Fourth Edition  $20.00

Poultry Health Handbook

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PENNSTATE

College of Agricultural Sciences
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FOREWORD

The collection, preservation, and interpretation of facts has been the prime scholarly function of colleges and universities since their beginning. But before the age of printing and universal education, men and women had little chance of benefiting from the work of scholars—education consisted principally of orders received from taskmasters. The idea of working people thinking for themselves was considered unnecessary, and even a waste of time.

In America, the development of the land-grant education system and its associated agricultural and home economics cooperative extension functions has made it possible for all citizens to learn. Today's media (with the more and more exciting role of telecommunication) have, for all practical purposes, eliminated the time and distance factors and now the campus and its scholars, libraries, laboratories, and classrooms can be a daily experience for all who desire it.

Penn State is proud of its role in forwarding land-grant ideals over the years, and the College of Agricultural Sciences is especially proud to publish this Fourth Edition of the Poultry Health Handbook. The College was fortunate, for a number of years, to have had on its faculty Dr. Dwight Schwartz, who wrote the first edition of this Handbook in 1972. He revised it in 1977, and again in 1988, by then a member of the faculty of Michigan State University.

Dwight Schwartz is recognized by all in the industry as one of our nation's most knowledgeable poultry diagnosticians. Although he's now retired from Michigan State University, he's still plenty busy. The College is thankful and pleased, therefore, that he has made the effort to provide us with another major revision of his Handbook.

Agriculture changes quickly. Much too quickly, at times, for agricultural enterprises that must obey growing seasons and the other set calendars of nature while at the mercy of the market-place. An interesting trend is the increase in the number of farmers who are including poultry in their agricultural enterprises. These flocks require the same level of health care as do those of a million birds or so, and thus the need for learning goes on. In the Commonwealth, the poultry industry just keeps growing—increasing by more than 9 percent in 1993, to a total value (before processing) exceeding 500 million dollars. This value more than doubles by the time the eggs, birds, and other poultry products reach the table.

Nearly any scholar will tell you that major achievements are seldom possible without the help of others. Dwight Schwartz would not be happy if I failed to mention the assistance of his former colleagues. He has called upon Drs. Charlie Pitts and Owen Keene to revise the material on ectoparasites and nutritional diseases, respectively. Others have done their share, as well. Successful extension programs have always required a team effort, and this book is evidence of what a team effort can do! It is indeed an honor to write this foreword to Dr. Schwartz's new edition.

DONALD E. EVANS
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PREFACE

The Penn State Poultry Health Handbook is published as an aid to all persons in the poultry industry whose daily work depends upon healthy birds. Flock owners and managers, workers in hatcheries, feed mills, processing plants, transportation, and other industries servicing poultry operations need to be knowledgeable about basic principles of poultry health, poultry diseases, and how they can be avoided or controlled. This Handbook is intended to provide such information.

This, fourth edition of this Handbook, presents a major revision with expanded write-ups plus write-ups of several diseases not listed in the earlier editions. Unhappily, poultry diseases do not go away, so it is necessary to include all that were there before. The information on these, where appropriate, has been updated to reflect new knowledge resulting from work in research laboratories and diagnostic clinics, as well as from field experience. It is anticipated that this Handbook will become a valued desk reference for workers in Extension and farm advisory agencies, and an addition to the personal libraries of poultry veterinarians and students of poultry science.

Individual diseases are listed in the Index, with the preferred name in bold. Other names of the disease are likewise indexed, but not in bold. In addition, each disease is listed serially on the contents page preceding each section. Section contents pages are indexed on page vi. Index to tables appears following the general index.

A careful reader may notice that certain diseases now seem to have attained new names. It is true that a disease may be renamed, perhaps because subsequent study has revealed that the original name was just plain incorrect. In some cases the profession agrees to adopt a different name in order to avoid confusion with a disease of a similar name.

Mention of trade names herein, of course, is not to be interpreted as endorsement of the product by the author or the publisher. Likewise, absence of the name of a particular product is not intended to imply lack of endorsement. If a drug or chemical compound is suggested in discussing control of a disease or condition, it is the treatment of choice; if two names appear, it is the author's opinion that they are equal in effectiveness. In most cases, other products may be available.
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CODES AND MEASURES

Following is a listing of relatively standard codes, abbreviations, and measurements used by drug manufacturers and health providers in the poultry industry.

CODES and ABBREVIATIONS:
Sc: subcutaneous injection (beneath the skin)
WD: Withdrawal time (number of days required for drug residues to clear a bird's tissues)
IM: intramuscular injection (into the muscle)
C: Continuous use
approx: approximate
d/w: day/week
g: gram
gal: gallon
kg: kilogram (1000 g)
ltr: liter
oz: ounce
pt: pint
ppm: parts per million
qt: quart
tsp: teaspoon	thbsp: tablespoon
T: ton (2000 lb)

LIQUID MEASURES (with metric equivalents):
1 tsp = 1/3 tbsp = 5.5 ml (approx)
3 tsp = 1 tbsp = 1/2 oz = 14.8 ml (approx)
6 tsp = 2 tbsp = 1 oz = 29.6 ml (approx)
1 cup = 1/2 pint = 8 oz = 236.5 ml (approx)
1 pt = 2 cups = 16 oz = 473 ml (approx)
1 qt = 2 pt = 32 oz = 946 ml (approx)
1 ltr = 1.06 qt = 33.9 oz = 1000 ml
1 gal = 4 qt = 8 pt = 128 oz = 3.8 ltr

DRY MEASURES (with metric equivalents):
1 oz = 29 g
1 lb = 16 oz = 454 g
1 kg = 2.2 lb = 1000 g
1 g = 1000 mg
1 ppm = 1 g/T = 1 mg/kg
FUNDAMENTALS OF DISEASE PREVENTION
IN POULTRY HEALTH MANAGEMENT

1. Preventive medicine is the only logical approach to health management in today's intensive poultry operations. As flock size doubles, the possibilities of disease quadruple.

2. Preventive medicine includes disease-free chicks, maximum hygiene and care, vaccination, medication, and adequate nutrition—performed under conditions of strict sanitation and biosecurity.

3. Thoroughly clean and disinfect house and equipment after each group of birds. Compost used litter to destroy source of disease carry-over. Use new litter.

4. Select vigorous, disease-free chicks, poulets, or pullets.

5. Keep young birds well isolated from older birds. Separate facilities and caretakers will increase chances of successful isolation. Maintain breeder flocks on separate premises.

6. Isolate poultry classes from other livestock. Chickens, cattle, turkeys, and swine are subject to cross-infections.

7. Provide nutritionally balanced feed, whether commercially or home-mixed.

8. Provide a continuous supply of potable water for all birds. In summer, keep the water cool by providing shade; in winter, protect it from freezing. Birds consume up to 2.5 times as much water as feed. When water intake decreases, there is a proportionate decrease in feed intake, too. Marked reductions in feed and water consumption are usually the first signs of illness.


10. Choose a sound vaccination program and follow it carefully. For young birds, raise house temperature 5°F during the vaccination reaction period. Schedule all vaccinations and revaccinations on farms with multi-age flocks for the same day. Live-virus vaccines can spread to susceptible poultry.

11. During brooding, regulate temperature, humidity, and ventilation to the comfort of the chicks or pouls. Prevent drafts, overheating, and chilling.

12. Keep unauthorized and unnecessary personnel out of the poultry house. Discourage unnecessary visits to your facilities and to other poultry operations.

13. Composting is the most satisfactory and economical method of dead-bird disposal. Incinerating, rendering, disposal pit and deep burying, in that order, are the next best methods. Composting, when properly done, is the most environmentally friendly method of disposal. Most states have passed laws legalizing the composting of poultry carcasses. Check with your state veterinarian before starting a composting unit. Dead birds, if not disposed of, become a disease threat to all poultry in the area.

14. In disease outbreaks, promptly obtain a reliable diagnosis. When the disease has been identified, use the best treatment available for that specific disease. Birds recovered from diseases like pullorum and mycoplasmosis should be sold for slaughter—not saved for breeder replacements.

15. It is best that you accompany your diseased or dead birds to the diagnostic laboratory; in this way you will be available to give additional information that might be needed.
BIOSECURITY

Biosecurity is safety or protection from transmission of infectious agents of any type—viral, bacterial, fungal, or parasitic.

How do you enforce biosecurity? First, always remember that "not-knowing" and/or carelessness by individuals is the biggest threat to biosecurity. For this reason, keep buildings and premises locked at all times. Wear fresh, clean coveralls, cap or hat, and boots when visiting a farm. Change to a fresh outfit before moving on to another farm.

All tools and equipment used on the farm should be cleaned, washed, and disinfected before it is moved to another farm (ideally, there should be a separate set of equipment for each farm, thus eliminating the need for moving tools and machinery from farm to farm). Especially, give careful attention to the cleaning and disinfecting of egg cases, hauling crates, delivery trucks, feeders, and waterers. Equal effort should be applied to loaders and dumpsters, tractors, tool boxes, pickup trucks, vaccine sprayers, and de-beakers. Any of these, if contaminated, can in turn contaminate. Be alert to all of the ways that disease can spread to your farm.

Other preventive measures that will pay off include planning and engineering your operations so as to block situations that may expose your flock to disease. For example, it is wise to schedule equipment and house repairs to begin after your flock has been marketed.

Provide a clean simple room, supplied with clean smooth-soled rubber or strong-soled plastic boots, where persons who must visit the flock can change clothes. Keep this footwear clean! You'll find this to be a good investment!

Good ventilation pays! Large amounts of fresh air dilute microbe populations and reduce disease buildup. Locate new poultry buildings and facilities as far as possible from other poultry operations and poultry traffic.

Do business only with those suppliers and other providers whose service-people practice high biosecurity standards.

BIOSECURITY DO'S AND DON'TS

Do's:

Keep poultry in pens, houses, or comfortable cages.
Practice "all in, all out" management.
Clean, wash, and disinfect housing and equipment at least once a year.
Promptly remove and compost, bury, or burn dead birds.
Keep free-flying birds, waterfowl, and wild seabirds away from your flock.

Don'ts:

Permit dirty poultry coops, crates, equipment, or trucks on your farm.
Keep or mix pet birds or other types of fowl.
House birds of different ages in the same facility.
Visit poultry buildings on other farms.
SANITATION AND ISOLATION FOR POULTRY

Disease problems on the poultry farm originate from three sources:
1. New poultry brought to the farm (chicks, started pullets, breeding males, or other poultry).
2. Contaminated premises (disease carryover from previous flocks).
3. Lack of sanitation, or the relaxation of biosecurity, during routine operations.

Good poultry house sanitation begins with a clean, disinfected house, prepared well in advance of arrival of new birds. Each house should remain empty for at least 2 weeks after its disinfection and fumigation. The effectiveness of sanitizing a house depends on the thoroughness of cleaning before a germicide is applied. Thorough cleaning is essential because it (a) reduces the total number of pathogenic organisms, (b) removes material that gives refuge to pathogens, and (c) exposes surfaces to light, air, disinfectants, and fumigants.

STEPS IN CLEANING AND DISINFECTING A POULTRY HOUSE:

1. Depopulate—Total depopulation of the poultry house (all-in, all-out) and elimination of all loose and stray poultry (yardbirds) outside the house is essential.
2. Clean out old feed—Unused feed should not be held over from one brood of birds to the next. Augers, hoppers, and feed bins should be completely cleaned. Be certain to remove all feed that is hardened and stuck to the bottom and walls of the bin. Lumpy feed is high in mold spores; it can produce thrush, gizzard erosion, and mycotoxicosis in poultry. Dispose by composting.
3. Remove, clean, and sun equipment—Diseases carry over on dirty equipment. Take out all movable equipment before beginning the cleaning operation. Clean and disinfect equipment and leave it outside in the sun while the house is being sanitized. Returning equipment not sanitized to your house destroys the benefits of sanitization.
4. Hose down ceiling and walls—Remove cobwebs and dust from walls and sills with moderate volumes of water. The splash-off will dampen litter and keep down dust during its removal. Marek’s Disease virus harbors in fine dust on rafters, window sills, and in seams and corners.
5. Remove all litter—All old litter should be hauled to a remote part of the farm and composted. Never pile or spread old litter near poultry houses; rats and vermin can carry the residual disease organisms back into the house.
6. Repairs—Make needed repairs of building and equipment at this time.
7. Clean exits and openings—Clean up spilled litter and other debris from doorways, feed room, outside under the windows, and around the house. Old litter, trash, and tall vegetation are avenues of introduction and reintroduction of disease microorganisms.
8. Wash down house thoroughly—Wash ceiling, walls, and floors with generous volumes of water. For better and easier cleaning, add detergent to wash water, or wet the inside walls, apply detergent to all inside surfaces, and let soak for 2 hours. Rewash with clear water. High-pressure orchard-type spray apparatus (500 lb/sq inch or greater) will ease the job of cleaning and do it better. Scrape areas where needed. Rinse down the building and let the excess water drain away before beginning with sanitizing.
9. Apply germicide—Mix water-soluble disinfectants and apply while building is still damp from washing. Quaternary ammonium, phenol compounds, iodophor, formaldehyde, coal-tar, and chlorine disinfectants are reliable. Certain coal-tar, phenol-formaldehyde, and chlorine compounds may require the wearing of protective clothing during application. Some may leave a residue, so follow label instructions for self-protection and rinsing following sanitization. Let excess water drain.
10. **Fumigate or Heat Fog**—This step may not be required if the germicides contain formaldehyde, or if a second application of the disinfectant is made. To fumigate, close building tightly, bring inside temperature to 70°F, then discharge the fumigant. Use either 1.2 oz (35 cc) of 37% formalin with 17.5 g of potassium permanganate (K₂MnO₄) per 100 cubic feet of room space, or a bound formaldehyde (paraformaldehyde) compound (the fumigant is released when heat is applied). In either case use safety precautions; put the chemicals in an earthen, ceramic, or enameled container with at least ten times more capacity than needed for the volume of chemical used. A bound fumigant requires a special heating container. Lock the house and let stand 2 to 24 hours.

**CAUTION!** - THOROUGHLY AIR THE BUILDING BEFORE RE-ENTERING.

OSHA discourages the use of fumigants. Heat-fogging may replace fumigation as the final step in C&D procedures and immediately follows the application of germicide.

11. **Apply insecticide**—Apply solution or dust of an insecticide to the floors, wall-floor junctions, and around base of posts. Select an insecticide approved for control of beetles and other floor insects on poultry and in poultry houses.

12. **Apply oil-based disinfectant**—For additional protection, spray a covering of germicide in light oil (such as cresylic acid disinfectant in fuel oil) to the floor, lower walls, and post bases. Use the strongest germicide concentration recommended on the manufacturer’s label.

13. **AIR BUILDING THOROUGHLY.**

14. **Put in NEW litter.**

15. **Reinstall the sanitized equipment.**

16. **Lock poultry house**—Rest the building for 2 to 4 weeks before bringing in new poultry. The survival times of microorganisms in a poultry house range from a few hours to several months. Keeping the sanitized house vacant and locked for 2 weeks, however, will cause die-off of a high percentage of any surviving microorganisms.

17. **Prepare house for chicks, poults, or pullets**—Fill feeders and waterers, start brooders, warm the building to the appropriate temperature, and set chick guards in place for floor rearing. The house should be up to temperature 24 to 48 hours before chicks or poults arrive.

18. **Mow weeds**—Keep area within 100 feet of the poultry house cleanly mowed. Collect and dispose of all trash or debris. A clean area of 50 to 100 feet or so around each house will help control insects, rodents, and disease.

**ISOLATION**

Isolation of poultry is essential for successful flock husbandry. For continued flock health and performance, poultry should be segregated according to age, species, and class. Suggestions follow:

1. **Isolate the poultry house**
   a. One house per farm is ideal. If you have two or more houses, they should be at least 50 (preferably 100) feet apart.
   b. Locate the house at least 1000 feet from all public roads or adjacent properties.
   c. Fence around the house and locate the feed bin so that it is filled from outside the fence.
   d. Provide a separate caretaker for each house, or at least for each age group.
   e. Take away all old litter and compost it at a remote area of the farm. The composting should be done no closer than 1000 feet to the poultry house.

2. **Segregate the birds**
   a. Screen out free-flying birds.
   b. Eliminate stray poultry (yard and all other birds).
   c. Segregate poultry by flock (don't mix flocks), by age (one age per house or farm), and by species (never mix chickens with turkeys, guinea fowl, or other types of animals).
d. Keep pets away from the poultry house.

3. Maintain biosecurity
a. Have new birds (chicks, poults, pullets) delivered in sanitized boxes or crates.
b. Require all service personnel, vaccination technicians, and other work crews to wear freshly laundered coveralls and caps and sanitized boots.
c. Dispose of dead birds promptly.

d. Maintain vermin control.
e. Insist that all vehicles bringing in litter and all other materials be sanitized.
f. Lock gate and/or the house. Keep unauthorized personnel out!
g. The caretaker and his family should avoid contact with others—such as employees of poultry-processing plants or hatcheries—who handle live poultry. Do not visit other farms or handle other birds.
DISINFECTANTS AND DISINFECTING

The market offers a wide variety of disinfectants for poultry sanitation, but the perfect germicide is yet to be developed. Each of those now on the market has advantages and disadvantages. With each, effectiveness is greatly improved if equipment surfaces and floor and other areas are clean. For this reason, thorough cleansing is the first and probably the vital step in sanitizing poultry houses.

Poultry health goes hand in hand with good housekeeping—frequent manure removal, routine cleanliness, and ongoing sanitization. Careful attention to good housekeeping helps prevent build-up of disease-causing organisms in the poultry-living area. Thorough cleaning and disinfecting between flocks prevents disease carryover and exposure of succeeding flocks. Increased performance and reduced mortality are the payoffs of good hygiene and biosecurity.

In recent years, the Environmental Protection Agency (EPA) has taken an active position on germicides considered to be potentially harmful to the environment. The EPA and animal-disease regulatory agencies together review germicides proposed for use in disinfecting facilities for livestock or poultry. Any chemical germicide that is tuberculocidal, for example, must have EPA approval as well as the approval of the state and federal animal-disease regulatory agencies.

TYPES OF GERMICIDES

ALKALIS. Strong alkali compounds include sodium, potassium, calcium, and ammonium hydroxides. Weak alkali compounds include carbonates, bicarbonates, silicates, and alkaline phosphates. The latter compounds are more beneficial as cleansers than as germicides.

At one time lye (sodium hydroxide) was recommended by the USDA for disinfecting animal pens, trucks, and equipment. However, it is now known that sodium hydroxide, diluted as formerly recommended, is not germicidal. A much stronger concentration is required, and its use becomes more hazardous. For this reason, the strong alkali compounds have lost favor as disinfectants, although some are considered useful as cleansers in preparing areas for disinfecting, i.e., for a total cleansing-disinfecting effect.

Properties: Any one of a class of compounds that form soluble soaps with fatty acids, turn litmus blue, and form soluble carbonates. They are the hydroxides of potassium, sodium, lithium, rubidium, cesium, and ammonium fats. Alkali solutions are caustic and thus very destructive to live tissues.

Recommendations: The applicator should wear protective clothing. This material is not recommended for use in tightly enclosed quarters. It is useful for cleaning trucks and outdoor pens. Thoroughly rinse all surfaces after cleaning, to avoid potential injury to chicks or birds.

QUATERNARY AMMONIUM. The quaternaries are called "quats," short for quaternary ammonium compounds (QAC). Quats vary in composition, and a trade formulation may be a mixture of two or three. Germex, Hi-Lethol®, San-O-Fec-50®, and Warden® are among the commercial quats.

Properties: Clear, odorless, and nonirritating to the skin. Provides deodorizing as well as detergent activity. Many quat products are on the market. Use with care, as their germicidal properties will be destroyed by soaps, detergents, and litter and other organic materials.

Recommendations: Surfaces to be disinfected must be clean. Solutions for sanitizing require 200 parts per million (ppm). For disinfecting, use 400 to 800 ppm. Quats are used for egg washing and dipping and disinfecting hatcheries, poultry houses, and equipment.

IODOPHORS. Sometimes called organic or "tamed" iodine, the iodophors are mixtures of iodine and other chemicals. When the characteristic iodine color fades, effective-
ness is gone. Examples include Losan®, Iofec®, Tamed Iodine®, and Scrub®.

Properties: Iodine, the active chemical in iodophors, is a member of the halogen group of chemical elements. Iodine vaporizes (passes off as a vapor) very rapidly after application. It is widely used in dairy and food processing. All halogens are rapidly destroyed in the presence of organic materials, so the areas to be disinfected must be clean.

Recommendations: Recommended concentrations for sanitizing solutions are 12 to 25 ppm; for disinfecting solutions, use 50 to 75 ppm. These solutions are used for egg dipping, hatchery and poultry house disinfecting, and for sanitizing processing plants, footbaths, and poultry drinking water.

HYPOCHLORITES. The hypochlorites are the chlorine (Cl) sanitizer-disinfectants derived from sodium hypochlorite; their chemical formulations include compounds that release chlorine into the sanitizing solution.

One major use of chlorine is in purification of water. Various types are available. Common household bleach contains 5 percent available chlorine; products manufactured for use in swimming-pool sanitation contain 15 percent available Cl. Other chlorine-releasing compounds include calcium chlorite and chlorine dioxide.

Properties: Chlorine, like iodine, is also a member of the halogen group. It is the active chemical in hypochlorite germicides. Hypochlorites are effective germicides, but like many germicides are effective only on precleaned surfaces. When hypochlorites are used in food-processing areas, work surfaces should then be rinsed to remove any chlorine residue. In diluted solutions these compounds are effective drinking water sanitizers. To avoid a calcium precipitate when making up a sodium-hypochlorite stock solution for use in proportioners, use softened water. Hypochlorites are most effective when slightly acid.

Recommendations: Use concentrations of 200 ppm for disinfecting and 50 ppm for sanitizing. Used for egg washing and egg dipping, disinfecting processing plants, and sanitizing poultry drinking water.

CRESOLS AND CRESYLIC ACIDS (COAL-TAR DISTILLATES). Coal-tar compounds, the largest group of germicides, have a strong characteristic odor. Concentrated solutions will irritate the skin.

Properties: These compounds are most effective in the acid pH ranges, have a strong germicidal action, and turn milky when added to water. Their strong persistent odor limits their acceptance for use in poultry houses, and they may be harmful to chicks. Many are combined with detergents during manufacture.

Recommendations: Recommended for disinfecting houses, equipment, and for footbath solutions. Concentration varies with type of compound.

PHENOL COMPOUNDS (CARBOLIC ACID). The phenols are another group of coal-tar derivatives, and include a great many compounds. Synthetic phenols are more germicidal and less toxic than natural phenols to animal tissues and have essentially replaced the natural phenols as general disinfectants. The synthetic phenol germicides are marketed with trade names like Lysol®, orthophenylphenol, 1-Stroke Environ®, and Laro®. Many of the synthetic phenol compounds are combined with soaps during manufacture. The cleansing action enhances their germicidal contact, and in turn, effectiveness. The phenols are incompatible with nonionic wetting agents.

Properties: Phenols have a characteristic odor, turn milky when added to water, and are effective germicides. Organic materials have a diluting effect but do not inactivate phenols.

Recommendations: Recommended concentrations vary, depending on the product and its intended use. Concentrations for sanitizing solutions range from 50 ppm or more;
those for disinfecting solutions may be as much as 100 ppm. Commonly used for egg dipping; for disinfecting of hatcheries, poultry houses, and equipment; and for footbath solutions.

SODIUM ORTHOPHENYLPHENATE. Sodium orthophenylphenate, also a coal-tar derivative and an effective germicide, has been approved by APHIS-USDA for use in disinfecting animal quarters during animal-disease eradication programs.

Properties: Grayish powder or white flakes, odor nonobjectionable, nontoxic, deteriorates when exposed to air. Will irritate eyes and mucous membranes, so care (such as protective clothing) during application is advised.

Recommendations: Most common use of this material is by federal agencies to eradicate exotic diseases.

BLENDED GERMICIDES. Blended germicides are a combination of two or more germicides, such as phenol, formaldehyde, alcohol, and quaternary ammonium compounds. The "blend" germicides have a broader spectrum of germicidal effectiveness than do the single compounds alone, but may be restricted in use, e.g., to purposes such as disinfecting buildings and equipment. Other use-limitations depend on the product. For example, formaldehyde causes deterioration of rubber, and certain plastics may be likewise affected.

Properties: The properties of these compounds vary with the respective formulations. Blended phenols have the properties of phenols; quaternary ammonia-alcohol blends and cresol-formaldehyde blends exhibit properties of the original components. The blends were developed to broaden the spectrum of activity, increase residual action, or both. Therefore, blended germicides are formulations of compounds that are compatible and complementary in action.

Recommendations: Because of the number and the variation in blends, general recommendations using these germicidal chemicals cannot be presented here. As a responsible user of agricultural chemicals, be sure that the product you are planning to use is currently registered and that you understand the instructions for its use. (Instructions for mixing and using, etc., are supplied by the manufacturer.) Then carefully comply.
WATER QUALITY

Good water is important to the health of poultry. Depending upon its age and sex, 55 to 75 percent of a chicken's body weight is water. The egg is 65 percent water. Water is essential in several critical biological functions in the chicken—e.g., regulating body temperature and aiding digestion, metabolism, and elimination of body wastes. When calculating poultry rations, water is treated as a nutrient.

Water is a solvent, and all natural waters contain dissolved substances. Many of these substances are salts, with calcium, magnesium, sodium chlorides, sulfates, and bicarbonates predominating. In some cases, these compounds may be present in such high concentrations that they produce harmful osmotic effects in birds, leading to poor performance, illness, or even death. The quality of water governs its suitability for poultry use; water quality can be determined only by laboratory analysis. For this reason, the importance of periodic tests cannot be too strongly emphasized.

Only pollution-free, potable water should be given to poultry. Polluted and/or mineral-laden waters stress the birds and interfere with their ability to perform. The Environmental Protection Agency (EPA) has established acceptable bacterial and pollution limits in drinking water for livestock. Fecal coliform count in any sample shall not exceed 5000 per 100 ml; the monthly arithmetic density may not exceed 1000 per milliliter. Water containing 500 ppm total dissolved solids is considered polluted and thus unsuitable for poultry water supplies.

The natural minerals in water are characteristic of the leaching bed (i.e., the geological strata) of its source. While mineral substances may differ in the mode of action, the end result to the animal may be the same. High concentrations of minerals in drinking water have a laxative effect on poultry. The sulfates irritate the intestine, producing diarrhea, while magnesium and other nonabsorbable minerals act as saline cathartics—again causing diarrhea or loose droppings. Nitrates and coliforms are surface-drainage pollutants that end up in the well, pond, or stream; they may drain into underground waters through fissures in rock strata. The latter situation is common in limestone areas.

Nitrates or nitrites in excess of 50 ppm are known to be harmful to chickens, and 75 ppm may harm turkeys. Other livestock may be even more sensitive to nitrates and nitrites, and 10 ppm to 25 ppm may produce harmful effects.

What can be done with water high in nitrates? If there is no way to stop contamination of the water supply, a new clean source must be found. If the underground stream is polluted, a new source is the only solution. According to water engineers, there is no practical way to remove nitrates or nitrites from water. These substances are natural degradation products of proteinaceous materials. They are sources of nitrogen for plant growth, but toxic to birds and animals.

Public-health laws of most states require that water for human use meet potability standards. Therefore local public-health agencies will usually test water samples free of charge. All new water sources should be tested. Usually it is more practical to develop a new water source than it is to clean up grossly polluted and contaminated water. Flock owners are advised to contact the local public-health office for potability standards.
SANITIZING DRINKING WATER FOR POULTRY

Sanitizers for drinking water are in common use today. Chemical sanitizers—namely chlorines, iodines, and quaternary ammonium—and ultra-violet (UV) radiation are used. Use of quaternary ammonium compounds for use as poultry drinking-water sanitizers is limited to birds younger than 14 weeks of age; it is not approved for use with laying flocks.

Chlorine sanitizers work at very low concentrations—usually 3 to 10 ppm. Iodine is more effective than chlorine against fungi (molds). UV sanitizers (electric lamps) can be installed along the water lines feeding the waterers. UV gives no microbial control after the water enters the trough or water cup; chemical sanitizers may be employed in conjunction with UV lighting to provide microbial control.

Slime in the water trough, a product of slime bacteria, may cause a slight loss in egg production or an occasional mild diarrhea in layers without notice by the flock manager. These subtle effects of microbial contamination and slime in the drinking vessels are harmful to all hens, but may be more noticeable in caged hens. Pure, safe water is vital to the health and maximum performance of poultry.

CHLORINE SANITIZERS

One product, sodium hypochlorite, is an inexpensive and effective way to sanitize drinking water for poultry. Sodium hypochlorite is commonly used as laundry bleach (like Clorox). One gallon of bleach in 17,500 gallons of water gives a chlorine level of 3 ppm, which is adequate. The safety margin for chlorine is quite wide. Chlorine concentrations of 50 to 100 ppm, well above recommended use levels, are tolerated. The term superchlorination has been applied to hypochlorite sanitizing.

Superchlorination at 5 ppm can control water-trough slime and coliform bacteria; to maintain this concentration through to overflow may require as much as 20 ppm at input. It is recommended that the water troughs, cups, etc., be cleaned prior to sanitizing. This will permit startup with chlorine at a maintenance level rather than at higher levels. This principle applies to use of all chemical sanitizers.

It is wise to avoid starting a flock on very high chlorine levels. High concentrations of chemical sanitizers may cause birds to cut back on their water intake, leading to a production drop. The flock should be conditioned by beginning with a low level, such as 3 to 5 ppm, then gradually increasing to a concentration that will control drinking-trough slime.

If you get your water from a public utility, a certain amount of residual chlorine is probably coming through the taps. You can determine the amount by testing. Chlorine test kits may be purchased from poultry supply houses or through sources suggested by municipal water authorities. A dilution guide for adding sodium hypochlorite (5% strength laundry bleach) through a water proportioner is:

1. Prepare stock solution—mix 1 to 1.5 oz bleach per gallon of water.
2. Add to drinking water—1 oz stock solution per gallon continuously (3 to 5 ppm at input).

For other chlorine sanitizers (not sodium hypochlorite), follow label instructions.

IODINE SANITIZERS

Iodine preparations have a tendency to foam when used in proportioners, and for this reason intermittent water treatment is perhaps preferable. The recommended concentration of iodine in drinking water is 12 ppm for continuous treatment and 25 ppm for the intermittent-treatment procedure. The iodine concentration may vary by manufacturer, but proper dilution is easily determined by using the 12- and 25-ppm levels in computations. As an illustration, using Whitmoyer’s Iofec-14, the 12-ppm level is reached by adding 1 oz of sanitizer (the
25-ppm level by adding 2 oz) to 10 gal of water. When proportioners that deliver 1 oz per gal are used, the stock solution is prepared by adding 8 oz lofec-14 to 2.5 qt of water.

Chlorine sanitizers are usually the first choice because of the low cost, availability, wide safety range, and ability to control water-trough slime. But chlorine sanitizers will not do the job on mold organisms. So if a problem of crop mycosis appears in the flock, iodine sanitizers are needed.