Color evaluation of the gills and eyes of fish: machine vision and image analysis methods

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INTRODUCTION

The color of the gills is an indication of the "freshness" of fish, and is used subjectively in the Quality Index Method (QIM). Similarly, the color of the eyes and their transparency /opaqueness is an indication of fish freshness and used in QIM. The automation and objective evaluation of these criteria is desirable.

OBJECTIVE

Our objective was to develop region-of-interest (ROI) methods to quantify the color of the gills region, and eyes of the fish during storage on ice.

MATERIALS AND METHODS

Fish

Snapper (*Chrysophrys auratus*) was obtained while fresh from a local market, in Auckland, New Zealand, and stored on ice for one week. The gill plates of the fish were cut out, exposing the gills.

Image acquisition

Every day, fish were removed from the refrigerator, and placed in a light box with polarized lighting. A Nikon D300 digital camera, with a circular polarizing filter was used to obtain the images. The importance of using polarized lighting to obtain accurate color information has been emphasized before. The images were obtained for 7 days (Figure 1).

Image analysis

Software was developed (LensEye, Engineering & Cyber Solutions, Gainesville, FL) to allow either circular or polygonal region of interest (ROI) definition on the images. These ROIs could be saved and later used again to always analyze the same location on the fish. Circular ROIs were used for the analysis of the eyes, and polygonal ROIs for the gills (Figure 2).

The LensEye software quantified the average colors (L*, a*, b*) of the ROIs in the images. Color calibration was also performed by using a reference object of know color in each image.

RESULTS

Table 1. L* values of eyes, and a* values of gills over storage days

	Eyes 1	Eyes 2	Gills 1	Gills 2
Days	L*	L*	a*	a*
1	23.67	30.65	28.83	29.87
2	27.1	34.03	21.43	21.48
3	26.69	33.37	20.77	20.93
4	26.83	34.23	20.4	19.72
5	28.3	32.07	24.97	22.57
6	28.62	30.22	19.57	17.11
7	32.05	31.28	17.46	15.78

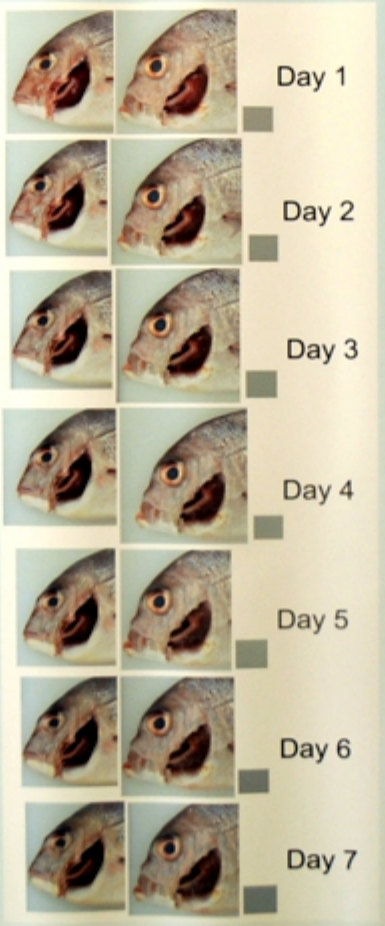


Figure 1. Images of the fish in refrigerated storage.



Figure 2. Images of fish and their equivalent circles from color primitives analysis.

The color of the eyes progressively changed to a lighter color, as evidenced by the increase in the L* values (Table 1). Since polarized light was used, the effect of the wetness, and reflection off the eyes did not affect the results.

The color of the gills also changed: the a* value that is a measure of redness decreased over time (Figure 3).

The disadvantage of this method is the increased difficulty of obtaining the image of the gills without cutting the gill plate. This can also be accomplished by small cameras, but present more challenges regarding illumination (including the use of polarized light) and the use of reference colors for accurate color readings.

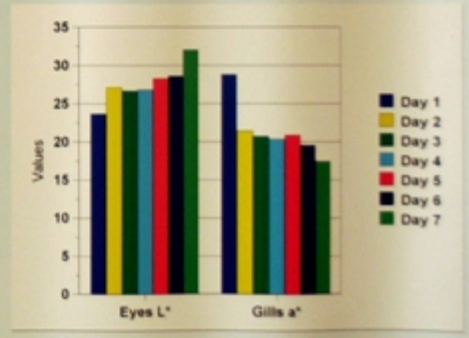


Figure 3. Color changes of the eyes and gills of snappers over time.

CONCLUSION

It is possible to accurately and objectively measure the color of the eyes and of the gills of fish using image analysis. The use of regions of interest simplify these measurements. This will help in the automation of the QIM procedure.

REFERENCES

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