TIPS FOR THE PREVENTION AND CONTROL OF DISEASE

First measure: maintenance of healthy Conditions

Two factors combined contribute to the breaking out of disease; the presence of a pathogenic agent and a stressful condition in the environment. The maintenance of optimal physico-chemical parameters (*i.e.* temperature, oxygen concentration, and pH) is without a doubt the most efficient method of disease prevention. In an open system, optimal conditions are difficult to maintain on an ongoing basis when seasonal variations in temperature, flow and quality occur. On the other hand, in a REBF (water REcycling and BioFiltration) system they are easy to maintain.

Where a number of REBF units are employed, the fact that they are physically isolated one from the other is an added measure in preventing the spread of disease in a fish-raising establishment**. It should be noted that where a number of REBF units are in use, the work tools (dippers, containers, brushes, and so on) should be kept separate for each unit**

The same prevention measures for salmonids reared in flow-through systems will apply to those raised in recirculating systems.

A routine of careful observation is essential in early detection of health problems: look out particularly for mortalities and abnormal swimming or feeding behaviour. Pay close attention to any factor which may increase stress and eliminate it before trouble breaks out. Stressed salmonidae are prone to disease. If disease should break out, reduce or eliminate any stress-producing agent which may have contributed to the outbreak. For instance, it is important to pay close attention to water quality. High concentrations of ammonia, nitrites, and/or suspended solids in the water can act as stress producing agents. High fish densities are also a common stress factor. **Remember to respect the holding capacity (g fish/L) specified for your system.**

Corrective measures for high concentrations of ammonia and nitrites

Except for short periods of time (ex: when feeding load is substantially increased over a short period of time, or during a sudden temperature drop), the biofilter should maintain nitrite and ammonium ions at an acceptable level for aquaculture. If these concentrations are abnormally high for period over 2 weeks, one should consider removing fish from the system and re-activating the biofilter. It is always an excellent idea to maintain extra biofilter media in a

small activation system (fed with an ammonia solution) for future use. However for an emergency situation the following can be applied:

- For high concentration of ammonia : minimise the percent of un-ionized NH_3 by adjusting the pH to near 7.0;
- For high concentration of nitrites: add NaCl in a $Cl/N\text{-}NO_2$ ratio of 10.

Dealing with pathogens

The presence of pathogens may be controlled on two levels:

a) by preventing their entry into the system, and
b) by eliminating them if they are present.

a) Prevention of entry of pathogens
The main preventive measure in keeping pathogens from entering into the system is to avoid the introduction of infected stock. The water used in the system should be spring- or well-water, because these sources are usually pathogen-free. If on the other hand, surface water has to be used, it should be disinfected (generally with chlorine) before it is introduced into the system.

b) Elimination of pathogens if they are present

Two series of measures can be put into effect to prevent a disease outbreak: preventive measures (UV and prophylactic treatments) and corrective measures. The later consists of applying a variety of treatments in order to destroy the pathogens.

Water sterilisation

UV treatment is widely used to keep pathogen levels under control. Except in special circumstances, we think it best not to hook up a sterilisation module in the water circuit. According to the bacterial counts that we have taken, nearly as many nitrifying bacteria are found in the water as in the biologic filter. UV treatment therefore kills good bacteria as well. In our opinion, as in that of other specialists in the field, as long as you do not interfere with the natural flora in the water, it will remain free to react with micro-organisms potentially dangerous to the aquatic life.

UV sterilisation never works at 100%. Some pathogens are always likely to slip by. One might also have to consider the possibility that if the fish are sheltered from contact with micro-organisms normally found in water, the development of their immune system and their ability to use it could be put at risk

Chemical Treatments

Suggested doses for treatment given are the same as those used by AQUABIOTECH in its own REBF operating units (see Table 6). This treatment

has been found to work well for salmonidae but, of course, do not replace a consultation with a fish health specialist. The effect of various treatment chemicals and doses on Nitrification appears in table 7.*[1]

When other species of fish or invertebrates are to be treated, we strongly recommend that you make a preliminary test *in vitro* using a small number of fish Where a number of REBF units are employed, the fact that they are physically isolated one from the other is an added measure in preventing the spread of disease in a fish-raising establishment. (*i.e.* in 1 litre of water) before you apply treatment to the entire REBF unit.

There are two methods of treatment which may be used; preventive and remedial.

Preventive Treatment:

Treatment is long-term in nature and should be applied to one rearing tank only at the time in a given system, and at weekly intervals. (Exception: incubators are all treated simultaneously) Thus it would take four weeks to treat all of the tanks of a 4-tank system. The already weak concentration of the product, linked with its dilution in the system water, means that treatment can be carried out without having to change the water in the tanks.

The method of treatment is very simple. You have only to dilute the product (e.g. Formaldehyde, chloramine) into 4-5 L of water and pour it into the tank to be treated. You do not have to make any changes to the level of water in the tank, nor to its rate of inflow or discharge.

Remedial Treatment:

This second type of treatment is done over the short-term and is applied when a health problem shows up. It can also be used as a preventive treatment, with the proviso that because the concentrations are stronger, the water in the tank to be treated has to be changed after the treatment. Treat one tank at the time. The first step is to reduce the tank level about half. This is accomplished by opening the purge valve. Always make sure that you stand by the valve and don't leave it unattended as long as it is open. Then the chemical is diluted in 4-5 litres of water and introduced slowly into the tank system. Record the time started so that you will know the duration of treatment. Next, reduce inflow of water to 1/4 during treatment. Keep a watch on the oxygen level during treatment. It may even be necessary to inject pure oxygen into the tank. The next step in the treatment is to flush the water by bringing the inflow up to maximum while the tank purge is still partly open. This will allow some of the chemicals to be discharged from the system. The chemicals left over is now of a weaker concentration and as such, it may now be distributed among the other

[1] Note that formalin reacts with the reagents for measuring ammonia in water (Neesler Method).

tanks as a preventive. In its weaker concentration it will have little or no effect on the biologic filter. Finally, all that is left to do is to increase flow from the water supply for a short period of time to make up for water lost.

Table 1: Doses found to be effective by Aquabiotech in the treatment of Atlantic salmon and trout within its own REBF units.*

Size of Fry and +	Product	Concentration	Treatment Time
Egg	Formaldehyde	1670 µL/L	15 min
Egg	Formaldehyde	60 µL/L	long term
Sac fry	Formaldehyde	130-200 µL/L	30 min
Sac fry	Formaldehyde	60 µL/L	Long term
Fry (first feeding)	Chloramine	10 mg/L	Long term
Fingerling and larger	Chloramine	10 mg/L	Long term long term

* Important: The use of Malachine green is no longer permitted. Formaline (100%) hydrogen (35%) peroxide and Bronopol (50%) are recommended as substitutes (see next table).

Table 2: Chemical treatments recommended by the Direction générale des pêches et de l'aquaculture commerciales du Québec*

Live stage	Product	Dosage	Duration of treatment
Egg	Formalin (100%)	1.7 to 2.0 g/L 1.7 to 2.0 mL/L	15 min, 2 to 3 times a week
Egg	Hydrogen peroxide (35%)	0.5 to 1.0 g/L 1.4 to 2.9 mL/L	15 min, 2 to 3 times a week
Egg	Bronopol (50%) $C_3H_6BrNO_4$ Commercialized as Pyceze® (Novartis Animal Vacccines)	30 to 50 mg/L 60 to 100 mL/m^3	30 min, 2 to 3 times a week. Applies to flow-through system
Fish	Bronopol (50%) $C_3H_6BrNO_4$ Commercialized as Pyceze® (Novartis Animal Vacccines)	15 to 20 mg/L 30 to 40 mL/m^3	30 min, 2 to 3 times a week. Applies to flow-through system

Source: Correction to 'Fascicule 3: Reproduction, incubation et alevivage' du guide 'Élevage des salmonidés' Ministère de l'Agriculture des Pêcheries et de l'Alimentation, 1996, ISBN 2-551-17085-0

* Note: the concentrations that apply to flow-through systems must be adjusted (reduced) for closed systems, as the product remains much longer in water. House tests are required.

Table 3: Effect of antibacterial and parasitic agents on nitrification

Composite	Concentration (mg/L)	% of nitrification inhibition or observed effect
Methylene blue	5 5 1	Disorder for 16 days* 100 92
Chloramphenicol	50 50	0 84
Chlorotretracycline	10	76
Erythromycine	50	100
Formaldehyde	0,1 (2,7 µL/L), constant 10 (27 µL/L), three times, every 2 days 15 (40,5 µL/L 25 (67,5 µL/L) 50-167 ppm during 1h 5000 µL/L, constant, 12 h 5000 µL/L, constant, 45 min	Slight disorder Insignificant* Insignificant* Insignificant* Insignificant* 100* Disorder with recovery within 3 days*
Nifurpirinol	1 0,01 4	0 20 44
Sodium Chloride NaCl	0,5% 1,5% 3%	No Yes Yes
Oxytetracycline (Terramycin)	50 10, constant	0 Insignificant*
Potassium Permanganate	4 1	0 86
Sulphamerazine	50	0
Sulphanilamide	25	65

Copper Sulphate	1 5	0 0
Malachite Green	0,1 0,1, constant 0,1, 3 h, 1 day out of 2 1	0 Slight interference after 6 days* Insignificant* Insignificant
Romet tm	50 mg/day by Kg of fish during 5 days	0
Tribissen **(Thioprin & Sulphadiazine)**	10 (addition of running water) 2, constant 10, constant	Insignificant* Insignificant* Slight interference after 3 days*
Chloramine T **(Tosylchloramide)**	20	Insignificant*
Formaldehyde with Malachite Green	10 (27µL/L) formaldehyde + 0,1 mg/L malachite green, three times 1 day out of 2 25 formaldehyde + 0.10 malachite green 1 day out of 2	Insignificant* Insignificant

Sources: Spotte, S.H., 1970. Fish and invertebrate culture. John Wiley & Sons, Inc., et Muir, F. James, 1982. Recirculated water systems in aquaculture. Pages 357-446 in J. F. Muir and R. J. Roberts, eds. Recent advances in aquaculture. Croom Helm, London. .

* Annual Review of Fish Disease Vol. 6 pp 65-92, 1996.