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

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Introduction

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.

The procedure used for this project was a wet-ashing procedure adapted from food chemistry methodology.

The new methodology should have clear results when differentiating between farmed salmon, and wild-caught salmon, and should allow for testing of specific elements such as; zinc, copper, iron, potassium, and arsenic. The intention was to create samples suitable for testing on either Atomic Absorbance Spectroscopy (AAS) or Atomic Emissions Spectroscopy (AES).

Materials

- Wild Chinook Salmon (eleven individual fish with three samples from each)
- Farmed Chinook Salmon (twelve individual fish with three samples from each)
- 70% Nitric Acid (HNO_3)
- 75% Sulfuric Acid (H_2SO_4)
- diH_2O
- Scintillation Vials
- Hot Plate
- Desiccator
- Watch Glasses
- Scale
- Mortar and Pestle

Methods & Results

Methods:

- Separate and label samples
- Record weight of all samples
- Place samples in desiccator (65-85 C), and bring samples to constant mass (±0.03 due to mass loss from handling)
- Store samples in sealed plastic vials and refrigerate
- Grind all samples individually
- Weight mass of sample (to calculate any difference from loss of mass during transfer)
- Round all sample weights down to the nearest whole number when adding acid
- For every 1g of sample, add 3mL of H_2SO_4, and 5mL of HNO_3 to sample
- Bring sample to boil
- When fumes turn white, immediately remove beaker from hot plate and add 5-10 mL more of HNO_3, and put back on hot plate
- Swirl or stir the mixture periodically
- Continue heating and adding HNO_3 until the solution is clear and a straw color
- Remove finished solution from heat and cool
- Create 40 mL of diluted sample (1.2 mL sample solution, and 38.8 mL diH_2O.)
- Store scintillation vials
- Create blanks for all (10) H_2SO_4/HNO_3 ratios

Results:

It was initially noted that the wild salmon was more pink in color while the farm-raised was more orange.

When desiccating the samples, it was noted that both had white fat leak out from the sample as a liquid and then re-solidify to the watch glass as a solid, only the farm-raised samples had a clear, bright orange oil consistently leak out of all the samples, making the desiccation time for the farm-raised 1-2 days longer than that of the wild salmon.

Image 1: Reaction between Sulfuric Acid and Nitric Acid used for digestion

Image 2: Ora King (Chinook) Salmon, farmed in New Zealand

References

Nielsen, S. (2003). Chapter 7: Ash Analysis. In Food Analysis (3rd ed., p. 108). New York, NY: Kluwer Academic / Plenum.

Discussion

The procedure created took a lot longer than anticipated, mostly due to availability of resources. Desiccation took anywhere from 3-5 days, whereas digestion took roughly 2.5 hours per batch of 3 samples, which would be feasible in a lab setting. This would be somewhat of an issue for forensic labs that are trying to get through testing as quickly as possible, especially with a time sensitive commodity. If done again, it is recommended to treat the samples with a solution that would remove the majority of the fat prior to desiccation, hopefully cutting down the desiccation period.

Conclusions

Sixty-nine samples of wild and farm-raised Chinook Salmon were successfully processed and digested into stable solutions ready for test. Further analysis is needed in order to find statistical differences between the concentration of trace elements in this particular species of salmon. This methodology could be the basis of a new technique for analyzing seafood fraud.

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