UDC 636.4.082.4:636.087

THE EFFECT OF ENTEROSORBENTS ON PIG REPRODUCTIVE ABILITY

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Methods of efferent therapy have been more widely used in animal husbandry lately. Oral administration of enterosorbents allows effective purification of the organism from toxins, as well as enhancement of immune system and reproductive potential of pigs.

Reproductive function of pigs is often disturbed in the context of hog enterprises, due to a number of reasons, including failure to meet feeding and housing conditions. Consequently, harmful products and ballast substances of endogenous and exogenous origins are accumulated in boar's body, exercising a negative impact on boar sperm quality, as well as fertility rates of sows. Moreover, as a rule, animals are unable to cope with this issue on their own.

Causes of toxic metabolites accumulation can be of external and internal origin. Animal organisms are most often subject to external infiltration of nitrates and nitrites, pesticides, antibiotics, and other medicines of chemical origin, mycotoxins, and a variety of chemical stimulants added into the feed, oxides and salts of heavy metals. Once in the body of the animal, many of them remain there permanently. While some undergo certain changes, others retain their original forms. Toxic substances of internal origin are intermediate products of metabolism in the body. For various reasons, these intermediate elements dropped out of the complex process of oxidation-reduction reactions that promote normal metabolism in the body, and as a result cannot be bred out. These insufficiently oxidized substances are called toxic metabolites.

According to many scientists, the main cause of toxicosis in farm animals is low-grade animal feed that may contain pesticide residues, heavy and radioactive elements, mycotoxins, nitrate exchange products and other hazardous compounds. The excessive content of toxic substances in feed and livestock products is primarily related to environmental pollution. In this regard, special attention should be given to such relevant objectives as search for detoxification methods for ration ingredients and prevention of the negative influence of exotoxins on metabolism, animal productivity and the quality of livestock products.

Presently, that colon cleansing has been proven to be one of the most effective methods of treating numerous disorders in the body. (L.V. Berketova, 2000, S. Bengmark, 1998., A.G.J. Voragen, 1998).

The use of sorption preparations in animal feed is an efficient way to reduce the content of potentially harmful substances that affect the processes of tissue metabolism and the quality of obtained products in the body of animals.

Understanding of processes involved in the development and course of endogenous and exogenous intoxication, as well as conviction in the enterosorption priority in relation to other methods of effective therapy, created prerequisites for using a wide range of enterosorbents with inhomogeneous mechanisms of action. Such active enteric agents as activated carbon, lignites, aluminosilicates, chitin and chitosan, kaolins, zeolites, silatrans have found widespread use both, in veterinary science and medicine. These

studies investigate the use of certain enterosorbents with the aim to increase the reproductive ability of pigs.

Materials and methods. In the studies, such enterosorbents as Enterosgel (non-linear polymerization product 1, 1, 3, 3-tetrahydroxy-1,3-dimethyldisiloxane polyhydrate) and Mival-Zoo were used.

Enterosgel has a porous structure of the organosilicon matrix of hydrophobic nature, which is characterized by sorption properties with respect to toxic metabolites. It has pronounced sorption and detoxication properties, it binds and removes from the body endogenous and exogenous toxic substances of different nature, including bacteria and bacterial toxins, antigens, food allergens, drugs and poisons, salts of heavy metals.

Experiments on feeding Enterosgel preparation to boars of a large white breed at the age of 2-3 years were carried out at LLC “Stroyplastmass-Agroprodukt”, the Ulyanovsk Region. By analogy principle, 5 groups of boars were formed: I - control; II-V - experimental (n = 4 in each group).

Feeding of breeding boars complied with standards of All-Russian Scientific Research Institute of Animal Husbandry. Boars of the control group were not administered Enterosgel preparation in addition to basal ration, while boars of the experimental groups (II-V) received in addition to the basal ration 10, 20, 30 and 40 mg / kg of live weight of Enterosgel preparation divided into 2 feedings. Feeding of boars with the preparation lasted for 2 months. In 40 days from the onset of feeding, sperm was taken for research twice a week for 2 months. The qualitative and quantitative indices of sperm obtained from boars of the control and experimental groups were determined, as well as its fertilizing capacity. Insemination of sows was undertaken twice with freshly received sperm of 100 ml with 3.0 billion active spermatozoa in a dose.

In the following experiment breeding boars were fed with Enterosgel preparation, and at the same time the quality of sperm, the parameters of frozen-thawed sperm and its fertilizing capacity were assessed.

According to the analogy principle, in JSC "Konstantinovo" stud farm in the Moscow region, 5 groups of large white breed boars were formed, 4 animals in each. Feeding of breeding boars was carried out according to the standards of All-Russian Scientific Research Institute of Animal Husbandry.

I group served as control; II, III, IV and V groups of boars in addition to the basal ration were fed with Enterosgel preparation 10, 20, 30 and 40 mg / kg of live weight for 90 days, divided into 2 feedings.

In the process of feeding, boar sperm was taken manually. Only its thick fraction was used, which was then diluted by dialysis. The sperm was frozen in granules on fluoroplastic plates of a 0.5 ml volume at the Central station of artificial insemination of farm animals of the Moscow region. To determine the quality of frozen-thawed semen, sperm samples were thawed and mobility indices, as well as survival rate at 39 °C and acrosome preservation were determined.

Frozen ejaculate was transported in cryogenic vessels to OJSC “Stroiplastmass-Agroproduct” of the Ulyanovsk Region for a two-fold insemination of sows (in the morning, immediately after the heat detection and repeatedly - after 24 hours). In addition, the following indicators were taken into account: the number of inseminated and farrow sows, the number of piglets received per 1 uterus and per 100 inseminated animals.

Special studies were performed to study the effect of Mival-Zoo preparation on reproductive function of boars and sows. Experiments on Welsh breed boars were conducted in a specialized collective farm named after Frunze in the Belgorod District of the Belgorod Region. In the experiments, animals

were kept in certain groups in a typical room, received a full-feed forage K-57-2 according to standards of All-Russian Scientific Research Institute of Animal Husbandry. The mechanism of action of Mival-Zoo is determined by the main active substances in its content : Mival and an analogue of auxins - plant "growth hormone".

For the trials based on the analogy principle, 3 groups of breeding boars of Welsh breed were selected, 5 animals in each, at the age of 2.5-3 years. Studies were conducted in two periods (preparatory period - 40 days and experimental - 60 days). In the preparatory period, boars of all experimental groups received K-57-2 compound feed 4 kg each per day without the addition of Mival-Zoo preparation. In the experimental period, the boars of I group did not receive admixture, and the animals of II and III group received Mival-Zoo additive 5 and 10 mg each per kg of live weight per day.

Results of the research. The addition of Enterosgel into boar feed had a pronounced effect on qualitative and quantitative sperm indices, especially in the IV and V experimental groups.

Table 1

Influence of feeding the preparation Enterosgel to boars at different doses on the quality of sperm

Indices	Group of animals				
	I (control)	II	III	IV	V
Number of Boars	4	4	4	4	4
Received ejaculate	56	60	76	84	84
Received semen dosis	711	1014	1466	1713	1707
Volume of ejaculate, ml	195	229	245$^{x)}$	250$^{xx)}$	249$^{xx)}$
Concentration. of spermatozoa, million / ml	195	221	237	245	245
Total number of spermatozoa, billion	38.0	50.6$^{x)}$	58.1$^{xx)}$	61.2$^{xxx)}$	61.0$^{xxx)}$
Sperm mobility,%	78	81	83	85	85
Resistance, conventional units.	975	1090	1295$^{x)}$	1650$^{xx)}$	1650$^{xx)}$
APV, standard units.	665	720	745	790	790
Preservation of acrosome,%	86	92	94$^{x)}$	95$^{xx)}$	95$^{xx)}$

$^{x)}$ — p=0.95; $^{xx)}$ — p=0.99; $^{xxx)}$ — p=0.999

During the study, in experimental groups of boars 7.1; 35.7; 50.0; and 50.0% more ejaculates were observed compared with the control group. The volume of ejaculate also increased significantly (Table 1). Compared with the control group, this index by groups is higher by 17.4; 25.6; 28.2 and 27.7%, respectively. The concentration of spermatozoa was also more intensified; thereby the spermodosis quantity from boars of experimental groups exceeded the control group by 1.4-2.4-fold. Mobility, resistance and apparent sperm viability (ASV) of spermatozoa in experimental groups also prevailed over the control group. The preservation of acrosomes in groups III-IV was soaring, attesting to significant improvement of sperm quality.

The sows of this farm were inseminated by the sperm of the boars of the control and experimental groups.

Table 2

Indicators for farrow sows

Indices	Groups of animals				
	I (control)	II	III	IV	V
Number of Boars	70	72	72	74	73
Received ejaculate	52 74.3	58 80.5	59 81.9	63 85.1	62 84.9
Received semen dosis	471	539	560	602	592
Volume of ejaculate, ml	9.06	9.29[x)]	9.49[xx)]	9.55[xxx)]	9.55[xxx)]
Concentration. Spermatozoa, million / ml	673	748	778	813	811

[x)] — p=0.95; [xx)] — p=0.99; [xxx)] — p=0.999

According to Table 2, the percentage of farrows in experimental groups was higher by an average of 6.2-10.8%, the prolificacy - by 0.23-0.49 piglets, and the number of piglets per 100 inseminated sows - by 75-140 heads.

The accumulation of toxic metabolites in pigs's bodies is bound to affect both the quality of boar sperm and its freezing capacity. Qualitative sperm indices were determined after freezing-thawing (Table 3).

Table 3

Influence of feeding the preparation Enterosgel to boars at different doses on the stability of spermatozoa during freezing-thawing

Indices	Groups of animals				
	I (control)	II	III	IV	V
Number of Boars	4	4	4	4	4
Frozen ejaculate	17	19	20	21	21
Received semen dosis	71	84	90	105	105
Mobility, %	35+1.2	39+1.0	39+1.0	44+0.9	44+0.9
Preservation of acrosome, %	42+2	47+2	46+2	58+4	58+4

It was found that during the experimental period, a different amount of ejaculate suitable for freezing was obtained from the same number of boars: compared with the controls, groups II, III, IV and V provided more ejaculate - 11.2, 17.6, 23.5, and 23.5%, respectively. Semen dosis from a given number of boars in these groups exceeded the control by 18.3, 26.7, 47.9 and 47.9%, showing that the increase in the number of ejaculates was accompanied by growth of their volume. With regard to the quality of frozen-thawed sperm, boars of groups IY and Y showed the best results, surpassing the control by 25.7-38.1%.

On inseminating sows with frozen-thawed sperm, the following fertilization results were obtained.

Table 4

Indicators of farrow sows

Indices	Groups of animals				
	I (control)	II	III	IV	V
Inseminated, number	33	38	44	48	49
Farrowed: - number - %	 17 51.5	 20 52.6	 25 56.8	 28 58.3	 29 59.2
Piglets received	152	182	229	262	268
Prolificacy, number	8.94	9.10	9.16	9.35	9.25
For 100 inseminated sows	461	479	520	546	547

Fertility of sows of experimental groups outpaced the control group by 1.1, 5.3, 6.8 and 7.7%, prolificacy was slightly higher in experimental groups.

In groups where sows were fed Enterosgel at a dose of 30-40 mg / kg, the best fertility and prolificacy indices were observed. Thereby, per 100 inseminated sows, 56 piglets could be additionally obtained (Table 4).

Feeding breeding boars with Mival-Zoo preparation led to the following results.

Table 5

Volume and concentration of boar semen depending on Mival-Zoo use (n - the number of ejaculates studied)

Experimental groups	Boar feeding conditions	Sperm volume, ml				Spermatozoa concentration million/ml			
		Preparatory period		Experiment period		Preparatory period		Experiment period	
		n	M±m	N	M±m	n	M±m	n	M±m
1	Basal ration	40	212.0±3.6	40	214.0±5.1	40	211.0±3.1	40	210.0±4.1
2	Basal ration + 5 mg per 1 kg of live weight Mival-Zoo	40	210.0±4.8	40	225.0±3.8	40	211.7±3.5	40	210.5±7.2
3	Basal ration + 10 mg per 1 kg of live weight Mival-Zoo	40	209.0±6.5	40	241.0±6.3	40	212.3±6.2	40	212.0±5.0

Studies showed that the volume of ejaculates in boars of I group did not change significantly in comparison with the preparatory period, but in boars of II and III groups this index increased by 7.3 and 15.3%, respectively.

The data in Table 5 also demonstrates that the concentration of spermatozoa in sperm of the experimental boars remained unchanged compared to the preparatory period. The total number of

spermatozoa in boar ejaculates of the first control group did not alter during the period of the experiment. However, feeding Mival-Zoo to boars at a dose of 5 and 10 mg per 1 kg of live weight (II and III groups) boosted the total number of sperm in the ejaculate by 6.7 and 15.1%, respectively, compared with the preparatory period. Consequently, in boars of II andIII groups, not only did growth in the volume of ejaculates differ in the increased liquid part, but it also varied in the elevated total number of spermatozoa in ejaculates.

Summarizing data on the effect of feeding boars with Mival-Zoo preparation on their quantitative indices of sperm production, it can be concluded that this preparation foments an enhancement of the secretion of the liquid part of the sperm and spermatogenesis, which is a positive fact.

However, the main sperm quality assessment is its fertilizing ability.

Table 6

Influence of differences in boar feeding on prolificacy and fetal size of sows

Experimental groups	Feeding conditions of boars	Run-in period			Experiment period		
		Piglets received, number			Piglets received, number		
		Total	Per farrow		Total	Per farrow	
1	Basal ration	255	10.2±0.1	1.22±0.02	246	10.2±0.1	1.21±0.02
2	Basal ration + 5 mg per 1 kg of live weight Mival-Zoo	258	10.3±0.1	1.21±0.01	261	10.8±0.2	1.20±0.01
3	Basal ration + 10 mg per 1 kg of live weight Mival-Zoo	256	10.2±0.1	1.22±0.02	274	11.0±0.1	1.18±0.03

The data in Table 6 shows that the prolificacy of sows inseminated with semen of the boars from I group did not change during the experimental period, while prolificacy of sows inseminated by semen of the boars from II and III groups, fed with 5 and 10 mg of Mival-Zoo per 1 kg of live weight in the experimental period, increased by 4.8 and 7.8%, respectively, compared with the preparatory period. With regard to fetal size of sows, this indicator is reliably independent from feeding boars with Mival-Zoo in different quantities.

To study the effect of feeding sows with the preparation Mival-Zoo on their productivity, according to the analogy principle, 3 groups of pregnant sows were selected, 30 in each. While conditions for all groups of animals were the same, feeding varied. Sows of I group received a balanced ration according to the norms of All-Russian Research Institute of Animal Husbandry. Sows of II and III groups, in addition to this diet, were fed 5 and 10 mg of Mival-Zoo per day, respectively, per kilogram to the live weight 40 days prior to farrowing and 20 days after farrowing.

In these experiments, prolificacy, fetal size of sows, as well as growth and capacity for survival of experimental sows' offspring were taken into account.

Table 7

Influence of feeding sows with Mival-Zoo preparation on the number of newborn piglets

Experimental groups	The quantity of Mival-Zoo per 1 kg of live weight, mg	The number of sows in group	The number of newborn piglets	
			Total	Per 1 farrow
1	Without feeding	30	285	9.5±0.1
2	5	30	303	10.1±0.1
3	10	30	330	11.0±0.1

The data in Table 7 shows that feeding sows with Mival-Zoo preparation 5 and 10 mg per 1 kg of live weight 40 days before and 20 days after the farrowing promoted an increase in the birth of live piglets compared with I control group, by 6.3 and 15.7%, respectively.

To study the effect of Mival-Zoo preparation on piglets' growth and capacity for survival, according to the analogy principle, 4 groups of piglets were selected at the age of 30 days, 20 animals in each group. Conditions for all the groups were identical, except for the feeding. Piglets of I group received a balanced diet in compliance with the standards of All-Russian Scientific Research Institute of Animal Husbandry. Piglets of II, III, and IY groups besides this diet were fed with 15, 30 and 60 mg of Mival-Zoo per day for 40 days (from 30-day to 70-day old). These studies took into account growth and capacity for survival of piglets up to 3 months.

Table 8 reveals that feeding of piglets with 15, 30 and 60 mg of Mival-Zoo per animal per day for 40 days contributed to an increase in the rate of growth of piglets in the period from 1 to 3 months by 3.0; 11.7; 21.2%, respectively, in comparison with the first control group. In addition, in the experimental groups (II, III, IY), the capacity for survival of piglets was 5.0% higher than in the control group.

Table 8

Influence of feeding piglets with Mival-Zoo preparation on their growth and capacity for survival up to 3 months

Experimental groups	Quantity of fed Mival-Zoo per 1	Quantity of piglets in the group	Live weight of 1 piglet, kg		Average daily growth from 1 to 3 months, g	Survival capacity from 1 to 3 months	
			In 1 month	In 3 months		Number	%
1	w/o	20	6.0	26.4±0.4	340	19	95.5
2	15	20	6.0	27.2±0.2	353	20	100.0
3	30	20	6.0	29.5±0.5	391	20	100.0
4	60	20	6.0	32.0±0.3	433	20	100.0

Thus, studies have shown that Mival-Zoo can be successfully used in raising piglets to boost their growth and capacity for survival.

CONCLUSION

Taking into account the experimental data, it can be concluded that additional feeding of boars with Enterosgel preparation foments purification of boar organism from toxic metabolites, improvement of blood indices, the quantitative and qualitative sperm indicators, and an increase in fertilization of the sows with frozen-thawed sperm. This points to the fact that Enterosgel can be successfully fed to boars to enhance the quality of sperm and mount its resistance to freezing. The recommended dose is 30 mg / kg of boar weight for 60-90 days.

The conducted study on Mival-Zoo leads to the following conclusions. The introduction of Mival-Zoo preparation in the amount of 5 and 10 mg per kg of live weight together with the mixed feed to the boar organism promoted an increase in the quantitative indices of sperm production by 6.7 and 15.1%, respectively, and enhanced biological full-value of the spermatozoa. Improvement of qualitative indicators of sperm resulted in an increase in the prolificacy of sows by 4.8 and 7.8%, respectively, in comparison with the animals in the control group.

The use of Mival-Zoo in pregnant sows 40 days prior to farrowing and within 20 days after had a positive effect on the course of gestation, parturation and the postnatal period: the quality of the offspring improved, farrowing of sows of II and III groups brought more live piglets than in the control group, by 6.3 and 17.5%, respectively. Growth and capacity for survival of piglets in experimental groups were superior. Mival-Zoo also has a growth-stimulating effect. The introduction of Mival-Zoo preparation into the ration of piglets one month of age provided an increase in body weight of 3.0; 11.7 and 21.2% in comparison with the control group.

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