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NEW ENZYME PREPARATIONS AND RESULTS OF THEIR USE IN PIG RAISING

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Abstract. *The article summarizes the results of research on the use of new enzyme preparations with pectolytic action for pigs feeding, i.e. multienzymatic compositions MEC-1–MEC-5 and Matseraza.*

Studies have shown that Matseraza and multienzymatic compositions have a high digestion activity of the food constituent portions in vitro. They also significantly increase the activity of the mucous membrane of the 12-rectum enzymes, i.e. protease, dipeptidases, amylase, lipase and do not affect the activity of alkaline and acid phosphatases.

The use of biologically active feed supplements for young pigs feeding improves digestibility of most diets nutrients and causes the better absorption of feed nitrogen by the body.

The positive effect of feed additives on metabolic processes, their ability to stimulate the structure development of some organs of the digestive and endocrine systems have been proved. It causes animals growth by intensifying the functions of individual organs and systems due to morphofunctional changes. It is a confirmation of one of the working hypotheses on accelerating animals ontogenesis by paratypic factors.

It was proved that feeding of preparations as a part of barley, wheat, corn and soybean meal diet of pregnant sows had a positive effect on reproductive properties, increased the growth of piglets, fattening and slaughtering qualities of young animals, digestibility of nutrients and absorption of nitrogen. It is recommended to enrich the cereal diets of pigs with enzyme preparations MEC-1 - MEC-5 in the amount of 0.75 kg per ton of grain and Matseraza in the amount of 0.4-0.5 kg per ton.

The results of research have been introduced at pork farms of the Vinnytsia region. Specified conditions have been developed and approved for the tested feed additives.

Key words: *pigs, enzymes, feeding, productivity, digestion, metabolism, efficiency*

Introduction. The scientific prove of researched enzyme preparations usage in pig raising causes making of new technological decisions on increasing of animals productivity and getting qualitative, free-range and safe products. In addition, their usage for pigs feeding can increase the level of splitting and transformation of plant biopolymers, turning released nutrients into products [1, 4].

The genetic potential of animal body is realized more effectively due to the mentioned above processes. The reproduction functions of animals and their health do not change [7, 14].

It is recommended to use enzyme preparations of exogenous origin for young pigs feeding because their digestive systems have not been formed yet. The synthesis of hydraulic enzymes is rather slow. Some of them are absent altogether. For example, glucanase and xylanase split the beta-glucan of barley and fiber [3, 11].

Exogenous enzymes used in forage enable fully utilization of the nutrients and biologically active substances it contains by splitting cellulose, non-starch polysaccharides, i.e. beta-glucan and pentosan. Nevertheless, since the polysaccharides of the cell walls of the vegetable feed are a complex of different compounds, it is unlikely that the individual enzyme preparations introduced into the feed can translate all non-starch elements into easily digestible monogastric animals, such as glucose. For their cleavage, a set of

enzymes in the form of a multienzyme complex is needed.

However, polysaccharides of cell walls of plant fodder are a complex combination. Therefore, it is unlikely that separate enzyme preparations introduced into the fodder are able to transform all non-starch elements such as glucose into an easily digestible form for monogastric animals. Some enzymes in the form of a multienzymatic composition is needed for their splitting.

Enzymes of exogenous origin convert polysaccharides form from insoluble to soluble one. It facilitates their splitting. Both energy absorption and the nutritional feed value increases when a complex of exogenous enzymes are used because enzymes destroy the plant cells walls releasing additional protein, fat and starch.

Thus, the destruction of cell walls and the release of previously inaccessible nutrients is one of the main functions of exogenous enzymes. However, multienzymic compositions causes the reduction of the chyme viscosity because of food nutrients increasing availability. Some non-starch polysaccharides such as barley beta-glucans or wheat pentosans dissolving in water form a viscous gel. A similar phenomenon happens in the gastrointestinal tract and it has a negative effect on the digestion and suction processes.

As enzymes increase the nutritional efficiency, it can be assumed that they increase both the level of feed energy use

and the overall feed efficiency. However, there are additional opportunities for cheaper diets and more efficient use of cheap feed raw materials.

The composition of enzyme preparations needs a special attention. The preparations available on the Ukrainian market are predominantly multienzymatic, i.e. they include such enzymes as proteases, amylase, beta-glucanase, xylanase and cellulases of different activity [2, 9, 12]. Such complexes have one or two main enzymes with high activity for hydrolysis of the predominant in the diet of the substrate [6, 13].

Materials and methods of research. The research involved the creation of enzyme preparations for the splitting of non-starch cereals polysaccharides. We have also researched their effectiveness in animal feeding. As a result, the following multienzymatic compositions were created:

MEC-1 is pectat-trans-eliminase with activity of 450 units per gram, amylase 300 units per gram, cellulase 75 units per gram;

MEC-2 is pectate-trans-eliminase with activity of 1000 units per gram, beta-glucanase 1000 units per gram, cellulase 75 units per gram;

MEC-3 is pectate-trans-eliminase with activity of 1500 units per gram, amylase 400 units per gram, beta-glucanase 1000 units per gram;

MEC-4 is pectat trans-eliminase with activity 1700 units per gram,

cellulase 150 units per gram, beta-glucanase 100 units per gram, xylanase 500 units per gram;

MEC-5 is pectat-trans-eliminase with activity of 3000 units per gram, cellulase 300 units per gram, protease not less than 7 units per gram;

Matseraza is pectat-trans-eliminase with activity of 3,000 units per gram, 2500, 2000 and 1000 units per gram, endo-and exopoligalacturonase 1500 units per gram.

The ground wheat bran is a filling material.

Enzyme preparations are produced at the facilities of BTU-Center (Ladyzhyn, Vinnytsia region). They have been tested for various aged pigs feeding.

Scientific and production experiments were carried out on pigs of a large white breed of universal type of productivity by the method of analogous groups [10]. It should be mentioned that pigs of control groups were fed by the main diet. The enzyme preparation was added to the main diet of animals from experimental groups according to the scheme of experiment.

The main diet consisted of a carbohydrate part (barley, wheat and corn brans) and a protein part (processed products of leguminous crops, i.e. soybeans, sunflowers, and peas). Premixes were used both in control and in experimental groups for balancing diets concerning nutritional elements. All the feeds were of their own production and of a well-known

chemical compound. The experiments were carried out on the same genotype of large white breed pigs at the Artemida experimental farm, Kalynivka district, Vinnytsia region.

We have researched in vitro digestibility of grain fodder nutrients, activity of enzymes of the duodenal ulcer mucous membrane, the productivity of different age groups of pigs, the quality of pork, digestibility of nutrients, nitrogen balance, hematological

parameters, the structure of the digestive and endocrine systems, and economic figures [10].

Results and discussions.

Researches have proved that Matseraza and MEC have a high in vitro splitting of feed components (Fig. 1). They also significantly increase the activity of enzymes, i.e. protease, dipeptidase, amylase, lipase in the the duodenal ulcer mucous membrane and do not affect the activity of alkaline and acid phosphatase.

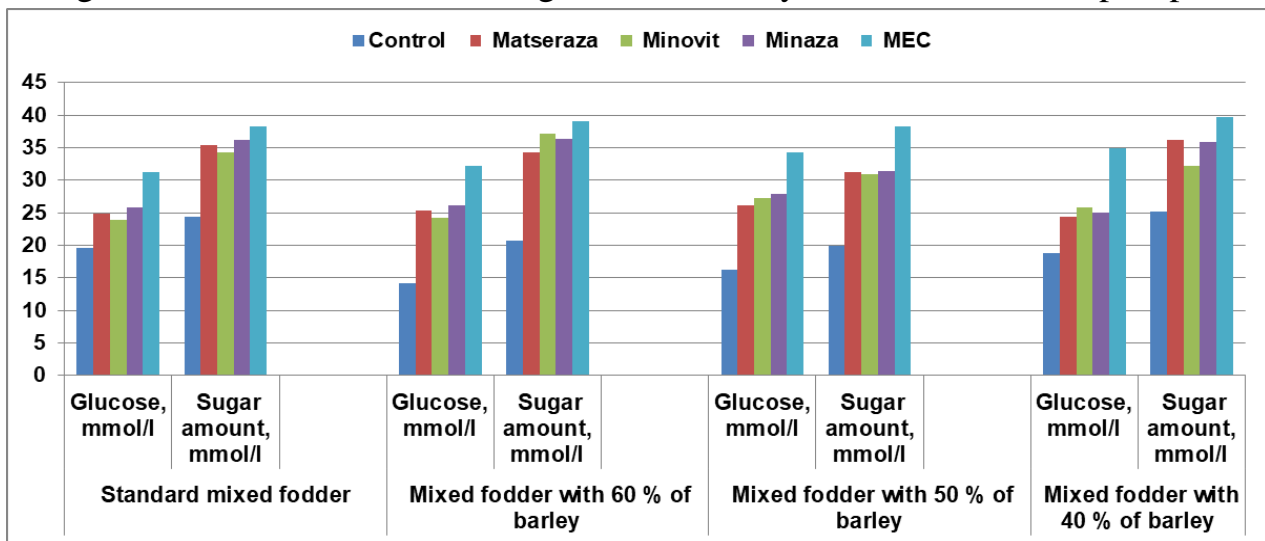


Fig. 1. Effect of enzyme preparations on in vitro splitting glucose ability and sugar content of researched mixed fodder, n=5.

Taking into account the enzyme preparations composition it is possible to predetermine their main specific effect on the splitting of hardly soluble non-starch polysaccharides of grain feeds. Thus, pectate-trans-eliminase compensates the enzymes lack in pig bodies that can hydrolyze polysaccharides (pectin, lignin, hemicellulose, glucans, pentosans, etc.), loosens the intercellular structure of plant materials, causes the release of nutrients from feed cells. It catalyzes the rupture of the α -1,4-liquoside bond in pectic substances and hemicelluloses that leads to loosening of the cementing substances of vegetable feeds and the destruction of cell walls. This ensures the release of reserve nutrients for their splitting by the animals enzyme systems [8].

It was proved that the usage of Matseraza and MEC-1 in diets of pregnant sows causes increasing their body weight during the period of gestation, and it also has a positive effect on piglets growth from their birth to weaning from sows at 45-days age (Table 1).

1. Sow productivity

Characteristics	Groups		
	1 (diet without enzyme preparations)	2 (Matseraza)	3 (MEC-1)
Period of farrowing			
number of piglets in the nest, heads	11.4±0.51	11.5±0.57	11.2±0.53
nest weight, kg	13.91±0.38	14.72±0.65	14.81±0.39
liveweight of one head, kg	1.22±0.03	1.28±0.04	1.34±0.05
Period of weaning at 45-days age:			
number of piglets in the nest, heads	10.0±0.35	10.2±0.51	9.7±0.45
nest weight, kg	94.0±2.76	114.0±6.52 ^{xx}	102.8±3.32
liveweight of one head, kg	9.4±0.26	11.3±0.47 ^{xx}	10.60±0.61
liveweight gain: absolute, kg	8.18±0.25	10.02±0.47 ^{xx}	9.35±0.58
average daily, g	182.0±5.56	223.0±10.32 ^{xx}	205.8±12.88

Therefore, we can observe a weight increase both of nest (by 5.82 - 6.47%) and of one pig at birth (by 4.92 - 9.84%) in the experimental groups. This tendency is also observed when piglets are weaned from sows at 45-days age. The experimental groups have higher figures than the experimental one, i. e. by 9.36-14.0% of the nest weight, by 12.76-20.21% of one pig live

weight, by 20.5% of average daily liveweight gains for the suckling period

The usage of enzyme preparations for young pigs feeding improves the digestibility of most nutrients in diets, i.e. protein by 6.1% ($P<0.01$) and fiber by 8.35% ($P<0.05$). Experimental animals also had better nitrogen balance (Fig. 2)

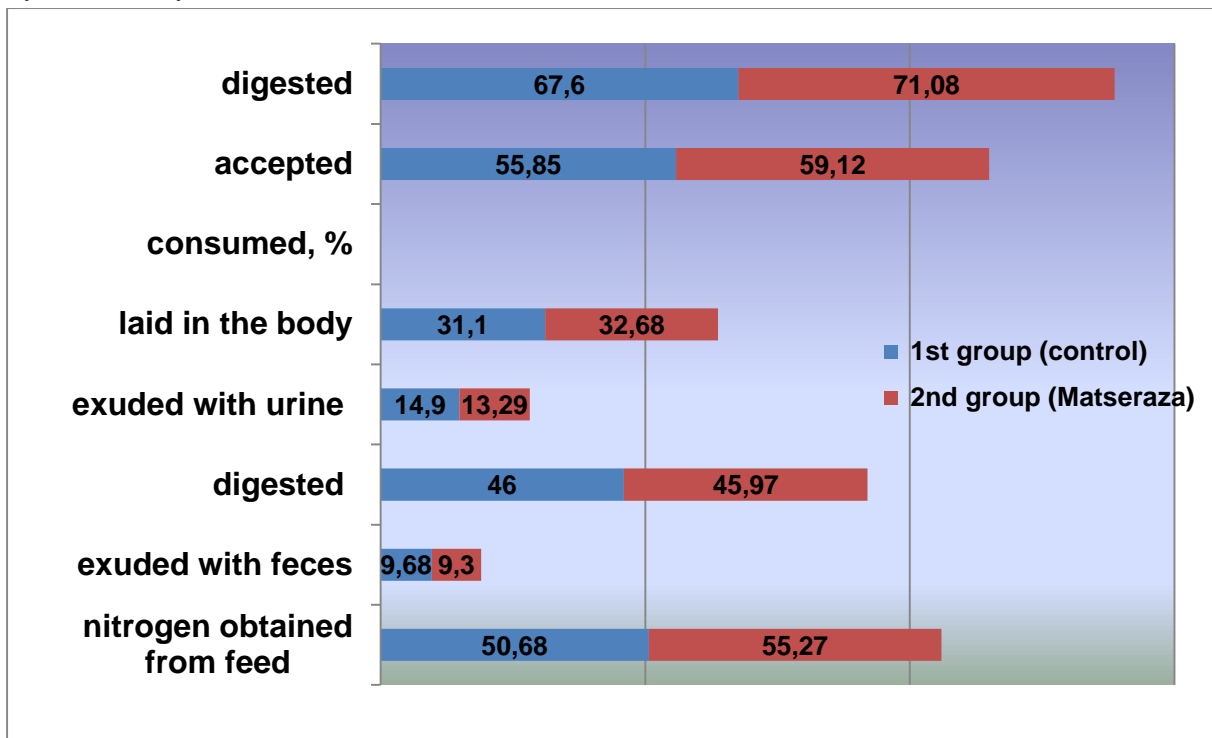


Fig. 2. Nitrogen balance of young pigs fed by Matseraza

The positive effect of the researched preparations on the metabolic processes, their ability to stimulate the development of individual structures of the organs of the digestive and endocrine systems have been proved. These positive effects also cause a significant increase in animal growth. In other words, there is an intensification of the functions of some organs. It is a confirmation of one of the working hypotheses on accelerating animals ontogenesis by paratypic factors.

The best productive and biological effect is observed when animals are fed by Matseraza obtained by spraying culture liquid on bran in comparison with drying in a stream of hot air.

Why have we chosen this enzyme? It is known, grain pig diets have a high content of necrochromic polysaccharides (cellulose, pectin,

pentosans, beta glucans). That's why it is recommended to use exogenous enzyme preparations for their splitting. As a rule, such polysaccharides are in the form of fiber. Insoluble pectin plays the role of binding ("cementing") material for different non-starch polysaccharides. Such enzymes as cellulase, beta glucanase, phytase etc. are used as a part of fodder in order to break down these polysaccharides. However, the main macerating pectolytic enzyme pectate-trans-eliminase (pectin-lyase) is not used. It is caused by the fact they often identify pectin-lyase with pectinase. The pectinase contains the enzymes pectinesterase, polygalacturonase and does not contain pectin-lyase. These two enzymes affect soluble pectin, and pectin lyase affects the insoluble pectin that forms the structure of fiber. It is their fundamental difference. Pectate-trans-

eliminase is responsible for the maceration of plant tissues.

The preparation macerating effect is connected with the activity of pectate-trans-eliminase. It is significantly enhanced by the complex effect on the xylanase plant raw material. Xylanase splits pentosans, pectin-lyase catalyzes the breakdown of the α -1,4-glucosidic bond in pectin substances and polyuronide hemicelluloses, which leads to the delineation of the cementing substances of plant tissues and destruction of the cell wall structure. This ensures the release of reserve intracellular nutrients for their digestion by the enzyme systems of the digestive canal of animals. Matseraza in immobilized form has high stability in an acidic environment. This is especially important when passing the enzyme through the stomach of pigs, and can also be used in the composition of granulated feed.

The Matseraza used for young animals feeding at the rate of 0.4 kg per one ton of mixed feed increases the average daily gains on growing and fattening by 18-20.4%, it also provides an additional 16.8 UAH revenue from every head. Multienzymatic compositions in the diet at the rate of 0.75 kg per ton of grain mixtures cause an increase in average daily gains on growing by 7.9 - 13.2% and on fattening by 11.9 - 14.9%. Respectively 21.7 - 39 UAH and 27.5 - 35.2 UAH were received from each head as a revenue.

The preparations has also positive effect on the efficiency of feed consumed by animals, the meat and lard output, the costs reduction, and high preparation payback. One invested hryvnia has from UAH 6.4 to 10.3 UAH of revenue.

Conclusions. It has been proved that increasing productivity of pigs of different age groups is ensured by using in their feeding new biotechnological (enzyme) preparations and their compositions, i.e. Matseraza and MEC-1-MEC-5. They are characterized by high splitting activity parts of the feed, fermentolysis in the intestinal mucosa and metabolism that ensures the intensive growth of animals and obtaining high-quality pork.

Matseraza and other preparations as a part of pigs diet have a positive effect on the reproductive ability of sows, growth and preservation of piglets, fattening and slaughter qualities of young animals, physical and chemical characteristics of meat quality, its protein, fatty acid composition and calorie content. Improved digestibility of most nutrients and feeds nitrogen assimilation were also noted.

The best productive and biological effect is observed when animals are fed by Matseraza obtained by spraying culture liquid on bran in comparison with drying in a stream of hot air. Its use for young pigs feeding increases average daily gains by 18.0-20.4% and ensures an additional 1.4 UAH of profit on the 1 UAH invested.

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НОВІ ФЕРМЕНТНІ ПРЕПАРАТИ ТА РЕЗУЛЬТАТИ ЇХ ЗАСТОСУВАННЯ В СВИНАРСТВІ

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Анотація: У статті узагальнюються результати досліджень щодо використання у годівлі свиней нових ферментних препаратів пектолітичної дії – мультіензимних комплексів МЕК-1 – МЕК-5 та мацерази.

Дослідження показали, що мацераза та МЕКи мають високу активність розщеплення *in vitro* складових частин корму, а також достовірно підвищують у слизовій оболонці 12-палої кишки активність ферментів – протеази, дипептидази, амілази, ліпази та не впливають на активність лужної олії.

Використання в годівлі молодняка свиней біологічно активних кормових добавок сприяє поліпшенню перетравності більшості поживних речовин раціонів та кращому засвоєнню азоту корму.

Доведено позитивний вплив кормових добавок на процеси обміну речовин, їх здатність стимулювати розвиток окремих структур органів травної та ендокринної систем, що пов'язано з підвищенням приростів тварин шляхом інтенсифікації функцій окремих органів та систем за рахунок морфофункціональних змін. Це є підтвердженням однієї з робочих гіпотез прискорення онтогенезу тварин паратиповими факторами, на відміну від генетичних.

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Показано, що згодовування препаратів у складі раціонів з ячменю, пшениці, кукурудзи та соєвого шроту порослим свиноматкам мало позитивний вплив на відтворювальні здатності, покращувалися показники росту та збереження поросят, відгодівельні і забійні якості молодняку, перетравності поживних речовин. Рекомендується збагачувати зернові раціони свиней ферментними препаратами МЕК-1 – МЕК-5 у кількості 0,75 кг/т зерноsumіші, мацеразою – 0,4-0,5 кг/т.

Результати досліджень запроваджено у господарствах з виробництва свинини у Вінницькій області. На досліджувані кормові добавки розроблено та затверджено Технічні умови.

Ключові слова: *поголів'я свиней, ферментні препарати, згодовування, продуктивність, перетравність, обмін речовин, ефективність*