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PROVIDING OF SANITARY AND HYGIENIC MEASURES AT FARMS AS AN IMPORTANT FACTOR IN INCREASING OF RESISTANCE AND PROPHYLAXIS AGAINST DISEASES IN PIGS

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Summary. The article summarizes our own research and publications on the importance of sanitary hygiene and technological factors to ensure disease prevention, to increase the resistance and productivity of pigs. The emphasis has been done not on the treatment but on the prevention of swine diseases due to the optimization of hygienic parameters' standards, tolerated permissible concentrations of substances in the environment, their influence not only on the processes of thermoregulation in the body and body adaptation but also to the increase of body resistance to infectious agents. Due to non-observance of hygiene and sanitation rules, feeding and drinking regimes in the pig-breeding enterprises, the annual death of animals exceeds 25%, digestive tract diseases are registered in 40–50% and respiratory diseases — in 25–30% of cases. Growth retardation is registered in young animals and the durability does not exceed 83.2–85.6%. High indoor air humidity should be considered as a factor of importance in the etiopathogenesis of respiratory diseases and temperature changes — as a factor to prevent hyperthermia and hypoglycemia. The increase in the efficiency of the work in pig-breeding complexes can be achieved: first, due to the decrease in the influence of environmental factors having the negative impact on the development of swine immunity; second, due to the elimination of negatively acting agents from the external environment and the strengthening of factors that increase the body resistance; third, due to the development of nonspecific immunostimulants and their rational use in the pig-breeding practice.

Keywords: swine, resistance, health, hygiene, sanitation, abiotic and biotic factors

Introduction. One of the main tasks of veterinary science and practice is to provide the effective protection of swine from diseases (Smirnov, 2012). Growth intensity retardation and the manifestation of non-contagious diseases are caused by such factors as non-compliance with microclimate and sanitary intervals for each age group of pigs, their feeding and drinking regime, low level of qualification of service personnel and zootechnical and veterinary specialists. As a result, the annual death of pigs exceeds 25%, respiratory diseases are registered in 25–32% of cases, the diseases of the digestive tract are revealed in 40–50% (Karelin, 1979; Chernyy et al., 2004). The nonspecific resistance of the body is weakened in the pig-breeding enterprises with a capacity of 12–24–36–54 thousand of heads and with 2–2.2 farrows, with the weight gains that are not less than 400 g/day in the pigs on rearing and 500 g/day in the pigs on fattening (Plyashchenko and Sidorov, 1979; Urban and Naymanov, 1984; Schulman, 1985)

The problem of swine disease prevention, the increase in their productivity and resistance to stressful abiotic and biotic factors is one of the most urgent since it is directly connected with the quality of the products. Therefore, special attention should be paid to the issue of sanitary and hygienic provision on pig-breeding farms (Dostoievskyi, 2012).

The aim of our work is to analyze the publications on the role of sanitary and hygienic and technological factors in the prevention of swine diseases and in the increase in swine productivity.

Materials and methods. The review of the publications has been done and the results of our own studies on swine resistance, productivity, conservation and incidence have been analyzed to obtain the necessary information to reveal the factors that affect the efficiency of the pig-breeding industry.

Results. The importance of the above mentioned problem and the necessity of its solution can be explained, on the one hand, by the biosphere pollution with emissions from the complex and, on the other hand, by the prevention of swine diseases. According to the reports (Volkov and Danilov, 2004; Tyurin et al., 2013) a significant amount of ammonia, hydrogen sulfide, carbon dioxide, dust, microflora is emitted into the atmosphere (Table 1). The above mentioned emissions cause respiratory diseases and growth retardation in pigs.

Table 1 — Air contamination at pig-breeding complex

Indicator, kg/h	Power, thousands of pigs			
	12	24	30	108
Ammonia, kg/h	8.9	17.2	20.1	54.3
Hydrogen sulfide, kg/h	6.8	12.1	14.2	25.8
Dust, kg/h	9.9	12.6	24.2	43.2
Microflora, × 10^9 CFU	19.8	36.6	40.2	71.8

Each 10% of animals are observed with affected lung tissue after slaughtering, which means a loss of 30 to 40 g of daily live weight gain. A swine that loses 30 g of average daily weight gain needs 0.1 kg more feeds and if the animal puts on 75 kg (25 to 100 kg) weight, it leads to a surplus of 7.5 kg of feeds/animal, it is 1.3–1.5 €/animal in European prices and as a result it leads to the shortfall in the production (Table 2).

Table 2 — Shortfall in livestock production per 1,000 animals due to poor microclimate

Quantity, animals	Livestock production			
	pork, t	beef, t	milk, t	eggs, thousands
1,000	10	15	400	25

The live weight gain in the young animals occurs due to muscle tissue and in the adult animals — mainly due to fat deposition. Therefore, to obtain high live weight gains at an early stage of rearing is economically and physiologically beneficial. The production of 1 kg of meat requires 30–35 MJ of exchange energy and 1 kg of fat — twice more.

Researchers and practical specialists pay much attention to the provision of optimal microclimate parameters, in particular, the temperature and humidity regime (Genev et al., 1974; Torpakov, 1980; Prange and Bergfeld, 1975; Schulman, 1985; Demchuk and Pavliuk, 1994).

The experience of pork production proves that 'keeping pigs in cold conditions is expensive'. That is, the optimal microclimate, even if it is not cheap, can provide high productivity, conservation of animals and the production of high-quality products that makes it possible not only to recoup all the costs but also to make profit.

Modern genotypes of swine are like a Mercedes, they require proper feeding, care and maintenance in order to get the maximum out of them. Such conditions are: temperature and humidity regime, full and balanced feeding with amino acid composition, especially lysine, which is essential for protein digestion in animal and human body. In addition, if 25 to 30 years ago pigs were treated 'pig-like', that time has irretrievably gone and therefore animals require careful attention (Demchuk and Chornyi, 2011; Medvedskyi, Brylo and Sadomov, 2014).

In our opinion, the reports on the advisability of keeping pigs at low temperatures are debatable. In the conditions of the economy of energy resources to ensure the required temperature and humidity regime, first of all, it is necessary to increase the resistance to heat transfer of the enclosing constructions and then, if necessary, to use a heating system.

The studies have shown that at the outdoor temperatures below – 10–15 °C (with daily fluctuations from 0 to 20 °C), the biological heat of animals is insufficient to provide the optimum temperature and humidity regime in the pigsties. The coefficient of walls' resistance to heat transfer (CRH) of walls is below 0.86, ceilings — below 1.34 W/m^2 °C but it is necessary to have not less than 1.5 W/m °C and 1.8 m^2 K/W are needed (Plyashchenko and Sidorov, 1987; Chernyy et al., 2004).

This is particularly true for the construction of the floor since the pigs contact with the floor for 70% of daily time. And if the coefficient of resistance to heat transfer is less than 2 W/m^2 °C it leads to hypothermia and, as a result, to respiratory disease (Kuznetsov et al., 2001).

An important factor that ensures a high level of sanitary conditions on the farms is the compliance with the principle 'everything is empty–everything is occupied'. In our experiments the pigs of the control group were grown in the pen (without sanitary interval), the pigs in the experimental group 2 were kept in accordance with the principle 'everything is empty–everything is occupied' and the pigs of the experimental group 1 were kept in accordance with the above principle when the pens were free (wet disinfection, current repair). Under these conditions, the level of air contamination with the microflora was: in the control group — 486.4 ± 20.1 × 10^3 CFU/m^3 before setting and 892.0 ± 17.1 × 10^3 CFU/m^3 after 60 days, in the experimental group 1 — from 390.3 ± 18.3 to 792.6 × 10^3 CFU/m^3, in the experimental group 2 the air contamination by microflora did not exceed from 115.3 ± 0.54 to 211.6 × 10^3 CFU/m^3, respectively. The young animals in sections 0–1 and control one were grown under the influence of biological stress — microflora, especially *E. coli*, α-β-hemolytic streptococci. The results are given in Table 3.

Table 3 — Productivity, morbidity and preservation of the young depending on the principle of 'everything is empty–everything is occupied'

Group	Average daily weight gain, g live weight, kg/2 months	Disease with symptoms, %		Preservation, %
		gastro-intestinal disorders	respiratory disorders	
Control	11.64/177	25.8	18.5	83.2
Experimental 1	12.35/189	17.6	11.2	85.6
Experimental 2	16.35/225	3.4	2.3	96.1

It can be seen from Table 3 that the use of the premises without sanitary intervals (control) or partially (0–1) did not give a positive effect. The average daily gain did not exceed 177 and 189 g, the preservation was 83.2 and 85.6%, gastro intestinal disorders were registered in 25.8–17.6%, bronchopneumonia — in 18.5–11.2%, respectively.

A factor to prevent hypothermia and hypoglycemia is the provision of temperature of 30–32 °C with a decrease to 20–24 °C for the suckling pigs in the area of their housing and high humidity should be considered as a factor of importance in the etiopathogenesis of respiratory diseases (Prange and Bergfeld, 1975; Vachev, 1979).

The duration of sows' use for rearing is also an important factor in the effectiveness of pig breeding. The importation of animals from outside, especially from abroad, can hardly be considered expedient and economically justified. From our point of view, the recognition of such an approach is not unambiguous and justified. Because of the weak selection, non-compliance with hygiene and full-value feeding, a threat to high productivity appears, and therefore it is necessary to recognize that the importation from other states is forced. Forcibly transported animals of import breeding are in a stressful situation in the absence of similar conditions and technologies that were in the 'homeland'. The practice shows that many highly productive imported animals have to be prematurely culled (Baranikov, Mikhaylov and Kolosov, 2012). The genetic potential of domestic swine genotypes is as good as that of imported ones and to a large extent they exceed imported animals. According to Akselgaard, the founder of the Danish firm 'Danosha' in Ukraine the selection, proper feeding, temperature regime and lighting for every period of animal growing, strict discipline, knowledge and skills of the staff are the solution of the problem (Koval'chuk, 2013).

The experience of the work of the farms shows that the metabolic pathology (avitaminosis, alimentary anemia, microelementosis, hepatodystrophy, ketosis), limb diseases: arthritis is registered in 3.8% of the pigs at the beginning of fattening, in 25.8% — at the end of the fattening period. Of the 200 surveyed 6 month aged pigs on fattening 36% of pigs of the Landrace, Large White breed kept without bedding on the slatted floors had the posture of a sedentary dog and immobility.

The animals of meat breeds are more susceptible to diseases. Morphofunctional disorders of the extremities were recorded in 72–80% of boars, deformation of the tarsal bones of the hind limbs was revealed in 35–43% of boars, in 7–10% of boars — paralysis of the forelegs and in 1.5–3% — paralysis of the hind limbs was registered.

In some European countries due to the achievement of genetics and quality of feeds, the costs for pork production were 2.0-3.1 kg, in Denmark — 2.66 kg, in Germany — 2.92 kg, in Ukraine — 4 kg, that is, the organization of proper feeding is a problem. Every 4th pig does not reach the commodity conditions because of the improper feeding, antisanitary conditions and respiratory diseases. Mycotoxins cause great damage to the pig-breeding enterprises that are protein factories. Data analysis of toxicological laboratories proved high contamination of grain and fodder with mycotoxins. Thus, desoxynivalenol (DON) was detected in 94%, T2 — in 39%, zearalenol — in 81% of the examined samples. Mycotoxins that contaminate fodder and food (meat, milk, eggs, cheese, cottage cheese) are of great danger. The impact of 200 °C temperature and higher on the above mentioned mycotoxins is ineffective and aflatoxin is inactivated at 320 °C. Because of the low molecular weight of toxicogenic fungi, animals and humans do not produce antibodies to mycotoxins, that is, the body is not protected from their effects during their lifetime (Smirnov, 2012). The content of mycotoxins in feeds in any concentration has a negative impact on the productive parameters of pigs (Table 4).

Table 4 — Effect of desoxynivalenol DON on the efficiency of weaner rearing

Indicators	DON content in feeds, mg/kg			
	0	4	8	10
Feeds consumption, kg/day	2.05	1.76	1.47	1.28
Feeds conversion/gains, kg/k. ed.	2.32	2.22	2.63	2.94
Average daily weight gain, g	890	800	580	450
Price of wheat, $/t	155	143	126	59

Despite the numerous studies, the requirements of pigs of different ages to temperatures, combination of temperature and humidity in the environment, duration of light, bacterial composition of the air, its permissible species and quantitative characteristics and the geometric parameters of the pigsties are not studies properly. In the early 1980s, a sensation was reported by the Irish farmer about the effectiveness of keeping pigs on fattening at the temperature of + 30 °C and humidity — 100%, when the ventilation went out of work. Nothing negative happened: no cases of animal death or diseases were registered, the average daily gain remained at the same level (Stasenko, 1974). It is worth mentioning because we have to state that according to the literature sources, very few people are engaged in studying the combination of microclimate parameters (temperature and humidity) and their influence on pigs. During the experiment (1965–1966) it was proved that the pigs weighing up to 60–80 kg grew better at 21 °C (the average daily gain was 200 g more than at 16 °C). It was found that when keeping pigs at temperatures up to 15 °C, the synthesis of nitrogenous compounds in pigs on fattening decreased by 2–3 times but it was enhanced and the above compounds were used as the energy material at low temperatures (Heyitman, Kelli and Bond, 1965 cited by Stasenko, 1974)

The main components of the productive potential are feeding (65%), breed features (15%), veterinary and zootechnical support (10%), conditions of maintenance (10%) (Plyashchenko and Sidorov, 1979; Kavardakov et al. 2012). According to the reports, the piglet of 60 kg live weight and an average daily gain of 850 g should consume 2.5 kg of dry matter of feeds that contain 435 g of crude protein and the body synthesizes 127.5 g of protein out of the above amount to maintain the productive potential.

This protein contains only 22 g of lysine, without lysine there is no assimilation of protein in the body of animals and humans.

There is no data on the health status of the long-living boars, sows, 6–8 farrows of different genotypes used in the industrial pig-breeding enterprises.

In the pigsties with 2-row-location of pens and imperfect ventilation the share of aerostases was 25–30% and with 4-row-location of pens — 35–40% of the floor space. Aerostases are characterized by high temperature — 28–30 °C, humidity — 86–92%, the concentration of ammonia — 20–30 mg/m^3, carbon dioxide — 2.5–3.5 l/m^3 (0.25–0.35%) which is the reason for the decrease in resistance and, hence, the safety and productivity of pigs (Sokolov, 1998). Until now, the size of technological groups of pigs on fattening has not been substantiated. The researchers who carried out the experiments with variants of 10, 20, 40, 50, 60, 100, 150, 200 animals in the pen without giving a reason came to the trend: ‘The less animals in the group, the higher the live weight gain and the higher the fodder payment for the best indicators of the quality of pork’ (Stasenko, 1974). The standards of water consumption have not been substantiated. The above-mentioned standards of water for drinking 6–8 l/kg of dry fodder adopted more than 100 years ago (Klimmer, 1912) did not have changes for pigs of different age groups (Skorokhod’ko, 1930; Onegov, Khrabustovskiy and Chernykh, 1984; Medvedskyi, Brylo and Sadomov, 2014). And only Sas (2008) clarified the drinking regimes and provided data on the norms of water consumption for pigs. Since the ratio and mixed fodders’ composition has been changed, a technologist should know not only how to calculate but also what norms to introduce into the project with given rations, as well as fodder preparation methods. The problem of wastes utilization and the norms of manure and urine output has not been solved. For example, an error in calculations per 100 g/animal at farms with a population of 5,000 pigs requires additional daily capacities (manure stores) or machines for its processing by 5 t. In our opinion, the existing standards for pigs, for water supply and manure output have the errors of up to 50% of daily excretion. (Stasenko, 1974)

The parameters of some factors such as the front and the frequency of feeding, the temperature of feeds prepared for eating have not been substantiated, there is not enough research on the study of swine ethology. The maximum permissible concentration of ammonia, carbon dioxide is required to be refined and revised since the above parameters have been provided for extensive pig breeding (Tyurin, 2004; Voronin, Kochish and Naydenskiy, 2006).

Discussion and conclusion. Data analysis of literature sources (Yurkov, 1985; Plyashchenko and Sidorov, 1987; Smirnov, 2004; Kirillov, Petryankin and Semenov, 2006; Baranikov, Mikhaylov and Kolosov, 2008; Chornyi et al., 2015) has shown that high level of morbidity in animals, premature culling of the breeding stock, low resistance of young animals and their growth retardation at pig-breeding enterprises are caused by the complex of abiotic and biotic factors: non-observance of the optimal microclimate, the maintenance of pigs under conditions of adynamia and hypoxia, high contamination of the air with microflora, using of premises without sanitary intervals; ecologically poor habitat, weak adaptation of the imported from outside pigs to the production technology, feeding type with commercial feeds, lack of insolation; metabolic disorders caused by the using of feeds contaminated with fungi; the presence of conditionally pathogenic microflora, causative agents of cutaneous and parasitic diseases (Urban and Naymanov, 1984; Kirillov, Petryankin and Semenov, 2006). The problem of non-contagious diseases is the most important pathology in general, including infectious pathology. That is why, in conditions of intensive animal use, the activity of veterinary specialists should be directed not to treatment of diseases but to their prevention. We keep in mind: first of all, prevention of non-contagious and infectious diseases and stress, mycotoxicosis, development of methods for stimulation of natural resistance mechanisms; second, microclimate optimization in accordance with age characteristics of animals providing their life ability and production of ecologically safe pork; third, the quality of feeds, the ecologization of the biosphere and minimization of drugs’ use, especially antibiotics; fourth, studying the impact of environmental factors on body resistance and immunological reactivity of pigs.

The solution of the posed tasks also refers to infectious pathology since abiotic stress factors can have depressing effect on immunogenesis and lead to decreasing in immunity intensity. We think that the problem of disease prevention can be solved by joint work of infectionists and hygienists (Sokolov, 1998; Smirnov, 2012). For today, hygienic and ecological standards of environmental conditions and sanitation cannot be considered acceptable without their physiological substantiation although immunological and physiological indicators have not been widely used in the hygienic research.

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