

Laura Jankowski

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Forensic Science – Biology, Biology – Pre-Med

Creation of Methodology for Differentiation between Wild and Farm-Raised Chinook Salmon via Elemental Analysis

Mentor: Dr. R. Christopher O'Brien, Ph.D.

Oceana found in a study that 42% of the salmon they collected was mislabeled. Researchers studying this made the assumption that all Pacific Salmon was wild, and all Atlantic Salmon was farm-raised¹. DNA testing was done to identify the specific species of salmon, but no conformation was done to show whether the fish was definitively farm-raised or wild-caught. The goal of this project was to create an alternative methodology for identification of salmon in cases of seafood fraud where a species of salmon is both frequently farmed and fished, and the origin of the salmon is in question. Typical methodology used for identification of flora and fauna are either morphological identification or DNA Barcoding; both solely for the purpose of species identification. This new method would allow scientists to differentiate farmed from wild-caught within a single species. The final goal of the project is to be able to use the stable samples prepared from the new methodology created on machinery, such as Atomic Absorption Spectroscopy (AAS), Atomic Emissions Spectroscopy (AES), or X-Ray Fluorescence (XRF), and show statistically relevant differences between elemental composition of the two Chinook salmon groups. Preliminary testing was done of the samples on the University's AAS machine, but due to time and error from the machine not all testing was able to be finished in the allotted SURF period.

With the methodology created through this research, the salmon specimens were weighed into 5.4-13.4 gram samples, desiccated over 3-5 day periods, and digested in a wet ashing protocol using 70% HNO₃ and 75% H₂SO₄. Samples were then diluted down using a 3:100 ratio. While the desiccation period was longer than desired due to the volatile nature of some of the elements needed for testing, such as Copper, Arsenic, and Iron, it was found through desiccation that the farmed salmon samples contained a translucent, bright orange, viscous liquid that leaked from all the samples, which none of the farm raised salmon samples contained. Both samples did contain normal white fat, that melted and re-solidified in the desiccator. It very well could be that the liquid found in the farmed salmon was due to the high concentrations of omega-6 fats found in most farmed salmon², along with added dye to make the fish fillets look more pink, but further testing would need to be done in order to identify the true nature of the liquid.

Further testing is needed on the samples as a whole in order to identify whether there are statistically relevant differences in the concentrations of certain elements. Because of issues faced with the AAS, testing needed to continue this project is planned to be done either using XRF or AES. Both other methods should show similar results, and don't require use of an open flame like AAS. Use of an open flame can cause variability in temperature, and is slightly harder to control. If the method is proven to be successful, future publication will be sought.

1. Warner, K., Mustain, P., Carolin, C., Disla, C., Golden Kroner, R., Lowell, B., & Hirshfield, M. (October 2015). Oceana Reveals Mislabeling of America's Favorite Fish: Salmon. Retrieved February 5, 2018, from <http://usa.oceana.org/publications/reports/oceana-reveals-mislabeling-americas-favorite-fish-salmon>
2. Hamilton MC, Hites RA, Schwager SJ, Foran JA, Knuth BA, Carpenter DO. Lipid composition and contaminants in farmed and wild salmon. *Environmental Science & Technology*. 2005;39(22):8622-8629.