Anaesthesia for fish

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Vietnamese people were known to use a climbing leguminous plant called *Derris Tonkinensis* to anaesthetise the fish long ago (aneasthetised fish are easier to catch). However, anaesthesia has just been used in the world's aquaculture for 60 years to reduce the stress on the fish and thus the injuries during transportation, breeding, capture, etc. The article provides a summary of the technical contents of the Seminar on Application of Anaesthetic Agents in Aquaculture held in Can Tho on December 1, 2010.

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Before considering the best way to anaesthetise fish it is worth discussing whether or not fish actually feel pain. While the scientific community has debated this matter over a number of years, more and more concrete evidence has appeared to support the notion that fish do feel pain. Consumers and those with an interest in the protection of animals from un-necessary suffering now have this matter on their agenda.

We must assume that fish, like other animals do feel pain and it is therefore our responsibility to ensure that we minimize suffering or distress as much as possible.

Because fish move adversely from any noxious stimulus (whether or not they feel pain) we sometimes use anaesthesia for procedures in fish where it is not used in other domestic animals for example: transport, handling fish (especially broodstock), and conducting painful procedures (e.g. tagging or injection vaccination in species where this is appropriate)

How do anaesthetic agents work in fish?

Anaesthetic agents are inhaled through the gills and rapidly enter the blood. From there they are transported to the central nervous system and excreted via the gills upon the fish's return to fresh water. They work by inducing a calming effect followed by a successive loss of equilibrium, mobility, consciousness, and reflex action.

Respiratory and cardiac failure follows overdose or exposure.

Before sedation or general anaesthesia, fish should be fasted for at least 12 to 24 hours or until one can ensure that the stomach is empty of food to prevent regurgitation. It is important that anaesthesia and recovery (without anaesthetic agent) tanks are prepared ahead of time.

The golden rules for fish anaesthesia

Use water from which the animals originate and at the temperature to which the animals are acclimated

Anaesthetic solutions and recovery tanks should be aerated at a level required by the particular species of fish

Monitor temperature, dissolved oxygen concentration, ammonia levels and build up of faecal and other solids in the bath

Monitor fish as they are introduced to the anaesthesia bath

When determining which anaesthetic agent to use attention should be paid to

* The product itself (is it registered for use in fish?)
* Dose
* Water temperature, hardness, salinity, & oxygen concentration
* Length of time of immersion
* Biomass of fish
* Stocking density of fish: Never overstock fish in an anaesthetic bath. A good guide is to try to keep at or below the standard stocking densities for fish culture. Species of fish (Some species may find a particular anaesthetic agent toxic)
* Size of fish
* The hands of the operator should always be wet
* Handle fish carefully to avoid damage
* Do not overheat or overcool fish while handling
* Respiratory failure and death can occur from prolonged exposure or overdose
* When sedated for long periods the level of sedation should allow the fish to maintain their

equilibrium and swimming position

* Fish should be returned to their original rearing water as soon as possible

* Finally remember that large mature fish can retain anaesthetic for a longer period after recovery

The ideal anaesthetic agent should have the following properties

* Produce rapid anaesthesia (1 - 5 mins)

* Produce a quick recovery (<5 mins)

* Non-toxic to fish and users

* Large safety factor

* Easy to handle

* No persistent effects on fish physiology and behaviour.

* Rapidly excreted or metabolised and leave no/low tissue residue.

* N

* Either a zero or short withdrawal time

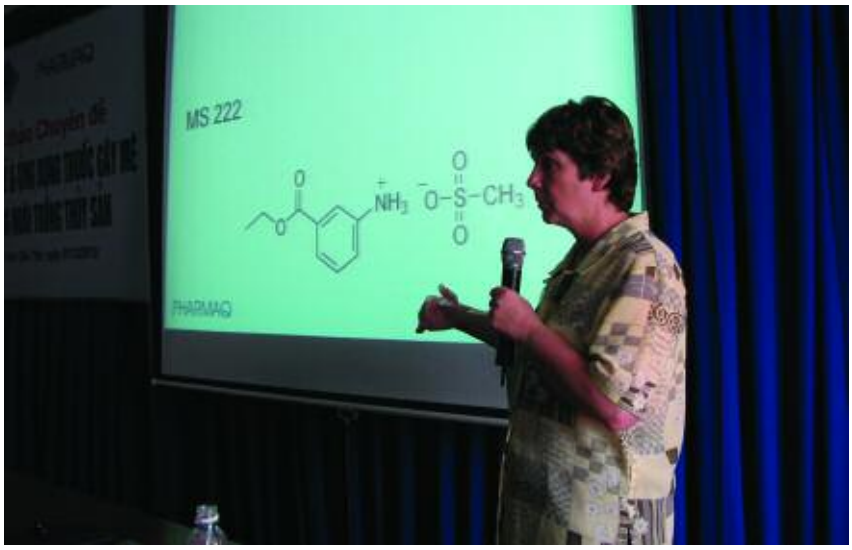
* Affordable

Features and benefits of the commonly used anaesthetic agents in fish:

This summary has been collected through personal experience of the author and from published literature on each product.

MS-222

Only MS 222 (tricaine methanesulphonate) has a veterinary medicinal product registration in the EU (UK). No Maximum Residue Limit (MRL) required. A safety limit of 70 degree days applied for withdrawal period for use in food fish. It is a benzocaine derivative anaesthetic allied to cocaine and is the most commonly used anaesthetic for fish worldwide. MS-222 is the only anaesthetic agent approved for use in food fish in Europe and has a wide margin of safety in a number of species. Other names for tricaine methanesulphonate which may be seen in catalogues are: 3-Aminobenzonic acid ethyl ester, ethyl m-aminobenzoate, It is a white to off-white crystalline powder and is water-soluble (to 11%). The powder is added directly to the anaesthetic bath although a stock solution may be made. One major advantage over other anaesthetic agents is that it is very water soluble. In soft acid waters it may reduce the pH of the water but this can easily be remedied by added small quantities of sodium bicarbonate to raise the pH back to normal levels. To maintain good activity the powder must be protected from light.



Dr. Lydia Brown speaking at the Seminar on Application of Anaesthetic Agents in Aquaculture

MS-222 acts systemically in fish but is considered to be a local anaesthetic agent in other animals. Its mechanism of action is as a sodium channel blocker and it has a rapid effect on muscle activity with a consequently rapid recovery from the anaesthetic agent. While large mature fish can retain the anaesthetic for a longer period after recovery it has a wide margin of safety in a number of species. In some species of frogs for example, the LC50 is greater than 6000 ppm (60 times the average anaesthetic dose for a fish). MS-2222 does not affect the respiratory system. In some older literature there is some evidence that chronic exposure in fish, amphibians, and humans may cause reversible retinal deficits but this has not been reported in modern times. General dose rates vary from 20 to 150 mg/L depending on fish species.

Benzocaine

Benzocaine powder is made into an anaesthetic solution by preparation of a stock solution in various organic solutions Commonly seen names in catalogues are Benzocainum, Ethyllis aminobenzoas (IP), Ethyl aminobenzoate and Ethyl p-aminobenzoate. It is a colourless crystal or white odourless crystalline powder which is insoluble in water. However in solution benzocaine is neutral. Dose rates normally used in fish vary around a norm of 50 to 100 mg/L. As for MS-222 benzocaine acts systemically in fish. From a Health and Safety perspective the stock solution may act as an irritant to the handler and care must be taken when preparing the solution.

2-phenoxyethanol

2-phenoxyethanol is a liquid anaesthetic used to sedate non-food fishes (ornamental fishes) during live transport. It is also called phenoxetol. The product is a colourless oily liquid with a faint aromatic odour but is only moderately soluble in water. It is said to have bactericidal and fungicidal properties but this seems to be anecdotal rather than scientifically proven.

2- Phenoxyethanol has a melting point of 13oC. Its major use is to sedate non-food fishes (ornamental fishes) during live transport. One major drawback is the large effective anaesthetic dose required. In general a dose of Ữ0.25 cm3/l is suitable for juvenile salmonid fish. The product acts rapidly and if exposure is limited, recovery is also rapid. However in normal aquacultural practices this might induce a certain degree of immunodepression in farmed fish. Again it has been shown to depress complement activity, phagocytosis, humoral, and cellular immune responses in gilthead sea bream.

Some published literature has shown that stress in trials was not alleviated by 2-phenoxyethanol anaesthesia. There are reports that it causes some neurophysiological syndromes and is irritating to the eyes and skin of users.

Clove oil

Derived from the stem, leaves and buds of the Eugenia caryophyllata tree. It is a commonly used anaesthetic for commercial (non-food) fish but should not be used in fish destined for human consumption. The use of clove oil is characterised by rapid induction, prolonged recovery, and the narrow margin of safety/ It is also known as Eugenol, 4-allyl-2-2methoxyphenol and AQUI-S.

The active ingredient is Eugenol (4-allyl-2-methoxyphenol), a phenolic compound which is not completely soluble in water (at low temperatures (< 15ºC) it is necessary to dilute the product 1: 10 in 95 per cent ethanol to yield a working stock solution of 1100 mg/ ml. Many claims have been made for this product ranging from antioxidant, antifungal agent, antibacterial agent, analgesic and local anaesthetic!!! Concentrations of between 25 and 50 mg per litre are effective in freshwater and marine species; recovery may be prolonged. However care must be taken when using high concentrations of eugenol for induction, because ventilatory failure may occur rapidly. Its analgesic properties are unknown and neither safety nor efficacy in fish has been systematically evaluated. Since it is oil this coats anatomic structures e.g. gill epithelia .Consequently exposure is prolonged. Recovery times of rainbow trout are 6 to 10 times longer than other anaesthetics. There is an inhibitory effect on the respiratory system resulting in a lesser ability to remove anaesthetic from the fishés system. Clove oil is listed as safe in humans at levels not exceeding 1500 ppm. It is rapidly lost from the bloodstream and tissues and is neither toxic nor carcinogenic although recent research suggests that a metabolite of eugenol is carcinogenic to rats. This data needs to be substantiated. When used in fish, concentrations of between 25 and 50 mg per litre are effective in freshwater and marine species.

Time to recovery of equilibrium for clove oil has been reported as not ideal.

Etomidate/Metomidate

These products have not been included in this review since they are believed to be tranquilising sedatives rather than full general anaesthetic agents. They produce a calming tranquilised state in fish but immobility of fish which have been given these products should be taken as a sign that they do not feel pain. There may be a use for these products where stress reduction is required (e.g. during transport).

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