NON-DESTRUCTIVE MULTI-PARAMETRIC INSTRUMENTS FOR FISH FRESHNESS ESTIMATION

P. Menesatti, G. Urbani, F. Pallottino, S. D'Andrea, C. Costa

Agritech Lab CRA-I.S.M.A. Via della Pascolare, 16 - 00016 Monterotondo (Roma) – ITALY
Tel: ++39-06-90675-1 (direct 214 - Lab. 264) e-mail: paolo.menesatti@entecra.it

1. Introduction

The freshness is considered one the most important characteristic for the determination of quality in fishing products.. A fish is defined fresh when its quality characteristics are maintained as similar as possible to the moment of the slaughter. On the market, fish freshness is defined and regulated by the EU directive n. 103/76 that classifies the product on the base of quality parameters, such as the consistence of the meat, the visual aspect (color of the eye and the gill, the brightness of the skin) and odor. Present methods of inspection for the determination of the degree of quality freshness are based on chemical characteristics (e.g. [1]). These methods are both destructive or non-destructive but in the latter case they show low-speed procedure mostly performed on the fish flesh. The aim of this work is to analyze these qualitative aspects through non-destructive instrumental techniques [2], [3].

2. Results and Discussion

Two fish species of farmed salt-water (Dicentrarchus labrax and Sparus aurata) and 2 wild commercial species (Scomber scombrus and Merluccius merluccius) were analyses at 6 different days of chilling storage (3 °C, 95% R.H.) and the same analysis was repeated 7 times along the year.

Spectral imaging. A Vis-Nir spectral imaging system (Spectral Scanner V1000, DV - INSPEC Ltd) was used for the measure of both spectral reflectance and CIELAB color of the of skin. For color, the most interesting parameter was represented by the lightness value (L*), which is directly related to the increasing time of conservation. PLS models on spectral reflectance data in the range 450-950 nm, allows a good performance of classification (63-94%) between fresh (1-2 days) and not fresh (>4 days) for all the species and sampling times (fig. 1). The analysis is sensible to the sampling times factor.

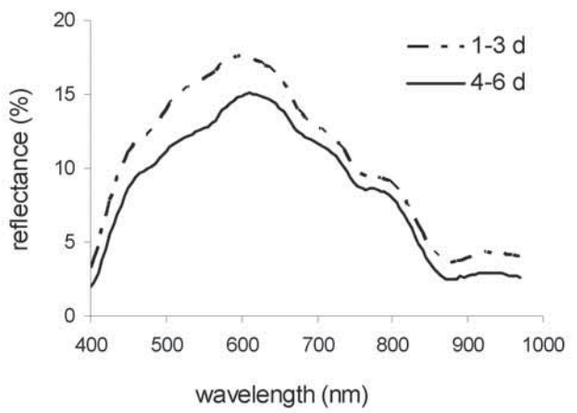

Figure 1. Mean spectral values of reflectance for fresh (1-2 days) and not fresh (>4 days) Sparus aurata.

Firmness. Texture was analyzed by low-structural alterative penetrometric test (Zwick UTM Ltd 1KN). A small deformation (2 mm) with a 6 mm diameter cone probe on the upper latero-dorsal area of the fish was applied. PLS models on the resistance force profile and elasticity module had a lower performance of classification (59-82%) between fresh (1-2 days) and not fresh (>4 days) for all the species and sampling times (Fig. 2).

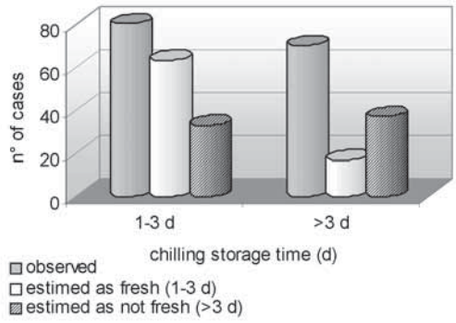

Figure 2. PLS prediction on texture data of Dicentrarchus labrax.

Odor. Odor (organic volatile compounds) was measured through an electronic nose (LibraNose). Data analysis was performed on both the single parameters and a whole database through linear regression and multivariate predictive models (PCA and PLS). The electronic nose sensor's pattern allowed to obtain a high prediction performance about the different chilling storage times (71-100%) (Fig. 3).

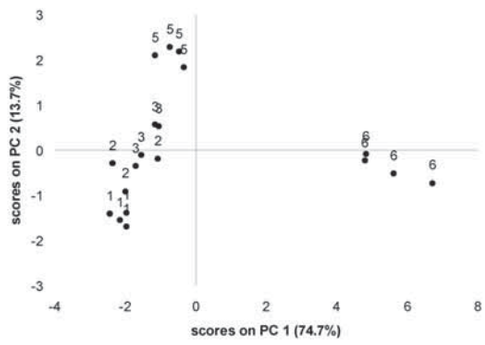

Figure 3. PCA on Sparus aurata odor data. Numbers refer to days of chilling storage.

3. Conclusions

The three method used to evaluate the fish freshness demonstrated the better accuracy of the electronic nose; this instrument is still used for this kind of quality inspection but it requested longer time for the analysis. Differently, the spectral imaging analysis gives good results and it could be used for a more rapid inspection. Texture analysis showed a low resolution and some practical problem as a contact technique. A future development in the assessment of quality could be the design of a portable system based on the three systems of analysis to be used by inspectors in the fish food market.

4. References

[1] M. Tapani Hattula, H.C. Wallin, Rapid method based on ATP catabolites for evaluating the freshness of Baltic herring, Interlaboratory Study. J: AOAC Int. 79(3), 1996.

[2] P. Menesatti, Urbani G., Prediction of the chilling storage time of fresh salt-water fishes by soft modelling (PLS) of low-alterative penetrometric test, International and European Agricultural Engineering conference - AgEng2004 - Workshop "Physical Methods in Agriculture". 12-16 September 2004 - Leuven Belgium –oral presentation -book of abstract p. 940 – 941, 2004.

[3] P. Menesatti, G. Urbani, M. Millozza, S. D'Andrea, S. Solaini, G. Paglia, I. Niciarelli, Prediction of the Chilling Storage Time of Fresh Salt-water Fishes by Means of Non-destructive Techniques, 2006 CIGR Section VI International Symposium on Future Of Food Engineering, Warsaw, Poland, 26-28 April 2006, oral communication, abstract p. 145, 2006.