

New probiotic bacteria shows promise for use in shellfish aquaculture

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The use of probiotic bacteria, isolated from naturally-occurring bacterial communities, is gaining in popularity in the aquaculture industry as the preferred, environmentally-friendly management alternative to the use of antibiotics and other antimicrobials for disease prevention. Known to the public for their use in yogurt and other foods to improve human digestion and health, probiotic bacteria isolated from other sources can also be used to improve survival, nutrition and disease prevention in larvae grown in shellfish hatcheries.

Researchers at NOAA's Milford Laboratory in Milford, Conn. have shown that naturally-occurring bacteria isolated from the digestive glands of adult eastern oysters (*Crassostrea virginica*) and northern bay scallops (*Argopecten irradians irradians*) may be used as potential probiotic candidates in oyster larviculture.

Two related research studies published in the *Journal of Shellfish Research* identify a new probiotic bacterium, designated OY15, which has been shown to significantly improve larval survival in pilot-scale trials during the first two weeks of life, the most critical stage for the organism when [mortality rates](#) are among the highest.

"We are cautiously optimistic that this probiotic candidate, OY15, will offer a number of significant benefits to the shellfish industry," said Gary Wikfors, co-author of both studies and head of the Milford Laboratory's Biotechnology Branch. "Commercial and public shellfish hatcheries can have low survival rates for shellfish seed during the first

two weeks, so improving those [survival rates](#) and the health of the organisms beyond that point is a pretty significant step forward."

Hatcheries produce shellfish seed to supplement natural seed, which is often limited by loss of habitat, contamination from pollution, climate change and other factors. Bacterial diseases caused mainly by [pathogenic bacteria](#) such as *Vibrio* are a major cause of mortality in hatchery shellfish, particularly at the very early larval stage. The result: significant financial losses to commercial growers and to production of farmed shellfish, which accounts for 25 percent of the total world aquaculture product.

Antimicrobial drugs approved for use in aquaculture in some countries, but not the US, have traditionally been used to treat [bacterial diseases](#), but overuse of antibiotics can result in the development of resistant strains of bacterial pathogens. The use of probiotic bacteria has become increasingly popular for improved nutrition, healthy digestion and [disease prevention](#) and is used in human foods like yogurt and in pet foods.

As demand for environmentally-friendly aquaculture grows, the use of probiotics for disease prevention and improved nutrition in shellfish aquaculture is also growing. While a number of research studies have shown promise, development of probiotics that can be used in aquaculture is a multistep process requiring fundamental research and full-scale trials.

"The objective of the first part of this study was to isolate and evaluate new probiotic bacteria which, when incorporated into foods used in shellfish hatcheries, might significantly improve larval survival," said co-author Diane Kapareiko, a microbiologist at the Milford Laboratory. The second part of the study was to test the new probiotic candidate on the survival of oyster larvae in pilot-scale trials during their first two weeks

of life.

"We conducted a very cautious, step by step study, to identify the best candidates under a variety of scenarios," Wikfors said. "Our bench-scale challenge studies indicated that oyster larvae exposed to probiotic candidate OY15 had the highest survival rate, and that the survival of pathogen-challenged larvae was further improved by the presence of OY 15 compared to the pathogen alone. It is somewhat analogous to a human building up immunity to a certain organism by being exposed to it, but without the involvement of antibodies."

The Milford scientists isolated 26 candidate probiotic bacteria from oysters and scallops of which 16 had an inhibitory effect against a known shellfish-larval pathogen (B183) of the *Vibrio* species of bacteria. Further screening for safe use in culturing the oyster larvae and their microalgal feed indicated which probiotic candidates would inhibit growth of the pathogen most effectively and therefore could confer a protective effect upon oyster larval survival.

Lab studies indicated that survival of two-day old oyster larvae during two-week pilot scale trials improved when supplemented with the probiotic candidate OY15 strain. Four treatments were conducted: a larval control with no bacteria, a pathogen control with larvae and pathogen B183 only, a probiotic control with larvae and probiotic candidate OY15 only, and a combination treatment comprised of larvae and both probiotic and pathogen.

"Our research focused on the critical first stage of larval growth, when mortality rates are among the highest," Kapareiko said. Positive effects of probiotic candidate OY15 were found on the survival of oyster larvae (short term), on growth of phytoplankton used as larval feed, and upon oyster survival during pilot-scale larviculture conditions.

"This two-part study confirms that use of naturally-occurring probiotic [bacteria](#) confers protection to oyster larvae against bacterial disease and improves their survival," Kapareiko said. "The results can be used as guidelines for isolating and screening other potential probiotic candidates for similar aquaculture applications, and provide the basis for developing functional foods for use in [shellfish](#) hatcheries that incorporate a naturally occurring, [probiotic bacteria](#)."

Provided by NOAA

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