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Reproductive parameters in sows after supplementation of natural micronutrients – immunomodulators

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Abstract

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The aim of this study was to investigate the effect of supplementing standard diet for sows at all stages of the reproductive cycle (gestation, lactation, WEI) with natural immunomodulators (*Swine Guard SHT* and *Swine Guard Farrowing*) to improve their immune status, estrus reaction after weaning, % of farrowing value and % of return value in the first post-lactation estrus, as well as in the analysis of the distribution and duration of regular and irregular return to estrus. Total of 332 sows were divided into experimental (n = 190) and control group (n = 142). The experimental group was fed with diet supplemented with Swine Guard SHT during gestation. During lactation and after weaning, until determined conception, sows were fed with Swine Guard Farrowing. Feeder control group was fed with standard rations, with no immunomodulator supplements. The result shows that the use of immunomodulators Swine Guard SHT and Swine Guard Farrowing in the diet of pregnant and lactating sows, significantly improves sows' reproductive parameters at all stages of the reproductive cycle.

Keywords: sows; reproduction; immunomodulators
Abbreviations: weaning-to – estrus interval (WEI)

Introduction

In intensive conditions of reproductive exploitation, housing conditions, micro climate, hygiene, specific microflora and nutrition, significantly reduce reproductive efficacy of breeding sows, which is primarily manifested by lower post-lactation estrus responsiveness, lower farrowing value and increased return value percentage. Numerous studies have shown that there is a reversed proportion between the interval of weaning-to – estrus (WEI) and sows' fertility in the next reproductive cycle (Wilson and Dewey, 1993; Vesseur, 1997; Poleze et al., 2006). Since the period of gestation is a biological constant and the lactation period can only be minimally varied in production, the duration of the lactation significantly determines the height of the annual farrowing index (Willis et al., 2003; Kraeling and Webel, 2015). The weaning-to-estrus interval (WEI) corresponds to the period between the day of weaning (Day 0) and the first day sow is showing standing heat, being part of the normal reproductive cycle of the female (Poleze et al., 2006). As return to estrus is the most frequent reproductive failure, the study of factors associated with its occurrence can help to identify females with a predisposition to this failure (Vargas et al., 2009). The WEI is one of the main components of non-productive days and may be influenced by lactation length, parity order, litter size, season, nutrition, boar exposure after weaning, genetic, diseases and management (Dial et al., 1992). The period of time from weaning to estrus is then an important economic

factor that should be used in measuring the reproductive performance of a sow in subsequent litters. For economic reasons, the longer a female stands open, the smaller will be the profits (Suwanasopee et al., 2006). Different stressful factors can significantly reduce the reproductive efficiency of the herd of breeding sows, which is manifested by conception percentage, farrowing value, embryonic and fetal mortality, return value, number of piglets in the first litter and increased mortality of piglets during lactation. Chronic stressors significantly reduce the immunity of animals. Reduced natural immunity and increased resistance of microorganisms to antimicrobial agents result in the increase of numerous infectious diseases, and consequently in the reduced reproductive performance of sows (Floss and Tubbs, 1999; Sutherland et al., 2006; Yeske, 2007). One of the biotechnological method that optimizes the immune status of sows, and promotes the construction of the immune system of animals, is the use of highly effective, natural micronutrients – immunomodulators. The term immunomodulator is often used to refer to substances that increase immune responses (Blecha, 1988). The goal of immunomodulation in food-producing animals is to regulate immunity for the benefit of the animal and production efficiency (Blecha, 2001). There is considerable potential for applying the rapid advances in immunomodulation research to benefit domestic animals. In domestic food animals, immunomodulators have the greatest potential for prevention and perhaps therapy in early stages of infectious diseases associated with immunosuppression (Kehrli and Roth, 1990; Thacker, 2010). Various immunomodulators of plant are used in order to increase the immunity of animals subjected to chronic stress in intensive production conditions (Steinmasl and Wolf, 1990; Blecha, 2001; Pavičić et al., 2003; Pragathi et al., 2011). Preparations of yeast extract, herbal extract, colostrum, and blood serum is commonly used as a natural immunostimulators (Bonneau and Laarveld, 1999; Davis et al., 2004; Gallois and Oswald, 2008; Gallois et al., 2009; Pragathi et al., 2011).

The aim of this study was to investigate whether the treatment by natural immunomodulators, could increase the farrowing value and decrease sows 'returns to estrus. Examination of the effects of oral administration of the prepared natural immunomodulators to the improved immune status of sows, was carried out on the basis of experimental results on a pig farm.

Materials and Methods

The experiment was carried out on a commercial pig farm, located in the Autonomous Province of Vojvodina, Serbia. Total of 332 sows were divided into experimental (n = 190) and control group (n = 142). In the gestation period experimental sows were fed with classic diet for pregnant sows, supplemented by 0.3% immunomodulator "Swine Guard SHT" (Hokovit, H.U. Hofman AG-CU–4922, Bützberg, Switzerland). During gestation, all sows received 3.5 kg of complete basic diet per day. During lactation and after weaning, until determined conception**,** sows were fed ad libitum with complete basic diet for lactating sows, supplemented by 0.5% immunomodulator "Swine Guard Farrowing". According to the manufacturer's declaration, active supstances in Swine Guard SHT and Swine Guard Farrowing include premium colostrum, herbal extracts and yeast extract, whose role is to support antibodies production and overall health of the sows' immune status. Feeder control group (n = 142) was fed with standard rations, with no immunomodulator supplements, provided that all sows had the same treatment with respect to feeding and holding during the experiment.

Estrus detection of weaned sows was performed twice per day (07:00 and 17:00), starting on day 1 after weaning with mature boar. The sows were inseminated 2 times after detection of standing estrus. Pregnancy is confirmed 28 to 30 days after insemination and reconfirmed 42 days later.

In order to investigate the post-lactation estrus reaction, all sows are divided into three groups, depending on the interval between the weaning and the first estrus (WEI). The first group included WEI within ≤ 7 days, the second group between 8-14 days, and in the third group the interval exceeded 15 days. In this section of the study, it was necessary to ascertain whether there are differences in estrus reaction after weaning, percentage of farrowing value and percentage of return value in the first post-lactation estrus, as well as in the analysis of the distribution and duration of regular and irregular return to estrus. Regular returns were considered those occurring at intervals of 19 to 23 days and 36 to 45 days after the previous insemination, while irregular returns were those that occurred at intervals less than 18 days, 24 to 35 days, and 46 and more days after the previous insemination.

The evaluation of parameters of the research results was done by the „Statistic 12" software package.

Results and Discussion

The percentage of sows showing estrus depending on the interval between the weaning and the first estrus (WEI) is present in Table 1.

A considerably higher degree of estrus response, observing the percentage of sows in which estrus was established during the examined period, was noted with sows immu-

Table 1. Distribution rate of sows' post lactation estrus response from weaning to estrus interval (WEI)

Sows ≤ 7		Weaning – estrus interval (WEI) – days			
		8-14	≥ 15	Total	
Experimental group	n	160	11	19	190
	%	84.2[a]	5.8[a]	10.0[a]	100.0
Control group	n	109	12	21	142
	%	76.8[b]	8.5[a]	14.7[b]	100.0

[a b] Values within the same column differ (P < 0.05)

Table 2. Weaning to estrus interval (days)

Sows ≤ 7		Weaning – estrus interval (WEI) – days			
		8-14	≥ 15	Total	
Experimental group	n	160	11	19	190
	days	5.5 [a]	11.2 [a]	21.4 [a]	7.4
Control group	n	109	12	21	142
	days	6.5 [b]	13.1 [b]	24.6 [b]	9.7

[a b] Values within the same column differ (P < 0.05)

nized with immunomodulator preparation. Thus, in the interval of ≤ 7 days, 84.2% treated, and only 76.8% of untreated sows were estrus reacted. This value was significantly ($p < 0.05$) higher in the experimental group in comparison with the control group of sows. In the WEI 8-14 and ≥ 15 days, estrus response was lower in treated sows ($p < 0.05$). The average duration of period from weaning to the first estrus is present in Table 2.

The average interval from weaning to the first estrus of all examined sows was 8.4 days. At all intervals of WEI, sows' immunization resulted in a shorter average interval (5.5, 11.2 and 21.4 days), compared to sows in the control group (6.5, 13.1 and 24.6 days). From the distribution shown, it can be clearly seen that the treatment of sows with the immunomodulator rations reduces the average duration of the WEI, as a result of a smaller number (%) of sows that manifest the first estrus during the second and third week after the weaning.

Table 3 shows the results of the application of natural immunogenic substances and their effect on weaning to estrus period in sows. The effect of immunomodulators in treated sows was analyzed in order to see the increase of the immune response, measured by the % of farrowing value.

The average farrowing value (%) of treated sows fed with the addition of immunomodulators was 84.2% at all stages of the reproductive cycle (gestation, lactation, WEI). This value is significantly lower in the control group of sows (76.8%). The treated sows had the highest percentage of farrowing (88.1%) in the WEI ≤ 7 days, and the smallest (54.5%) in the interval 8–14 days. The sows whose first post-lactation estrus lasts for 15 days or more, show again significantly increased farrowing value, amounting to 68.4%. Control group of sows showed a similar trend at WEI ≤ 7 days, 8-14 and ≥ 15 days (81.7, 58.3 and 61.9%).

Table 3. The farrowing rate (%) of sows from weaning to estrus interval

Sows			Weaning – estrus interval (WEI) – days			
		≤ 7	8-14	≥ 15	Total	
Experimental group	Inseminated sows	n	160	11	19	190
		%	84.2	5.8	10.0	100.0
	Farrowed sows	n	141	6	13	160
		%	88.1 [a]	54.5 [a]	68.4 [a]	84.2 [a]
Control group	Inseminated sows	n	109	12	21	142
		%	76.8	8.5	14.7	100.0
	Farrowed sows	n	89	7	13	109
		%	81.7 [b]	58.3 [a]	61.9 [b]	76.8 [b]

[a b] Values within the same column differ (P < 0.05)

Table 4. Return to estrus value (%) after insemination in the first post weaning estrus

Sows ≤ 7		Weaning – estrus interval (WEI) – days			
		8-14	≥ 15	Total	
Experimental group	Inseminated in first estrus (n)	160	11	19	190
	Return to estrus (%)	11.9 [a]	45.5 [a]	31.6 [a]	15.9 [a]
Control group	Inseminated in first estrus (n)	109	12	21	142
	Return to estrus (%)	18.3 [a]	41.7 [a]	38.1 [a]	23.2 [b]

[a b] Values within the same column differ (P<0.05)

Table 4 presents return to estrus rate measured by the percentage of return to estrus (regular or irregular) after insemination at the first post weaning estrus. The return to estrus of sows inseminated in the first post-lactating estrus, which occurred in the first seven days after weaning, showed significantly lower values in the experimental group (11.9%) than in the control (18.3%). Similar results were obtained in the case when the first estrus after a weaning occurred in the period after 15 days or more (experimental group 31.6%; control group 38.1%). The exception is for sows where the first post-lactation estrus occurred during the period 8-14 days after weaning, where the percentage of return to estrus was 45.5% in the experimental group and in the control 41.7%.

Table 5 shows the distibution of return to estrus rate during regular and irregular intervals from the first insemination until the first return to estrus. During both regular intervals from the first insemination until the first return to estrus (18-23 and 36-45 days), return to estrus value was higher in the experimental group (38.7% vs. 22.6%). During irregular intervals, ≤ 18, 24–35 and ≥ 46 days, a higher % of sows returning to estrus in experimental group than in control group was noted (11.4 % vs. 6.4%, 34.2% vs. 25.8%, 8.7 % vs. 6.5 %).

A regular return to estrus suggests that the sow was served or inseminated, but at the wrong time to achieve conception or there was an imbalance of hormones in the sow caused by cystic ovaries, seasonal infertility, certain stress factors. Irregular return to estrus suggests that fertilization has occurred but the developing embryos have died before pregnancy has been fully established. Returns to service following insemination and subsequent failure to farrow are major factors in culling sows from the breeding herd (Koketsu et al., 1997). A major factor contributing to return to estrus in inseminated female pigs is early pregnancy loss, a phenomenon which occurs in all livestock species and one in which failure of fertilized ova to reach the blastocyst stage is common (Betts and King, 2001).

Inseminated females returning to estrus were classified into the following categories depending on how many days after insemination they were first detected as being in estrus: regular intervals 19–23 and 36–45 days; irregular intervals ≤ 18; 24–35 and ≥ 46 days.

In Table 6 it was presented that out of total number of sows returning to estrus, 53.0% returned to estrus during regular intervals while 47.0% returned to estrus during irregular intervals. The return to estrus ratio during regular and irregular intervals is more favourable in sows treated with immunomodulators (61.3%: 45.7%) than in sows fed with standard diet (38.7%: 54.3%).

Table 6. Regular and irregular return to estrus value (%)

Sows		Experimental group	Control group	Total
Return to estrus	n	31	35	66
Regular returns[1]	n	19	16	35
	%	61.3	45.7	53.0
Irregular returns[2]	n	12	19	31
	%	38.7	54.3	47.0

[1]Regular returns: 19-23 days, 36-45 days
[2]Irregular returns: ≤18 days, 24-35 days, ≥46 days
[a b] Values within the same column differ (P<0.05)

Table 5. Distribution rate of sows returning to estrus after first insemination

Sows		Interval 1. insemination – 1. return to estrus (days)					Total
		≤18	19-23	24-35	36-45	≥46	
Return to estrus (n)		6	22	20	13	5	66
Experimental group	n	2	12	8	7	2	31
	%	6.4[a]	38.7[a]	25.8[a]	22.6[a]	6.5[a]	100.0
Control group	n	4	10	12	6	3	35
	%	11.4[b]	28.6[b]	34.2[a]	17.1[a]	8.7[a]	100.0

[a b] Values within the same column differ (P < 0.05)

Conclusion

The results of this study clearly show that the use of natural immunomodulators in the diet of pregnant and lactating sows had a shorter weaning to estrus interval, higher farrowing value and more favourable ratio of return to estrus during regular and irregular intervals.

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