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THE EFFECT OF NETTLE EXTRACT ON ANTIOXIDANT DEFENSE SYSTEM IN PIGLETS AFTER WEANING

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Background. The effect of common nettle (*Urtica dioica* L.) extracts on the free radical processes and antioxidant system in piglets during the critical period of weaning from sows has been studied.

Materials and Methods. Large white piglets were divided into 2 groups (control and experimental), 9 animals in each. Piglets of the experimental group from 14 days of age and before weaning received the standard diet and the nettle extract in the dose of 6 mg/kg of body weight for 22 days. The blood, as well as erythrocyte hemolysates and plasma of piglets obtained at 14, 36, and 42 days of age, were studied.

Results. Our results have shown that weaning causes an oxidative stress in piglets. This state leads to an increase in the concentration of metabolites of free radical damage to protein molecules – carbonyl groups of proteins on the first day and primary products of lipid peroxidation on the seventh day after weaning. This activation of oxidative damage occurs in piglets against the background of a physiologically immature antioxidant system and is characterized by a decrease in the activity of the enzymatic chain – superoxide dismutase, glutathione peroxidase and catalase, as well as the concentration of its non-enzymatic antioxidant – reduced glutathione.

Feeding piglets with nettle extract leads to activation of the antioxidant defense system in erythrocytes (higher activity of superoxide dismutase, catalase, glutathione peroxidase, glutathione reductase and an increased reduced glutathione level compared to the control values) and a decrease in the concentration of oxidative damage products in the plasma (the content of lipid hydroperoxides, TBA-active products and carbonyl groups of proteins).

Conclusion. The positive effect of nettle extract on the inhibition of free radical processes and activation of antioxidant systems indicates that this extract can be added to the standard diet of young animals to increase stress resistance and adaptability of their organism in critical periods of ontogenesis.

Keywords: antioxidant system, oxidative damage products, nettle extract, piglets, weaning stress

INTRODUCTION

Public awareness of the potential health risks associated with the use of antibiotics, growth hormones, and various synthetic pharmaceuticals in agricultural production has changed consumer attitudes and approaches to food. The presence of residual antibiotics in meat and the emergence of resistant bacteria that could adversely affect human health led to a ban on their use as growth promoters in animal and poultry feeding throughout the European Union in 2006 (Regulation (EU) 1831/2003) (López-Gálvez *et al.*, 2021). Currently, the international market requires high-quality standards for environmental, ethical, and welfare standards in meat production.

Changes in legislation controlling the use of additives in the feeding of farm animals and poultry stimulate interest in the implementation of bioactive natural substances as alternative means for improving efficiency in livestock. Thus, the use of plants and plant extracts to replace synthetic chemicals in traditional animal husbandry, and higher consumer demand for environmentally friendly products, have stimulated the study of the effects of phytopreparations and their active compounds on animals, feed quality, and meat (López-Gálvez *et al.*, 2021; Paskudska *et al.*, 2018).

Many studies have shown that plant feed additives intensify animal growth via a beneficial impact on the ecosystem of the gastrointestinal microbiota, limiting the development of potential pathogens, improving feed taste, stimulating appetite, regulating digestion, and can perform protective functions. Medicinal herbs also strengthen the immune system, have anti-inflammatory, antibacterial, and antidiarrheal properties (Lillehoj *et al.*, 2018). This is especially important for sensitive periods of the production cycle of animals characterized by a high susceptibility to gastric disorders, for example, during the growing of piglets or chickens. Researchers note that stabilizing the intestinal microbiota with plants makes animals less vulnerable to bacteria, toxins, and other unwanted bacterial metabolites such as ammonia and biogenic amines (Basak *et al.*, 2020; Radzikowski & Milczarek, 2021).

Plants have become important in animal nutrition due to their high content of bioactive molecules. Involvement of eco-friendly non-traditional raw materials of plant origin, such as phytoextracts in the production of food additives and drugs allows for easy and quick elimination of the deficiency of essential nutrients, activates the body to adverse environmental factors, thereby reducing morbidity and increasing animal welfare (Piao *et al.*, 2023; Woo *et al.*, 2017).

Common nettle (*Urtica dioica* L.) has long been known for its healing properties. It contains a large amount of biologically active substances with a wide spectrum of biological action (Grauso *et al.*, 2020; Marotti *et al.*, 2022). Nettle leaves are rich in various nutrients, such as phylloquinone (vitamin K1) at 0.2%, carotenoids up to 50 mg%, including β-carotene (up to 60%), hydroxy-α-carotene, luteoxanthin, lutein epoxide, violaxanthin, xanthophyll, and xanthophyll epoxide. They also contain ascorbic acid at 0.6%, vitamins B1, B2, B3, E, and PP, chlorophyll at 5%, carbohydrates (including starch at 10% and gums), and organic acids such as oxalic, succinic, fumaric, lactic, citric, quinic, formic, silicic, butyric, glycolic, glyceric. In addition, they contain phenolic carboxylic acids (such as gallic, n-coumaric, caffeic, ferulic), coumarins (such as ellagic acid), flavonoid quercetin, tannins at 3.1%, and nitrogen-containing compounds (such as alkaloids at 0.019–0.29 %, acetylcholine, histamine, 5-hydroxytryptamine), glycoside urticine, and methylheptenol, acetophenone. Nettle roots contain lectins, carbohydrates, β-sitosterol, tannins, and the alkaloid nicotine. Nettle seeds, on the other hand, have a high content of fatty oil at 16–33 %, which includes linoleic acid (Marotti *et al.*, 2022).

With regard to the huge complex of natural biologically active compounds in nettle and large reserves of eco-friendly raw materials in almost all continents, (Gorgani *et al.*, 2017) the development of new drugs and food supplements from nettle extracts becomes a priority task. These preparations can be used to increase the adaptability and correct metabolic disorders in animals and humans (Keleş *et al.*, 2020; Grauso *et al.*, 2020). In our previous study on laboratory animals, we reported stimulation of erythropoiesis, activation of protein metabolism, inhibition of free radical processes, and an increase in endogenous reserves of antioxidant protection in the blood and tissues of nettle extract-supplemented rats after adrenaline-induced stress (Buchko *et al.*, 2019).

The aim of the current study was to determine the effect of nettle extract on the antioxidant system and free radical processes in piglets after weaning.

MATERIALS AND METHODS

Experimental plant collection, identification, and preparation. The common nettle (*Urtica dioica* L.) was harvested in Skole district, located in the Carpathian highlands. The plant was identified as the common nettle (*Urtica dioica* L.), using the atlas-identifier of plants of Ukraine (Morozyuk. & Protopopova, 2007). Nettle air parts were dried under normal conditions (in a dark place, temperature 20–25 °C, relative humidity 30–60 %). Then, the dry material was crushed to a particle size of 1.5 mm and placed in the extractor. The extraction process took 8 days at a temperature of 20 °C. We used a classical maceration with the ratio of raw material to 40 % water-alcohol solution as an extragent (1:20, m/v). After extraction, the nettle extract was filtered and dehydrated using a rotary evaporator until it acquired a powdery form. For the experiment, the dry extract was used.

Experimental animals and design. The experiment was performed on 14-day-old piglets of a large white breed with a live weight from 5.18 to 5.48 kg. After farrowing two groups (control and experimental) were formed: 3 sows with piglets in each group. Each sow was kept in a separate cage with piglets (8–10 heads). On the 35th day after birth, piglets were weaned and each litter was kept in a separate weaner cage. Animals were fed a standard diet *ad libitum*, using a premix from Sano (Ferkengold Forte) for weaned piglets with free access to feed and water.

All experiments were conducted according to the EU Directive 2010/63/EU for animal experiments. The permission to perform the experiments was obtained from the Bioethics Committee of the Institute of Animal Biology NAAS of Lviv, Ukraine, protocol No 77 of 20 December, 2021.

Piglets of the experimental group (Nettle) received a 40 % extract of nettle in the dose of 6 mg/kg of body weight. The feed was mixed with a dry nettle extract and added to the feeders each morning for a group of animals in the cage from the 14th day after birth and to the weaning day (35th day of age).

The extract feeding period lasted 22 days. At the same time, sows did not have access to the feed crib. The piglets of the control group (Control) were kept on a standard diet. The experiment lasted 30 days. Blood of piglets for the study (3 heads from each cage, 9 animals from the group) was taken before morning feeding from the anterior vena cava at 14, 36 (1 day after weaning), and 42 days of age (7 days after weaning).

Sampling procedures. Piglets' blood and erythrocyte hemolysates were studied. All procedures on tissues were carried out at 4 °C. 1% solution of heparin was used as an anticoagulant. The blood plasma was separated by centrifugation at 700 g for 15 min, and the erythrocytes were washed three times with 0.150 M NaCl solution, then a suspension of cells was centrifuged at 700 g for 5 min. Indicators of the antioxidant system were determined in erythrocyte hemolysates as described in (Vlizlo, 2012).

Biochemical analysis. The activity of superoxide dismutase (SOD, EC 1.15.1.1) was evaluated in the erythrocyte hemolysates by the inhibition of the rate of NBT-reduction in the presence of NADH and phenazine methosulfate. Catalase (CAT, EC 1.11.1.6) activity was quantified by the formation of a stable colored complex of hydrogen peroxide and molybdenum salts. Glutathione peroxidase (GP, EC 1.11.1.9), glutathione reductase (GR, EC 1.6.4.2) and reduced glutathione (GSH) were determined according to (Vlizlo, 2012).

Lipid hydroperoxides (LHP) in the plasma was determined by reaction with ammonium thiocyanate. TBA-active products were quantified in the reaction between malonic dialdehyde and thiobarbituric acid; the carbonyl groups of protein (CP) was detected using 2,4-dinitrophenylhydrazine as it was described in (Vlizlo, 2012). The survival and morbidity of piglets of both groups were monitored during the experiment.

Statistical analysis. The data were processed using one-way ANOVA followed by Tukey's multiple comparison tests. Statistical differences were considered significant at $p < 0.05$. Results were expressed as mean ± standard error.

RESULTS AND DISCUSSION

Our study has shown that the supplementation of piglets' diet with nettle extract caused a decrease in their blood products of free radical oxidation. In the plasma of the experimental animals on the 1st and 7th days after weaning, a probable decrease in the concentration of LHP by 1.6 and 1.7 times, respectively, was found. It should be noted that this primary metabolite of lipid peroxidation in the blood of the control piglets increased with age and 42 days after birth was 1.6 times higher compared to the beginning of the study. At the same time, the concentration of LHP in the experimental group was almost the same throughout the study period (**Fig. 1*A***).

The concentration of the final metabolites of free radical oxidation – TBA-active products in the plasma of piglets of the experimental group on the 1st day after weaning was about 1.3 times lower, and on the 7th day – 1.2 times lower than the control (**Fig. 1*B***).

It has been found that the concentration of the carbonyl groups of proteins in the blood of 36-day-old piglets of the control group increased by 1.6 times compared to the beginning of the study. The content of CP in nettle extract-supplemented animals in this period was statistically lower than the control by 1.5 times (**Fig. 1*C***).

The decrease in the initial (LHP) and final (TBA-active products) products of free radical damage to lipid and protein (CP) molecules in the blood of piglets can be explained by the fact that the presence of a whole complex of biologically active substances with antioxidant action in nettle (organic acids, flavonoids, chlorophyll, ascorbic acid, carotenoids, kaempferol, isorhamnetin, quercetin, isoquercitrin, astragalin, rutin) triggers the mechanisms of reducing free radical oxidation reactions (Grauso *et al.*, 2020; Ciampi *et al.*, 2020).

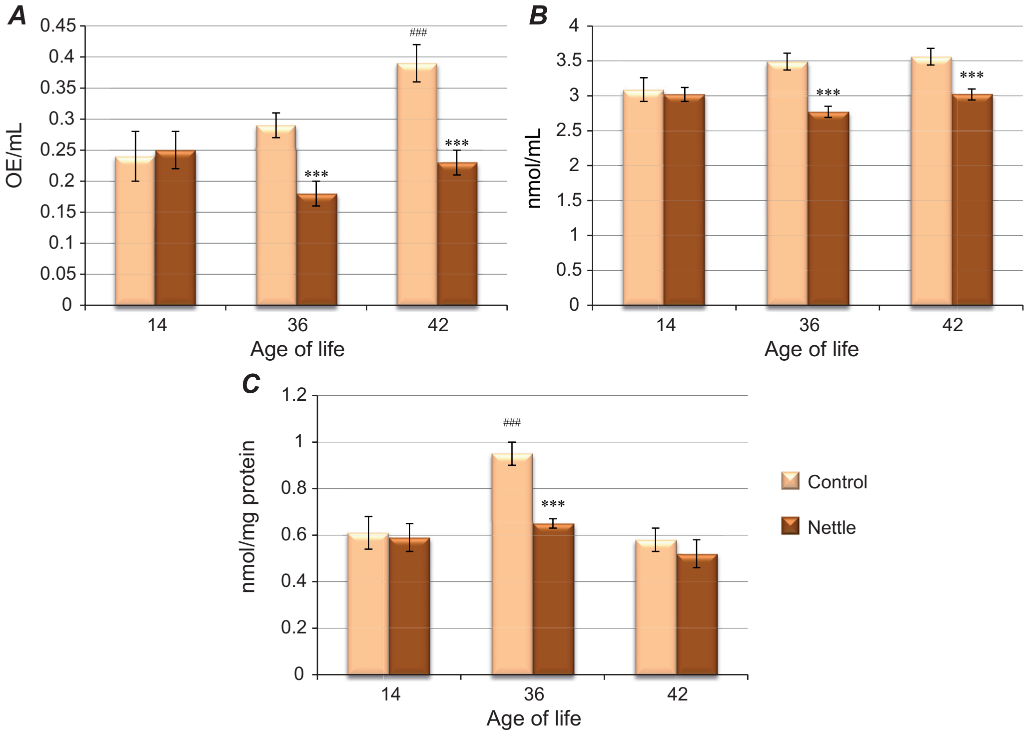

Fig. 1. The concentration of LHP (***A***), TBA-active products (***B***) and carbonyl groups of proteins (***C***) in the blood of piglets (M ± SE, n = 9)

Note: * – the differences are significant between the control and experimental groups of piglets (* – P <0.05; ** – P <0.01; *** – P <0.001); # – the differences are significant compared to 14-day-old animals (# – P <0.05; ## – P <0.01; ### – P <0.001); Control - control group of piglets; Nettle – experimental piglets, which were fed additionally to the standard diet 40% extract of nettle (*Urtica dioica* L.) in the dose of 6 mg/kg of body weight

Feeding piglets with nettle extract caused the activation of the antioxidant defense system. In 36- and 42-day-old experimental animals, an increase in the activity of these enzymes of the first line of antioxidant defense – SOD and CAT was observed.

The activity of SOD decreased with age in both the control and experimental piglets. However, in nettle extract-supplemented piglets, SOD activity was 1.5 times higher on the 1st day after weaning and 1.6 times on the 7th day compared to the control. In 42-day-old control piglets, the activity of this enzyme also decreased by 3 times compared to 14-day-old control piglets (**Fig. 2*A***). As can be seen from **Fig. 2*B***, the activity of CAT increased in the blood of experimental piglets with age, while the tendency to lowering of catalase activity was observed in 42-day-old control piglets. Nettle extract-supplemented piglets had a higher CAT activity on the 1st and 7th day after weaning in comparison with the control piglets. The increase in the activity of antioxidant enzymes under the action of the extract can be explained by the presence of such microelements as Fe, Cu and Zn in its content, which are part of the active centers of CAT and SOD, stimulating their synthesis (Jaiswal & Lee, 2022).

Our results have shown a positive effect of nettle extract on the activity of the glutathione-related processes in the antioxidant defense system in the piglets. Thus, on days 1 and 7 after weaning, in the erythrocytes of the animals of the experimental group a 2.4- and 1.4-fold increase in GP activity was observed, respectively, compared to the control. On the 36th day after birth in experimental piglets, the activity of this enzyme was 1.3 times higher, while in the control animals the activity of GP was 1.9 times lower than on the beginning of the study (**Fig. 3*A***). The activity of another enzyme of this chain – GR probably increased by 12% in the blood of 42-day-old experimental piglets compared to the control (**Fig. 3*B***). So, as can be seen from our results, the glutathione chain of antioxidant system in the organism of the experimental piglets was higher after weaning compared to both the control group and the beginning of the experiment.

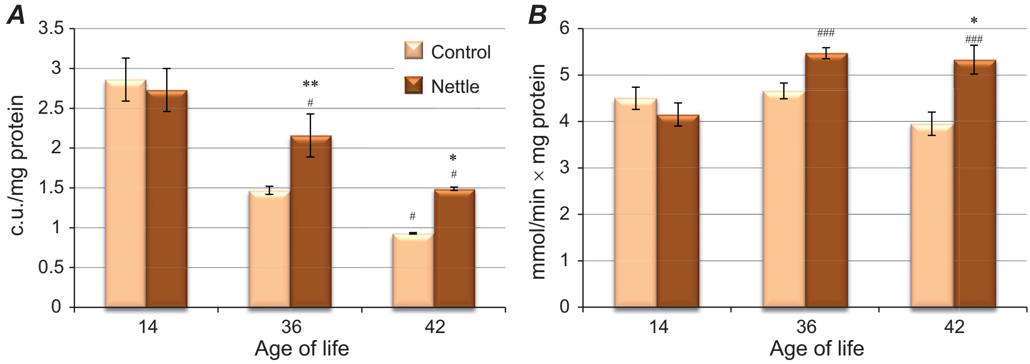

Fig. 2. The activity of SOD (***A***) and CAT (***B***) in the blood of piglets (M ± SE, n = 9)

The obtained results are explained by the presence in the composition of nettle of such a trace element as Se, which is a cofactor of GP, as well as glutamic acid and glycine – components of GSH (Keleş *et al.*, 2020). The increase in GR activity on the 7th day after weaning due to the effects of nettle is explained by a sufficient amount of intracellular NADPH reserves provided by the activity of NADPH-generating enzymes (G-6-FDH) (Jaiswal & Lee, 2022).

The content of GSH was significantly higher in the blood of nettle extract-supplemented piglets compared to the control on the 1st and 7th day after weaning – by 1.6 and 1.2 times. In the control animals, the concentration of this metabolite was significantly lower by 2 times (1 day after weaning), but on the 7th day after weaning, GSH concentration increased by 1.3 times compared to 14-day-old piglets (**Fig. 3*C***).

In pig breeding technology, the period of weaning is the most unfavorable. Young animals need special attention because beginning from the 2nd to the 4th week they suffer from sudden environmental changes, physiological and social stress, vaccination, anemia, immature digestive and immune systems (Szczepanik *et al.*, 2023; Xiong *et al.*, 2019). The most critical periods in the piglet life are:

- the first 24 hours after birth. During this period, immunoglobulins are completely absent from the blood of animals; their production begins a week after birth. Antibodies come only from colostrum; piglets have a deficiency of the B immune system, low activity of cellular immunity, and a lack of iron;
- the first 10–14 days of piglet life are characterized by intensive growth when the need for nutrients in the sow's milk increases. During this period, there is a shortage of mother's milk;
- on the 20th–21st days of life, colostral protection goes out, and piglets' bodies only begin to form their immunity. There is a period of transition to separate

feeding, which is accompanied by age-specific complications of gastrointestinal tract development. At this time, the digestive tract of piglets is not fully formed. Due to insufficient secretion of hydrochloric acid in the stomach, protein digestion is not completed (Szczepanik *et al.*, 2023). Undigested remains create a favorable environment for the growth of pathogenic microorganisms in the intestines. Toxins produced by microorganisms can damage the intestine epithelium, which leads to a decrease in absorption.

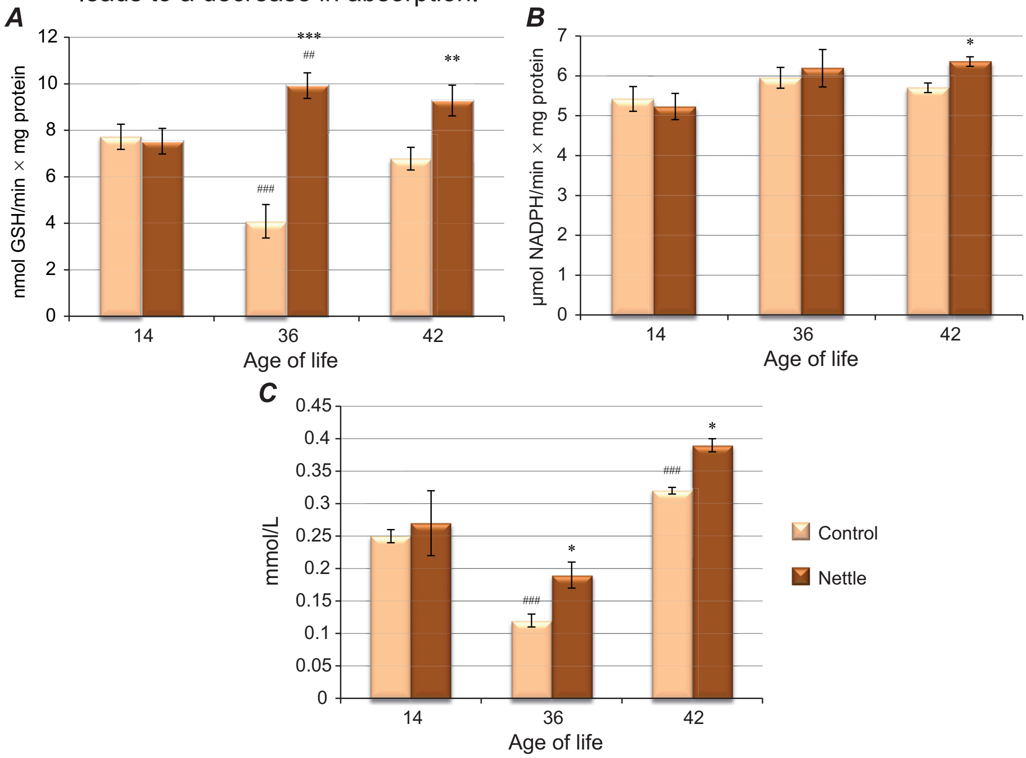

Fig. 3. The activity of GP (***A***), GR (***B***) and the concentration of GSH (***C***) in the blood of piglets (M ± SE, n = 9)

The result of all the above-mentioned processes is a decrease in appetite and feed consumption, immunity lowering, diarrhea, and higher susceptibility to diseases, which ultimately leads to an increase in the mortality of young animals. Researchers emphasize that the rate of diarrhea in piglets can reach 50 %, respiratory diseases – 40 %, their mortality after weaning is 6–10 %, and sometimes it can increase to 20 % (López-Gálvez *et al.*, 2021; Xiong *et al.*, 2019; Cao *et al.*, 2018).

On the other hand, many researchers believe that all types of stress, including weaning, are based on oxidative stress – a metabolic disorder that affects the health of animals and is defined as an imbalance between the rate of production of reactive oxygen species (ROS) and the power of antioxidant protection and restoration, which leads to oxidative damage to biomolecules. When the production of free radicals exceeds the capacity of the body's endogenous antioxidant barriers and the antioxidant defense activity is low, it can potentially cause damage to cellular components, trigger harmful autoimmune responses, and induce oxidative stress (Sies & Jones, 2020). As a result, the latter causes changes in the physiology and behavior of animals, which leads to poor growth performance, impaired immune system, and increased susceptibility to many diseases (Piao *et al.*, 2023; Santibáñez-Andrade *et al.*, 2023). The amount of oxidative stress can be measured directly by detecting free radicals or indirectly by determining the concentration of antioxidants and biomarkers of oxidative impact.

According to scientists, adaptive reconstruction in the body of newborn piglets to new conditions of life and nutrition finalizes up to two months after birth with the formation of a fully functioning antioxidant defense system. This system is able to control and maintain a stationary level of free radical oxidation processes by means of overcoming the imbalance between its enzymatic and non-enzymatic chains (Szczepanik *et al.*, 2023).

Our results agree with other data that oxidative stress in piglets during weaning is manifested by an increase in the concentration of CP on the first day and LHP on the seventh day after weaning in the blood of animals (Novais *et al.*, 2020; Hao *et al.*, 2021). The activation of free radical processes occurred against the background of an immature antioxidant defense system. In the control piglets, it was characterized by a decrease in the activity of the enzymes – SOD, GP, and CAT and the concentration of GSH. It should be noted that a decrease in the activity of the glutathione chain of the antioxidant defense system was observed only on the 1st day after weaning in the control animals, while the activity of SOD and CAT was lower compared to the pre-weaning period. On the 7th day after weaning, these indices did not reach the values observed at the beginning of the study. It is can be evidence of the prolonged effect of oxidative stress on the piglets during the period of weaning from their mothers.

The industrial technology of agricultural production with the predominance of a concentrated type of feeding has disrupted the evolutionarily complex system of the supply of natural biologically active substances to the body of animals with juicy fodder. Therefore, synthetic antioxidants, such as vitamins E, C, A, carotenoids, and others, are usually added to the diet to improve metabolic processes in the animal body and counteract various stress factors (Liu *et al.*, 2018; Bacou *et al.*, 2021; Tveden-Nyborg, 2021). Taking into account the fact that humans are the final consumers of animal products and the corresponding concerns about the safety and toxicity of products, current practice focuses on reducing the use of synthetic antioxidants in animal nutrition. Thus, the search for natural additives, especially herbal ones, for the activation of the anti-stress effects, increasing adaptation, resistance, and metabolism in the body of farm animals is highly relevant. Most natural antioxidants are safe, showing a milder effect on the body compared to synthetic analogs. Therefore, there is a need to develop preparations based on natural ingredients to provide the animals with all the necessary nutrients, especially in critical periods of ontogenesis, prevention, and therapy of diseases in young animals (López-Gálvez *et al.*, 2021; Lillehoj *et al.*, 2018; Gāliņa *et al.*, 2020).

As it was mentioned above, during the weaning period, weighing and moving young animals, combining them into new groups, and changing the feeding regime and the diet composition negatively affect the physiological state of piglets, causing a cumulative effect on their body that increases the stress, during which accumulation of products of free radical damage is observed (Szczepanik *et al.*, 2023; Parraguez *et al.*, 2021). In our study, we established that these metabolites cause tension in the enzymatic chain of antioxidant protection and this can lead to the depletion of the reserve of internal antioxidants with the development of oxidative stress, which is considered a universal chain in the pathogenesis of many diseases of young animals. Under such conditions, the biological value of phytoextracts increases as substances characterized by prophylactic, immunomodulatory, and antioxidant effects on the organism.

The high antioxidant activity of a 40 % nettle extract in the organism of animals can be explained by the fact that we extracted as much water-and fat-soluble natural antioxidants from nettle as possible. It is known from the literature that there is a functional connection between ascorbic acid and plant polyphenols in the living organism (Parraguez *et al.*, 2021; Gessner *et al.*, 2017). Polyphenols are chemical compounds that contain aromatic rings with hydroxyl groups. They have the ability to neutralize free radicals and other reactive oxygen species by donating electrons or hydrogen atoms. On the other hand, the biochemical role of ascorbic acid is also related with its ability to donate electrons and act as a reducing agent. It can act as a free radical scavenger and protect cellular biopolymers from oxidation by inhibiting the interaction of phenolic molecules with highly reactive lipid peroxidation products. In the living organism, polyphenols are reduced by ascorbic acid. Additionally, they can also bind metal ions into stable polyphenolic complexes, which in turn can inhibit the catalytic oxidation of ascorbic acid by metals of variable valence, such as Fe^{2+} (Gessner *et al.,* 2017; Gęgotek & Skrzydlewska 2022).

According to a similar scheme, the interaction between ascorbic acid and the body's main antioxidant metabolite – GSH takes place. Authors indicate that ascorbic acid, being a natural antioxidant, is a powerful reducer and stabilizer of SH-groups of thiols, enzymes, and glutathione. On the other hand, the constant supply of ascorbic acid to erythrocytes occurs through the arrival of the oxidized form of ascorbate (dihydroascorbic acid) from the plasma, which is restored due to the presence of reduced forms of pyridine coenzymes and GSH in the cells (Bacou *et al.*, 2021; Tveden-Nyborg, 2021).

It is important to note that adding herbal preparations to the diet of farm animals, like any other biologically active compounds, should be done carefully. The positive effects of these additives on the animal metabolism, general resistance, and overall health can only be achieved if optimal conditions are maintained. This includes ensuring that the animals receive full and balanced nutrition, and a high level of their well-being is maintained.

CONCLUSION

A powerful complex of natural biologically active substances of a 40 % nettle extract causes the suppression of free radical processes and activation of the system of antioxidant protection. Therefore, it is conceivable to propose the incorporation of the investigated nettle extract to the standard diet of young animals to increase the stress resistance and adaptive capacity of their organism in critical periods of ontogenesis.

COMPLIANCE WITH ETHICAL STANDARDS

Conflict of Interest. The authors received no specific funding for this work and declare no conflict of interest.

Human Rights. The article does not contain any experiments with humans.

Animal Rights. All international, national and institutional guidelines for the care and use of laboratory animals were followed.

AUTHOR CONTRIBUTIONS

Conceptualization, [O.B.]; methodology, [O.B.]; investigation, [O.B.; O.Y.]; resources, [O.B.; V.P.; V.T.]; data curation, [O.B.; V.T., O.Y.]; writing – original draft preparation, [O.B.; V.H.]; writing – review and editing, [O.B.; V.H.]; visualization, [V.P.; O.Y.] supervision, [O.B.; V.H.]; project administration, [O.B.; V.H.]; funding acquisition, [–].

All authors have read and agreed to the published version of the manuscript.

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ВПЛИВ ЕКСТРАКТУ КРОПИВИ НА АНТИОКСИДАНТНУ СИСТЕМУ ПОРОСЯТ ПІСЛЯ ВІДЛУЧЕННЯ

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Вступ. Вивчено вплив екстракту кропиви дводомної *Urtica dioica* L. на вільнорадикальні процеси та систему антиоксидантного захисту поросят у критичний період відлучення від свиноматок.

Матеріали та методи. Поросята великої білої породи були розділені на 2 групи (контрольну та дослідну) по 9 тварин у кожній. Поросята дослідної групи з 14-денного віку і до відлучення протягом 22 діб отримували стандартний раціон із додаванням екстракту кропиви дводомної *Urtica dioica* L. у дозі 6 мг/кг маси тіла. Досліджували цільну кров, гемолізати еритроцитів і плазму 14-, 36- і 42-добових поросят.

Результати. Встановлено, що відлучення від свиноматок в організмі поросят спричиняє стан оксидативного стресу, який призводить до зростання концентрації метаболітів вільнорадикального пошкодження протеїнових молекул – карбонільних груп протеїнів на першу і первинних метаболітів ПОЛ – гідропероксидів ліпідів на сьому добу після відлучення. Активація вільнорадикальних процесів відбувається на тлі фізіологічно незрілої антиоксидантної системи, що призводить до зниження у крові поросят активності ферментативної ланки – супероксиддисмутази, глутатіонпероксидази і каталази, а також концентрації неферментативного антиоксиданта – відновленого глутатіону.

Згодовування поросятам екстракту кропиви приводить до активації системи антиоксидантного захисту в еритроцитах (до підвищення активності супероксиддисмутази, каталази, глутатіонпероксидази, глутатіонредуктази та до концентрації відновленого глутатіону порівняно з контрольними значеннями), а також до зниження процесів оксидативного стресу в плазмі (до концентрації гідропероксидів ліпідів, ТБК-активних продуктів і карбонільних груп протеїнів).

Висновок. Позитивний вплив екстракту кропиви на пригнічення вільнорадикальних процесів і активацію антиоксидантної системи поросят під час відлучення свідчить про доцільність додавання досліджуваного екстракту до стандартного раціону молодняку для підвищення стресостійкості й адаптаційних можливостей їхнього організму в критичні періоди онтогенезу.

Ключові слова: антиоксидантна система, продукти окисного пошкодження, екстракт кропиви, поросята, стрес відлучення

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