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Research of Detection of Fish Freshness Based on Nis

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Abstract: Freshness is one of important index of fish or the quality of product, which is very important for the final product quality. Therefore, rapid and accurate evaluation for fish freshness is concerned with the vital interests of the people, and for the fish and products of the transportation, storage and processing process also has important scientific significance and application value. The experiment, using of near infrared spectral analysis technology, collecting the freshwater fish nose, gill, eye, seven parts of the spectra, through the select 520 nm-1180 nm within the scope of the spectral data, develops a analysis model of 563 nm, 679 nm and 731 nm absorption spectrum in strength and data for the index Total Volatile Basic Nitrogen (TVB-N) value. It is importantly meaningful on fast, nondestructive testing freshwater fish freshness. *Copyright © 2014 IFSA Publishing, S. L.*

Keywords: Freshness, Fish, Near infrared spectrum, Partial least square method, Quantitative analysis model.

1. Introduction

With the improvement of living standards, consumers are increasingly concerned about food quality and safety. Freshness of fish or fish products is an important indicator and the quality of the final product is very important. Therefore, fast and accurate evaluation of fish freshness, is vital to people's interests, then transportation, storage and processing of fish and its products has important scientific significance and application value. Near-Infrared Spectroscopy (NIRS) has developed rapidly in recent years as convenient, efficient, low-cost green analysis techniques, with analytical simple, rapid, low-cost, non-polluting and non-destructive and multi-sample simultaneous determination of other advantages. At present, research and application of near infrared spectroscopy technique in water product testing is very small. In foreign countries, Shimamoto J used the near infrared detected the fat content of freezing fish and thawing fish [1]; Khodabuxa K used near infrared detected the water, protein and fat content of tuna fish [2]; Nilsena and Esaiassen used NIRS to study the gills of fish freshness, the result shows that the correlation coefficient spectra and sensory evaluation scores have higher [3]; Beknaes used the NIRS (near infrared spectroscopy) prediction of storage temperature and storage time of fish fillet and surimi, using partial least squares analysis (PLS) and principal component analysis (PCA) modeling analysis, results showed that the near infrared spectroscopy can be used to predict the fish freshness[4]; in domestic, Limited research is concentrated in the low moisture products, such as the study of additive in fishmeal, Yang Luo in Shanghai Ocean University recently are studying fish elastic by near infrared detection [5], and no other reports.

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2. Experimental Design

In this experiment, 100 live carp selected as samples (which were bought from Tianjin Hongqi Aquaculture Market), were detected for spectral data of seven parts each carp, such as nose, eye, gills, fins, scales, abdomen and mouth, and it is shown in Fig. 1, until after the death of fish samples, records of each time of death, packaging respectively for food preservation bags, which would be 50 Carp stored in the artificial climate box, storage temperature is 4 °C; the remaining 50 Carp placed in the laboratory, the room temperature was 26 °C, and measure spectral data once every 4 hours.

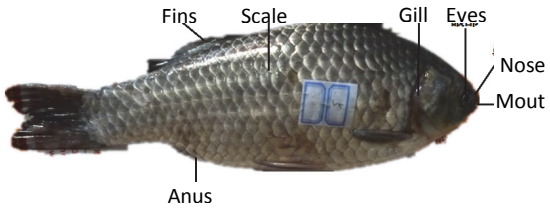

Fig. 1. Sample of fish.

Design ideas for the use of Visible-Near Infrared Spectroscopy to detect fish freshness: the standard carp samples using LS-1 tungsten halogen lamp irradiation fish samples, computer hardware connection through the spectrometer USB2000 signal conversion, the use of the spectra Suite analysis software acquisition be illuminated fish sample spectra and intensity data, the selection of an effective and optimum characteristic wavelength range, to avoid the error caused by the presence of near-infrared spectral data peaks overlap and collinear to improve the prediction accuracy, and then using the sample spectral data of the measured freshwater fish to establish a mathematical analysis model, and compare the data obtained with the use of chemical methods, in order to further test the visible-Near Infrared Spectroscopy method of measuring the freshness of freshwater fish.

The specific experimental program flow diagram is shown in Fig. 2.

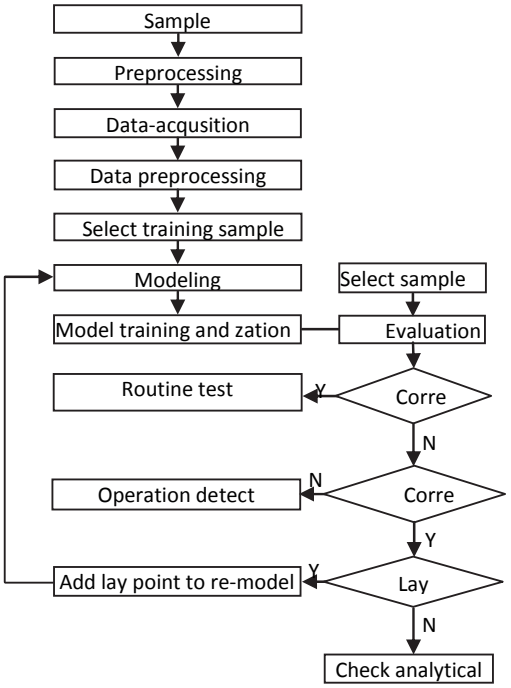

Fig. 2. Chart of experimental flow.

3. Spectral Data Acquisition & Analogy

3.1. This is a Subtitle Example

30 carp samples, through the spectrum acquisition 30 carp samples in different parts of the building were analyzed, and mathematical model of the data used the partial least squares method. The spectrums of different parts of carp samples using NIRS are shown in Fig. 3 – Fig. 9.

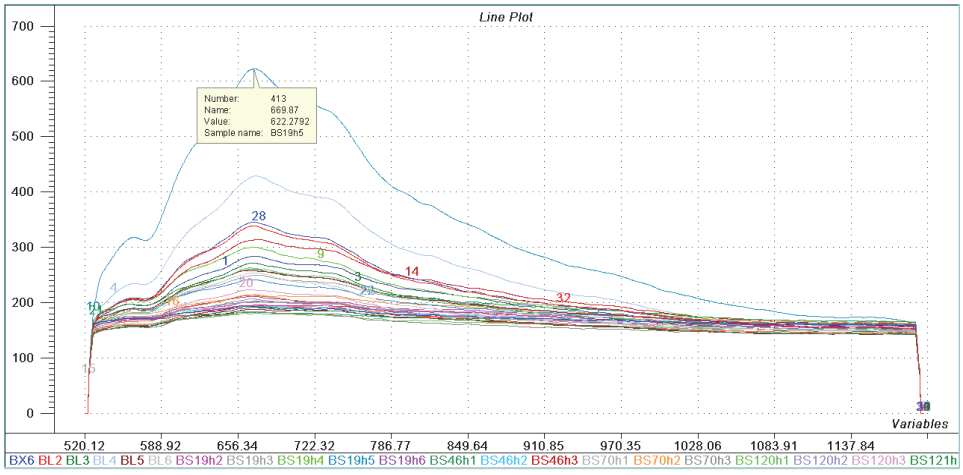

Fig. 3. Spectra of the nose.

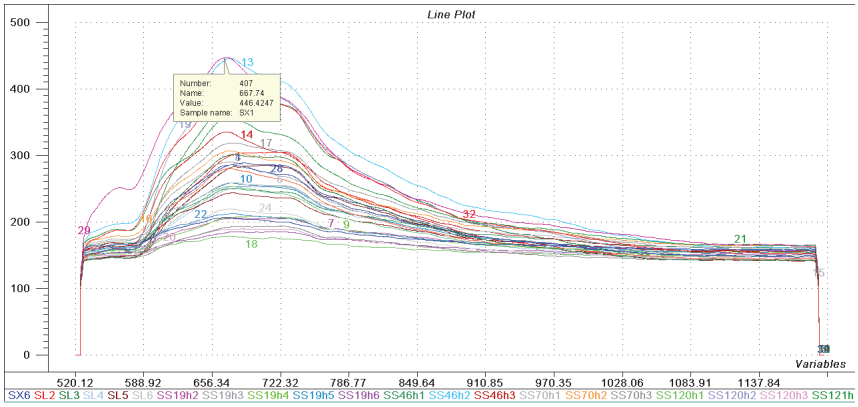

Fig. 4. Spectra of the cheek.

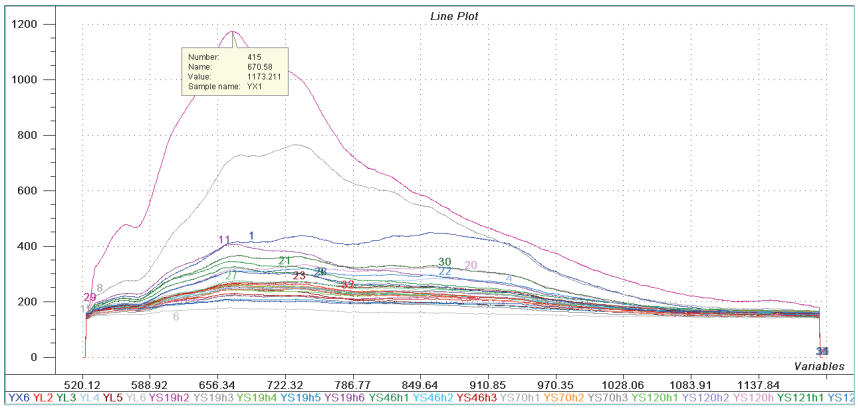

Fig. 5. Spectra of the eye.

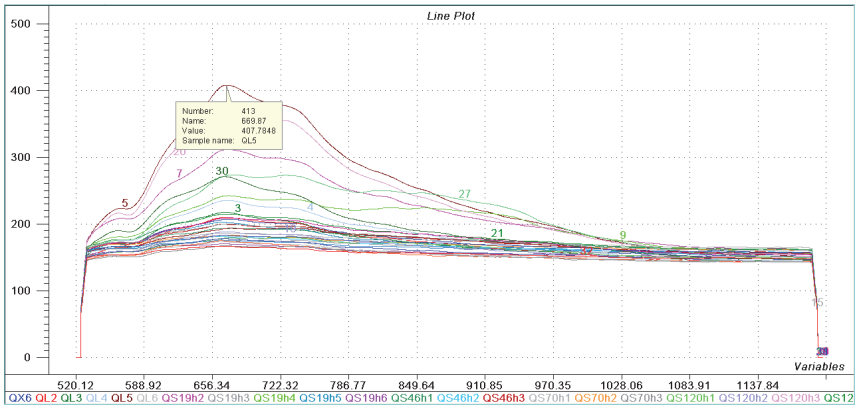

Fig. 6. Spectra of the fin.

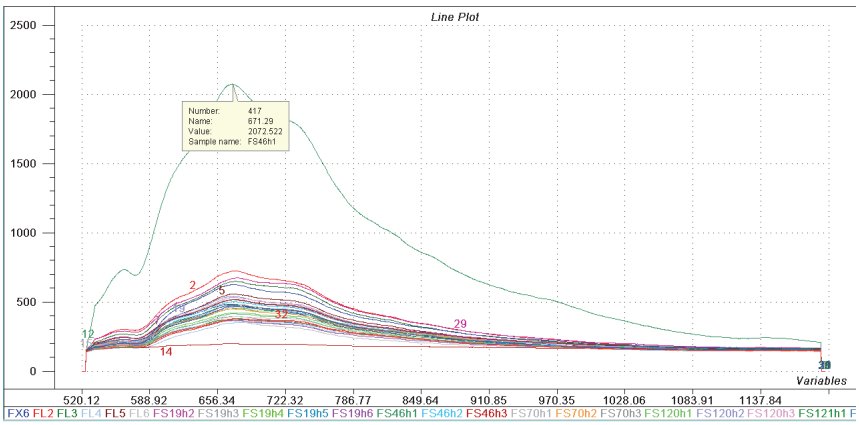

Fig. 7. Spectra of the scale.

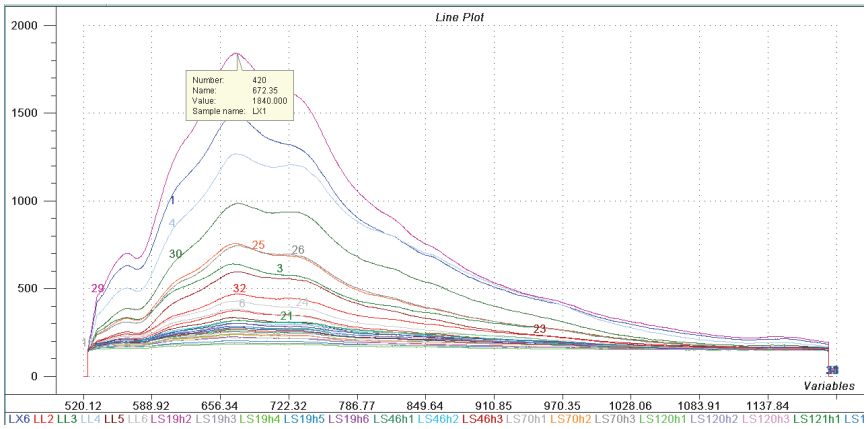

Fig. 8. Spectra of the belly.

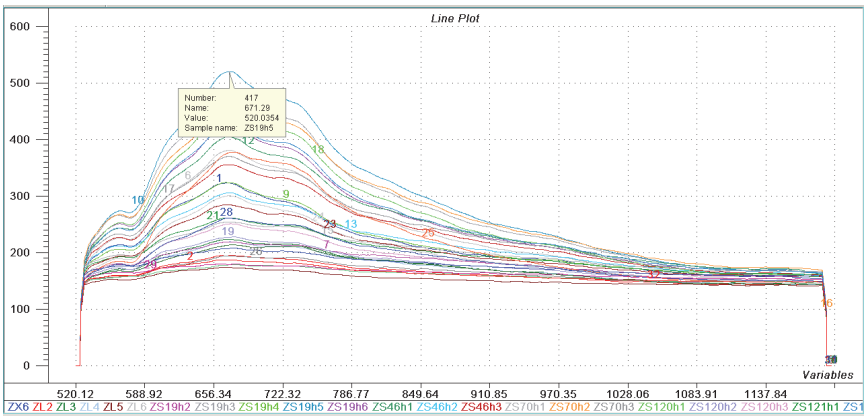

Fig. 9. Spectra of the mouth.

The Table 1 shows that three absorption peaks in the short-wave near-infrared region of the spectrum, the maximum absorption peak wavelength of 671 nm region, and the eyes of the fish, scales and abdomen at a wavelength of 671 nm region absorbance higher than other parts, is conducive to the past acquisition of the infrared spectrum, with the growth of time, the more obvious changes can be found in the three parts of the freshness, while no obvious changes in the freshness of the nose, cheeks, fins and mouth, which, from an intuitive point of view, the gills Ministry of color change from bright red to dark red.

Table 1. Constrast of deference part of fish.

No.	Parts	Wavelength (nm)	Absorbance (nm)	Change
1.	Nose	669.87	622.28	Obvious
2.	Cheek	667.74	446.42	Small
3.	Eye	670.58	1173.21	Obvious
4.	Fin	669.87	407.78	Small
5.	Scale	672.35	1840.00	Larger
6.	Belly	671.29	2072.52	Large
7.	Mouth	671.29	520.03	Weak

3.2. Least Square Method

Model is set up by standard normal variate transformation for processing spectrum, after the partial least squares method, and the calibration set prediction error, test set prediction error and correlation coefficient, would be as the evaluating model quality. The following is the model data collected from eyes of the partial least squares method used for fish graphics.

Fig. 10 shows the test sample, the four level status of fish eye is divided into fresh, dying, corruption and severe corruption, using YX1, YL1, YS19h1 and YS123h1 for four fish samples validation, verification of the results, YX1 falls in the fresh degree of the region inside, YL1 falls in the death degree area, YS19h1 falls on corruption in the region, YS123h1 landed in severe corruption within the region.

3.3 Data Analogy

From the Fig. 11, the wave of the eyes, the abdomen and the squama changes with the time increasing freshness, but the changes of fins and nose are not obvious. When fresh, absorption spectrum

of fish scale is the best, and most obvious, next is the eyes; dead after 19 h, absorption spectrum of squama and eye is most obvious, and after 46 h, absorption spectrum of belly changed dramatically, absorbance from 608 nm to 2031 nm, then the mouth also have certain degree of change; after 70 h, absorption spectrum of belly dropped rapidly again; after 120 h, absorption spectrum of nose, cheeks and the squama arrived at the lowest absorbance.

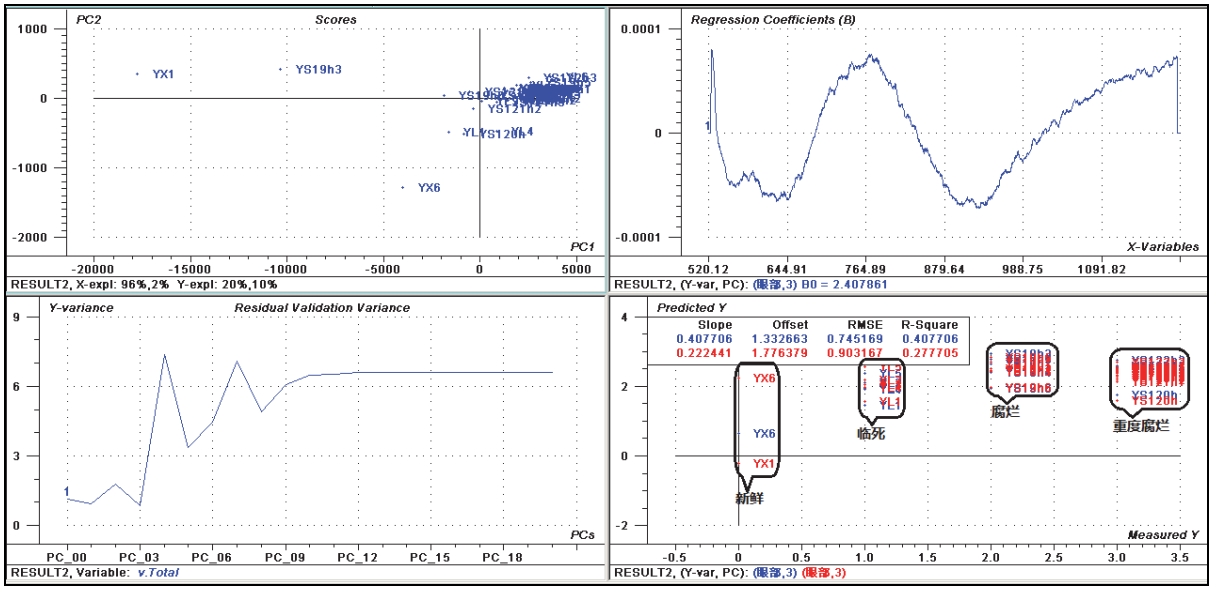

Fig. 10. Analysis of eye samples fish partial least squares method.

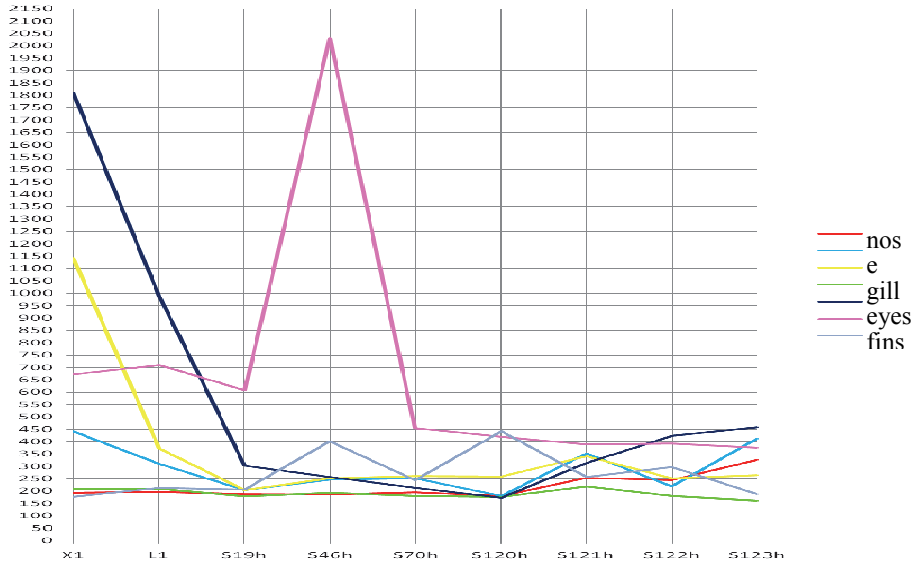

Fig. 11. Different positions on the same wavelength circumstances change.

4. Conclusions

Freshwater fish samples were collected to conduct a preliminary feasibility study, detected the spectra in the wavelength range of 520 ~ 1182 nm and light intensity peak.

In this study, the fish samples were divided into two, the temperature of part in the refrigerator was 0-4°, which was not corrupted after 19 hours, and then the other in the indoor was 26°, which were corrupted.

Fresh refrigerated (0~4 °C) in a certain period of time is effective to inhibit the carp in the growth and reproduction of bacteria and TVB-N value changes, to keep the carp high sensory quality. Refrigerated fresh methods of the fish from the changes of the quality indicators to analyze preserved not suitable for longer-term storage, after 8 days

of cold storage, carp have spoilage. The refrigerated preservation is a convenient fish preservation method applicable in the short term. Freshness of changes in eyes, abdomen and scales Ministry manifested are most obvious than others, and have great growth changes in absorption spectrum with the increase of time, conducive to the near-infrared spectral data acquisition.

Acknowledgements

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