



Gut Check: Why the Microbiome Matters

By Geoff Geddes, for Swine Innovation Porc

Like humans, pigs are complex creatures. The more we understand our animals, the better we can support them, and healthier pigs mean healthier profits. Fair to say, then, that taking a few hours to hear three experts talk about the role of the microbiome (the genetic material of all the microbes - bacteria, fungi, protozoa and viruses - that live on and inside the body) in human and pig health is time well spent.

As Swine Innovation Porc held an information session just prior to the 2020 Banff Pork Seminar, the first speaker was Dr. Emma Allen-Vercoe, Professor, Canada Research Chair, Department of Molecular and Cellular Biology at the University of Guelph.

Though she is focused on humans, much of what Dr. Allen-Vercoe had to say applies to the pig microbiome as well, and it came down to a few key questions.

How does our lifestyle affect the gut microbiome?

“Advertising today suggests that all microbes are bad, and that must change. How many times have you bought soap because it was ‘anti-bacterial’, and you figured that must be a good thing as bacteria is something to avoid?”

The problem is that only a tiny fraction of microbes are pathogens and therefore harmful. While we are trying to target those “bad” microbes with products like anti-bacterial soap, the soap doesn’t distinguish between pathogens and microbes. As a result, the product ends up killing beneficial microbes as well and doing more harm than good to the microbiome.

Then there is the growing issue of antibiotics and their impact on the gut. Many studies show that the gut microbiome changes with antibiotic use. It can take a long time after treatment for the microbiome to return to baseline, and sometimes it never does. As well, repeated hits of antibiotics can cause vast changes, almost like clear cutting a rainforest.

Antibiotics during pregnancy can be especially problematic for the gut, perhaps having pervasive effects on offspring such as obesity and colitis.

“I’m not saying that antibiotics are a bad thing,” said Dr. Allen-Vercoe. “They are a miracle of modern medicine, but we haven’t used them very well. We must start considering the importance of applying antibiotics judiciously for infection because of their impact on the microbiome.”

One of the greatest barriers to reducing antibiotic use is the public’s fear of germs, a fear that has been inflated by television and magazines.

“Nobody wants to return to the time of cholera, but we must take a stand against fear mongering about germs. The best way to remove pathogens from hands without damaging the natural microbiome is to use soap and water. We need to start thinking about using the microbiome as a way to manage pathogens



Swine Innovation Porc held its third annual swine health session in Banff, Alberta on January 7, 2020. Photo: SIP

“We need to start thinking about using the microbiome as a way to manage pathogens without trying to get rid of them, because when you try to kill pathogens, that’s when they develop resistance.” - Dr. Allen-Vercoe

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A few years ago, researchers developed the missing microbiota hypothesis, which, though controversial at the time, is now proving to be true. It states that by using antibiotics and other drugs, maintaining a poor diet and following a sedentary lifestyle, we are eroding the microbial ecosystem in our bodies, especially the gut. If that trend continues, we can wind up with extinction events in this ecosystem that will span generations.

“If someone takes antibiotics or has a major upset of the microbiome, this can be compensated for by acquiring other microbes from the environment. Unfortunately, the rate at which we are losing microbes may be greater than the speed with which we can acquire new ones.”

Over a lifetime and through generations, we see less and less microbial diversity, and experience changes in global health as a result, such as dramatically rising instances of chronic diseases.

How do we acquire our microbes?

Though sterile at birth, babies rapidly pick up microbes before eventually acquiring a mature microbiome by around the age of 3; the early months and years are critical to the microbiome development process. Breastfeeding is a good source of microbes, yet many common practices impact the natural course of microbiome development in a negative way. These include c-sections, maternal antibiotics, formula feeding, indoor living, excessive sanitation and chemical preservation of food.

This is not to say that all of those practices are bad,

just that they impact the very narrow window for proper development of the microbiome and, consequently, children’s health. Examples of diseases associated with altered gut microbiota diversity are eating disorders, obesity, Parkinson’s, colorectal cancer and diabetes.

“The point is that context is everything. Many opportunistic pathogens act like bad teenagers in a subway station. In a crowded environment, they tend to behave and can even be a force for good. When the crowds are gone, however, they act out in antisocial ways. In the same way, when you lose diversity in the gut microbiome, you lose that pacifying police force and allow opportunities for pathogens to behave badly.”

While it may sound all doom and gloom, there are options for fixing some of the damage done to the gut, with some options being better than others.

Probiotics

One of the oft-cited solutions is probiotics. These are live microorganisms promoted with claims that they provide health benefits when consumed, generally by improving or restoring the gut microbiota. There are numerous types and strains of probiotics and many manufacturers, some of which are legitimate, but most are not.

“We see a lot of overinflated claims about probiotics and too many celebrity endorsements. Celebrities rarely have degrees in microbiology, yet profess to know more than they do.”

There also tends to be this one-size-fits-all mentality, where the same probiotic product that treats Aunt Sarah’s psoriasis will supposedly work on baby Jane’s



diarrhea. This thinking completely disregards the fact that everyone's microbiome is different.

Not surprisingly, the view of the layperson towards probiotics differs greatly from that of the microbial ecologist.

"Consumers go to the supermarket and see all of these products just begging to colonize their intestines, but this is based on two myths. The first is that the probiotics found in food are the same species as the ones in the gut, yet they are very different."

The second myth assumes that probiotics colonize the gut and provide long term benefits, when in fact they are only present during consumption.

In contrast, the microbial ecologist sees that normal gut microbiota number between 100 billion and 1 trillion cfu (colony forming units) per ml, versus 2-15 billion cfu per capsule of probiotic. While 2 billion sounds like a big number, it's simply not enough to have a major impact on the microbiome.

In spite of probiotics being poorly regulated and showing modest benefits at best in clinical trials, the lack of significant side effects may mean they are worth a try. The key is selecting the right one based on sound scientific research rather than what your favorite soap star recommends.

Fecal transplants

If the very name makes you want to turn the page, you're not alone. Fecal transplants use a healthy donor's microbial cells to replace those of a sick ecosystem. The procedure results in a cure in over 90% of *C. difficile* cases, with only rare recurrence of the infection. *C. diff* infections involve bacteria that can cause swelling and irritation of the large intestine, or colon. This inflammation, known as colitis, can cause diarrhea, fever and abdominal cramps.

In terms of drawbacks, we don't yet understand the potential downside of fecal transplants or how to

screen for unknown dangers. Super donors can be hard to find and may become compromised, and there have been reports of weight gain and even death following the transplant.


Potential solution?

A promising alternative to probiotics and fecal transplants for maximizing gut health are microbial ecosystem therapeutics. This option, which is currently being developed as a drug for oral delivery, involves deriving pure, well characterized microbes from healthy donors and applying them much like probiotics.

"Using this approach is safer, cleaner and easier than fecal transplants, and more effective than probiotics. It is based on the idea of microbial synergy, that microbes work better in teams and are more likely to colonize the gut this way."

If you're thinking that Dr. Allen-Vercoe spent a lot of time talking about humans at a pork conference, you're right, but there's a good reason for it. When it comes to the microbiome, pigs and people share several relevant attributes including body size, gross gastrointestinal anatomy, digestive processes and omnivorous diet.

"The pig's microbiota responds to dietary modulation much the way a human's does; in fact, human microbiota researchers consider the pig an important model for their work."

Fresh air, majestic mountains and some key revelations about pig guts. For attendees of the 2020 Banff Pork Seminar, it doesn't get much better than that. 

To watch a video of Dr. Allen-Vercoe's talk, [please click here](#).

This article is part two of a special four-part series on the Swine Innovation Porc health session held in January 2020. [Check out our website](#) for more R&D featured articles.