Ike Jime: Lessons from the Japanese Method of Humane Harvesting

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OVERVIEW

In April of this year, the Freshwater Institute and the Ike Jime Federation, LLC collaborated on a small study with big implications. The first question was simple: how do current humane slaughter practices in use at the Freshwater Institute compare to a centuries-old Japanese technique that gave birth to one of the most seafood forward food cultures in the world. And the second question is more provocative: who's listening?

PURPOSE

1. Learn about menus beyond the traditional, American status quo;
2. Explain why a vacuum exists for non-traditional American seafood menus and why demand continues to grow;
3. Discuss the competitive advantages of RAS-farmed fish and humane slaughter techniques that optimize quality.
4. Describe the study and key findings.
Traditional meat consumption in the U.S. takes many forms.

Breakfast, lunch, dinner  
Bone-in or boneless  
Skin-on or skinless  
Fried or grilled  
Braised or cured

The bottom line:  
*We take meat seriously!*
Over the last several decades, we have witnessed a dramatic shift in consumer demand for meat that has been responsibly raised and slaughtered. 

*See Animal Welfare Act 7 U.S.C. 2131 et seq. (1976)*

The meat industry has responded to such demand with efforts towards transparency and sustainability.
What about Fish?
Traditional Seafood Consumption in the U.S. is relatively basic.

- Headless
- Boneless
- Baked
- Grilled
- Fried
- Seared

The bottom line:

*We haven’t taken our seafood very seriously!*
More recently, we have witnessed a dramatic shift in consumer demand for premium seafood products (e.g., sashimi/sushi, crudo, ceviche, tartare).

The seafood industry has been slow to respond to such demand in a meaningful way.
Tastes are changing . . . See, e.g., sushi restaurants

We want to take our seafood seriously!!
Fresh is the only word we use to connote quality. It’s not enough.

What does “fresh” mean?
The *Ike Jime* Process
The *ike jime* process was developed centuries ago in Japan to optimize the quality, safety, and flavor of fish. It’s still in use today.

1. **Fish at Rest**
   - **Why?** No stress.
   - **How?** Rest (if line/net caught); farmed

2. **Brain Death**
   - **Why?** No pain; no voluntary muscle movements
   - **How?** Stunner, brain spike/ablation

3. **Exsanguination**
   - **Why?** Rid carcass of blood, which is significant source of bacteria
   - **How?** Cut to gills and/or major arteries, ideally while heart still beating

4. **Spinal Cord Destruction**
   - **Why?** Sever residual signals from nervous system to muscles. This preserves ATP.
   - **How?** Run a wire down length of neural canal and ream out spinal cord.

5. **Rapid Cooling**
   - **Why?** Bring core body temperature down to inhibit bacterial growth
   - **How?** Ice slurry (2:1)
We’ve proven that it’s biologically and technologically feasible to raise Atlantic salmon to market size in land-based RAS

Davidson et al., 2016. Aquacultural Engineering 74, 1-16

doi:10.1016/j.aquaeng.2016.04.007
Market-size (4-5 kg) salmon harvested from relevant scale RAS and moved to depuration system
Partial reuse with stacked CO₂ stripper/ LHO

17 m³ culture tank

3-4 hr system hydraulic retention time
Salmon kept off feed and typically purged for 6-7 days prior to slaughter.

For the study, ~50 fish remained in purge and depurated for 10-11 days to accommodate study timeline.
Humane Slaughter with SI-7 Stunner

A pneumatic piston strikes fish at brainstem and a blade simultaneously cuts/bleeds the fish.
The *Ike Jime* Process vs. Freshwater Institute Protocols

**The *Ike Jime* Process**

1. Fish at Rest
2. Brain Death (Stunner or manual)
3. Exsanguination (Manual)
5. Rapid Cooling

**The Freshwater Institute**

1. Fish at Rest (RAS)
2. Brain Death (SI-7 Stunner)
3. Exsanguination (SI-7 Stunner)
4. Rapid Cooling

Incidentally, a centuries-old process is largely overlapping with current technology.
Ike Jime Protocol
Ten salmon (4.9 ± 0.2 kg) evaluated using 2 slaughter techniques:

- SI-7 Stunner with automated bleeding
- SI-7 Stunner followed by manual bleeding & *ike-jime* spinal cord destruction

Fish were tagged and placed in ice-water bath for about 45 mins to rapidly cool the body temperature.

Fish were then packed on ice.

Fish removed from ice at intervals to assess muscle temperature, pH, and rigor.

After fish had resolved from rigor they were processed - 3 days post-harvest.

One day after processing, and again at 7 days, fillet attributes (color, texture, composition) were measured at West Virginia University.
Rigor onset significantly slower for salmon euthanized using automated stunner

Slower rigor onset generally correlated with improved fillet quality
Salmon slaughtered with SI-7 stunner had significantly higher muscle pH immediately after slaughter indicating reduced struggle/muscle activity.
Post-Slaughter Rigor

- Salmon slaughtered with SI-7 stunner experienced slightly different rigor onset compared to fish slaughtered with SI-7 + spinal cord destruction.
<table>
<thead>
<tr>
<th>Raw Fillet Color</th>
<th>4-d post-slaughter</th>
<th>11-d post-slaughter</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Stunner</td>
<td>Stunner w/ SCD</td>
</tr>
<tr>
<td>L* (Lightness)</td>
<td>37.7 ± 0.4</td>
<td>38.9 ± 0.4</td>
</tr>
<tr>
<td>a* Color (Red)</td>
<td>9.00 ± 0.42</td>
<td>8.81 ± 0.42</td>
</tr>
<tr>
<td>b* Color (Yellow)</td>
<td>10.2 ± 0.3</td>
<td>10.8 ± 0.4</td>
</tr>
<tr>
<td>Fillet Parameter</td>
<td>4-d post-slaughter</td>
<td>1-d post-processing</td>
</tr>
<tr>
<td>----------------------</td>
<td>--------------------</td>
<td>---------------------</td>
</tr>
<tr>
<td>pH (raw)</td>
<td>6.27 ± 0.03</td>
<td>6.25 ± 0.01</td>
</tr>
<tr>
<td>Texture (raw)</td>
<td>306 ± 15</td>
<td>288 ± 11</td>
</tr>
<tr>
<td>Texture (cooked)</td>
<td>355 ± 11</td>
<td>351 ± 12</td>
</tr>
</tbody>
</table>
Study Conclusions

- This study provides preliminary evidence that the SI-7 stunner provides similar food quality advantages as the highly regarded *ike jime* technique.

- We plan to conduct further studies to compare changes in fillet attributes, flavor development, and consumer preferences for salmon that are humanely slaughtered using each method.

Photo courtesy: Jeff Lewis (Chef) Charthouse Restaurant, Alexandria, VA
Conclusions

- Although *ike jime* and the humane slaughter techniques used at the Freshwater Institute were developed independently of one another and in different centuries, they share the same principles.

- *Ike Jime*/Humane slaughter is a modest proposal that results in profound quality differences from conventionally slaughtered fish.

- RAS represent a fish production technology that provides a low stress environment for fish during culture, harvest, and slaughter that aligns with new culinary trends *AND* increased consumer demand for responsibly sourced, sustainable, and healthy seafood.

- Next Steps:
  - Existing science *applied*;
  - Continued transcultural and interdisciplinary collaborations
  - Continued investment in RAS technology;
  - Continued education and *smart* marketing campaigns
“Sashimi-grade” fish begins at 1.5x the price of regular fish.
Acknowledgements

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- Opinions, conclusions, and recommendations are of the authors and do not necessarily reflect the view of the USDA.

- All experimental protocols were in compliance with Animal Welfare Act (9CFR) and were approved by the Freshwater Institute Animal Care and Use Committee.

- Special thanks to Zachary Janiak, Lauren Cheeks, and Chance Younker for hands-on support and to and Kata Sharrer for images and photography.
Addis, et al. 2D DIGE/MS to Investigate the Impact of Slaughtering Techniques on Postmortem Integrity of Fish Filet Proteins, JOURNAL OF PROTEOMICS 75 (2012) 3654-3664.


Bane, Brendan. The More Humanely a Fish Is Killed, The Better It Tastes, SCIENCE MAGAZINE, Dec. 10, 2015 (increase in hydroperoxides (compounds that accrue in the body during stress, which break down into aldehydes and ketones = foul smell/bitter taste))


Donath, Wessells, Johnsoton, and Asche, Consumer Preferences for Ecolabeled Seafood in the United States and Norway: A Comparison. IIFET 2000 PROCEEDINGS.


