Replacing animals
used in scientific research

Alternatives to shellfish toxicity testing

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Replacing animals used in scientific research

Scientists are busy developing some really exciting high-tech methods to replace the use of many animals in scientific research and teaching, like organs-on-a-chip, advanced animal mannequins and computer assisted learning.

replacement: *where possible, replacing animal use with alternative techniques*

What problem are scientists trying to solve?

Shellfish are a significant part of New Zealand's seafood export industry, but can accumulate toxins produced by marine microalgae (phytoplankton). Depending on the toxin involved, they can lead to vomiting, neurological problems and, in severe cases, death. Unfortunately, these toxins cannot be destroyed by cooking or freezing so, under the Animal Products Act 1999, commercially grown or harvested seafood is monitored to ensure it is safe and meets the export requirements set by destination countries.

Traditionally this monitoring has involved injecting shellfish extracts into mice. There are several disadvantages to using mice in this way:

- The test provides no information on what toxin in present
- Pain and suffering is caused to mice during the test
- Toxicity from injecting toxins may not be the same as toxicity after oral ingestion
- Results can be affected by the strain and age of the mice, and whether they are male or female
- Mouse bioassays are slow and expensive
- Compounds in shellfish that are not toxic to humans can kill mice, giving false positive results.

The solution

Liquid chromatography–mass spectrometry

A shellfish toxicity test using liquid chromatography-mass spectrometry (LC-MS) has been developed by the Cawthron Institute in New Zealand.

How is it done?

This chemical method allows the separation, detection and identification of most shellfish toxins. The test is more sensitive, faster and cheaper than the mouse bioassay, giving mussel farmers forewarning to harvest their shellfish before toxin levels become a problem. New Zealand was the first country in the world to approve LC-MS testing for regulatory use in 2001. In addition, a high-performance liquid chromatography method has also been developed. This led to the discontinuation of the mouse bioassay in New Zealand in 2010.

LC-MS system © Agilent Technologies, Inc. 2003; Reproduced with Permission, Courtesy of Agilent Technologies, Inc.

Advantages

- Replacement of the use of mice in shellfish toxicity testing.
- Faster results.
- Cheaper technique.
- Information provided on the type of toxin present.
- More sensitive than bioassay technique.

Disadvantages

- The analysis of high-resolution spectrometry produces large data files which can result in laborious and complex data handling.

References

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Risk assessment of shellfish toxins. Munday R and Reeve J (2013). *Toxins* 5, 2109–2137.

Acute toxicities of saxitoxin, neosaxitoxin, dacarbamoly saxitoxin and gonyautoxins 1 & 4 and 2 & 3 to mice by various routes of administration. Munday R, Thomas K, Gibbs R, Murphy C, and Quilliam MA (2013). *Toxicon* 76, 7783.

Helpful links

www.sciencelearn.org.nz/Contexts/Toxins/Sci-Media/Video/Monitoring-shellfish-safety

www.sciencelearn.org.nz/Contexts/Toxins/Sci-Media/Video/Mouse-bioassays

www.foodsafetynews.com/2014/02/new-shellfish-safety-test-readies-to-save-thousands-of-mice/#.WDef-X0rjOA

www.fao.org/docrep/007/y5486e/y5486e00.htm#Contents

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