Chemotherapeutic Use in the Ontario Trout Industry

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INTRODUCTION

Fish farmers and fisheries scientists are facing a rapidly dwindling selection of drug-based disease control options. Regulatory agencies are becoming increasingly restrictive towards the use of non-registered products in aquaculture (Schnick, 1991). At present, only a few therapeutants are approved and available in North America (oxytetracycline, Romet and formalin solution in the U.S.A and oxytetracycline and Romet in Canada), and little activity is underway to register new products. As compared to terrestrial species, registration procedures for drugs to be used in aquaculture are further complicated by the need to thoroughly assess potential environmental impact.

In addition to facing these regulatory difficulties, fish farmers need to respond to the growing concern among consumers over both the safety of their food and the potential negative impact of farming practices on the environment. In Canada, federal and provincial agencies, as well as private industry, are working to establish programs for quality assessment and regular monitoring of farm-raised fish products.

Certain base-line data are needed in order to expedite registration-oriented research on chemical compounds useful in aquaculture and to design good monitoring programs. In particular, it is desirable to obtain information from practising fish farmers on which drugs they use, and on the frequency of, and reasons for, drug use. For this reason, we conducted a personal interview survey 1990/91 to determine why and how trout farmers in Ontario, Canada were using chemotherapeutants. The primary objectives of this survey were to ascertain:

1. Which chemotherapeutics are being used;

2. The reasons why, and the fish in which, chemotherapeutics are used;

3. The frequency of chemotherapeutic usage;

4. What constitutes a treatment regime.

QUESTIONNAIRE

A questionnaire was designed to collect data on disease observations and chemotherapeutant use on selected trout farms during the twelve months preceding the interview. Data collected included the sizes and percentages of fish treated, the number of treatment regimes administered, the chemotherapeutants used, the purpose of treatments and the methods of treatment administration. Three interviewers personally administered the final questionnaires, between September, 1990 and February, 1991. Of the seventy largest trout farms in Ontario, the owners or managers of 66 were asked to participate in the survey, and four were excluded because of distance. Sixty-two (94%) of these 66 farmers participated in the survey. The survey group produced approximately 9.9 million trout fry and 5.2 million fish of greater than 15 cm fork length in 1990. Their total production of fish larger than 15 cm fish was 2,250 tonnes of rainbow trout and 13 tonnes of speckled trout, accounting for 91% of the total 1990 production in Ontario (Moccia and Bevan, 1991).

A treatment regime was defined as one or more applications of a certain therapeutant (or drug combination) instituted for a specific purpose, and having a definite termination, in a given size range of fish. Each farmer reported how many distinct treatment regimes he/she had initiated in at least some of the fish within a given size range during the previous year, the chemotherapeutant used and the reason for each treatment initiation. Preventive treatments were defined as those given in the absence of clinical signs. Treatment failures were subjectively identified as such by farmers. Farmers specified their own size ranges; these data were later grouped into broodstock and into three size categories of production fish: 2 to 10 cm total length, 11 to 20 cm and greater than 20 cm.

MEASUREMENT OF TREATMENT FREQUENCY

Almost all drug treatments used in aquaculture are administered at the tank level. As such, epidemiologic methodology for estimating treatment rates as a type of incidence rate are not applicable (Thorburn, 1991). Instead, we used the following approach to estimate the frequency with which an "average" fish in a specific size range had been treated (FREQ). For each farm, and within each size category, the proportion of fish which were treated at least once during the year was multiplied by the average number of treatment regimes administered to those treated. For instance, if 40% of the fish between 2 and 10 cm were treated once, 30% treated three times and 30% not treated:

$$FREQ = (.40)(1)+(.30)(3)+(.30)(0) = 1.30.$$

WHICH DRUGS ARE USED?

The following chemotherapeutants were reported to have been used:

1. Chloramine-T (sodium para-toluene-sulphonchloramide) was used by 41 (66%) farms.

2. Formalin was used by 34 (55%) farms (1 of which used it on eggs only).

3. Salt was used by 14 (23%) farms.

4. Malachite green was used by 12 (18%) farms (7 of which used it on eggs only).

5. Oxytetracycline, Roccal, potassium permanganate, copper sulphate, furanace and di-n-butyl tin oxide were used by at most two farms each.

For the three most commonly used chemicals, chloramine T, formalin and malachite green, more than half of the total amounts used by the study group were used by 8, 3 and 1 farms, respectively.

WHY ARE DRUGS USED?

Formalin was used to treat or prevent a variety of diseases, while chloramine-T was used primarily to control gill diseases, and malachite green was mostly used as a fungicide. Salt was most frequently used as a prophylactic.

A total of 408 treatment initiations were reported by the 62 farmers. Of these, 271 (66%) were initiated for preventive purposes. Of 137 therapeutic regimes, 90 (66%) were initiated to treat suspected or confirmed disease in groups of fish which had not been previously treated for the same disease and 47 (34%) to treat fish in which initial treatment regimes had failed to give a satisfactory response.

WHAT IS THE FREQUENCY OF DRUG USE?

The overall frequency of drug usage varied considerably among farms. Three farms (5%) used no chemotherapeutants at all and three (5%) used only salt. An "average" fish on half of the 56 remaining farms underwent 2.3 or fewer treatment regimes with any drug other than salt, and 2.3 or more on the other farms. The farm with the highest treatment frequency treated an average fish approximately 26 times.

Most farms treated at least some 2 to 10 cm fish, while more than half of the farms did not treat fish larger than 20 cm. On the other hand, large fish were treated more frequently (FREQ>4) by a higher percentage of farms than were small fish. This finding was due to the use of routine prophylactic treatments in large fish by some farms. While very few farms had to treat larger fish for therapeutic purposes, the percentage of farms which treated fish for preventive purposes was fairly constant over the different size categories.

WHAT CONSTITUTES A TREATMENT REGIME?

More than half of the described preventive treatment regimes consisted of only one application of chemicals per regime, with an average of 2.1 and a maximum of 10 consecutive applications. The median, average and maximum number of consecutive applications for therapeutic regimes were 2.0, 2.8, and 14, respectively. When examined by chemotherapeutant, the median number of applications per regime was: for chloramine T, 2.0; for formalin, 2.0; and for malachite green, 1.0.

CONCLUSIONS

Although there are no published studies similar to ours for other trout producing regions in North America, we believe that the overall usage of chemotherapeutants by the Ontario trout industry is quite low. However, a great deal of variability in the frequency of drug use was found among farms. This variability could largely be explained, at least superficially, by the disproportionate, and frequent, use of prophylactic treatments by some farmers. Most Ontario farmers do not, however, rely on preventive treatments. Further investigation is needed to determine why certain farmers routinely use preventive treatments, so that, if possible, changes can be implemented to reduce the frequency of prophylactic and possibly unnecessary treatments.

The relatively high frequency of treatment failure reported in this study raises some concern, and deserves investigation. One of the reasons for these treatment failures may be sub-optimal delivery of drugs. We found a very large variability in the ways in which farmers actually administered drugs. This variability could be useful for evaluating treatment-related factors contributing to therapeutic efficacy in the field. Because of the uniqueness of each land-based farm (in terms of water quality and chemistry, physical aspects of the holding units and water delivery, etc.), it has been difficult for farmers to adapt the few published treatment regime recommendations for formalin (reviewed by Schnick, 1973) and chloramine-T (Bullock et al., 1991; From, 1980) to their own situations. Even the optimal number of treatment administrations for a given regime is not known. For instance, while we routinely recommend 3 consecutive days of treatment with chloramine-T for treatment of BGD, Bullock et al. (1991) reported a good success rate with a single treatment. In the present study, the number of consecutive administrations of chloramine-T in a given treatment regime ranged from 1 to 5.

To monitor drug usage in the aquaculture industry by implementing a surveillance system of drug residue testing in market fish is not, at present, a viable alternative. Accurate and economically feasible procedures for slaughter-side testing are not currently available. Furthermore, the actual absorption, distribution and elimination of drugs by fish is highly variable, and is influenced by external factors such as feed composition and water pH, hardness and temperature and by several host-specific factors (as reviewed by Rasmussen, 1988). Thus, while data collected in a residue monitoring program, even if it were possible to obtain, might provide some assurances to consumers that they were purchasing residue-free fish, they would provide little information to aquaculturists which could be constructively used to modify farm health management programs.

Monitoring drug use in North American aquaculture by surveying the suppliers of therapeutants is not likely to yield particularly valid or useful information, either. At present, fish farmers purchase drugs from a variety of sources, including feed companies, veterinarians, pharmaceutical companies and various retail suppliers. Extra-label drug use and the use of chemicals, such as chloramine-T, which have never been registered for use as drugs in any species, is quite common (Mitchell, 1989).

I would suggest that, at present, the most reasonable approach to the surveillance of drug use in aquaculture is to proactively involve fish farmers in data collection. The validity of such an approach will depend to a large extent on farmers' abilities and willingness to keep records and on researchers' abilities to pose the right questions. A survey such as the present one provides important preliminary information. However, to obtain data which will enable researchers to closely examine determinants of treatment frequency and efficacy, and to estimate the environmental and food safety impacts of present chemical use, a routine and ongoing epidemiologic approach will be required.

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Table I. Usage categories of the 3 chemicals most commonly administered for disease control on Ontario trout farms.

Chemical	General Purpose	Disease Class[a,b]	Number of farms[c]
Formalin	Preventive[d]	Gill disease	7
		General or combination	5
		Fungus:	
		Live fish	2
		Eggs	10
	Therapeutic	Gill disease	21
		Ectoparasites	7
		Columnaris	2
		Other	2
		Fungus:	
		Live fish	2
		Eggs	2
Chloramine T	Preventive[d]	Gill disease	13
		General or combination	4
	Therapeutic	Gill disease	37
		Unknown	2
Malachite Green	Preventive[d]	Fungus:	
		Live fish	1
		Eggs	8
		General or combination	1
	Therapy	Fungus:	
		Live fish	3
		Eggs	2
		Ectoparasites	2

a) The number of farms in each disease class was calculated according to the information provided by the farmers. There is probably some error in these classifications since, in most cases, the disease being treated was predicted (preventive treatments) or diagnosed (therapeutic treatments) by the farmer.
b) Except for the treatment of fungus in eggs, all disease classes listed refer to treatment of live fish.
c) Several farms used the same chemical for more than one purpose.
d) The reasons behind using chemicals for prevention varied. Some farmers only used chemicals prophylactically when there was a high probability of disease occurrence, eg. following transport, during significant rises in water temperature, etc. Others used them on a fairly routine basis.

Table II. Distribution of chemotherapeutant use in specific sizes of fish during one year on 62 Ontario farms, given as percentage of farms in each frequency category

	Fish size		
Frequency of treatment (FREQ)	2-10 cm	11-20 cm	21 cm-market
No drugs used	7%	49%	58%
Only salt used	8%	3%	6%
Drugs other than salt used FREQ $\leq$ 1	43%	21%	15%
FREQ = 1.1 to 4	38%	15%	8%
FREQ > 4	3%	12%	13%

FREQ = The proportion of fish in the given size category which were treated at least once, multiplied by the average number of treatment regimes administered to those treated.