Quality Control for Healthy Foods: Why the Label is as Important as the Content

Maureen Dolan
Assistant Professor at
Arkansas State University and
CSO, Applied Food Technologies

Presented at: OFPA 106th Annual Convention & Expo, April 4, 2012

So....Why should the industry care about mislabeling?

- Economic issue
- Industry reputation
- Conservation efforts
- Serious health implications
  - Allergens to specific types of fish or to the antibiotics used in producing farm-raised fish
  - Substitutions in sushi market – Escobar for Tuna
  - Associated toxins with certain fish – select species
  - Heavy metals associated with some fish species

Labeling Laws impacting Seafood Products

Federal Statutes:
- Federal Food, Drug, and Cosmetic Act (FDCA) Sec. 409.121 U.S.C. 343 (Misbranded Food
- Food Allergen Labeling and Consumer Protection Act of 2004 [Public Law 108-283, Title 1]
- Lactacy Act
- Seafood, Beauty, and Labeling Act
- Public Health Security and Bioterrorism Preparedness and Response Act of 2002
- Tariff Act of 1930 (19 U.S.C. § 1592), Section 592

Federal Regulations:
- Import Alan 16.04
- Import Alan 16.178
- 21 C.F.R. PAR 101
- 21 C.F.R. PAR 101—ANIMAL FOOD LABELING
- U.S. Food and Drug Administration’s RACCP Guide

Tackling the issue: Leveraging science know how to meet seafood industry testing needs

- 2000 – Started development of DNA-based diagnostics for seafood species identification through USDA SBIR research grant targeted toward the growing national issue.

Fish Identification: Where we started

- Morphology
- Protein based methods

Twenty years experience working with the seafood industry and regulators.
Fish Identification: The era of molecular methods

FDA Office of Seafood: "a molecular method may be used as long as it is developed utilizing taxonomically verified reference standards"

Morphology

Protein-based methods

DNA

Taxonomically Validated References

2000 – Collaborated with the Seafood Industry to collect fish and shellfish species for taxonomical verification at museums across the country to establish a validated database of reference specimens.

Species ID Database: Contains genetic data for > 1000 species

Fish Identification: Current testing formats

FDA Office of Seafood: "a molecular method may be used as long as it is developed utilizing taxonomically verified reference standards"

Morphology

Protein-based methods

PCR Multiplex

DNA

Molecular –based methods involve ability to amplify DNA

• 2004 – Developed & launched PCR multiplex for catfish – Authenti-kitSM for Catfish

Catfish product

Commonly substituted Fish

Molecular –based methods involve ability to amplify DNA

• 2006 – Authenti-kitSM for Catfish becomes the first DNA method accepted for regulatory compliance testing by FDA under Import Alert 16-128.

Fish Identification: Current Methods

FDA Office of Seafood: "a molecular method may be used as long as it is developed utilizing taxonomically verified reference standards"

PCR Multiplex

DNA Sequencing

Morphology

Protein-based methods

DNA

Fish species I.D. DNA barcoding

FDA has designated a segment of DNA to be used in a taxonomic method called “DNA barcoding” for identifying fish species

DNA EXTRACTION

Extracted DNA

Instrumentation

PCR AMPLIFICATION

Detect diagnostic DNA target

DNA SEQUENCING

Silico-based analysis

Validated Fish Database

DATA ANALYSIS
How DNA Barcoding works

- Fish sample DNA sequences are "aligned" with the validated reference sequences to compare similarity to each
- Fish of the same species have exactly or almost exactly the same sequence as the validated reference fish's DNA sequence (% confidence value)
- This is why the FDA requires the validated reference - this is the most important piece of information in the experiment!

DNA Sequencing/Barcoding

- Universal primers
  - Cytochrome b (Cyt b)
  - Cytochrome c oxidase (CO1)
  - Nuclear genes: ITS1/2
  - Others
- Limitations:
  - Long DNA fragment - may not be recovered from heavily processed samples
  - Not all genes discriminate
  - Can not analyze mixtures

Universality of Barcoding Primers?

Media Reports – 74% of red snapper is mislabeled in the market
- Cyt b and CO1 do not discriminate between:
  - Lutjanus campechanus
  - Red Snapper
  - Lutjanus purpureus
  - Caribbean Red Snapper
  - Lutjanus vivianus
  - Silk Snapper
- Similar situation with tuna
- R&D needed to go beyond sequencing to distinguish closely related species.

Equipping the industry with best available science

- Provide testing service for the industry and regulators
  - [is it really grouper or is it Vietnamese basa or tra?]
- Worked with the industry to develop an acceptable sampling plan for species identification testing. FDA accepted it.
- Collaborated extensively with FDA and others to create regulatory standards and protocols currently recommended for molecular regulatory compliance testing for species identification.
- Ongoing R&D efforts

Collaborations key to testing method development

- FDA and other key players share a common goal of assisting the industry in protecting the consumer.
- Resources are limited!!...resources shared to help create the protocols currently in use for FDA's DNA barcoding method.
- The "best available science" for seafood species identification to provide confidence to end-users that their testing program is as sound as it possibly can be.

Who uses Fish species I.D. testing?
- foreign suppliers, importers, domestic suppliers, distributors, restaurants and grocery chains; also test for federal and state regulatory agencies.
- Additional services to address various other issues in the seafood industry:
  - Chemical and microbial analysis
  - Net weights
  - New market label guidance
  - Aquaculture health and environmental testing

What are the costs of testing?
- Testing service adds less pennies per pound now than it once did
- Currently less than 3 cents per pound
- Risk-benefit: compromising company reputation and financial consequences can be mitigated/even avoided through testing.
Active R&D program developing molecular diagnostics to address issues of concern in the seafood industry since 2000 – “best available science”

Addressing needs of the industry
- Testing for Sysco and US Foods since 2006
- Only company meeting FDA’s guidance requiring use of a reference database of adequately authenticated samples
- For AFT customers testing regularly, mislabeling decreased significantly for grouper from 2006 to 2011
- Proper labeling of seafood species contributes to efforts in maintaining high standards of US food supply and consumer health