Original: For publication in Prog. Fish-Cult.
cc: Fish Division
Educ-Game
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September 23, 1956

Report No. 1482

Possible Value of Continuous Feeding of Medicated Dry Diets to Prevent and Control Pathogens in Hatchery-Reared Trout

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In Michigan, and in general wherever trout are reared under hatchery conditions, a disease of bacterial origin, Aeromonas salmonicida, (commonly known as furunculosis) has caused serious epidemics. McCraw (1952) stated that no fish disease is to be feared more by the hatchery man than furunculosis. McCraw's review presents information gathered from various literature sources. The disease appears to act more severely on certain species of trout than on others. In Michigan, brown trout, Salmo trutta, are more susceptible than others, and brook trout, Salvelinus fontinalis, are next. Various investigators have determined that many other species of fish contract furunculosis, but epidemic status is reached less frequently than in brown or brook trout. A method of treatment often used is to feed a mixture of sulfaguanadine and sulfamerazine with the daily food ration.

In hatcheries where furunculosis frequently reoccurs, it is often necessary to feed successively higher levels of sulfa drugs for adequate treatment or control. Because of this it might be safe to assume that the particular strain of pathogen becomes somewhat resistant to the drug and that if the progressive increase in the level of drugs administered continues, the host could be adversely affected before the drug acts on the pathogen. It seems as though medicaments of mild chemical and physiological nature, adapted to continuous feeding, could offer a means for controlling this

disease indirectly; that is, by reducing the numbers of organisms of low pathogenicity in the intestinal tract. In other words, "cleaning up" the intestinal tract may be all the chemotherapy needed to prevent a serious outbreak of furunculosis.

In order to test this hypothesis, it was necessary first to select a drug or group of drugs that could be applied to continuous feeding without adversely affecting the animal in general.

In investigations conducted with warm-blooded animals it has been found that a group of antibiotics can be fed continuously and effectively, and that benefit is derived from this practice. Antibiotics have been found to: (1) be different in structure and biochemical activity, (2) have considerable variance in spectra, (3) be compatible to other diet ingredients when mixed together, and (4) be essentially non-toxic even in excess quantities. Besides suppression of organisms causing subclinical diseases, antibiotics work to suppress intestinal organisms which compete with an animal for vitamins in the food it eats (Jukes, 1955), and thin the walls of the intestine permitting better absorption of vitamins and nutrients in the body.[1] This group of drugs appeared to provide the

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[1] Gordon, H. H., 1952: A morphological and biochemical approach. In a colloquium: Studies on the growth effect of antibiotics in germ-free animals. June 4, 1952, Lobund Institute, University of Notre Dame, South Bend, Ind.

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physical and chemical qualifications necessary to test the hypothesis previously described.

Recently a new type of trout food was adopted by the State of Michigan. It consists of animal and vegetable meals pelleted in various sizes. Food

in this form offers several advantages for the introduction of medicaments to trout. Medicated diets in pellet form can be stored for several months at each hatchery, thus insuring an adequate supply at all times. Daily mixing of drugs with other diet ingredients can be eliminated. Drugs can be mixed more uniformly in dry meal diets, and this gives better control of amounts fed.

In 1953, a broad-spectrum antibiotic, aureomycin, was mixed with dry meals and pelleted. An animal-feed supplement containing 10 grams of Chlortetracycline-Aureomycin (Trade mark of the American Cyanamid Co. for the antibiotic chlortetracycline) per pound was used at a one-percent level, furnishing 200 grams aureomycin activity per ton of finished feed. (This level was found to be compatible in poultry feeds.) The diet was fed for a six-month period to rainbow and brook trout fingerlings to determine the gross effect of aureomycin as a trout-food additive. All trout reacted favorably and it was not possible to attribute any advantage or disadvantage to the presence of the drug in the diet.

Previous experiments at other stations also failed to show any beneficial effects from feeding antibiotics to trout. Schumacher (1955) demonstrated (by Chi-square) no statistically significant differences in the effect of aureomycin on the growth rate of brown trout fingerlings. Phillips et al. (1952) concluded from experiments with brown trout that aureomycin, terramycin, penicillin and bacitracin had no beneficial effects in respect to growth, conversion or mortality. In one test Phillips found that aureomycin depressed the growth rate of rainbow trout. Wagner (1954) demonstrated that rainbow trout lost weight during the first two weeks of feeding penicillin or aureomycin.

In disease-prevention studies Snieszko (1952) demonstrated that aureomycin was ineffectual when used to treat brook trout artificially injected with Aeromonas salmonicida. In vitro, aureomycin did inhibit the growth of this pathogen, but the effect was not so pronounced as that of chloramphenicol or terramycin.

To determine whether furunculosis could be controlled by continuous feeding of mild medicaments, it was necessary to wait for the disease to appear as a natural infection (rather than through mechanical injection of the pathogen), so that the condition would be more representative of that occurring during normal hatchery operation. It is suspected that Aeromonas salmonicida is constantly present in hatchery water supplies where repeated outbreaks of furunculosis occur, although it is possible to rear trout in such waters. Thus, the fish either are more resistant physiologically at one time than at another, or the pathogen is not able to exert its full destructive force at all times because of variations in environmental conditions or particularly variations in intercurrent subclinical infections. Therefore, it might be expected that injecting fish with pathogens to produce an artificial epidemic would produce results less valid than those from fish contracting furunculosis from endemic contamination.

Since it was already demonstrated that normal rainbow and brook trout were not appreciably affected by continuous feeding of aureomycin at a certain level, a diet containing this drug was kept in stock ready for instant use in the event furunculosis appeared in any group of trout.

An opportunity to test the disease-prevention properties of aureomycin was presented on September 3, 1955, at the Wolf Lake, Michigan, Hatchery. Furunculosis was detected in a group of two-year-old brook trout. These trout had been reared in concrete tanks since hatching and had been

sustained on an all-dry-meal diet. Immediately upon detection of the disease, all trout were counted. One-half, 106 in number, were left in the original tank and one-half were placed in an adjacent tank. A pelleted diet containing 200 grams of aureomycin per ton of feed was used for the medication. The group of 106 in the original tank were fed the medicated diet in amounts equal to 1.7 percent of body weight per day and the other group continued to receive the pelleted diet fed before the disease was noted, at the rate of 1.7 percent of body weight per day. The experiment was in effect two hours after the disease was detected.

During the course of the experiment, September 1955 to March 1956, both lots of fish were artificially spawned and the fertilized eggs incubated in water at 42° F. At the time of spawning the medicated group had been fed aureomycin continuously for two months.

There was a wide difference in the number of fish surviving in the two groups (Table 1). On November 18, 1955, 83 percent of the brook trout on the medicated diet survived, whereas only 58 percent of the fish on the non-medicated diet were still alive. On February 29, 1956, these percentages were 57 and 21, respectively. Thus it appears that aureomycin contributed to the well-being of the fish afflicted with furunculosis. Since the only known variable in the diet was the aureomycin, there is a good chance that the medicated diet abetted recovery of those fish already afflicted and/or served as a preventive measure in those fish not yet under the influence of rapid multiplication of bacteria. Since fish in both groups were spawned, some mortality must be attributed to rough handling during this operation. However, the two groups were handled in a similar manner; therefore, it is unlikely that the observed difference in mortality was due to spawning operations alone.

Table 1.—Percentage survival of brook trout infected with furunculosis, after feeding on a diet medicated with aureomycin, and on a non-medicated diet.

Date	Medicated diet		Non-medicated diet	
	Number surviving	Percentage	Number surviving	Percentage
Before spawning				
1955				
Sept. 3	106	100	106	100
Sept. 30	101	95	101	95
Oct. 31	93	88	96	91
Nov. 18	88	83	62	58
After spawning				
1955				
Nov. 30	87	82	48	45
Dec. 31	78	74	30	28
1956				
Jan. 31	67	63	26	25
Feb. 29	60	57	22	21

Fifty-eight percent of the eggs produced by fish on the medicated diet hatched, whereas the hatching percentage was 23 for eggs from fish on the regular diet. These data indicate that egg production and fertilization are possible in fish suffering from furunculosis, and that continuous medication by feeding aureomycin for two months before spawning did not adversely affect fertilization and hatchability.

Since the data presented are based on only one experiment and two groups of animals, the work must be considered as preliminary. Therefore, feeding trials, using some of the other antibiotics for continuous medication, should be conducted before setting down recommendations.

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