



## PRINCIPLES OF BUILDING A HEALTHY DIET IN MODERN INDUSTRIAL PIG FARMING

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### ABSTRACT

*Excessive differentiation of pigs by meat qualities corresponds to well-defined genetic data and has led to a weakening of the constitution. The heart has become relatively small, the blood volume is large with a thick consistency, the hypothalamus is underdeveloped, the thermoregulation mechanism is not well-established, and the limbs are very weak. Intensive breeding of such pig breeds under the conditions of industrial technology implementation coincides with the most powerful negative impact on mental sensitivity and a tendency to herd hysteria. Among the main reasons for the decrease in adaptation to the microclimate of pig keeping, experts highlight: 1) the need to optimize pregnancy, 2) early weaning of piglets from maternal nutrition, 3) the formation of very large groups of piglets (more than a thousand) for growing and fattening, 4) transportation of animals, which causes a stressful state, which is accompanied by a decrease in the quality of meat products.*

*The biochemical basis of the emotional stress response of animals is oxidative stress, which can be counteracted with the help of the powerful antioxidant chitin-glucan-melanin complex from the tinder fungus *F. fomentarius* (CHMC). At the same time, CHMC has an aseptical mechanism of action. Unlike antibiotics, it is not toxic to the host cells and is simultaneously aimed at overcoming non-infectious diseases by binding the detritus of the body's own tissues, mediators of the general inflammatory reaction, free radicals, in particular reactive oxygen species, nitrogen, etc. The introduction of CHMC into feed mixtures reduces signs of stress reaction, has a positive effect on the blood system, excretory system and immunity. The result of such a policy is an improvement in the health of the studied pigs, an increase in the quality and reduction in the cost of meat obtained from them.*

**Keywords:** *Fomes fomentarius, Chitin, Glucan, Melanin, glucan-melanin complex,*

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## INTRODUCTION

Under proper feeding conditions, a commercial pig requires half the amount of feed to gain a kilogram of weight than other ungulates, and with virtually zero waste in production, its weight increases more than 100 times in nine months. But early weaning of piglets from their mothers and the formation of large groups for rearing cause stress even when problems with rodents and parasites are resolved.

Therefore, keeping piglets in large farms is accompanied by growth retardation, increased morbidity and mortality of pigs, impaired reproductive ability, and reduced quality of meat products. A dangerous disease can spread to the entire livestock and cause mass death of animals.

Prevention of swine diseases depends on many factors. Special attention is paid to diagnostics, timely and correct treatment, especially of infectious diseases. For this purpose, we tested the effectiveness of a remedy from the basidiomycete fungus *Fomes fomentarius*, which is widely distributed in Ukraine and has been used in Slavic folk medicine since ancient times.

From ancient times until the Middle Ages, this mushroom was considered a panacea and was an essential component in recipes for protection against various poisonings, and was used for bruises, fractures of limbs, diseases of the genitals, liver (jaundice) and kidneys, menstrual disorders, colic and stomach pain, as a laxative, for the treatment of dysentery, epilepsy, heart failure, chronic cough, snake and animal bites, for general strengthening of the body. Today, the ability to implement anti-stress activities, quickly stop bleeding and absorb toxins of various nature, as well as the antibacterial, antiviral, and antifungal properties of biopolymers from *Tincture officinalis* are the subject of our research.

### Problems in raising modern pigs

The first problem is caused by the intensive breeding and fattening of easily excitable meat pigs with certain genetic programs and a weakened ability to withstand stress before slaughter [1]. Being in conditions of intensive industrial technologies leads to disruption of the functioning of the reproductive system of sows, their mammary glands and a decrease in milk yield. These objective circumstances cause a negative stress effect on the central nervous system of piglets in the first place.

Due to changes in allele frequency ratios during selection and selection in the genotypic structure of Western European and American pigs, a recessive mutation of the ryanodine receptor gene emerged with changes in metabolic processes in skeletal muscles and an increase in the proportion of lean meat. The torso is elongated, without adequate development of the capillaries of the cardiovascular system and with an increased load on the circulatory system, increased susceptibility to stress factors of various nature and a weakening of the constitution. The heart is relatively small, there is a large volume of thick blood, the hypothalamus is underdeveloped and the thermoregulation mechanism is not well-established, there is a tendency (especially when kept in crowded conditions) to herd hysteria, hereditary limb weakness syndrome, and severe stress contributes to the occurrence of meat defects, which are currently described in two categories - PSE (pale, soft, exudative meat) and DFD (dark, firm, dry meat). Stress caused by cold weather fights, starvation, and transportation 12-48 hours before slaughter leads to depletion of muscle glycogen to compensate for nervous and physical costs, which causes a high final pH value of meat and its instability during storage [2, 3]. And acute short-term stress (excitement or a fight immediately before slaughter) lowers the pH of the meat, giving it a sour taste and a lighter color. This meat is PSE (pale, soft, exudative meat). It must be sent for the manufacture of cooked-smoked products or frozen. In developed European countries, the amount of meat with signs of PSE and DFD ranges from 5 to 40%, and in the CIS countries its amount reaches 80%, [4].

There is another classification with the allocation of pork quality groups depending on the course of autolysis, which is more complete and better takes into account the condition of the raw material for further processing [5]. RFN meat (reddish-pink, firm, not watery - reddish-pink color, firm texture without watery surface, lean fresh pork corresponds to high quality meat), PFN (pale, firm, not watery - pale, hard, not watery) and RSE quality group (reddish-pink, soft, exudative Meat with RSE defect is close to normal in color, but exudative, like PSE. PSE muscle tissue has a small volume of myofibrils, myoglobin cannot absorb light and therefore it scatters directly on the surface. Losses of meat juice during processing of RSE meat reach 11.2%, PSE – 8.2%. According to statistics, about 20% of EU pork has signs of PSE. The color of meat is mainly due to the presence of coloring substances (90% myoglobin and 10% hemoglobin), and to some extent depends on the pH. Pork at pH 5.6 is pinkish-red, and at pH 6.5 and above it is dark. A pinker-red color of pork corresponds to good bleeding of the carcass and fresh meat. It was found that only 6.6% of pig carcasses corresponded to PSE meat in terms of their characteristics, and the majority (87%) belonged to the RSE quality group. PFN- and RSE-pork accounted for more than 15% of all defects, compared to PSE (13%) and DFD (10%). There is also a proposal

to register a defect called ASE (sour, soft, exudative - when the meat has a sour reaction, soft, exudative [6]. These defects most often occur on the most valuable parts of meat carcasses, and the pH indicator provides information about the potential safety of the meat, as well as its technological suitability. But it is important to remember that when assessing muscle pH, color, or meat tenderness, these parameters vary depending on the part of the carcass from which the sample is taken [7]. Even then, it became clear that psychological stressors (excitement and fighting) have a more detrimental effect on meat quality than physical stressors (fasting or cold weather) [8]. Stress is driven by hormonal mechanisms involving the secretion of adrenaline and glucocorticoids. Adrenaline activates animals in the classic “fight or flight” response, while glucocorticoids are released later and help maintain energy reserves and resist stress [9]. The significant increase in the amount of meat raw materials with the above characteristics requires finding not only ways to identify them, but also to prevent the causes of the appearance of such raw materials, in particular stress. Only in normal pork (NOR) does normal glycolysis occur during the maturation of meat.

The second problem is the formation of infectious and non-infectious diseases.

The largest and most dangerous for animals is the group of infectious diseases that are difficult to treat or are incurable. The most common are *viral diseases* - African swine fever (ASF) - ASF virus, classical swine fever (CSF) - Togavirus, influenza A, vesicular exanthema (VEZ) - calicivirus of the genus Vesivirus; rabies - rabies virus, Aujeszky's disease (pseudo-rabies), causative agent porcine herpesvirus type 1. Viral gastroenteritis - coronavirus; foot-and-mouth disease - picornavirus (RNA virus Aphtovirus); foot-and-mouth disease - Aphthovirus, family Picornaviridae, seven strains (A, O, C, SAT1, SAT2, SAT3 and Asia1) and other diseases. *Diseases caused by bacteria* – pasteurellosis, caused by the bacterium Pasteurella; enterotoxemia, caused by a type of Escherichia coli; erysipelas (beshiha) of pigs – caused by the bacterium Erysipelothrix insidiosa; anthrax – the bacillus Bacillus anthracis; salmonellosis (paratyphoid) – Salmonella cholerae suis and its variants; atrophic rhinitis bordetellosis of pigs, caused by toxigenic bacteria Pasteurella multocida type D, as well as Bordetella bronchiseptica; leptospirosis – caused by pathogenic leptospire, 202 serovars combined into 23 serological groups; clostridia (anaerobic enterotoxemia), bacteria of the genus Clostridium and other diseases. *Parasitic diseases of pigs* are caused by external or internal parasites: protozoa, arachnids, helminths, insects. These are ascariasis (Ascaris suum, Ascaris lumbricoides), trichinosis (Trichinella spiralis), cysticercosis (Cysticercus cellulosus), sarcoptic mange (intradermal mites Sarcoptes Suis and Sarcoptes Parvula). Therefore, the induction of anti-stress effect must be combined with a non-toxic anti-infective effect through the gastrointestinal tract.

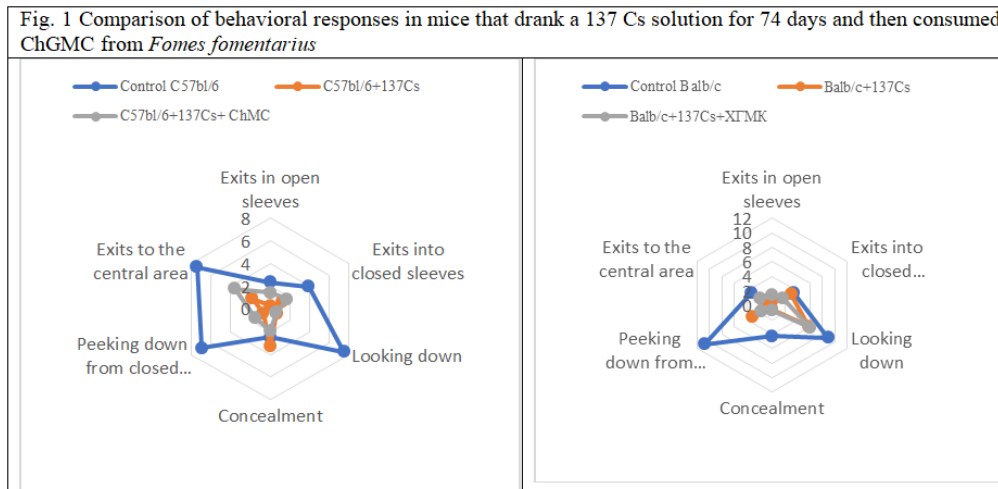
It has long been known that stress affects pigs, forming different groups in terms of stress sensitivity (strong mobile and strong balanced type, weak unbalanced type), changes the activity of endocrine glands and the course of metabolic processes, causing changes in all types of metabolism in the animal body [10, 11]. It has also long been established that psychological stressors (excitement and fighting) have a more detrimental effect on meat quality than physical stressors (starvation or cold weather) [8]. And it is precisely anti-stress activities in animal husbandry that can positively influence the development of large industrial pig farms. Increasing the protective and adaptive mechanisms of the animal body to the effects of stress factors can be achieved by correcting biochemical reactions using vitamins, minerals and other adaptogens (eleutherococcus extract, fumaric and succinic acid preparations, etc.) [12]. The appearance of defects in finished meat products largely depends on the state of the central nervous system of animals immediately before slaughter. Therefore, timely anti-stress effects on animals require special attention.

To optimize the adaptation of pigs to industrial conditions, it is necessary to reduce motor activity and aggressiveness, relax muscles, suppress pain, and increase resistance to negative influences using appropriate agents that are conveniently given with feed or water. The functioning of the central nervous system (CNS) is highly dependent on the state of the oxidant-prooxidant system [13]. Induction and enhancement of adaptation mechanisms to adverse environmental factors in the body of farm pigs is the most reliable, effective and environmentally safe way to prevent stress.

#### **Anti-stress method of caring for piglets**

The domestic pig is one of the most intelligent animals, thanks to its subtle observation and intelligence. It is very close to humans in terms of biochemistry, blood formula, omnivory, composition and digestibility of food. In some anatomical and physiological parameters, pigs are very close to humans, they suffer from the same diseases as humans and can be treated with the same medicines as humans. We previously showed that in a new environment, BALB/c mice with a genetically determined pronounced fear response, as well as C57bl/6 mice with a genetically determined active search response [14], when receiving the adaptogenic agent chitin-glucan-melanin complex from the tinder fungus *Fomes fomentarius* (ChMGC), demonstrated the ability to overcome stress caused by internal radiation exposure and a tendency to form less cautious behavior with a lower level of

anxiety and fear [15] (Fig. 1), as well as a wide spectrum of anti-infective activity of this complex [16]. The ChGMC was obtained without damaging the native fibrous nature. Quantitative study of individual components of this complex is currently possible only through their hydrolysis to monosaccharide residues.



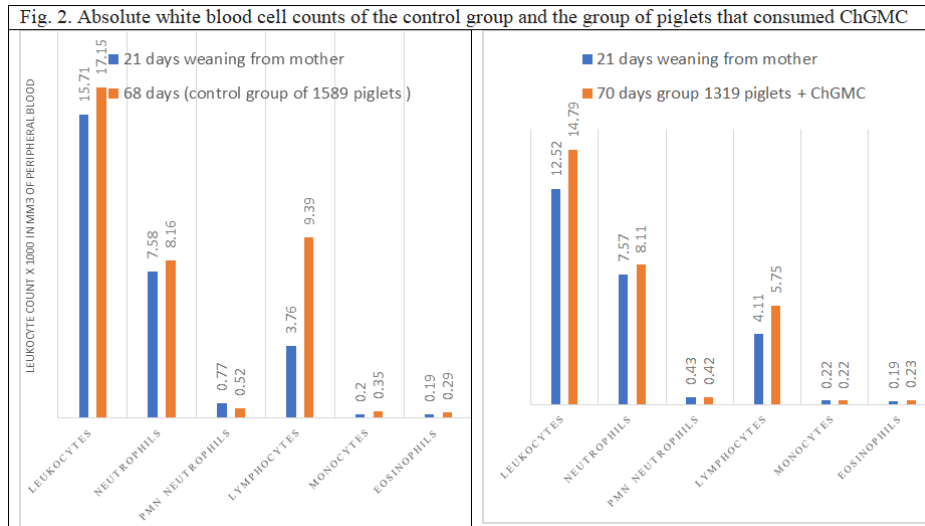
ChGMC consists of the following biopolymers: chitin – 70%, melanins – 10% and 1,3-1,6- $\beta$ -glucans – 20%, and is able to effectively bind free radicals. It is non-toxic, has no side effects and contraindications to long-term use and is indifferent to biologically active macro- and microelements. The universal reaction of a living organism to mental stress is oxidative stress, which can be counteracted by a high-molecular fraction of true mushroom melanin [17]. The antioxidant properties of glucan-melanin and purified melanin products were studied by changing the reaction rate of peroxidase oxidation of benzidine and showed that the glucan-melanin complex has a higher antioxidant capacity than purified melanin. This is apparently explained by the higher content of functional groups, paramagnetic centers, and a developed system of conjugated double bonds, which are partially destroyed during melanin purification. This compound is characterized by a high concentration of paramagnetic centers - up to  $10 \cdot 10^{17}$  spins/g, and one melanin molecule can neutralize up to 18-20 free radical oxidants [17]. Their redox properties are due to the ability to exist in oxidized (quinone) and reduced (hydroquinone) forms and allow melanin to provide powerful antioxidant, radio- and photo-protective, and electron-ion exchange properties [18 - 20], protect body cells from the development of chronic and acute stress, i.e. act as a stress adaptogen. It reduces the negative impact of stress on the brain by enhancing the antioxidant protection of the cerebral hemispheres. In addition to its powerful antioxidant action, melanin exhibits other biological activities, including thermoregulatory, radio- and photoprotective, antimicrobial, antiviral, antitumor, anti-inflammatory, and immunomodulatory. It accelerates the healing of gastritis and ulcerative lesions of the mucous membranes of the stomach and colon, stimulates peristalsis and eliminates dyskinesia of the gastrointestinal tract with atony. Under the conditions of using ChMC, the possibility of complications disappears.

Extreme stimuli that do not correspond to the level of evolutionarily determined protective and adaptive reactions of the organism are early weaning of piglets from mothers, formation of groups for rearing and fattening, transportation of animals, etc. As a result of their action, a stressful state occurs with growth retardation, increased morbidity and mortality of pigs, impaired reproductive ability, and decreased quality of meat products.

The first study of the effectiveness of the influence of ChGMC was carried out at LLC "SPE "Globynsky Pig Complex" (Ukraine, Poltava region, Globynske village) on technological groups of piglets - an experimental group of 1589 heads and a control group of 1319 heads in the growing-out shop (Fig. 2).

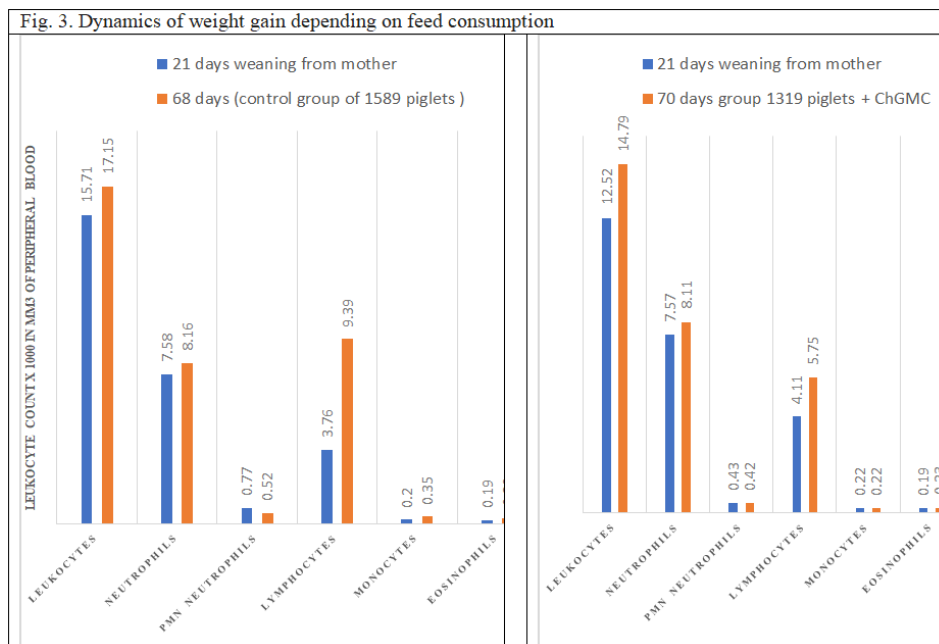
In piglets that consumed ChGMC, on the 70th day of life, the absolute number of leukocytes in the peripheral blood increased by 18.1%, lymphocytes by 40.0%. And the ratio of the number of segmented neutrophils and lymphocytes decreased from 1.84 to 1.41 and indicated a shift in adaptive reactions towards increased adaptations to

the shift of adaptive reactions occurred from the zone of a stressful state to increased activation. In peripheral blood, the absolute number of leukocytes increased by 9.2%, and lymphocytes by 146.3%. The ratio of segmented neutrophils and lymphocytes decreased from 2.87 to 0.73 and indicated a state that was more anxious compared to the group of piglets that received ChGMC [21].



During the observation period, piglets in the experimental group demonstrated better health indicators. Their total losses in the experimental group were 16.4% lower, and losses due to culling were 2.5 times lower (Fig. 3).

On the 21st day of observation, the number of sick animals (arthritis) in the experimental group was 2.35 times lower than in the control group, and the blood parameters of the piglets in the experimental group indicated a significantly lower level of infectious diseases. A higher absolute weight gain per 1 piglet was observed in the experimental group (by 9%).



In the experimental group, the average feed intake per piglet was unexpectedly lower (by 14%), and the financial costs per kilogram of gain were also lower (by 17%). Feed conversion in the experimental group was 20% better.

### Preliminary conclusions

As a result of the described study, in the process of growing piglets, the addition of ChMC to the feed gave two effects: qualitative and financial. The qualitative effect is that more piglets survive in the experimental group, and the blood parameters of the piglets are better compared to the control group. The financial effect is that in the experimental group, piglets gain more weight while consuming less feed. The most reliable, effective, and environmentally safe way to prevent stress in pigs, along with the selection of stress-resistant breeds, is to improve their breeding methods by adding ChMC to feed, which forms mechanisms in their bodies to adapt to the effects of adverse environmental factors.

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