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ORIGINAL PAPER

Effect of selenitetriglyceride supplementation in pregnant sows on hematological and biochemical profiles, Se concentration and transfer to offspring

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Abstract

Selenium (Se) is a micronutrient responsible for regulating immune, antioxidant, and reproductive processes in the body. Selenitetriglycerides are a novel, organic form of Se; to date, the effects of selenitetriglyceride supplementation have been studied only in ruminants. The aim of this study was to determine the effect of selenitetriglycerides administered to sows before parturition on the Se concentration and selected hematological and biochemical parameters, and to evaluate the efficacy of selenitetriglyceride supplementation in preventing Se deficiency in sows and piglets. The study was conducted on 12 pregnant sows and their offspring. The control group consisted of sows that did not receive the selenitetriglyceride supplement, and their offspring. The experimental group consisted of sows that were orally administered a selenitetriglyceride supplement at 0.5 mg Se kg^{-1} BW, 15, 10, 5, and 3 days before the parturition date, and their offspring. Blood samples for analyses of the Se concentration, morphological parameters, selected biochemical parameters (AST, ALT, TP, ALB, UREA, CREA), and GSH-Px activity were collected from sows 15, 10, 5, and 3 days before parturition and 2 days postpartum. Blood samples for analyses of the Se concentration were collected from 3-, 5-, 10-, and 15-day-old piglets. No significant differences in hematological or biochemical parameters were observed between the groups of sows. Beginning on the fifth day of the experiment, the Se concentration and GSH-Px activity were significantly higher in the experimental than in the control group sows. During the entire experiment, Se levels were significantly higher in the experimental than in the control group piglets. The results of the study indicate that selenitetriglycerides are a safe and effective source of Se for pigs. Selenitetriglycerides are effectively transferred to offspring with the mother's milk and colostrum, and they can be administered to prevent Se deficiency in pigs.

Keywords: selenium, selenitetriglycerides, sows, piglets, supplementation, deficiency, biochemical parameters, hematology

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INTRODUCTION

Selenium (Se) is a micronutrient that plays a key role in the cellular metabolism of living organisms, in particular in antioxidant, immune, and reproductive processes. In pigs, an adequate supply of Se is required in critical stages of the production cycle, including pregnancy, parturition, and lactation. Selenium is also an essential nutrient for piglets directly after birth and weaning, but it also plays an important role during growth by improving the quality characteristics of meat. In boars, Se is responsible for maintaining high semen quality (Surai and Fisinin 2016). Selenium deficiency can lead to various disorders in animals. In ruminants, horses, and poultry, Se deficiency can cause nutritional muscular dystrophy (NMD, white muscle disease) (Żarczyńska et al. 2013). In pigs, insufficient Se supply can lead to sudden death, hepatosis dietetica (HD), and mulberry heart disease (MHD), and it can damage lungs and gastrointestinal tract tissues (Helke et al. 2020, Rao et al. 2023). Young animals are more susceptible to Se deficiency. Rapidly growing organisms have a greater demand for Se, but unlike adult individuals, they do not have Se reserves in their bodily tissues. Genetic selection for improved growth and meatiness has been associated with an increased incidence of MHD in pigs (Oropeza-Moe et al. 2015).

Soil, water, and plants are deficient in Se in many regions of the world. Plant-soil interactions influence the availability of Se in human and animal diets. An analysis conducted with the use of data mining techniques revealed that 66% of cropland will lose around 9% of plant-available Se by the end of the 21st century, which will further increase the worldwide prevalence of Se deficiency (Jones et al. 2017). At present and in the foreseeable future, Se supplementation is the only viable method of preventing Se deficiency in animals, including pigs.

In nature, Se occurs in both organic and inorganic form. Inorganic Se, including selenites, selenates, selenides, and metal selenides are found in minerals. Organic Se, mainly selenomethionine (SeMet), is present in animal feed derived from plant materials such as grain and oilseed meal (Surai and Fisinin 2016). Plants absorb Se from soil in the form of selenites and selenates, and they synthesize Se-containing amino acids, including SeMet. Inorganic Se supplements have been used in pig and poultry production since the 1980s. However, inorganic Se can exert toxic effects at high doses. In addition, sodium selenite has pro-oxidant properties, and it can induce oxidative stress in the body and enhance lipid peroxidation (Staneviciene et al. 2023). Organic sources of Se such as SeMet and Se yeast are less toxic and more bioavailable than inorganic sources of Se, and they provide a viable alternative to sodium selenite and selenate. Research has shown that SeMet is better absorbed by humans (98%) than sodium selenate (84%), and that Se uptake by the liver occurs more rapidly after the administration of SeMet than sodium selenate. Furthermore, Se excretion decreases in response to organic Se supplementation, compared with inorganic Se supplementation (15% vs. 35%) (Duntas and Benvenga 2015). Selenomethionine is also more effectively recirculated in the body, and the mean residence time was determined at 363 days for SeMet and 147 days for sodium selenate (Patterson et al. 1989, Duntas and Benvenga 2015). According to many authors (Surai and Fisinin 2015, 2016), organic Se deliver health benefits for sows and females of other animal species because Se can be stored in tissues, mainly muscles, in the form of SeMet, and these reserves can be utilized during oxidative stress. Organic Se is also more effectively transferred to the fetus and newborns through the placenta, colostrum, and milk.

Selenitetriglycerides are a novel, organic form of Se with a +4 oxidation state. These compounds are formed by chemical modification of sunflower oil by selenic acid. To date, selenitetriglycerides have been studied only in rats (Jastrzebski et al. 1997) and ruminants (Żarczyńska et al. 2020*a*, 2020*b*, 2021). As previously noted, Se protects cells against the adverse consequences of oxidative stress. A study conducted on Swiss mice confirmed that antioxidants (glutathione peroxidase – GSH-Px and thioredoxin reductase) were activated in response to both a single dose of selenitetriglycerides and long-term supplementation with these compounds (Sochocka et al. 2014).

There is general scarcity of research studies investigating the impact of selenitetriglycerides on pregnant sows, their potential role in preventing Se deficiency in sows and piglets, and the influence of selenitetriglyceride supplementation on the synthesis of selenoproteins. Therefore, the aim of this study was to determine the effect of short-term, oral supplementation with selenitetriglycerides in pregnant sows on Se concentration before and after parturition, as well as the amount of supplemental Se that is transferred to the offspring. Selected hematological and biochemical parameters, including GSH-Px activity, were also analyzed to evaluate the efficacy of selenitetriglycerides in pigs.

MATERIALS AND METHODS

All experimental procedures were carried out in accordance with the guidelines of the Local Ethics Committee for Animal Experimentation.

Animals, diets, and experimental design

The study was conducted on 12 pregnant Large White (Topigs Norsvin) sows (third and fourth lactation) and their offspring (12 piglets, third piglet from every litter), which were divided into two equal groups. The control group (Sow-CON) comprised sows that did not receive selenitetriglycerides, and their offspring (Piglet-CON). The experimental group (Sow-STG) consisted of sows that were orally administered selenitetriglycerides supplement at 0.5 mg Se kg^{-1} BW (with the use of a medicine dispenser), 15, 10, 5, and 3 days before the parturition date, and their offspring (Piglet-STG). All animals were weighed before supplementation to adjust the supplement dose to their body weight. Pregnant sows were fed a complete dry diet for pregnant sows (Table 1) at 3-3.2 kg per day and had *ad libitum* access to water. Sows were placed in individual farrowing pens 7 days before the expected parturition date. After parturition, sows had *ad libitum* access to a complete diet for lactating sows (Table 2) and water. Piglets were housed with the mothers until weaning at 28 days of age. In the first 7 days of life, piglets received only the mother's milk, after which a prestarter diet was introduced (Table 3).

Table 1

Composition of the complete diet for pregnant sows

Proximate chemical composition (%)	crude protein – 13.03, crude fiber – 5.38, crude fat – 2.21, crude ash – 5.69, lysine – 0.64, calcium – 0.73, sodium – 0.28, methionine – 0.21, phosphorus – 0.50
Ingredients	wheat, triticale, wheat bran, dried beet pulp with molasses (sugar beets), oats, corn kernel meal, dehulled sunflower seed meal, wheat gluten, rapeseed meal, calcium carbonate, sodium bicarbonate, vegetable oil and fat (soybean), sodium chloride, magnesium oxide, monocalcium phosphate
Additives per 1 kg	vitamin A – 10000 IU, vitamin D3 – 1800 IU, vitamin E – 150.0 mg, iron – 110.0 mg, copper – 16.0 mg, zinc – 100.0 mg, selenium – 0.40 mg, manganese – 50.0 mg, iodine – 1.0 mg

Table 2

Composition of the complete diet for lactating sows

Proximate chemical composition (%)	crude protein – 16.54, crude fiber – 4.28, crude fat – 5.83, crude ash – 5.69, lysine – 1.00, calcium – 0.85, sodium – 0.21, methionine – 0.28, phosphorus – 0.53
Ingredients	wheat, barley, soybean meal, oats, wheat bran, triticale, corn kernel meal, calcium carbonate, vegetable oil and fat (soybean), monocalcium phosphate, sodium sulfate, sodium chloride, magnesium oxide, calcium nitrate dihydrate, poultry and pork fat, phosphate
Additives per 1 kg	vitamin A – 12000 IU, vitamin D3 – 2000 IU, vitamin E – 150.0 mg, iron – 110.0 mg, copper – 16.0 mg, zinc – 100.0 mg, selenium – 0.40 mg, manganese – 50.0 mg, iodine – 1.0 mg

Sampling and analyses

In all sows, blood was sampled from the superior vena cava (*v. cava cranialis*) 15, 10, 5, and 3 days before parturition (before the administration of the selenitetriglyceride supplement) and 2 days after parturition. The blood sampling kit consisted of a disposable needle (ø 1.2 mm, length – 100 mm), a disposable syringe (10 ml), a clot activator tube (9 ml, Vacuette, Greiner Bio-One, France) for analyses of Se concentration and biochemical parameters, and a K2EDTA tube (1 ml, Vacuette, Greiner Bio-One, France) for ana-

Table 3

Composition of the prestarter diet for piglets

Proximate chemical composition (%)	crude protein – 19.40, crude fiber – 2.32, crude fat – 3.98, crude ash – 5.74, lysine – 1.50, calcium – 0.55, sodium – 0.47, methionine – 0.52, phosphorous – 0.56
Ingredients	barley, extruded soybean meal, wheat, puffed barley, pregelatinized wheat flour, oat flakes, whey powder, porcine blood plasma, fish meal, glycerin, vegetable oil and fat, calcium carbonate, vegetable oil and fat (soybean), fish oil, fatty acid glycerides, monocalcium phosphate, dicalcium phosphate, sodium chloride, sodium butyrate, refined/ hydrogenated palm oil, calcium butyrate
Additives per 1 kg	vitamin A – 16000 IU, vitamin D3 – 2000 IU, vitamin E – 150.0 mg, iron – 150.0 mg, copper – 135.0 mg, zinc – 2999.7 mg, selenium – 0.40 mg, manganese – 50.0 mg, iodine – 1.2 mg

lyses of morphological parameters and GSH-Px activity. In all piglets, blood was sampled from the superior vena cava (*v. cava cranialis*) at 3, 5, 10, and 15 days of age with the use of a sampling kit composed of a disposable needle (ø 0.9 mm, length – 25 mm), a disposable syringe (2 ml), and a clot activator tube (2 ml, Vacuette, Greiner Bio-One, France) for the determination of Se concentration. Blood samples for Se estimation were frozen at a temperature of -22°C until further analysis.

The serum Se concentration was determined by hydride generation-flame atomic absorption spectrometry with the use of a Unicam 939 Solar spectrophotometer. Hematological parameters were determined in whole blood samples by flow cytometry and laser scanning cytometry in an ADVIA 2120 hematology analyzer (Siemens). The following parameters were determined: white blood cell (WBC) counts, red blood cell (RBC) counts, hemoglobin concentration (HGB), hematocrit (HCT), mean corpuscular volume (MCV), mean corpuscular hemoglobin (MCH), mean corpuscular hemoglobin concentration (MCHC), and platelet (PLT) counts. Biochemical parameters were determined with the use of a Cormay ACCENT 200 automatic biochemical analyzer and Cormay diagnostic kits. The following parameters were determined: activity of aspartate aminotransferase (AST), alanine transaminase (ALT), and erythrocyte GSH-Px, and the concentrations of total protein (TP), albumin (ALB), urea (UREA), and creatinine (CREA).

Statistical analysis

The results were assessed for normal distribution and homogeneity of variance with the use of Shapiro-Wilk and Levene's tests in Python (v. 3.11.2, Python Programming Language, Frederick, Maryland, USA, 1991). The Sow-CON group (sows without supplementation) was compared with the Sow-STG group (sows supplemented with selenitetriglycerides) at various time points, from 15 days prepartum to 2 days postpartum. Piglets from the experimental sows were examined on postpartum days 3 to 10. The results were normally distributed, and group means were compared by parametric t-tests in R (v. 4.1.0, R Development Core Team, Vienna, Austria, 2008). Time-dependent changes in hematological and biochemical parameters were analyzed from 15 days prepartum to 2 days postpartum by repeated measures analysis of variance. The Greenhouse-Geisser correction was applied when the sphericity assumption was not met. Statistical significance was set at † $p<0.05$, * $p<0.05$, ** $p<0.05$, and *** $p<0.001$.

RESULTS AND DISCUSSION

An analysis of the mean values of hematological parameters revealed no significant differences between the Sow-CON group (sows without supplementation) and the Sow-STG group (sows supplemented with selenitetriglycerides) throughout the experiment (Figure 1). These results indicate that the administered Se dose had no effect on RBC parameters, WBC counts, or PLT counts. Zavodnik et al. (2011) did not report changes in the hematological parameters of pregnant sows administered organic Se yeast. Falk et al. (2018) compared the influence of various dietary sources of Se (sodium selenate, Se yeast, and SeMet) on the hematological parameters of finishing pigs in the final fattening stage, and similarly to the present study, they found that the analyzed parameters were not affected by Se. No changes in the hematological profile were observed in adult ruminants and two-day-old calves receiving oral selenitetriglycerides supplements (Żarczyńska et al. 2020*a*, Żarczyńska et al. 2020*b*, Żarczyńska et al. 2021). In turn, a decrease in PLT counts was noted by Fontaine et al. (1977) in young pigs and by Żarczyńska et al. (2017) in calves with Se and vitamin E deficiency. In Se-deficient calves, thrombocytopenia can be caused by the interaction between increased homocysteine concentration in the blood (observed in hyposelenosis) and increased platelet aggregation (Żarczyńska et al. 2017).

In the current study, significant changes in individual hematological parameters were observed in both groups of sows (Figure 1). A significant increase in WBC counts and a decrease in RBC counts, hemoglobin and hematocrit values were noted in both Sow-CON and Sow-STG groups directly before and after parturition. Platelet counts and MCHC values increased significantly after parturition in both groups of sows. Hematological parameters remained within the normal ranges (Constable et al. 2017, Ježek et al. 2018). Similar results were reported by other researchers (Czech et al. 2017), which indicates that hematological parameters in pigs are largely determined by the animals' overall health status and age.

No significant differences in AST and ALT activity were found between the groups during the entire experiment (Table 4). This observation implies that the applied dose of selenitetriglycerides (0.5 mg Se kg^{-1} BW) did not compromise the liver function, and that this form of Se is well tolerated by pigs. Albumin and TP concentrations were similar in both groups throughout

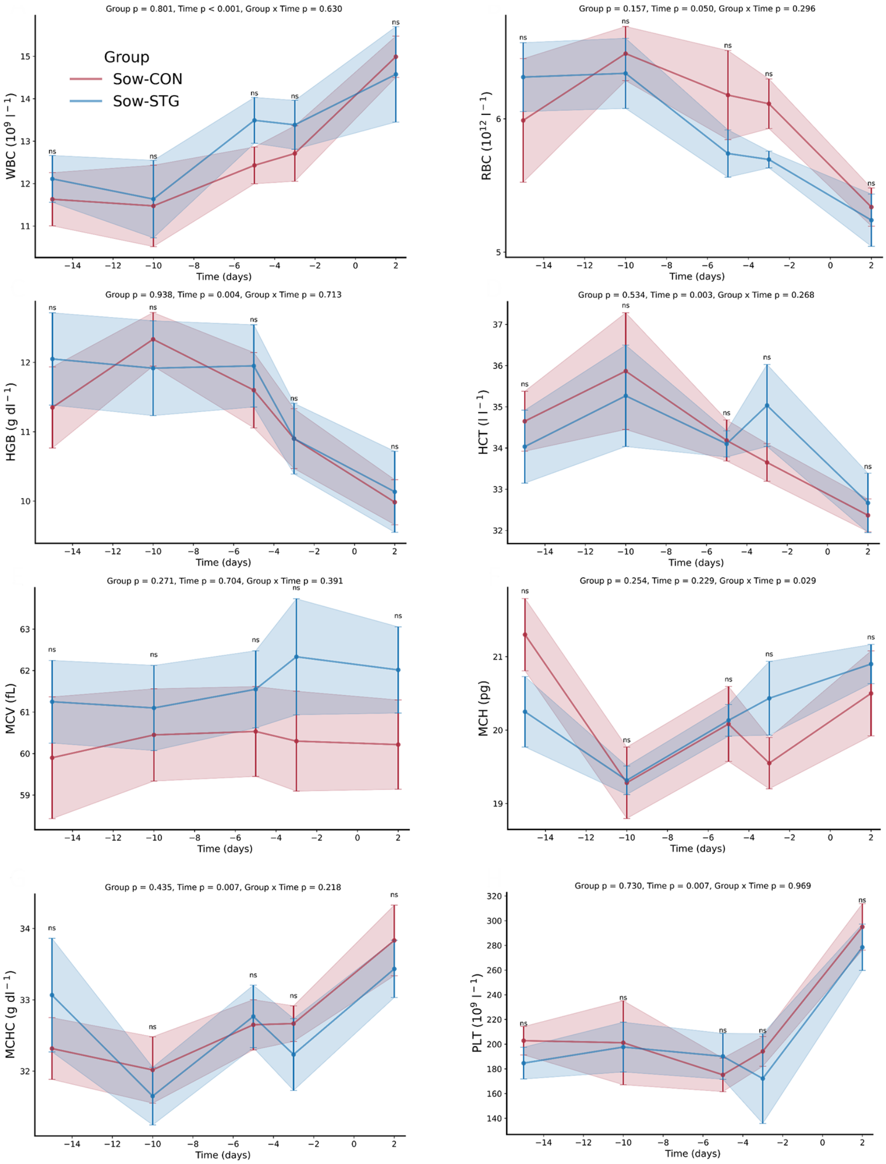

Fig. 1. Hematological parameters (mean + SD) in sows supplemented (Sow-STG) and not supplemented (Sow-CON) with selenitetriglycerides in 15, 10, 5, and 3 days before parturition and 2 days after parturition

the experiment (Table 4), which suggests that Se supplementation had no effect on these parameters. During the entire experiment, no significant changes were observed in serum UREA and CREA levels (Table 4), which indicates that the applied dose of selenitetriglycerides did not affect kidney function.

Table 4

Biochemical parameters (mean + SD) in sows supplemented (Sow-STG) and not supplemented (Sow-CON) with selenitetriglycerides

6	Group	N	-15	-10	-5	-3	2
ALT ($U\ l^{-1}$)	Sow-CON	6	54.83±5.82	45.00±2.78	49.50±6.72	52.83±5.97	49.50±5.17
	Sow-STG	6	48.33±2.95	42.83±2.60	45.50±3.08	51.67±3.54	45.40±2.14
AST ($U\ l^{-1}$)	Sow-CON	6	61.67±10.11	48.00±9.13	62.83±5.71	60.33±5.19	56.67±6.44
	Sow-STG	6	60.50±7.20	47.17±5.60	60.67±6.34	56.17±4.96	54.40±7.69
CREA ($\mu mol\ l^{-1}$)	Sow-CON	6	163.46±9.30	183.45±11.12	166.14±15.66	142.63±8.68	159.43±10.08
	Sow-STG	6	167.37±11.62	172.27±8.31	160.53±7.51	151.67±18.75	178.12±7.17
UREA ($mmol\ l^{-1}$)	Sow-CON	6	4.73±0.24	3.78±0.27	5.32±0.37	4.53±0.18	4.33±0.11
	Sow-STG	6	4.85±0.26	4.10±0.54	4.63±0.28	4.50±0.31	4.74±0.46
ALB ($g\ l^{-1}$)	Sow-CON	6	43.82±1.06	42.97±1.37	43.87±1.62	43.35±1.09	43.03±0.80
	Sow-STG	6	42.38±1.10	41.83±1.14	42.38±1.70	44.40±0.99	41.38±1.99
TP ($g\ l^{-1}$)	Sow-CON	6	80.33±2.57	78.27±1.06	78.60±2.67	77.30±2.05	81.92±3.03
	Sow-STG	6	77.48±1.79	75.87±2.03	75.32±3.04	79.43±1.92	73.08±3.63

Statistical significance was set at † $p<0.05$, * $p<0.05$, ** $p<0.05$, and *** $p<0.001$, no statistical difference was noted between the groups of sows

Selenitetriglycerides administered orally on a daily basis at 0.5 mg Se kg^{-1} BW for 7 days had no effect on the kidney or liver function in cows (Żarczyńska et al. 2020b) or camels (Żarczyńska et al. 2020a). No changes in these parameters were reported in calves administered a single dose of selenitetriglycerides supplement (0.5 and 1 mg Se kg^{-1} BW) relative to the control group (Żarczyńska et al. 2021). Similarly to the present study, porcine diets supplemented with sodium selenate, SeMet, and Se yeast (at 0.33, 0.32, and 0.32 mg Se kg^{-1} feed, respectively) over a period of 64 days did not induce significant changes in the liver parameters of pigs (Falk et al. 2018). In turn, Zavodnik et al. (2011) reported significantly lower ALT and AST activity in sows and piglets receiving organic Se yeast relative to the control group. An analysis of biochemical parameters in pigs with acute selenosis during grower and finisher stages revealed the greatest increase in AST activity (Nathues et al. 2010). In these animals, the average AST activity reached 94.1 U l^{-1}, and it significantly exceeded the reference range (8-35 U l^{-1}).

In pigs, normal serum Se levels are difficult to establish due to considerable discrepancies in the literature. According to Constable et al. (2017), serum Se concentration in adult pigs should range from 180 to 220 μg l^{-1}. In turn, Puls (1994) argued that the optimal range of serum Se levels in pigs is 100-200 μg l^{-1}. In the present study, Se concentration was somewhat below or similar to the lower reference limit proposed by Constable et al. (2017) in the Sow-STG group on the first sampling date (15 days before parturition) and in the Sow-CON group during the entire experiment (Figure 2). No significant changes in the Se concentration were observed in the Sow-CON group throughout the experiment. In turn, in the Sow-STG group, the Se concentration increased significantly (from 182.83 to 256.25 μg l^{-1}) already on the second sampling date and remained high until the end of the experiment (Figure 2), which indicates that the administered supplement was readily absorbed from the porcine digestive tract. Orally administered selenitetriglycerides were also highly available for ruminants. In cows, serum Se concentration doubled 24 h after the administration of selenitetriglycerides at 0.5 mg Se kg^{-1} BW (Żarczyńska et al. 2020*b*). In female camels, an identical dose of selenitetriglycerides supplement increased the serum Se concentration from 40.18 μg l^{-1} to 198.79 μg l^{-1} after 24 h (Żarczyńska et al. 2020*a*). After one week of daily supplementation, the serum Se concentration in camels reached 514.76 μg l^{-1}. In two-day-old calves, which are considered monogastric at this age, a single dose of selenitetriglycerides supplement (0.5 and 1 mg Se kg^{-1} BW) induced a 2.9- and 3.17-fold increase in serum Se levels, respectively, relative to baseline values on the next day after administration (Żarczyńska et al. 2021). In a study of pregnant sows that received a concentrate based on Se yeast (250 g t^{-1}; 0.1% SeMet as the active ingredient) throughout pregnancy and lactation, the serum Se concentration increased from 117 to 193 μg l^{-1} (Zavodnik et al. 2011). A similar increase was noted in the current study after the administration of a single oral dose of selenitetriglycerides. Numerous studies have shown that organic sources of Se deliver greater health benefits and improve performance in pigs (Falk et al. 2018, Falk et al. 2020). This observation was confirmed by a recent meta-analysis investigating the effects of various Se sources on the reproductive performance of sows and the growth and development of piglets (Zhou et al. 2021). The cited study demonstrated that organic Se supplements administered to sows significantly increase Se levels in the serum, colostrum and milk, thus increasing the Se concentration in piglets and increasing their body weights at birth and weaning.

Serum Se levels were significantly higher in piglets whose mothers received the selenitetriglycerides supplement (Piglet-STG) than in control piglets (Piglet-CON) (Figure 2). At 3 days of age (first sampling date), the average Se concentration in the Piglet-CON group reached 49.75 μg l^{-1} (± SD 4.35 μg l^{-1}) and was significantly below the reference range proposed by Constable et al. (2017) (70-90 μg l^{-1}). In the Piglet-CON group, the average Se concentration remained below the norm during the entire experiment. According to Sivertsen et al. (2007), plasma Se levels are below the lower reference limit in 54% of piglets between birth and weaning. Pehrson et al. (2001) observed that the Se concentration exerts a greater impact on the health of newborn piglets than vitamin E levels. In the present study, the serum Se concentration in three-day-old piglets whose mothers received selenitetriglycerides on four dates (15, 10, 5, and 3 days prepartum) was higher than that reported by Falk et al. (2020) in five-day-old piglets whose mothers received sodium selenate and SeMet supplements over a period

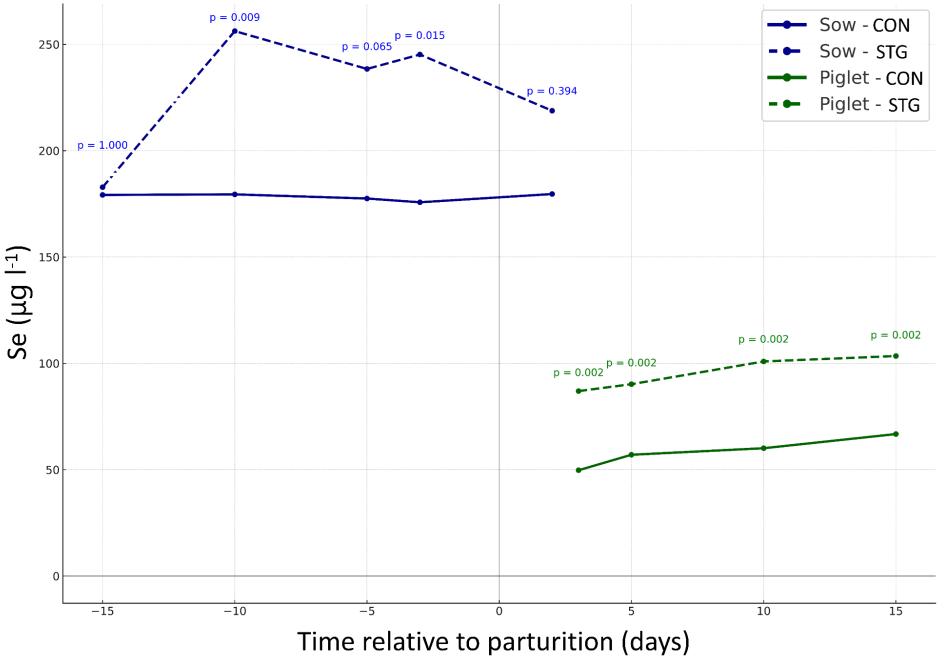

Fig. 2. Serum selenium concentration in sows supplemented (Sow-STG) and not supplemented (Sow-CON) with selenitetriglycerides, and their offspring (Piglet-STG and Piglet-CON)

of one month before parturition. Serum Se concentration increased in both groups of piglets (Figure 2) because Se is transferred with the mother's milk and colostrum to the offspring. Similar observations were made by Falk et al. (2022) who concluded that SeMet is more effectively transferred with the mother's milk than inorganic Se, and is a better source of Se for piglets. According to Surai and Fisinin (2016), in comparison with inorganic Se, organic Se in sow diets is more effective in increasing Se levels, enhancing the antioxidant status of weaned piglets, improving thyroid metabolism, and increasing the activity of the main digestive enzymes in the pancreas of piglets at weaning. In turn, Mahan (2000) supplemented the diets of pregnant sows with various doses of sodium selenite or Se yeast and found that Se levels in piglets were influenced by the Se dose administered to sows, rather than the source of Se. These findings were corroborated by Fagan et al. (2015) who noted considerable differences in Se content between various batches of preparations containing Se yeast. In addition, unlike pure SeMet, Se yeast contains a combination of Se compounds (Far et al. 2010).

The activity of GSH-Px in the whole blood of sows increased significantly in the Sow-STG group relative to the control group (Sow-CON). A significant increase in GSH-Px activity was noted already after five days of selenitetriglyceride supplementation. The analyzed parameter continued to increase during the experiment, and reached the highest value on the last sampling date (2 days postpartum). In the Sow-CON group, GSH-Px activity decreased on successive days of the experiment, and it was lowest on the last sampling date (Figure 3). During late pregnancy and lactation, sows are particularly susceptible to oxidative stress caused by a high metabolic load (Li et al. 2021). Various defense mechanisms involving antioxidant enzymes and non-enzymatic antioxidants have evolved in cells to restore the body's oxidative balance. Glutathione peroxidase is one of the most important enzymes with strong antioxidant activity. This enzyme is composed of four protein subunits, where each subunit contains one Se atom. In the current study, a very high and rapid increase in GSH-Px activity was observed in sows receiving selenitetriglycerides. An equally high and rapid increase in GSH-Px activity was reported in calves after the administration of a single oral dose of selenitetriglycerides (Żarczyńska et al. 2021). Selenitetriglyceride supplements were also effective in enhancing GSH-Px activity in humans (Ksiazek et al. 2013) and mice (Sochocka et al. 2014).

In a recent study, Rao et al. (2023) administered various types of Se supplements (sodium selenite, Se yeast, and hydroxy-selenomethionine) to weaned piglets, and concluded that the source of Se had no influence on GSH-Px activity. Similar conclusions were drawn by Mahan et al. (2014), who found no differences in serum GSH-Px levels between growing-finishing pigs receiving sodium selenite or Se yeast at 0.3 mg kg^{-1}. In the meta-analysis conducted by Zhou et al. (2021), GSH-Px activity was 6.4% higher in sows whose diets were supplemented with organic Se than in sows receiving inor-

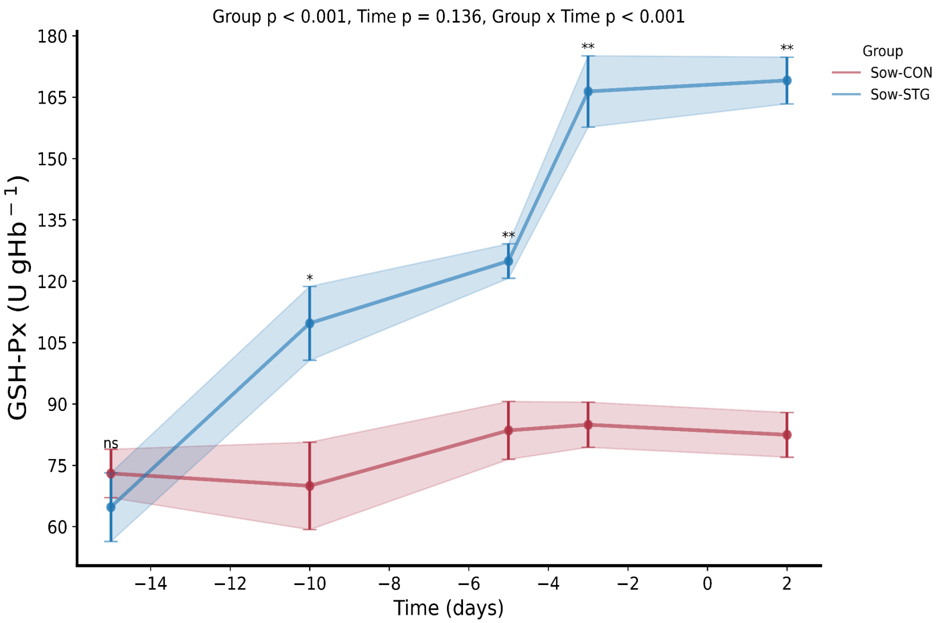

Fig. 3. Glutathione peroxide (GSH-Px) activity in the whole blood of sows supplemented (Sow-STG) and not supplemented (Sow-CON) with selenitetriglycerides

ganic Se. According to the cited authors, pregnant and lactating sows are particularly susceptible to oxidative stress, and an increase in the levels of Se from organic sources in their tissues can improve their antioxidant status. The study demonstrated that the serum Se concentration in sows begins to decrease around 60 days after fertilization and that Se levels decrease significantly before parturition. The decrease in the Se concentration is accompanied by a drop in GSH-Px activity (Mahan and Peters 2004), which increases the risk of oxidative damage in sows, compromises fetal development and the growth of newborn piglets (Zhao et al. 2013). In the present study, high GSH-Px activity in the Sow-STG group indicates that Se derived from selenitetriglycerides significantly stimulates the antioxidant defense system in sows and can minimize the negative effects of oxidative stress in their offspring. According to Surai and Fisinin (2016), selenoproteins play a key role in the antioxidant defense system of newborn piglets, which are characterized by low levels of vitamin E and ascorbic acid.

CONCLUSIONS

This is the first study to investigate the effect of selenitetriglycerides on sows and their offspring. The results indicate that the oral administration of selenitetriglycerides to sows is a safe and effective method of Se supplementation in both sows and piglets. In sows, selenitetriglycerides significantly minimize oxidative stress by increasing GSH-Px activity. Further research is needed to explore the underlying mechanism of action and the potential of selenitetriglycerides supplements in pig nutrition.

Author contributions

G.Ś., D.T., K.Ż. – designed and coordinated the study, K.Ż. – collected the samples, G.Ś., K.Ż. – analyzed the samples, D.T. – conducted statistical analyses, G.Ś., K.Ż – performed the literature review and drafted the manuscript. All authors have read and agreed to the published version of the manuscript.

Conflicts of interest

The funders had no role in the design of the study; in the collection, analyses, or interpretation of data; in the writing of the manuscript, or in the decision to publish the results.

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