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The complete biosecurity solution

Biosecurity and Disinfection in Salmon Farming

This review was prepared at the request of Scottish Aquaculture Forward (SAF), an independent group of Scottish aquaculturists, veterinarians and consultants keen to advance the quality, health, environmental sustainability and reputation of Scottish farmed fish and fish products in all its different forms. It is intended as an information source to advise Statutory Bodies, Farmers, Politicians and Media on the real issues affecting sustainable Aquaculture in the Scottish context.

Introduction

In May 1998 the first outbreak of Infectious Salmon Anaemia (ISA) occurred in Scotland (Rodger et al. 1998). Until then the disease, caused by the ISA orthomyxovirus, had only been described from Norway (Thorud & Djupvik 1988) and Canada (Bryne et al. 1998). It subsequently spread, from its initial focus in Loch Nevis, to 11 sites on the Scottish mainland, Skye and Shetland, in association with the movement of fish or well boats from infected loci (Stagg et al. 2001).

ISA is a major clinical problem for the fish farming industry, with outbreaks leading to serious economic losses due to death of affected fish and progressive spread to other sites. It is therefore placed on the EU list under Directives 91/67/EEC and 93/53/EEC, which requires the disease to be eradicated when it occurs. When the 1998 outbreak was reported immediate action was taken by the authorities to remove infectious foci and prevent further spread. Actions took the form of isolation of suspected stocks, compulsory slaughter where infection was found and isolation, quarantine and fallowing of contiguous areas, with enhanced disinfection and biosecurity procedures.

Although ISA virus is not the only significant pathogen of farmed salmonids, its advent in Scottish salmon farms marked a watershed in management practices in the industry. Until the advent of this serious outbreak, biosecurity measures in the salmon farming industry in UK in general and information and arrangements for disinfection were less than adequate. Detailed biosecurity plans and disinfection application protocols, which are commonplace in intensive pig and poultry production, had not yet been instituted and there was no proper identification of disinfectants that were both effective and environmentally acceptable. Due to the urgency of the circumstances, disinfection procedures, largely based on the use of hypochlorite at high concentration (100-1,000 mg/l in fresh water) were immediately introduced.

Discharge of disinfectants to the environment is controlled under the Food and Environment Protection Act 1985 Part II Deposits in the Sea, as amended by the Environment Protection Act 1990 (FEPA) and The Control of Pollution Act 1974 as amended by the Water Act 1989 and the Environment Act 1995 (COPA). COPA discharge consent is issued by the Scottish Environment Protection Agency (SEPA) and must be obtained for discharges made, not only during emergency slaughter, but during any activities, such as net and cage disinfection, at both cage sites and shore bases and for effluent disinfection at processing plants.

The Scottish Environment Protection Agency is responsible for control of all discharges into the environment and maintains a presumption against the authorisation of the discharge of effluents containing active residual chlorine, where there is significant risk that this may lead to organochlorine production. The routine controls over use of such chlorine based disinfectants were set aside on a temporary basis at the onset of the ISA outbreak, in the form of a derogation to allow fish farmers and processors to implement effective procedures rapidly. The controls have, however, been re-instated with the resolution of the ISA outbreak and the use of sodium hypochlorite and other active chlorine compounds, unless neutralised, stored and discharged through a SEPA approved discharge site, is once more proscribed.

The Joint Working Group Report

In 2000, the Scottish Executive/ Aquaculture Industry Joint Working Group on ISA (JWG) issued a detailed report and set of recommendations for the future management of the ISA risk. The JWG recognised that the situation with regard to disinfection, in respect to any future outbreak, was particularly unsatisfactory, declaring that at present there was insufficient data on the efficacy of more environmentally acceptable alternatives to sodium hypochlorite. The Group's recommendation was that an urgent review be carried out of possible acceptable alternatives to hypochlorite in relation to both efficacy and environmental acceptability (JWG Report 2000).

This review has not yet taken place, some three years after the recommendation was published. There are concerns within the industry, however, that not only is there an ever present risk of a recurrence of ISA but also the economically important virus diseases Infectious Pancreatic Necrosis (IPN) and Pancreas Disease (PD) are increasing in incidence and improved guidance on both efficacy and environmental acceptability are necessary. The present document has, therefore, been produced, in an attempt to address the environmental and health aspects of biosecurity in aquaculture, at the behest of a group of commercial and industry operators including marine and freshwater finfish farmers, processors and veterinarians involved in fish production. It is hoped that it will inform the efforts of the 'Code of Practice' Working Group, currently attempting to establish an acceptable code of working practices for the industry and also the Authorities, within SEPA and the Scottish Executive Environment Rural and Agriculture Department (SEERAD), which are ultimately responsible for the management of the environment and of fish health, in the national interest.

This paper therefore reviews the health and safety and environmental aspects of the available products for aquaculture disinfection and highlights the points that have to be addressed in relation to such a study. It also makes firm recommendations, based on published data, wherever possible, for efficacious, as far as can be determined, safe and environmentally acceptable disinfection procedures. These would apply not only in the event of any future ISA outbreak but also for general use in day to day biosecurity within Scottish aquaculture. Data has, where possible, been derived from peer review publications, but these are very limited in this field and recourse has also been made to UK, Australian and US Government Reports and official websites, company literature and commercial websites.

Efficacy

Since the author has no particular experience in disinfection per se, only the public safety and environmental aspects, it is not possible to present authoritative primary efficacy recommendations, whether for ISA or other more general disinfection requirements. Clearly, however, there is little value in reviewing the environmental acceptability of disinfectants against virus infections if they have poor virucidal activity, so the review is based on the general recommendations of suitable candidate compounds recommended in the JWG ISA Report viz:

- Chloramine T
- Glutaraldehyde
- Iodophores
- Chlorine Dioxide
- Peracetic Acid

Following consultation with veterinarians and the official DEFRA (Department for Environment Food and Rural Affairs, UK), USDA/APHIS (US Department of Agriculture/ Animal and Plant Health Inspection Service) and AUSVETPLAN (Australian Veterinary Emergency Plan) websites, for those disinfectants generally recommended for agricultural epidemics such as Foot and Mouth disease, which also had published efficacy for fish viral and bacterial pathogens, the agricultural biocide ‘Virkon S’ was added.

As well as being reputedly the most universally proven veterinary biocide disinfectant, this formulated triple salt of potassium monopersulphate also has published efficacy data against the salmon pathogens ISA and IPN viruses and Aeromonas salmonicida and Vibrio anguillarum (vide infra) as well as a range of other exotic fish pathogens. It is also becoming widely used and recommended by veterinarians in aquaculture, despite its absence from SEERAD's listing. When used in aquaculture it does not normally attract a maximum discharge level condition from SEPA as part of a discharge consent. (It was also, incidentally, I discovered, invented and patented by a distinguished Scottish chemist, TRA Auchincloss).

The reason for the exclusion of Virkon-S from the JWG list is puzzling, since it is used as the principal virucidal disinfectant biocide in the diagnostic laboratories of the two national fisheries research institutes, which advise government on aquaculture disinfection policy. It is also one of only two disinfectants approved for use by the Norwegian Veterinary Authorities for well-boat and aquaculture site disinfection. (Norway Fisheries Regulation 194 -Cleaning of Aquaculture Sites)

It is assumed that as well as Virkon-S, for which published data is available, all five of the disinfectants which the Joint Working Group recommended also have efficacy to some degree against ISA, IPN and other fish pathogens. The review of their operator safety and environmental data, where available, has been made in the context of the concentrations and locations where they would be required to be used for biosecurity purposes, according to the details given in the SEERAD Field Guide to Disinfection Procedures (Version II December 1999).

Disinfection Procedures in Aquaculture

The environmental suitability of a disinfectant or biocide will to a degree depend on the way in which it is to be used, the concentration and the ability to dispose of it without allowing it to contaminate drains or waterways at environmentally significant levels.

The Marine Laboratory, Aberdeen, produced a field guide to disinfection procedures in regard to the ISA virus, which identified the key areas of fish husbandry systems where such disinfection would be expected to be used. These were:-

1. Well Boats
2. Pallets
3. Nets
4. Cages and Moorings
5. Divers and Diving Gear

In biosecurity systems however, these are only the major factors for consideration. In addition there is of course the requirement for use of disinfectant in relation to foot-baths and waterproof clothing sprays, helicopter bins, lorries and effluents and fomites from processing and packing stations.

In terms of environmental impact, the volume of discharge and exact mode of usage in all of these circumstances will also ultimately influence the environmental effect of a biocide. Volumes used in large production facilities, however, are significant and can have an impact, as effluent, over a considerable area. In aquaculture disinfection systems the following factors are particularly relevant in relation to both the disinfection process and to subsequent disposal.

1. Disposal directly at sea

A typical well-boat will have a well capacity of 500 - 750m3. This may be in the form of one large well or two small ones but overall volume is relatively similar. Where a boat moves between zones, it must be slipped and the hull disinfected. This is only necessary once or twice in a season, but on every occasion that a ship moves between sites, cleaning and disinfection procedures require first, total scrubbing of wells, decks and pumps, followed by hot water pressure cleaning with detergent, followed by disinfection. Currently in Scotland iodophore is recommended by SEERAD for this purpose. In Norway only Virkon S for Aquaculture or Halamid (Chloramine-T) are recommended (Norwegian Government Regulation 194), since iodophores are both environmentally toxic and of low efficacy in the presence of organic matter, (AUSVETPLAN 2001).

Well-boat disinfection may take place at sea some 500 times each year in Scotland. Currently this results in an estimated discharge of between 125 and 375 million litres of dilute disinfectant per annum into the coastal marine environment, from well-boat cleaning alone. As use of well-boats for harvest transfers and increase in farming of other fish species, this usage will increase. It is already noted as a source of public concern. (Sunday Telegraph 11/01/2004). It is essential therefore that the detergent and the terminal sanitiser used in well-boat cleaning are both as environmentally acceptable as possible. The current SEERAD recommendation of iodophore, while apparently of doubtful efficacy is also certainly not of minimal environmental impact in the marine environment.

In addition to well-boats, work boats and other vessels such as feed barges and harvesting barges are also involved in movements to and from marine farm units and these also are disinfected daily, and in all moves between farms, adding to the volume of disinfectant discharging directly into the sea. Nets, cages and on-cage foot-baths are also routinely disinfected. Nets and cages are only disinfected on installation and removal but foot-baths are refilled every three days, and the effluent usually discarded to the sea.

In Chile, glutaraldehyde is routinely used as a foot-bath disinfectant and hypochlorite as a salmon net and cage disinfectant. In Norway, iodophore, Virkon-S or Chloramine-T are used for foot baths. In Scotland, iodophore is still widely used, due to the ISA-JWG recommendation, although more sophisticated biosecurity operations are now specifying Virkon-S for Aquaculture or Halamid (Chloramine-T).

2. Protective Clothing

Divers are widely employed in aquaculture and their wet-suits and diving equipment are identified as major potential infection transfer agencies. In some farms each site has its own gear. More often, the wet-suits and equipment have to be disinfected between sites. This requires complete immersion, on shore, for at least 20 minutes, in disinfectant, with subsequent rinsing. The disinfectant and rinsate both discharge, usually via an uncontrolled drainage system, to the sea.

In addition to the special case of diving gear, all operatives will have their waterproof protective clothing spray washed down with detergent and disinfectant when completing a task such as feeding or harvesting. This again leads to significant discharges.

Volumes of discharge from this are estimated as of the order of 6.5million litres per annum across the Scottish industry and represent a significant total discharge of relatively undilute disinfectant.

3. Fish Processing

Two systems of primary processing of salmon harvest are used. The first, traditional method, involves slaughter and bleeding at sea and transfer to shore in sealed bins. The second employs use of well-boats to transfer the fish live to a processing station ashore.

In either case, all wastewaters, blood and iced waters must be disinfected before discharge to sea or to a drainage system. Estimates of total volumes of water and blood thus discharged vary but on the basis of the Scottish production of 140,000T of salmon, a figure of the order of 56 million litres of disinfectant discharge does not seem unreasonable. This may well be discharged to a drainage system and possibly through sewage treatment but this does not affect the SEPA discharge consent requirement.

4. Disposal of Disinfection Effluent to Freshwater

Although the largest volumes of disinfectant usage in salmon aquaculture are used in the sea stages and in processing, nevertheless disinfectants are also required for use in foot-baths and in net and tank cleaning in salmon hatcheries and in net and cage disinfection for use in freshwater lochs.

Currently iodophores are generally used in foot-baths and for cleaning cages, but the extreme fish toxicity, fabric staining and somewhat doubtful efficacy data for iodophore disinfection are leading to wider use of Chloramine-T and Virkon-S for Aquaculture.

Volumes used in freshwater aquaculture are of the order of 280,000 litres dilute disinfectant per annum. This is usually discharged directly into a drain system to the sea or watershed, being diluted en-route but rarely neutralised.

Thus on a very generalised basis, the aquaculture industry, assuming good bio-security practices are generally applied, will discharge some 220-450million litres of disinfectant effluent into watersheds, and particularly marine environments. This does not include disinfection of lorries and fork-lifts between sites, disinfection of equipment or the higher biosecurity requirements necessary when there is a major epizootic control measure under way.

Given the importance of the coastal ecosystem of the North and West of Scotland it is important that these large volumes of disinfectants are not only efficacious but also safe for the users and of minimal environmental impact.

In all cases, the process of biosecurity cleaning and disinfection could be expected to result in disinfectant entering drainage systems, open waters or the sea, depending on where the operations are taking place. It is therefore critical that on all sites where such operations take place, full environmental assessment of the compounds being proposed for use and allocation of a considered discharge consent for the location have been made.

It is unlikely, however, that disinfectants such as hypochlorite, highly toxic in the environment and capable of generating organochlorines or chemicals posing serious human health risks, such as glutaraldehyde, will be acceptable under any circumstances.

The Candidate Disinfectants

This section reviews the environmental and operator safety aspects of the JWG-ISA committee recommended disinfectants viz. Glutaraldehyde, Chloramine-T, Iodophores, Chlorine Dioxide, Peracetic Acid and also Virkon-S for Aquaculture, as indicated above.

Glutaraldehyde

Glutaraldehyde should not, under latest UK Health and Safety COSSH regulations, be used for disinfectant purposes, in UK, since it is subject to a Maximum Exposure Limit (MEL), under Health and Safety regulations. Using it at the disinfectant levels normally required in aquaculture means that it is likely to exceed the MEL levels.

Of even greater concern, in environmental terms, is the recommendation by the manufacturers, Union Carbide Ltd, that the product should never be disposed of by draining into a sewer system or natural waterway as it is highly toxic to aquatic life in natural waters.

Glutaraldehyde does not appear from the literature (AUSVETPLAN 2001) to have superior biocidal properties to other compounds, but raises serious health and safety and aquatic environmental impact issues. It is included at around 12% in some compounded disinfectants used in aquaculture, but in view of its inherent toxicity there are doubts as to whether it should even have been considered as a possible satisfactory aquatic biosecurity disinfectant or biocide by the JWG-ISA Committee.

Chloramine T

Organic chlorine release compounds such as Chloramine T have widespread usage in the disinfection of surfaces. Chloramine-T is also used as an occasional agricultural, medical and dental biocide. Its use as a biocide in virus diseases such as foot and mouth disease and swine vesicular disease, however, is only approved by DEFRA for use at very high concentration, as it is readily inhibited by organic material such as mucus or blood. Presumably this limitation would apply in relation to IPN and ISA also, since these are normally disseminated via blood, mucus or faeces.

Chloramine T is currently used, albeit without an EU or UK Veterinary Medicine Marketing Authorisation, as a treatment for certain flavobacterial diseases of fish. It is not currently licensed in USA for use in aquaculture and because of possible concerns over p-toluene sulphonamide (pTSA), its major metabolite, it is currently under review by the Environmental Protection Agency (EPA). Registration for use of Chloramine T in eating establishments and as a herbicide was withdrawn in the 1980's. In terms of human health, it is considered harmful if swallowed, inhaled or absorbed through skin and eyes. In addition to frank toxicity it is also particularly liable to cause asthmatic and dermal hypersensitivity. (International Programme on Chemical Safety (IPCS) 1999). pTSA is listed as a substance which may not under any circumstances be present in cosmetic products in the UK (UK Cosmetic Regulations 2000). OECD, (Organisation for Economic Cooperation and Development), regulations also recommend that although at low usage levels concerns may be less, if it was to be used in consumer products at any frequency (eg in aquaculture?) then long term toxicity testing would be necessary because of concerns for possible carcinogenicity (OECD 1994).

In fish it has been shown to be poorly absorbed from the water, but that which is absorbed is rapidly metabolised to the pTSA metabolite. Despite this, no minimum residual level (MRL) has been issued for chloramine T in USA or Europe since it is not an authorised veterinary medicine.

There is no specific information available on the acute and chronic environmental impact of Chloramine T, but some data is available from the manufacturer, on the formulated product Halamid, which includes a high percentage of Chloramine T. Based on that data Chloramine T would be expected to be classified as R52--Toxic to Aquatic Animals under the draft EU Biocide Directive criteria.

On dissolving in water, Chloramine T dissociates, hydrolyses and disproportionates to produce a variety of organochlorine species, relative proportions of which are dependent on pH. This has consequences for the toxicity of Chloramine solutions, (Gottardi 1992). For example solutions are more toxic in acidic waters such as are found in the West and North of Scotland, and also in sea water. Original concerns in the US about possible carcinogenicity of Chloramine T's main metabolite pTSA now appear to have been resolved, but the fact that Chloramine T is itself an organochlorine compound, (SEPA has a presumption against such compounds or precursors capable of producing organochlorine compounds), means that where discharge consents for Chloramine T are sought by fish farms in Scotland, a daily limit on allowable discharge is currently applied.

The current consent limits reflect the small quantities of Chloramine T which some farms use as a treatment chemical (albeit without a Veterinary Marketing Authorisation) and not the volumes required for use as a general disinfectant for nets, boats and cages. Thus, given the possible US concerns about the human safety in usage, as well the fact that its disinfectant activity is actually dependent on its inherent organochlorine nature, Chloramine-T and formulated products containing significant quantities of it as active ingredients cannot be recommended, on health or environmental grounds, as preferred disinfectants for volume usage in aquaculture.

Chlorine dioxide

Chlorine dioxide is a gas, which is highly explosive above 10% and permanent lung damage can result from repeated exposure to low concentrations. It is a very effective disinfectant and has been proven in the water industry to be relatively safe for the environment. The dangers that it presents for handling and the requirement that it has to be generated in situ since it is difficult and dangerous to transport, limit its feasibility for use on farms. It is unlikely to be of value in the aquaculture context except perhaps in large shore based processing plants, where it would provide safe reliable and environmentally acceptable disinfection without risk of organochlorine residues because of its mode of usage. It has little relevance to the needs of biosecurity within hatcheries or marine cage farms.

Peracetic Acid

Peracetic acid is an oxidising agent with good disinfection properties, particularly useful in the presence of organic matter.

Peracetic acid products have been shown to have strong activity against viruses such as ISAV even in the presence of blood or mucus. Little is known of its action against more resistant agents such as IPN but it is likely to be similarly effective.

Environmental data is available for peracetic acid in formulations combined with hydrogen peroxide which show it to be of generally low aquatic toxicity though it is defined as of 'medium' toxicity to Daphnia. (WRc 1997). It is biodegradable with no persistent residue concerns.

Iodophores

Iodophore disinfectants have been widely used in the aquaculture industry for historic reasons, despite their very high toxicity to fish, both on the farm and in the surrounding environment. They are also corrosive and stain clothing and tissues although some proprietary organic iodophore compounds are less so. They are generally effective against pathogens in low concentrations but are inhibited in the presence of organic matter or hard water more than most disinfectants.

In UK they are currently recommended by SEERAD for cleaning and disinfection of well-boats (SEERAD 1999), but, because of their lowered efficacy in the presence of organic matter, and environmental considerations, they are excluded from Norwegian legislative requirements for this purpose. (Norwegian Fisheries Regulation No 194; 1997)

Iodine is highly toxic for all aquatic life and Organisation Internationale des Epizooties (OIE 2003) recommends that whenever iodine compounds are being discharged they should always be neutralised with an equivalent amount of sodium thiosulphate.

Given this widely recognised toxicity and the impracticality of carrying out the thiosulphate neutralisation whenever discharge is made, iodophore compounds cannot be recommended for use as general or specific disinfectants in the aquaculture environment. Currently SEPA frequently includes use of iodophore disinfectants on discharge consents without volume limits. Discharge consents for iodophore disinfectants should in future be subject to volume limits and only be granted where high rates of dilution are immediately accessible.

Virkon® S

Virkon S is the most widely proven terminal disinfectant in terrestrial animal production and specified for aquaculture disinfection in Norway. Unlike the other disinfectants reviewed, this patented, formulated product combines efficacy as demonstrated by third party documentation, with very low environmental impact and operative safety.

It has a unique mode of biocidal activity, based on the Haber-Will-Statter chemical reaction, which causes the generation of biocides in situ in the presence of water, by means of a peroxygen based cyclic reaction. As a peroxygen based disinfectant it does not contain any free chlorine although when diluted, hypochlorous acid is produced as part of the cyclic reaction. Presence of the biodegradable stabilizing agents sulphamic and malic (apple) acids removes virtually any possibility of organochlorine production

(McCoy 1999) in contrast to the proclivity of the traditional hypochlorite and chloramine based disinfectants. From the published data it appears to be a potent virucide, active at relatively low concentrations against all virus classes and specifically ISAV and IPNV, as well as bacteria and fungi, in the presence of organic material (Antec Website: www.virkons.com).

In general, formulated disinfectants are safer for the user than the more toxic and corrosive basic chemicals such as aldehydes and sodium hydroxide. Nevertheless, risks remain. Acidified iodophores cause burns and chlorine release compounds, such as hypochlorites or organochlorines such as Chloramine T, are potent skin irritants or sensitizers. The data for the safety of Virkon S is extensive and demonstrates low risk potential to humans, not least because of its high and rapid biodegradeability.
The Health and Safety Executive in the UK does not therefore make any Maximum Exposure Limit (MEL) stipulation. There are no special precautions required for its transport or storage or for the disposal of working solutions to drain. AUSVETPLAN the Australian National Biosecurity Plan, states only that "reasonable care is necessary during use" whereas with other products the same source recommends high precaution to ensure user safety.

Virkon® S is one of the few candidate disinfectants that does have data available relating to its environmental toxicity in the aquatic context. Studies at Water Research Centre, Marlow, showed that at all water values (pH, dissolved O2, temperature and hardness) toxicity values for fish and annelids were well within acceptable boundaries, though for Daphnia, toxicity was "medium".
Studies on acute fish toxicity at Inveresk Research (Inveresk, 1987), showed that for Atlantic salmon the 96hLC50 was 25ppm at 14o C while long term toxicity studies in rainbow trout and Atlantic salmon fry at the University of Idaho showed that at 6ppm continuous exposure it was tolerated by fry without any loss of feeding or growth or any apparent chronic effect for four months at 15oC (Hardy 2003).

European Classification.
Classification of aquatic toxicity and rate of environmental degradation is already a requirement of European classification and labelling. Thus all producers of substances or preparations having dangerous characteristics are required to test their aquatic toxicity towards three relevant species (daphnia, algae and fish) and their biodegradation profile, using specified methods.

This legislation will be implemented for all biocidal products from June 2004. Most of the candidate disinfectant products suggested in the JWG for review as disinfectants for aquaculture biosecurity are likely to be classified as 'very toxic' or 'toxic' to the environment when such data becomes available. This will inevitably lead to a tightening of discharge consent conditions in relation to such products or their elimination if toxicity profiles are not provided.

Conclusion

Biosecurity for fish farms has become a key issue both for the industry and also for SEERAD and SEPA in terms of controlling key viral diseases and also general raising of fish health standards.

SEERAD has not yet, however, carried out the review of suitable disinfectants requested by the Joint Working Group in 2001 after the last ISA outbreak. Similarly no consideration has been given by SEPA to the environmental effects of the larger and increasing volumes of disinfectant now used and discharged as part of the improved general biosecurity efforts of the industry.

Having reviewed the disinfectant options for the UK aquaculture industry in relation to its environmental responsibilities and based on my own previous experience of the likely requirements of SEPA in relation to their usage, it is my view, based on published and other available literature on these various products, that, on environmental grounds, only the aquatic biocides Virkon-S and Peracetic Acid can be recommended as aquaculture biosecurity prime disinfectants. In the case of large scale processing operations Chlorine Dioxide, generated in situ, can also be recommended as acceptable under the same constraints that govern its usage in the water industry.

As well as appearing, from the published data insofar as it is available, to have excellent microbiocidal and virucidal properties, it is their low toxicity and rapid biodegradability that clearly differentiate these compounds from other candidate products. I am therefore of the view that these three products or others with similar minimal environmental impact profiles should form the basis for all biosecurity management and epizootic control requirements in aquaculture. None of the other products on the Joint Working Group suggested list for consideration for such a role appear to be able to demonstrate such a profile.

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