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OPTIMIZATION OF INDOOR MICROCLIMATE PARAMETERS IS AN IMPORTANT FACTOR IN STIMULATING METABOLISM IN THE BODY AND INCREASING PIG PRODUCTIVITY

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Abstract

Numerous scientific studies conducted in recent years have proven that, along with genetic and feeding factors, the provision and control of optimal microclimate parameters is closely related to the physiological state of animals, the course of the main metabolic processes in the body of pigs of different ages and productive groups. It is known that the potential productivity of animals under unsatisfactory housing conditions is realized only by 70-80%. Among these indicators, an important role in the process of growing pigs belongs to the microclimate of the premises - temperature, humidity, speed of air movement, its gas composition, concentration of harmful gases, microorganisms and dust in it. When pigs deviate from the optimal parameters, thermoregulation and metabolism are disturbed, the digestibility and assimilation of feed nutrients deteriorates, and as a result, productivity decreases, which ultimately negatively affects the quality of pork and the efficiency of production. Taking into account the constant intensification of pork production processes and climatic changes on the territory of Ukraine, the study of the influence of indoor microclimate parameters on metabolic processes and productive qualities of pigs of different age groups is relevant and of both scientific and practical interest.

Key words*: indoor microclimate, metabolism, pig productivity, stress.*

INTRODUCTION

Countries with a developed pig-breeding industry are constantly improving the technologies of keeping, feeding, selection and breeding of animals. It should be noted that in recent years, significant progress has been made in our country in improving the technologies of this branch of animal husbandry and increasing the efficiency of pork production.

Along with this, it should be emphasized that climate changes create a number of problems in ensuring proper microclimate standards in premises for keeping pigs, especially under modern, industrial technologies of their cultivation.

The microclimate of livestock premises is a set of various parameters, primarily such as: temperature, humidity, speed of air movement, chemical composition of air, content of dust, microbes, and harmful gases in it. The microclimate of the premises largely depends on the seasonality of maintenance, technology, livestock, supply of feed and water, removal of manure.

Modern pig farms today look more like intensively working industrial facilities than the traditional farms of the past. Rooms for keeping pigs are equipped with complex systems for creating and controlling optimal microclimate parameters, which take into account the growing requirements for new genotypes of pigs, comfort, economy and environmental friendliness of their keeping and breeding technologies.

Taking into account global climate changes, which cause a significant and long-term increase in temperature, causes the development of heat stress in pigs, it is an urgent problem that requires the creation of optimal microclimate maintenance systems in rooms for keeping all technological groups of pigs.

MATERIALS AND METHODS

The article has a review and analytical nature, in which the results of numerous scientific studies of domestic and foreign scientists in recent years are analyzed and summarized regarding the violation of metabolic processes in

the body of pigs when the optimal parameters of the microclimate are not observed, as well as the relationship with the state of health and productivity of animals.

RESULTS AND DISCUSSIONS

In the conditions of intensification of the pig breeding industry, it is necessary to evaluate the effect of all factors affecting the welfare of animals. First of all, this concerns the microclimate of the premises and its most important parameters, such as temperature, humidity and air movement speed, as well as the presence of harmful gases. In this connection, the requirements for the creation and operation of automated microclimate systems are increasing.

The formation of microclimate in the premises is influenced by various factors, in particular the climate and topography of the area, the ecological condition of the soil, heat-insulating and other properties of building materials, the type and age of animals, the technology of their maintenance and other factors. In order to maintain proper health and productivity, full manifestation of physiological functions in the body of pigs, it is necessary to maintain optimal parameters of the microclimate in the premises and take into account the effect of seasonal factors, both positive and negative effects of which have been confirmed by many scientists. In particular, Gerasimchuk (2018) believes that in order to increase the profitability of pig farming in Ukraine, as in the whole world, more and more attention is being paid to the development of new technological approaches to the issues of livestock conservation, growth intensity, health animals and veterinary well-being, and increasing the level of these factors is possible only under the condition of a comprehensive solution to the issues of the influence of microclimate conditions, the action of stressogenic factors, maintenance, feeding for the growth and development of pigs of various technological groups.

In turn, Mylostyviy (2019) asserts that high air temperatures in the hot period of the year are an acute problem in the conditions of keeping a large number of animals in a limited space, and taking into account the seasonal dynamics of the content of pests gases in premises for keeping pigs, it is the transitional periods of the year that are problematic for maintaining the optimal content of ammonia, hydrogen sulfide and especially carbon dioxide in it, even in conditions of significant air movement.

In the works of Mikhalko & Povod (2019) it was established that at high outdoor air temperatures, the geothermal type ventilation system makes it possible to create more comfortable temperature conditions in the room for keeping sows and realizing their productive qualities. However, the increase in temperature and low air humidity in the premises for sows require the implementation of additional measures to normalize their regime.

According to Bugaevskii et al. (2010), temperature is closely related to relative air humidity and has a significant impact on pig development indicators. Increased or decreased humidity negatively affects the health of piglets. When the air temperature in the pigsty deviates from the norm and decreases, the moisture concentration automatically increases. Condensate settles on the walls and ceilings in the room, which leads to the freezing of the room, the development of fungi and pathogenic microorganisms. At elevated temperatures, air humidity drops catastrophically and the air dries out. In such conditions, pigs overheat, which also negatively affects their general condition. The optimal moisture content in the room where the pigs live should be in the range of 60-70%. Such an indicator contributes to the active development of healthy animals and the increase of their population.

The long-term harmful effect of an unfavorable temperature and humidity regime often remains imperceptible, so the damage caused by such an effect is usually not taken into account, and the overspending of feed to support heat exchange processes at low temperatures and high air humidity leads to a decrease in efficiency. the difficulties of running the pig industry, especially at enterprises with small herds (Mylostyviy et al., 2019). Thus, in the climatic conditions of Ukraine, the study of the influence of the above parameters of the indoor microclimate on the reproductive qualities of sows, the live weight of newborn piglets and the course of oxidation-reduction processes in the body of animals are relevant and require a more detailed study.

Foreign researchers, in particular, Baumgard (2015) and others note that non-compliance with the optimal parameters of the microclimate can contribute to the spread of diseases, a decrease in the natural resistance and productivity of pigs. In turn, compliance with regulatory parameters in premises for keeping pigs contributes to the full course of physiological processes in the body, supports its homeostasis, strengthens adaptive capabilities, prevents the occurrence of stressful conditions, ensures high productivity of animals and profitability of the industry.

The research of Muns (2016) proved that under the influence of seasonal factors, phenotypic fluctuation is observed for some productive and reproductive characteristics of pigs. In particular, high ambient temperature negatively affects feed consumption in sows and the weight of weaned piglets. High temperatures during farrowing worsen the welfare of the brood stock, which negatively affects the growth and health of the offspring.

The scientific works of Claus & Weiler (2020) show that under the influence of seasonal temperature fluctuations, boars of different genotypes often show a reduced synthesis of steroids, the number of sperm and libido in the summer, compared to the optimal indicators that are characteristic of the winter period. In sows, ovarian anestrus can be affected mainly in summer, occasionally in February - March. In addition, the frequency of ovulation in sows is lower in summer, and its frequency increases in late autumn and winter. As a result, the interval from weaning piglets to estrus in sows increases in the summer, during this period mating causes a decrease in the level of fertilization and, as a result, a smaller number of piglets at birth.

It was also established by De Rensis (2017) that, in firstborns and sows, the summer-autumn season is characterized by reduced fertility, and heat stress in the warm season can cause a decrease in feed consumption, while the imbalance of activity disrupts the physiological development of follicular and luteal bodies, reduces the quality oocytes and increases the mortality of embryos.

Bloemhof (2013) notes that heat stress has a more pronounced effect on reproductive performance in gilts than in mature sows. In particular, heat stress during the third week (from 14 to 21 days) before the first insemination significantly affects the farrowing speed. Heat stress in the period between the 7th day and before successful fertilization, i.e. up to the 12th day, significantly affects the total number of piglets born.

Studies by Kerr (2003), Renaudeau (2012) and Johnson (2015) showed that heat stress negatively affects live weight gains in pigs and suggested that this may be related to the course of physiological processes in the body caused by an increase in body temperature.

According to Pearce (2012), an increase in body temperature causes morphological changes in the intestines of pigs, since animals under heat stress have a higher body temperature and may have more intestinal damage. than in animals that are in comfortable conditions. In addition, under the influence of high temperatures, the secretion of gastric juice is suppressed, its bactericidal function is insufficient, the activity of pepsin decreases and the concentration of total protein in the blood increases. The proteolytic group of enzymes – pepsin, trypsin, enterokinase – is most inhibited, as a result of which digestion processes worsen and the rate of absorption of amino acids decreases. In addition, pancreatic enzyme secretion is inhibited, intestinal motility is suppressed. Accordingly, the appetite decreases, and therefore the productivity of animals. Kluzáková (2013) also found a significant decrease in sulfur gain in piglets raised in machines located away from fans and air intakes of the microclimate system.

Renaudeau et al. (2008) found that mitigating the negative impact of heat stress on pigs by creating an optimal microclimatic environment in a piggery can be achieved by designing premises, ventilation systems and using methods of evaporative cooling taking into account the peculiarities of local climatic conditions. However, Morello (2018) notes that despite any technical improvements of modern indoor microclimate systems, the air composition of the environment in pig farms is significantly affected by unpredictable external climatic changes, which can negatively affect the productivity of pigs.

In the scientific research of Costa (2014), it is reported that there is a difference in microclimate indicators for typical ventilation systems

in the same rooms for growing pigs, which can have different effects on the thermoregulation of animals. According to Close et al. (2014), air velocity is important in convective heat loss, and its decrease can reduce the power of heat removal in piglets, which causes an increase in body temperature and, as a result, temperature stress.

Krommweh et al. (2014) established that increasing air mobility at high ambient temperature has a positive effect on the body of pigs, increasing heat output and preventing overheating. With an uneven distribution of air flows in the room, there are dead zones, that is, zones with a reduced air movement speed (less than 0.05 m/s) and a high concentration of harmful gases, dust and microorganisms, which has a negative effect on the health of animals. In the cold and transitional periods of the year, the optimal speed of air movement in pig houses is 0.15-0.3 (m/s). In summer, the speed of air movement can be up to 1 m/s or more, depending on the season and climatic zone.

The results of numerous scientific studies indicate that as a result of the vital activity of animals, the decomposition of nitrogen and sulfur-containing substances in manure and bedding, as well as insufficient air circulation in the premises, significant concentrations of ammonia and carbon dioxide can accumulate, hydrogen sulfide, mercaptans, methane and other gases. As research by Patel et al. (2018) shows, long-term keeping of pigs in closed rooms with an increased concentration of these gases causes deviations and disorders in the course of metabolism in the body, the development of deep morpho-functional disorders in organs and tissues, and a decrease in natural resistance and immunological reactivity of the body.

It has also been studied that in livestock premises where the excessive level of ammonia, hydrogen sulfide, and carbon dioxide in the air reduces the productivity of pigs and increases the percentage of culling, as well as increases the level of overspending of feed per unit of production.

Research by Parker (2010) indicates that elevated concentrations of ammonia have a pronounced effect on the ethological interactions of pigs, while animals in such conditions demonstrate greater aggression. In addition, pigs exposed to a high level of mechanical noise, which is a feature of artificial ventilation, are less prone to aggressive actions than pigs kept under elevated ammonia levels. It is noted that increased concentrations of ammonium can worsen social stability in technological groups, although the mechanisms of its influence are currently unknown.

According to Philippe (2011), high density of animal housing or inadequate design of machines can increase floor pollution and cause an increase in NH3 concentration, which is statistically correlated with the ambient temperature and ventilation rate in the room for keeping pigs.

The research results of Saha (2014) proved that the concentration of NH_3 in the pig complex changes seasonally and depends on the values of the external temperature. During the year, significant correlations ($P<0.001$) of NH_3 concentration with external seasonal climatic fluctuations were established, including external temperature, humidity, wind speed and direction, hour of the day and day of the year.

The above literary data generally indicate that the creation of comfortable conditions for keeping pigs supports the normal course of metabolism in the body, reduces morbidity, reduces feed costs and improves the economic efficiency of pork production.

CONCLUSIONS

Experimental studies conducted in recent years have established that the creation of comfortable housing conditions and appropriate microclimate standards at pork production enterprises is an important component of modern intensive pork production. The given literary data also show that the regulatory provision of such microclimate parameters as temperature, humidity, air in the room with the optimal concentration of harmful gases in them are extremely important factors for ensuring the welfare of pigs, optimizing the course of metabolism in their organism, the proper productivity of animals and obtaining high-quality products of the pig breeding industry.

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