

Shape Analysis and Vitality Estimation of pacific oyster (*Crassostrea gigas*) Using Three-Dimensional Morphometric Techniques

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Pacific oysters (*Crassostrea gigas*) are widely cultivated as an important marine fishery resource. Despite their production steadily rising over the years, their short survival and preservation period make the selection and maintenance of highly vital oysters a prime concern. While previous studies have explored the correlation between the shape of an oyster and its quality, this research proposes a novel, non-invasive, and immediate method for grading the freshness of Pacific oysters intended for brand sales. By exclusively applying 3D morphometric techniques to analyze oyster's external shapes, this method can replace the inconvenient but highly accurate chemical freshness assessment with a more streamlined approach..

In this study, the authors accurately describe the unique oyster shapes, including aspects like mean flattening ratio, the difference in this ratio at the front and back, the center axis curvature, and its orientation angle. Along with the shell height to length ratio, these five features form the external shape features to obtain detailed biochemical data about oyster vitality. They then use principal component analysis (PCA), a multi-variable technique, to simplify this five-dimensional feature space to one, and create a formula for classifying oysters as round or flat. Using this formula, they first separate the oysters into these two categories. Next, they arrange the oysters based on the A.E.C. value, a freshness and vitality indicator, separating the round (higher A.E.C.) and flat (lower A.E.C.) oysters again. Finally, they compare these classification results to calculate their accuracy.

The study used 90 oysters for the experiment, including 40 from Toyama-ken, purified in deep-sea water, and 50 from Yamada-machi, Iwate-ken. The proposed method accurately classified 70.0% of the round and flat Toyama oysters (20 each) and 76.0% of the round and flat Yamada Town oysters (25 each). As the two different species were collected at different attachment and growth periods in two major macaque production areas in different marine areas, the effectiveness of the classification method proposed in this study was demonstrated. The experimental results also prove that there are disparities in vitality maintenance between round and flat oysters defined by the proposed method. Applying this study in practical settings could enhance oyster branding and quality during distribution, such as at wholesale markets or during transportation.

Keywords: Pacific oyster, *Crassostrea gigas*, 3D morphometric techniques, vitality, shape features, flattening ratio, curvature, center axis, A.E.C. value, principal component analysis