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THE USE OF FEED ENZYMES IN THE DIETS OF FARROWING AND SUCKLING SOWS

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Feed additive Allzyme PT of the leading feed company Alltek UK Ltd. is an enzyme agent for better assimilation of wheat, rye or triticale in the rations of poultry and pigs. The general effect of using this drug consists in neutralization of antinutritional substances, release and assimilation of additional metabolic energy, increase of protein digestibility and availability of amino acids, and reduction of chyme viscosity. The use of this feed additive allows you to increase the nutritional value of grains by 4-10%, depending on the type and type of grain ingredients of the diet.

Many experiments have established that the introduction of fat additives into compound feed also has a positive effect on the reproductive qualities of sows, the growth and development of piglets. Based on the conclusions of previous researchers, it was decided to introduce fat additives and enzyme preparations into the diet of sows, confirm or refute their conclusions, and independently establish the effect of fat additives and enzyme preparations on the reproductive qualities of sows and their effect on biochemical indicators of blood. The final goal of the experiment was to determine the expediency of using the enzymatic preparation "Allzyme PT" independently or with the simultaneous introduction of 2.5% sunflower oil into the basic diet in a specific commercial enterprise.

Having analyzed the results of the scientific and production experience, it can be concluded that the best effect on the reproductive qualities of sows has the addition to the diet of the combination complex of feed preparations "sunflower oil + feed enzyme Allzaim PT". This is explained by the fact that vegetable oils contain a large amount of unsaturated fatty acids – linoleic and linoleic, which are necessary for the construction of cells and some hormones, but cannot be synthesized in the body of pigs. The use in diets of specific enzyme complexes that break down non-starchy polysaccharides allows you to significantly increase the digestibility of nutrients from it. As a result, the level of metabolic energy, assimilation of protein and amino acids, and carbohydrates increases significantly. The simultaneous use of such an optimal combination of feed additives leads to an improvement in the conversion of feed due to its digestibility, and, as a result, has a positive effect on the improvement of feed assimilation, an increase in the safety of piglets and their live weight, which in general leads to a decrease in costs per unit of production and confirmed by the economic analysis of the results of zootechnical studies. Additional annual income on the farm after the introduction of the technology of feeding sows, the addition of sunflower oil to the main ration adopted in the farm together with the enzyme feed Allzaim PT will allow to increase the production of products on the reproduction plot by 5198.8 UAH on the nest of sows.

Key words: *fodder additive, compound feed, sow, reproductive qualities.*

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Pig breeding in Ukraine, as well as in many countries of the world, is an important livestock industry that produces a significant amount of meat for the needs of the population (McGlone, 2013; Povod et al., 2022). Among the factors that most significantly influence the productive qualities of pigs and the efficiency of the industry as a whole is balanced and high-quality feeding, which provides the animals' need for energy and all necessary nutritional factors (Cromwell, 2008; Mykhalko, 2020; WuY , et al., 2000). In the structure of costs for the production of pork, feed occupies the largest share (Nguyen, 2017 Povod et al., 2023), so the search and implementation of ways to improve the efficiency of their use in production is quite relevant today (Masey O'Neill et al., 2014 ;Recharla et al., 2019 ; Khalak&Gutyj, 2022).

Non-starchy carbohydrates make up a significant part of all carbohydrates in cereals.feed components that are the basis of rations for pigs (Jha &Berrocoso, 2015). They have such a feature: they are broken down with the help of specific cellulolytic bacteria. But digestive enzymes capable of breaking down and digesting these polysaccharides – fiber, betaglucan, pentoses, etc. are not synthesized in the animal body. There are practically no specific bacteria in the intestinal microflora of pigs (Lindberg, 2014; Passoset al., 2015; Sun et al., 2013; Zhang et al., 2013).

The absence or lack of endogenous enzymes leads to the fact that plant foods included in the diet and containing non-starch polysaccharides are not absorbed, passing through the digestive tract almost undigested. They can be considered ballast of the diet. In addition, excessive consumption of polysaccharides in dry feed leads to their accumulation in the stomach. This, in turn, negatively

affects the work of the gastrointestinal tract.delaying the passage of feed, which becomes a favorable condition for the reproduction of pathogenic microorganisms and worsens intestinal motility (Inborr, 1990; Choct, 2010; Cadogan &Choct, 2015; O'Dohertyetet al., 2021).

This problem is relevant for many pig breeding enterprises in Ukraine, where dry concentrate type of feeding is used. In such relatively small, non-specialized agricultural enterprises, they mainly use self-grown and therefore relatively inexpensive fodder. The basis of rations for pigs is a traditional feed milled grain mixture of rye, oats, wheat, barley, sunflower meal and bran. These components of the feed mixture contain a high level of fiber and other hard-to-digest carbohydrates. This can lead to overspending of feed nutrients in the range of 10-30%. (Shursonet al., 2021; Patience & Ramirez, 2022). And although such feed means are the cheapest at the enterprise, and in planned calculations their use reduces the cost of feed in the structure of the cost of production, in reality everything is a little different: filling the gastrointestinal tract with ballast does not give the desired result, because digestibility and digestibility feed nutrients decreases and, as a consequence, a decrease in feed efficiency, worsening of its conversion rates, and a decrease in the intensity of pig growth are observed. (Zhang& Adeola, 2017).

An effective and relatively low-cost prevention of the effects of the antinutritional properties of non-starch polysaccharides today is the use of artificial exogenous enzymes. These artificial enzymes are able to promote the breakdown of the indicated difficult-to-digest carbohydrates into glucose that is easily absorbed by the body. Feed additives containing exogenous enzymes are recognized as biocatalysts that accelerate the rate of biochemical reactions in the animal body. The consequence of their action is the destruction of the cell walls of plant material, which facilitates the availability of digestive juices. (Heyer et al., 2022). In addition, the use of such artificial enzymes is considered more organic and biologically safe compared to exogenous hormones and even vitamins. They are not absorbed into the blood, practically do not participate in metabolic processes, and therefore do not get into the final products of animal husbandry. Some authors consider the use of specified enzyme feed additives to be an ecological tool, since their improved feed conversion contributes to a decrease in the amount of manure, which contributes to a decrease in the release of nitrogen and phosphorus into the atmosphere (Selle& Ravindran, 2008).

It should be noted that on farms that do not grow, but buy ingredients for the production of compound feed, the use of enzyme preparations in the technology of feed production makes it possible to effectively replace expensive feed in the diets of pigs, for example, corn and soybean meal, which are cheaper, but with an increased fiber content. without the risk of deterioration of animal health (Yin et al., 2001; Araujo et al., 2014). However, some researchers (Willamil et al., 2012) argue that the use of enzyme preparations may not have the desired positive effect on corn-soy rations.

The high efficiency of using feed nutrients through the use of enzymes has been proven by a number of studies by many scientists. It has been established that the introduction of enzyme preparations of different spectrum of action in compound feed allows to ensure high productivity of animals. As a result, the cost of purchasing feed is reduced and the profitability of production increases (Patience &Bedford, 1992).

Today, the industry offers for compound feed production preparations with a unidirectional action: to increase the digestion of carbohydrates (Vahjen et al., 2008; Nortey et al., 2007; Yin et al., 2010) for the digestion of protein substances (Upadhaya et al. Wang et al., 2008), as well as a fairly wide range of combined multienzyme compositions (Araujo et al., 2014, Recharla et al., 2019).

It was estimated that phytases and carbohydrases make up 90% of the world market of feed enzymes for monogastrics, and proteases and lipases make up 10% (Adeola &Cowieson, 2011).

But before making a decision to purchase one or another enzyme preparation, you should familiarize yourself with their action and decide on a set of feed ingredients for animals.

Currently, in Ukraine, complex microbiological enzyme preparations of well-known world brands and domestic enzyme preparations, for example, produced by the Enzym State Enterprise, are widely used. In addition to improving the assimilation of fodder, it has been empirically established that the use of certain enzyme agents in fodder mixtures for pigs, due to the reduction of the amount and humidity of stool and bedding, contribute to the improvement of hygienic conditions of keeping, as well as the improvement of the environmental condition of the environment due to the better assimilation of nitrogen and phosphorus reducing the release of these substances into the environment. The specified functions of modern enzyme preparations and their influence on the improvement of production, economic and economic indicators unconditionally prove the justified need for their use in pig production technology.

Feed additive Allzyme PT of the leading feed company Alltek UK Ltd. is an enzyme agent for better assimilation of wheat, rye or triticale in the rations of poultry and pigs. These cereals contain a certain amount of anti-nutritional substances called pentosans – long-chain polymers of pentoses (arabinose, xylose, etc.). Allzyme PT (pentosanase) is a specific enzyme complex designed to split pentosans. It contains a significant level of activity of cellulase, amylase, protease, betaglucanase, as well as hemicellulose and pectinase. The general effect of using this drug consists in neutralization of antinutritional substances, release and assimilation of additional metabolic energy, increase of protein digestibility and availability of amino acids, and reduction of chyme viscosity. The use of this feed additive allows you to increase the nutritional value of grains by 4-10%, depending on the type and type of grain ingredients of the diet. The manufacturer of fodder enzyme recommends using it: in periods of reduced feed consumption, for example, reducing the effects of technological stress; to increase the nutritional value and quality of raw materials, allowing to reduce the cost of fodder (ration); to prevent diarrhea and enteritis and increase the productivity of pigs.

It should be noted that the Alltech company does not use genetically modified organisms in the production of feed enzymes. Enzymes are heat-resistant and retain their activity in the composition of premixes and compound feeds for 6 months. The rate of introduction of Allzeim PT is 0.5-1 kg/t .

Many experiments have established that the introduction of fat additives into compound feed also has a positive effect on the reproductive qualities of sows, the growth and development of piglets. Based on the conclusions of previous researchers, it was decided to introduce fat additives and enzyme preparations into the diet of sows, to confirm or refute their conclusions and to establish the effect of fat additives and enzyme preparations on the reproductive qualities of sows and their effect on biochemical blood parameters.

The final goal of the experiment was to determine the expediency of using the enzymatic preparation "Allzyme PT" independently or with the simultaneous introduction of 2.5% sunflower oil into the basic diet in a specific commercial enterprise.

Materials and methods of research. A scientific and economic experiment to determine the technological and economic expediency of using in the rations of sows the enzyme preparation of the company Oltek – "Allzaim PT" was conducted by us in the conditions of the swine farm LLC named after Shevchenko, Sumy district.

For the formation of groups, 20 sows of the large white breed were selected in the last growth period. When forming analog groups, age, live weight, and number of litters of dams were taken into account.

During the research period, animals of all groups received the usual ration accepted in the household, the basis of which are grain ingredients grown in the household (% composition, by weight): wheat – 58, barley – 24, soybean meal – 10, sunflower cake – 5, vitamin – mineral premix – 1, dicalcium phosphate – 1.5, table salt – 0.5. The nutritional value 1 кгof such fodder was 1.12 fodder. Ed. and 155 rraw protein. The ration was balanced and detailed in accordance with feeding standards. Evaluation of their reproductive qualities was carried out by generally accepted zootechnical methods. At the beginning of the fourth week of lactation, blood was collected from sows for biochemical studies.

Animals were divided into 4 groups of 5 heads per group (Table 1) based on age, live weight, and number of farrowings.

Research results. The results of the experiment are presented in table 2. It is known that the use of vegetable oils in feeding pigs contributes to the enrichment of rations with energy and unsaturated fatty acids. Newborn piglets use fat as a source of energy. At the beginning of the post-embryonic period, they receive ego exclusively from mother's milk, about 60% of the caloric content of which is provided by fats.

It was experimentally established that no significant and reliable intergroup differences were found in terms of multiple fertility. In our opinion ,the use of feed additives in the late post-embryonic period does not affect the condition and development of embryos in pigs. But in piglets after birth, a reaction to a change in the feeding technology of their lactating mothers was observed. They were on average more powerful in all experimental groups compared to the control population from the first group. The addition of either vegetable fat, or the "oil+enzyme" complex, or exclusively enzymatic Allzheim PT to the main ration adopted in the farm for deep-breed sows contributed to an increase in the average weight of the nest at birth in all groups.

Table 1

Scheme of a scientific and economic experiment

Group	Appointment of the group	The number of sows in the group, ch.	Feeding conditions
I	Control room	5	Basic ration (OR)
II	Experienced	5	OR + 2.5% sunflower oil
III	Experienced	5	OR + 2.5% of sunflower oil + 0.05% of the preparation "Allzyme PT"
IV	Experienced	5	OR+0.05% enzyme preparation "Allzyme PT"

Table 2

Reproductive qualities of sows, M±m

Indicator	Group			
	I	II	III	IV
Multi-fruited, ch.	10.7±0.3	10.8±0.4	10.9±0.4	10.7±0.2
Share of stillborn piglets, %	7.4±0.2	5.0±0.2	4.0±0.1	5.7±0.2
Nest weight at birth, kg	14.8±0.4	15.5±0.3	15.9±0.3*	15.2±0.2
Average large-fruitedness, kg	1.38	1.43	1.45	1.42
Conditional milk yield, kg	49.7±1.1	54.3±1.9*	58.6±1.5***	53.2±1.2*
The weight of the nest when weaning is [1] kg	163.2±3.5	177.8±3.9**	185.4±3.0***	172.9±3.6*
Safety of piglets during the suckling period, %	86.5	86.9	91.0	86.0

Note: [1] – based on weight at 2 months of age

Predominance on the 21st day after the birth of piglets in separate nests showed that the lactation ability of sows of all experimental groups is significantly higher compared to animals from the control group. This reliable trend was most strongly observed in sows from the third experimental group, whose milk yield was on average 17.9% higher than that of control sows. The second experimental group of sows with piglets was also noted to have the most massive nests.

The main activity of the pig farm is the reproduction of piglets with subsequent sale. Therefore, it does not take place in one day, but selectively for 5-6 weeks, and sometimes later, and the calculation of the weight of the nest at weaning was carried out by calculating the real age of the weaned piglets by multiplying by the conversion factor of their weight in 60 days. The obtained results showed that the weight of the nest at the age of 2 months of sows of the II experimental group exceeded the control by 9%, IV experimental – by 6%, but the largest piglets were in the III experimental group. They were 13.6% heavier than their control peers (P >0.999). Piglets from this group were also the most viable. The safety of suckling piglets to weaning in them was 91%, while in the control group the average safety was observed at the level of 86.5%.

To carry out biochemical tests, blood was collected from suckling sows for biochemical tests. The results presented in table 3 show that significant reliable (P<0.95) differences between the experimental groups and the control group were not established. All characteristics were within physiologically acceptable standards. The reason for the insignificant tendency to decrease the content of total protein in the blood serum of the experimental groups may indicate an increase in protein metabolism. In animals from 2 and 3 experimental groups, an increase in the relative concentration of albumins, which perform the body's transport function, was observed, including for macro- and microelements, which may indicate stimulation of the exchange of the albumin fraction of proteins. This trend was most pronounced in sows receiving feed enzyme in addition to the main ration at the same time as adding vegetable oil. The level of calcium and phosphorus in the blood indicates the absence of impaired mineral metabolism in lactating sows. But due to a slight decrease in phosphorus in the blood of mothers III and It can be assumed that the fodder enzyme promotes the release of phosphorus and other macro- and microelements in the diet and, as a result, increases the safety of piglets and their live weight before weaning. Studies revealed insignificant intergroup differences in carbohydrate and fat metabolism, but they remained within physiological values.

Conclusions. Having analyzed the results of the scientific and production experience, it can be concluded that the best effect on the reproductive qualities of sows has the addition to the diet of the combination complex of fodder preparations "sunflower oil + fodder enzyme Allzaim PT". This is explained by the fact that vegetable oils contain a large amount of unsaturated fatty acids – linoleic and linoleic, which are necessary for the construction of cells and some hormones, but cannot be synthesized in the body of pigs. The use in diets of specific enzyme complexes that break down non-starchy polysaccharides allows you to significantly increase the digestibility of nutrients from it. As a result, the level of metabolic energy, assimilation of protein and amino acids, and carbohydrates increases significantly. The simultaneous use of such an optimal combination of feed additives leads to an improvement in the conversion of feed due to its digestibility, and, as a result, has a positive effect on the improvement of feed assimilation, an increase in the safety of piglets and their live weight, which in general leads to a decrease in costs per unit of production and confirmed by the economic analysis of the results of zootechnical studies. Additional annual income on the farm after the introduction of the technology of feeding sows, the addition of sunflower oil to the main ration adopted in the farm together with the enzyme feed Allzaim PT will allow to increase the production of products on the reproduction plot by 5198.8 UAH. on the nest of sows.The calculations were made in the prices of fodder, the purchase of feed additives and the sale of piglets to the population as of November 1, 2022.

Table 3

Biochemical indicators of the blood of lactating sows (week 4)

Indicators	Physiological norm	Group			
		I	II	III	IV
Total protein, g/l	70-85	83.7±2.6	82.4±2.1	79.8±1.9	80.4±2.2
Albumin, g/l	28-47	33.4±1.4	34.2±1.2	35.0±1.5	32.8±1.3
Albumin, %	35-45	40.1	39.3	43.8	42.0
Globulin, %	55-65	59.9	60.7	56.2	58.0
Total calcium, mmol/l	2.8-3.2	2.85±0.19	3.14±0.12	3.22±0.16	3.05±0.11
Phosphorus is inorganic, mmol/l	1.4-2.1	1.65±0.07	1.70±0.11	1.59±0.09	1.58±0.10
Glucose, mmol/l	2.5-3.9	3.13±0.24	3.05±0.17	3.35±0.28	3.20±0.25
Urea, mmol/l	3.3-6.0	4.5±0.65	4.2±0.74	4.0±0.56	3.88±0.65
Cholesterol, mmol/l	1.55-2.85	2.10±0.13	1.98±0.17	2.15±0.15	1.88±0.22

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Використання кормового ензиму в раціонах поросних і підсосних свиноматок

Кормова добавка Оллзайм ПТ провідної кормової компанії Оллтек ЮК Лтд – ферментний засіб для кращої засвоюваності пшениці, жита або тритікале у раціонах птиці та свиней. Загальний ефект від застосування цього препарату полягає у нейтралізації антипоживних речовин, вивільненні і засвоєнні додаткової обмінної енергії, підвищенні перетравності протеїну і доступності амінокислот та зниженні в'язкості хімусу. Застосування цієї кормової добавки дозволяє підвищити поживну цінність зернових на 4-10% в залежності від виду та сорту зернових інгредієнтів раціону.

Багатьма дослідами встановлено, що введення до комбікормів жирових добавок також позитивно впливає на відтворні якості свиноматок, ріст та розвиток поросят. Базуючись на висновках попередніх дослідників, було вирішено ввести до раціону свиноматок жирові добавки та ферментні препарати, підтвердити або спростувати їх висновки та самостійно встановити вплив жирових добавок та ферментних препаратів на відтворювальні якості свиноматок і їх вплив на біохімічні показники крові. Кінцевою метою досліду стало визначення доцільності використання ферментативного препарату «Оллзайм ПТ» самостійно, або з одночасним вводом до основного раціону 2,5% соняшникової олії в конкретному товарному підприємстві.

Проаналізувавши отримані результати науково-виробничого досліду, можна зробити висновок, що найкращий вплив на відтворювальні якості свиноматок має додавання до раціону комбінаційного комплексу кормових препаратів «олія соняшникова +кормовий фермент Оллзайм ПТ». Пояснюється це тим, що рослинні олії містять велику кількість ненасичених жирних кислот – лінолевої і ліноленової, які необхідні для побудови клітин і деяких гормонів, але не можуть синтезуватись в організмі свиней. Застосування в раціонах специфічних ферментних комплексів, що розщеплюють некрохмалисті полісахариди, дозволяє значно підвищити засвоюваність з нього поживних речовин. В результаті цього рівень обмінної енергії, засвоєння протеїну і амінокислот, вуглеводів істотно підвищується. Використання одночасно такої оптимальної комбінації кормових добавок обумовлює поліпшення конверсії корму за рахунок його перетравності, і, як наслідок, – позитивно впливає на покращення засвоєння корму, збільшення збереженості поросят і їх живої маси, що в цілому призводить до зниження витрат на одиницю

продукції, що й підтвердив економічний аналіз результатів зоотехнічних досліджень. Додатковий щорічний дохід на фермі після впровадження у технологію годівлі свиноматок додавання до основного прийнятого в господарстві раціону соняшникової олії разом з ферментним кормовим засобом Оллзайм ПТ дозволить збільшити виробництво продукції на ділянці відтворення на 5198,8 грн. на гніздо свиноматок.

Ключові слова: *кормова добавка, комбікорм, свиноматка, відтворювальні якості.*