Newsletter

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> EDITORIAL

A large and diverse range of bacteria are living in the gastrointestinal (GI) tract of our animals and most of these bacteria form a symbiotic relationship with the host. The important role of gastrointestinal microflora in health and disease of animals and humans is increasingly recognized. The microorganisms that colonize the gut have a major impact on the health status of their hosts. However, the composition and metabolic activities of the microflora in the GI tract are influenced by many factors of which nutrition is the most important. It should be a goal when formulating diets to favourably influence the microbial community in the gut. The feeding of probiotics can be used as a tool to achieve this. Current research investigates the effects of probiotic microorganisms in animals as well as humans. Most commonly used probiotic bacteria in animal feeding are species like Enterococcus, Pediococcus, Lactobacillus, Bifidobacterium and Bacillus. In several scientific studies it was shown that they have a beneficial effect on performance, pathogen inhibition, modulation of intestinal microflora and immuno-modulation. This newsletter gives a short introduction into the gastrointestinal microflora and its influence on the host. The feeding of Biomin probiotic products can be used as an effective tool to favourably manage the microbial communities in the gut of our animals for better health and improved performance.

Enjoy reading.

Michaela Mohnl

Biomin® probiotic product line

A well established intestinal microflora is crucial for the health of our animals, especially if we expect high production performance. A healthy normal microflora is the first line of defense to invading pathogens and thus it is extremely important for the ability to fight off infections with enteric pathogens. Furthermore, it is also necessary for a well functioning and effective digestion of nutrients, resulting in good growth performance parameters.

Gastro-intestinal microflora and its influence on the host

Besides nutrient absorption, the intestine plays an important role as the biggest immune organ of the body. It is hence part of the body's defence system and represents an important barrier against invading pathogens. In addition to general defence mechanisms, the immune system, with its unspecific and specific reactions, helps to protect against pathogenic microorganisms. The intestinal microflora also suppresses pathogens.

Important functions of the *gut microflora* for the organism

- Digestion and absorption of nutrients
- Metabolism of xenobiotics[1] and endogeneous[2] toxins
- Direct inhibition of pathogens
- Epithelial function
- Action on the immune system within the gut

[1] Is a chemical which is found in an organism but which is not normally produced or expected to be present in it
[2] Produced within or caused by factors within the organism.

Intestinal microflora

The intestinal microflora comprises all bacteria, protozoa and fungi present in the GI tract and consist of approximately 400 to 500 different species. In monogastric animals approximately 10^{14} microbes can be found in the intestine. The initially sterile digestive tract is colonised by microorganisms soon after birth. Diversity and total number of the microorganisms increase from the small intestine to the caecum. The microflora is subdivided into the **main**, the **satellite** and the **residual** flora (Gedek *et al*, 1993). The **main flora** is composed mainly of anaerobic species *(Bifidobacteria, Lactobacillae, Bacteroides and Eubacteria)* which produce lactic acid and other short-chain fatty acids. The **satellite flora** represents approximately 1% and consists mainly of *Enterococci* and *E. coli*. The **residual flora** is below 0.01% and is composed mainly of harmful microorganisms.

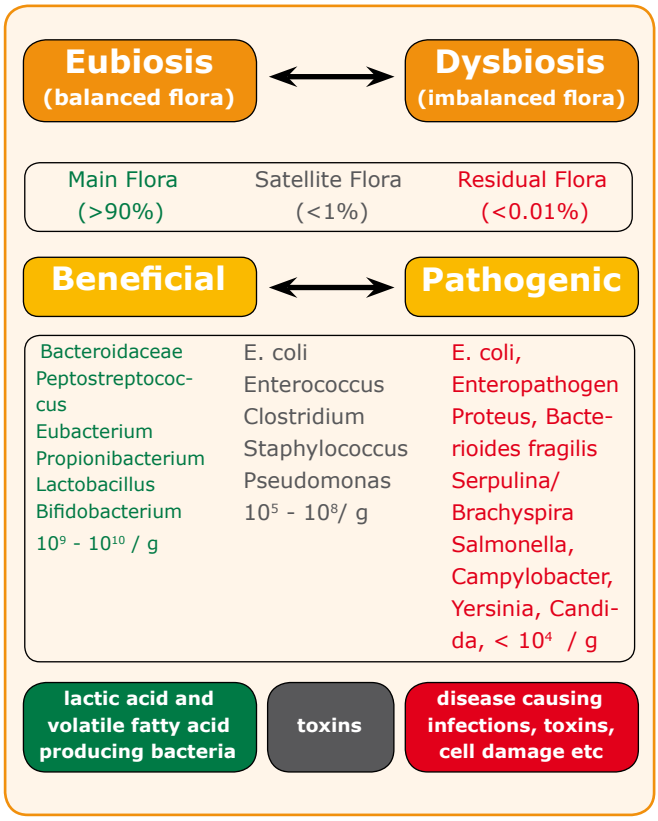

Figure 1: Bacterial genera and their influence on the host

Eubiosis vs. Dysbiosis

The composition of the intestinal microflora is a dynamic equilibrium among the various species and changes with the conditions in the digestive tract. When the microflora is in equilibrium, the proportion of the main flora is over 90%, the satellite flora is around 1% and the residual flora is below 0.01% *(Figure 1)*. This state is called **„Eubiosis"**. In this situation, the host and the microflora live together in symbiosis, meaning, with mutual benefit. The host provides good living conditions. In exchange, the intestinal microflora, when in the state of eubiosis, supports the host with essential activities. If this relationship is severely disrupted, the condition is called **„Dysbiosis"**. Dysbiosis can have a significant negative impact on the host animal. The growth of potential pathogens, which are normally kept at a very low level, can dramatically increase. Bacterial toxins are produced which may harm the host *(Figure 2)*.

Eubiosis

„Good" coexistance of host and microflora - Symbiosis

- **Protection** of the intestinal mucous membrane against invading microorganisms
- **Antagonistic effect** on undesired microorganisms
- Contribution to **maturation** and stimulation of host´s **immune system**
- **Nutrient digestion**
- **Vitamin** syntheses
- **Protein** syntheses

Dysbiosis

„Bad" coexistance of host and microflora

- **Damage** to the intestinal epithelium. Gut wall thickening > reduced resorption of nutrients
- **Toxic metabolic substances** (NH_3, biogene amines, toxins)
- Decomposition, **increased gas production** (CH_4, H_2S, CO_2)
- **Weakening** of immune system.
- **Immune reaction** >increased need of energy
- Acceleration of cell turnover > increased need of **energy**

Figure 2: Eubiosis vs. Dysbiosis

Possible reasons why eubiosis turns into dysbiosis

Nutrition is the most important factor influencing the composition and metabolic activity of the intestinal microflora. Feeding errors and substantial dietary changes, low-quality feed components and inadequate feed hygiene all compromise eubiosis *(Figure 3)*. For example the change from a low protein diet to a high protein diet favors the growth of certain bacteria such as *clostridia* and reduces the conditions for *lactobacilli*

• Feed → **When you feed the animal you feed also the microflora**

- ✔ **Substantial dietary changes**
- ✔ **Low-quality feed components**
- ✔ **Inadequate feed hygiene**

• Stress → **Influences digestive secretions and peristalsis**

- ✔ **Transportation**
- ✔ **Overcrowding**
- ✔ **Climate**
- ✔ **Disease**
- ✔ **Vaccination**
- ✔ **etc**

Figure 3: Possible reasons why eubiosis turns into dysbiosis

or *bifidobacteria*. Furthermore every kind of stress can have a direct impact on the gut microflora because stress influences the release of digestive secretions and the type and frequency of intestinal movements (peristalsis).

Probiotics

The feeding of probiotics can be used as a tool to favourably influence the microbial community in the gut to achieve or reestablish the state of eubiosis. In general, the following modes of action of probiotics are assumed:

- **Competition** with pathogenic bacteria for space, intestinal attachment sites and nutrients
- Change of **environmental conditions** in the intestine (Lowering of pH through increased production of volatile fatty acids (VFA) and lactic acid)
- Production of **antimicrobial substances** (lactoferrin, lysozyme, bacteriocins... „Natural antibiotics“)
- **Modulation** of **intestinal immune response**

Intake of probiotics should result in the creation of gut microecology conditions that suppress harmful microorganisms and favor beneficial microorganisms, and ultimately enhance gut health.

In a study which was carried out by the *Department* of *Animal Nutrition of the Agricultural University of Athens* (Mountzouris *et al*, 2007) the efficacy of Biomin® Poultry5Star on broiler nutrition was investigated in comparison to the AGP Avilamycin. Biomin® Poultry5Star is a well-defined, multi-strain synbiotic product which combines the beneficial effects of probiotic strains from the genera *Enterococcus, Pediococcus, Bifidobacterium* and *Lactobacillus* with prebiotics.

Results

Treatment effects on parameters of broiler performance, cecal microflora composition, concentration of volatile fatty acids, and activities of glycolytic enzymes were determined. Overall **growth performance** expressed with the broiler productivity index was comparable between the Biomin® Poultry5Star group and the AGP group *(Figure 4)*. The administration of Biomin® Poultry5Star resulted in a **beneficial modulation of the cecal microflora** *(Figure 5)*. Concentrations of bacteria belonging to *Bifidobacterium spp., Lactobacillus spp.*, and gram-positive cocci were significantly ($P \leq 0.05$) higher in the Biomin® Poultry5Star group in comparison to the control and AGP group. The Biomin® Poultry5Star group had significantly higher ($P \leq 0.05$) specific activity of α-galactosidase compared to the control and the AGP group and β-galactosidase activity was significantly higher ($P \leq 0.05$) in comparison to AGP group *(Table 1)*. Bacterial glycolytic enzymes play an important role in the **fermentation of undigested carbohydrates**.

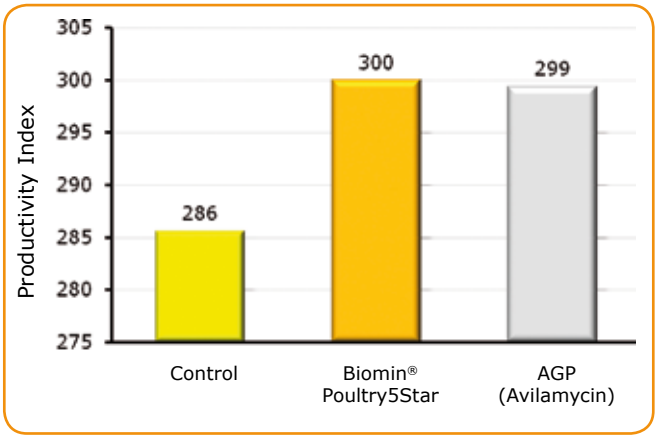

Figure 4: Broiler productivity index (Liveability [%] x live weight [kg]/age [d]/FCR x 100) after 42 days

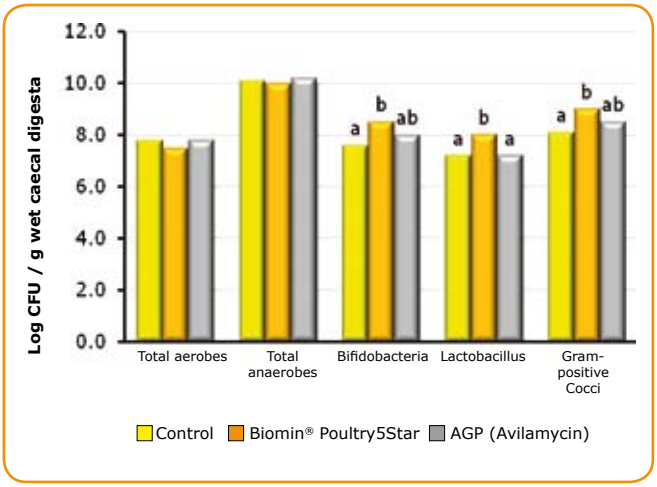

Figure 5: Cecal microflora composition of broilers at the age of 42 days in control, Biomin® Poultry5Star and antibiotic (Avilamycin) group. Bars with different letters (a,b) differ significantly (P ≤0.05).

Table 1: Microbial glycolytic enzyme activity (mmol of p-nitrophenol released/min per g of protein) in the cecal digesta of 42-d-old broilers

	Control	Biomin® Poultry5Star	AGP
α-Galactosidase	17.6^{a}	34.6^{b}	25.6^{ab}
β-Galactosidase	53.1^{ab}	79.5^{a}	38.0^{b}
α-Glucosidase	40.7	50.1	41.5
β-Glucosidase	15.8	18.9	17.4
β-Glucuronidase	48.1	58.4	41.6

a,b Means with different superscripts within the same row differ significantly ($P \leq 0.05$).

Conclusion

Biomin® Poultry5Star treatment displayed a growth-promoting effect that was comparable to Avilamycin treatment. In addition, administration of Biomin® Poultry5Star modulated the composition and, to an extent, the activities of the cecal microflora, resulting in improved eubiosis and enhanced gut health.

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> EVENTS

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We are looking forward to meeting you there!

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> LITERATURE

FEFANA booklet on probiotics in animal nutrition

Mountzouris K.C., Tsirtsikos P., Kalamara E., Nitsch S., Schatzmayr G., and K. Fegeros. (2007)
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Perry, G.C. (2006)
Avian Gut Function in Health and Disease. Poultry Science Symposium Series Vol. 28, Carfax Publishing Company, UK

> IMPRESSUM

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