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How Intestinal Microflora Changes In Animals and Poultry

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Key Points:

- Animals are germfree before birth/hatching; bacteria colonize the gut right after
- Different bacteria are introduced and colonize the gut at different times
- By changing dietary factors, gut microflora can be altered
- Introducing beneficial bacteria helps stabilize gut microflora

The intestinal tract of a mammal fetus in the mother's body is germfree. It's not until after birth that Enterobacteriaceae bacteria including *Escherichia coli* begin to colonize. Later aerobic bacteria, such as enterococci, start to colonize within the intestines. Lactobacilli and bifidobacteria, which utilize lactose in milk, start colonizing when the animals begin suckling, which in turn leads to suppression of Enterobacteriaceae. By the time the animal weans, colonization of anaerobic bacteria such as Bacteroidaceae, bifidobacteria, and clostridia can be seen. Reports indicate that the production of antibodies against lactobacilli has not been detected in rodent's blood for around one week after the birth, which helps allow the lactobacilli to colonize the gut.

The intestinal tract of an embryo within an egg is also germfree. The hygiene status of the environment where chicks grow considerably influences the intestinal flora establishment in the chicks (without lactation). The trend of intestinal microflora establishment looks very similar between mammals and birds. First, aerobic bacteria in the environment, such as Enterobacteriaceae or enterococci, colonize just after the hatch; secondly, lactobacilli are found after feeding starts; and lastly, anaerobic bacteria, such as Bacteroidaceae, bifidobacteria, and clostridia, start to colonize. Lactobacilli species are dominant in the gut of many mammals and birds throughout their lifetime.

There are some unique characteristics of intestinal microflora that relate to individual animal species. For example, more clostridia can be found in pigs and cats than found in other animals. *Bifidobacterium* is more dominant in humans, and *Lactobacillus* in rats. Enterococus shows higher dominance in dogs. The balance of intestinal microflora in each case is influenced by environment and diet. Cats and humans, eating more meat than the other animals, have extremely low ratios of lactobacilli. High numbers of lactobacilli in rodents' intestinal microflora could be a result of their diet that contains a lot of natural grains, which supply carbohydrates indigestible by the host, but are available (and digestible) to lactobacilli living in the hindgut of the animal.

After birth, once bacteria are ingested by the animal and settle in the intestinal tract they will reside there (for bacterial "generations") as long as the host animal survives. As thousands of different bacteria inhabit intestinal tracts, the microorganisms have to compete with each other for dominance. The bacteria that successfully colonized and predominated in the gut in the course of evolution are the ones that adapted well to anaerobic conditions of the gut and utilized nutrients leftover by the hosts. Food ingredients that cannot be digested by digestive enzymes of host animals become nutrients for intestinal bacteria. Polysaccharides, especially, are important nutrients for gut flora.

As an example, in a pig feeding study, researchers found that clostridia and Enterobacteriaceae were significantly decreased when indigestible oligosaccharides were added to the animals' diet. At the same time, the total number of intestinal bacteria increased.

In a broiler feeding study, authors reported that *C. perfringens* increases in the lower gastrointestinal tracts when a high methionine and glycine fish meal is part of the diet. In the report, the primary protein source for the control group diet was supplied from soybean meal which has a high carbohydrate ratio. The authors concluded it may be possible that not only the amino acid composition, but also the high carbohydrate ratio may have affected the gut bacterium balance.

In a trial evaluating several glycine inclusion levels in the diets of broilers, when *C. perfringens* was orally administered, mortalities were significantly higher in the groups having 3% or 4% of glycine in the feeds. It was found that the higher the glycine level in the feed, the lower the number of Lactobacilli in cecum, suggesting a shortage of carbohydrates necessary to support the growth of Lactobacilli.

As seen in these experiments, the number of intestinal bacteria change all the time according to the quantity and quality of substrates, or nutrients, that reach the portion of the gut where the bacteria reside.

Other research shows that it is not only the nutritional components of feed that influences gut bacteria populations, but also an intake of live bacteria can alter the intestinal microflora balance. Researchers report that the continuous intake of *Bacillus subtilis* C-3102 (CALSPORIN®) decreased *C. perfringens* both in broilers, layers and pigs. In the case of broilers, the population of gut Lactobacilli increased, and in the case of pigs, increases of Bifidobacteria was observed. It is thought that there are several modes of action by which *Bacillus subtilis* C-3102 increases *Lactobacillus* or *Bifidobacterium*.

Since *Bacillus subtilis* is often found in the soil and associated with decaying plants, the bacterium naturally has a higher ability to utilize nutritional ingredients derived from plants. This indicates that the microorganism may be able to influence the intestinal microflora of animals by changing the composition of substrates to be utilized in their intestinal tracts.

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