

The technology of using the disinfectant "Hyponate BPO" for disinfection of refrigerated chambers

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Abstract. The article presents the results of production tests of developed modes of refrigerant disinfection using the "Hyponate BPO" disinfectant. It was found that the disinfectant "Hyponate BPO" provides 100 % disinfection of refrigerated chambers and auxiliary equipment of meat processing enterprises. It was determined that the positive effect of surface disinfection when controlling the *E. coli* test culture was achieved by using a 2 % solution during 30 minutes, when controlling staphylococcus – using a 3 % solution during 50 minutes, and when controlling the TMC – using a 4 % solution during 60 minutes.

1 Introduction

Of great importance for agricultural industries and enterprises for the production of finished food products of animal origin is ensuring its safety in human consumption.

One of the factors of this provision is the observance of a high sanitary level of their production, storage, sale and transportation conditions. In this regard, attention should be paid to the choice of a disinfectant, which must be presented with the following requirements: they must have a wide range of disinfecting effects, effectively destroy bacteria, viruses, fungi and spores; they must have a washing and minimal corrosion ability; be safe for humans and animals; as simple as possible to use; be relatively inexpensive and environmentally friendly.

As follows from recent scientific publications, most types of antimicrobials which active substances are stable chemical compounds do not meet these requirements, despite the fact that such drugs are widely used at present in practice (caustic soda, formalin, bleach, phenols, cresols, acids, iodophors, etc.) as well as compositions based on them. The development of new disinfectants is mainly due to the creation of chemical compositions, which increases their cost [1, 2].

Thus, the development of new highly effective, cheap and multi-functional disinfectants, as well as environmentally friendly ones, is an important and priority area of research in the field of veterinary sanitation and disinfection of veterinary surveillance facilities.

The disinfection is one of the factors ensuring the high sanitary level of finished products. When using raw materials with initially low contamination, one can predict the microbial contamination in the process of storage and sale of finished products. One of the main

points of contamination is a slaughter point, where bacterial contamination occurs through the surface of the slaughter carcass; therefore, maintaining a low bacterial background in the slaughter premises is an urgent task. A low bacterial background can be ensured by high-quality and timely disinfection of the premises.

Meat is a very favorable environment for the development of many microorganisms. It can be infected with pathogenic microorganisms during the life of the animal (endogenous seeding), and slaughter, cutting, transportation and storage (exogenous contamination); therefore, in all cases, sanitary and hygienic rules for storing and transporting meat must be observed. In order to maintain quality, the meat is subjected to various types of processing, such as cold storage, salting, drying and others.

At the same time, the microflora of meat changes. If the storage conditions are violated, meat and meat products undergo microbial spoilage and often cause microbial food poisoning (salmonella caused by *Salmonella*, toxic infections caused by *Proteus*, *E. Coli*, botulism caused by meat products infected with *Clostridium botulinum* and many other pathogens that are dangerous both for animals and humans). Even a short stay with pathogenic or conditionally pathogenic bacteria is enough for the development of infection. [3–6].

One of the most important sources of meat contamination during storage is the sedimentation of microorganisms on the surface of the carcass during storage. This can be prevented by carrying out high-quality disinfection of industrial premises and cold rooms.

At present, in the Russian Federation, more than 400 stable chemical products containing chlorine, hydrogen peroxide, formaldehyde, acids, alkalis, colloidal forms of metals, essential oils, etc. are used for disinfection of

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premises. They may be volatile, toxic, environmentally unsafe, expensive.

The report "Conference on the Prevention of Nosocomial Infections" emphasizes that a number of disinfectants do not meet modern requirements for their specific effectiveness and hygienic safety. In particular, it is noted that cationic surfactants, having good detergent properties, are at the same time inactive or inactive against mycobacterium tuberculosis, fungi, and bacillus spores.

The adverse properties of this is the rapid and frequent formation of resistance of microorganisms to their effects. The same report indicates that aldehydes have high toxicity and sorption ability, which does not allow them to be widely recommended for surface treatments and other objects. Thus, the high toxicity of glutaraldehyde is well known. Its use has been prohibited by law in England since May 2002. However, in Russia, advertising and selling drugs based on it still continue.

Some disinfectants do not meet modern requirements for their specific effectiveness and hygienic safety. For example, cationic surfactants, having good detergent properties, are at the same time inactive or inactive against mycobacterium tuberculosis, fungi, and spores of bacilli. The adverse properties of surfactants is the rapid and frequent formation of resistance of microorganisms to their effects.

Aldehydes have high toxicity and sorption ability, which does not allow them to be widely recommended for surface treatment and other objects. Thus, the high toxicity of glutaraldehyde is well known. Its use has been prohibited by law in England since May 2002, but in Russia, its sale and development of new multicomponent preparations based on it continue [7–14].

2 Materials and methods

A multicomponent disinfectant based on sodium hypochlorite "Hyponate BPO" was tested under the production conditions. For the development of a disinfectant we used: sodium hypochlorite A, calcium hypochlorite, lithium hypochlorite, alkyl dimethylbenzylammonium chloride, catamine AB containing 50 % of the basic substance, technical caustic soda. We mixed the components.

The object was refrigerators for temporary storage of chilled meat (pork) owned by Prodtorg+ LLC, Podolsk District, Moscow Region,

The study of the disinfectant properties of a multicomponent agent based on sodium hypochlorite "Hyponate BPO" was carried out in accordance with the Methodological Instructions on the procedure for testing new disinfectants for veterinary practice" (Moscow, 1987), "Guidelines P 4.2.2643-10. Methods of laboratory research and testing of disinfectants to assess their effectiveness and safety" (Official Edition, M., 2011)

When conducting tests under the production conditions, the quality of disinfection was controlled by the isolation of *Escherichia coli* and *staphylococci*

and by the total microbial count (TMC) from swabs from naturally contaminated surfaces of the premises in accordance with the Rules for the Disinfection of State Veterinary Surveillance Facilities (2002). Swabs from the surfaces taken before disinfection were the control samples. The effectiveness of disinfection was determined by the presence or absence of growth of the microorganisms after treatment.

The quality control of disinfection was carried out by examining swabs before and after treatment. The nutrient media of Koda, *staphylococcus* – 6.5 % salt MPB and 8.5 % salt MPA were used to isolate *E. coli*, and MPA was used to determine the TMC. The final results were obtained on the 7–14 day.

3 Results

The laboratory of veterinary and sanitary examination of the All-Russian Research Institute of Veterinary Sanitation, Hygiene and Ecology – a branch of the Federal State Budget Scientific Institution "Federal Scientific Center – All-Russian Research Institute of Experimental Veterinary Medicine named after K.I. Skryabin and Ya.R. Kovalenko conducted research on the development of "Hyponate BPO", determined the bactericidal and bacteriostatic effect in relation to vegetative and spore forms of microorganisms, the phenolic index, and corrosion.

The studies were carried out to determine the microbial contamination of refrigerator chambers at the meat processing enterprises of LLC "Prodtorg +" (Table 1).

Table 1. Indicators of bacterial contamination of slaughtering and primary processing workshops at a meat processing enterprise (n = 3)

No	Sampling point	TMC	<i>E.coli</i>	<i>St. aureus</i>
		CFU/100 cm ²		
1. Bacterial contamination of the surface of refrigerator chamber No. 1				
1	Floor	100*10 ²	30*10 ²	48±3
2	Wall	60*10 ²	25*10 ²	12±2
2. Bacterial contamination of the surface of refrigerator chamber No. 2				
1	Floor	25*10 ²	0	12±1
2	Wall	63*10 ²	35*10 ²	21±2
3. Bacterial contamination of the surface of refrigerator chamber No. 3				
1	Floor	89*10 ²	26*10 ²	12±2
2	Wall	42*10 ²	19*10 ²	8±2

P>0,001

Table 1 shows that the refrigeration chambers were contaminated with vegetative microflora. The total microbial count has been identified. These studies made it possible to analyze microbial contamination and conduct the production tests of Hyponate BPO under the laboratory conditions.

The results of the production tests are presented in Tables 2–4.

Table 2. The results of the experiment on the use of a multicomponent disinfectant based on sodium hypochlorite when controlling *E. coli*.

Concentration, %	Exposure, min			
	10	20	30	40
0,5	+	+	+	+
1,0	+	+	+	+
2,0	+	+	-	-
3,0	+	-	-	-

Note: (-) – no growth; (+) – growth.

Table 3. The results of the experiment on the use of a multicomponent disinfectant based on sodium hypochlorite when controlling staphylococcus.

Concentration, %	Exposure, min				
	20	30	40	50	60
1,0	+	+	+	+	+
2,0	+	+	+	+	+
3,0	+	+	+	-	-
4,0	+	+	-	-	-

Note: (-) – no growth; (+) – growth.

Table 4. The results of the experiment on the use of a multicomponent disinfectant based on sodium hypochlorite when controlling TMC.

Concentration, %	Exposure, min				
	30	40	50	60	70
2,0	+	+	+	+	+
3,0	+	+	+	+	+
4,0	+	+	+	-	-
5,0	+	+	-	-	-

Note: (-) – no growth; (+) – growth.

The refrigerator chambers were disinfected:

- when controlling the quality of disinfection for the *E. coli*, surfaces of the floor and walls were disinfected with a 2.0 % solution of hypochlorite-based products at a flow rate of 0.25–0.5 l/m² and an exposure time of 30 minutes (Table 2).
- when controlling the quality of disinfection for the isolation of staphylococci, surfaces of the floor and walls were disinfected with a 3.0 % solution of Hyponate BPO at a flow rate of 0.25–0.5 l/m² and an exposure time of 50 minutes (Table 3).
- when controlling the quality of disinfection for the TMC, surfaces of the floor and walls were disinfected with a 4.0 % solution of Hyponate BPO product at a flow rate of 0.25–0.5 l/m² and an exposure time of 60 minutes (Table 4).

In control swabs from the chamber surfaces (after cleaning and washing), *Escherichia coli* was found in 85 %, and staphylococcus – in all the samples.

After disinfection, the cargo compartments of wagons should be washed with tap water to remove residues of the drug, bearing in mind that after its spontaneous neutralization on the treated surface, there is a small light-colored precipitate.

Laboratory studies to determine the disinfecting effect of the agent “Hyponate BPO” in relation to spore microflora on various test surfaces.

Laboratory experiments to determine the effectiveness of Hyponate-BPO solutions in the disinfection of test surfaces seeded with various test microorganisms showed that the disinfecting effect of the agent depended to a large extent on the type of material of the treated surfaces and test microorganisms.

Table 5 shows the results of experiments on the disinfection of test surfaces contaminated with *E. Coli* with 1.0–3.0 % solutions of Hyponate-BPO, with an exposure of 10 to 40 minutes.

From table 3 it follows that at 1 % concentration of the drug, only test surfaces of tile, stainless steel and plastic were disinfected at an exposure of 40 minutes. The agent was applied in experiments without protein protection on wood and concrete at the rate of 0.5 l/m², and on the remaining surfaces – 0.25 l/m²; with protein protection, the product was applied at a rate of 0.5 l/m² on all surfaces. 100 % disinfection of all surfaces was achieved at 3 % concentration of the drug with an exposure of 40 minutes (both without and with protein protection).

The disinfection of surfaces with protein protection is explained both by the increased dose applied to all surfaces (0.5 l/m²), and to a large extent by the high oxidizing properties of sodium hypochlorite (formation of active radicals, in particular, singlet oxygen).

At the same time, experiments with protein protection indicate that the consumption of disinfectants in this case increases, which is economically costly, and therefore, preliminary mechanical cleaning and washing of surfaces should be carefully carried out to eliminate organic pollutants.

Table 5. Disinfection of test surfaces contaminated with *E. coli* culture with “Hyponat-BPO” solutions

Solution concentration, %	Exposure, min	Test surfaces (n = 3)				
		wood	concrete	tile	stainless steel	plastic
I. Surfaces without protein protection						
1	30	+	+	+	+	+
	40	+	+	-	-	-
2	30	-	-	-	-	-
	40	-	-	-	-	-
3	30	-	-	-	-	-
	40	-	-	-	-	-
II. Surfaces with protein protection						
1	30	+	+	+	+	+
	40	+	+	+	+	+
2	30	-	-	-	-	-
	40	-	-	-	-	-
3	30	-	-	-	-	-
	40	-	-	-	-	-

Note – (+) – the presence of growth of the test culture; (-) – lack of growth of the test culture; on concrete and wood surfaces without protein protection, the solution was applied at a rate of 0.5 l/m², and on the remaining surfaces – 0.25 l/m²; on all surfaces with protein protection, the solution was applied at the rate of 0.5 l/m²; control – the growth of culture on surfaces treated with sterile water.

Quality control of disinfection was carried out by examining washes from experimental and control test

objects for the presence of a given test culture. For spores, *B. cereus* is a meat-peptone agar. The final accounting of results of crops was made in 7–14 days. Effective considered the concentration of the solution, providing the results of at least three experiments disinfection of all test objects used in the experiments in the presence of growth in crops with control test objects.

4 Conclusion

When choosing modern disinfectants, it is necessary to take into account a number of their properties and features, namely: antimicrobial activity against 4 groups of resistance, toxic effects on humans and animals, effects on the treated surfaces, conditions, shelf life and stability of concentration during storage, ease of use, as well as the possibility of using various devices, environmental impact. Only multicomponent modern disinfectants can meet such requirements.

The microbial contamination of refrigeration chambers of the meat processing enterprise was studied.

It was determined that the disinfectant "Hyponate BPO" has a high activity against gram-positive and gram-negative vegetative forms of bacteria and the total microbial count. Based on the results of the experiments, the Hyponate BPO disinfectant can be recommended for prophylactic disinfection of veterinary surveillance facilities, in particular refrigeration chambers of meat processing enterprises.

The laboratory of veterinary and sanitary examination has developed a composite preparation based on sodium hypochlorite "Hyponate BPO" stabilized against active chlorine with enhanced disinfectant action. The bactericidal activity and the disinfecting action of the disinfectant "Hyponate BPO" are determined.

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