

Reproductive ability of sows under action of iodine citrate of nanotechnological origin

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The purpose. To find out influence of different quantities of iodine in the form of aqua-citrate on reproductive ability and milking ability of sows and their productive qualities. **Methods.** By a principle of analogues, in view of age (160 – 170 days) and weight of a body (95 – 100 kg) they formed 3 groups of repair pigs. Animals of control group received standard mineral premix (MP) which structure included iodine in the form of salt of potassium iodide. Pigs of test groups were fed with premixes without inorganic form of iodine. However, in a diet, according to the scheme of experiment, they added a water solution of aqua-citrate iodine in the quantities making 100 and 50% of the content of an element in MP. **Results.** It is established that colostrum and milk of sows differ under the content of general lipids. However at addition of iodine citrate of nanotechnological origin in diets of animal of test groups the concentration of general lipids both in colostrum and milk did not change essentially. At sows fed with forage with iodine in form of aqua-citrate in quantity twice smaller, than its content in standard mineral premix, in colostrum they fixed increase of phospholipids on 18,4% ($P < 0,01$) and free cholesterol — on 14,2 % ($P < 0,05$), and also in milk — content of mono- and diacylglycerols on 16,6% ($P < 0,01$) in comparison with parameters of analogues of control group. Alongside with that they observed growth of milk ability of sows on 28,7%, birth rate of piglets — on 10,2%, weight of piglets — on 8,5% (as compared to control group). At addition in a diet of iodine (0,38 mg/kg) in the form of aqua-citrate, equivalent to its content in inorganic form, they fixed decrease of multiplicity at sows, drop in survival of piglets and daily average buildup. That characterizes such doze as irrational and undesirable. **Conclusions.** Aqua-citrate iodine, being the highly active and bioaccessible form, provides stimulating influence on reproductive ability of sows in the quantities making 50% of a dose of iodine in the molecular form.

Key words: *pregnant and lactating sows, milk, colostrum, milking ability, safety of livestock.*

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Mineral homeostasis in the pigs depends on a complete and balanced feeding, including from provision of macro - and microelements. Among others, the vital or essential elements iodine belongs to [1 – 3] whose deficiency in pigs leads to violations of the functional state of the thyroid gland, and, as consequence, to decrease reproductive ability and productive qualities [4, 5].

The main source of trace elements for animal feed. However, despite the fact that their mineral composition is dependent on soil type, climatic conditions, plant species, vegetation phase, chemical activities, the technology of harvesting, storage and preparation for feeding, and other factors, there is often a lack of one and an excess of other elements [6]. In order to prevent this, feeding uses different connections, but its biological availability varies [7]. In addition, the technological properties of inorganic salts of trace elements significantly affect the quality of premixes and animal feed [8].

In recent years, developed and widely used in animal husbandry, various methods of compensation of deficiency of bio-elements [9, 10]. However, of particular interest are organic forms of nutrients in the form of citrates, food acids, which, when getting into the cell, directly involved in energy metabolism [11]. At the same time, promising are studies of the effect of organic compounds of iodine nanoparticles obtained by the method of application of the erosion-explosive nanotechnology, on the reproductive capacity of sows and the quality received from them calves [12, 13].

The purpose of the research is to determine the effect of different amounts of iodine in the form of aquacitrate on reproductive ability, milk yield and productive qualities of sows.

Materials and methods research. The study was performed on 3 groups of gilts: control (K) and experimental (D1 and D2) and later used for gestating and lactating sows, in terms of pig farms "Amila"

Turiysk district of Volyn oblast for rearing gilt F1 from the pure maternal lines Landrace x Large White. Groups are formed according to the principle of analogs with regard to age (170 – 180 days) and body weight (110 – 115 kg).

To study the metabolic actions nanocavity of iodine and the possible inclusion of this essential microelement in such form, the composition of the premixes we used aquacitrate iodine made on the basis of nanotechnologies in TOV "SPK Avatar" (the activity of 1 g per 1 l of solution). Animals in the control group received standard mineral premix (MP), composed of iodine in the salt form of potassium iodide. Pigs of experimental groups were fed with a premix without the content of inorganic forms of iodine. However, to the diet, according to the scheme experience (table. 1), was added an aqueous solution of aquacitrate iodine in varying amounts way moisture they dry food.

That is, animals of the experimental groups received the iodine number was 100 and 50% of its content in the form of inorganic salts in the composition of MP.

Sows on the 3rd day of lactation took colostrum, and 21 days — milk to determine the content of General lipids and correlation of their classes.

According to the results of farrowing sows and development of piglets was estimated: prolificacy (number born alive piglets); body weight of newborn piglets and the weight of the nest; body weight of newborn piglets and the weight of the nest in weaning piglets at the 28th day analyzed the safety (the ratio of the number of live piglets at weaning and newborn); the average body weight of one pig and a lot of nests; average daily gains in this period. On milk yield of sows was concluded by the difference in the weight of the nest of living piglets at birth and weaning.

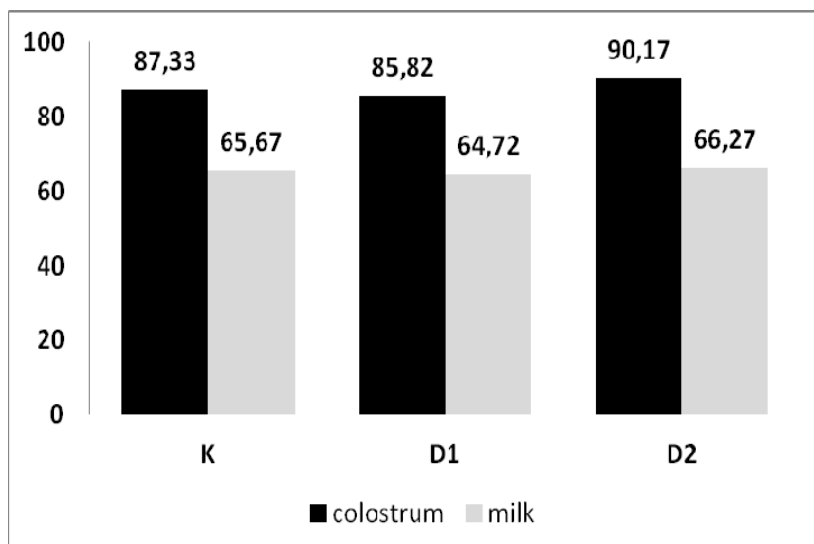
The results of the research. Energy reserves of newborn piglets are very small and consist mostly of glycogen in the liver and muscles. The amount of energy that the pig gets at birth is influenced by genetics and feed quality sows in the period of gestation.

1. The experimental setup for gestating and lactating sows

Group of animals	The diet of sows	
	pregnant	lactating
K	CF+MP (per 1 kg of feed of 0.38 mg iodine in the form of potassium iodide)	CF+MP (per 1 kg of feed of 0.50 mg iodine in the form of potassium iodide)
D1	CF+MP (devoid of iodine) + 0,38 mg iodine in the form of aquacitrate	CF+MP (devoid of iodine) + 0,50 mg iodine in the form of aquacitrate
D2	CF+MP (devoid of iodine) +0,19 mg iodine in the form of aquacitrate	CF+MP (devoid of iodine) +0,25 mg iodine in the form of aquacitrate
Note. CF— complete feed.		

Energy Piglet at birth covers about 35 – 40% of its needs on the first day of life. Therefore, the survival of the piglets is extremely important that the consumption of colostrum and the accumulation of fat in the body. Colostrum from sows allocated at the beginning of lactation for 4 to 5 days it's chemical composition gradually changes and approaches the composition of milk. It is established that all the nutrients contained in the colostrum and milk of the sow to the piglets digested at 90 – 98% and are easily digested. This contributes to significantly higher, compared with the young of other species of farm animals, the growth rate of piglets in the first months of life.

By results of the conducted researches, it is established that colostrum and milk of sows vary according to the content of total lipids (figure).



The content of total lipids in colostrum of sows, $M \pm m$, $n=3$

However, the addition of citrate of iodine nanotechnology origin in the diets of the animals of the experimental groups the concentration of total lipids in colostrum and in milk did not undergo significant changes.

2. The ratio of classes of lipids in colostrum of sows ($M \pm m$, $n=3$), %

Indicators	Colostrum			Milk		
	K	D1	D2	K	D1	D2
Phospholipids	$3,7 \pm 0,3^1$	$3,9 \pm 0,5$	$4,4 \pm 0,4^*$	$3,3 \pm 0,8$	$3,6 \pm 0,3$	$3,7 \pm 0,5$
Mono - and diacylglycerols	$7,2 \pm 0,7^1$	$7,5 \pm 0,5$	$6,8 \pm 0,5^{111}$	$10,3 \pm 0,7$	$10,7 \pm 0,7$	$12,0 \pm 0,4^{**}$
Free cholesterol	$6,6 \pm 0,4^1$	$6,7 \pm 0,3$	$7,6 \pm 0,2^{*1}$	$5,4 \pm 0,6$	$5,3 \pm 0,1$	$5,9 \pm 0,3$
Free fatty acids	$4,1 \pm 0,3^{111}$	$2,8 \pm 0,4^{**}$	$2,8 \pm 0,4^{111}$	$11,9 \pm 0,5$	$10,2 \pm 0,7$	$9,5 \pm 0,8^*$
Triacylglycerols	$70,1 \pm 2,2^{111}$	$70,9 \pm 1,9$	$70,1 \pm 2,0^{11}$	$59,1 \pm 0,9$	$59,8 \pm 3,1$	$58,8 \pm 1,8$
Esterified cholesterol	$8,2 \pm 0,5^1$	$8,2 \pm 0,9$	$8,3 \pm 0,4^1$	$10,1 \pm 0,5$	$10,5 \pm 0,7$	$10,2 \pm 0,5$

Note. $1P < 0,05$; $11P < 0,01$; $111P < 0,001$ — colostrum compared with milk;
 $*P < 0,05$; $**P < 0,01$; $***P < 0,001$ — in comparison to the control (table. 2, 3)

At the same time found that the main lipids of colostrum and milk of sows are triacylglycerols (table. 2), and their content in the colostrum animals of the control group in the first days of lactation was higher than their content in milk by 18.7% ($P < 0,01$). Triacylglycerol — form accumulation of fat in the body, is one of the main sources of energy and the most common among the natural lipids.

Compared to milk in the colostrum was significantly higher was the level of phospholipids by 13.5% ($P < 0,05$) and the content of free cholesterol — by 23.6% ($P < 0,05$). Conversely, in the milk of sows, compared with the colostrum, the higher was the concentration of mono - and diacylglycerol, esterified cholesterol, and free fatty acids.

Is especially important fat-like substances are phospholipids. It is also complex compounds of glycerol and fatty acids, but fats from these they differ in that they contain the residue orthophosphoric acid. Phospholipids due to its structure, have the ability to form bilipidic layer, which is the basis of biological membranes.

In the colostrum of sows that consumed feed iodine in the form of aquacitrate in the amount, which was twice less than in the standard mineral premix, the increase in phospholipids in comparison with control, 18.4%(P<0,01) and free cholesterol by 14.2%(P<0,05).

In the milk of sows in this group the content of mono - and deacilgliceroles increased, compared with the analogues figure of the control group, 16.6%(P<0,01) , with tendency to a slight growth of the percentage of phospholipids and reduce the level of free fatty acids (see table. 2).

Thus, the iodine that enters the body of pigs with feed due to better bio-availability with its aquacitrate form, is actively involved in metabolic processes, provides the corresponding function for the synthesis of thyroid hormones and through it affects the processes of lipogenesis in the body. Thyroid hormones independent and parallel ways stimulate the expression of those genes, which belong to the enzymes that control lipogenesis, lipolysis and the use of lipids as energy sources.

Iodine deficiency in pigs affects the functional state of the thyroid gland. The consequence of non-activities that may be reducing fertility (fertilizing and reproductive ability) of sows, increase the number of abortions, intrauterine mortality of fetuses, retention of placenta and piglets can be born with signs of goiter.

We have found that the use of aquacitrate of iodine in diets in amounts, in terms of the element two times lower than in the control animals and the group D1, contributed to the increase in the birth of young animals, respectively by 5.3 and 10.2%. At the same time, the body weight of piglets obtained from sows of group D2 was 8.5% higher in comparison with newborn piglets in the control group (table. 3). In addition, the pigs were active, with a shiny coat, had a good appetite, thus ensuring their normal growth and development in the suckling period.

3. The influence of aquacitrate iodine on body weight of pigs (M±m, n=5)

Group of animals	Newborns		At weaning (28th day)	
	Weight, kg			
	body 1 head.	the nest	body 1 head.	the nest
K	1,18±0,05	15,69±0,62	7,39±0,21	88,68±2,16
D1	1,10±0,056	13,97±0,59	6,34±0,33*	67,84±1,15**
D2	1,28±0,08*	17,92±0,71*	8,41±0,32*	111,85±2,04***

Obviously, the dose of iodine that has entered the piglets of the group D2 with mother's milk was sufficient for the synthesis of thyroid hormones and their respective effects on metabolic processes, and, simultaneously, contributed to the intensification of the function of milk synthesis in the body itself sows, as evidenced by the indicators of milk ability. In particular, the milk of sows of the experimental group was 93,9 kg and was higher by 28.7%, compared to counterparts in the control group.

It is believed that normally developed piglets at birth and weigh 1 to 1.3 lbs. The weight of pigs at birth is of great importance in the practice of pig production, as is the initial value of the mass of the body, from which proceeds the growth of animals post-embryonic period of life.

In our researches it is established that the performance of fetal weight of piglets obtained from sows of group D2, was dominated by the weight of newly born piglets from the animals of the control group and D1, respectively, 8.5 and 16.4% of (P<0,05).

At the same time, the introduction in the diet of sows of iodine in the citrated form in the amount equivalent to its content in mineral premix standard is unreasonable and most likely undesirable, because it is characterized by certain negative trends in the evaluation of reproductive properties of sows. At the established high levels of thyroid hormones in the blood of sows in group D1 compared to the control group they decreased multiple pregnancies, which was at the level of 95.5%. The weight of newborn piglets significant deviations experienced.

However, to our knowledge, the piglets obtained from sows of group D1 were less viable (table. 4). For the period of weaning from sows, their safety was 91.5% and exceeded the permissible withdrawal set for this local group of animals.

4. The safety of the offspring at weaning from sows

Group of animals	Number of piglets, head	Safety, %
K	12,6±0,58	94,5
D1	11,6±0,33	91,5
D2	13,6±0,33	97,0

Average daily gains of piglets of the study team in the suckling period was 36 g less (see table. 4), and their weight during weaning was 84.9% by weight of piglets of the control group. And it is natural that the mass of a nest weaned piglets from sows of group D1 was lower by 23.5%(P<0,01).

Insights

Aquacitrate iodine as highly active and bioavailable form provides a stimulating effect on the reproductive ability of sows in amounts representing 50% of the dose of iodine in molecular form. The amount of iodine in the form of aquacitrate equivalent to its content in inorganic form (0,38 mg/kg), sows reduces the multiple pregnancies, the safety of piglets and their average daily weight gain that characterizes this dose as irrational and undesirable.

In the future, it is necessary to conduct studies of the effectiveness of Aqua citrate of iodine in the diets of young pigs after weaning and growing-finishing.

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