

Evaluation of the effectiveness of disinfection in dog shelter

Abstract

Cleaning and disinfection are among the most important tasks in shelters and an important link in the prevention and battle against infectious diseases. Inadequate cleaning and ineffective disinfection can spread the disease to animals in the surrounding pens or to people during their daily contact and care of the animals. It is important to follow the order of the individual steps performed during hygiene procedures and carry out subsequent control of their efficacy. The aim of this study was to evaluate the effectiveness of disinfection by means of swabs taken from selected surfaces in a dog shelter – Happy dog, located in eastern Slovakia. The surfaces were disinfected with Savo Prim contains active substance sodium hypochlorite and anionic surfactant. For good cleaning effect was added disinfectant in a ratio of 1:5 to hot water at a temperature of 50°C and sprayed under pressure of 50 Bar. The effectiveness of mechanical cleaning followed by disinfection was evaluated by microbiological swabs from watering and food bowls, wall and floor. Swabs were taken before and after mechanical cleaning and disinfection, from 10cm² areas. The surface area was wiped with a sterile cotton swab, the swab was placed in a sterile tube with 10ml of sterile saline solution and 0.1ml from this mixture was applied to Endo agar and meat peptone agar. Swabbing of the disinfected surfaces showed a significant decrease in TCB (total count of bacteria) and CB (coliform bacteria). However, on the walls and floors were detected small count of TCB and CB after disinfection in comparison with the counts detected before cleaning but the number of indicator bacteria was below the recommended value. Based on these observations, we can evaluate the hygienic program with the disinfection performed in the shelter as sufficient.

Keywords: animals, cages, sodium hypochlorite, microbiological swabs, total count of bacteria

Volume 5 Issue 2 - 2020

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Received: December 04, 2020 | **Published:** December 31, 2020

Introduction

The dog is the man's best friend and, in addition to being a faithful companion, he occupies an irreplaceable position in the society. It helps to save human lives by finding lost people, is able to detect drugs and makes life easier for blind people.¹ During thousands of years of domestication, dogs have come a long way, their appearance, nature and uses have changed and many breeds have emerged.² The World Dog Organization called Fédération Cynologique Internationale divided a total of 340 breeds into 10 groups.³

The most important fact when buying a dog is not his appearance and price but his nature. Precisely, because of the unsatisfactory nature, the lack of time of the owners and, last but not least, the lack of money, some dogs end up on the street. That is why shelters are being set up to save these discarded dogs and create conditions for their better, temporary life. Many times also abused and sick dogs are housed in shelters. In the shelter they will receive sufficient care and especially medical assistance. Following recovery in the shelter, they are waiting for their new home and new family.⁴

Maintaining cleanliness and creating suitable conditions for the life of dogs in the shelter contributes to the health and mental well-being of dogs. Cleaning and disinfection are among the most important parts of a sanitation program and an important link in the prevention and battle against infectious diseases.⁵ Although the main purpose of cleaning of animal shelters is to prevent the spread of infectious diseases, an additional benefit is the increased public's willingness to adopt and support a shelter that looks and smells clean.⁶

Considering the importance of animal health, the sanitation program should be approached in a systematic, thoughtful and regular

manner and in order to ensure its functioning. For good shelter sanitation program must be adhered to four principles:

- use effective products
- clean where it counts
- minimize stress and fomite transmission
- perfection not required and not an excuse.⁷

The correct selection and use of disinfectant is one of the main hygienic procedures of the proposed sanitation program. In order to be effective, all disinfectants share some features:

- disinfectants must be used at the correct concentration
- adequate contact time is required
- disinfectants must be applied to a basically clean, non-porous surface, free of organic matter
- disinfectants and detergents can cancel each other's actions, and should not be mixed unless specifically
- directed by the manufacturer.⁸

Generally, disinfectants are used on the interior surfaces of animal housing under a wide variety of conditions. Many factors influence the efficacy of the disinfection (e.g. temperature, pH, presence of organic materials, composition of the surface). However, incorrectly performed, cleaning and disinfection can be ineffective or actually serve to spread disease. Disinfectants can even cause significant harm if used incorrectly.⁹

Therefore, the aim of this study was to determine the effectiveness of disinfection of different materials in the dog shelter with Savo Prim liquid activated in hot water by means of microbiological swabs of various surfaces and evaluate the level of disinfection.

Material and methods

Dog shelter

The dog shelter – Happy dog, located in eastern Slovakia, is a shelter operated by a non-profit civic association founded by volunteers,



Figure 1 From left: Quarantine section and distribution of pens in a shelter.

Source: Foto by Valkošáková (2018).

Hygiene programme in the shelter

During our study, 30 dogs aged 1-7 years were kept in the shelter. The hygiene programme in the shelter is based on regular removal of excrement from cages, cleaning and regular disinfection. The pens are cleaned twice a day, in the morning and in the evening. Disinfection of food bowls is performed daily. Mechanical cleaning of cages is performed once a day. Disinfection of cages after mechanical cleaning is done once a week, usually on Fridays together with the disinfection all items in the cage (lying surface, food and water bowls). Complete cleaning and disinfection consisted of the following steps:

- a. Emptying all items from cage
- b. Removal of feces and any remaining debris
- c. Spraying the cage starting at the top of the walls, applying a coat of disinfectant (Savo Prim) across each wall
- d. Stepping out of cage and spraying door; making sure to foam all door frames, latches and hinges
- e. Returning to cage and scrubbing surfaces with long-handled brush, working down toward the floor
- f. Repeat disinfectant application in cage
- g. Scrubbing walkway in front of cage
- h. Allow the disinfectant to dry for 20-30 minutes
- i. Rinsing all surfaces with water and allow cage to dry.¹⁰

As a disinfectant in the monitoring shelter was used Savo Prim liquid (Penta, Prague, Czech Republic) contains sodium hypochlorite 47g/kg (4.7%), other composition: less than 5% anionic surfactants, perfume. Savo Prim is intended for cleaning any surfaces, including floors. Used disinfectant has broad-spectrum efficacy, is effectiveness against vegetative bacteria, fungi, poliovirus, adenoviruses, *Bacillus subtilis*, *Mycobacterium spp.* For good cleaning effect was added disinfectant (Savo Prim) in a ratio of 1:5 to hot water at a temperature

that helps abandoned and stray dogs. The shelter has no employees, only volunteers, who in their free time help the owners of the shelter with the care of the premises. The shelter consists of a building, a quarantine section, a main section and an enclosure. In the quarantine part there are 3 cages intended for housing, of newly brought dogs for 4 weeks. The building has a feed store, toilet, infirmary and 5 cages for postoperative conditions or for small and sick dogs. In the main part there are 11 cages of 6m² size. From the main part there is an entrance to a large paddock (Figure 1).

of 50°C under pressure of 50 Bar according to the manufacturer's instructions.

Checking the effectiveness of disinfection

We evaluated the effectiveness of disinfection by means of 30 swabs evenly distributed over different surfaces: wood and tile floor, sheet metal wall, tile wall, watering and feed bowls. According to Vargová et al.¹¹ were taken swabs from the monitored surfaces before disinfection and 30 minutes after disinfection. Microbiological swabs were taken in duplicate from areas of 10x10cm and the average result was reported. After wiping the surface with a moistened sterile swab, the swab was returned into a tube with 10ml of sterile saline solution and, after mixing, 0.1ml of the mixture was applied to Petri dishes, one containing Endo agar and another containing meat peptone agar. The colonies grown on Endo agar and meat peptone agar were counted after incubation at 37°C for 24 hours (Figure 2).

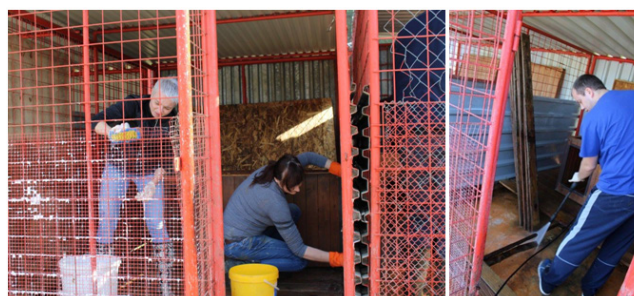


Figure 2 Disinfection of pens and floor in the monitored shelter.

Source: Foto by Valkošáková (2018).

Statistical analysis

The statistical analysis was performed using Microsoft Excel by Student's t-test for paired comparisons. The differences in the indicators bacteria (TCB and CB) was calculated between the start of mechanical cleaning and 30 min. after spraying the disinfectant solution. The categorical variables were described over the average of

5 samples from selected surfaces (CFUx10cm²) whereas continuous variables were described using mean (M) ± standard deviation (SD). A level of 0.05 was considered significant (p).

Results and discussion

Placed dogs in the shelter must get used to the housing conditions and contact with new people. Most individuals are brought in poor physical condition and with reduced immunity, so it is important to follow sanitation program with proper hygienic procedures for cleaning and disinfection of the entire environment in which they occur.^{2,5}

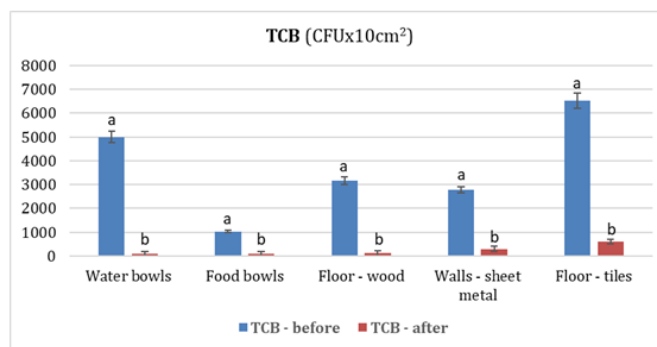
An important step in the sanitation program (before applying an effective disinfectant product) is mechanical cleaning. Mechanical cleaning precedes the disinfection itself and is necessary to remove impurities and some microorganisms. During mechanical cleaning, it is appropriate to remove all items from the cage in order to achieve the largest possible cleaned surface. In case of insufficient mechanical cleaning, impurities remain and they are a suitable source for microorganisms. This reduces the effect of disinfection and is therefore an integral part of effective disinfection. Residues of feces, feed or other coarse impurities must be removed first.^{6,7}

Table 1 & 2 show the numbers of CFU per 10cm² of the swabbed area before and after mechanical cleaning followed by disinfection of different materials. Disinfected were stainless steel bowls for water and feed, wooden floors, tiles and sheet metal on the walls. After mechanical cleaning and subsequent disinfection with Savo Prim liquid mixed in ratio 1:5 with hot water under pressure of 50 Bar, we detected very high efficiency (P<0.001) of elimination of TCB and CB counts on metal wall surface and water and feed bowls (Table 1, Graph 1 & 2). On the surface of the wooden floor and the tiles we observed a minimum contamination of TCB and CB counts in comparison with the counts of indicator bacteria before mechanical cleaning and disinfection (Table 2, Graph 1 & 2).

Some porous surfaces, such as wooden floors, are more difficult to remove dirt by mechanical cleaning. In this case, when it is not possible to perform a sufficient mechanical cleaning, disinfecting effect must be ensured by selecting a suitable agent. As shown in our study, the use of Savo Prim activated in hot water eliminated (P<0.01) the number of indicator bacteria below the recommended value of the original number.

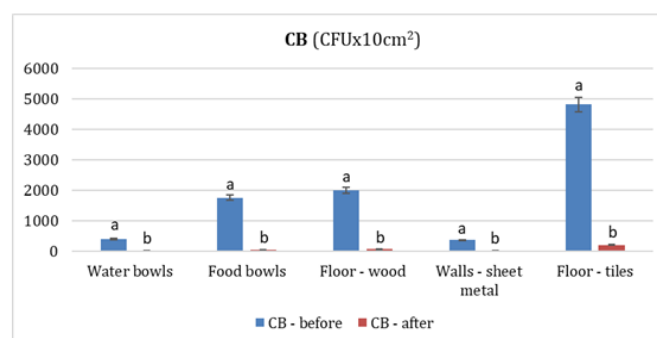
Similar results were reported by Vargová et al.¹¹, who applied Savo by spraying in 3% of concentration without heating to clean cages in a dog shelter. The disinfectant was effective on floor and wall where were significant decrease of TCB, CB and molds after mechanical cleaning, no bacteria after disinfection, but on the kennel were detected 25 CFU of TCB, 3 CFU of CB and 1 CFU of molds after mechanical cleaning which represent minimal decrease of microorganisms, in compare with numbers of microorganisms before mechanical cleaning.

Correia-Sousa et al.¹² reported a very high efficiency of using sodium hypochlorite which is an active ingredient in many disinfectants on the contaminated materials. The efficiency of disinfection reached 99.9%.



Graph 1 Statistical evaluation of disinfection efficiency on TCB using Savo Prim.

Note: TCB, total count of bacteria; a,b different letters between columns are significantly different (Student's t-test for paired comparisons, p<0.001).



Graph 2 Statistical evaluation of disinfection efficiency on CB using Savo Prim.

Note: CB, coliform bacteria; a,b different letters between columns are significantly different (Student's t-test for paired comparisons, p<0.001).

Ondrašovičová et al.¹⁰ stated that the effectiveness of preventive disinfection is satisfactory if the number of indicator bacteria is up to 10% of the original number. In the present study, after disinfection of the selected surfaces the counts of indicator bacteria did not exceed 10% of their original counts, which can be considered a very good result of the disinfection efficiency.

Purkrtová et al.¹³ demonstrated in her study that from 23 tested *S. aureus* strains isolated from food industry in the Czech Republic were able to adhere and most of the them were able to produce biofilms at a significant level. The disinfection with Savo at various concentrations and times of application displayed the different physiological properties of the strains studied. Savo at concentration 1X (1:10 in sterile distilled water) inhibited the growth of all strains after incubation in its presence for 24h. With 24h old planktonic cells treated for 10 min, 1X and 2X (2:10 in sterile distilled water) Savo concentrations caused 80–100% reduction of the growth, while the 4X (4:10 in sterile distilled water) concentration was completely lethal for all strains.

Table 1 The effectiveness of disinfection monitored microbiological swabs taken from watering and food bowls

Before disinfection		After disinfection		Before disinfection		After disinfection	
Meat peptone agar		Meat peptone agar		Endo agar		Endo agar	
Water bowls							
Sample	TCB (CFUx10cm ²)	TCB (CFUx10cm ²)	Sample	CB (CFUx10cm ²)	CB (CFUx10cm ²)	Sample	CB (CFUx10cm ²)
I	5.4x10 ³	0	I	0.2x10 ³	0		

Table continued...

Before disinfection Meat peptone agar		After disinfection Meat peptone agar		Before disinfection Endo agar		After disinfection Endo agar	
2	4.4×10 ³	0		2	0.2×10 ³	0	
3	3.6×10 ³	0		3	0.1×10 ³	0	
4	5.2×10 ³	0		4	0.2×10 ³	0	
5	6.4×10 ³	0.1×10 ³		5	0.3×10 ³	25	
Food bowls							
Sample	TCB (CFU×10cm ²)	TCB (CFU×10cm ²)	Sample	CB (CFU×10cm ²)	CB (CFU×10cm ²)		
1	3.4×10 ³	0	1	1.0×10 ³	0		
2	19.1×10 ³	0.1×10 ³	2	2.3×10 ³	0		
3	10.8×10 ³	0	3	0.5×10 ³	0		
4	7.1×10 ³	0	4	2.8×10 ³	50		
5	10.8×10 ³	0	5	2.2×10 ³	0		

TCB, total count of bacteria; CB, coliform bacteria; CFU, colony forming units

Table 2 The effectiveness of disinfection monitored by microbiological swabs of walls and floors

Before disinfection Meat peptone agar		After disinfection Meat peptone agar		Before disinfection Endo agar		After disinfection Endo agar	
Floor - wood							
Sample	TCB (CFU×10cm ²)	TCB (CFU×10cm ²)	Sample	CB (CFU×10cm ²)	CB (CFU×10cm ²)		
1	1.1×10 ³	0	1	0.85×10 ³	0		
2	5.0×10 ³	0.1×10 ³	2	3.8×10 ³	0.1×10 ³		
3	3.7×10 ³	0.1×10 ³	3	2.3×10 ³	0.1×10 ³		
4	4.0×10 ³	0.25×10 ³	4	2.4×10 ³	0.1×10 ³		
5	2.0×10 ³	0.11×10 ³	5	0.68×10 ³	0		
Walls - sheet metal							
Sample	TCB (CFU×10cm ²)	TCB (CFU×10cm ²)	Sample	CB (CFU×10cm ²)	CB (CFU×10cm ²)		
1	1.1×10 ³	0	1	0.1×10 ³	0		
2	2.0×10 ²	0	2	0.4×10 ³	25		
3	1.0×10 ²	0	3	0.2×10 ³	0		
4	5.8×10 ³	0.3×10 ³	4	0	0		
5	4.0×10 ³	0	5	0.1×10 ³	0		
Floor - tiles							
Sample	TCB (CFU×10cm ²)	TCB (CFU×10cm ²)	Sample	CB (CFU×10cm ²)	CB (CFU×10cm ²)		
1	8.6×10 ³	0.15×10 ³	1	3.8×10 ³	0		
2	8.5×10 ³	0.39×10 ³	2	3.5×10 ³	0.3×10 ³		
3	2.4×10 ³	0.74×10 ³	3	2.0×10 ³	0.2×10 ³		
4	10.6×10 ³	1.1×10 ³	4	4.0×10 ³	0.1×10 ³		
5	25.0×10 ³	0.65×10 ³	5	10.8×10 ³	0.4×10 ³		

TCB, total count of bacteria; CB, coliform bacteria; CFU, colony forming units

Conclusion

Shelters should have a stable sanitation program with a proven arsenal of disinfectants suitable for various uses. Based on the results, disinfection with Savo Prim liquid added in a ratio of 1:5 to hot water successfully decreased the number of TCBs and CBs and ensured sufficient hygiene level in the monitored dog shelter. The finding of the monitored microorganisms on the wooden floor and tiles is related to imperfect mechanical cleaning but did not exceed the limit for preventive disinfection.

Acknowledgments

None.

Conflicts of interests

Authors declare that there are no conflicts of interest.

Funding

This work was supported by the Slovak project KEGA no. 006UVLF-4-2020 'Implementation of new scientific knowledge in teaching and improving the practical training of students in breeding technology from subject Animal husbandry'.

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