Selection and Use of Disinfectants in Disease Prevention – Pork Industry Handbook
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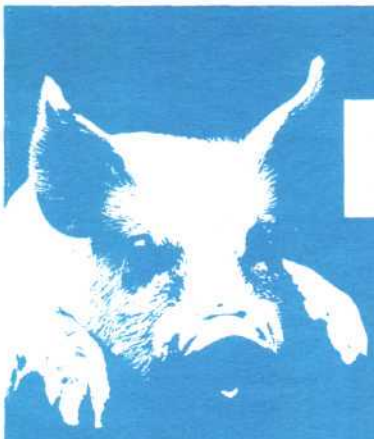

pork industry handbook

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Selection and Use of Disinfectants in Disease Prevention

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Cleaning and disinfecting are very important in controlling the accumulation and spread of disease-causing microorganisms. It also improves air quality and reduces dust. This is especially true in modern swine buildings where continuous use and high concentrations of animals may result in a condition referred to as "disease buildup." The all-in, all-out management program is recommended to facilitate the cleaning process and to improve pig performance.

As disease-producing bacteria, viruses, fungi, and parasite eggs accumulate in the environment, disease problems can be transmitted to each successive group of animals raised. Thorough cleaning and disinfecting often provides the only successful solution to breaking the disease cycle and controlling the problem.

Disinfection can be improved when the area is thoroughly cleaned. Organic matter such as dirt and manure can protect microorganisms and inactivate certain disinfectants. Manure removal followed by a simple scrubbing , a high velocity stream of water, or a steam generator can do an excellent cleaning job. Detergent solutions hasten dirt and manure removal by increasing the wetting speed and breaking organic matter into small particles that easily wash away. A siphoning system or proportioner can be utilized to combine a detergent or a detergent-disinfectant with the cleaning process. A high pressure stream of water or spray (200-1000 psi) can be used to remove manure and debris. Portable steam generators, "steam jennies," are also used for cleaning dirty surfaces. The nozzle should be held not more than 6-8 in. from the surface to have much value in killing organisms. The steam cleaning-detergent process works effectively on wood, metal, concrete and especially on slotted and wire floors. Many disinfectants and detergents work better at warm temperatures of the steam generator. Effective cleaning removes more than 95% of the contamination and permits disinfectants to more easily penetrate and kill organisms.

Choosing a Disinfectant

Many factors must be weighed before choosing a proper disinfectant for a particular job. A germicide intended for the disinfection of a building should work well in the presence of organic matter, be compatible with soaps or detergents, be harmless to building materials, and be relatively non-toxic. A disinfectant suitable for decontaminating a building might be too toxic for use in sanitizing feed and water utensils. Select the disinfectant to fit the job.

Chemical agents have different mechanisms of action and spectra of activity. Warmer temperatures with some disinfectants, such as those containing chlorine or iodine, drive off the active ingredient from the solution. Some disinfectants are influenced by an acid or alkaline pH and/or hardness of the water. Characteristics and uses of common disinfectants can be evaluated using Table 1.

Commonly Available Disinfectants

Saponated solution of cresol is almost insoluble, especially in hard water. Compounds of cresol with soap (saponated) such as Lysol® are normally used to increase solubility and are applied in a 2-4% solution; a dilution of 4 oz. of cresol per gal. of water is recommended. Hot solutions are more effective. Saponated solution of cresol is an effective disinfectant to use in the presence of organic matter and is suitable for disinfecting animal quarters, vehicles and premises. These compounds can also penetrate wooden materials. Cresol has a strong and persistent odor to consider when using in farrowing houses or other tightly enclosed buildings.

Synthetic phenols such as orthophenol are available. They have a wide range of antimicrobial activity and are relatively good in the presence of organic material. They usually have no objectionable odor. Some are fortified with synthetic detergents for one-step cleaning and disinfecting. They are sold under various trade names (see Table 1).

Free Iodines: Tincture of iodine (2% iodine in alcohol) and strong tincture of iodine (7%) have been used as antiseptics and disinfectants; but because of their staining, corrosive and skin irritant properties, organic or "tamed" iodophor compounds are commonly used. Tincture of iodine could be used on skin prior to, or after, minor surgical procedures such as castration. As

with alcohols, the proper concentration must be maintained.

Iodophors are combinations of iodine and agents that aid solubility, usually non-ionic detergents. They are non-staining, non-irritating, and largely free from the risk of producing skin hypersensitivity reactions. Iodophors, sometimes referred to as "tamed iodines" or "organic iodines" are now commonly used for disinfection of utensils, equipment and precleaned surfaces. They are not highly active in the presence of organic material. In combination with detergents, they provide a slow release germicidal action that has residual activity for at least 7 days after application. They are effective in hard water but should not be used with alkali soaps.

Alcohols: In general, ethanol (grain), methanol (wood) and isopropyl (rubbing) alcohols are not suitable for most disinfection applications found in pork production. Isopropyl alcohol could be used to maintain sterility of clean instruments but other products are usually better suited. After a "surgical scrub," it could also be used as a final application to skin prior to surgical procedures. If used, proper concentrations must be maintained (70-78%).

Chlorine compounds have rapid action against bacteria, spores, fungi, and viruses. Preliminary cleaning is essential before disinfection with chlorine compounds because their activity is substantially reduced by the presence of organic matter. Solutions of sodium hypochlorite, similar to those used as laundry bleaches, are commonly used to disinfect utensils. Such solutions decompose upon exposure to light and should be kept protected. A 2% solution of calcium hypochlorite (bleaching powder, chloride of lime) is an economical and effective disinfectant for buildings and utensils. Its action, however, is readily dissipated by organic matter and careful cleaning should precede its use. Powdered chlorinated lime may be dusted directly on contaminated livestock quarters as a deodorant as well as a disinfectant. It should be stored in airtight containers because it deteriorates when exposed to air. Chloramines are organic chlorine compounds which release chlorine slowly and exert a prolonged bactericidal effect. They are less toxic and irritating than the hypochlorites.

Lye (soda lye) contains approximately 94% sodium hydroxide, a very effective disinfectant. Concentrated lye is a caustic poison and must be handled with great care. Solutions of lye will damage painted or varnished surfaces and textiles if allowed to remain in contact with them for very long. Lye does not injure bare wood, enamelware, earthenware or any of the common metals except aluminum. It is not highly effective against tuberculosis organisms and spore-forming bacteria as commonly used. For highly effective disinfectant purposes, lye should be applied as a 5% solution (one 13½ oz. can to 2 gal. of water). It is commonly used at a lower concentration (1-2 lb. to 10 gal. of water) that is less hazardous to the user.

Chlorhexidine is a synthetic compound with action against a variety of bacteria and many viruses. It is not appreciably inactivated by small quantities of organic matter and is non-toxic. Chlorhexidine is relatively ineffective against the gram-positive cocci, Pseudomonas, and resistant viruses such as the parvoviruses.

Quaternary ammonium compounds are surfactants commonly used for general disinfection of dairy, meat-packing, and food-handling equipment. They are antibacterial but do not possess substantial viricidal, fungicidal or sporicidal action and are used chiefly as sanitizing rinses after mechanical cleaning. These compounds are not suitable for disinfection of premises since they are readily inactivated by organic matter. They are neutralized by soaps so surfaces to be disinfected with them should be pre-rinsed.

Formaldehyde and other aldehydes can be purchased as an aqueous solution containing about 40% formaldehyde gas, commonly known by the name "formalin." A concentration of 4% formaldehyde gas is a reliable disinfectant that is lethal to anthrax spores within 15 min. Fumigation with formaldehyde has been popular for use in large poultry houses and swine units. Proper disinfection depends on a long period of exposure at proper concentration and humidity. Because the gas tends to condense at low temperatures, fumigation with formaldehyde is unreliable below 65°F. Temperatures above 80°F are preferred. Buildings should be thoroughly cleaned before fumigation and must be aired for 12-24 hr. before reuse. There are two methods of fumigating with formaldehyde gas. The first employs wide bottom buckets placed approximately every 10 ft. through the length of the building. In each receptacle place 175 gm. (10 level tablespoons) of potassium permanganate, then 12 oz. (1½ cups) of a 40% solution of formaldehyde (formalin) are poured over it. Under proper conditions this mixture will generate enough formaldehyde gas to disinfect 1,000 cu. ft. of space. Paraformaldehyde is a white powder used in commercially available electric heating units which release the gas from the powder. With either method, the floor should be moistened about 15 min. before fumigation; and the building must be kept tightly closed for at least 8 hr. Glutaraldehyde is a more effective germicide than formaldehyde and has a less irritating odor. However, it is significantly more expensive. A commercial spray fumigant is also available. The formula slowly releases formaldehyde and kills bacteria on contact and for up to 7 days. **Use of fumigants is hazardous to humans and animals; use properly.**

Footbath Preparation and Maintenance

Footbaths can be effective in preventing contamination through traffic between buildings (by footwear). They also serve as a constant reminder of the need for hygienic measures. If footbaths are not properly prepared and maintained, they are not only ineffective but act as sources of further contamination while providing a sense of false security. The following should be considered in preparing and maintaining footbaths:

- The footbath should be long and wide enough so people are forced to walk through it.
- The design should facilitate easy drainage and cleaning.
- The depth should be at least 4 in.
- It should be protected from weather (flooding, freezing).
- Disinfectant should be replaced when dirty (daily, if needed).
- Phenols and cresols are most commonly used but iodophors are also sold for footbaths.
- Clean footwear is more effectively disinfected than dirty, mud, or manure covered footwear. Provide adequate facilities (water spray) to easily and thoroughly pre-clean footwear.

Safety Precautions

Many cleaners and most disinfectants are poisonous. Store in tightly closed containers in a safe, locked area out of reach of children and other unauthorized persons, and away from feed and other supplies. Do not use bleach and ammonia together. Keep the labels on all containers. Read and follow directions carefully. Observe all safety precautions. Avoid skin contact, wear goggles and avoid breathing of spray mist or fumigant.

Practical Testing for the Effectiveness of Disinfection Procedures

Laboratory testing for the effectiveness of disinfectants or disinfection procedures may be complicated and can be misleading if cleaning and disinfection is not done thoroughly. However, veterinarians can provide a practical and simple method

(inexpensive) for interested pork producers. Swab samples are obtained from surfaces before and after disinfection and cultured for various bacterial organisms. A marked difference in the type and quantity of bacteria grown in cultures should be seen between the samples.

Table 1. Common disinfectants–characteristics and uses.

	Chlorhexidine	Formaldehyde and other aldehydes	Chlorine hypochlorites chloramines	Iodophors	Sodium hydroxide	Quaternary ammonium compounds	Cresols phenols
Spectrum of activity							
Gram pos. bacteria	S.A.,[1] not pyogenic cocci	Yes	Yes	Yes	Yes	Yes	Yes
Gram neg. bacteria	S.A., not pseudomonads	Yes	Yes	Yes	Yes	S.A.	Yes
Tuberculosis bacilli	S.A.	Yes	S.A.	S.A.	S.A.	No	S.A.
Bacterial spores	S.A. at 1% concentration	Yes	S.A.	S.A.	Yes (5-10% solution)	No	No
Fungi	S.A.	Yes	Yes	Yes	Yes	S.A.	S.A.
Viruses	S.A., not parvovirus	Yes	S.A.	S.A.	Yes	S.A.	S.A.
Special properties							
Resistance to organic debris	Good	Good	Very poor	Poor to fair	Good	Fair	Excellent
Effect of hard water	None	None	None[2]	None[2]	None	3	
Detrimental effect of heat	No	4	5	5	No	No	No
Residual activity	Yes	6	7	Yes	Yes	No	Yes
Most effective pH range	Alkaline	Not affected by pH	Acid	Acid	Alkaline	Alkaline	Acid
Compatibility with anionic surfactants (soaps)	Yes	Yes	Yes	Yes	Yes	No	Yes
Compatibility with non-ionic surfactants	Yes	Yes	Yes	Yes	Yes	Yes	No
Disadvantages	Reduced activity against certain organisms	Irritating fumes[8]	Inactivation by organic debris	Inactivation by organic debris	Caustic	Incompatible w/soaps - limited spectrum	9
Commonly used concentrations							
Disinfecting solution	1%	2-8%	Hypochlorites 3-5% [10,11]	50-75 ppm	2-10%	400-800 ppm	Variable
Sanitizing solutions	0.5%	1-2%	Hypochlorites 2-3%[11]	12-25 ppm		200 ppm	
Appropriate uses							
E - Equipment Ce - Clean equipment P - Premises F - Footbaths	E,P,F	E,P,F	CE	CE	P	CE	E,P,F
Common brands and names[12]	Nolvasan®	Cidex® DC & R® Formaldegen® Formalin	Chloramine-T® Chlorox® Halazone®	Betadine® Iofec® Isodyne® Losan® Tamed Iodine® Weladol®	Lye	Germex® Hi-Lethol® San-O-Fec® Warden® Zephiran®	Cresl-400® Environ® Tek-Trol® Lysol® Orthophen-ylphenol Sodium orthophenyl-phenate

[1]S.A. - Some Activity.
[2]Unless hard water is alkaline.
[3]Reduces speed of kill.
[4]Formaldehyde gas works best at 80-140°F.
[5]Use at less than 110°F, active principal driven off by heat.
[6]No, except slow-release formulas.
[7]Hypochlorites: No, chloramines: Yes.
[8]Glutaraldehyde is less irritating and is superior to formaldehyde as a germicide.
[9]Strong odor with coal and wood tar distillates.
[10]3.3% Chlorox inactivates parvovirus on clean surfaces.
[11]Chloramines variable.
[12]Products listed are intended as examples, not endorsement; many suitable products are not listed.

References

Disinfection in Veterinary and Farm Animal Practice. 1987. Ed. by Linton, A.H., Hugo, W.B. and Russell, A.D., YearBook Medical Pub., 35 E. Wacker Dr., Chicago, IL 60601

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Table 2. Definitions.

Anti-	a prefix meaning against; to prevent.
Antiseptic	an antimicrobial agent sufficiently free of toxic effects that may be used on body surfaces, e.g. alcohol, iodine.
Antisepsis	the prevention of infection(s) or the result of infection(s).
Caustic	corrosive or destructive to living tissues
-cidal	suffix meaning "to kill".
Detergent	an agent that aids in cleansing; may be used in a solution with disinfectants.
Disease buildup	the result of any condition that allows or permits the number of disease producing organisms to increase.
Disinfectant	an antimicrobial agent that is too toxic, irritating or corrosive to be used on body surfaces but is suitable for use on equipment, floors or environmental areas.
Fumigation	exposure of an area or object to disinfecting fumes.
Germicide	an agent (substance) that kills germs.
Germicidal activity	the relative ability of an agent (substance) to kill germs.
Germ(s)	disease producing microorganisms.
Hardness of water	amount of calcium, magnesium, or other minerals dissolved in water that may interfere with cleansing ability.
Hypersensitivity reaction	an exaggerated reaction of the body or tissues to contact with a substance or foreign agent; allergic reaction.
Micro-	a prefix meaning small; not seen with the naked, unaided eye.
Microorganism	small, living organisms usually seen only with the use of a microscope.
Organic Matter	material that comes from living organisms or tissue, e.g., blood, manure, dirt, urine, afterbirth, mucus.
pH	the symbol used to express whether a solution is acidic or basic (alkaline). pH 7 is neutral, below 7 is acid, and above 7 is alkaline.
Proportioner	a device that meters (adds) one substance (solution) to another; as a liquid proportioner.
Sepsis	the presence of disease producing organisms (germs) or their toxins in blood or other tissues; putrefaction; decay.
-static	suffix meaning "to stop".

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