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Review of prescription and administration procedures of drugs and pesticides in Canada

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Canada

Foreword

This series documents the scientific basis for the evaluation of aquatic resources and ecosystems in Canada. As such, it addresses the issues of the day in the time frames required and the documents it contains are not intended as definitive statements on the subjects addressed but rather as progress reports on ongoing investigations.

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TABLE OF CONTENTS

ABSTRACT

The purpose of this CSAS document is to review the standard practices to prescribe and administer in feed and bath treatments within finfish aquaculture activities. This document will provide peer-reviewed science advice to DFO's Aquaculture Management Directorate. For this paper, we provide background information related to the in-feed antibiotic and anti-sea lice drugs used in marine finfish farming, along with the standard method to prescribe and administer in feed treatments. The same approach is used to describe the application of approved pesticides in Canadian marine finfish operations to treat sea lice infestations. Nine actively engaged veterinarians, each having more than five years of experience, were also interviewed to assess the frequency of which specific modifiers might occur during in feed or bath treatments and affect optimal delivery of each.

INTRODUCTION

Drugs and pesticides are administered to net pen aquaculture operations throughout Canada to control pests and pathogens in the fish farming sector. These products receive various levels of approval prior to administration. The application of drugs and pesticides are reasonably consistent across Canada based on generally accepted professional veterinary and industry standards.

The overall purpose of this specific report was to review aspects of pesticide and drug administration at marine aquaculture sites in Canada. This information will support Fisheries and Oceans Canada (DFO) to develop an appropriate post-deposit monitoring program for the fish farming sector in Canada.

Specific questions addressed within this review as they apply to the project purpose include:

1. How are approved drugs and pesticides prescribed and administered at marine aquaculture sites in Canada?
2. What standard operating procedures are in place for bath pesticide usage, including both tarp and well boat treatments?
3. What standard operating procedures are applied for administration of in feed antibiotics and sea lice drugs throughout the duration of treatments?
4. What relevant environmental and infestation conditions guide modifications to standard operating or administration procedures on sites?

METHODS

This report compiles information available online from the various federal regulatory authorities of Health Canada, interviews with provincial fish health-focused veterinarians, and industry veterinarians who are overseeing the determination for, and prescribing treatment solutions followed by, application procedures.

This review is divided into two primary parts focused solely on either in feed treatments (antibiotics and anti-sea lice) or bath pesticides (anti sea lice). This approach was chosen given the discrete nature related to the use of in feed and bath treatments in ocean net pen aquaculture practices. Each major section begins by discussing the in feed and bath treatments that are used to treat marine aquaculture fish in Canada. Next, the report describes the general procedure to acquire and administer in feed and bath treatments. Nine practicing industry veterinarians, each having more than five years of field experience, were interviewed to determine the frequency of modifications to the standard treatment practices and what relevant environmental and infestation conditions guide modifications to standard operating or administration procedures on sites. Finally, each section concludes with discussion related to in feed or bath treatment product release into the environment.

IN FEED ANTIBIOTICS/SEA LICE PRODUCTS IN USE WITHIN CANADA MARINE FISH FARMS

Drugs approved for specified species at an approved dosage and for an approved treatment period follow the specific label prescription. Off-label use of a specified drug may occur based on alterations to the label prescription criteria as follows:

- Approved drug for specified species at an approved dosage for an **extended treatment period**;
- Approved drug for specified species at a **greater than approved dosage** for an approved treatment period;
- Approved drug for specified species at a **greater than approved dosage** for an **extended treatment period**; or,
- Approved drug but **not for specified species**.

Note that all off-label scenarios must still meet antibiotic tissue minimum residue levels prior to harvest and this is completed by extending the withdrawal period post-medication. It is also worthwhile to note here that non-approved drugs may be prescribed for use with the target fish species with a planned dosage and treatment period following agreement by the Veterinary Drugs Directorate and under an approved Emergency Drug Release (EDR).

There are presently 22 in feed medication products used in marine fish farm operations in Canada to treat a host of microbial infections and sea lice infestations (Table 1). Sixteen of these products are prescribed based on a Drug Identification Number (DIN) for use in Canada with the remaining six products prescribed on an EDR basis as deemed necessary by the attending veterinarian overseeing the specific case.

Table 1. List of 22 in feed medication products to treat fish at marine sites in Canada for microbial infections and sea lice infestations.

Product	DIN	Active Ingredient
Oxysol 220	02223902	Oxytetracycline (22%)
TM-100	02246807	Oxytetracycline (22%)
Oxytetracycline 100	00654787	Oxytetracycline (22%)
Terramycin 100 MR	No DIN	Oxytetracycline (22%)
TM100D	No DIN	Oxytetracycline (22%)
Oxysol 440	00685224	Oxytetracycline (44%)
Oxytetracycline 200	00719315	Oxytetracycline (44%)
TM-200	02246808	Oxytetracycline (44%)
TM-Aqua	00607657	Oxytetracycline (44%)
Oxy 1000	00786039	Oxytetracycline HCL 100%
OTC 91	No DIN	Oxytetracycline HCL 91%
Romet	02242954	Ormetoprim (5%) + Sulfadimethoxine (25%)

Product	DIN	Active Ingredient
Tribrissen 40	02146037	Trimethoprin (6.67%) + Sulfadiazine (33%)
Aquaflor	02231742	Florfenicol (50%)
Slice	02328216	Emamectin Benzoate (0.2%)
Calicide	02245684	Teflubenzuron (100%)
Ivomec (0.6% premix)	01913085	Ivermectin (0.6%)
Erythromycin	No DIN	Erythromycin
Erythromycin Thiocyanate	No DIN	Erythromycin Thiocyanate (70%)
Gallimycin-50	02185385	Erythromycin Thiocyanate (11%)
Amoxicillin	No DIN	Amoxicillin
Penn-P-110	00648191	Procaine Penicillin G

IN FEED MEDICATION SEQUENCE OF EVENTS AND INVOLVED INDIVIDUALS

The Eastern Aquaculture Veterinary Association provided broad guidelines for issuance of prescriptions to treat fish in June 2000 (Appendix A) and the Canadian Veterinary Medical Association offers a framework for non-binding professional standards related to the use of antimicrobials. These guidelines generally outline minimal details required by the attending veterinarian prior to issuing a treatment prescription. Greater detail associated with on-farm level communications and activities to diagnose fish health issues, acquire prescriptions and apply the treatment follows here.

Information gained from the marine site activities guide the use of antibiotics to treat fish dealing with a microbial infection or sea lice infestation. On an ongoing basis, the industry attending veterinarian monitors the site fish behaviour, feeding behaviour, reviews site records and consults with the site manager to assess whether fish health concerns are present. This ongoing dialogue is augmented by regular monthly site visits by the attending veterinarian or designated team member to collect fresh mortalities or moribund fish, which are collected by site divers, for necropsies. The site manager retains the ability for open communication with the attending veterinarian in the interim period between regular site visits to report changes in observations that might reflect a fish health concern such as:

- reduction in feed consumption,
- change in fish behaviour,
- presence of sores/erosions and dermal haemorrhaging observed on mortalities removed daily from a net pen,
- acute plankton blooms, and

- presence/counts of ectoparasites as determined by trained sea lice counters.

Tissue samples may be collected at any time following necropsies of suspect fish and submitted to either a government or corporate laboratory for further analysis and bacterial plating, including drug sensitivity analysis as required. This detail will greatly influence the veterinary choice as to the specific antibiotic based on sensitivity laboratory results. In the case of sea lice, information related to the sea lice life stages present will help to determine the treatment option taken. Other decision factors may include specifics as to the Bay Management Area objectives to cycle the use of specific treatment options, water temperature affecting metabolic rate and digestive activity level, and site dissolved oxygen levels typical for the time of year.

The attending veterinarian will write the prescription when required taking into account all of the information collected related to the specific case. The prescription details are based on the biomass of fish within the treated growing unit (i.e., net pen), present feed rates (%bw/kg/day) and water temperature. Four scenarios will typically result as noted above based on the approval status of the drug and label direction versus veterinarian experience:

- approved drug at approved dosage for approved treatment period (on label),
- approved drug at approved dosage for an extended treatment period especially if the feed rate is lower than desired (off label),
- approved drug at greater than approved dosage for approved treatment period especially if the site is experiencing a mortality spike and the objective is to rapidly achieve the loading dose to flatten this mortality level (off label), or
- non-approved drug at a dosage rate agreed by the Veterinary Drugs Directorate of Health Canada under an approved EDR submission.

The written prescription is submitted to a Canadian Food Inspection Agency certified feed mill for production of the medicated feed. The chosen feed mill top-coats the prescribed medication at the correct dosage on feed pellets in small batches (typically 250-500 kg lots). After sufficient mixing, fish oil is sprayed onto the top-coated pellets, mixed again, then a vacuum is generated to sufficiently draw the medication into the pellet matrix to minimize antibiotic leaching from the pellet surface into the seawater when fed. The medicated feed is bagged, clearly labeled as medicated feed, palletized and shipped to the site.

The site manager receives the medicated feed, which is isolated from any other feed onsite, then either loads the medicated feed into the designated vessel/cage feed blowers or automated feed barge silo(s). The site manager accepts responsibility to dispense the medicated feed according to the veterinary prescription instructions including:

- number of medicated feed meals per day (typically 1 meal per day),
- rate of feeding,
- number of consecutive days for medicated feeding,
- ensure that precautionary measures are followed when handling medicated feeds,
- monitor fish for any changes in feeding patterns, indicators of stress, etc. during the medicated feed treatment period using direct observation and net pen underwater cameras,
- monitor each medicated feeding occurrence, utilizing net pen underwater cameras/pellet counters to minimize any feed loss through over feeding or exceeding fish feeding rates, especially if affected fish appetite is declining, and

- monitor for any changes to environmental parameters, such as algae blooms, reduced dissolved oxygen levels, storm occurrence, etc. during the treatment period. This is important as environmental conditions that interrupt feeding of medicated feeds (especially in the first 3-4 days) will delay time to achieve the loading dose in the target fish, depending on the pharmacokinetics of the drug being fed, and therefore efficacy of the treatment. In such cases, the attending veterinarian may choose to delay the onset of the treatment period if a more suitable weather window is anticipated in the forecast to ensure the loading dose is achieved as desired through uninterrupted feeding.

MODIFICATIONS TO ADMINISTER IN FEED MEDICATION

Nine practicing veterinarians, each having more than five years of field experience, were interviewed to determine the frequency in which specific scenarios might be encountered and resulting in potential sub-optimal treatments and possible efficacy within feed prescriptions. Results from these interviews are summarized in Table 2. One important deliberate modification alluded to earlier is that the attending veterinarian has the capacity to prescribe drugs for off label use in Canada, which is an important distinction to the use of pesticides for bath treatments whereby off label use is forbidden. Requests were made to the Canadian Food Inspection Agency to acquire data that might indicate the quantity and frequency of label versus off label use. Such data were not made available for inclusion within this report.

Table 2. Frequency that a potential modifier might be encountered that could affect overall efficacy of the in feed drug treatment.

	Never Encountered	Rarely Encountered	Seldom Encountered
Environmental Characteristics			
Water temperature (affects digestibility/metabolism)	0	5	4
Wind speed affects waves (pellets pushed out of cage)	8	1	0
Abrupt tidal changes (spring tides)	9	0	0
Daylight length	9	0	0
Plankton blooms, upwelling (reduces DO)	0	1	8
Low ambient dissolved oxygen restricts feeding	0	2	7
Stressors (presence of predators, cleaning nets in situ)	1	1	7
Presence of hazardous plankton species	0	2	7
Net fouling (reducing water exchange through cages)	3	6	0
Mechanical Characteristics			
Availability of silo on feed barge for medicated feed	9	0	0
Accuracy of feed distribution and feed rate within cages	5	2	2
Net pockets of bulging of nets	9	0	0
Feed camera failures	9	0	0
Calculation Errors			
Number of fish	2	2	5
Size of fish	2	3	4
Feeding rate (%bw/kg) must be lower than actual feeding rate	7	2	0
Prescription writing	7	2	0
Amount of feed consumed by cleaner fish	9	0	0
Mixing error/vacuum issues at feed mill	7	2	0
Other Characteristics Leading to Reinfestation/Treatment Failure			
Connectivity between sites (hydrographic and equipment)	6	3	0
Not following Bay Management Treatment Plan	9	0	0
Delays related to prescription writing (vet site visit)	6	3	0
Delays related to laboratory analysis results	0	7	2
Delays related to feed mill production	0	6	3
Delays related to medicated feed delivery	0	5	4
Assessing the health of sea lice infesting fish (flukes, epiphytic growth)	0	7	2
Miscalculating sea lice life stages by site encounters	1	4	4
No pre-treatment drug sensitivity analysis/bio-assays	0	5	4
Treatment product resistance	0	4	5
Failure to employ product rotation	9	0	0
Failure to reach/maintain correct dosage level in fish tissue (loading dose)	0	3	6
Environmental conditions disrupt consecutive medicated feed days	0	1	8
Mx feed palatability issues (i.e., Romet)	0	4	5
Delays in drug delivery to feed mill post EDR approval	0	4	5
Certain drugs are immunosuppressive	8	1	0
Some drugs alter diversity of gut bacterium therefore negatively affect digestibility during treatment period	4	5	0
MRLs and withdrawal periods unknown for off-label drugs	0	0	9
Carriers for drug products affect digestibility	2	7	0
Affect of top coating drugs on hot/warm feed (denaturing a % of active ingredient if thermosensitive)	5	4	0
Are anti-maturing lights being used	4	0	5

IN FEED MEDICATION RELEASE TO THE ENVIRONMENT

Drugs administered through in feed medication may be released to the environment from uneaten feed or excretion from the treated fish. Published information associated with uneaten feed entering the environment during medication were not available. Overfeeding is generally counterproductive and never a production target at the farm level given the cost of feed involved in fish farming and managers tend to be even more cognizant of this concern while attempting to medicate fish displaying symptoms of poor health or high sea lice infestation. Regardless, estimates for some in feed medications are that up to 75% of the drug consumed by the medicated fish is excreted into the water even in the best scenarios of site feed management (Burridge et al. 2010; Romero et al. 2012). The primary routes for elimination from the medicated fish are generally compound class specific as outlined within Table 3. The fate and effects of in feed medications were addressed in other post deposit monitoring CSAS documents.

Table 3. Compound class of drugs prescribed for use in Canada to treat fish in marine sites and the primary routes of elimination to the environment.

Compound Class	Product Example	Main Elimination Routes
Tetracyclines	TM-200	Liver (fecal) > kidney > gills [1] ; poorly absorbed (70-80% in feces)
Sulfonimides	Tribrissen 40	Liver (fecal) > kidney > spleen > gills [2]
Amphenicol	Aquaflor	Bile > kidney > gill > liver [3]
Avermectin	Slice	Kidney > liver (fecal) [4]
Benzoylphenyl urea	Calicide	Kidney > liver (fecal) [5]
Macrolide	Gallimycin-50	Fecal (poorly digested) > kidney
Beta-lactum	Penn-P-110	Kidney > gill > liver (fecal)

[1] Doi et al. (1998); Zhang and Li (2007); Romero et al. (2012).

[2] Zheng (1993).

[3] Miranda and Rojas (2007); Feng and Xiao-Ping (2009); Pourmolaie et al. (2018).

[4] Whyte et al. (2011).

[5] Anonymous (2009); Burridge et al. (2010); Romero et al. (2012).

PESTICIDES IN CANADA MARINE FISH FARMS

There are presently three (3) bath treatment pesticides currently registered and used in marine fish farm operations in Canada to treat sea lice infestations (Table 4). These products were registered by the Health Canada's Pest Management Regulatory Agency (PMRA) under authority of the Pest Control Products Act. A unique registration number was granted to each product at the time of registration. In Canada, sea lice bath treatment pesticides are registered as restricted commercial products and may only be applied by individuals who are provincially

certified and trained in the application of the product and who hold a pesticide applicator certificate or license recognized by the provincial/territorial pesticide regulatory agency where the application occurs.

Table 4. Products registered in Canada as pesticides to treat fish at marine sites to control sea lice infestations.

Product	PMRA Reg. #	Active Ingredient	Safety Data Sheet
Salmosan 50 WP	32506	Azamethiphos	Link to Safety Data Sheet (PDF)
Interox Paramove 50	31393	Hydrogen Peroxide	Link to download Safety Data Sheet
Aquaparox 50	32401	Hydrogen Peroxide	See Appendix B

BATH PESTICIDE TREATMENT SEQUENCE OF EVENTS AND INVOLVED INDIVIDUALS

Use of anti-sea lice treatment options are informed by trends observed in weekly ectoparasite sea lice counts by certified counters as entered into the Atlantic Veterinary College (University of Prince Edward Island) sea lice repository and communicated to the industry attending veterinarian and Provincial authorities. The attending veterinarian visits the site monthly to inspect fresh mortalities and moribund fish, which also involves verification of weekly sea lice counts as reported by site staff. Provincial field staff may also visit the sites monthly in some jurisdictions to further verify the reported sea lice counts. Site visits may also result in collection of specific sea lice life stages to facilitate *in vitro* bioassays to monitor and determine sensitivity of the sea lice population to the various treatment options available to the veterinarian within the specific jurisdiction.

If an in-feed drug treatment is chosen to treat sea lice infestations, then the attending veterinarian will follow the same protocol to prescribe the treatment as described in the earlier in feed treatment section. In the case of a bath treatment pesticide, the attending industry veterinarian will write the prescription based on the reported sea lice counts and present life stages, bioassay sensitivity findings if any, and observations related to their knowledge of treatment success and failure at the farm or area in the past. Additional decision factors to choose a treatment pesticide may include the specific Bay Management Area objectives to rotate specific treatments, present environmental conditions related to seawater temperature, dissolved oxygen level, seasonality and seawater turbidity level, site location relative to other users in the area (e.g., to avoid lobster holding pounds), and other known fish health issues. The prescription details are based on the fish biomass to be treated, water quality parameters and water temperature. The method of application – tarped net pen or well boat – is determined through consultation between the attending veterinarian and operational staff, such as an area and/or site manager. The final prescription is submitted to the Provincial pesticide regulator and the site/corporate (Provincially) certified pesticide applicator, who is the only individual permitted to handle the pesticide during the treatment.

Fish to be treated with pesticides are taken off feed four to six days prior to the treatment. A pre-treatment sea lice count is completed no sooner than three days before or just prior to the treatment to monitor for efficacy in sea lice removal. Water clarity is an important consideration as a measure of organic loading present in the treatment seawater and determined by the site

manager or pesticide applicator on the day that treatment is planned using a Secchi disc. Likewise, ambient seawater dissolved oxygen, salinity and temperature are all measured and recorded prior to and during the treatment operation.

The following steps are taken to perform a pesticide treatment using a tarped net pen:

- Net pen volume is decreased by shallowing the net depth,
- Tarp is installed external to the entire net and secured to the circumference surface collar,
- Oxygen diffusers are placed inside the net at various points and an oxygen source is turned on (e.g., cylinders, oxygen generator, etc.),
- Dissolved oxygen monitoring begins, typically using hand-held instruments (e.g., YSI, ProOceanic, etc.),
- Pesticide is mixed into an appropriately sized tank (e.g., 1-3 m^3 tank) by a Provincially certified pesticide applicator according to the label instructions,
- Pesticide mixture is injected into the tarped net pen typically through a series of perforated hoses extending from a treatment barge across the diameter of the net pen,
- Treatment start time begins when the pesticide mixture has been completely discharged from the mix tank into the tarped area, and
- Treatment duration proceeds according to the PMRA label for the chosen pesticide. Note that the prescribed duration may not be achieved if dissolved oxygen levels drop below a critical threshold or if the treated fish behaviour indicates severe acute stress requiring the treatment to be ended early in order to protect the health of the fish.

For well boat treatments, the following typical steps are taken:

- Well boat ties alongside the net pen,
- Fish are cork seined adjacent to the well boat intake/discharge hoses,
- The wells are filled with ambient seawater and the internal dissolved oxygen diffusers and sub-well cameras are engaged,
- Fish are pumped into the wells through an automated biomass counter with the number of fish pumped into each well predetermined based on fish size and seawater temperature,
- Fish are allowed 10-20 minutes to acclimate to the new surroundings,
- Certified applicator either adds the pesticide into an appropriately sized mix tank (e.g., 1-3 m^3 tank) for delivery through a series of sub surface well injectors or immediately initiates the injector pumps for delivery of a set volume of liquid pesticide (e.g., hydrogen peroxide),
- Each well circulation pump is engaged,
- Start of treatment begins when the pesticide mixing container has been emptied or when the desired volume of liquid pesticide has been supplied (note that this is verified chemically for hydrogen peroxide by testing a sample of the treatment well water deckside),
- Determination of concentration occurs every 5 minutes for the duration of the treatment period in the case of hydrogen peroxide,
- Treatment duration continues according to the PMRA label for the chosen pesticide. Note that the duration may not be achieved if dissolved oxygen levels drop below a critical threshold or if well cameras indicate that fish behaviour is indicative of severe acute stress

(i.e., increased ventilation rate, rapid swimming behaviour, etc.) requiring the treatment to be ended early in order to protect the health of the fish,

- At treatment stop time, flushing the well occurs by engaging two well pumps simultaneously with one discharging the pesticide treatment water from the well while the other pump draws in ambient seawater from outside the vessel, and
- After flushing, the fish are then pumped back into the net pen over the cork seine.

A post-treatment sea lice count is carried out for all treatment methods three to seven days post-treatment depending on the treatment pesticide used. Feeding of treated fish typically resumes 24 hours post treatment.

MODIFICATIONS TO ADMINISTER BATH TREATMENTS

Nine practicing veterinarians, each having more than five years of field experience, were interviewed to determine the frequency in which possible scenarios might be encountered and result in potential sub-optimal treatments with bath applications. Results from these interviews are summarized in Table 5. It is important to note that no off label use of pesticides is allowed, unlike in feed drugs, so the directions for use of each product must be strictly followed without any deviations (see Table 4 for links to Safety Data Sheets for specific product labels and directions for use of each).

Table 5. Frequency that a potential modifier might be encountered that could affect overall efficacy of the bath treatments.

	Never Encountered	Rarely Encountered	Seldom Encountered
Environmental Characteristics			
Abrupt tide change (e.g., spring tides)	3	5	1
Low water temperatures based on label directions	8	1	0
High water temperature resulting in low dissolved oxygen levels	0	6	3
Wind affecting level of exposure	8	1	0
Low dissolved oxygen possibly from plankton or upwelling events	0	7	2
Hazardous plankton species present	9	0	0
Predator presence elevating stress	6	3	0
High organic load in water	0	4	5
Mechanical Parameters			
Older tarps stretch thereby increases volume	8	1	0
Billowing of tarps to create pockets	3	5	1
Pesticide mixing error	9	0	0
Uneven distribution of product throughout tarp	0	9	0
Well boat pumps fail during mixing	8	1	0
Well boat pumps fail during discharge	8	1	0
Probes not calibrated (e.g., DO, product dose)	7	2	0
Fish held in cork seine for too long causing stress and mechanical dislodging	1	5	3
Oxygen diffusor system efficiency compromised	0	4	5
Fish counter inaccuracy in well boats	9	0	0
Camera failures in wells monitoring behaviour	7	2	0
Maintaining narrow temperature range (i.e., lice cooker)	9	0	0
Maintaining narrow pressure range (i.e., lice cooker)	9	0	0
Calculation Errors			
Number of fish (including cleaner fish)	1	7	1
Size of fish (including cleaner fish)	0	8	1
Volume within tarp	0	7	2
Start-stop time start prior to even product distribution	8	1	0
Prescription writing	9	0	0
Determining concentration of product in well or tarp	0	4	5
Other Parameters Leading to Reinfestation			
Connectivity between sites (e.g., hydrographic or equipment)	4	1	4
Not following Bay Management Treatment Plan	9	0	0
Too long to complete a total farm treatment	2	6	1
Mechanical knock off in cork seine	6	3	0
Treatment product resistance	0	3	6
Failure to employ product rotation	9	0	0
Other Parameters Leading to Treatment Mortalities			
Failure to monitor carbon dioxide levels	8	1	0
Failure to monitor ammonia levels	8	1	0
Failure to monitor pH	8	1	0
Excessive or inexcessive days off feed prior to treatment	8	1	0
Failure to check gill health prior to treatment	2	7	0
Excessive net fouling to restrict water flow	0	6	3
Too long to remove tarp	0	5	4
Too long to discharge fish from well	2	6	1
Failure to calculate dissolved oxygen requirements prior to treatment	9	0	0

BATH PESTICIDE RELEASE TO THE ENVIRONMENT

Liquid pesticides that are used as a bath treatment are released into the environment from tarps or well boat discharges following treatment. The degree of persistence in the water column, and eventually in sediment, is compound specific. For example, some compounds may have very short half-lives of only several hours whereas others may be completely stable. The rate at which a compound may bind and partition to sediment is also compound specific. For example, water soluble compounds are more likely to remain in the water column while compounds with very low solubility are more likely to bind and partition to sediment.

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APPENDIX A: EASTERN AQUACULTURE VETERINARY ASSOCIATION GUIDELINES FOR ISSUANCE OF PRESCRIPTIONS FOR THE TREATMENT OF FISH

June 9, 2000

In the event of a request for a prescription the veterinary practitioner will require:

1. A visit to the site for collection of moribund fish (see note “A” below).
2. Examination of appropriate fish samples.
3. Appropriate laboratory testing (see note “B” below).
4. Receipt and examination of their records:
   a. mortality records
   b. recent laboratory reports (eg. ISA surveillance)
   c. information on prior medical history and prior treatments
5. That the requested treatment is:
   a. reasonable and required
   b. does not interfere with other disease control programs (eg. ISA)
6. That the farm is not the regular client of another veterinarian. If the client prefers that a second veterinarian treat the fish, not his/her veterinarian, that veterinarian will tell themthey have to consult the regular veterinary prior to any treatment.

Notes

1. If the farm is a regular client whom is visited regularly, a site visit may not be requiredbut fish samples must be sent to the practice for examination.
2. For the purposes of making a diagnosis that results in a prescription, laboratory results must be derived from samples collected by the practitioner, or someone working underdirect supervision.

If another veterinarian, or someone working under the direct supervision of another veterinarian collected the samples, that veterinarian should write the prescription.

If samples were collected by a non-veterinarian they are not valid for the purposes of writing a prescription.

Exceptions

There are cases when prescriptions are valid without visiting the site or examining the fish. These cases are usually routine or preventative treatments for regular clients; cases in which useful information cannot be gained from visiting the farm or examining the fish. The most common occurrences are a prescription for an in-feed sea lice preparation or an anesthetic.

(For example; a client requests a treatment for sea lice. The client provides the lice counts and it is determined that the sea lice infestation is comparable to a neighboring farm that has been recently visited etc.)

In these cases it is required that:

1. There is a veterinarian-client relationship with the farm (see note “A” below).

2. The farm is not the client of another veterinarian (see note “B” below).
3. The following information is provided:
    a. mortality records
    b. recent laboratory reports (eg. ISA surveillance)
    c. sea lice counts, if applicable
    d. other relevant information
4. The request is reasonable based on:
    a. the practitioners knowledge of the farm
    b. the practitioners knowledge of the local bay area and the industry in general
    c. the treatment is not contraindicated or will interfere with another
    d. disease control program (eg. ISA Control Program)
    e. examination of the fish is warranted (eg. elevated mortality in a number
    f. of cages but the farm wants to do a lice treatment).

Notes

1. A minimum of two site visits per year is required to maintain the veterinarian client relationship. This is subject to increase depending on the disease circumstances on the farm.
2. If the practitioner has been to the farm a couple of times in the past year but they have been using another veterinarian to work out a problem over the past month, the farmershould be referred to the other veterinarian.

If the client still prefers that the first veterinarian prescribes the treatment, they will be told that the other veterinarian will be consulted prior to treating and a farm visit will likely be required.

APPENDIX B: SAFETY DATA SHEET FOR AQUAPAROX 50

2018-3707

2019-02-22

AQUAPAROX 50

For Treatment of Sea Lice on Atlantic Salmon Reared in Marine Aquaculture Sites.

RESTRICTED SOLUTION
DANGER POISON
CORROSIVE TO EYES AND SKIN
READ THE LABEL BEFORE USING
ACTIVE INGREDIENT: Hydrogen Peroxide …….50.5%
REGISTRATION NUMBER: 32401 PEST CONTROL PRODUCTS ACT
NET CONTENTS: 205 L, 1200 L, 17,000 L, 75,700 L
REGISTRANT: Alpha Chemical Ltd
CANADIAN CONTACT: Alpha Chemical Ltd., B3B 1K2, (902) 481-2532

NOTICE TO USER:
This pest control product is to be used only in accordance with the directions on the label. It is an offence under the Pest Control Products Act to use this product in a way that is inconsistent with the directions on the label.
NATURE OF RESTRICTION: Only to be applied by individuals who are provincially certified and trained in the application of this product and who hold a pesticide applicator certificate or license recognized by the provincial/territorial pesticide regulatory agency where the application occurs. This product is to be used only in the manner authorized. Consult local pesticide regulatory authorities about use permits which may be required.

RESTRICTED USES: Aquaparox 50 is effective for the removal of sea lice (*Lepeophtheirus* spp. and *Caligus* spp.) in farmed Atlantic salmon. Aquaparox 50 temporarily paralyses sea lice, causing them to fall off the host. Aquaparox 50 also reduces egg string viability. Aquaparox 50 does not remove all growth stages; therefore it should not be used prophylactically. It should be used to treat fish infested with post-chalimus growth stages and before serious skin damage is evident. Some sea lice may recover and re-attach to hosts following treatment. Repeat treatments may be necessary. This product is to be used only in the manner authorized; consult provincial pesticide regulatory authorities about use permits that may be required. The restricted uses of Aquaparox 50 may be subject to other legislative requirements such as those under the *Fisheries Act*.

DIRECTIONS FOR USE: Aquaparox 50 is administered as an external bath treatment by either using wellboats or completely enclosed tarpaulins. Treat only when thresholds are reached as directed by a veterinarian. Aquaparox 50 must be added as quickly as possible, while avoiding splashing, to reach the target concentration within the shortest timeframe. Fish to be treated should be starved for at least 24 hours pretreatment. Do not administer to fish weighing less than 200 g mean bodyweight or fish exhibiting signs of gill damage. Steps should be taken to remove lice floating on the water after treatment to prevent reinfestation. When a wellboat is used for treatment, it is recommended that measures be taken to ensure that dislodged sea lice are not released with discharge water near the farm site (e.g., by using screens on outflow ports to capture dislodged sea lice from discharge water). Allow for a minimum of 7 days between applications. Do not apply more than 5 applications of Aquaparox 50 per year. The optimum treatment to remove infestations of sea lice is an immersion in a solution of Aquaparox 50 at a concentration of 1500 ppm of hydrogen peroxide for a period of 20 minutes at temperatures up to 13°C (55°F). Aquaparox 50 treatments may be extended for up to 30 minutes if desired. Shorten treatment time if water temperature is higher than 13°C (55°F). Additional guidance is provided in the table below:

Water Temperature	H_2O_2 Concentration (ppm or mg/L)	Amount of Aquaparox 50 in Sea Water (g/L)
Below 8°C	1700-1800	3.4-3.6
8-10°C	1550-1700	3.1-3.4
10-14°C	1400-1550	2.8-3.1
Greater than 14°C	1200-1400	2.4-2.8

NOTES: Temperatures greater than 13°C and/or exposures longer than 20 minutes may result in damage or mortality of treated fish. Use extreme caution when applying at higher temperatures. Discontinue treatment and flush with sea water immediately if signs of distress in fish are observed. Efficacy of treatment may be reduced when using concentrations below 1500 ppm. The fish to be treated must either be crowded into a small area of the production net and completely encircled with a tarpaulin or transferred into a wellboat confinement area. Fish must not be crowded to the point where scale loss occurs. Water temperature and dissolved oxygen levels will dictate the stock density in the treatment area. Supplemental oxygen must be supplied during crowding and treatment. The volume of water entrapped must be calculated (surface area of treatment area times the depth of the enclosed pen/well minus the fish biomass = cubic metre) then the estimated quantity of Aquaparox 50 required to achieve the target concentration indicated above should be added using a dedicated dosing system, such as a pump with venture and hoses/pumps for the enclosed tarpaulin method and a batch controller for the wellboat method. Representative water samples from the treatment area must be taken at regular times during the treatment period and tested to determine the concentration of hydrogen peroxide. The first sample should be taken at least 5-8 minutes after the start of the addition of Aquaparox 50 to the fish pen and then taken at regular intervals thereafter (e.g., 15, 20, 30 minutes) to ensure that the concentration of hydrogen peroxide is maintained for the entire duration of the treatment. The requirement to add more Aquaparox 50 or shorten the treatment period is based on these analytical results. Concentrations can be reduced by pumping fresh sea water into the treatment enclosure.

BEST USE RECOMMENDATIONS:
Please note that Aquaparox 50 contains hydrogen peroxide. Product performance should be closely monitored following treatment. In addition, any sea lice population may contain individuals naturally less susceptible to Aquaparox 50 and hydrogen peroxide. These individuals may dominate the sea lice population if hydrogen peroxide is used repeatedly in the same site. Other mechanisms leading to decreased susceptibility, such as enhanced metabolism, may also exist. Appropriate management strategies should be followed:
▪ Where possible, rotate the use of Aquaparox 50 or other hydrogen peroxide products with different groups that control the same pests in a site.
▪ Use of this product should be based on an IPM program that includes scouting, record keeping, and considers cultural, biological and other chemical control practices.
▪ Monitor treated pest populations for product performance.
Contact an aquaculture specialist for any additional IPM recommendations for the specific site and pest problems in your area. For further information or to report problems with product performance, contact Alpha Chemical Ltd. at (902) 481-2532.

PRECAUTIONS FOR SALMON:
Hydrogen peroxide has a short term adverse effect on fish gills. This is aggravated when gills have been damaged or compromised pre-treatment. Treatments must not be carried out if; 1) there has been or is an algal or plankton bloom, or 2) there is high organic and/or metal loading in the water of the treatment pens. Treatments must not be considered if the Secchi disc reading is less than 4 metres. If there is any doubt, it is advisable to have histology studies carried out on samples of gill before treatment. Net changes, grading and other management procedures that stress fish must be avoided the week before treatment. Crowding of fish as per the treatment instructions may stress fish. Dissolved oxygen meters must be used to monitor oxygen levels at all times. Supplemental oxygen must be supplied to the pen during the crowding period, setting of the enclosed tarpaulin or introduction into the wells and during treatment. The oxygen supply may be ambient level. Greater care is required in monitoring dissolved oxygen levels and stress as water temperatures increase. Irrespective of concentration of Aquaparox 50 achieved, extended exposure times are toxic to fish. Treatment times must not be extended beyond 30 minutes from the achievement of the target concentration of Aquaparox 50 in the treatment pen/well. Discontinue treatment and flush with sea water immediately if signs of distress in fish are observed. Monitor treatments for signs of distress by fish. If necessary (e.g., concentration of hydrogen peroxide exceeds 1800 ppm), take immediate steps to flush treatment area with fresh sea water using appropriate physical agitation. A sample of water from the treatment area should be taken and analyzed for hydrogen peroxide concentration between 2 and 5 minutes after treatment is completed to ensure rapid removal of any residual hydrogen peroxide from the wells or enclosed tarpaulins. Target concentration of hydrogen peroxide in the treatment area at the end of the treatment is 0 ppm. NOTE: Use only systems/procedures that are capable of determining hydrogen peroxide concentrations in sea water.

PRECAUTIONS:
▪KEEP OUT OF REACH OF CHILDREN.
▪CORROSIVE to eyes and skin. Fatal or poisonous if swallowed. May be fatal if inhaled. DO NOT get in eyes or on skin. Avoid inhalation of fumes.
▪Aquaparox is an oxidizing agent and will cause severe burns to skin and eyes. When using well boats, all personnel involved in handling, storing, transferring, mixing, loading, applying the concentrate, clean-up, repair and in activities immediately after application must wear chemical resistant coveralls (Tyvek or PVC full chemical splash protective suit) over a long-sleeved shirt and long pants, chemical splash proof face shield, socks and chemical-resistant boots and gloves.
▪When applying to sea cages, all workers involved in handling, storing, transferring, mixing, loading, and applying the concentrate, clean-ups and repairs, and in activities immediately after application must wear a NIOSH-approved respirator for hydrogen peroxide (http://www.cdc.gov/niosh/npg/npgd0335.html), chemical resistant coveralls (Tyvek or PVC full chemical splash protective suit) over a long-sleeved shirt and long pants, chemical splash proof face shield (when not wearing full face respiratory protection), socks, and chemical-resistant boots and gloves. Observe respirator use limitations specified by NIOSH and the manufacturer.
▪Wash thoroughly with soap and water before eating, drinking or smoking. Remove protective equipment immediately after handling, wash thoroughly and change into clean clothing.
▪Entry into fish farm areas is restricted until all treatments are completed. Recreational activities in treated water near fish farm areas are not permitted until tidal flushing occurs.

FIRST AID:
If swallowed: Call a poison control centre or doctor immediately for treatment advice. Have person sip a glass of water if able to swallow. Do not induce vomiting unless told to do so by a poison control centre or doctor. Do not give anything by mouth to an unconscious person.
If inhaled: Move person to fresh air. If person is not breathing, call 911 or an ambulance, then give artificial respiration, preferably by mouth-to-mouth, if possible. Call a poison control centre or doctor for further treatment advice.
If in eyes: Hold eye open an rinse slowly and gently with water for 15–20 minutes. Remove contact lenses, if present, after the first 5 minutes, then continue rinsing eye. Call a poison control centre or doctor for treatment advice.
If on skin or clothing: Take off contaminated clothing. Rinse skin immediately with plenty of water for 15–20 minutes. Call a poison control centre or doctor for treatment advice.
Take container, label or product name and Pest Control Product Registration Number with you when seeking medical attention.

TOXICOLOGICAL INFORMATION: Treat symptomatically.

ENVIRONMENTAL HAZARDS: Toxic to aquatic organisms. Apply only to net pens enclosed by a tarpaulin or in a wellboat. Product is designed for the treatment of fish; however, at levels greater than the treatment dose, the product could be harmful to fish and aquatic life. Do not contaminate irrigation or drinking water supplies or aquatic habitats by cleaning of equipment or disposal of wastes.

STORAGE: To prevent contamination, store this product away from food or feed.

DISPOSAL:
1. Triple- or pressure-rinse the empty container. Add the rinsings to the treatment site or tank.
2. Follow provincial instruction for any required additional cleaning of the container prior to its disposal.
3. Make the empty container unsuitable for further use.
4. Dispose of the container in accordance with provincial requirements.
5. For information on disposal of unused, unwanted product, contact the manufacturer or the provincial regulatory agency. Contact the manufacturer and the provincial regulatory agency in case of a spill, and for clean-up of spills.