EFFICACY AND RESIDUES OF QUINALDINE SULFATE, AN ANESTHETIC FOR STRIPED BASS *(ROCCUS SAXATILIS)*

by

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ABSTRACT

Sills, Joe B., and Paul D. Harman. (Southeastern Fish Control Laboratory, Warm Springs, Ga.). *Efficacy and residues of quinaldine sulfate, an anesthetic for striped bass (Roccus saxatilis).* Proceedings of the 24th Annual Conference of the Southeastern Association of Game and Fish Commissioners, pp.

Striped bass *(Roccus saxatilis)* were exposed to solutions of quinaldine sulfate containing 10, 25, 40 and 55 p.p.m. of quinaldine. Fish were effectively anesthetized at concentrations of 25 to 55 p.p.m. Residue levels in muscle tissue of fish exposed to 40 p.p.m. of quinaldine at 4° C. for 10 minutes reached 2.60 p.p.m., but were essentially gone after 24 hours of recovery in fresh water.

INTRODUCTION

Considerable numbers of striped bass *(Roccus saxatilis)* are raised and distributed by national and state fish hatcheries. Anesthetics are often necessary when handling this fish because of its large size and wild nature. The Federal Food, Drug, and Cosmetic Act requires that chemicals used on fish be cleared and labeled for their specific uses (Lennon, 1967). Some of the information needed to initiate clearance of quinaldine sulfate for use as an anesthetic for fish include its efficacy and residues in fish tissues. This work was undertaken to obtain this information on striped bass.

Since quinaldine was first suggested as a fish anesthetic (Muench, 1958), many fishery workers have used it successfully. Klontz (1964) and Bell (1967) described the use of quinaldine as an anesthetic for fish. Locke (1969) found quinaldine to be quite effective on the commonly handled salmonids in Maine. Schoettger and Julin (1969) made a comprehensive study of quinaldine's efficacy as an anesthetic for seven species of freshwater fishes.

Quinaldine that is commercially available today is an oily liquid with a strong, disagreeable odor, and contains 5 percent of various impurities including aniline and other quinolines. It is not readily soluble in water, and therefore must be dissolved in a vehicle such as acetone or alcohol before effective water solutions can be made. To overcome these undesirable properties, we prepared a solid formulation, quinaldine sulfate, for use in our laboratory and field testing programs. Quinaldine sulfate, an acid salt, is water soluble, has no disagreeable odor, and assays to be 99.4 percent pure.

MATERIALS AND METHODS

Quinaldine sulfate (2-methylquinoline sulfate) was described by Stecher and Szafranski (1960), but a supplier could not be located by consulting standard chemical catalogs. Therefore, the material used was prepared in our laboratory from 95-percent quinaldine purchased from Eastman Kodak Company.

Quinaldine was reacted with concentrated sulfuric acid to produce the acid salt. The salt was further refined by recrystallization from hot methanol, and oven-dried.

The striped bass used in this investigation were furnished and tested at the National Fish Hatchery, Edenton, N. C. All fish had been held in concrete tanks containing fresh flowing pond water at least 48 hours before testing. This water, which was used to prepare test solutions, had a temperature of 4° C., a pH of 7.2, and a total hardness of 185 p.p.m. as $CaCO_3$.

Efficacy

Test solutions containing 10, 25, 40 and 55 p.p.m. of quinaldine were prepared by dissolving quinaldine sulfate crystals in measured quantities of water. Since the molecular weight of quinaldine sulfate is approximately 1.7 times that of quinaldine, an appropriate adjustment in weight was made in preparing test solutions.

Ten 6- to 9-inch fish were placed in 15 liters of test solution, and observed at 1-, 2-, 3-, 5-, and 10-minute intervals. After a 10-minute exposure, all fish were placed in fresh water to recover. Criteria for judging efficacy of the chemical were those described by Schoettger and Julin (1969).

Residues

Fish were anesthetized for 10 minutes in solutions containing 40 p.p.m. of quinaldine, and then placed in fresh water to recover. Enough fish then were collected at intervals of 0, 1, 3, 6, and 24 hours after treatment to give a minimum of three 50-gram samples of muscle tissue for analysis. The fish were placed in plastic bags, frozen, and returned to the Warm Springs, Ga. laboratory for residue analysis. Residue analyses for quinaldine were performed according to the gas chromatographic method developed by Allen and Sills (1970).

RESULTS AND DISCUSSION

Efficacy

Solutions of quinaldine sulfate were judged to be efficacious when loss of equilibrium, stage II, occurred in 2 to 5 minutes. Fish in this condition show the following characteristics: locomotion ceases, although fin movement may continue; opercular rate is slowed; tactile response is elicited only by pressure on caudal fin or peduncle. At 25 p.p.m. of quinaldine, this occurred within 3 to 5 minutes, and at 40 and 55 p.p.m. all fish were anesthetized in 2 to 3 minutes (table 1). Fish showed only partial loss of equilibrium within 10 minutes in the 10 p.p.m. test solution.

Schoettger and Julin (1969) anesthetized channel catfish *(Ictalurus punctatus)*, bluegills *(Lepomis macrochirus)*, and largemouth bass *(Micropterus salmoides)* at temperatures ranging from 7° to 27°, and showed that recovery from anesthesia occurred more quickly at the higher temperatures. Recovery times of the fish we treated at 4° ranged from 20 to 50 minutes which were similar to the recovery times they reported at 7°. Apparently metabolic deactivation of the drug and/or excretion occurs more slowly as the temperature is reduced.

There was no loss of fish from exposure to quinaldine sulfate for 10 minutes at the concentrations tested.

Residues

The mean residue of quinaldine in striped bass muscle tissue after exposure to 40 p.p.m. of quinaldine for 10 minutes at 4° was 2.13 p.p.m. (table 2). This is somewhat low compared to residues in channel catfish, bluegill, and largemouth bass anesthetized at higher temperatures. Unpublished data from the

TABLE 1

EFFICACY OF QUINALDINE SULFATE AS AN ANESTHETIC FOR 6- TO 9-INCH STRIPED BASS AT 4° C.

Concentration (p.p.m. quinaldine)	Number of fish	Time to reach loss of equilibrium, stage II (min.)	Time for recovery (min.)
10	10	--[1]	20
25	10	3-5	21
40	10	2-3	30
55	10	2-3	50

[1]No fish reached loss of equilibrium, stage II, at this concentration, but partial loss of equilibrium was evident.

TABLE 2

RESIDUES OF QUINALDINE IN MUSCLE TISSUE OF 6- TO 9-INCH STRIPED BASS ANESTHETIZED WITH QUINALDINE SULFATE[1] AT 4° C.

Withdrawal times	Number samples	Residues (p.p.m.) Mean	Range
0 hour	3	2.13	1.44-2.60
1 hour	3	0.98	0.83-1.10
3 hours	3	0.57	0.53-0.59
6 hours	3	0.43	0.38-0.52
24 hours	3	0[2]	0
control fish	3	0	0

[1]Anesthetized for 10 minutes with 68 p.p.m. of quinaldine sulfate which is equivalent to 40 p.p.m. of quinaldine.
[2]Residue levels below 0.01 p.p.m. are reported as 0.

Southeastern Fish Control Laboratory at Warm Springs, Georgia, show residues of 5 to 6 p.p.m. of quinaldine in bluegill and largemouth bass muscle after exposure to 20 p.p.m. at 17° for 10 minutes. Residues in channel catfish muscle tissue are approximately 9 p.p.m. after exposure to 70 p.p.m. of quinaldine under the same conditions.

The residue level in striped bass after 1 hour decreased slightly more than 50 percent, whereas in the bluegill and largemouth bass tests they decreased approximately 95 percent. Schoettger, *et al.* (1967) showed that residues varied with temperature, and that MS-222 was excreted slower at 7° than at higher temperatures. Residues in striped bass 24 hours after treatment were below the detectable limit of 0.01 p.p.m.

CONCLUSIONS

1. Quinaldine sulfate will effectively anesthetize striped bass at quinaldine concentrations of 25 to 55 p.p.m. at 4° C.

2. Quinaldine residue in striped bass is essentially gone 24 hours after exposure to 40 p.p.m. of quinaldine for 10 minutes.
3. No mortalities of striped bass occurred when exposed to solutions of quinaldine sulfate containing up to 55 p.p.m. of quinaldine for 10 minutes at 4° C.

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