CALIBRATION DEVELOPMENT FOR RAPID ASSESSMENT OF FISH SPECIES FOR DOLPHINS IN HUMAN CARE USING NEAR INFRARED REFLECTANCE SPECTROSCOPY (NIRS)

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Abstract
Near infrared reflectance spectroscopy (NIRS) is a fast, accurate, and cost effective method for analyzing organic compounds. Dolphins as a species are highly sensitive to changes in the energy and nutrient contents of their diets. We analyzed monthly samples (*n*=148) of capelin, herring, and squid for dry matter, crude protein and crude fat. The dried and ground samples were returned to our lab and analyzed via NIRS for collection of spectral data. Calibrations were developed using the wet laboratory analysis as reference values to develop prediction equations. We were able to produce strong equations with low standard error of cross validation (SECV) = 1.29 to 1.90; r^2= 0.90 to 0.98. These indicate good predictive power of our equation and will allow accurate assessment of the nutrient content of fish.

Introduction
Dolphins held under human care are sensitive to slight fluctuations in dietary energy. Earlier research from our laboratory found high variability of nutrient content in the fish species that compose a majority of dolphin's diets at Disney (Sullivan et. al., 2013). Regular analysis of the main dietary components allows nutritionists to adjust for these dietary fluctuations and maintain the dolphins within a target weight range. We aim to expand our Near Infrared Reflectance Spectroscopy (NIRS) program researching its utilization as a quick, accurate, and cost effective method for regularly assessing these fish species as both dried (Sullivan et. al., 2008) and test the ability to analyze fresh samples.

Materials and Methods
Monthly samples (n = 148) of capelin, herring, and squid were collected by the marine mammal team at the Seas and sent to our laboratory and also to Dairy One Forage Laboratory for analysis of dry matter (DM), crude protein (CP), and crude fat. Wet chemistry data were utilized as reference values for subsequent NIRS calibration development and cross validation. The dried and ground samples were returned to our laboratory, scanned by NIRS (SpectraStar 2500X-RTW System with InfoStar Software v. 3.11.1, Unity Scientific, Brookfield, CT), and reflectance spectra were collected over a range of 680 to 2500nm with 1nm wavelength increments. Calibration development was achieved by treating the full spectra with partial least squares. Cross validation of the prediction equation was achieved by dividing the calibration set into independent groups. Each group was pulled out of the calibration set, and tested by predicting their nutrient values against their laboratory value. This tested the predictive accuracy of the equation.

Results and Discussion

When the spectra for the dried fish samples were modeled via principal component analysis (PCA), the results indicated a balanced population that could be analyzed as a robust, mixed species prediction (Figure 1). When analyzed as a mixed group, the nutrient prediction equations for dried fish were very strong with low standard error of prediction (SE) = 0.86 to 1.86; r^2= 0.96 to 0.99 and low standard error of cross validation (SECV) = 1.29 to 1.90; r^2= 0.90 to 0.98. These results indicate a strong predictive power of our equation and will allow our laboratory to accurately assess the nutrient content of fish. In future research, to improve the efficiency of sample analysis, our laboratory will be assessing the ability of NIRS to predict blended, whole fresh fish samples to more easily assess the nutrient profiles presented to our dolphin population.

Acknowledgements

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Literature Cited

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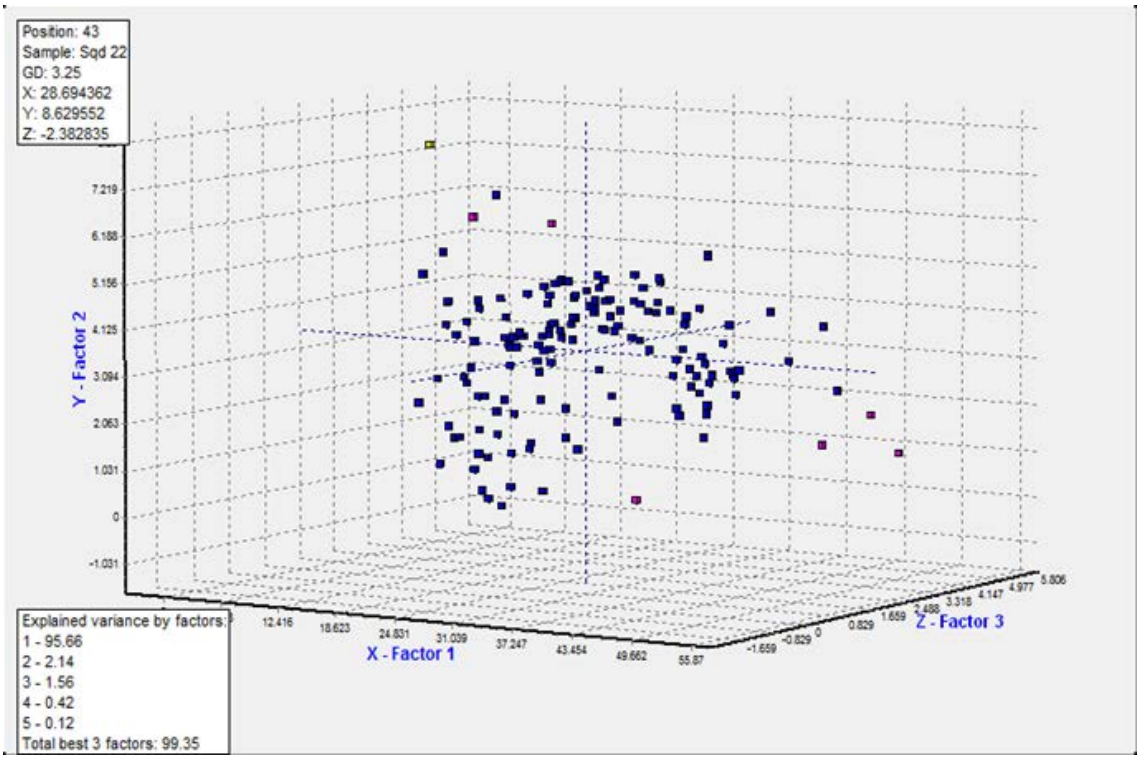

Figure 1. Principal component analysis of dried fish spectra, mixed Species.