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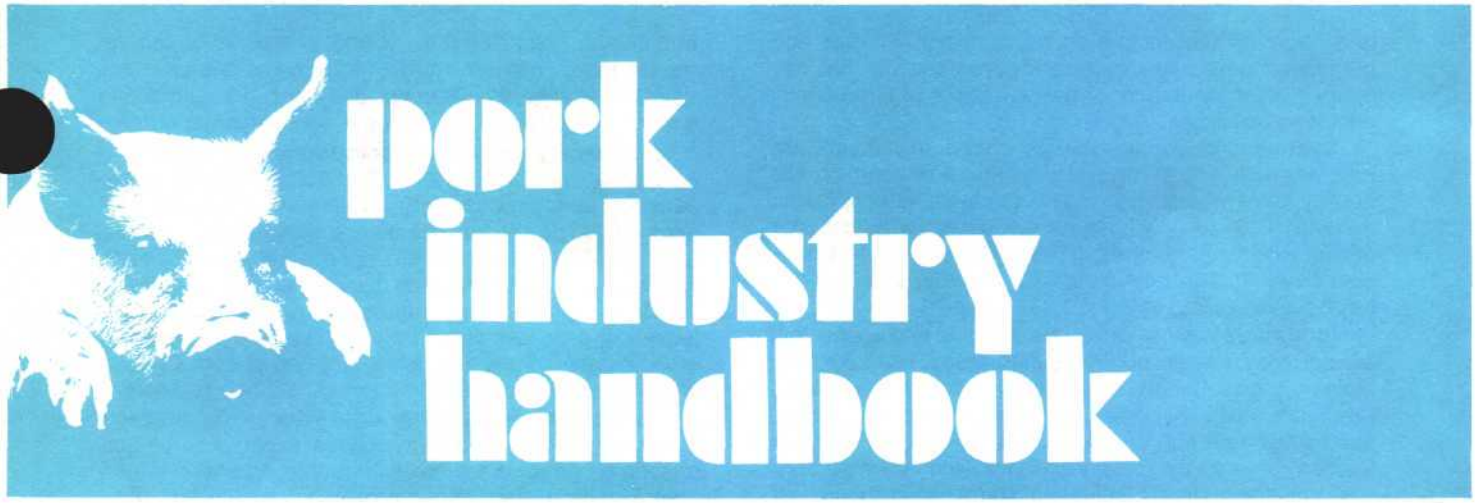

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Selection and Use of Disinfectants in Disease Prevention

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Cleaning and disinfecting is very important in controlling the accumulation and spread of disease-causing microorganisms. 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." 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.

Because organic matter, such as is found in dirt and manure, inactivates certain disinfectants and protects infective microorganisms from germicidal activity, good cleaning practices are necessary for proper disinfection. Manure removal followed by a simple scrubbing, a high velocity stream of water, or a steam generator can do an excellent cleaning job. In addition, the use of detergent solutions hastens 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) removes manure and debris with great efficiency. Portable steam generators, "steam jennies," are also excellent for cleaning dirty surfaces but the nozzle would have to 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 other surfaces. It is especially helpful in cleaning slotted and wire floors. An additional advantage of the steam generator is that many disinfectants and detergents work better at warm temperatures. Effective cleaning removes more than 95 percent of the contamination and permits disinfectants to more easily penetrate and kill infective organisms.

Choosing a Disinfectant

Many factors must be weighed before choosing a proper disinfectant for a particular job. For example, 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.

Several other factors influence the performance of disinfectants. The various chemical agents have different mechanisms of action and spectra of activity. Most disinfectants work better at warmer temperatures but with some disinfectants, such as those containing chlorine or iodine, excessive temperatures may drive off the active ingredient from the solution. Disinfectants are also influenced by an acid or alkaline pH. Hardness of the water may affect some disinfectants. For the purpose of evaluating characteristics and uses of common disinfectants, Table 1 may be used.

Several disinfectants are commonly available to pork producers:

Saponated solution of cresol is a popular disinfectant. 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 percent solution; a dilution of 4 oz. of cresol per gal. of water is recommended. Hot solutions are more effective. Saponated solution of cresol is one of the best disinfectants to use in the presence of organic matter and

is suitable for disinfecting animal quarters, vehicles and premises. Cresol has a strong and persistent odor that may make it objectionable in farrowing houses or other tightly enclosed buildings.

Synthetic phenols such as orthophenylphenol are now 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 excellent one-step cleaning and disinfecting. They are sold under various trade names (see Table 1).

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.

Chlorine compounds have rapid action against bacteria, spores, fungi, and viruses. Their activity, however, is substantially reduced by the presence of organic matter so that preliminary cleaning is essential before disinfection with chlorine compounds is undertaken. 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 percent solution of calcium hypochlorite (bleaching powder, chloride of lime) is a cheap but 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 powerful deodorant as well as a good 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 percent sodium hydroxide, a very effective disinfectant. For highly effective disinfectant purposes, lye should be applied as a 5 percent solution (one 13½ oz. can to 2 gal. of water). It is commonly used at a lower concentration (1-2 lbs. to 10 gal. of water) that is less hazardous to the user. 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.

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 quite non-toxic. Chlorhexidine is relatively ineffective against the Grampositive 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 for eating, drinking and dairy utensils after mechanical cleaning. These compounds are not suitable for disinfection of premises since they are readily inactivated by organic matter. They are also neutralized by soaps so surfaces to be disinfected with them should be pre-rinsed.

Formaldehyde and other aldehydes are disinfectants that are gaining in popularity. Formaldehyde can be purchased as an aqueous solution containing about 40 percent formaldehyde gas, commonly known by the name "formalin." A concentration of 4 percent formaldehyde gas is an excellent and reliable disinfectant and 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 hrs. 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 tbsp.) of potassium permanganate, then 12 oz. (1½ cups) of a 40 percent 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 hrs. Glutaraldehyde is a more effective germicide than formaldehyde and has a less irritating odor. However, because of its expense, it may not be as suitable as formaldehyde for large-scale disinfection of buildings and equipment. 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.

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. 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.

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 + bacteria	S.A.,[1] not pyogenic cocci	Yes	Yes	Yes	Yes	Yes	Yes
Gram - 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]	None
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 - Foot baths	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 ® Iotec ® Isodyne ® Losan ® Tamed Iodine ® Weladol ®	Lye	Germex ® Hi-Lethol ® San-O-Fec ® Warden ® *Zephiran* ®	Cresl-400 ® Environ ® Laro ® Lysol ® Orthophenylphenol Sodium orthophenylphenate

[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.

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