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Influence of heavy metals in diets on the level of their acomulation in organs and tissues of slaughter pigs, productivity and extraction of ammoniac nitrogen

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The purpose. Complex solution of ecological problems — contamination by joints of heavy metals (lead, cadmium, nickel — Pb, Cd, Ni) of feedstuffs for swine breeding — in a direction of tracking their “behaviour” in linkage: feedstuffs — feed — health of animals — productivity — ecology (level of excretion of active nitrogen), and also their accumulation in meat. **Methods.** Zootechnical, chemical-analytical, mathematical-statistical. **Results.** Influence is determined of heavy metals in feedstuffs on their accumulation in organs and tissues of pigs, productivity and excretion of ammonia nitrogen. Availability in rations of Pb, Cd and Ni in the amounts exceeding maximum allowable level in 10 times affected productivity and well-being of animals (daily average incremental values dropped on 10%, over expenditure of feedstuffs attained 13%) and ecology of emissions of ammonia nitrogen (counting upon unit of increase — up to 11%); promoted their accumulation in killing products. In test group the pathology was observed of weakening of extremities that testified to exacerbation of deficiency of calcium in an organism. It coincided with data about negative influence of heavy metals on metabolism of feed calcium. **Conclusions.** Availability in feed rations of heavy metals in the amounts exceeding maximum allowable level in 10 times negatively reflected in productivity of animals and ecology of emissions, promoted their accumulation in killing products. Heavy metals (Pb, Cd and Ni) were accumulated mainly in bones, liver, kidney and slightly in meat of pigs. Monitoring of heavy metals in rations and feedstuffs has urgency at planning feed provision, risk-management of swine breeding, especially in working areas of technogenic pollution.

Key words: *pigs, ecology, heavy metals, accumulation, killing products, nitrogen emission, productivity.*

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Technogenic development negatively on the state of agroecosystems, and it stipulates the necessity of developing measures to reduce the consequences of its influence, in particular, on the so-called agricultural agrobiocenoses (including pig farms) [3; 4; 6]. In soluting the problems of the production of ecologically oriented pig production in the immediate proximity of the objects of technogenic pollution (highways, metallurgy, and chemical), there is a need to take into account the presence of toxic elements in the diets and their "behavior" in the chain: groundwater-diet-pigs - products slaughter [4; 11]. Scientific monitoring in this chain is a necessary research vector in finding ways to neutralize them and accelerate the removal from the body of pigs before they are slaughtered.

The purpose of research. The search for a comprehensive solution to environmental problems - pollution of heavy metals (lead, cadmium, nickel (Pb, Cd, Ni) feeds for pig breeding - in the direction of tracking their "behavior" in the chain: feed-nutrition-health (welfare) of animals [1] - productivity- Ecology of excretion (including active Nitrogene) - accumulation in the body and meat products [2]. Experimentally substantiate the possible zoecological consequences of contamination of feed by heavy metals (it is actual in riskmedezhment of profile enterprises), the development of technological principles of ecologically oriented farm and industrial pig production (with the cultivation of animals with proper health status, optimized level of greenhouse gas emissions and production of environmentally safe meat

production. In particular, the effect of elevated (10 times the MAC) levels of heavy metals (lead, cadmium and nickel) in the diet of fattening pigs was studied: the level of excretion of Nitrogen and productivity of pigs; accumulation of these heavy elements in organs and tissues (products of slaughter) of animals.

Materials and methods. The scientific and economic experiment was carried out in the conditions of the Experimental Base of Institute of Pig Breeding and AIP NAAS on fattening substrates-analogs of the Poltava Meaty breed according to the scheme presented in Table. 1

Table 1. Scheme of experiment

Group	Number of animals	Feeding conditions
1k	5	OP-main ration
2d	5	OP+Pb,Cd,Ni (in 10 times exceeding PDK)

The main diet was modeled for farms using their own feed and consisted mainly of barley and extruded legumes. It is balanced by energy and protein, but somewhat scarce (according to the norms of nutrition) for the mineral components of macro-up to 30%, micro-30-58%, as well as vitamins A, D3, B2 and B12. The control diet was different from the main contents of lead, cadmium and nickel, which were administered in the diet in quantities exceeding the maximum permissible levels of 10 times (lead - 50 mg / kg; cadmium 4 mg / kg; nickel 35 mg / kg. Young pigs - analogues at 3 months of age were divided into 2 groups of 6 heads. Housing - 2 heads in the machine. Feeding twice a day with wet mixes, available for free water. Salts of heavy metals were added to the grain mixture, pre-dissolving them in water. In the course of the experiment, we studied the indicators: zootechnical (definition of live weight, energy of growth, feed costs,); ecological (level of emissions of nitrogen (nitrogen) per unit of growth. etc. At the end of the scientific and economic experiment in the conditions of the industrial slaughter shop, 5 heds were slaughtered from the control and experimental group. Samples of meat, fat, liver, heart, lungs, kidneys, bones and skin and hair were taken from the carcasses.

At the slaughter, in order to identify possible visible pathological changes in the pig's body, they carried out a veterinary and sanitary examination, in accordance with the "Rules for the veterinary inspection of slaughtered animals and veterinary and sanitary examination of meat and meat products" N 427 (z1261-13) dated 10.07. 2013 [8] ..

The level of Nitrogen excretion per unit of a gain of pigs was determined according to the methodological approaches described in "... National Greenhouse Gas Inventories Principles, 2006 IPCC (Reference: EuropeanEnvironmentalAgency, 2002; USAEPANationalNH3 InventoryDraftReport, 2004 and GHG Inventory Data of Annex I)" [9; 7] .

The trace elements (lead, cadmium, nickel) in the selected samples were determined after appropriate preparation of samples at the atomic absorption spectrophotometer C-600. Biometric data processing was according to specialized computer programs.

Research results. The results of the experiment (presented in Table 2) indicate that the presence of heavy metal salts in the diet significantly reduces the efficiency of fattening pigs, and significantly increases the level of excretion of Nitrogen in a 1 kg of a gain.

Table 2. Results of fattening the pigs on the moderated unbalanced diets with increased contain of heavy metals *(10-fold increase in MAC on Pb, Cd, N i)*

Indexes	Groups 1 (control)	2 (experimental)
Live weight of 1 head starting, kg	28,4± 0,64	28,1± 0,71
Final, kg	89,2± 4,6	81,9+ 5,6
Average daily gain, g	437±29,7	395±40,9
Expenditures of feed per 1 kg:		
f.un., kg	5,07	5,74
Digestible protein, g	502	568
a) Emission of Nitrogen per 1 kg of a gain, g (% ± to control)	1,25	1,40(+10,7)

*- P<0,05; a) -(calculation according to "Leading principles MGEIK 1996; European Environmental Agency, 2002; USAEPA National NH3 Inventory Draft Report, 2004 …and data of the inventory PG of supplement I, presented by sides in the secretariat RKIK OON in 2004» - 0,55 kg N / 1t of live weight – for commodity pig breeding [9].

Thus, the average daily gain of control animals were higher by almost 10%, but the difference in rates was unreliable (P <0.05 Reducing the productivity in the 2nd group led to an overgrowth of feeds per 1kg of a gain, respectively: by feed units (and exchange energy) by 13.2%; digestible protein to 13.1%. A marked increase in the level of nitrogen excretion, calculated per 1kg of a gain in the 2d group, is almost up to 11% (according to control). It is characteristic that during the experiment, in the experimental group there was a pathology of weakening of the extremities, which can be explained by an exacerbation of calcium deficiency in the body. The latter coincides with the data on the negative influence of heavy metals on the metabolism of feed calcium [11]. According to the control slaughter of pigs (in samples obtained from meat, fat, bones, internal organs and skin and hair (Table 3)) it was determined that the introduction of heavy metal salts (in terms of the element - 10 times higher than the maximum tolerable level) to a moderately unbalanced diet of fattening pigs, leads to an increase in the accumulation of heavy elements in products of slaughter pigs.

Table 3. Content of lead, cadmium and nickel in different biological tissues of experimental pigs, mg / kg

Biological tissue	Lead (Pb)		Cadmium (Cd)		Nickel (Ni)	
	1 (control)	2 (experimtntal)	1 (control)	2(experimental)	1 (control)	2 (control)
Meat	0,30± 0,05	0,31± 0,03	0,009± 0,001	0,014± 0,003	1,21± 0,17	1,76± 0,22
Liver	0,83± 0,002	1,02± 0,25	0,049± 0,0036	0,016± 0,006	4,72± 0,67	5,65± 0,62
Kidneys	1,09± 0,43	1,14± 0,13	0,06± 0,02	0,038± 0,007	5,62± 0,29	4,55± 0,69

Lungs	1,27± 0,55	1,37± 0,18	0,019± 0,005	0,017± 0,008	4,32± 0,7	5,87± 0,06
Heart	0,93± 0,17	1,92± 0,51	0,014± 0,001	0,051± 0,03	4,0± 0,35	3,39± 0,25
Bones	3,28± 1,37	4,29± 1,89	0,07± 0,02	0,095± 0,015	24,95± 4,26	34,60± 2,92
Skin	0,85± 0,16	0,80± 0,11	0,1± 0,01	0,12± 0,02	1,51± 0,08	1,56± 0,26

The content of lead in the biological tissues of experimental pigs (mg / kg) is shown in Fig. 1

Fig.1. Diagram of lead content in different biological tissues and organs of experimental pigs, mg / kg (n = 5).

The content of cadmium in the biological tissues of experimental pigs (mg / kg) is presented in Fig. 2

Fig.2 Diagram of cadmium content in different biological tissues and organs of experimental pigs, mg / kg (n = 5).

The content of nickel in the biological tissues of the experimental, pigs (mg / kg) is shown in Fig. 3

Fig.3 Diagram of the content of nickel in different biological tissues and organs of experimental pigs, mg / kg (n = 5).

Analyzing the data of Table 3 and Diagrams in Fig. 1-3, a tendency of the increase of lead content (Pv) in the internal organs, as well as, especially in the bone tissue was noted. Increasing the content of cadmium (Cd) and nickel (Ni), in addition to the internal organs occurred in meat. But a reliable difference is not determined (P> 0.01).

In general, it should be noted that to a greater extent heavy metals are concentrated in bones, and smaller - in meat. At the same time, the veterinary examination of carcasses and internal organs did not show visible pathological disorders in the pigs of the experimental group.

At the final stage of the experiment blood was taken to determine lead and cadmium in its serum. The obtained data showed that the concentration of lead in the blood serum of the 2d pigs' group was higher by 25% -0.2 mg / l, whereas in control animals 0.15 mg / l. As for the cadmium concentration, this dependence is not determined.

Conclusions:

The presence of heavy metals (lead, cadmium and nickel) in feed rations in quantities exceeding the maximum permissible level of 10 times negatively affects on the productivity (well-being) of animals and the ecology of emissions (ammoniac Nitrogen, per unit of a gain); contributes to their accumulation in slaughter products. Heavy metals - lead (Pb), cadmium (Cd) and nickel (Ni) - accumulate mainly in the bones, liver and kidneys and, to a lesser extent, in pig meat. Monitoring of heavy metals in diets and feeds is relevant to the planning of forage supplies, as well as in the analysis of the *risks* of the development of pig breeding, especially in zones of industrial pollution.

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