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Rapid Quantification of Fish Freshness Using Digital Noninvasive Methods

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AQUACULTURE

Introduction

How do digital devices perform at quantifying fish freshness compared to a trained sensory expert? The current standard of measuring fish freshness (quality) is organoleptic sensory evaluation. New technologies have emerged that can quantify freshness by measuring the resistance and reactance of an electrical current passed through tissue in a process known as bioelectrical impedance analysis (BIA) (Cox et al., 2021).

The objective of this study is to use the Certified Quality Reader (CQR) 3.0 by CQFoods to compare its freshness scores with 1) organoleptic sensory scores and 2) days refrigerated. The CQR3.0 electrode location was manipulated in order to determine the importance of standardizing electrode location.

Materials and Methods

- 25 Olive Flounder (*Paralichthys olivaceus*) were euthanized via Ike Jime and placed in a -0.7 °C ice slurry following a three-minute exsanguination period
- Fish were aged at temperatures below 4°C and every five days for 20 days, each of five flounder were measured 1-10 times with a CQR3.0
- Comparisons were made between Certified Quality Number (CQN) scores and a) days in the fridge and b) sensory scores
- Organoleptic sampling was performed by SQSA Lab (Mr. Scott Zimmerman), quantified with the USDC's Sensory Quality Indicators for fresh/frozen rockfish
- After sampling fresh ("wet"), fish were frozen for 20 days and thawed at 4°C the night before sampling of "thawed" fish
- Day 1 thawed fish were sampled using the same methodologies used for wet fish (organoleptic and CQR sampling). Remaining fish were sampled using a CQFoods development kit ("dev kit") to obtain additional data
- The mean and standard deviations of repeated fish freshness measurements were compared statistically at a significance level of 0.05.

Figure 1. Organoleptic sampling

Figure 2. Bagged flounder

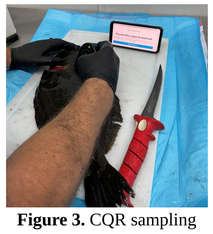

Figure 3. CQR sampling

Figure 4. Dev kit sampling

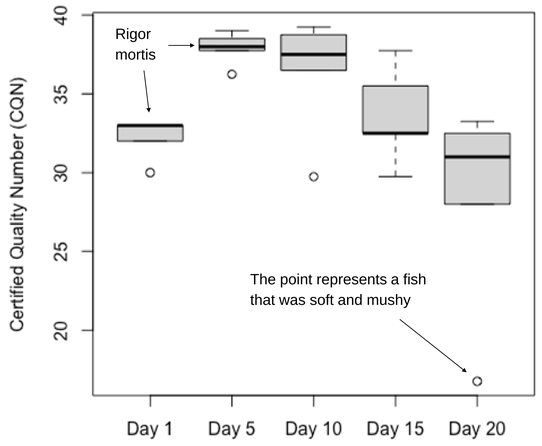

Figure 5. Certified Quality Number (CQN) compared to days in the fridge. Five fish were measured during each sampling period.

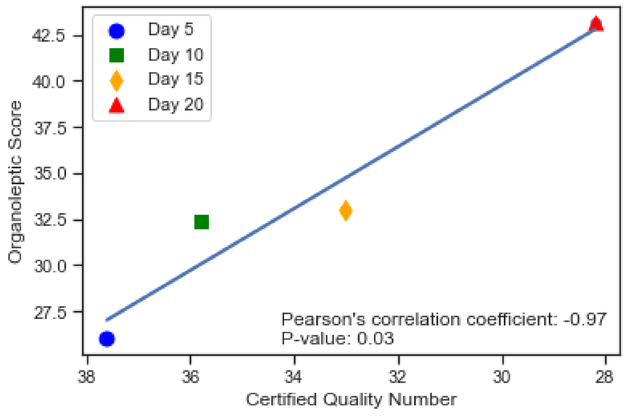

Figure 6. Mean Certified Quality Number (CQN) compared to mean organoleptic score post rigor.

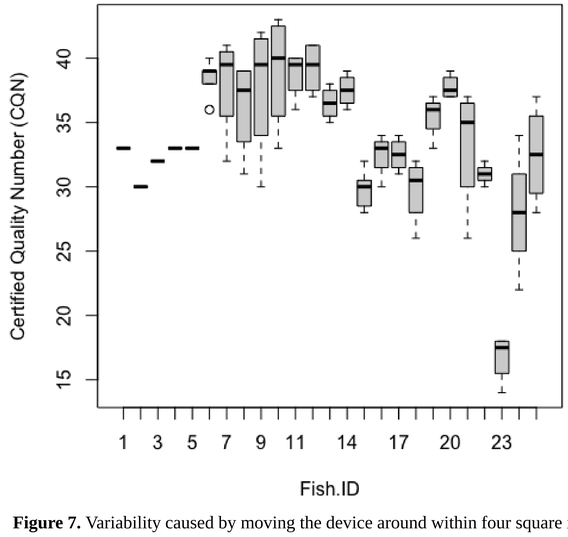

Figure 7. Variability caused by moving the device around within four square inches.

Conclusions

- Certified Quality Numbers (CQN) decreased significantly after rigor mortis for 20 days post harvest
- Strong correlation between organoleptic data and CQN
- Large difference between CQN of day one wet and thawed fish
- Variability within measurements of individual fish likely due to moving electrodes between measurements, indicating the need to determine set anatomical locations for measurements
- There exists a need for rapid differentiation of fresh, never frozen and thawed fish and BIA may be a useful tool for this
- Olive Flounder (*P. olivaceus*) is an excellent candidate for land-based aquaculture facilities in the United States (Stieglitz et al., 2021) and results of this study indicate harvested fish, when properly euthanized and cared for, have long shelf-life as fresh product
- Attempting to pass thawed fish off as fresh, never frozen, is unfortunately a common practice in the seafood industry (Chiesa et al., 2020)
- Using the CQR device, smaller scale seafood operations may have a cheaper alternative to quantifying the freshness of their fish with little training necessary
- On large scales, simple, objective, noninvasive digital testing methods have a significant advantage over organoleptic sampling

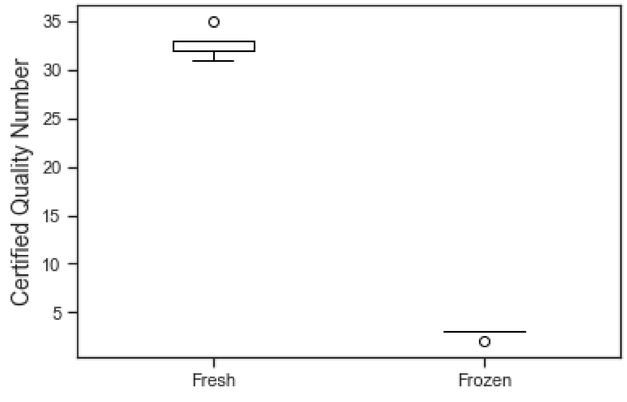

Figure 8. Difference between CQN of fresh and frozen samples for day one fish.

References:

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