# INNOVATIONS IN FEED ADDITIVES

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Animal nutrition has changed from feeding self-grown silages, through the mixtures of simple compound feeds based on a variety of raw materials to current precise nutrition where many micro-elements are added to the diet for optimized nutrition. Faced by many challenges, today's nutritionist is requested to formulate a diet that allows an efficient production by a healthy animal with low pressure for the environment in a profitable way. New challenges arise: continuous need for animal protein and food security, climate change and competition for land with biofuel, zoonoses and antibiotic resistance, animal health and welfare are topics faced by the animal feed industry. These topics can be forced upon by consumer wishes, governments, other stakeholders or as a form of product differentiation and marketing. These defined topics are the main drivers to form a more precise nutrition by new or adjusted feed additives

Feed additives can act on several levels, the main categories divided in: functional ingredients (amino acids, trace minerals, vitamins, micronutrients), gut health (plant extracts, organic acids, pro- and prebiotics), digestion (enzymes, emulsifiers), immune system (beta-glucans, nucleotides, probiotics) and neutralisation of undesirable substances (ANF's, mycotoxins, ammonia).
Innovation in these type of products can originate from a large scope . True innovation is found with complete new molecules being introduced to the market. But innovation may also be found in a new application for an existing molecule. This can be the case when a molecule is introduced with application for a new animal species, serves a new purpose (lower environmental shedding, production of functional foods), with improved handling or processing features (e.g. heat stability, hygroscopicity, dust elimination) or with improved characteristics (e.g. solubility, bio-availability).

A complete new field of research or mode of action can be found on gut level. In the early stage, feed hygiene was the followed pathway (mainly via organic acids). In a second step, more emphasis has been put on control of pathogens in the intestines (plant extracts, MCFA, coated organic acids). This transferred to a higher knowledge of balanced microflora (probiotics, prebiotics) and more attention for diet-host interactions (immune modulation, tight junctions and epithelial cells, gene expression). The latest innovations go even further, discussing communication between bacteria in the microflora (quorum sensing).

Improved functionality can be found within the spectrum of emulsifiers. Launched at first was lecithin, derived from soybean. At later stage lysolecithin was introduced as a more effective molecule. This innovation was quickly followed by modified lysolecithin, where enzymatic treatment of the molecule allows to make a more water soluble product. Further investigation has led to understanding that the balance between hydrophilic and lipophilic part of the emulsifier (HLB value, rule of Bankroft) allows to create an emulsifier with a higher HLB value dedicated to a fat:water ratio that is similar to the animals' intestinal environment.

Increased bio-availability is a key component in trace mineral nutrition. Trace minerals initially were delivered via raw materials only. In the 1950's supplementation of inorganic trace minerals (oxides, sulphates) was discovered. Approximately from 1970's onwards, research started focussing on trace mineral-amino acid ligands (chelates) and these products gained more interest in the 1990's, later on even diversified towards glycinates. Latest development is the application of hydroxy-trace mineral application in which the solubility characteristics are the fundamental basis for the mode of action.
Specific attention can be given to selenium. This particular trace mineral cannot react in chemical way to from a chelate with amino acids. Selenium doesn't bind to amino acids, but can replace sulphur inside sulphur-containing amino acids such as methionine. Innovation in this field followed a different pathway. In inorganic form (selenate, selenite) it has been added to animal diets for decades, successfully followed by organic selenium from selenized yeast in animal nutrition approximately 10 years ago. A third generation selenium has become available to the industry from 2014 onwards based on specific preparations with pure L-Selenomethionine, allowing more accurate and efficient application of selenium.