Synthetic Biology, Gaming and Food Safety

A Unique Collaboration on World Food Day

According to the World Health Organization (WHO), one in 10 people worldwide are affected by a foodborne illness every year. Children under five are the hardest hit, accounting for almost one-third of deaths from foodborne diseases. While the familiar diarrheal diseases caused by viruses or bacteria – such as norovirus, Salmonella and E. coli – account for more than half of global foodborne disease, parasites, molds, toxins and contaminants also significantly contribute to the problem.

In fact, aflatoxin, a poisonous substance released by mold which grows on grain, is a major contributor to the global foodborne health crisis. Four and a half billion people are chronically exposed to this naturally occurring poison, which can lead to stunted growth among children (low physical growth and intellectual development), liver cancer and death.

While the Western world has been successful in limiting the amount of aflatoxin in food for humans and livestock, the developing world has not. Subsistence farming and underregulated food production has allowed aflatoxin to spread in Africa and Asia. In one 2001 analysis, newspapers reported that South African school children were fed peanut butter with 2,700 times the legal limit of aflatoxin.

A unique collaboration is looking to change that.

“It is our hope that we can mitigate this serious health concern in the developing world by joining forces and leveraging the capabilities and know-how of each member in this unorthodox partnership,” says Helge Bastian, vice president and general manager of synthetic biology at Thermo Fisher Scientific. “By utilizing Thermo Fisher’s proprietary and industry-leading gene synthesis technologies and platforms we also want to demonstrate that synthetic biology is a key discipline for a sustainable future. Synthetic biology is bringing life science know-how closer to the consumer and has the potential to alleviate societal issues and to make our world a healthier, cleaner and safer planet.”

To address the dangers of aflatoxin, Mars, Incorporated asked scientists at Thermo Fisher and the University of California, Davis to help develop a way to destroy or mitigate the poison. The aflatoxin initiative launched on World Food Day (October 16) with a game-a-thon demo where players used a crowdsourcing computer game, Foldit, to attempt to restructure a protein enzyme that can be used to destroy aflatoxin.

The University of Washington developed Foldit in 2008 to help crowdsource solutions for scientific conundrums. Players around the world have already solved Foldit puzzles that ultimately led to serious breakthroughs in scientific research, including a major leap forward in finding an AIDs vaccine.

Starting with the World Food Day game-a-thon, gamers will attempt to rework a protein enzyme structure that can detect and neutralize aflatoxin. Players will be given the opportunity to restructure the enzyme and mutate side chains in order for the enzyme’s active site to fit with aflatoxin. A second round will allow players to include, insert and delete regions of the protein enzyme’s active site. The DNA encoding for the most promising enzyme structures will then be synthesized using Thermo Fisher’s proprietary gene synthesis platforms and the novel, potentially Aflatoxin-degrading enzymes will be tested at Professor Justin Siegel’s lab at UC Davis. The gamers needn’t be scientists; they are more often ordinary people using puzzles to solve serious human health challenges in their spare time.

Previous attempts to mitigate the spread of aflatoxin in the developing world have been largely ineffective. The toxin cannot be neutralized with the normal food processing approaches to contamination (such as the application of heat or cleansing chemicals). Food researchers believe that a micro-level approach – where a protein enzyme is used to degrade the aflatoxins – may be a more effective and scalable approach.

If researchers, aided by gamers, are successful in developing a protein enzyme to degrade aflatoxin, the enzyme will be added to food and animal feed to decrease toxicity in real time. The financial and, more importantly, the life-saving impact of this would be significant.