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Clinical Trials Of The Medicinal Product For Veterinary Use "FLYBLOCK® Insecticidal Tag" Against Bloodsucking Insects.

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ABSTRACT

Bloodsucking two-winged insects are widespread and abundant in various climatic zones of Central Russia. As mechanical and biological carriers of many infectious and invasive diseases, they can cause anemia and stress in highly productive and young animals. Current means of protection of dairy cattle from bloodsucking two-winged insects needs improvement. Conduction of clinical trials and assessment of the insecticidal and repellent properties of the "FLYBLOCK® insecticidal tag", manufactured by AVZ Animal Health LLC, Russia, during periods of maximum seasonal and daily activity of bloodsucking two-winged insects. For 3 years (2017-2019) clinical trials of a medicinal product for veterinary use of the FLYBLOCK® insecticidal label (manufacturer: AVZ SP LLC, Russia) in livestock farms of the Central region of the Russian Federation (Tambov, Ryazan and Moscow regions) on dairy cattle have been conducted held. More than 600 animals were included in this study. It was found that after attaching FLYBLOCK® ear tags on the animals' ears, protective effect developed 6-8 hours after attachment. The repellent and protective effect of the product "FLYBLOCK® insecticidal tag" on bloodsucking two-wing insects is 17 weeks, i.e. 115-120 days. Based on the study results, the Repellent Coefficient (RC) of the product in livestock premises, in the housing of animals amounted to 87.4– 96.7% (depending on the animals living conditions). When using the product on ground runs, as well free grazing of cows RC was 91.2- 98.8%. On the basis of the results of calculation of bloodsucking two-winged insects and zoophilic flies in experimental and control groups, the high efficiency of the veterinary product "FLYBLOCK® insecticidal tag" was established when using for animals contamination within 17 weeks, with reduction of abundance index to 0 since the 2nd day of study, while in the control group the number of insects was 46-68 insects per animal.

Keywords: FLYBLOCK®, S-fenvalerate, piperonylbutoxide, cattle, blood-sucking two-winged insects, insecticidal ear tags.

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INTRODUCTION

Bloodsucking Diptera (zoophilic flies, mosquitoes, hornfly, horseflies, midges) are widespread and abundant in various climatic zones of Central Russia. This is due to favorable environmental conditions, an abundance of nesting sites for bloodsucking Diptera insects, as well as a high density of livestock complexes (feeders) specializing in dairy farming in the region of interest [18, 20, 21].

Being mechanical and biological carriers of many pathogens of infectious and invasive diseases (anaplasmosis, brucellosis, moraxellosis, calasiosis, ehrlichiosis, viral conjunctivitis, tularemia, etc.) can cause anemia and stress in highly productive and young animals [13, 15, 19]. The economic burden of reducing productivity due to stress and releasing animals from the herd is hundreds of millions of rubles per year [3, 12, 22].

Modern means of protecting dairy cattle from bloodsucking Diptera insects need to be improved [2, 23].

Multiple treatments with organophosphate and carbamate preparations on pastures in the spring-summer and early-autumn seasons are economically inefficient. Medicinal products in the form of separate polymer plates (ear tags, tail bands) impregnated with synthetic pyrethroids are more optimal in terms of effectiveness and duration of exposure to bloodsucking diptera insects, as well as safe for animals and the environment [1,3, 4, 20].

In this regard, the development of alternative methods of livestock protection has begun all over the world, which allows for long-term control of ectoparasite populations with minimal labor and medication costs [26, 32, 35].

All these methods are based on the principle of individual long-term protection, which consists in the use of various types of devices attached in one way or another to the animal and consisting of a solid filler in which the substance of a highly toxic insecticide for parasites is evenly distributed. Practical implementation of this principle was first undertaken in 1970 to protect cattle from the small cow bloodsucking fly Hematobiairritans. By placing wax bars containing krotoxifos on 23-33 % of the heads in the herd, they could achieve satisfactory protection of the entire herd within a week, and when using dichlofos-impregnated resin collars, bars on neck chains and ear tags, 100% control of the horn fly was achieved within a week or month.

Insecticide vapors, penetrating the fur of the treated animal, provided it with constant protection; but the temperature of the air had a decisive influence on the rate of evaporation of the active substance.

The most rational approach was to use ear tags that mark livestock. These tags, usually measuring 8.5 x 6 cm and weighing 10-20 g, made of insecticide-filled filler, reliably protect animals for a long period, while performing both functions simultaneously [16,30, 32].

Each tag is equipped with a plastic holder that allows you to attach it to the animal's ear. However, the operation of threading the tag can lead to the development of necrosis of the ear tissues, as a result of which the effectiveness of the tag is significantly reduced, since bleeding wounds strongly attract myosis. Given this circumstance, some researchers recommend fixing the tag on the animal without damaging the tissues [19, 26, 29]. Experiments on simultaneous treatment of livestock with the same insecticides in the form of solutions and ear tags show in favor of tags both in terms of effectiveness and duration of protective action [31]. At the same time, the amount of the drug that penetrates the hair and successfully protects the animal is 3-4 times less than with standard treatments with solutions of 0-25-0.5 % [29]. So, a week after the cows were fed two tags containing cypermethrin, the amount of peretroid was 5.5+2 mg per kg of wool; after 7 weeks, this level decreased to 3.4+0.5 mg, and the concentration of the drug on the flanks of animals was higher than on other parts of the body [28].

Using ear tags against Diptera, it is not necessary to supply them to every animal in the herd, since the active movement of flies in the pasture necessarily leads them to contact with treated animals, long enough for the insect to receive a lethal dose of insecticide. Thus, when treated with two tags containing sumicidin only 70-90% of the heads in the herd, complete control over the small horn fly was achieved

within 5-6 months [5, 25, 33]. Experiments using styrophos have shown that treating every third animal in a herd with two tags is just as effective against as treating every animal with two tags, and more effective than supplying all animals in a herd with one tag [9]. This result is explained by the fact that when using a single label, the resulting protective effect is reduced by more than two times compared to shelf treatment (two labels), since the concentration of insecticide on the fur of the animal in the latter case is significantly higher than on the wool of the corresponding side in left-or right-hand treated animals [7,8]. Incomplete treatment is acceptable when protecting livestock from small cow lice, but it is completely ineffective for successful control of populations of miasma flies, which requires the mandatory supply of animals with two tags [4, 21, 34].

Good protection from Haematobiairritans was also achieved when placing tags not directly on animals, but on chains, ropes, sandbags that were hung on the way of the cattle to the water, or to boxes with salt. Contact with them of animals was sufficient to protect the herd by 85-100 % for 7-18 weeks when using tags with sumicidin for 6 weeks - with styrofos [9]. With this method of protection, using tags with cumafos, it was possible to increase the annual weight gain of yearling bulls by 3-5 kg compared to the control group during b years of experience [9, 30].

In addition to ear tags, resin plates containing 20% dichlophos and attached to polyethylene hoops that were put on the animal's hind legs were successfully used against the horn fly . Almost all the flies died in the first 30 minutes of the experiment, and for 10 weeks, 90% of the livestock was protected from bloodsuckers. The advantage of this method of processing is that the pasture where the processed herd was grazed did not produce flies from the dung lumps [34].

With regard to the autumn fly Stomoxyscalcitrans, there is only a single indication in the literature of 90% control of the blood sucker for 11 weeks when using tags impregnated with cypermethrin [30].

With less success, methods of individual long-term protection were able to control the number of field flies Muscaautumnalis-the dominant species among non bloodsucking grassland flies in North America and England, causing severe eye irritation in livestock. The best results were achieved using sumicidin-impregnated tags, which provided an average 90% reduction in the number Of M. autumnalis over the course of the season [23, 34]. However, when using cypermethrin tags, despite the complete disappearance of the small cow louse, only an 82 % decrease in the field fly population was observed for 11 weeks [30], permethrin tags controlled M. autumnalis only by 50% for 13 weeks, with 95% protection of livestock from the horn fly for the same period (Williams, Westby, 1980). Similar results were obtained by other researchers when working with tags containing cypermethrin, permethrin and styrofos-field fly control was carried out for 7-16 weeks at 30-85 % [33, 35]

In England, research has developed on the use of ear tags to protect cattle and sheep from hydrotaeairritans flies that parasitize open wounds of animals. The use of pyrethroids in the form of sheep treatments at intervals of 28 days was ineffective, since the number of insects managed to recover in the intervals between treatments, the increase in the latter did not represent economic benefits. At the same time, long-term protection of sheep with ear tags containing 8.5% cypermethrin allowed successful control of populations of miasic flies throughout the summer moreover, the protective effect of PYRETHROID extended from tagged sheep to lambs grazing with them [9].

Treatment of cattle with ear tags impregnated with cypermethrin or sumicidin protected the animals for 12 weeks by 70-80 % and 60 %, respectively [34]. However, when using tags with flucitrinate, the decrease in the number of flies occurred only 2 weeks after the start of the experiment, reaching 40 % over the next 12 weeks. At the same time, the drug had an effect only on the part of the population of H. irritans that occupied the animal's head; it is possible that the use of insecticide tapes placed on the tail or legs and providing a higher concentration of pyrethroidP on the animal's body, would have contributed to better results in the fight against this horn fly [7,9].

Thus, the control of populations of non-bloodsucking Diptera by methods of individual long-term protection, carried out although with less success in comparison with bloodsucking Diptera, is nevertheless more economically profitable than the use of animal treatments with insecticide solutions for the same purpose[13, 29, 30].

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Study purpose

Conduction of clinical trials and assessment of the insecticidal and repellent properties of the "FLYBLOCK® insecticidal tag", manufactured by LLC «AVZ Animal Health», Russia, during periods of maximum seasonal and daily activity of bloodsucking two-winged insects.

MATERIALS AND METHODS

Study area and period of study

Studies of insecticidal and repellent effects of "FLYBLOK® insecticide tag" manufactured by LLC«AVZ S-P», Russia, were carried out on dairy cattle Holstein, Simmental and Black-and-White, of different ages in livestock farms of the Central region of the Russian Federation (Tambov, Ryazan and Moscow regions). More than 600 animals were included in this study (350 animals were equipped with FLYBLOCK®ear tags, 250 animals served as control).

Objects of research

Collection of zoophilic flies and insects of the bloodsucking complex to study the species composition of bloodsucking two-winged insects was carried out by hand with the help of entomological net. Entomological monitoring of insects was conducted using field binoculars with high resolution. Over the period from May to September, 2018- 2019 on the territory of livestock complexes according to generally accepted methods. Type-specificity was established with the help of MBS-1 microscope with the use of insect detectors.

In order to study hematological and biochemical parameters in animals with attached ear insecticide-repellent tags, as well as to control the residual amount of the S-phenvalerate + piperonylbutoxide preparation, blood was sampled from the middle-tail vein in 10 animals using 3 samples from each according to the generally accepted method and delivered to the veterinary laboratory. Blood for the above indicators was examined during the experiment: once before attaching the ear tags, and on 10thJune, 12th July, 11thAugust, 10thSeptember) and 10thOctober after the experiment.In addition, the residual amount of the S-phenvalerate + piperonylbutoxide preparation was determined in each sample of the experimental animals in wool samples, and two months after the installation of the "FLYBLOCK® insecticidal tag" (pieces of parenchymal organs, heart, diaphragm, subcutaneous fat, skeletal muscle) from the killed animals.

The efficacy of insecticidal tags was assessed by the duration of their protective action calculated on the basis of the number of insects of *Hypodermatidae, Tabanidae, Heleidae, Culicidae, Hippoboscidae, Simuliidae, Muscidae* families present on animals of experimental and control groups, according to the Guidelines on the study of the efficacy of repellents and insecticides in veterinary medicine [5,6].

The Repellency Coefficient (RC) for insects was estimated using formula according to the methodological guidelines - MU 3.5.2.1759-03 (Methods for estimation of the efficacy of insecticides, acaricides, development regulators and repellents used for medical disinsection):

$$RC = \frac{A-B}{A} \times 100\%, \text{where}$$

A - number of insects on animals without ear tags over 5 minutes of observations;
B - the number of insects on animals with ear tags over 5 minutes of observations;
100 - factor for percentage calculation.

RESULTS

Genera and species of insects were determined in non-tagged animals of the control group: Bloodsucking and non bloodsucking flies (Muscidae family) -Lipirosiairritans, Fanniacamculans, Fanniacanicularis, Hydrotaeairritans, Haematoboscastimulans, Stomoxyscalcitrans, Sarcophagidae spp., Wohlfahrtiamagnifica, Muscadomestica;__mosquitoes (Culicidae family) -Culexpipiens, Aedes detritus,

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Aedesvexans, Anopheles messeae, Ochlerotatuscommunis, Ochlerotatuscantans; midges (Ceratopogonidae family) -Culicoidespulicares, Leptoconopes; deer flies (Tabanidae family) -Tabanusbovinus, Tobanusbromius, Haematopota spp.., Chrysopsrelictus;botflies (Oestridae family)- Hypodermabovis; black flies (Simuliidae family) -Simuliumlatipes, Simuliumornatum.

As can be seen from the diagram (Fig. 1), bloodsucking two-winged insects and zoophilic flies on non-tagged animals were observed throughout the study, the intensity of the invasion reached high values (the maximum observed number was 234 insects on one animal). The number of insects per animal was recorded over 2 minutes at the peak of their daily activity, i.e. from 12.00 to 16.00.

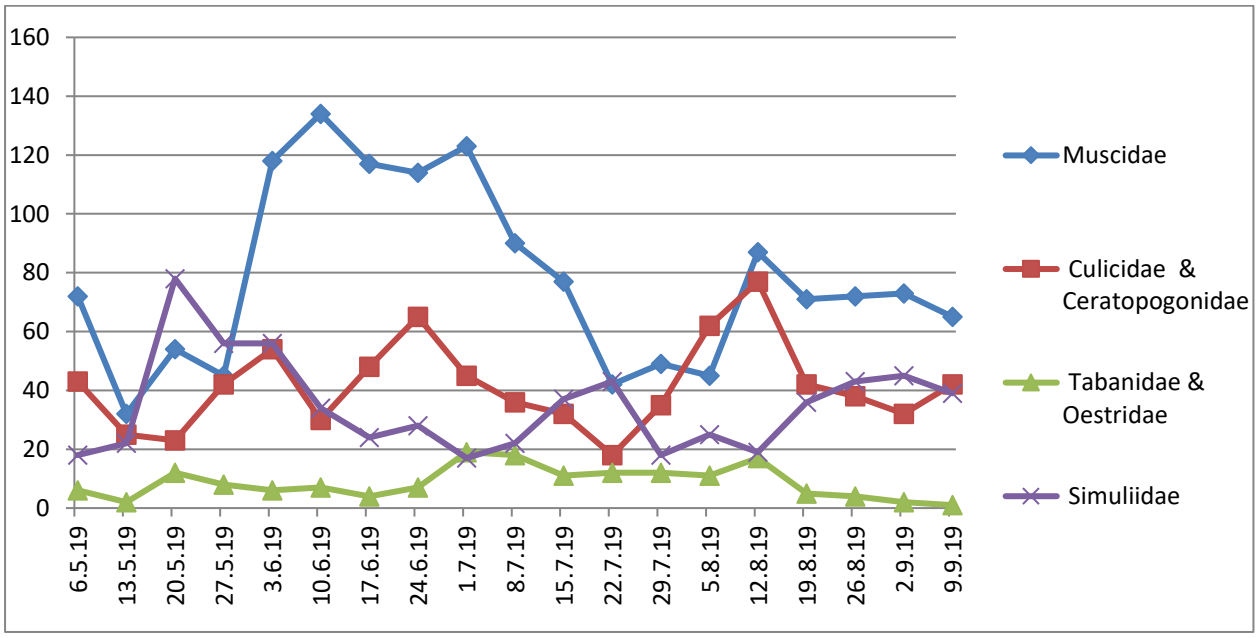

Figure 1. Dynamics of the number of bloodsucking insects and zoophilic flies on animals without the use of ear tags.

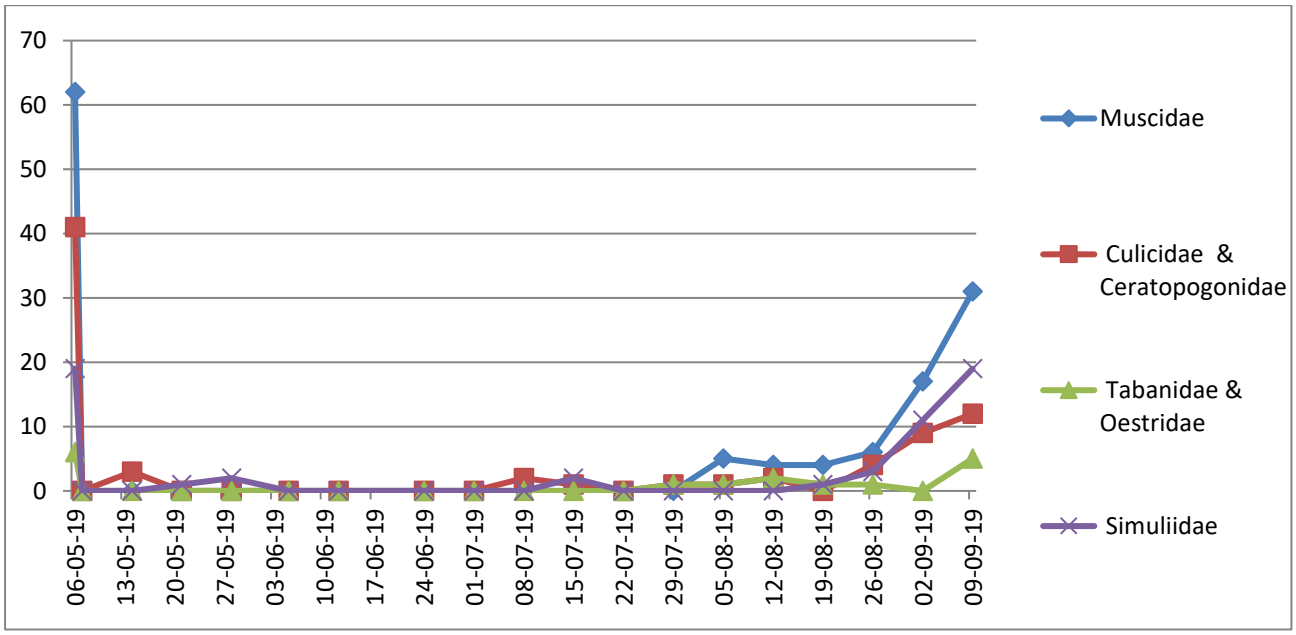

Figure 2. Dynamics of the number of bloodsucking insects and zoophilic flies on animals with FLYBLOCK® ear tags.

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We found that after attaching FLYBLOCK® ear tags on the animals' ears, protective effect developed 6-8 hours after attachment. The next day after the attachment of ear tags, the number of attacks of two-wing insects on animals decreased sharply, repellent and insecticidal effect of the product "FLYBLOCK® insecticidal tag", for bloodsucking and licking zoophile flies, mosquitoes, deer flies, blackflies and midges was 17 weeks on average, i.e. 115 to 120 days (Fig. 2).

Period of registration of bloodsucking insects(month)	The number of insects per 5-minute count (specimen / animal) in groups		RepellentCoefficient, %
	The experimental animals group	The control animals group	
beforethebeginning	57.4±4.5	56.8±4.6	-
May	2.2±0.2	67.2±4.6	96.7
June	3.5±0.3	72.3±4.2	95.2
July	4.2±0.3	71.4±4.2	94.1
August	5.2±0.3	62.6±3.8	91.7
September	8.3±0.2	65.8±4.4	87.4

Table 1. - The Repellent Coefficient (RC) of the product in livestock premises, in the housing for animals.

Period of registration of bloodsucking insects(month)	The number of insects per 5-minute count (specimen / animal) in groups		RepellentCoefficient, %
	The experimental animals group	The control animals group	
beforethebeginning	32.6±2.5	33.2±2.4	-
May	0.5±0.2	41.2±4.6	98.8
June	1.1±0.3	52.3±4.2	97.9
July	2.3±0.3	48.4±4.2	95.2
August	3.2±0.3	40.6±3.8	92.2
September	4.3±0.2	48.8±4.4	91.2

Table 2. - The Repellent Coefficient (RC) of the product in using the product on free grazing of animals.

Based on the study results, the Repellent Coefficient (RC) of the product in livestock premises, in the housing of animals amounted to 87.4– 96.7% (depending on the animals living conditions). When using the product on ground runs, as well free grazing of cowsRC was 91.2- 98.8%.

CONCLUSION

On the basis of the results of calculation of bloodsucking two-winged insects and zoophilic flies in experimental and control groups, the high efficiency of the veterinary product "FLYBLOCK® insecticidal tag" was established when using for animals contamination within 17 weeks, with reduction of abundance index to 0 since the 2nd day of study, while in the control group the number of insects was 46-68 insects per animal.

We confirm that the drug "FLYBLOCK® insecticidal tag". "is effective and provides insecticidal and repellent effects up to 5 months depending on the conditions of the animals. Is safe for humans, animals and the environment, pharmacological residues of the active substances are not found in milk and large meat cattle involved in research.No adverse and negative effects in animals were registered during clinical trials of the "FLYBLOCK® insecticidal tag".

Authors' Contributions

AVM, SVE, AAD, and ESE contributed equally to the design of the work. SVE, AAD and ESE contributed to data analysis. AVM contributed to sample collection. VM, ESE contributed to writing the work. All authors read and approved the final manuscript.

CONFIRMATIONS

The work was performed at the Department of Parasitology, Federal State Budgetary Educational Establishment of Higher Education "Moscow State Academy of Veterinary Medicine and Biotechnology named after Academician K.I. Scriabin "in the period 2018-2019.

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