ELECTRICAL STUNNING: IS IT AN ALTERNATIVE FOR CAPTURED FISH?

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IMARES and AFI are cooperating in “WAGENINGEN AQUACULTURE”
Introduction

For quality and efficient handling of the catch the following steps need to be given attention

- 1. Loading and live holding – transferring the catch gently, efficiently and live from the fishing gear to live holding tanks on board.

- 2. Stunning and killing – automatic and accurate stunning and killing of the individual fish in the catch.

- 3. Chain management and automatic documentation – monitoring and optimizing the catch handling processing chain and ensuring traceability within the chain.
Stunning and killing are two handling operations that are essential in order to establish a high quality in the catch after loading and holding.

A stunned fish is motionless and this facilitates further processing of the catch on board.

Stunning and killing of e.g. farmed African catfish is a more efficient process than live chilling of batches.
Stunning should render the fish unconscious immediately (< 1sec) and permanently. However...

Electrical stunning does not kill fish; they recover.

Hence, the approach is stunning followed by a killing method to avoid recovery. For instance, chilling in ice water or a combination of gutting and chilling can be used as killing methods.

Stunning with an electrical current that is too low may lead to carcass damage (haemorrhages, a broken spine, loss of scales) in fish.
**Introduction**

- Data on assessment of killing methods.

<table>
<thead>
<tr>
<th>Killing method</th>
<th>Time to loss of consciousness (EEG)</th>
<th>Time to loss of self-initiated behaviour</th>
</tr>
</thead>
<tbody>
<tr>
<td>Asphyxia</td>
<td>5.5 min (seabream)</td>
<td>4.0 min</td>
</tr>
<tr>
<td>Gutting</td>
<td>Electrical stunned plaice and sole recover</td>
<td>Not determined</td>
</tr>
<tr>
<td>Freezing</td>
<td>&gt;&gt; 0.5 min (eel)</td>
<td>Not determined</td>
</tr>
<tr>
<td>Chilling on ice</td>
<td>5.0 min (seabream)</td>
<td>5.0 min</td>
</tr>
<tr>
<td>Bleeding</td>
<td>Decapitated eel:13 min</td>
<td>Not determined</td>
</tr>
<tr>
<td></td>
<td>Gill-cutting after electrical stunning: A. salmon recovered 3 min post-stun Nile tilapia recovered 10 min post-stun.</td>
<td>VORs absent After 10 min not lost</td>
</tr>
<tr>
<td>Throat cutting</td>
<td>Not determined</td>
<td>Not determined</td>
</tr>
</tbody>
</table>
Introduction

The objectives were

1) for a Norwegian project DANTEQ, led by Sintef:

- To measure consciousness and survival, using measurements of brain (EEGs) and heart activity (ECGs) and behaviour of cod (Gadus morhua) and haddock (Melangrammus aeglefinus) landed on deck

- To establish conditions to provoke immediate loss of consciousness without recovery in cod and haddock by electrical stunning on board, using a so-called “dry” stunning.
Introduction

Objectives-continued

2) for a Dutch project, coordinated by Ekofish and managed by Scienta Nova:

- To establish conditions to provoke immediate loss of consciousness without recovery in plaice (*Pleuronectes platessa*) and dab (*Limanda limanda*) by electrical stunning on board, using a so-called “dry stunning”.

- Construct and test a first prototype for electrical stunning of caught cod, sole (*Solea solea*), dab, turbot (*Psetta maxima*) and plaice.
Criteria for the construction of a stunner-established for farmed fish

- A brief summary of criteria for the construction of equipment for “dry electrical stunning”
  - a dosing system to avoid that 1) fish are exposed to pre-shocks when they are not between the electrodes yet; 2) fish do not enter the stunner tail-first; 3) more than one layer of fish is present in stunner.
  - The power source needs to be stable when the stunner is filled with fish. The voltage remains sufficiently high, regarding the electrical current).
  - Exposure to the electricity is sufficiently long to avoid recovery during the application of a killing method.
Introduction

Assessment of a 1 second electrical stun.
Options for electrical stunning

- For example electrical stunning prior to killing in a slurry of ice and water. Two approaches- expose to electricity after dewatering (so-called “dry stunning” or expose to electricity in water.
Assessment of survival of landed fish and of electrical stunning

- EEG. Electrical activity in the brain to assess whether consciousness and sensibility are lost.

- ECG. Electrical activity in the heart as measure for survival and to assess whether electrical stunning results in defibrillation.

- Behaviour. Responses to administered stimuli. Observation of behaviour only has to be used with caution.
Results-Norwegian project
Results-Norwegian project

- EEG and ECG of a cod and a haddock stored “dry”. 

![Graphs showing EEG and ECG results for cod and haddock stored at different time intervals](image)
Results-Norwegian project

- Observation of behaviour
  - For cod we observed that the capacity to respond in behaviour was lost after 2 h elapsed, while the EEG traces revealed that these animals were still conscious.
  - For conscious haddock we observed that after 2 h of storage responses in behaviour to administered stimuli were absent.
Results-Norwegian project

- For cod and haddock we established that by exposure to 52 V_{\text{rms}} sufficient current (0.34 ± 0.09 and 0.36 ± 0.12 A_{\text{rms}}, respectively) was passed through individual cod and haddock for an instantaneous stun.

- When these fish species are exposed to electricity for at least 3 s recovery can be prevented by applying throat cutting as killing method.
Results-Dutch project

- **Dab**: $106 \text{ V}_{\text{rms}}$ for 1 s to pass sufficient current through the fish. Exposure for 15 s followed by killing by bleeding (cutting the artery along the spinal cord behind the head) avoided recovery. Fillet yield, however, is low.

- **Plaice**: $106 \text{ V}_{\text{rms}}$ for 1 s to pass sufficient current through the fish. Exposure for 15 s combined with killing in ice water for 15 min avoided recovery. This killing method is slow. Improvement is needed.

- Conditions for stunning and killing of turbot ($106 \text{ V}_{\text{rms}}$) and sole ($106 \text{ V}_{\text{rms}}$) are available.
Results - Dutch project

Installation of first prototype on board

First prototype being installed on board.

Fish between the electrodes

Preliminary trials revealed that the first prototype needs to be adapted with respect to the dosing system.
Conclusions

- Norwegian project
  - Since the cod and haddock remain conscious for at least 2 h after landing on deck.

- Electrical stunning by applying $52 \, V_{\text{rms}}$ for at least 3 s and immediate killing by throat cutting is recommended to pass sufficient current through a fish for an instantaneous stun.
Conclusions

- Dutch project

  - Preliminary tests of the stunner in the Dutch project reveals that optimisation is needed.

  - Dab and plaice can be rendered unconscious within 1 s by applying $106 \text{ V}_{\text{rms}}$. Both stunned species can be killed without recovery after exposing them for 15 s to the electricity followed by chiling in ice water.

  - Optimisation of killing of stunned fish is needed.
Acknowledgements

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- The crew of the research vessel Jan Mayen.
Thank you for your attention

My motivation to perform experimental work.

To read about is one thing but to feel, see, hear and smell is a completely different thing in order to understand (A. Kiessling, 2010).