New method could lead to avian flu-resistant birds

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Creating a strain of avian flu-resistant chickens and exploring how canaries learn to sing are two of many potential uses for a Picower Institute of Learning and Memory researcher's simple new way to create transgenic birds. The work will appear this week in the online early edition of the Proceedings of the National Academy of Sciences.

There are only four known types of animals that learn to communicate vocally: humans, whales, hummingbirds and songbirds. Hummingbirds do not breed well in captivity and whales have obvious issues as lab animals, but brain researchers can learn a lot from songbirds such as finches and canaries because they learn songs by imitating adults, just as children learn to talk. "Songbirds are a very practical animal system to study the genetic and neurobiological basis of learning and communication," said co-author Carlos E. Lois, assistant professor of neuroscience at MIT's Picower Institute.

In addition to creating transgenic chickens resistant to avian flu, scientists could also engineer chickens to produce high levels of therapeutic protein in their egg whites. For example, transgenic chickens carrying the gene encoding human insulin could produce high levels of insulin in a very pure form.

Benjamin B. Scott, a graduate student in the Department of Brain and Cognitive Sciences at MIT, and Lois came up with a way to transport genes directly into the genome of egg cells much more effectively than previously possible, creating transgenic birds with ease. In addition, the transgenes could be activated reliably in specific organs, such as brain or muscle tissue.

In addition to the benefits of using transgenic bird models to advance developmental biology and neurobiology, manipulating the avian genome could lead to chickens that do not transmit diseases to humans; chickens that are resistant to common chicken diseases such as tuberculosis; and chickens that produce large amounts of useful pharmaceuticals such as insulin, growth hormone and hormones that increase blood production in patients with cancer, anemia and other diseases.

In the PNAS paper, the researchers reported that they used their method to create transgenic quails with a fluorescent marker in their neurons that allowed researchers to visualize with fluorescent microscopy the birds' axons and dendrites.

Traditional methods of injecting DNA into the nucleus of an embryo result in only around 1 to 3 percent of cells incorporating the new DNA properly. With this low rate of DNA delivery, this method can still be used to produce transgenic mice, but it was not useful for creating transgenic birds. In 2002, Lois described a new method to generate transgenic animals by taking advantage of the specialized molecular machinery of lentiviruses. The viruses transport DNA into the nucleus efficiently in a way that integrates the new DNA more consistently. In 2002, Lois applied this method to mice and rats with a 90 percent success rate. More recently, lentiviral vectors also have been used to generate transgenic pigs and cattle. Their work on birds has a 30 percent to 40 percent success rate because when the egg is laid, it has some 40,000 cells and getting the retroviruses into all the egg cells through the yolk is difficult.

Lois said that transgenic techniques will likely not be useful in creating a better chicken for human consumption, because chickens have already been selectively bred for years to create birds with a lot of meat on their bones. "The differences between today's chickens and wild chickens are as large as those that separate poodles and wolves," Lois said. "If chickens had any more muscle mass their legs would not hold them up. I really think we have pushed the body of the chicken close to the edge."

Source: MIT

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