Sea Fish Industry Authority

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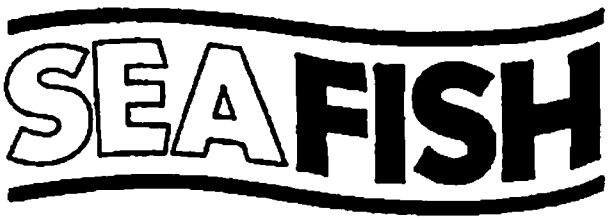

Scallop Working Group Briefing Paper: PSP/DSP in Bivalve Molluscs

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Summary

Extensive closures of scallop fisheries were experienced in the summer of 1995 due to toxic algal outbreaks of PSP. This lead to an increase in the need for sample monitoring and a heightened awareness of the problems associated with the toxic algal contamination of bivalve shellfish. This briefing paper was produced for the Scallop Working Group meeting on the 23rd February 1996. It provides some background information about the different types of toxic algae and their effects and outlines the current legal position regarding product standards and monitoring. The Scallop Working Group is a cross sectoral industry group of fishermen's associations, buyers and processors which meets regularly to discuss issues of concern to the scallop industry.

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1. Introduction

A number of species of dinoflagellate micro algae found in plankton can produce toxins which cause illness in mammals. These toxins enter the marine food chain and can be concentrated by bivalve molluscs, such as mussels, scallops, oysters and cockles filter feeding on the algae. They do not normally cause a problem in other species of fish and shellfish in our waters.

Some of these toxins are harmful to humans but they do not usually affect the molluscs themselves. The toxins cannot be detected by taste. Shellfish can remain toxic for several weeks after an algal bloom subsides. Each type of toxin poisoning is linked to specific algal species that produce different types of toxins. Each toxin type causes different illnesses.

Toxic algae are a global problem and throughout the world a number of different forms of poisoning have now been recognised :

PSP	Paralytic shellfish poisoning
DSP	Diarrhetic shellfish poisoning
NSP	Neurotoxic shellfish poisoning
ASP	Amnesic shellfish poisoning

Both PSP and DSP are regularly found in UK waters. NSP and ASP have not been identified in UK waters.

2. Different Types of Poisoning

The different types of poisoning are:-

2.1 PSP

Paralytic shellfish poisoning results from the consumption of mollusc's that have been filter feeding on toxic dinoflagellates. These algal species are *Alexandrium tamerense, A. minutum, Gonyaulax catenella, G.tamarenses* and *Gymnodinium cateratum. Alexandrium tamerense* is the primary causative organism in the UK. It can form cysts which act as an overwintering stage. When environmental conditions are right, the cysts enter a motile stage and can reproduce to create very large numbers of the organism.

The cause of PSP is a complex of toxins known as neurotoxins, including saxitoxin. These are potentially life threatening, but more usually cause tingling and numbness. A rapid onset time, 15 minutes to 10 hours is characteristic of this intoxication, and symptoms can persist for up to 3 weeks. Intoxication follows oral intake of 144 micrograms to 1660 micrograms per person, with fatalities occurring at levels of 300 micrograms - 12,400 micrograms PSP per person. Levels commonly found in UK shellfish. PSP can be tested for by bioassay, HPLC (high performance liquid chromatography), and ELISA (enzyme linked immunoabsorbant assays) tests. The ELISA testing is not yet fully developed. With the bioassay, the levels of toxin in shellfish are measured in mouse units (MU). One mouse unit being the amount required to kill a 20 g mouse in 15 minutes following intra peritoneal injection (approximately 0.2 micrograms). Typically this requires extensive and secure laboratory facilities to carry out the tests.

2.2 DSP

Diarrhetic shellfish poisoning is caused by the dinoflagellates *Dinophysis fortii, D.acuminata, D. norvegica, D.acuta* and *Procentrum lima.* A number of toxins have been identified, most commonly okadaic acid (OA) and dinophysis toxins (DTX 1-3). Symptoms include diarrhoea, nausea and vomiting. Onset of symptoms is usually within a few hours of ingestion. Recovery occurs spontaneously within several days and no fatalities have been recorded. Doses producing diarrhoea in adults are estimated at 40 micrograms for OA and 36 micrograms for DTX 1. There is a bioassay for DSP. HPLC can be used for OA and DTX 1 - 3 determination.

2.3 NSP

Neurotoxic shellfish poisoning is caused by the red tide dinoflagellate *Gymnodinium breve.* The cause of NSP is a toxin known as a breve toxin. This causes respiratory irritation / gastroenteritis and is not usually fatal. There is a bioassay for NSP.

2.4 ASP

Amnesic shellfish poisoning is caused by the diatoms *Nitzschia pungens, Pseudonitzschia seriata* and *N.pseudodelicatissima*. The toxin is domoic acid. The symptoms are vomiting, diarrhoea, disorientation and memory loss. There have been reports of a few deaths in older people. Domoic acid can be tested for by HPLC.

3. The Legal Position

The Food Safety (Live Bivalve molluscs and Other Shellfish) Regulations 1992 define, amongst other things, the maximum permissible levels of algal toxins. The total PSP content in the edible parts of molluscs (that is the whole body or any part edible separately) must not exceed 80 micrograms per 100 g of mollusc flesh in accordance with the internationally accepted biological testing method (bioassay) - in association, if necessary, with a chemical method for detection of saxitoxin. For DSP the customary biological testing must not give a positive result to the presence of DSP in the edible parts of molluscs.

The Food Safety (Fishery Products) Regulations 1992 state that prior to processing bivalve molluscs must meet the requirements of the Live Bivalve Mollusc Regulations.

The risks of both PSP and DSP are controlled in the UK by the Government shellfish monitoring programmes. Samples of shellfish are analysed for toxins, mainly by bioassay, from sites around the UK coastline. Approximately 60 sites in Scotland and 20 in England and Wales are sampled between April and September for PSP toxins, either weekly or fortnightly depending on the risk at each site. Monitoring for PSP in scallops continues throughout the year, as does DSP monitoring. Detection of the toxins above the statutory acceptable levels will result in a closure until the shellfish from that site test negatively for toxins. PSP is detected annually, mainly off the North East of England and around Scotland. DSP also appears there and in coastal areas in the South and North West of England.

When a closure is notified fishing must cease in the designated area. Shellfish caught before the closure is issued may be landed.

4. Discussion

The extensive closure of scallop fisheries this summer has been a milestone in terms of toxic algal outbreaks in the UK as it was only the second closure to affect commercial wild capture fisheries and the first closure to last for a long period, 6 months in some areas. This has in turn lead to an increase in the need for sample monitoring and a consequent stretching of resources at the laboratories monitoring the situation. The bioassay is at present the quickest and most reliable test for all PSP and DSP toxins. HPLC is much slower and will not provide results as rapidly as the bioassay. However, the use of the bioassay method is both costly and restrictive in terms of sample numbers. There is a strong need to develop reliable HPLC with easily obtainable and stable standards and/or ELISA tests for the monitoring of toxic algae.

There is a widespread view that the spread of toxic algal blooms and the subsequent changing patterns of occurrence of shellfish intoxications, is due to changing environmental conditions, nutrient inputs into coastal waters and algal carriage by ships in ballast water. The observed increases could also be due to increased surveillance. The extent to which each of these factors has played a part in the increases seen around the British Isles over the last 5 years is open to debate. What is clear though is that this is a worldwide problem which seems to be on the increase and is not likely to go away from our waters.

So we should ask what positive steps can be taken in the coming years to gain a better understanding of the toxic algae problem and to ensure product safety whilst maintaining industry viability. Outlined below are a number of suggestions which might help:-

a) Increased staff and facilities for monitoring the algal blooms
b) More research into rapid and inexpensive toxin identification methods
c) More research into the causes of toxic algal blooms
d) More research into satellite surveillance of algal blooms
e) More research into the uptake and removal of the toxins by molluscs
f) Increased end product standard testing closer cooperation between industry and monitoring laboratories, including better dissemination of information

These factors could lead to a better control system with smaller closure areas and/or shorter closure periods.