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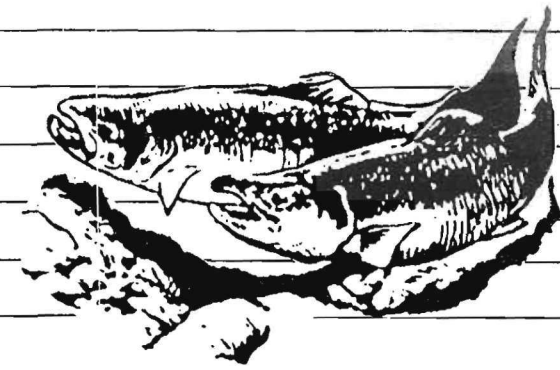

Hydrogen Peroxide Controls Fungal Infections on Trout Eggs

Malachite green, once the preferred fungicide for fishery use, is no longer permitted for treatment of fish or fish eggs for control of fungus—the Food and Drug Administration has restricted the use of malachite green on food fish. Formalin is an effective fungicide, but fishery managers are concerned about safety to the user and effluents in the environment. Other antifungal agents, therefore, are needed to maintain healthy fish and eggs in fish culture systems.

Hydrogen peroxide is active against a wide variety of organisms—bacteria, yeasts, fungi, viruses, and spores. Federal agencies list this chemical as Generally Recognized As Safe when used as a bleaching agent in manufacturing or feeding practices or as an antimicrobial agent in cheese production or drinking water treatment. Furthermore, hydrogen peroxide has been used as an antiseptic and a treatment for skin parasites, protozoans, and monogenetic trematodes on fish and is proposed as a treatment for sea lice on salmon. We designed experiments to evaluate the effectiveness of hydrogen peroxide for control of fungal infections on eggs of rainbow trout (*Oncorhynchus mykiss*).

In Vivo Procedures

Green eggs of rainbow trout were placed in Heath incubation trays and maintained in well water with a flow rate of 1 L/min. Groups of 500 eggs were confined within 15-cm diameter acrylic rings that were fastened to the screen of each incubation tray. Eggs were inoculated with fungus (*Saprolegnia parasitica*) actively growing on hemp seeds suspended by tea balls in the upper tray of each duplicated treatment. Infection of eggs generally occurred within 7 days. The infection rate of about 10% in each tray was obtained by exchanging infected eggs between trays. Eggs infected at the 0 and 10% level were then exposed to hydrogen peroxide for 15, 30, or 60 min every other day for 2 weeks. Treatments ceased when the eggs began to hatch. A positive control group was inoculated with fungus but not treated with hydrogen peroxide. A negative control group was not inoculated with fungus nor treated with hydrogen peroxide.

Efficacy of Hydrogen Peroxide

Artificial infection of eggs was successful —infection rates increased substantially in the positive control and the hatch rate for those eggs was only 2.1% (Table). Hydrogen peroxide treatments of 500 ppm controlled fungal infections on eggs not infected (0% infection) at exposures of 15, 30, and 60 min; hatch rates were significantly higher than for control groups. This treatment concentration was effective for control of fungus at the 10% infection rate only in the 60-min exposure. The 1,000-ppm treatments, however, were effective for control of fungus and increasing the hatch rate at

all three exposure periods. Both treatment concentrations controlled fungus and increased hatch rate of uninfected eggs (0% infection) at all exposures.

In reality, the 10% infection rate is perhaps a "worst case" situation in hatcheries where treatments are normally done when the fungus first appears or is suspected. The 1,000-ppm treatment rate may be excessive, especially for the longer exposures. It is premature to recommend a general treatment rate, therefore, a suitable treatment rate should be developed to meet the particular conditions in individual hatcheries. Hydrogen peroxide seems to be equally or more effective than formalin for control of fungus on trout eggs in similar in vivo experiments.

Availability for Use in Fisheries

Hydrogen peroxide is one of the most environmentally compatible chemicals because the primary decomposition products are oxygen and water. This versatile chemical already has widespread application and acceptance in pulp and paper, textile, waste treatment, mining, petroleum, food and chemical processing, cosmetic, and pharmaceutical industries. The U.S. Food and Drug Administration recently approved a petition from the National Fisheries Research Center—La Crosse that hydrogen peroxide be classified as a low regulatory priority when used to control fungi on all species and life stages of fish, including eggs. This ruling means that hydrogen peroxide can be used as a fungicide without an investigational new animal drug permit or a new animal drug application.

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Table. Efficacy of hydrogen peroxide on different rates of fungus (*Saprolegnia parasitica*) infected eggs of rainbow trout for exposures of 15, 30, and 60 min at 12° C.

Treatment (ppm)	Exposure Time (min)	Infection (%) Initial	Infection (%) Final	Hatch (%)
(+) Control[1]	—	7.2	98.5	2.1
(–) Control[2]	—	0.0	72.0	39.1
500	15	0.0	2.9	67.4
		10.1	84.6	14.6
	30	0.4	18.2	64.7
		10.3	78.9	27.3
	60	0.0	0.0	74.8
		10.2	54.2	61.3
1000	15	0.0	0.0	69.0
		10.8	53.1	55.0
	30	0.0	0.0	70.5
		10.2	31.4	60.8
	60	0.0	0.7	65.2
		10.3	32.7	50.2

[1] Infected and untreated.
[2] Uninfected and untreated.