

## Genetically Modified Salmon in Aquaculture: Well Regulated and Safe

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**Abstract:** A Massachusetts company, Aquabounty Technologies, submitted an application to the U.S. Food and Drug Administration (FDA) in 1995 to grow a genetically modified AquAdvantage® Atlantic salmon to be marketed as a food product. Aquabounty proposed to raise the broodstock fish on Prince Edward Island, ship their eggs to a contained inland recirculating production system in Panama to grow, harvest and process the fish, and then ship food grade product back to the United States for sale. The fish for this physically secure production system would be at least 99 percent triploid and all-female, as an additional reproductive-containment measure.

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The AquAdvantage® Atlantic salmon carries a Chinook salmon growth hormone gene that results in production of growth hormones that enable the fish to grow to market weight in half the time it normally takes (Fig. 1) This gene is regulated by a segment of DNA from the ocean pout, a blenny-like fish found in frigid waters of the Northwest Atlantic.

The review process used by FDA on the AquAdvantage® salmon involved a team of scientists and subject-matter experts on the Veterinary Medicine Advisory Committee who advise the FDA and the general public on scientific issues as they relate to ensuring public and animal health. The FDA released a 172 page briefing packet and an 84 page environmental assessment containing information relevant to the application in advance of a public advisory committee meeting



**Fig. 1.** AquAdvantage® and non-GM Atlantic salmon of similar age.

held in September 2010. This briefing packet summarized their scientific review, and the basic conclusions were that the AquAdvantage® salmon are safe, nutritionally comparable to other Atlantic salmon, and when produced as described in the application do not pose a threat to the environment. The review process used by FDA on the AquAdvantage® salmon was rigorous, detailed and extensive, spanning more than 15 years. Specific conclusions from the report stated that “Food from AquAdvantage® Salmon is the same and as safe to eat as food from other Atlantic salmon.”

In reference to concerns about adverse environmental impacts the report states “There is substantial, reliable information available in the environmental assessment document to conclude that AquAdvantage® Atlantic salmon are not expected to have a significant impact on the environment when raised and reared under the current conditions of physical, biological and geographical/geophysical confinement present at hatchery and grow-out facilities in Canada and Panama. We have a high degree of certainty in our conclusions regarding AquAdvantage® Salmon.”

Despite this rigorous scientific review, there remains considerable public controversy regarding the potential for FDA approval of this Aquabounty application to produce and market a genetically

modified salmon. As a result, 11 senators signed a request that FDA stop the process for approving genetically modified AquAdvantage® Atlantic salmon. The manner in which this review for approval of a transgenic animal for agricultural production and marketing in the United States has progressed has stymied American research in this promising sector of animal biotechnology.

New technologies to genetically improve food and animal crops are one tool to supply the additional food people will need in the future, improving human health, reducing the use of pesticides and fertilizers, and lessening the carbon footprint of animal and plant agriculture. A 2008 scientific review published in the *Journal of the Royal Society of Medicine* noted that genetically modified foods had been eaten by millions of people worldwide for 15 years, with no reports of ill effects.

salmon farming and world markets and then analyze three scenarios based on the level of acceptance of GM salmon in the marketplace. The three scenarios were named as 1) 'no market for GM fish,' 2) 'GM salmon for dinner,' and 3) 'GM salmon doesn't take off.' The authors provide a summary of the main outcomes for each scenario.

FDA 2012. AquAdvantage® Salmon, Draft Environmental Assessment. Center for Veterinary Medicine, United States Food and Drug Administration, Department of Health and Human Services. Washington D.C.

This document provides a detailed environmental assessment of the transgenic AquAdvantage® Salmon

#### Annotated Bibliography

Van Eenennaam, Alison L., and Muir William M., 2011: Transgenic salmon: a final leap to the grocery shelf? *Nature Biotechnology*, **29**, 706–710.

This paper presents a detailed analysis of the regulatory and review process that FDA used for the AquAdvantage® salmon.

Entis, Elliot and Greenberg, Paul. 2013: The Salmon Dialogue: What's the future of sustainable, genetically engineered foods? Genetic Literacy Project. <http://www.geneticliteracyproject.org/2013/09/17/the-salmon-dialogue-whats-the-future-of-sustainable-genetically-engineered-foods/#.UjpTgtLBOSo>

This online debate features, Elliot Entis, whose company has created a genetically modified salmon that may soon be for sale in the U.S., who discusses the environmental and health impacts of this controversial technology with author Paul Greenberg, a critic of GM fish.

Menzio, Davide, Mora, Cristina and Merigo, Alberto. 2012. *Journal of Agrobiotechnology Management & Economics*, Volume 15, Number 3.

In this paper the authors provide an overview of