

The Blue Stuff or the Brown Stuff – Properties of Various Disinfectants

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Abstract

Sanitation and biosecurity involve not only preventive practices to reduce potential exposure of cattle to disease, but also cleaning and disinfection of items and areas that can transmit or harbor disease agents. Important to understand are the types of different cleaning and disinfectant chemicals and the kinds of disease agents they are effective against. The purpose of this article is to provide bovine veterinarians and technicians with guidelines for use of cleaning and disinfectant products.

Introduction

Two important components of cattle practice and effective biosecurity programs are cleaning and disinfection. There are a myriad of different cleaning and disinfectant chemicals each with its specific range of targeted disease agents and set of limitations or things that interfere with its effectiveness. This paper focuses on the effectiveness of different products for specific disease agents, factors that may reduce their effectiveness, and important disinfection concepts for veterinarians and veterinary technicians.

Diseases and the Agents of Disease

Disease agents for which veterinarians might use cleaning and disinfectant agents include viruses, bacteria, protozoa, fungi, and prions. Some of the diseases/agents that bovine veterinarians may have to deal with include:

**Viruses (enveloped and non-enveloped viruses)*

Enveloped viruses

Bovine respiratory syncytial virus (BRSV)
Bovine Virus Diarrhea virus (BVDV)
Coronavirus
Infectious bovine rhinotracheitis (IBR)
Bovine leukemia virus (BLV)
Parainfluenza-3 (PI3)
Cow pox (Vaccinia)
Rabies

Papular stomatitis virus
Vesicular stomatitis virus
Malignant catarrhal fever (MCF)
Herpes mammillitis virus

Non-enveloped viruses

Bluetongue
Papilloma (wart) virus
Rotavirus
Papillomatosis
Foot and mouth disease (FMD)

* Bacteria – For example: *Salmonella*, *Escherichia coli*, *Mycoplasma spp*, *Staphylococcus spp*, *Streptococcus spp*, Footwart spirochetes

* Protozoa – For example: *Cryptosporidium parvum*

* Fungi – For example: ringworm.

* Prions – For example: Bovine Spongiform Encephalopathy, Scrapie, etc.

Many of these disease agents can be carried on and transmitted by fomites. Possible fomites include: hands, needles, multi-dose syringes, ear-taggers, tattooers, boots, coveralls, nose-tongs, halters, sleeves, feed buckets, and feed-hauling equipment. To reduce the possibility of disease transmission, it is recommended to:

- Clean and disinfect equipment between cows and between farms
- Clean table/truck/tires between farms
- Clean boots/coveralls between farms

Cleaning agents are used to remove dirt, scum, or filth of any sort. Some are soaps, and may not include disinfecting agents. Their primary function is to release the potential infecting material from the fomite and reduce the amount of organic material that may interfere with the action of the disinfectant. It is important to CLEAN a surface first BEFORE using a DISINFECTANT.

Use of Disinfectants

There are several general guidelines to using disinfectants effectively. These include:

- Use the right concentration for the right contact time.
- Most are inactivated with too much manure or blood. The solutions may need rejuvenation to be effective. Clean the surfaces before disinfection.
- Disinfectants vary in ability to kill different kinds of disease agents.
- Need to be stored properly
- Read the LABEL!

Types of disinfectants include:

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|-----------------------|-------------------------------|
| – alcohols | aldehydes |
| – acids/alkalines | halogens: iodine/chlorine |
| – quaternary ammonium | chlorhexidine (an antiseptic) |
| – phenolics | peroxides |

A summary of the use of each type of disinfectant is given below:

Acids and Alkalines – These chemicals work by altering the pH and enzyme activities of microbes. They can be very caustic. Examples of these include: muriatic acid, acetic acid, and sodium hydroxide (NaOH). Acetic acid at 4-5% (vinegar is 4%) may be effective against FMD virus. Sodium hydroxide (lye) at 2% can be effective against FMD virus. (Add 2.7 oz lye to 1 gallon water.)

Ammonia – Ammonia is a single ammonium compound. A 5% solution of ammonia has some activity against *Cryptosporidium parvum* oocysts.

Alcohols – Alcohols kill bacteria and enveloped viruses at many different concentrations. They have no action against spores or non-enveloped viruses and require some contact time to work. Their activity is limited in the presence of organic matter. They can cause damage to rubber and plastics, may be rapidly evaporated, and are flammable. They can also cause irritation to skin with prolonged contact.

Aldehydes – Aldehydes have a wide germicidal spectrum, slight to moderate residual activity, and are relatively effective in the presence of organic matter. However, because of the irritating formaldehyde fumes, the fact that they must be mixed properly, and that they are possible carcinogens, limit their use. Examples include formaldehyde and glutaraldehyde.

Chlorhexidine – Chlorhexidine disinfectants are effective against many bacteria, viruses, and fungi. They are not effective against spore-forming bacteria and are ineffective against some important disease agents. They maintain effectiveness in the presence of organic material but are inactivated by hard or alkaline water. They have some residual activity but must remain in contact with the surfaces for at least five minutes. Some examples include: Nolvasan, Chlorhex and Chlorasan solution (brand names).

Halogens – Halogens include a number of different kinds of agents such as iodine-based disinfectants and chlorines.

Iodine and Iodophors – Iodophors are combinations of elemental iodine and a substance that makes the iodine soluble in water. Iodophors are effective against bacteria, fungi, and many viruses but are not very sporocidal. They act to denature proteins. They are the least toxic of the disinfectants, but are inactivated in the presence of organic material. They must have color to be potentially active. They also require prolonged contact with surfaces. They have poor residual activity, and can stain clothing and porous surfaces. Examples include: Betadine, Povidone, Weladol and One Step (brand names).

Chlorines (e.g. chlorine bleach) – Chlorines can eliminate both enveloped and non-enveloped viruses, fungi, and bacteria but are not effective against spores. They are good, fast-acting disinfectants on clean surfaces, but are quickly inactivated by dirt and manure. They are relatively inexpensive. They are more active in warm water than in cold water. Available chlorine is taken up by organic material. Therefore, it is often valuable to disinfect at least twice with this compound. There is no residual activity. These chemicals are irritating to skin, and corrosive to metal and the fumes are irritating. Examples include: Clorox, Chloramine-T and Halazone (brand names). Sodium hypochlorite (NaOCl) or household bleach (stock concentration 5.25% available chlorine) is effective against most viruses at a concentration of 0.1%. Add 30 ml (or about 1/8-1/2 cup) of household bleach into a gallon of water or 1 gallon of bleach plus 50 gallons of water. A 3% solution is recommended for FMD virus (2 gallons of chlorine bleach to 3 gallons water).

Oxidizing Agents – Oxidizing agents include hydrogen peroxide and other oxidizing agents, like peracetic acid and propionic acids or acid peroxygen systems. They are active against bacteria, bacterial spores, viruses, and fungi at quite low concentrations. They work better at higher temperatures, retain more activity in the presence of organic material than iodine or chlorine-containing disinfectants, have good activity against anaerobes, but are not effective against spores. They are ineffective in the presence of organic matter. Examples include: hydrogen peroxides and Virkon S® (a combination of peroxides and an organic acid with a pH of 2.6). Virkon S® at 1% is labeled as being effective against FMD virus, and is effective against *Mycobacterium avium paratuberculosis* – Johne's disease. The solution is stable for about seven days.

Phenolics – Phenols are coal-tar derivatives and turn milky in water. Phenols are effective antibacterial agents, and are effective against enveloped viruses. They work better at higher temperatures, retain more activ-

ity in the presence of organic material than iodine or chlorine-containing disinfectants, and are not effective against enveloped viruses and spores. They are not compatible with detergents, have limited residual activity and can cause tissue irritation. Examples include: Environ, One-Stroke, Lysol, Pine-Sol, Cresi-400, Discan, and Tek-Trol (brand names).

Quaternary Ammonium Compounds – Quaternary ammonium compounds are bactericidal, virucidal (against enveloped viruses), not sporicidal, and have limited fungicidal activity. They are generally odorless, colorless, non-irritating and deodorizing. They have some detergent action, and are good disinfectants. Some may be inactivated in the presence of some soaps or soap residues, and hard water salts. Their antibacterial activity is reduced in the presence of organic material. They have some residual activity and are non-corrosive. Examples include: Roccal, Germex and Zephiran (brand names).

Natural Disinfecting Agents — Natural forces that reduce pathogen loads in the environment include

sunlight (UV irradiation), heat, cold, drying (desiccation) and agitation.

Conclusion

A disinfectant must be used after cleaning surfaces. The right disinfectant must be selected based on the known or potential agents of disease you are concerned with. Finally, disinfectants must be mixed, used and stored according to label directions to ensure the efficacy and safety of these chemicals.

References

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