

A GENE IS JUST A GENE?

BY: MICHELLE HANEY, NEBRASKA PORK PRODUCERS ASSOCIATION INTERN

A gene is just a gene unless you're Dr. Brett White, Associate Professor and Swine Physiologist in the Department of Animal Science at the University of Nebraska-Lincoln. White's research focuses on the relationship between a hormone that is absolutely essential to reproduction, gonadotropin-releasing hormone (GnRH), and its receptor, or docking site. Specifically, he is examining the role that the GnRH receptor gene plays in determination of ovulation rate, or the number of eggs that are available to be fertilized following insemination. This includes studying the mechanisms that regulate the GnRH receptor gene.

He's finding the ways that the GnRH receptor gene is turned on and off, and what determines the 'volume control' setting for this gene. Dr. White is also studying methods to take the wanted genes from one swine line and put them into another line to make specialized lines that have a higher productivity, for example, increased litter sizes. These lines are called transgenic, or are transferring genes from one line to incorporate them into another line.

A little background about the biology behind the GnRH hormone. GnRH is made in the hypothalamus, which is the region of the brain that is the main control center for regulating sleep cycles, body temperature, appetite, etc., and also produces hormones including the releasing factors, like GnRH, that control hormonal secretions from the pituitary gland. GnRH attaches to its receptor, much like putting two pieces of a puzzle together, and causes the pituitary gland to make luteinizing hormone (LH) and follicle-stimulating hormone (FSH). These hormones are important to reproduction, because they stimulate development of eggs and cause ovulation, which combined determine ovulation rate.

Dr. White said they are attempting to manipulate the interaction between GnRH and its receptor in order to increase ovulation rates.

"We are studying what can block the receptor and what can make it come back," he said.

He also indicated that in humans, pituitary tumors respond to GnRH, so if there was a way to block receptors, we would be able to control some of those cancers.

It's known that right before ovulation there is a huge surge of GnRH from the hypothalamus, thus there needs to be a lot of receptors in the pituitary gland to attach to the GnRH, according to Dr. White.

"This is a way by which swine regulate their own receptors," he said.

For their research, Dr. White and his laboratory team are trying to find what causes the gene for GnRH receptors to be turned on in the pituitary gland and how the gene is stimulated by GnRH.

Scientists have also found that a marker for ovulation rate and the gene for GnRH receptor are on the same chromosome, linking the two together at a genetic level, he said. Therefore, their research also includes studying lines of sows with different ovulation rates to see if the GnRH receptor gene is regulated differently between them. These lines are: the Chinese Meishan (pictured bottom right), which have approximately 4 to 5 more piglets per litter than occidental swine lines; the Index line was developed at UNL by Dr. Rodger Johnson and has undergone selection based on an index of ovulation rate and embryonic survival, resulting in 1 to 2 more piglets per litter than randomly selected females; and a Control white crossbred line typically found in the industry. If they find specific regions of DNA for the GnRH receptor that differ between lines, they can find markers for ovulation rate, he said.

"The ultimate goal is to be able to screen for ovulation and be able to tell if a one-day-old piglet will be a candidate for market versus breeding stock," White said.

In fact, a mutation in the GnRH receptor gene from the Chinese Meishan compared to the other lines has already been found and associated with ovulation rate. Dr. White and his lab team are still hard at work at UNL, but they aren't ready to take blood samples from pigs just yet.

"Many of the maternal lines in the industry already have increased ovulation rates anyway, however the GnRH receptor gene may also be associated with increased uterine capacity or other physiological traits determining litter size, as well," White said.

With this research, Dr. White said that the findings would probably be more beneficial to producers raising swine lines known for their growth and carcass traits, not necessarily maternal traits. He explained that genetic screening may be more beneficial to them because these lines likely have more room for improvement of reproductive efficiency. This would let producers spend their money and time more wisely because then they'd know what's in the future for each animal, he said.

"I'm very excited that this could potentially enhance profitability for producers," White said.

Other projects Dr. White and his team are working on are finding ways to take important genes from the Chinese Meishan and combine those genes into swine lines commonly found in production today.

"Thus making a genetically enhanced line of pigs," White said "The procedures are out there, but we have a ways to go yet," he said.

Dr. White wasn't always elbow deep in genes, he is originally from Hershey, Nebraska and his dream job was to become a professor at UNL. He completed his undergraduate degree at UNL, and got started in swine research with a summer internship supervised by Dr. Johnson. Now, he is living his dream as an associate professor at UNL, which includes teaching reproductive physiology and a course about new techniques in reproductive biology.



Dr. White, above, shown with several of his research pigs on the University of Nebraska Lincoln East Campus.

The Meishan breed, below, was introduced into the United States under a cooperative effort of the USDA, the University of Illinois, and Iowa State University. This effort also imported Fengjing and Minzhu pigs from China. A total of 144 pigs from these breeds were shipped to the United States.

Meishan pigs come from the region of lakes and valleys in China. They are considered Taihu pigs, deriving their name from the Taihu Lake in their region of origin. This region lies in the Mid Subtropic Belt, a narrow region between North and Central China, in the Lower Changjiang River Basin and Southeast Coast. This area has a mild climate.

