

Gene Editing

The animal agriculture industry is keenly aware of emerging science which can benefit **people** through improved food and worker safety, **pigs** through enhanced animal welfare, and the **planet** by identifying and reducing any negative environmental impacts of raising animals for food.

Producers have a long history of developing and implementing genetic solutions for production and disease challenges. (i.e. genetic selection of pigs in production to identify and remove the halothane gene for greater lean growth; selection based on development of breeding stock that have genetic resistance to K88 colibacillosis in neonatal piglets.) This selection can be accomplished in nature over a long period of time with traditional genetic management and breeding and accelerated with the use of artificial insemination.

Modern technology has evolved to the point where maneuvering specific genes can be done more quickly and with greater accuracy, therefore accelerating the desired trait in a population. There is no difference in these animals regardless of the technique that was used to create them. Additionally, this is critical to continuous improvement of the genetic potential of animals raised for food.

Benefits are important to humans, animals and the environment. The National Pork Board's strategic plan reflects this in its focus on doing what is right for people, pigs and the planet.

General points about today's pig farming

- Today's pigs are raised by farmers who have dedicated their life to providing for the best in health, well-being and safety of their animals and about the safety of the food they produce.
- Pork producers also recognize that today's consumers are asking more questions about where their food comes from and how it is raised. That's why we welcome every chance we get to talk to people about today's pork production.
- Over 60,000 of America's pork producers are certified in Pork Quality Assurance Plus® and more than 16,500 sites have been independently assessed, as part of the industry's **continuous improvement** educational program that helps assure consumers that we are producing safe, high-quality pork and that we are providing the best possible care for our animals.

People – Food Safety

- Having animals that are resistant to specific diseases would require less antibiotic use to maintain health. This is true even in animals that are resistant to a viral disease because animals that are not resistant to viral disease often receive antibiotics to reduce the incidence of secondary infections caused by bacterial infection.
- Additionally, animals that are resistant to specific enteric pathogens provide a greatly reduced risk of human sickness from foodborne pathogens.
- The National Pork Board diligently works on prevention, detection, response and recovery from all foreign animal diseases. This new technology aligns with the Secure Pork Supply Plan currently under development by the U.S. pork industry. This plan will enhance communication and coordination, accelerate a successful FAD response, and support continuity of operations for pork producers.

Pigs – Animal Welfare

- Development of animals resistant to specific diseases has substantial implications for animal health and well-being, and the responsible use of antibiotics. Research has shown that animals that face even a moderate health challenge grow more slowly and have different body composition compared to animals that have not faced a health challenge.
- Animals resistant to specific diseases experience less morbidity and mortality and therefore experience improved health and well-being.
 - An example of this type of technology is CRISPR Cas-9 edit of the gene CD 163¹. This specific gene edit creates a pig that is resistant to Porcine Reproductive and Respiratory Syndrome virus (PRRS), one of the most economically costly diseases with an annual impact of \$664 million per year².
 - The essential composition of such a pig is unchanged with the exception of the edited gene and there is no added proteins or compounds.
- Pork producers are aware of the challenge of antibiotic resistance and work hard to preserve the effectiveness of antibiotics, both on the farm and in human medicine. Gene editing could reduce disease in swine herds and thereby reduce the need for antibiotics to be administered.
- Reducing the need for antibiotics and understanding the concept of antibiotic resistance (two very different things) is something the U.S. pork industry has been working to clarify for some time. Our responsible antibiotic use education plan for farmers has been in place for two years.
- New FDA rules define how medically important feed-grade antibiotics will be used to treat, control and prevent disease, as well as eliminate the use of medically important antibiotics for growth promotion. These new rules also require veterinarian oversight for the use of medically important antibiotics in feed and water, and improved record keeping.
- Preserving the effectiveness of medically important antibiotics is critical in our commitment to ensure a safe food supply, build consumer trust and maintain the health and welfare of pigs.

Planet – Sustainability and Environmental Welfare

- The availability of resources necessary to produce meat, milk and eggs is being reduced due to global human population growth. Additionally, the economic situation of many developing nations is improving and people in these countries preferentially replace plant-based protein sources with animal-based proteins in their diets.
- Animals that are resistant to specific disease grow more efficiently and therefore use less grain during the growing period. By far the single most important factor in reducing the carbon footprint of livestock production is efficiency of production.
- In the past 50 years, pig farmers have nearly doubled the amount of pork produced while **reducing land use by 78%, water use by 41% and reducing the carbon footprint by 35%.**

¹ Use of the CRISPR/Cas9 system to produce genetically engineered pigs from in vitro-derived oocytes and embryos. Whitworth KM1, Lee K1, Benne JA1, Beaton BP2, Spate LD3, Murphy SL1, Samuel MS3, Mao J2, O’Gorman C2, Walters EM2, Murphy CN1, Driver J4, Mileham A5, McLaren D5, Wells KD3, Prather RS6. Biol Reprod. 2014 Sep;91(3):78. doi: 10.1095/biolreprod.114.121723. Epub 2014 Aug 6.

² Assessment of the economic impact of porcine reproductive and respiratory syndrome virus on United States pork producers. DJ Holtkamp, JB Kliebenstein, EJ Neumann... - Journal of Swine Health and Production, 2013.