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THE INFLUENCE OF THE COMPLEX FEED ADDITIVE «GEPASORBEX» ON THE FATTY-ACID AND MACROELEMENT COMPOSITION THE PIG’S OF MEAT

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For the purpose of biological evaluation of pig meat, an analysis of fatty acid and mineral composition is carried out, since the nutritional value of meat, specific taste, biological value and juiciness depend on the amount of lipids, calcium and phosphorus in muscle tissue. However, mycotoxins present in feed negatively affect not only the productivity of animals, but also deteriorate the quality of meat raw materials. Therefore, in order to obtain balanced fat and muscle tissue, it is necessary to organize the feeding of animals with adsorbents of mycotoxins, which have a positive effect on the biosynthesis of fatty acids and macroelements in the body of pigs.

The main aim of the manuscript was to study the effect of a new complex sorbent of mycotoxins in the diets of pigs on quality meat characteristics in the conditions of industrial technology. To do this, in the conditions of LLC «Tavriya Pigs» of the Kherson region, fattening pigs of the combination ♀ (White Large × Landrace) × ♂ «Maxter» were divided into three groups of 30 heads each according to the principle of analogues: 1st control group of pigs used the basic diet «Grower» , «Finisher»; pigs of the 2nd experimental group consumed the basic diet «Grower», «Finisher» with the addition of 0.15% by weight of the commercial analogue of the adsorbent of mycotoxins; the animals of 3rd experimental group were given the basic diet «Grower», «Finisher» with the addition of 0.15% by weight of feed complex preparation of «Gepasorbex».

It was found that the total content of saturated fatty acids in animals of 3rd group at slaughter of 100 and 120 kg, was higher compared to other experimental groups, which is 0.22% more than the similar indicator of animals of 2nd group and by 0.77% – the pigs 1st control group. The highest content of unsaturated fatty acids in adipose tissue was found in pigs of the 3rd group when slaughtered at 100 kg – 36.14%, and when slaughtered at 120 kg – 36.12%. The complex feed additive of the adsorbent of mycotoxins «Gepasorbex» did not affect the content of calcium and phosphorus in the pork meat at the slaughter of 100 kg, 120 kg.

Key words: *pigs, sorbent of mycotoxins, macroelements, saturated fatty acids, unsaturated fatty acids.*

Лихач В.Я., Кондратюк В.М., Лихач А.В., Леньков Л.Г., Баркарь Є.В., Фаустов Р.В. Вплив комплексної кормової добавки «Гепасорбекс» на жирнокислотний і макроелементний склад м'яса свиней

З метою біологічної оцінки м'яса свиней проводять аналіз жирнокислотного і мінерального складу, оскільки від кількості ліпідів, кальцію та фосфору м'язової тканини залежить харчова цінність м'яса, специфічний смак, біологічна цінність і соковитість. Проте, мікотоксини, що присутні у кормах негативно впливають не тільки на продуктивність тварин, а й погіршують якість м'ясної сировини. Тому, для отримання збалансованої жирової і м'язової тканин необхідно організовувати згодовування тваринам адсорбенти мікотоксинів, що позитивно впливають на біосинтез жирних кислот та макроелементів у організмі свиней.

Основна мета роботи полягала у дослідженні впливу нового комплексного сорбенту мікотоксинів у раціонах молодняку свиней на якісні м'ясні ознаки в умовах промислової технології. Для цього, в умовах ТОВ «Таврійські свині» Херсонської області відгодівельних свиней поєднання ♀ (велика біла × ландрас) × ♂«Maxter» за принципом аналогів розділили на три групи по 30 голів у кожній: 1 контрольна група свиней використовували основний раціон «Гроуер», «Фінішер»; свині 2 дослідної групи споживали основний раціон «Гроуер», «Фінішер» з додаванням 0,15% за масою корму комерційного аналогу адсорбенту мікотоксинів; тваринам 3 дослідної групи застосовували основний раціон «Гроуер», «Фінішер» з додаванням 0,15% за масою корму комплексного препарату «Гепасорбекс».

Виявлено, що загальний вміст насичених жирних кислот у тварин 3 дослідної групи, котрі споживали комплексну добавку адсорбенту мікотоксинів «Гепасорбекс» при забої 100 і 120 кг був вищим відносно інших експериментальних груп, що на 0,22% більше аналогічного показнику тварин 2 дослідної групи й на 0,77% – свиней 1 контрольної. Найбільший вміст ненасичених жирних кислот у жировій тканині встановлено у молодняку свиней 3 дослідної групи при забої у 100 кг – 36,14%, а при забої у 120 кг – 36,12%. Комплексна кормова добавка адсорбенту мікотоксинів «Гепасорбекс» не вплинула на вміст кальцію та фосфору у м'ясі тварин при забої у 100 кг, 120 кг.

Ключові слова: *свині, сорбенти мікотоксинів, макроелементи, насичені жирні кислоти, ненасичені жирні кислоти.*

Statement of the problem. Currently, the further increase in production and improvement of the quality and safety of agricultural products is of great importance. In addition, in the conditions of a market economy and European requirements, a competitive pig meat producer must supply the market with quality products that meet the requirements of European legislation [9, 13, 15–17, 22]. Such prerequisites dictate the further progress of Ukraine in the use of modern technologies in the pig breeding. It's in the context, of this aspect about development of modern technologies causes a questions for scientists and practitioners, in particular: creation of a sustainable fodder base with the use of innovative feed, deepening of breeding work with the possibility of predicting the genetic potential of animals based on the use of DNA markers, solving the problem of ethical or humane relation to pigs [6, 8, 9, 12–13, 18].

One of the important factors in increasing the performance of animals is the creation of proper housing and feeding conditions, which forces scientists to look for various approaches to the conditions of adaptation and comfortable stay of animals in livestock farm.

Analysis of recent research and publications. In order to eliminate the negative effect of mycotoxicosis on the animal body (reduction in performance, reproductive traits, weakening of the immune system of animals, disruption of the gastrointestinal tract, kidneys, hepatoprotective function of the liver, deterioration of the quality of meat raw, etc.), it`s necessary to strictly control the content of mycotoxins in feed, that are fed to pigs, which in the future ensures the preservation of not only the health of animals, but also the end consumers of livestock products [10, 19–21].

It should be noted that the neutralization of mycotoxins in feed using sorbents is a common and almost the only method in systematic measures to combat mycotoxicosis

in pigs [14, 19–20]. The use of intensively innovative technologies and pigs of high genetic potential to ensure performance due to the effective use of feed resources, maximum preservation of animals and prevention of various diseases is a feature of the modern pig breeding industry. This fact makes significant demands on scientists and practitioners in providing high-quality and ecologically clean feed, which is associated with their contamination with various toxins, heavy metals, pesticides, nitrates, etc. [9, 18–21, 23].

With sufficient and balanced feeding, the share of transformation of the nutrients of the consumed feed into the substances of products when growing pigs is 45–50%. An important aspect in solving this problem is the organization of full-fledged, balanced feeding of animals, that is, the use of diets that best meet the needs of pigs in terms of the content of the main nutrients and biologically active substances [10, 13]. Therefore, a number of studies are currently being conducted [14, 18, 20, 23] to search for the most effective sorbents that will allow to get rid of mycotoxins and maximally preserve biologically active substances in the body of animals.

It is worth noting, that adsorbents of mycotoxins differ from each other in the nature of origin, composition, adsorbing capacity, speed of endogenous detoxification, bioavailability and from generation to generation due to technological developments, they become more and more perfect and diverse in terms of adsorption properties, and also reveal a mediated therapeutic effect. Feed sorbents have the ability to quickly bind a wide range of toxicants. Sorbents are stable at different pH values, thermostable during feed granulation. The use of mycotoxin adsorbents as feed additives is beneficial for reducing the toxic effect of mycotoxins in pigs, which ensures a more sustainable use of feed [9–10, 12–13].

Setting objectives. To identify the effect of a new complex sorbent of mycotoxins in pig`s diets on quality meat characteristics on the industrial technology of the farm.

Materials and methods. A total of 90 fattening pigs were used in the experiment, which lasted throughout 2021, in the ratio: 50% – castrated boars and 50% – sows, where the maternal form was a combination of the White Large × Landrace breeds, and the parental form was boars of the terminal line «Maxter», which were kept in the farm of LLC «Tavriya Pigs» of the Kherson region.

The fattening was divided into two periods: the first fattening period («Grower») – animals with a live weight of 30–60 kg (12–17 weeks) consumed 2.4–2.6 kg of feed per head per day using compound to nutrition: crude protein – 180.25 g/kg; exchangeable energy – 13.04 MJ/kg, pigs were placed on a concrete slotted floor with an area of 0.65 m^2/head according to VNTP-APK – 02.05 «Pig enterprises (complexes, farms, small farms)» [9]; a second period of fattening («Finisher») – animals with a live weight of 61–120 kg (17–26 weeks) consumed 2.8–3.2 kg of feed per head per day with the use of combined feed with nutrition: crude protein – 140, 88–153.08 g/kg; exchangeable energy – 12.90–13.14 MJ/kg, pigs were placed on a concrete slotted floor with an area of 0.85 m^2/head according to VNTP-APK – 02.05 «Pig enterprises (complexes, farms, small farms)» [9].

As the basic diet (BD) was used compound feed of our own production using premixes produced by the company LLC «PK Alternativa» (Ukraine) in the appropriate composition «Grower» (%): wheat – 32; barley – 12.1; corn – 17.38; bran (wheat) – 8; soybean cake – 24.3; sunflower cake – 3.22; premix – 3; «Finisher» (%): wheat – 24; barley – 24; corn – 19; bran (wheat) – 12; soybean cake – 11.6; sunflower cake – 6.9; premix – 2.5.

When transferring pigs from the rearing shop to the fattening shop of the first period, in order to equalize the animals and purity of research in the period from 11–12 weeks,

the equalization period started. Then all experimental animals were divided into three groups (on the principle of analogues) [7, 11] of 30 heads: the control group of pigs fed the BD of both «Grower» and «Finisher»; pigs of the second experimental group consumed the BD of both «Grower» and «Finisher» with the addition of 0.15% by weight of the commercial analogue of the adsorbent of mycotoxins; and the third experimental group fed the BD of both «Grower» and «Finisher» with the addition of 0.15% by weight of feed complex preparation of Gepasorbex (Table 1).

The composition of 1 kg of «Gepasorbex» produced by VetServiceProduct LLC contains the following active ingredients (%): silica dioxide (60.2–70.8); aluminum oxide (8.0–12.0); magnesium carbonate (1.0–2.5); titanium dioxide (0.8–0.15); selenium (0.32–0.35); clineopleolite (4.2–4.5); active fodder yeast (8.0–10.0); milk thistle Silybum marianum (18.0–20.0) (the registration certificate = AB-08268-04-19).

The composition of the feed additive «Commercial analog»: silicon dioxide (SiO2), kaolinite clay, magnesium silicate, inactivated yeast (Saccharomyces Cerevisiae), Laminaria sugar, extracts of wild chicory and medicinal calendula, dry matter – 954.0 g.

According to laboratory studies, the main compound feed used for feeding the pigs of the experimental groups was recognized as slightly toxic in terms of aflatoxin, ochratoxin and zearalenone, contract № 837 to 07.06.2021 (LLC Expert center «Biolights», Kyiv).

The determination of the fatty acid composition of the studied meat samples in the amount of 5 units of each group of pigs (1st – control, 2nd – experimental, 3rd – experimental) for achieving pre-slaughter live weight of 100 kg and 120 kg was carried out in the independent laboratory of «Biolights» Expert Center LLC according to DSTU ISO 5508 - 2001 «Animal and vegetable fats and oils», DSTU ISO 5509-2002 «Analysis by gas chromatography of methyl esters of fatty acids» [1, 2].

The influence of the complex supplement «Gepasorbex» on the macronutrient composition of pig meat when the latter reaches a pre-slaughter live weight of 100 and 120 kg in the conditions of an independent laboratory of the «Biolights» Expert Center LLC: calcium – by the trilonometric method; phosphorus – by the photometric method using an electrophotometer of the KFK - 3 brand.

The rules for the treatment of animals in the experiment were fully complied with European legislation on animal protection and comfort kept on farms (Directive № 95/58

Table 1

The scheme of the experiment

Age	Group	Feeding conditions
Age 11–12 weeks – EW		
Age 12–17 weeks	1st, Control	BD for «Grower»
	2nd, Experimental	BD + 0.15% by weight of feed commercial analogue of the adsorbent of mycotoxins
	3rd, Experimental	BD + 0.15% by weight of feed «Gepasorbex»
Age 17–22 weeks	1st, Control	BD for «Finisher»
	2nd, Experimental	BD + 0.15% by weight of feed commercial analogue of the adsorbent of mycotoxins
	3rd, Experimental	BD + 0.15% by weight of feed «Gepasorbex»

Notes: EW – equalization period; BD – basic diet

EU «From the protection of farm animals» of the EU Council of 20.07.1998 as amended by EU Regulation № 806/203 of 14.04.2003, № 91/630 EU «Minimum standards for the protection of pigs» of 19.11.1991 as amended by EU Regulation). The protocol of experimental study on blood sampling in pigs, approved by the local Commission on Bioethics of the National University of Life and Environmental Sciences of Ukraine on Good Clinical Practice (GCP) for the protection and humane treatment of experimental animals.

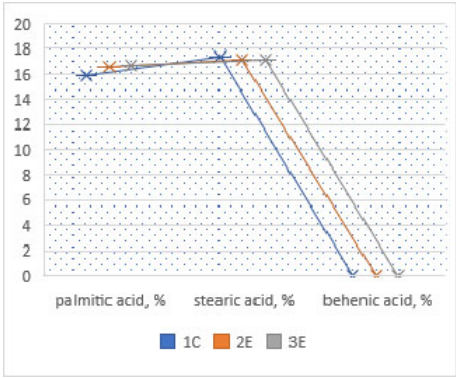
Presentation of the main research material. The results of a laboratory study on the content of saturated fatty acids in the meat of experimental animals when they were slaughtered at 100 and 120 kg are shown in figure 1.

The digital data of the depicted figures regarding the change in the content of saturated fatty acids in the meat of experimental groups of pigs at their slaughter with a live weight of 100 and 120 kg shows that the content of palmitic fatty acid in the meat of experimental pigs increases with age, its content varies at slaughter of 100 kg –15.82–16.72%, and at 120 kg – 23.0–24.8%.

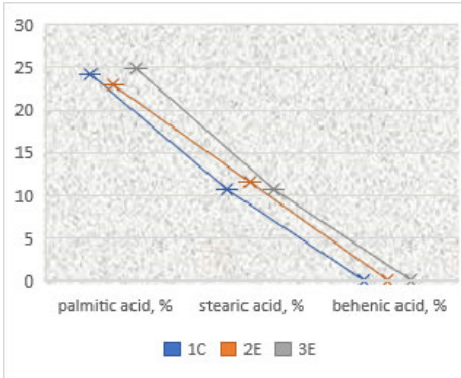
Regarding stearic acid, which acts as a storehouse of energy reserves, we note, that its content at the slaughter of 100 kg in experimental groups of pigs was at the level of 17.15–17.31%, and already at the slaughter of 120 kg, the value of the indicator decreased slightly, which is obvious, and fluctuated within – 10.70–11.60%.

Since behenic acid is mainly found in plant products, according to the results of laboratory analysis, its insignificant amount was found in the meat of the animals of the experimental groups, which corresponds to the normative indicators and ranged from 0.02 to 0.04% – at the slaughter of 100 kg and 0. 04–0.05% – at a slaughter of 120 kg. By increasing its amount in products of animal origin, the latter can increase the level of cholesterol in human blood [4].

So, our research established, that the total content of saturated fatty acids in the animals of the 3rd experimental group, which consumed the complex additive of mycotoxin adsorbent «Gepasorbex» at the slaughter of 100 kg, was within the physiological norm, but higher, than in other experimental groups and amounted to 33.93%, which is 0.22%



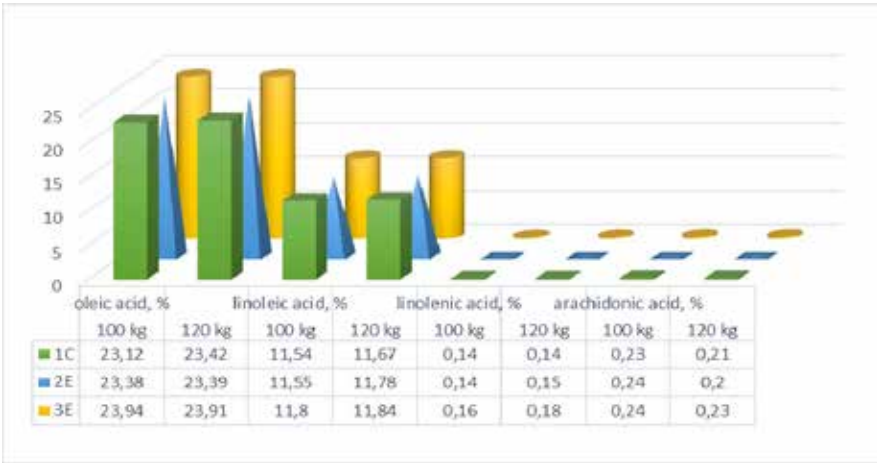
at a slaughter of 100 kg



at a slaughter of 120 kg

Figure 1. Dynamics of the content of saturated fatty acids in the meat of experimental groups of pigs under different weight conditions

Notes: 1C – animals of the 1st control group; 2E – pigs of the 2nd experimental group; 3E – animals of the 3rd experimental group.



	oleic acid, %		linoleic acid, %		linolenic acid, %		arachidonic acid, %	
	100 kg	120 kg	100 kg	120 kg	100 kg	120 kg	100 kg	120 kg
1C	23,12	23,42	11,54	11,67	0,14	0,14	0,23	0,21
2E	23,38	23,39	11,55	11,78	0,14	0,15	0,24	0,2
3E	23,94	23,91	11,8	11,84	0,16	0,18	0,24	0,23

Figure 2. Dynamics of the content of unsaturated fatty acids in the meat of experimental groups of pigs under different weight conditions

Notes: 1C – animals of the 1st control group; 2E – pigs of the 2nd experimental group; 3E – animals of the 3rd experimental group.

more, than the similar indicator of animals of the 2nd experimental group and 0.77% – 1st control pigs. A similar trend persists at the slaughter of pigs weighing 120 kg, which probably indicates a positive effect of the feed additive on the biosynthesis of lipids in the muscle tissue of pigs.

Next, unsaturated fatty acids were determined. The results of a laboratory study on the content of unsaturated fatty acids in the meat of experimental animals when they were slaughtered at 100 and 120 kg are shown in figure 2.

According to the digital data in the figure, it was established that the highest content of unsaturated fatty acids in adipose tissue (within the physiological norm) was in the young pigs of the 3rd experimental group at a slaughter of 100 kg – 36.14% and slightly decreased at a slaughter of 120 kg – 36.12%, and the lowest in the animals of the 2nd experimental group – 35.25% at a slaughter of 100 kg and 35.39% –at a slaughter of 120 kg.

On the basis of the conducted analysis, we state that the content of linoleic, linolenic and arachidonic acids in the first control and experimental groups is satisfactory both for slaughtering 100 kg and 120 kg. However, our experiment established that the fatty acid composition of the meat of pigs, that were not fed mycotoxin adsorbents is unbalanced. It has been proven that in order to obtain high-quality balanced fatty tissue, it is necessary to organize the feeding of animals with feed additives that bind and remove mycotoxins from the intestine, and also have a positive effect on the biosynthesis of fatty acids in the body of pigs.

A study of the composition of the meat of pigs of experimental groups at slaughter of 100 and 120 kg was carried out according to the content of microelement's in it, in particular calcium and phosphorus. Spectral analysis data are presented in figure 3.

The analysis of the results shows, that the meat of pigs of all three experimental groups has a fairly good macroelemental composition in terms of the content of the studied mineral substances. The content of these nutrients in the meat of all groups was

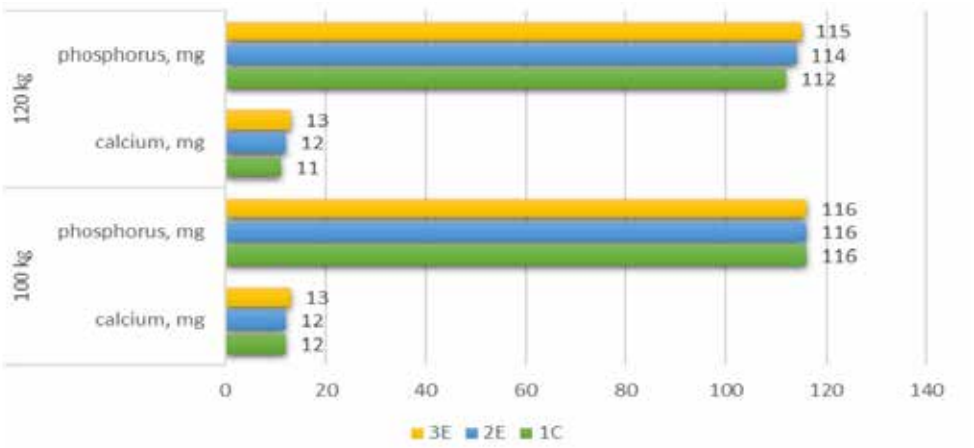


Figure 3. The content of calcium and phosphorus in pork meat (in 100 g), mg

Notes: 1C – animals of the 1st control group; 2E – pigs of the 2nd experimental group; 3E – animals of the 3rd experimental group.

practically the same both when slaughtering 100 kg and 120 kg. Thus, the calcium content varied within the groups at the level of 12–13 mg for a 100 kg slaughter, and 11–13 mg for a 120 kg slaughter. Regarding phosphorus, the situation is as follows: 116 mg of the value of the indicator was typical for all experimental groups at a slaughter of 100 kg, 112–115 mg – at 120 kg.

Thus, as a result of the conducted research, we state that the complex feed additive of the adsorbent of mycotoxins «Gepasorbex» in a specific case did not affect the content of calcium and phosphorus in the meat of animals at the slaughter of 100 kg, 120 kg.

Conclusions and suggestions. The total content of saturated fatty acids in the animals of the 3rd experimental group, at the slaughter of 100 kg and 120 kg, was within the physiological referent interval, but higher compared to the other groups and amounted to 33.93% and 35.57%, respectively, which significantly indicates a positive the influence of «Gepasorbex» on the biosynthesis of lipids in the muscle tissue of pigs. The highest content of unsaturated fatty acids in adipose tissue (within the physiological norm) was found in young pigs of the 3rd experimental group at a slaughter of 100 kg – 36.14% and slightly decreased at a slaughter of 120 kg – 36.12%.

The meat of pigs of all three studied groups has a normative macroelemental composition in terms of calcium and phosphorus content. The calcium content varies within the groups at the level of 12–13 mg for a 100 kg slaughter, and 11-13 mg for a 120 kg slaughter. The value of the phosphorus indicator – 116 mg was typical for all experimental groups at a slaughter of 100 kg, 112–115 mg – at 120 kg.

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СПОЖИВАННЯ ВОДИ ПЕРЕПЕЛАМИ ЗА ВИКОРИСТАННЯ У ЇХ РАЦІОНАХ ДРІЖДЖОВОГО ЕКСТРАКТУ

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Вода, як невід'ємна складова метаболізму птаха, бере участь у різноманітних біохімічних реакціях, зокрема перетравлюванні, засвоюванні, транспортуванні поживних речовин та виведенні продуктів обміну. Споживання води тісно пов'язане зі фізико-хімічними властивостями кормів, умовами довкілля, біохімічним та клінічним статусом організму, фізичними факторами довкілля, іншими факторами, які прямо чи опосередковано впливають на споживання води.

У даній статті висвітлено вплив додавання дріжджового екстракту (Saccharomyces cerevisiae) на рівень споживання питної води молодняком перепелів. Експериментальні дослідження проводилися в умовах навчально-науково-виробничої лабораторії технологій виробництва продукції птахівництва Національного університету біоресурсів і природокористування України.

За результатами проведених досліджень, встановлено, що за додавання різних рівнів дріжджового екстракту до комбікормів для птиці впродовж 35- денного періоду досліджень рівень споживання води відрізнявся залежно від рівня екстракту. Визначено, що за збільшення в раціонах вмісту дріжджового екстракту від 0,3 до 0,7 % спостерігається підвищене споживання води птицею порівняно з контрольною групою, яка не споживала екстракту дріжджів.