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EXCHANGE OF PHOSPHORUS COMPOUNDS IN PREGNANT AND LACTATING ANIMALS

ОБМІН ФОСФОРНИХ СПОЛУК У ВАГІТНИХ ТА ЛАКТУЮЧИХ ТВАРИН

Prylipko T.M. / Приліпко Т.М.
d.a.s., prof. / д.с.н.. проф.
ORCID: 0000-0002-8178-207X
Publons: AAF-5445-2019
Koval T.V. / Коваль Т.В.
c.a.s., as.prof. / к.с.н., доц.
ORCID: 0000-0002-7132-5887
Higher education institution « Podolsk State University», Kamianets-Podilskyi, Shevchenko,13,32300 Заклад вищої освіти «Подільський державний університет»

Abstract. *The results of the study of phosphorus metabolism at a high level of lactation are given. In the first phase of lactation, a high content of NF was found in the blood of cows, in subsequent phases due to depletion of phosphorus reserves in the body, the level of NF decreased, and with the end of lactation, the amount of NF increased again. It is noted that the concentration of pyruvic acid increases in the blood of pregnant animals. In the blood serum of rabbits in the second decade of pregnancy, the content of phosphopyruvic acid (FPA) increases, and by the end of pregnancy it decreases, with the beginning of lactation (post-sucking period), the level of FPK increases again, but in the second half of the post-sucking period (15-20 days after birth), it decreases , reaching the lowest values by the end of lactation 25-30 days after the cycle. The content of KrF increases significantly by the middle of pregnancy, decreases by the time of parturition, and increases slightly again by the end of the suckling period. In the conducted experiments, lactating females were slaughtered 22-26 days after parturition. At the same time, the tissues of control (non-lactating) rabbits were studied. The clearest changes were found only in the NF content. In the liver of animals, the content of FPK, total and inorganic phosphate decreased, in the muscles the level of NF only decreased, and in the blood not only NF, but also CrF. In the bones of lactating rabbits, the level of total phosphorus and calcium was also slightly reduced. The results of the experiments are convincing that during intensive lactation, animals have a significant phosphorus deficiency, which is reflected in the content of total and inorganic phosphorus not only in blood, but also in other tissues, in particular - liver, muscles and bones. In the blood of pregnant and lactating animals, a certain dependence is observed between the activity of alkaline phosphatase and the exchange of phosphorus compounds.*

Key words: *phosphorus, element, animals, phosphorylation, blood, fetus, diet, insolation*

Formulation of the problem.

During the period of formation of the fetus in pregnant animals, all types of metabolism increase and energy expenditure increases. In order to carry out synthesis reactions, an increased formation of ATP is necessary due to the activation of those processes during which ATP is resynthesized, that is, primarily due to the reactions of oxidative and substrate phosphorylation. In addition, pregnant animals, in connection with the expenditure of phosphorus on the formation of the fetus, feel an increased need for this element.

Analysis of recent research and publications.

The state of exchange of phosphorus compounds in pregnant and lactating cows can be concluded primarily from the change in the level of inorganic phosphate (NF) in the blood of these animals. As expected, the content of NF in the blood serum of

pregnant animals is not constant. In cows, in the first half of pregnancy, there is an increase in NF [7], from the sixth month, its level decreases. The minimum content of NF is detected in the ninth month of pregnancy.

According to [2], the NF content in the blood of pregnant rabbits gradually decreases until parturition. The main depot from which the body uses phosphorus during pregnancy is bone tissue. In the middle of pregnancy, the bulk of phosphorus is sent to the placenta. At the end of pregnancy, phosphorus especially intensively leaves bone tissue and passes through the placenta to the fetus, saturating its tissues, especially bone tissue.

The level of NF in the blood of pregnant women largely depends on the nature of animal feeding. [6] in 50 pregnant rabbits, it was possible to prevent a decrease in the level of NF in the blood by introducing phosphorus and calcium into their diet. With a well-balanced diet with an optimal content of protein, phosphorus and calcium, it is possible to keep the level of NF in the blood of pregnant animals within normal limits.

Phosphorous metabolism reaches a significant stress at a high level of lactation. In the first phase of lactation in the blood of cows [3] found a high content of NF, in subsequent phases due to depletion of phosphorus reserves in the body, the level of NF decreased, and with the end of lactation, the amount of NF increased again.

Studies [2, 5] showed that in winter and spring, the phosphorus balance in lactating cows is negative (as early as the sixth and seventh months of lactation). A positive balance of phosphorus appears only at the end of the lactation period. According to the author's observations, in the summer months with the presence of green fodder, the phosphorus balance becomes positive from the sixth month of lactation. the main reason for the normalization of phosphorus-calcium metabolism was the increased insolation of animals and the synthesis of vitamin D3.

Research material and methodology.

It was noted [4] that there is an increase in the concentration of pyruvic acid in the blood of pregnant animals. In the blood serum of rabbits in the second decade of pregnancy, the content of phosphopyruvic acid (FPA) increases, and by the end of pregnancy it decreases, with the beginning of lactation (post-sucking period), the level of FPK increases again, but in the second half of the post-sucking period (15-20 days after birth), it decreases , reaching the lowest values by the end of lactation 25-30 days after the cycle. The content of KrF increases significantly by the middle of pregnancy, decreases by the time of parturition, and increases slightly again by the end of the suckling period. The content of ATP+ADP during pregnancy and lactation changed relatively little. Only a slight increase in the level of adenine nucleotides was observed in the middle of pregnancy and a slight decrease at the beginning of lactation. By the end of the lactation period, the content of ATP + ADP increased slightly again. The content of NF changed to a much greater extent. By the middle of pregnancy, its level increased, and by the end of pregnancy it decreased, at the beginning of the suckling period, an increase was observed again and a subsequent significant decrease until the end of lactation.

In general, the dynamics of the studied components during pregnancy and lactation is characterized by an increase in the level of macroergs and NF in the

middle of pregnancy. The level of phosphorus compounds decreases by the period of flowering. With the beginning of lactation, the content of KrF, FPK and NF increases, and by the end of the suckling period, it decreases again.

The high content of phosphorus compounds and inorganic phosphate in the middle of pregnancy indicates the activation of the metabolic processes of the mother's body in connection with the intensive growth of the fetus. The simultaneous increase in the amount of FPK, ATP + ADP, KrF and NF indicated the acceleration of glycolysis and oxidative phosphorylation reactions.

In the second half of pregnancy, a significant part of nutrients is directed to the fetus. The body weight of the embryos increases rapidly at this time. Intensive synthesis reactions in the body of embryos require significant energy expenditure. In connection with the mobilization of proteins and energy-rich phosphorus compounds by the growing fetus, the reserves of these substances are depleted, and their level in the blood of the mother's body decreases.

In lactating rabbits, a significant part of NF is excreted with milk. It is possible that inorganic phosphate under these conditions becomes a factor that limits the intensity of glycolysis reactions and ATP resynthesis, as well as phosphorylation of components of the glycolytic cycle.

During intensive lactation, the ATP content in the blood of animals does not decrease, but the amount of CrF decreases, the phosphate groups from which are more intensively transferred to ADP (CrF + ADP → ATP + creatinine).

It was interesting to find out the influence of lactation on the content of phosphorus compounds in animal tissues. For this purpose, the studied components were determined not only in blood serum, but also in liver, muscles and bones. In the conducted experiments, lactating females were slaughtered 22-26 days after parturition. At the same time, the tissues of control (non-lactating) rabbits were studied.

The most clear changes are found only in the content of NF. The content of FPK, total and inorganic phosphate decreased in the liver of animals, the level of NF only decreased in the muscles, and not only NF, but also CrF in the blood. In the bones of lactating rabbits, the level of total phosphorus and calcium was also slightly reduced.

The results of the experiments show that during intensive lactation, animals have a significant deficiency of phosphorus, which is reflected in the content of total and inorganic phosphorus not only in the blood, but also in other tissues, in particular, the liver, muscles and bones.

In the blood of pregnant and lactating animals, a certain dependence is observed between the activity of alkaline phosphatase and the exchange of phosphorus compounds.

The activity of alkaline phosphatase changes significantly during pregnancy and lactation in animals. It increases in the first half of pregnancy, sharply decreases in the second half, remaining very low throughout it and in the first half of lactation. In the second half of lactation, the activity of phosphatase is restored to the initial level, which is determined in animals before the beginning of pregnancy.

Table 1 - The content of phosphorus compounds in the tissues of lactating and non-lactating rabbits (in mg% P)

components, that are determined	Non-lactating rabbits		lactating rabbits		in %
	number of animals	M ± m	number of animals	M ± m	
Liver					
PDK	6	2,63 ± 0,39	6	1,72 ± 0,38	65,40
ATP + ADP	6	17,01 ± 3,06	6	17,43 ± 0,41	102,46
H R	6	19,46 ± 0,44	6	16,01 ± 1,24	82,27
General R	6	325,6 ± 33,2	6	227,9 ± 9,84	69,99
Muscles					
P R K	6	3,14 ± 0,45	6	3,64 ± 0,28	115,92
Kp R	6	33,94 ± 0,35	6	31,45 ± 0,29	92,26
ATP + ADP	6	22,80 ± 1,33	6	22,94 ± 1,00	100,61
P R K	6	21,16 ± 3,44	6	13,66 ± 0,70	64,55
General R	6	310,0 ± 33,4	6	255,3 ± 14	82,34
Blood					
PDK	6	0,41 ± 0,03	6	0,31 ± 0,04	72,09
Kp R	6	0,72 ± 0,13	6	0,42 ± 0,03	58,33
ATP + ADP	6	2,92 ± 0,33	6	2,85 ± 0,16	97,60
H R	6	4,01 ± 0,32	6	2,51 ± 0,14	62,18
Calcium (mg%)	6	15,24 ± 0,48	6	11,20 ± 0,42	73,49
Bones 6					
Phosphorus is common	6	6514 ± 90	6	6139 ± 51	94,24
Calcium (mg%)	6	15740 ± 514	6	14811 ± 187	94,10

At the first stage of pregnancy, some parallelism is observed between the components to be determined. With a sharp increase in phosphatase activity in the second half of lactation, the content of labile phosphates and NF decreases, that is, in this period, an inverse relationship is observed between these components.

The obtained materials showed the presence of rather complex connections between alkaline phosphatase and the exchange of phosphorus compounds. As [7] showed, with the increase in the activity of alkaline phosphatase in blood serum, the level of NF increases. Similar results were observed when rabbits were irradiated with UV rays. But such dependence is not always manifested. There are known cases when an inverse relationship is found between the NF level and the activity of alkaline phosphatase, and this will be more natural and understandable. For example, with rickets in animals, high activity of the enzyme is often observed at a low level of NF.

How the activity of alkaline phosphatase changes in the mammary gland of rats during pregnancy is very clearly shown [1].

If we compare the activity of the enzyme in the blood of pregnant rabbits with the indicators of phosphatase activity in the mammary gland, it can be understood that during this period the activity of the enzyme in the blood falls due to the mobilization of alkaline phosphatase by the mammary gland.

It is possible that in the second half of lactation, the excretion of phosphorus with milk and a significant decrease in the reserves of this component in the body cause a low concentration of NF in the blood of animals. The need for growing baby chicks, which suck their mother's milk, is increasing every day. There is a persistent need for additional mobilization of phosphorus into the blood, and then into the milk. One of the ways of this mobilization is the increase in the activity of alkaline phosphatase, an enzyme that catalyzes the separation of NF from organic phosphorus compounds.

Thus, the increase in the activity of alkaline phosphatase in this case, as in rickets, should be considered as an adaptive act caused by a drop in the level of NF in the blood to values that are below the physiological norm.

One of the reasons for the increase in the activity of alkaline phosphatase in the blood of animals at the end of the lactation period is a drop in the level of metabolism in the mammary gland due to the attenuation of its function

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Анотація. *Наведені результати дослідження фосфорного обміну при високому рівні лактації. В першій фазі лактації в крові корів* знаходив *високий вміст НФ, в наступні фази в зв'язку з виснаженням в організмі запасів фосфору, рівень НФ знижувався, а із закінченням лактації кількість НФ зростала знову. Відмічено, що в крові вагітних тварин спостерігається зростання концентрації піровиноградної кислоти. В сироватці крові крільчих в другій декаді вагітності наростає вміст фосфопіровиноградної кислоти (ФПК), а до кінця вагітності знижується, з початком лактації (підсисний період) рівень ФПК наростає знову, але в другій половині підсисного періоду (15-20 діб після окролу) він знижується, досягаючи до кінця лактації на 25-30 добу після окролу найнижчих величин. Вміст КрФ до середини вагітності значно зростає, до моменту окролу знижується, а до кінця підсисного періоду знову дещо зростає.* У проведених дослідах лактуючі самки забивались на 22-26 доби після окролу. *Одночасно досліджувались тканини контрольних (нелактуючих) крільчих.Найбільш чіткі зміни виявляються лише у вмісті НФ. В печінці тварин зменшувався вміст ФПК, загального та неорганічного фосфату, в м'язах лише знижувався рівень НФ, а в крові не тільки НФ, але і КрФ. В кістках лактуючих крільчих рівень загального фосфору і кальцію був також дещо зниженим. Результати дослідів переконують в тому, що при інтенсивно протікаючій лактації тварини мають значний дефіцит фосфору, що відображається на вмісті загального та неорганічного фосфору не тільки в крові, але й інших тканинах, зокрема – печінці, м'язах і кістках. В крові вагітних і лактуючих тварин між активністю лужної фосфатази і обміном фосфорних сполук спостерігається певна залежність.*

Ключові слова: *фосфор, елемент, тварини, фосфорилування, кров, плід, раціон, інсоляція*