

## EVALUATION OF THE PRODUCTIVE AND REPRODUCTIVE QUALITIES OF BLACK MOTTLE COWS WITH THE USE OF FORAGE SORBENTS

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### Abstract

Currently, the presence of toxins in the composition of all feed for cattle is recorded as a result of a violation of the technology of harvesting and storing feed. The most famous are aflatoxins, ochratoxins, zearalenone, T2 toxin, deoxynivalenol (DON), fumonisin, which, getting into the blood of an animal, quite negatively affect the body of cows, reducing their productivity and fertilizing ability. Of particular importance is the determination of toxins in feed when feeding highly productive livestock under conditions of intensive milk production technology. The purpose of the work is to establish the degree of influence of different dosages of feed sorbents on the productive and reproductive qualities of cows. The studies were carried out in the conditions of the breeding reproducer of the black-and-white breed LLC Barmino in the Nizhny Novgorod region. The objects of research were cows of the first lactation of the Black-and-White breed, but the subject of research was the milk productivity of animals and the efficiency of insemination of cows. It was found that milk productivity and higher rates of reproductive abilities were the best in cows of the third experienced groups that received the largest amount of feed sorbent - 2 kg per ton of concentrated feed.

**Key words:** cows, black-and-white breed, toxins, sorbent, productivity.

### INTRODUCTION

Currently, the presence of toxins in the composition of all feed for cattle is recorded as a result of a violation of the technology of harvesting and storing feed - high humidity (more than 13%), the presence of oxygen, a sufficient amount of heat, a sharp temperature drop, damage to grain by insects and competition with other microorganisms for a nutrient substrate (Golovnya, 2017; Laptev et al., 2014; Klaenhammer et al., 2012; Zdorovinin et al., 2021).

The main known toxins found in feed include: aflatoxins, ochratoxins, zearalenone, T2 toxin, DON (deoxynivalenol), fumonisin.

Getting into the blood of an animal, toxins can affect the state of the body in a variety of ways, and symptoms often appear that veterinary specialists associate with other diseases (Malkov et al., 2016, 2018; Xue, 2020).

Two of the above toxins, such as zearalenone and DON, have a negative effect on the reproductive state of cows - they cause estrogen syndrome, provoke vaginitis, endometriosis, infertility, abortion, cause false heats (Diaz D., 2006; Uyeno et al., 2015) (Table 1).

Table 1. The main toxins in feed and their effect on the body of cattle (Diaz D., 2006)

Toxins	Effect on the animal
Aflatoxins	Decreases appetite, causes lethargy, rough coat, affects the liver, poses a serious risk of contamination of milk
Ochratoxins	Affect the liver and kidneys, contribute to the removal of vitamins and minerals from the body, causing destruction of hooves, horns, teeth
Zearalenone	Causes estrogen syndrome, provoking vaginitis, infertility, abortion, false heat, edema, genital and udder hypertrophy
T2 toxin	Causes a decrease in appetite, depression, a drop in productivity. The formation of necrosis on the skin and mucous membranes, worsens blood clotting
DON (deoxynivalenol)	Reduces appetite and, as a result, productivity, increases the number of somatic cells in milk, disrupts reproductive functions
Fumonisin	It affects the liver, has a nephrotoxic and carcinogenic effect, reduces the immunity of the animal.
Mycotoxins	They affect the health and productivity of animals, are found in meat, milk and offal.

Elimination or reduction of the concentration of toxins that enter the body of animals with food is possible with the help of various feed sorbents, which include both a mineral complex (coal, zeolite, silica), which is the primary filter for toxins, and live bacteria that are embedded on particles solid sorbent. Bacteria of the genus *Bacillus* are used as bacteria (Nekrasov et al., 2013; Filipyev, 2016). They have a significant advantage over other representatives of the microflora: they are able to increase the nonspecific resistance of the host organism, have antagonistic activity against a wide range of pathogenic and opportunistic microorganisms and high enzymatic activity, are resistant to lytic enzymes and thereby cause high viability throughout the gastrointestinal tract (Pozdnyakova et al., 2019, 2020). Thus, determining the effect of feed sorbents on the productive and reproductive qualities of cows is a relevant and practically significant topic for scientific research.

## MATERIALS AND METHODS

The studies were carried out in the conditions of a breeding reproducer of the black-and-white breed LLC Barmino, Lyskovsky district, s. Barmino, Nizhny Novgorod region.

The farm contains 1983 heads of purebred black-and-white cattle, of which 795 heads are dairy herds. The average productivity for 305 days of lactation is 8847 kg, the mass fraction of fat in milk is 4.06%, protein is 3.29%.

The method of keeping cows is mixed - some of the animals are kept loose in sections, milking takes place in the Tandem type milking parlor for 24 heads, and some are kept in stalls in a tethered way, milking is carried out in the milk pipeline.

The repair of the herd is carried out at the expense of own reproduction, the culling of cows is 21.5%.

The reasons for the withdrawal of cows from the herd are shown in Figure 1.

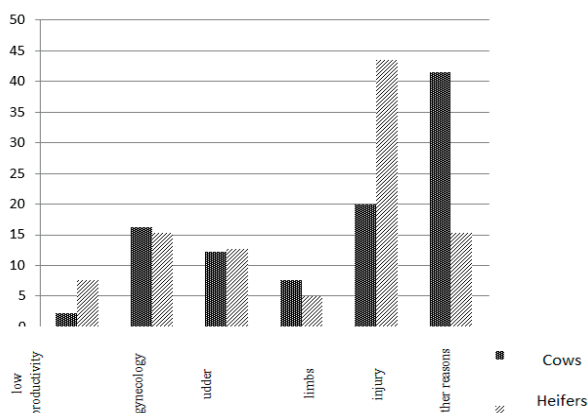


Figure 1. Reasons for culling cows from the herd

From Figure 1 it follows that the main reason for cow culling is technological problems 19.9% in adult cows and 43.5% in first-calf heifers, gynecological diseases and barrenness account for 16.3% and 15.3%, respectively.

An analysis of the reproductive qualities of the herd showed that the service period lasts 103 days, the dry period - 63 days, the number of inseminations per one fruitful - 1.9, and the yield of live calves per 100 cows - 79%.

These indicators can be considered satisfactory for a dairy farm with an average productivity of more than 8000 kg. However, the identification and elimination of the causes that keep repro-

duction at this level is practically necessary. To establish the effect of feed mycotoxins on the productive and reproductive qualities of cows, we conducted an examination of the concentrated part of the feed in accordance with GOST 34108-2017 - Feed, mixed feed, feed raw materials.

The presence of mycotoxins was determined by a direct solid-phase competitive enzyme immunoassay in the testing laboratory of the State Budgetary Institution of the Nizhny Novgorod Region "Regional Veterinary Laboratory" for the presence of mycotoxins (Table 2).

Table 2. Analysis of feed for the content of mycotoxins

No.	Indicator	Test result	Norm
1.	Aflatoxin B1, mg/kg	Less than 0.002	0.004
2.	Deoxynivalenol (DON), mg/kg	0.349	Not more than 1.0
3.	Zearalenone, mg/kg*	0.251	0.1
4.	Ochratoxin A, mg/kg*	0.021	0.005
5.	T-2 toxin, mg/kg	0.020	0.06

\*excess of MPC

Thus, the conducted studies revealed the excess of the permissible norm of mycotoxins of zearalenone by 2.5 times and ochratoxin by 4.2 times.

Currently, the farm uses the Provitol feed additive to normalize the rumen digestion of cows, which accelerates the formation of rumen microflora and helps to increase productivity and improve the quality of milk (Yildirim et al., 2018, 2019, 2020). However, this feed additive, in our opinion, does not eliminate the negative impact on reproductive properties caused by feed toxicosis.

As a feed sorbent, we chose the Russian-made probiotic sorbent Vetosporin-aktiv, which is a multicomponent preparation. It is a suspension of live bacteria of natural strains of *Bacillus subtilis* 11B (with antifungal) and *Bacillus subtilis* 12B (with antifungal) activity.

The objectives of the research included studying the effect on the productivity and reproductive qualities of cows supplementing the main diet with the Provitol feed additive and the Vetosporin-Active feed additive.

Feed additive Provitol and drug Vetosporin-active were introduced in various dosages in the feed shop during the production of the concentrated part of the feed, and then fed as part of a mono-feed for 75 days - starting from

the transfer of animals to the late dry group up to the 2<sup>nd</sup> month of lactation inclusive.

For the experiment, 5 groups of cows were selected by the method of pair-analogs, 12 heads each, in the physiological state of the late dry period (2 weeks before calving), of the same age and approximate live weight.

The first group is the control group, which did not receive a feed supplement to the main diet; the second group - experimental - received the Provitol feed additive at a dose of 1.5 kg per ton of feed (as recommended by the manufacturer); the third group - experimental - received the Provitol feed additive at a dose of 2.5 kg per ton; the fourth group - experimental - received the Vetosporin-active feed additive at a dose of 1.0 kg per ton of feed (as recommended by the manufacturer); the five group - experimental - received the Vetosporin-active feed additive at a dose of 2.0 kg per ton of feed.

## RESULTS AND DISCUSSIONS

When assessing the reproductive qualities of experimental animals, we took into account the following features: ease of calving, the number of live calves at birth, the number of postpartum complications, the duration of the service period, the number of doses of semen used (Table 3).

Table 3. Indicators of the reproductive abilities of cows when using feed sorbents

Indicators	I counter	II Experienced 1.5 kg/t	III Experienced 2.5 kg/t	IV Experienced 1 kg/t	V Experienced 2 kg/t
Number of calves, head	12	12	12	12	12
Alive, head	10	7	12	12	11
%:	83.3	58.3	1	1	91.7
Stillborn, head	2	5	100	100	1
%	16.7	41.7	-	--	8.3
Ease of calving, score	1.67±0.15	1.58±0.16	1.88±0.9	1.17±0.12	1.08±0.09
There was no separation of the placenta, %	16.7	8.3	8.3	-	-
Registration of endometritis, no of cases, %	25	25	16.7	8.3	0
Duration of the service period, days	103.5±1.1	100.5±1.1	98.2±0.8	90.7±1.2	83.3±0.8***
Doses of semen consumed	2.0	2.0	2.2	1.5	1.1

Note: \* - p<0.05; \*\* - p<0.01; \*\*\* - p<0.001

The ease of calving was assessed according to the system adopted by the International Association of Animal Breeders, where points are distributed from 1 (calving with no problems) to 5 (extremely difficult calving, with fetal death).

In the first group, 1 case of 5-point calving was registered, which ended in the death of the fetus. In other groups, the ease of calving varied from 1 to 2 points. In the fifth experimental group, all calving was successful. Childbirth in animals ends with the separation of the fetal membranes (after birth).

The retention of the placenta is considered to be the state of the cow when its separation did not occur - after 10-12 hours. In the 1<sup>st</sup> group, two cases of retention of the placenta (16.7%) were registered, and in the 2<sup>nd</sup> and 3<sup>rd</sup> one each.

Often, difficult births in cows and non-separation of the placenta lead to postpartum endometritis, so in the 1<sup>st</sup> control group and in the 2<sup>nd</sup> experimental group, three cases each (25%) were recorded, in the third group - 2 cases, and in the fourth - only in one cow. In the fifth experimental group, all 12 cows were healthy.

The duration of the service period in the fifth group was significantly less compared to other groups ( $p < 0.001$ ). The number of doses of semen used in the fifth group was the lowest - 1.1 doses. Obviously, this is due to the well-tolerated calving and the absence of gynecological diseases in this group.

The degree of influence of various probiotics and their dosage on the milk production of experimental animals is presented in Table 4.

Table 4. Indicators of milk productivity of cows when using feed sorbents

Indicators	I counter	II Experienced 1.5 kg/t	III Experienced 2.5 kg/t	IV Experienced 1 kg/t	V Experienced 2 kg/t
Average daily milk yield for the milking period, kg	35.6±0.73	37.5±0.78	39.4±0.97**	38.8±0.67**	42.1±1.03***
Milk yield for the milking period (4 months), kg	4184.1±120.1	4314.3±98.9	4465±116.5	4556.9±62.1*	4754.4±141.6**
Milk yield for 305 days of lactation, kg	8405.7±243.8	8928.2±234.1	9127.5±191.9*	9174.2±157.2*	9220.3±197.5*
The content of the mass fraction of fat in milk, %	3.78±0.06	3.84±0.05	3.86±0.05	3.84±0.04	3.92±0.03
The content of the mass fraction of protein in milk, %	3.18±0.04	3.2±0.05	3.17±0.04	3.21±0.05	3.33±0.08
The number of somatic cells. thousand/cm <sup>3</sup>	258.6±10.1	251.2±8.5	259.8±12.3	156.3±9.1***	125.6±3.8***

Note: \* -  $p < 0.05$ ; \*\* -  $p < 0.01$ ; \*\*\* -  $p < 0.001$

The average daily milk yield for the milking period was the highest in the fifth experimental group and amounted to 42.1 kg, which is significantly higher than the milk yield in the control group by 6.5 kg ( $p < 0.001$ ), and in the second group by 4.6 kg ( $p < 0.01$ ). Animals from the 4<sup>th</sup> group that received the Vetosporin-active sorbent at a lower dose (1 kg/t of feed) also significantly exceeded ( $p < 0.01$ ) the average daily milk yield in cows of the control group by 3.2 kg. These data are also confirmed by the assessment of the total milk yield for the period of milking (from 1 to 4 months): on average, 11.9% more milk was received from cows of the 5<sup>th</sup> group than from cows of the control group ( $p < 0.01$ ) and 9.3% than in cows of the 2<sup>nd</sup> group ( $p < 0.05$ ), respectively.

Milk yield for 305 days of lactation was significantly higher ( $p < 0.05$ ) in animals receiving feed sorbents: in the 3<sup>rd</sup>, 4<sup>th</sup> and 5<sup>th</sup> groups, respectively, by 7.9%, 8.4 and 8.8%, than cows in the control group. However, no significant difference was found between the groups.

A reliable effect of feed sorbents from different companies and their dosages on the quality indicators of milk (mass fraction of fat and protein) has not been determined, however, a trend towards an increase in milk fat and protein content is noted in the milk of animals of the 5<sup>th</sup> experimental group.

For many years, the main indicator for evaluating milk was the mass fraction of fat in it, but at present, the purchase price of milk is

also determined by the content of somatic cells. When the body is poisoned with mycotoxins, a sharp increase in the number of somatic cells in milk is observed, which affects its quality (Olchowy et al., 2019).

The presence in feed of a hormone-like mycotoxin such as zearalenone (Table 2) causes mammary tissue hypertrophy with increased cell rejection. Thus, as a result of mycotoxicosis, the content of leukocytes in milk increases, the number of desquamated mucosal cells in the udder ducts increases, and the number of mammary gland cells increases, which leads to a significant increase in somatic cells in milk (Oikonomou et al., 2012; Spaniol et al., 2014).

When examining milk samples, it was found that the number of somatic cells in the 5th group was significantly ( $p < 0.001$ ) 2.1 times lower than in the control, 2 times than in the 2<sup>nd</sup> group, and 2.1 times than in group 3. There is also a significant difference between the milk samples of the 4th and 5th groups ( $p < 0.001$ ): a higher concentration of feed sorbent of 2 kg per ton of feed made it possible to reduce the number of somatic cells in the milk of the 5<sup>th</sup> group to 125.6 kg/cm<sup>3</sup>.

## CONCLUSIONS

The data obtained indicate that the animals (fourth and fifth experimental groups) that received the Vetosporin-Active feed sorbent in addition to the main diet had a higher assessment of productive and reproductive qualities, in comparison with analogues of other experimental groups. They noted the best ease of calving, the absence of problems with the separation of the placenta and endometriosis, the optimal duration of the service period and the minimum cost of doses of semen for fruitful insemination.

The cows of the fourth and fifth experimental groups used the nutrients of the feed more efficiently during the milking period, which had a positive effect on milk synthesis and higher productivity.

Of the quality indicators of milk, significant differences in favor of the fifth group were observed only in the number of somatic cells.

Thus, the research results allow us to recommend the use of Vetosporin-active feed

sorbent at a dose of 2.0 kg per ton of feed as a feed additive in the main diet of highly productive cows to improve reproductive and productive qualities.

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