

DNA-based Seafood Identification

Seafood is one of the most highly traded commodities in the world. In the interest of public health, it is vital that both domestically processed and imported seafood is safe, wholesome, and properly labeled. To aid in the proper labeling of seafood, the Food and Drug Administration (FDA) maintains a list of acceptable market names for seafood sold in U.S. interstate commerce: [The Seafood List - FDA's Guide to Determine Acceptable Seafood Names \(/food/guidance-documents-regulatory-information-topic/guidance-industry-seafood-list\)](#).

Several years ago, the Food and Drug Administration (FDA) produced a web-based resource known as the [Regulatory Fish Encyclopedia \(/food/reference-databases-and-monitoring-programs-food/regulatory-fish-encyclopedia-rfe\)](#) (RFE) to aid in the identification of commercially important species of fish (1). Organized in a series of species "pages," the RFE contains high resolution images of whole fish and their marketed product forms (*e.g.* fillets, steaks), as well as other taxonomic, geographic, and relevant tools for species identification. An example of an identification method listed in the RFE is protein identification by isoelectric focusing (2). Isoelectric focusing is a currently accepted tool employed in the identification of fish fillets for regulatory use, but such analysis requires subjective interpretations of gel results and the inclusion of perishable frozen tissue standards in each run. Further, the technique is not effective in the case of processed or cooked samples. The RFE was designed so that it could be expanded to include additional data and to accommodate the use of newer analytical tools as they became available. In 2007, using methods developed as part of the Barcode of Life initiative, DNA barcode sequences were generated for fish contained in the RFE and the utility of DNA barcoding for regulatory seafood identifications was demonstrated. (3)

The [Barcode of Life \(http://www.barcodeoflife.org/\)](http://www.barcodeoflife.org/) [↗](http://www.fda.gov/about-fda/website-policies/website-disclaimer) (<http://www.fda.gov/about-fda/website-policies/website-disclaimer>) initiative represents an ambitious effort to develop an identification system for eukaryotic life based upon the analysis of sequence diversity in short, standardized gene regions. Work is furthest advanced for members of the animal kingdom. In this case, a region of the cytochrome c oxidase subunit 1 gene (COI) has been targeted and pilot studies have shown its effectiveness in species identification. The Fish Barcode of Life campaign (FISH-BOL (<https://pubmed.ncbi.nlm.nih.gov/22684969/>)) is a collaborative international research effort which seeks to establish a reference library of DNA barcodes for all fish species derived from voucher specimens with authoritative taxonomic identifications (4). Fishes comprise nearly half of all vertebrate species; the group includes approximately 15,700 marine and 13,700 freshwater species ([FishBase \(http://www.fishbase.org\)](http://www.fishbase.org) [↗](http://www.fda.gov/about-fda/website-policies/website-disclaimer) (<http://www.fda.gov/about-fda/website-policies/website-disclaimer>)).

FDA's Center for Food Safety and Applied Nutrition (CFSAN) and Center for Veterinary Medicine (CVM), in collaboration with the University of Guelph's Biodiversity Institute of Ontario, Canadian Center for DNA Barcoding, and the Laboratories of Analytical Biology at the Smithsonian National Museum of Natural History, Suitland, MD, USA, first provided details on protocols, reagents, and equipment required to carry out a validation study for barcode generation for fish identification in the form of FDA Laboratory Information Bulletin No. 4420) (5). In 2008, this protocol was evaluated by three laboratories in an inter-laboratory trial and the results of this trial were used to further refine the method. This modified version of the method was then subjected to a formal single laboratory validation (SLV) at CFSAN and published in the Journal of AOAC (6). A [step by step protocol \(/food/dna-based-seafood-identification/single-laboratory-validated-method-dna-barcoding-species-identification-fish\)](/food/dna-based-seafood-identification/single-laboratory-validated-method-dna-barcoding-species-identification-fish) based on this published SLV study, with minor modifications, is provided below. For FDA purposes, this SOP is intended to replace LIB No. 4420.

Literature Cited

1. Tenge BJ, Dang NL, Fry FS, Savary WE, Rogers PL, Barnett JD, Hill WE, Wiskerchen JE, Wekell MM. (1997). **Integration of Computer and Laboratory Techniques for Species Identification Including Development of a Regulatory Fish Encyclopedia. in Fish Inspection**, Quality Control, and HACCP - A Global Focus, p. 214-226. Martin, Collette, and Slavin, (eds.), Technomic Publishing, Lancaster, PA.
2. AOAC. (1980). **Official Method 980.16 Identification of Fish Species: Thin-Layer Polyacrylamide Gel Isoelectric Focusing Method.** *J. AOAC* **63**:69 (1980); corr. 684.
3. Yancy HF, Zemlak TS, Mason JA, Washington JD, Tenge BJ, Nguyen NT, Barnett JD, Savary WE, Hill WE, Moore MM, Fry FS, Randolph SC, Rogers PL and Hebert PDN. (2008a). **The Potential Use of DNA Barcodes in Regulatory Science: Applications of the Regulatory Fish Encyclopedia.** *J. Food Prot.* **71**(1):210-7.
4. Ward RD, Hanner R, Hebert PDN. (2009). **The Campaign to DNA Barcode all Fishes, FISH-BOL.** *J. Fish Biol.* **74**:329-356.
5. Yancy HF, Fry FS, Randolph SC, Deeds JR, Ivanova NV, Grainger CM, Hanner R, Weigt LA, Driskell A, Hunt J, Ormos A, Hebert PDN. (2008b) LIB No. 4420: **A Protocol for Validation of DNA-Barcoding for the Species Identification of Fish for FDA Regulatory Compliance.** FDA Laboratory Information Bulletin Vol. 24.
6. Handy, SM, Deeds, JR, Ivanova, NV, Hebert, PDN, Hanner, R, Ormos, A, Weigt, LA, Moore, M, Yancy, HF. (2011). **A single laboratory validated method for the generation of DNA barcodes for the identification of fish for regulatory compliance.** *J. AOAC.* **94**(1):201-210. A [Protocol \(/food/dna-based-seafood-identification/single-laboratory-validated-method-dna-barcoding-species-identification-fish\)](/food/dna-based-seafood-identification/single-laboratory-validated-method-dna-barcoding-species-identification-fish) based on this publication is available (accessed 4/23/2014).

Resources

- [Reference Standard Sequence Library for Seafood Identification \(/food/dna-based-seafood-identification/reference-standard-sequence-library-seafood-identification-rssl\)](/food/dna-based-seafood-identification/reference-standard-sequence-library-seafood-identification-rssl)
- [Single Laboratory Validated Method for DNA-Barcoding for the Species Identification of Fish for FDA Regulatory Compliance \(/food/dna-based-seafood-identification/single-laboratory-validated-method-dna-barcoding-species-identification-fish\)](/food/dna-based-seafood-identification/single-laboratory-validated-method-dna-barcoding-species-identification-fish)
- [Fish and Fishery Products Hazards and Controls Guidance - Fourth Edition \(/food/seafood/fish-and-fishery-products-hazards-and-controls-guidance-fourth-edition\)](/food/seafood/fish-and-fishery-products-hazards-and-controls-guidance-fourth-edition)
- [Guidance for Industry: The Seafood List \(/food/guidance-documents-regulatory-information-topic/guidance-industry-seafood-list\)](/food/guidance-documents-regulatory-information-topic/guidance-industry-seafood-list)

Was this helpful?

Yes

No