

Use of Formalin to Control Fish Parasites¹

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Introduction — what is formalin?

Although the terms “formalin” and “formaldehyde” are often used interchangeably, they are actually different products. Formaldehyde is a gas while formalin is a liquid comprised of formaldehyde and water. “Pure” formalin is made of approximately 37% formaldehyde gas saturated in water resulting in 100% active ingredient formalin. Solutions of formalin for use on fish contain 10 to 15% methanol, which inhibits formation of paraformaldehyde (discussed below), a highly toxic compound.

Two commercial formalin products are currently approved by the U.S. Food and Drug Administration (FDA) and available for use as a drug on fish. These products are Parasite-S, manufactured by Syndel USA (formerly Western Chemical), and Formacide-B, manufactured by B. L. Mitchell, Inc. Both products are approved for use to control external parasites on all finfish species as well as *Saprolegnia* (water mold, “fungus”) on all finfish eggs. Because formalin does not accumulate in the tissues of fish, there is no required withdrawal period (time after the chemical is used before fish can be slaughtered for food) or safety concerns associated with consumption of fish treated with the chemical.

How is formalin used in aquaculture?

Formalin is used as a bath treatment to control parasitic infections on the external surfaces (skin, fin, gills) of fish. It is extremely effective against most protozoans as well as some larger parasites, such as monogeneans. It is not the preferred treatment for external bacterial or fungal infections on fish; however, it is used to control water mold (“fungi”) on fish eggs. Formalin is not effective against internal infections of any type.

Special concerns regarding the use of formalin

Concerns for safety of personnel

1. Formaldehyde, the active ingredient in formalin, is a known carcinogen and is considered hazardous. It should only be handled by trained personnel wearing appropriate personal protective equipment (PPE) such as gloves and eye and respiratory protection. A current safety data sheet (SDS) should be available at all times and carefully read before use.
2. Formaldehyde is a noxious gas. Formalin must be kept in a sealed container in a well-ventilated area. Exposure to fumes may result in headaches and irritation to eyes and respiratory tract. Increased exposure time increases effects to the handler.

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3. With repeated handling of the chemical, some people develop a sensitivity to formalin over a period of time. These individuals should avoid handling the chemical.

Concerns for safety of fish

1. Formalin can significantly affect the dissolved oxygen concentration of treated water. System water should be vigorously aerated throughout a formalin treatment.
2. Formalin is an algacide. When applied to pond water, formalin kills at least a portion of the phytoplankton/algae present, thereby reducing the ability of the phytoplankton to produce oxygen through photosynthesis. Further decreases in oxygen concentration in the pond can result because oxygen is consumed as the dead phytoplankton decomposes. Dissolved oxygen levels should be closely monitored and aeration used during and after treatment with formalin.
3. Formalin should be stored in a tightly sealed container in an area where it is protected from sunlight and extremes of heat and cold. Never use formalin when storage temperatures fall below 40°F (5°C) or when a white precipitate (powdery solid) is present in the normally clear liquid. At cold temperatures, formaldehyde is transformed into paraformaldehyde, a highly toxic material which will kill fish on contact. Paraformaldehyde forms as a white precipitate which may collect on the bottom of the container or cause the formalin to appear cloudy.
4. When treating parasites on sensitive species of fish, the concentration of formalin delivered in a prolonged bath should not exceed 12.5 mg/l.

Application of formalin as a parasiticide for fish

Formalin is added to the water as a bath treatment. The dosage rate used is determined by the period of time the fish are to be in contact with the chemical, and by the condition of the fish. At lower dosages, formalin can be applied as a prolonged bath, which means it is put directly into the system water with the fish and left indefinitely. By keeping the fish in their original system for the treatment, the fish are not subjected to additional handling stress; pathogens are not spread to other areas; and parasites in the system water are exposed to the treatment, helping reduce reinfection. The concentration of formalin appropriate for a prolonged bath is 12.5 to 25 mg/l. The higher concentration of 25 mg/l is easily applied to smaller systems by adding 1 milliliter (ml) of formalin per 10 gallons of system water

(or 2 drops of formalin per gallon of water). The lower concentration of 12.5 mg/l would be appropriate for more sensitive fish species or extremely sick fish which may not be able to tolerate a “full” treatment. It may be dosed by adding 0.5 ml per 10 gallons of water. This lower dose may also be appropriate for ponds in some situations; however, the use of formalin in ponds is often discouraged for several reasons, which are discussed below.

Any time formalin is applied, vigorous aeration must be provided. When using formalin as a prolonged bath in a flow-through tank system, we recommend that the water flow be turned off for at least 12 hours (and up to 24 hours) to ensure a sufficient contact time with the parasite of concern. Ensure that water quality (e.g., ammonia, nitrite, pH, dissolved oxygen) is optimal before stopping water flow and beginning the treatment.

Research has shown that formalin at the above dosage rates does not have a significant effect on nitrifying bacteria in the biofilter of a recirculating system. However, higher dosage rates appear to have a negative impact on nitrite-oxidizing bacteria (the bacteria that convert nitrite to nitrate), which could lead to increases in nitrite concentration. Formalin will interfere with some water quality testing chemicals, most notably Nessler’s reagent, the chemical used in many ammonia test kits. A salicylate-based test kit should be used to test ammonia whenever formalin is present in the water.

In some situations, a high dosage rate of formalin up to 250 mg/l (1 ml formalin per gallon of water) may be applied as a short-term bath of 30–60 minutes. This treatment method is most appropriate in systems which have constant high water-flow rate, such as salmonid raceways, or where an individual or small number of fish will be moved into a new system with formalin-free water immediately after treatment. Tolerance of fish to this high dose rate and potential movement of pathogens if fish are moved to a new system must be considered.

Fish exhibiting signs of distress (e.g., darting, gasping, or trying to jump out of the water) during a chemical treatment should immediately be moved into clean (untreated) water.

Use of formalin in fish ponds

Although formalin has historically been used to control protozoan infestations of fish in ponds, its use in aquaculture ponds is often discouraged. First, it is quite expensive, and large volumes are needed to treat even a small pond.

Other less expensive chemicals, such as copper sulfate, are available have the same spectrum of activity as formalin, but are more cost-effective for commercial use. Second, formalin chemically removes dissolved oxygen from water, and this action, along with its algacidal activity, may create an uncontrollable oxygen depletion resulting in a fish kill. The direct cost and risk associated with the use of formalin make its use in ponds difficult to justify unless no other safe and effective options are available.

Use of formalin in hatcheries to control fungus on eggs

Formalin is approved by FDA for control of water mold (usually called fungus, although this is technically incorrect) in fish hatcheries. Concentrations of 1000 to 2000 mg/l can be applied to fish eggs for 15 minutes. Hatchery managers are reminded that sanitation is important for the prevention of water-mold invasions on fish eggs. Dead eggs should be removed from the system promptly because they serve as a source of infection for adjacent, healthy eggs.

Use of formalin as a preservative

Researchers and clinicians often use formalin to preserve tissue specimens for storage and/or processing such as histology. The formalin used for this application is a formulation that contains 10% formalin (3.7% formaldehyde) and buffers that neutralize the solution to reduce damage (artifact) to tissues during preservation. It also contains little to no methanol unlike treatment formalin. This 10% neutral-buffered formalin (10% NBF) should not be used to treat fish parasites or water mold/fungus and, likewise, 100% formalin should not be used to preserve tissues.

Summary

Formalin is a liquid formulation of approximately 37% formaldehyde gas dissolved in water. Two brands of formalin, Parasite-S (manufactured by Syndel USA) and Formacide-B (manufactured by B. L. Mitchell, Inc.), have been approved by the FDA and are available to control external protozoan and monogenean parasites on fish of all species. It is not generally considered the best treatment for external fungal or bacterial infections on fish; however, it is approved and useful to control water mold (“fungus”) on fish eggs.

Formalin is an excellent parasiticide for use in tanks and aquaria, but its use in ponds is often discouraged because it chemically removes oxygen from the water, is algacidal, and can contribute to a catastrophic oxygen depletion under

pond conditions. This depletion can be more easily avoided in tanks and aquaria by always supplying vigorous aeration when formalin is used.

Formalin can be used as an indefinite bath at a concentration of 12.5 mg/l to 25 mg/l or in a short-term bath (30–60 minutes) at a concentration up to 250 mg/l. High concentrations of formalin (1000 to 2000 mg/l for 15 minutes) can be used to control water-mold (“fungal”) infections on fish eggs; however, appropriate management practices must be implemented to prevent recurrence.

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