Estimation of Statistical Correlations between Ca and P and Period of Gestation and Lactation to Sows Reared in Semi-Intensive System

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Abstract
The research took place in a pig farm which is part of a growing household -annex of semi-intensive type, in the city of Campina, Prahova county. The investigation lasted for 6 months (august 2012 - january 2013).The purpose of the research was to estimate the correlation between the physiological condition of sows and the phosphocalcic status.The research was conducted on two groups of 15 sows chosen differently depending on the physiological state gestating or lactating. They were monitored before, during pregnancy and lactation and after pregnancy, during august 2012-january 2013, taking into account the serum calcium and phosphorus levels. Aimed to monitor the dynamics of serum calcium and phosphorus levels for both batch to groups of sows: gestating sows and sows in lactation, taking into account the average values of the two parameters distributed over a period of six months, so that can make a more accurate estimate of the influence of two physiological status of the two mineral metabolism

Keywords: estimation, gestation lactation, phosphocalcic

1. Introduction

It is known that phosphocalcic metabolism known permanent fluctuations influenced by many factors acting on the animal organism such as age, sex, physiological status, stress, microclimate conditions, genetic factors and feed and exploitation of pigs. In determining the need for energy and nutrients must be taken of the milk production of sows and lactating that prevails disassimilation processes and therefore will lose weight sows [1]. The lactating sow needs energy and nutrients to maintain body tissues and support milk production, while allowing for maternal growth. Excessive negative nutrient balance during lactation can be minimized by increasing sows feed intake or, to a lesser extent, increasing nutrient concentrations of the diet. Sows can produce eight week lactation, 350-400 kg milk. In case of poor feeding conditions, losses can reach up to 40% by weight with devastating effect on productive performance [2]. The energy and nutrient requirements for milk production are directly related to litter growth rate, and can therefore be estimated from growth rate of the suckling pig and number of pigs nursing [3]. Nutrient balance is a critical factor in nutrition of lactating sows. Energy and nutrient demands for body maintenance and milk production must be offset by the energy and nutrients extracted from feed and body tissues. If body tissue is required to make excessive contributions to maintain nutrient balance, the sow will respond by reducing milk output or delaying her return to estrus after weaning [4].

2. Materials and methods

The research was conducted in a pig farm, semi-intensive type, in Prahova county. The
investigation lasted for 6 months, August 2012 - January 2013. Investigations were conducted on two groups of animals: a group of 15 sows in the IIIrd and IVth months of gestation; a group of 15 sows in the third week of lactation.

The experimental protocol was performed during the following phases: information, documenting and methods; selecting animals to assess calcium and phosphorus levels correlated with the physiological state; optimal timing for delivery of metabolic profile; processing samples; organizing information.

Methodology in determining serum calcium and phosphorus: determination of serum calcium was achieved by using EDTA volumetric method. Determination of serum phosphorus was achieved by emission spectrometry. Was used Spectra - Span VI (ICP-AES). Radiation intensity is measured by a photomultiplier, which is amplified and converted digital signal is stored in memory DATA - Spain VI. Statistical analysis was done in order to establish relations between the two categories of various events (mineral status and physiological condition of sows) using average, standard deviation and based on linear correlation with coefficient Pearson (r) (p<0.05; IC 95%) using the program Quattro pro Excel and SPSS Statistics.

3. Results and discussion

The two batches formed from 15 sows picked different according to their physiological state (gestation or lactating), were monitored before, after and during the pregnancy and the lactating period, during August–January, regarding the calcium and phosphorus. The aim was to monitor the dynamics of serum calcium and phosphorus levels for both batches of sows (sows in the IIIrd and IVth months of gestation and sows in the third week of lactation). It was taken into account the average values of the two parameters distributed over a period of six months, so that the estimation of the influence of the two physiological status of the two mineral metabolism could be made as accurate as possible (Table 1).

<table>
<thead>
<tr>
<th>Parameter followed</th>
<th>Units of expression</th>
<th>VIII</th>
<th>IX</th>
<th>X</th>
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</thead>
<tbody>
<tr>
<td>Calcium</td>
<td>mg/dl (X̄)</td>
<td>10.3</td>
<td>10.0</td>
<td>9.6</td>
<td>9.3</td>
<td>9.5</td>
<td>10.0</td>
</tr>
<tr>
<td>Phosphorus</td>
<td>mg/dl (X̄)</td>
<td>6.4</td>
<td>7.6</td>
<td>6.9</td>
<td>6.6</td>
<td>6.9</td>
<td>6.2</td>
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<tr>
<td>Calcium</td>
<td>mg/dl (SD)</td>
<td>0.34</td>
<td>0.15</td>
<td>0.28</td>
<td>0.38</td>
<td>0.25</td>
<td>0.15</td>
</tr>
<tr>
<td>Phosphorus</td>
<td>mg/dl (SD)</td>
<td>0.55</td>
<td>0.6</td>
<td>0.49</td>
<td>0.54</td>
<td>0.49</td>
<td>0.61</td>
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Based on the value of $r = 0.368$ ($r^2=0.136$) it can be said that when the 15 sows were tested there was a weak correlation between this parameter and period of gestation (Figure 2).

Comparing the calcium and phosphorus values obtained during the monitoring period with those obtained in the gestating group the following results were obtained:

1. calcium values had a descending trend during the monitoring period, but it maintained the average serum calcium values close to those of the physiological limits (9.3 and 10.3 mg Ca/dl) (august 2012–january 2013).

2. for this reason, based on serum calcium values obtained in the group consisting of the 15 sows that were in the third and the fourth month of pregnancy it can be estimated that the percentage of cases of hypocalcaemia was raised without being influenced by the initial calcium status (10.3 mg Ca/ml in august). So 59.66% sows in the third month of gestation and 86.32% sows in the fourth month of gestation were diagnosed with different degrees of hypocalcemia;

3. the levels of phosphorus values recorded during augus 2012–january 2013 were below the reference value of phosphorus which motivates the high percentage (88%) of cases of severe hypophosphatemia of sows in different months of gestation. Generally when considering the necessary of calcium and phosphorus for pig populations it should be borne in mind that proper use of these minerals in the body is dependent on three factors:

- adequate levels of calcium and phosphorus in an available form;
- a corresponding relation between them (about 1/2 Ca to P);
- sufficient vitamin D to enable the assimilation of calcium and phosphorus [5].

The monitoring of serum calcium and phosphorus for the lactating sows from august 2012 to january 2013.

For the lactating sows the same monitoring status of phosphorus and calcium was used during august 2012-january. In determining the need for energy and nutrients it should be taken into account both the milk production of sows and the fact that lactating sows do not assimilate just as well thus they will lose weight (Table 2).

<table>
<thead>
<tr>
<th>Parameter followed</th>
<th>Units of expression</th>
<th>VIII</th>
<th>IX</th>
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<th>I</th>
</tr>
</thead>
<tbody>
<tr>
<td>Calcium</td>
<td>mg/dl ($\mathcal{X}$)</td>
<td>10.3</td>
<td>9.8</td>
<td>9.1</td>
<td>9.5</td>
<td>9.1</td>
<td>9.0</td>
</tr>
<tr>
<td>Phosphorus</td>
<td>mg/dl ($\mathcal{X}$)</td>
<td>7.0</td>
<td>7.2</td>
<td>6.4</td>
<td>6.3</td>
<td>6.6</td>
<td>7.0</td>
</tr>
<tr>
<td>Calcium</td>
<td>mg/dl (SD)</td>
<td>0.34</td>
<td>0.31</td>
<td>0.28</td>
<td>0.25</td>
<td>0.21</td>
<td>0.34</td>
</tr>
<tr>
<td>Phosphorus</td>
<td>mg/dl (SD)</td>
<td>0.61</td>
<td>0.4</td>
<td>0.55</td>
<td>0.34</td>
<td>0.49</td>
<td>0.61</td>
</tr>
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</table>
Through diet it is aimed to reduce the losses so that when the sows are weaned they should be in a good state of maintenance. This influences the appearance of oestrus after weaning, the ovulation rate and the fecundity one. Normal body weight loss of sows is between 13-15% of the after calving weight, when a sow lactates for 8 weeks. In case of poor feeding conditions, losses can reach up to 40% of the weight with devastating effect on production performance. Good sows can produce around 350–400 kg of milk during a 8 week lactation [5].

If we take into account the concentration of sow milk nutrients during the 8 weeks of lactation the sow loses through her udders 68–77 kg dry matter out of which 23–26 kg protein, 24–27 kg fat, 17.5–20 kg lactose and 3.5–4 kg mineral salts. During the lactation period the dynamic trend line of calcium has an upward trail with variations in serum calcium levels between 9 mg Ca/ml serum and 10.3 mg Ca/serum. The maximum level of the serum calcium determined by the average serum calcium levels for six months was recorded in august (10.3 mg Ca/ml serum) and the lowest during the first month of lactation (9 mg Ca/ml serum). Based on the value of $r=0.861$ ($r^2=0.7427$) it can be estimated that there are strong positive correlation between serum calcium levels and the lactation period (Figure 3).

![Figure 3. Serum calcium dynamics and trend line in IIIrd week of lactation (august–January)](image)

Regarding phosphorus for the six months of the monitoring it was established a downward trend of the phosphorus dynamic with a slight increase during the first month of lactation (7 mg P/ml serum). Based on the value of $r=0.275$ ($r^2=0.076$) it can be said that for the 15 sows there was a weak correlation between the lactation period and this parameter (Figure 4).

![Figure 4. Serum phosphorus dynamics and trend line in IIIrd week of lactation (august–January)](image)

The high percentage of hypocalcemia registered in lactating sows (93.33%) may be due to limited serum calcium reserves; serum phosphorus showed values close to the reference value for this physiological category (7±1). This may motivate the severely low percentage of phosphorus (20%) for the group of sows in the third week of lactation. According to the literature the percentage of calcium used in the food is near maximum value. For this reason it is necessary that in the composition of CN recipes to take into account that the total amount of calcium in the diet can be used by the body [6]. Medical substances used in food to treat some diseases can affect calcium absorption during the treatment without affecting animal production. Serum calcium levels during august-january at gestating sows remained in a downtrend until the beginning of the lactation. For these reasons during the metabolic evaluation period 59.66% sows in the third month of gestation and 86.32% sows in the fourth month of gestation were diagnosed with varying degrees of severe hypocalcemia. Phosphorus values for the gestating sows during the monitoring period were below the reference level of phosphorus, resulting in a high percentage of cases of severe hypophosphatemia (88% of all sows in different months of gestation). Causes that may lead to these results may be related to the form in which phosphorus is presented in the food and especially the chosen food type. It is known that about 60-70% of organically bound phosphorus is in the form of phytate and this is little available for the pork [7].To increase the biological bioavailability of phosphorus animal protein food must be chosen, dehydrated alfalfa, etc. Moderate amounts of phosphorus obtained during monitoring lactating sows (6.3 and 7.2 mg P/ml serum)
resulted in recording a lower percentage (20%) of cases of severe hypophosphatemia in third week lactating sows; although during the six months monitoring period of lactating sows the serum calcium values were maintained within reference values (10±1) we obtained a high percentage of hypocalcemia (93.33%). This can be explained by the fact that serum phosphorus and calcium are maintained by a balance between osteogenesis and osteolosis and by adjusting intakes and eliminations involving hormonal and vitamins complexes in conjunction with animal production, influencing the metabolism (especially the bone) and reproductive function [8]. Based on the obtained results by both laboratory tests and statistical processing of data, it was shown that there are some nutritional deficiencies in quantitative ratio and especially regarding the phosphocalcic balance of gestating and lactating sows. Out of the mineral elements, calcium, phosphorus and sodium are often missing from the rations and rations supplemented with the salts of these elements are mandatory.

4. Conclusions

It seems that the gestation period is marked by greater losses of phosphorus than calcium, while calcium loss during lactation is higher than those of phosphorus. Comparing calcium and phosphorus values obtained in the group of gestating and lactating sows, with the values obtained from august-january it was appreciated that there is a positive correlation between the concentration of serum calcium and phosphorus before gestation and lactation, and during those two periods. High percentage of severe hypophosphatemia cases (88% of sows in different months of pregnancy) may be due to group values for gestating sows who were below the reference level of phosphorus during the monitoring period. Moderate phosphorus values obtained during the monitoring period of lactating sows (6.3 and 7.2 mg P/ml serum) resulted in recording a lower percentage (20%) of cases of severe hypophosphatemia in third week lactating sows. In terms of quality the recipes for the given food were considered adequate although there are some concerns regarding the quantity and especially the quality of the food after the biochemical laboratory results of the investigations carried out on blood samples collected from sows before, during pregnancy and lactating were released.

References

5. Farmer, C. and Quesnl, H., Nutritional, hormonal and environmental effects on colostrum in sows. Journal Animal Science, 2009, 8(13), pp. 56-64