Best practices for the prevention and control of *Salmonella* in poultry

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Salmonellosis is one of the most prevalent foodborne zoonoses worldwide. Food animals could be reservoirs for non-typhoid (zoonotic) *Salmonella* infections. In addition, host-specific *Salmonella* infections cause fowl typhoid and pullorum disease that produce great economic losses in different parts of the world. Several measures are involved in the prevention and control of *Salmonella*; therefore we would like to briefly review the fundamental techniques for the control of *Salmonella* in poultry flocks.

The best start would be to ensure that all day-old chicks or laying pullets that we are entering into the farm come from parent breeder flocks and hatcheries free from *Salmonella*. The implementation of 'all in, all out' rearing systems is fully recommended. Furthermore, a comprehensive cleaning and disinfection program should be implemented: the drinking system should be tested and cleaned at the end of each production cycle; houses, cages, tools, adjacent areas, tanks, and pipes should be disinfected in order to eliminate biofilms of organic matter. Likewise, feed and feed transport vehicles must be clean and free of *Salmonella*. The heat treatment of the feed and the use of organic acids in feed mills reduce bacterial contamination. The silos and feed distribution systems must be kept clean and in good condition to prevent access of wild birds, rodents and environmental pollution. A pest control program should be in operation (rodents, insects and wild birds) in order to avoid the contamination of the feeding systems.

Another important approach is the use of competitive exclusion products, probiotics, prebiotics and essential oils which can also reduce the risk of infection in the farms. The corresponding biosecurity program is also fundamental as this considers not only general cleanliness and the recommended infrastructure but also the proper vehicle disinfection, barrier systems (area separation, footbath with disinfectants at the entrance to every house), personal protective equipment (wear protective clothing and footwear specific to each animal house) and shower rooms with strict rules for personal hygiene. Preventing visitors and domestic animals (dogs and cats) from entering the farm may help to avoid the entrance of *Salmonella* via these potential carriers. It is required that trucks and transport crates of birds are thoroughly cleaned and disinfected as *Salmonella* can contaminate those birds either entering the farm or leaving to the slaughterhouse.

Another consideration is the proper disposal of dead birds, waste and remains of dust which may be contaminated with *Salmonella*. In general, biosecurity, animal welfare, gut health, and control of the causes of stress and immunosuppression can help to prevent or minimize colonization and excretion of *Salmonella* in poultry. In addition, monitoring plays an essential role; it is recommended that a regular microbiological analysis of *Salmonella* (self-monitoring) be carried out to assess the health status of birds and the effectiveness of cleaning and disinfection of animal houses and warehouses. The implementation of self monitoring systems and programs for Hazard Analysis Critical Control Points (HACCP) in slaughterhouses, processing plants and egg grading and storing rooms significantly prevent and reduce microbiological contamination of poultry products and contribute directly to food safety.

Finally, the use of *Salmonella* vaccines can decrease public health risk by reducing colonization and organ invasion (including reproductive tissues) and by diminishing faecal shedding and environmental contamination. Vaccination against *Salmonella* in parent stocks, breeding flocks, and laying hens reduces the risk of infection, excretion and transmission to eggs and offspring.

With this editorial we hope to have contributed to the awareness about our common commitment with humankind in producing healthy poultry products to ensure food safety.

Enzymes: more than catalyzers for your business

Dr. Bernhard Herbort, Category Manager Feed Efficiency,
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Do you like poultry meat? I guess most readers of this magazine do, and probably not just because we are committed to poultry production. But there are billions more consumers and global meat demand is increasing year by year due to continued world population growth, income changes and urbanization.

Development of global poultry meat production is a story of success. A look back at the path already behind shows an increase in global chicken meat production since the 1960's by a factor of nearly 10, resulting from a high increase in the number of chickens and productivity (Thornton 2010). And, if we may trust the current projections of OECD/FAO (2012) after many years of being the 'eternal runner-up' global poultry meat production is about to overtake pork in approximately nine years. With a projected annual growth of 2.2% poultry remains the fastest growing meat production sector in the world.

But beyond these promising perspectives a look at the high and also very volatile feed prices brings disenchantment. Feed costs reflect about 60-70% of total costs in broiler production. According to OECD/FAO feed costs are anticipated to remain high.

All in all the expected tremendous growth of poultry meat production and the high significance of feed costs imply that feed efficiency is not only a factor of profitability. More than ever before feed efficiency will also be a central standard for the handling of valuable resources by our industry. With the output of poultry meat and the corresponding demand for feed the industry's responsibility for sustainability is further increasing. This refers especially to phosphates with their limited global inventory.

In response to rising input costs the application of enzymes in animal nutrition has increased rapidly, particularly in the last 5-10 years. This saves the global feed market an estimated 3-5 billion USD per year (Adeola and Cowieson 2011). Enzymes are widely added to feeds for pigs and poultry, and have (with breeding) contributed to the substantial gains in feed conversion efficiency that have been achieved. (Thornton 2010).

Feed efficiency includes many factors related to genetics, health and environment and we can only tackle these factors by a thorough 360° perspective. The high impact of enzymes within this holistic approach, however, is clear. Phytases improve the availability of phosphorus and reduce the anti-nutritional impact of phytate, resulting in an improved availability of other nutrients. The carbohydrases xylanase and ß-gluconase break down certain nonstarch polysaccharides, fibres which cannot be digested by poultry, but usually 'hide' valuable nutrients. Carbohydrases can improve energy, dry matter, starch and mineral utilization in poultry. Finally NSP-enzymes can improve growth performance of broilers, pullets, improve egg-shell quality and reduce incidence of dirty eggs (Adeola and Cowieson 2011). Besides their potential to increase performance in relation to feed input, enzymes provide a higher uniformity of performance.

Yet enzymes are no panacea. Feed enzyme application without appropriate adaptation of the feed formulation can in the worst case even result in undesirable effects on performance. Ask your enzyme supplier for clear and reliable matrix values and exact recommendations for your formulations. Feed efficiency is much too important for the profit of your company, for spare management of valuable resources and for our environment, to 'just play around' with enzymes.

And finally: 'Let's do good and talk about it !' There are lots of biased imaginations about poultry production. But how many consumers have ever heard about tools such as feed enzymes bringing great benefits for both profitability and environment?

Carnitine – much more than just a 'nice to have' micro-nutrient!

Dr Bernhard Herbort, Category Manager, Lohmann Animal Health GmbH

Have you ever tried to survive without your mobile phone? Of course survival without these small but technically impressing and very useful devices is possible in principle. Nonetheless, our private life would be less convenient and especially business life would be much more difficult and less efficient. The 'nice to have' accessory becomes a crucial 'must have' tool as soon as efficiency enters the equation.

With dietary carnitine supply in animal nutrition it is a similar matter. Carnitine is not an absolutely essential nutrient, and therefore not a classical vitamin. However, just like the use of a mobile phone dietary supplementation of carnitine also reveals its most convincing benefits when efficiency is concerned. And which objective could be more important in animal nutrition than feed respectively feed cost efficiency?

L-Carnitine, the biologically active carnitine isomer, is a (B) vitamin-like substance which is present in animal and (to a much smaller extent) in vegetable feed materials. Furthermore, L-carnitine can be synthesized endogenously by the animal organism in the liver from lysine and methionine. Nevertheless, many trials with several domestic animal species have shown positive effects of dietary L-carnitine supplementation, such as improvement of reproductive performance (sows) and gain/feed ratios (pigs), improvement of daily gain (broilers) and reduction of abdominal fat content (broilers) as reviewed by Harmeyer (2003).

Specific reviews on the effects of L-carnitine in poultry production have been published by Arslan (2006) and Golzar Adabi et al. (2011). The latter, more detailed review covers a broad spectrum of L-carnitine supplementation benefits proven in poultry so far, for example growth promotion, improved feed conversion, improved egg production, decrease in abdominal and mesenterical fat percentage, strengthening of the immune system, antioxidant effects and improved semen quality. From their review Golzar Adabi et al. concluded that L-carnitine bears a multi-functional purpose in poultry production. A further literature review on L-carnitine supplementation in poultry nutrition by Abidin et al. (2011) with special emphasis on antioxidant activity certifies L-carnitine as having very good antioxidant abilities. These authors further conclude that L-carnitine enhances fat metabolism, improves egg quality and is also a good immunomodulatory agent.

The many benefits of L-carnitine can partly be explained from its key role in energy respectively fat metabolism. L-carnitine is indispensable for mitochondrial ß-oxidation of fatty acids and can stimulate the citrate cycle. However, the extensive biochemical functions of L-carnitine known today are by far not restricted to an energetic impact. This can be seen already from the broad range of mentioned benefits in poultry production including performance, feed efficacy, reproduction, health and quality related effects. The increasing application of L-carnitine in human medicine and nutrition is another indication for the broad spectrum of biological functions. All in all the comprehensive benefits of L-carnitine clearly show that this very impressive multifunctional agent is not just a 'nice to have' micro-nutrient. L-carnitine is an essential strategic tool for feed efficiency improvement and health/quality considerations in poultry production.

In practical L-carnitine supplementation it is important to choose a product with a precisely defined percentage of pure (bio-efficient) L-carnitine, with excellent processing properties in the feed plant (non-hygroscopic, good mixing properties) and highest degree of safety for animals, humans and the environment. Your supplier should also be able to give you clear and scientifically based application recommendations and further technical advice.

Lohmann Animal Health GmbH together with Lonza AG from Switzerland are the pioneers of the introduction of L-carnitine to animal production. Make use of our long-term experience, our high quality L-carnitine solutions and technical service!

Comprehensive and preventive approach in animal production is essential to keep up with consumer demands

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Economically efficient production of high quality products for an affordable price is no longer the latest state of the art for meat and egg producing integrations. Next to a rising number of legal requirements, retail, non-governmental organisations and increasingly educated and interested consumer groups make high demands on food safety, amal welfare, traceability, transparency and sustainability. To keep up with these challenges, comprehensive solutions for the whole supply chain and a holistic approach is the key to the future in this business. Single interventions only help in the short-term. Long-term survivors with sustainable success will build on a comprehensive and effective Prevention concept.

Lohmann Animal Health provides this knowledge and competence. We are a well-known provider of avian vaccines and feed additives. But we now have more to offer than products. With Lohmann Solutions, we channel our biggest strength within a new consultancy division: our comprehensive view and experience in animal food production. Lohmann's strategy to support integrations meet these challenges is 360 degrees. We advise major customers on holistic and individual measures to optimise animal production and to offer them tailor-made consultancy services called 'Integrated Solutions'.

How can 'Integrated Solutions' support integrators? Healthy and safe food of high quality requires healthy animals. Animal health, however, has many aspects. Lohmann Solutions group works with integrations to improve biosecurity on a professional level, targeting antibiotic use, providing data management concepts and optimising quality assurance schemes along the supply chain.

For the prevention of foodborne zoonoses, our consultancy team has a broad range to offer, here is one example: Our proprietary Zoonosis Risk Index (ZRI) checks the prevention status of your farms and results in a quick 'traffic light' guided SWOT analysis that helps you pinpoint areas that could be optimised.

The poultry industry focuses on healthy and safe food, invests a lot of effort to reduce the risk of illness and loss of performance, as well as ensuring the well-being of animals in all parts of the food supply chain. There are several important parameters of animal welfare; one of them is the absence of foot pad dermatitis (FPD). As foot pad lesions cause pain, result in gait abnormalities and often lead to difficulties in reaching feed and water, FPD is an important aspect of bird welfare.

Lohmann Solutions offers unique expertise to develop a preventive control and monitoring strategy to minimise the occurrence of foot pad dermatitis. Our holistic and tailor-made FPD prevention package includes innovative process schemes for proper farm organisation and husbandry, hygiene and environmental management as well as animal health and drinking water programs – designed for sustainable effects.

All our 360° consultancy programs have the same focus – to support integrations to extend their position in the market on a long term basis. We therefore provide Integrated Solutions for the livestock industry that is as ethically responsible as efficient and safe – in Europe and all over the world.

Prevention first.

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Vaccination as a cornerstone in the control of chicken anaemia virus in breeding flocks with strict biosecurity

Dr Felix Ponsa, Technical Support Manager, Lohmann Animal Health GmbH

Worldwide chicken anaemia virus (CAV) causes considerable economic losses in the poultry industry. Clinically infected birds may appear pale, depressed and show reduced weight gain. In pathological examinations anaemia, haemorrhages, atrophy of the thymus and changes in the bone marrow can be found. Furthermore, the reduction of T-lymphocytes leads to immuno-suppression, reduced production of antibodies and higher susceptibility to secondary infections.

Besides the clinical form of CAV (mostly seen in birds without maternal antibodies against CAV), subclinical CAV also has to be considered when it comes to economic losses caused by the disease. Chickens that have very low maternal antibody levels at hatch become infected with CAV at a relatively early age. They may appear healthy, but show CAV titers around day of slaughter. Analysis of production parameters of such flocks shows that feed conversion and weight gain are lower compared to birds negative for CAV titers at slaughter.

CAV was first isolated in Japan in 1979 by Yuasa et al. Eight years later, in 1987 Lohmann Animal Health launched the first CAV vaccine, AviPro Thymovac, which has been successfully used worldwide for the last 25 years. Together with biosecurity and hygienic measures, vaccination of breeders against CAV is directed at limiting vertical transmission. High, homogeneous and long-lasting titres in the breeding flocks induce via maternally-derived antibodies (MDA) protection of the progeny not only against vertical, but also against horizontal infection.

In breeding farms with high biosecurity standards, in order to protect young birds from becoming infected and to improve performance of broilers, vaccination of breeder flocks with live vaccines is the method of choice. By vaccinating young breeder pullets between 8-16 weeks of life, they have enough time to develop high levels of antibodies against CAV before being transferred to the laying house. When egg production starts, they will transmit those antibodies to their progeny and thus protect them against early infections with CAV. Effective protection of the progeny is monitored on the basis of mean titres and uniformity (CV or coefficient of variation) of the antibody levels induced by vaccination of the breeders.

Vaccination is the best way of obtaining prompt high and homogenous levels of maternally-derived antibodies (MDA). The higher and more uniform the MDA level, the longer the protection in the progeny. Since AviPro Thymovac vaccine became available 25 years ago, many breeder flocks have been vaccinated in a global basis during the rearing period in order to protect the progeny from vertical and horizontal transmission. Based on historical data and evaluating the mean titres and the CVs, vaccination of the breeders via drinking water results in inducing high, homogeneous and long-lasting levels of CAV specific antibodies and protects throughout the production period.

Administration of feed additives via drinking water – a successful tool for poultry flock management

Marika Ayecke-Thun, Senior Product Manager, Lohmann Animal Health GmbH

Commercial poultry is usually supplied with all necessary nutrients for growth and good performance via a well-balanced feed formulation. However, in different stages of a bird's life, there are increased requirements for nutrients. In times of insufficient nutrient intake (placement, rapid growth, change of feed phase, etc), water additives are capable of providing the birds with essential components. In addition, stressful conditions, such as transport, catching, extreme climates and disease, may require a quantity of nutritional supplements higher than can be supplied by the daily feed uptake.

The administration of nutritive additives can be prophylactic or corrective action. In case of prophylactic action, the decision for the application is taken to prevent negative effects. For example this could be the application of antioxidants, such as vitamin C and E or selenium in case of expected high temperature conditions.

Corrective action means providing poultry flocks with nutrients in order to compensate a deficiency. In most cases this lack of nutrients is detected by clinical symptoms or post mortem results. Accordingly, the target is to restore the birds' health and flock performance as fast as possible. In cases where immediate provision of nutrients is necessary, application via drinking water is generally the preferred treatment.

The nutrient application via drinking water is possible through different forms of products – water soluble powders, liquids and effervescent tablets or granules. Lohmann Animal Health offers all three different forms, whereas the liquid form is most commonly used worldwide. The extremely high quality standard of Lohmann products leads to clear liquid products that avoid any residue in the sensitive drinking water system of poultry houses whilst providing high-value nutrients. During the development procedure, every liquid formulation has to pass a well-defined testing-protocol to ensure product stability under different climate situations to fulfill the requirement of worldwide sales.

In addition to the common liquid products, Lohmann Animal Health also offers unique granules under the brand AviPro. These granules dissolve effervescently and residue-free in water. The special innovative granulation technology leads to a characterful soluble product with excellent stability properties. One of these is AviPro Granule BX, an award winning formulation containing vitamins of the B-complex and vitamin K3 designed for use in all critical stages of layers and breeders, especially after debeaking. Another outstanding product from this line is AviPro Granule Anilyte+C, an isotonic drink to counteract heat-stress in all kinds of poultry. This formulation with Vitamin C which was specially developed to meet increased requirements of electrolyte stimulating water uptake due to its fine touch of aniseed. Further granulated products are currently in development.

The advantages of granulated products are obvious: they are outstandingly soluble in water and spread independently, effervescently and residue-free in the drinking water. Undesirable deposits in drinking water equipment are a thing of the past. Thanks to their compact and concentrated application form, they are also easy to use and far easier to transport than traditional liquid products. Not least, thanks to the innovative manufacturing process they contain stable combinations of active ingredients, especially formulated to meet the requirements of poultry. An ideal drinking water supplementation for animal health that fits perfectly in Lohmann's concept of 'Prevention first'.

Antioxidants in feeding*

Antioxidants are used in forage to prevent oxidative spoilage and thus protect oxidation-sensitive lipids and nutrients during storage. Fats, oils and feedstuffs containing fats spoil through many different degradation processes, in particular oxidation. Oxidation is influenced by the impact of oxygen, high temperatures and long storage periods. Feeding oxidised forage means the animals are exposed to a high number of free radicals, thus inducing oxidative stress. It also leads to decreased vitamin E content in the tissue which has a negative impact on animal health and the quality of animal products.

The importance of Vitamin E

Vitamin E is certainly the most important fat-soluble antioxidant in the animal organism. Here it ensures the maintenance of cell membranes by preventing stress-related damage by free radicals. Especially in high-performance animals vitamin E is important to maintain good health and quality of flesh and fatty tissue. The content of vitamin E in the tissue is directly linked to the quality and storage stability of meat. The majority of conventional supplements of vitamin E exceed the physiological requirements of the animals. The recommended supply allows extensive safety margins whereby very high supplementation with vitamin E is said to have so-called 'add-on effects' such as improved immune competence and better meat quality. The absorption of Vitamin E takes place together with fat in the small intestine and is equally dependent upon the fat content and quality. The uptake of oxidised fatty acids leads to a considerable decrease in the absorption of vitamin E, thus causing reduced contents of vitamin E in muscle tissue. Furthermore, the increased formation of free radicals causes a diminished endogenous antioxidative potential resulting in damaged cell structures. Oxidative stress is thus often considered as the cause of many secondary diseases. Supplementation with high levels of vitamin E leads to higher contents of vitamin E in the organism. However, it cannot prevent the oxidation of the forage. Vitamin E is added to the feed as α-tocopherol-acetate, which obtains its activity following hydrolization of the acetate groups in the small intestine. In order to prevent the oxidation of the feed it is necessary to add effective antioxidants which protect it during storage. Both synthetic and naturally-occurring antioxidants can effectively prevent and/or delay the oxidation of the feedstuff.

Antioxidants in poultry nutrition

One of the effects which could be observed when using antioxidants is an increase in the transfer rate of vitamin E into the organs, muscle and fatty tissue. This indirect influence on parameters surrounding meat quality could be observed in a number of studies. From trials carried out by Bartov (1981) with synthetic antioxidants it is known that the concentrations of vitamin E in the liver, muscle tissue and fatty tissue also increase by supplementing synthetic antioxidants even when the dosage of vitamin E remains the same. The presence of antioxidants thus belongs to the factors influencing vitamin E transfer. An increase in the concentration of vitamin E in animal products can, therefore, be increased not only by increasing the dosage of vitamin E in the feed.

Conclusion

Vitamin E plays a major role in the organism by protecting the membrane structures against oxidative destruction. It is essential in this function and cannot be replaced by other substances. The use of antioxidants has further functions which are linked to vitamin E: they prevent lipid-oxidation in forage and reduce the influx with harmful radicals which cause oxidative stress. Furthermore, antioxidants can improve the efficacy of vitamin E supplementation. An adequate supply with vitamin E and ensuring long-term optimal feed quality by using antioxidants must therefore be considered as the wisest combination.

*All About Feed 05/2010 'Antioxidants in feeding' Dr Antje Holthausen.

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