 0,05$ between periods 1-3 and 10-13 days *post partum*. High significance at level by $P < 0,01$ we had between periods 5-7 and 10-13 days *post partum*. Very high significance at level $P < 0,001$ we had between periods 1-3 and 5-7 days *post partum* and estrous, then, between 5-7 and 16-19, 21-28 days *post partum* and estrous, between 10-13 and 21-28 days *post partum* and estrous period, between 16-19 and 21-28 days *post partum* and estrous and finally between 21-28 days *post partum* and estrous again.

Table 5. Testing of variations at average values length of the follicles in left ovaries/mm
Tabela 5. Testiranje razlika srednjih vrijednosti dužina folikula levih ovarija/mm

Testing of variations at average values length of the follicles in left ovaries/ Testirane srednje vrijednosti dužina folikula levih ovarija					
Days/ dani p.p.	1.-3.	5.-7.	10.-13.	16.- 19.	21.- 28.
5.- 7.	xxx 3.990				
10.- 13.	xx 2.766	1.219			
16.- 19.	1.067	xxx 3.751	x 2.125		
21.- 28.	x 2.498	xxx 6.864	xxx 5.485	xxx 3.926	
estrous	xxx 5.838	xxx 9.913	xxx 8.639	xxx 7.375	xxx 3.582

It is significant to accenuate that estrous period of examined animals is characteristic by the total number of found follicles which is smaller regarding to researched periods post partum. In the same time follicles of the left and right ovaries in estrous are by length and width significantly bigger regarding to the periods after partus. We may freely assert that if follicles on the ovaries of examined animals were by length and width bigger their total number was smaller and vice, if follicles were smaller their number was bigger. This assert we connect with practical application in swine breeding. Ultimate aim of every swine breeding farm is to get as much as possible healthy piglets. When we have lesser number of ripe follicles we have lesser number of ripe ovums which are going to ovulate or not. If we have bigger number of follicles possibility for most of them to ovulate increase, which instantly increase chance of fertilization for bigger number of ovums.

Size of the follicles during early puerpery and estrous in right and left ovaries at examined sows cross breed SL x LW has significantly fluctuated. By comparative consideration of average values for size of the follicles, respectively their length and width in both ovaries, we perceived that the follicles in left ovaries are smaller compared to follicles in right ovaries. Alike is the number of total found follicles variated as in right so as in left ovaries, which was dependent on researched periods of *post partum* and estrous.

On the basis of this results we can assert that the right ovary in sows is more active regarding to the left, respectively folliculogenesis is more intense in right ovaries. Comparing our results with findings of *Geoffrey-a* (1975) we

assert that dimensions of follicles in right ovaries are approximate those which author cite. Namely *Geoffry* (1975) is researching ovaries in sows identified that follicles were big and dimensions were in span from 0,8 to 10 mm. In our case dimensions span for lenhgt of the follicles in right ovaries is from 1,5 to 10 mm, while in left ovaries that span was from 1 to 10 mm. *Sisson* (1961), point to that in ovaries of sow there are rounded knobs which look like cluster. Those are ripe follicles, dimensions from 7 to 8 mm. *R'atky* (2005) researching ovaries in sows of different age, ascertained that in older animals cross breed of Swedish Landrace and Large White sow follicles are bigger regarding to younger examined animals, and their size were in span from 6,3 to 7,2 mm. *Noake* at al. (2001) researched ovaries in sows concomitant dimensions and total number of the follicles. Researches are shown that immediately before estrous, 11 to 14 dana before first signs of estrous, there was the most of follicles with dimensions in span from 0,8 to 1,3 mm. The biggest number of follicles according to same authors was in the period from 21 to 22 days after estrous, total 50, dimensions from 2 to 5 mm.

Table 6. Testing of variations at average values width of the follicles in left ovaries/mm
Tabela 6. Testiranje razlika srednjih vrijednosti širina folikula levih ovarija/mm

Testing of variations at average values width of the follicles in left ovaries/ Testirane srednje vrijednosti širina folikula levih ovarija					
Days/ dani p.p.	1. -3.	5. -7.	10. 13.	16. - 19.	21. - 28.
5. - 7.	xxx 4.485				
10. - 13.	x 2.206	xx 3.110			
16. - 19.	0.859	xxx 4.744	1.695		
21. - 28.	1.741	xxx 7.749	xxx 5.080	xxx 3.835	
estrous	xxx 6.047	xxx 10.730	xxx 8.412	xxx 7.458	xxx 3.865

According to *Britt* at al. (1985) follicular development in the time of early lactation on sows is characteristic by big population of small size follicles and small population of medium size follicles. As lactation advance number of the follicles is changing in favour to medium and large sized follicles. Weaning upon labor often lead to divergence in follicular development and positive response of LH to estradiol is not happening in time of first week *post partum*. LH in time of lactation is controlled with intensive breast feeding of the litter, while FSH is controlled by inhibin. Breast feeding determines ejaculation of GnRH, and weaning lead to increase of GnRH in hypothalamus simultaneously

with increase of LH in front part of pituitary, and growth of the follicles increase.

Factors like feeding, season, stimulation by hog, litter size... influence on follicular development in the time of lactation and after weaning. *Kudlač et al.* (1979) cite that De Graff follicles in ovaries of the sows in first week after delivery are with more or less expressed degenerative changes. Same author assert that from second week *post partum* activity of follicular development is small but it increase as in number of follicles so as in their size in third week *post partum*.

Considering ditto, and on base of obtained results, we can conclude that in sows right ovaries are a little more active respectively to the left. To get as reliable informations about ovarial cyclicity in sows, we took into consideration length and width of found follicles in left and right ovaries.

Conclusions

By researching of activities in right and left ovaries in sows cross breed SL x LW in *post partus* period and in the time of estrous we established that:

-Maximal length of the follicles in right ovaries at period from 21 to 28 days *post partum* and estrous, while minimal values of length are recorded from 10 to 13 days *post partum*, where we also established minimal width. The largest width of the follicles in right ovaries we recorded in estrous period.

-In left ovaries maximal follicles length was from 21 to 28 days *post partum*. In the same period we recorded the largest width of the follicles. The smallest length of the follicles, 2 mm was in the time of estrous, like in certain periods *post partum*, and we perceived smallest width from 5 to 7 days *post partum*.

Results of our research refer the fact that optimal period for next conception of sows cross breed of Swedish Landrace and Large White is from 21 to 28 days *post partum*, when we found the biggest number of the follicles. Implementing our results in practice could considerably increase annual flock craft and by that income of every swine breeding farm.

Folikularna aktivnost ovarija krmača križanaca švedskog landrasa i velikog jorkšira u *post partumu* i estrusu

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Rezime

Folikularna geneza na ovarijima krmača križanaca švedskog landrasa i velikog jorkšira bila je kontinuirna, ali različitog intenziteta u istraživanim periodima. Najmarkantnije promjene na ovarijima, kako desnim tako i lijevim zapazili smo u periodu od 21. do 28. dana *post partum* gdje smo zabilježili i najveće, maksimalne vrijednosti u dužini i širini folikula, što je bio slučaj i u periodu estrusa.

Najniže vrijednosti dužine i širine folikula bile su od 10. do 13 dana *post partum* što se tiče desnih ovarija, dok su najniže vrijednosti na lijevim ovarijima bile u periodu od 5. do 7 dana *post partum*.

Na osnovu navedenog, najintenzivnija folikulogeneza je dakle, ipak bila od 21. do 28. dana *post partum* i u estrusu.

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