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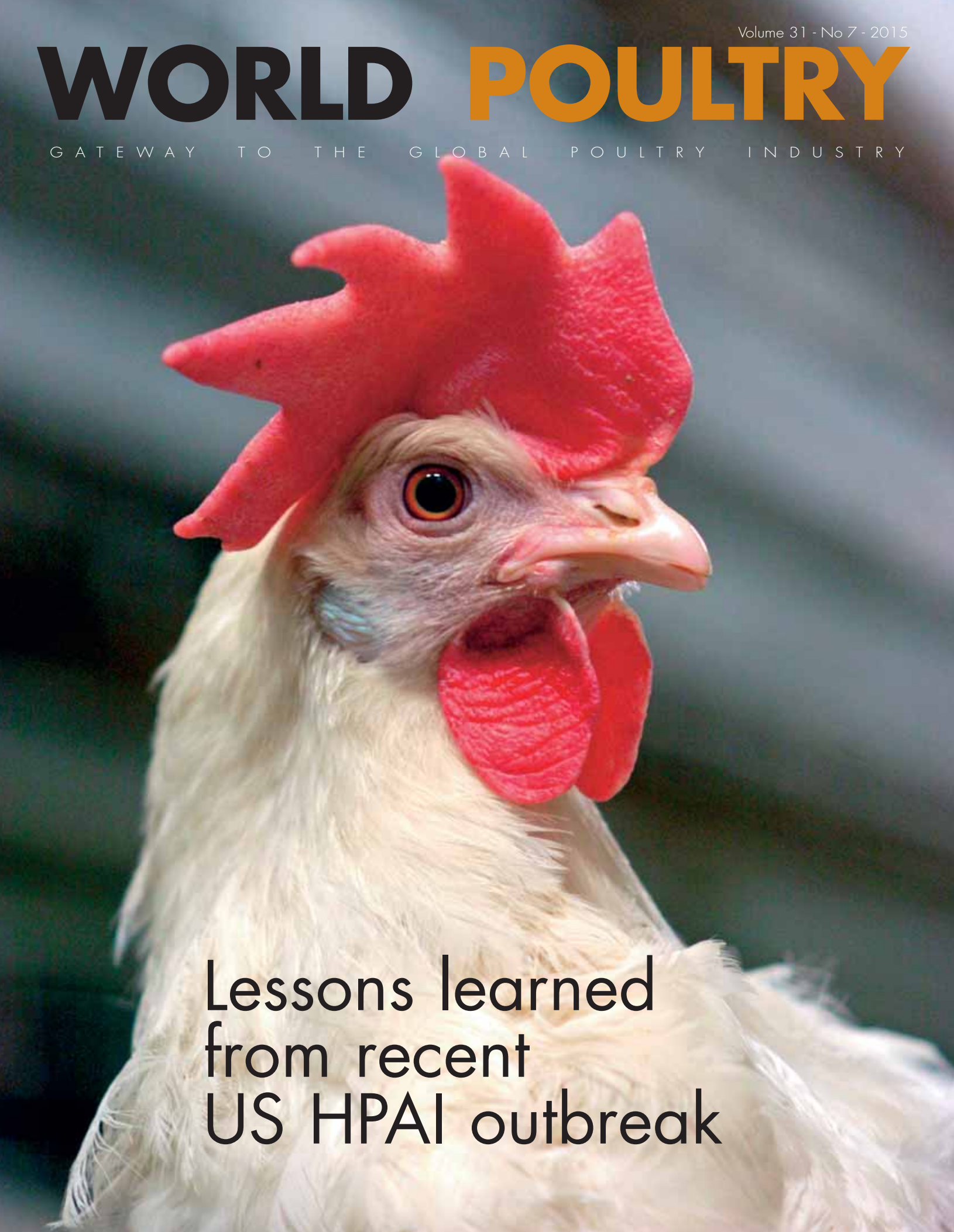
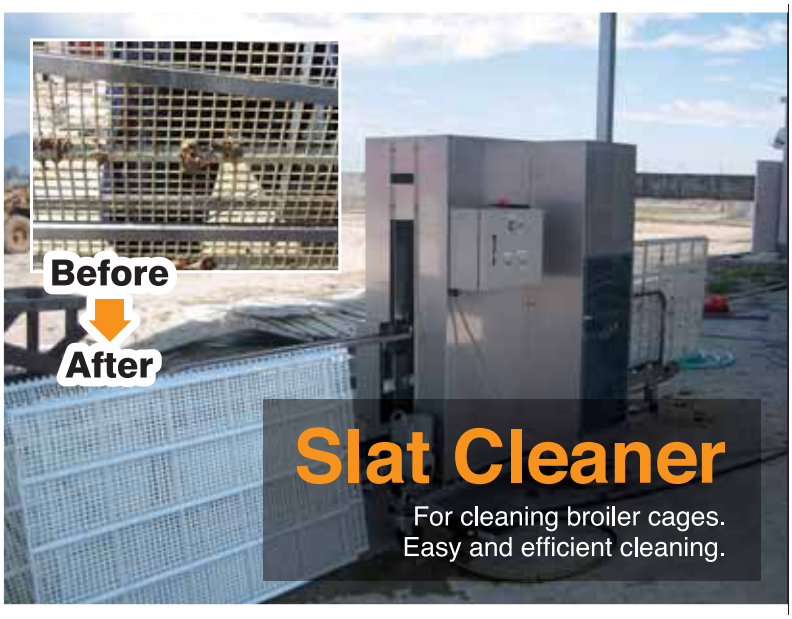
WORLD POULTRY

GATEWAY TO THE GLOBAL POULTRY INDUSTRY



Lessons learned from recent US HPAI outbreak



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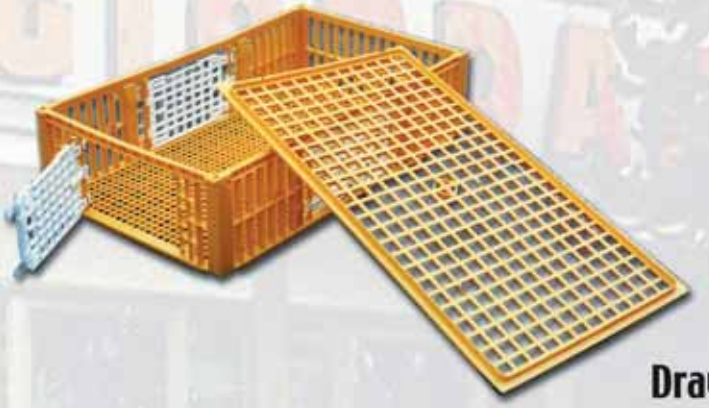

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Necrotic enteritis eating into our profit

It may come as no surprise to anyone in the poultry sector that necrotic enteritis (NE) is a costly disease. That said, chances are that it is still underestimated. For the last 15 years, the figure used to sum up the damage of sub-clinical necrotic enteritis was as much as US$0.05 per bird, with total global loss reaching almost US$2 billion.

That is not good news, but it gets worse. The poultry industry has changed over the years. The global poultry industry has more than doubled over 15 years and, because antibiotic growth promotors were phased out, the incidence of NE has steadily increased. In this issue of *World Poultry,* authors Ben Wade and Anthony Keyburn come to the conclusion that the real cost of NE is close to triple what everyone thinks. NE is eating our profits away to the tune of about 6 billion a year. And that statement is on the safe side.

Keeping NE at bay has to involve everyone, from farm, feed manufacturer to university. Necrotic enteritis can be controlled with competitive exclusion products, probiotics, prebiotics, organic acids, enzymes, plant extracts, hen egg antibodies, bacteriophages and vaccination, combined with good hygiene management and smart diet composition. Unfortunately, there is no simple answer to this multifactorial disease. As stated above, the problem is worth investing time, money and research in, even more than has been done up to now. There are at least 6 billion reasons to do so.

Fabian Brockötter, editor *World Poultry*

COLOPHON

WORLD POULTRY

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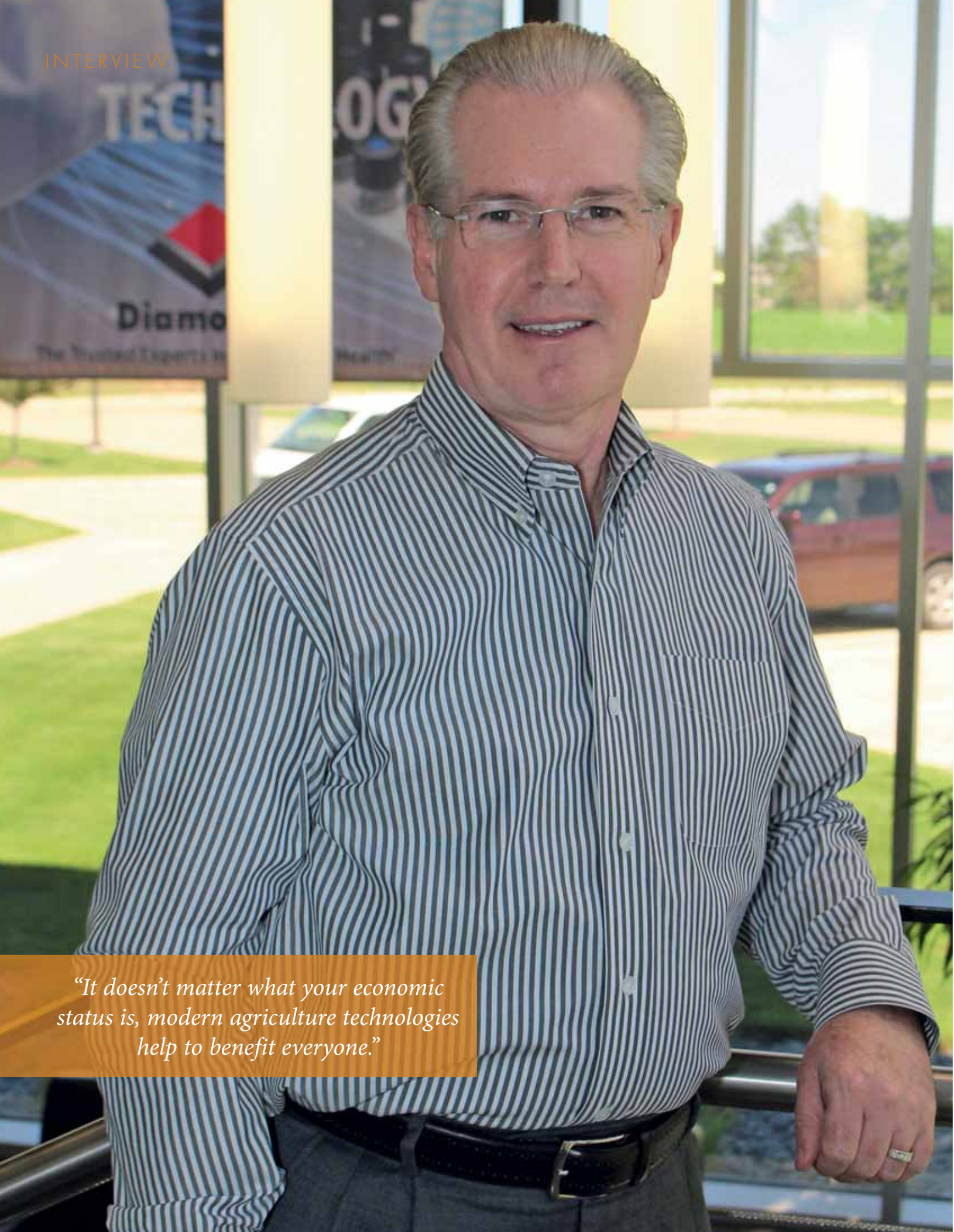

"It doesn't matter what your economic status is, modern agriculture technologies help to benefit everyone."

"We help animals do more with less"

An Iowa farm boy, with grassroots in agriculture, Diamond V CEO, Jeff Cannon, takes the role of feeding the world through modern food producing practices very seriously. He explains the measures Diamond V is taking to ensure safe and sufficient food availability.

By Rosie Burgin and Vincent ter Beek

Growing up on a farm in rural Iowa, Jeff Cannon always had meat in the freezer, vegetables in the refrigerator and access to an abundant supply of all sorts of ingredients. It is therefore unacceptable to him that people in the US and beyond are currently going hungry. In his role as CEO of Diamond V, a producer of natural feed additives, he feels it his obligation to explain to consumers about sustainable food production in the US and to ensure that they recognise that innovation and technologies are essential in achieving this. The company's headquarters are in Cedar Rapids, Iowa, the heartland of US agriculture. From here the company exports technologies and products, which are produced through a proprietary fermentation process, to over 60 countries around the world.

***World Poultry*: I'm presuming that Iowa means a great deal to you?**

Jeff Cannon: "I am proud to have grown up here in the state of Iowa. We have a reputation for having a very solid work ethic and I think that comes from the farm background. I went to school locally in Cedar Rapids, obtaining an accounting degree. I was a partner in a national accounting firm for over 20 years and, during my tenure as a partner, I was involved primarily in business advice, merger and acquisitions, and consulting, and I worked specifically with agriculture companies. Diamond V was a client of mine and I was responsible for it for many years. Then in 2004 I was approached by John Bloomhall, the president/CEO at that time, and one of the founding family members, who invited me to join Diamond V. It was a time in my career when I was ready for a new challenge, so I started with Diamond V. When John retired at the end of 2013, I became the first non-family president/CEO at Diamond V."

Here in the US, just like in Europe, antibiotics are under increasing criticism and feed additives can play a role in their replacement. What is your take on that?

"Certainly everything associated with feed, including feed additives, medicated feed and antibiotics, are under constant review. There is a trend towards finding new ways to address some of the antibiotic concerns that consumers and our own industry have about sustainability, animal health and nutrition for animals. Diamond V has been investing for literally our entire existence, some 70 years, in identifying all natural ways that we can address the health and nutritional issues of all species of animals. I think recently that interest in the types of technologies that we have has certainly gotten more attention and this increase is encouraging us to be more innovative in the ways we look at the nutrition and health of animals. Through this, I think that we're definitely in a very exciting and growth-driven time at the moment."

For the last three years, as one of the first independent and privately owned companies, we have been involved in a partnership with the National Animal Disease Center (NADC) in Ames, IA. One of the purposes was to review the technologies and the products that we have here at Diamond V as a replacement for antibiotics. We're at least offering one of the

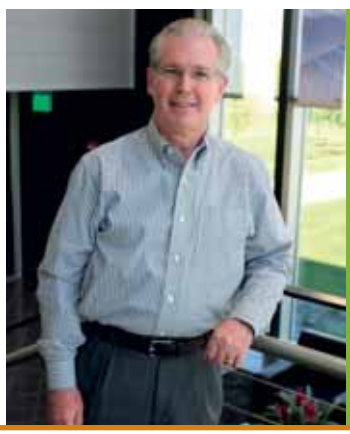

PHOTO: VINCENT TER BEEK

Jeff Cannon

Biography

Jeff Cannon has been CEO of Diamond V since 2014, after entering the company in 2004. His previous role was senior vice president of planning and business development. Prior to joining Diamond V, he was a partner in an international accounting firm and served as a business advisor to agricultural companies for 22 years, including Diamond V. He completed his education in accounting at Mount Mercy College , Cedar Rapids, Iowa.

"We as an industry, will address the growing population challenge through innovation, research and hard work."

types of technologies that could help to mitigate and support nutritional regimens that would reduce, if not eliminate, the use of antibiotics."

Are we going to feed 9 billion people in 2050?
"Absolutely. I think one thing that I've observed about agriculture in my life and in my career is that we are a very innovative and resourceful industry. We, as an industry, will address the growing population challenge through innovation, research and hard work. We all know the scenario – there's limited resources and decreasing supplies of water and virtually all available land is in production. Innovation and technology will have to continue to develop and that includes the use of GMOs. I know that we have an ongoing discussion about GMOs and we have regulations and oversight over their use. I think, at the end of the day, GMOs will be accepted globally and more readily. Certainly we need to have more oversight to make sure that everything is done in a correct and appropriate way, but it's technology like genetically modified seed and crops, it's technologies like the types of things we're developing here at Diamond V and other ingredient-additive companies and innovations across the entire value chain of agriculture that will allow us to meet that growing demand in the next 30 years."

If you compare your products to others on the market, what makes Diamond V stand out?
"Our products are produced through a proprietary process of fermentation. Groups of ingredients are subjected to a fermentation process that has been developed over a period of time, resulting in something that is different than anything else in the marketplace. Our products include a wide array of all-natural biochemicals that we call nutritional metabolites. It's a combination of these metabolites and the way that they interact with the digestive system and the immune system that creates the beneficial effects in production animals that we see with our products. We are not a single-compound product; we are not a certain strain of a probiotic; we are not a certain compound of a prebiotic; and we are not a single vitamin or a mineral or some isolated compound. Through our proprietary fermentation processes, we create this product that has all of these various different types of natural biochemicals that, in concert, become the active ingredients in our products. The products don't have patents, but have been protected by trade secrets for over 70 years, so it's very important for us to maintain the integrity of those trade secrets.
We are also a very research-oriented company with 10% of our annual revenue invested in research. This is equal to any pharmaceutical company. This investment has allowed us to produce a research library on our Original Line of products that really is second to none in the world. We have already been able to build a substantial library on the effect of our technologies on the reduction of pathogens inside the animal, as well as pathogen loads that are excreted from the animal. Food safety is very important to consumers in the current market place, and is certainly important to all of us involved in the agriculture industry as well.
Further, we have invested heavily in a team of experts to collaborate with producers and the entire production chain, to make sure that we bring the best possible solutions. We do that through a number of additional expert services like facility management audits, nutrition formulation analysis and food safety audits, etc."

What is your take home message to consumers?
"What we really do is help animals do more with less and in a safe way. There's no negative side to that at all. If you have products and technologies that do this in a sustainable manner, then it's a win-win. The world needs to embrace those types of technologies and not resist them. We can't go backwards. I think that there's a fallacy out there that, if we go backwards and do things the way they used to be done, it would be better. But in fact we're living longer today than we have ever done before because we are improving our nutrition, we're improving the quality of the food, we're improving the safety of the food. It doesn't matter what your economic status is, modern agriculture technologies help to benefit everyone."

Spreading the word through movies

Diamond V has collaborated with other industry partners in a non-profit organisation to help educate the market place about modern agriculture. In the US less than 2% of the population is still actively involved in agriculture, so the consumer has gotten further away from farming thus creating a huge knowledge gap between consumers and producers. An idea to communicate better about where food comes from was to produce a feature length movie entitled 'The Ivy League Farmer'. Diamond V felt that scientific studies, documentaries and on farm videos seemed to be missing the mark on connecting with consumers on a more emotional basis and educating them in a manner that they're more accepting of. Arrangements are being made for the movie to be shown on a national cable network this Autumn. It will also be marketed through the internet, where it can be purchased online. Proceeds from the movie premiere in Iowa help support a local non-profit organisation which provides back-packs of food for school children who would otherwise not have enough to eat over the weekend.

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Euthanasia and removal of hens from high-density cage units was a laborious manual process.

Lessons learned from the recent US HPAI epornitic

The last confirmed case of H5N2 highly pathogenic avian influenza (HPAI) was diagnosed in Iowa in a commercial layer complex on June 17th. All indications are that outbreaks of this strain - which emerged in early March in Missouri and later devastated flocks in Minnesota, the Dakotas, Iowa and Nebraska - have ended. Now it is time to draw conclusions.

By Prof. Simon Shane

The United States Department of Agriculture-Animal Plant Health Inspection Service (USDA-APHIS) has issued regular weekly reports on progress in the control and disposition of cases. The approach used by APHIS has followed the conventional sequence as used by regulatory authorities, conforming to the recommendations of the World Organisation for Animal Health (OIE). This includes rapid presumptive diagnosis (antigen-capture immunoassay), immediate quarantine, establishing infected zones and outer control areas with structured surveillance for AI, confirmation of the diagnosis (PCR) and, to prevent further spread of the disease, euthanasia of flocks, with depletion and disposal by

either incineration or in landfills, decontamination, testing and eventually restocking.

The fact that existing procedures weren't sufficient to cope with the crises and should be rethought is the main conclusion in hindsight. At a hearing called by the US Senate Agriculture, Nutrition and Forestry Committee on July 7th, the Chief Veterinary Officer of the USDA, Dr John Clifford, and the Director of the Southeast Poultry Research Laboratory (SEPRL), Dr David Swayne, provided testimony and responded to questions relating to the epidemiology, molecular biology and control of the disease and gave predictions of future events. Representatives of the turkey and egg production industry and an agricultural economist, Dr Thomas Elam, also provided perspective on the outbreak.

Shortcomings in procedures

The US poultry industry operated according to a standard of structural and operational biosecurity incapable of protecting flocks from the introduction of a highly pathogenic virus. The injudicious concentration of large complexes with up to five million hens in close proximity, based on financial expediency and least-cost production, was contrary to principles of sound conceptual biosecurity and exacerbated the losses sustained following the introduction of HPAI into a county. Even in the case of turkey farms with up to 20,000 birds, the proximity of units in limited areas, common ownership of adjacent farms and obvious deficiencies in biosecurity contributed to inter-farm spread.

According to an updated epidemiological study by Aphis, many of the turkey farms affected by H5N2 highly pathogenic avian influenza in the US this year had biosecurity in place, but the protocols were not being audited properly. Only 43% of the case farms were properly audited. "In the majority of cases, feed trucks, live haul loaders, pre-loaders and other items were shared by multiple farms," said the study. "Wild birds, another possible route of disease transmission, were observed inside barns on 35% of the farms."

Many of the lessons learned from the 2015 US outbreak will be applicable to other nations and subsequent outbreaks. Highly pathogenic avian influenza is now a world problem with implications both for domestic industries and trade. Accordingly, compliance with sound scientific and epidemiologic principles should be applied to prevent the deleterious results of catastrophic mortality and trade embargos. The application of regionalisation for commercial production and compartmentalisation for breeding stock should be reconsidered and applied. Acceptance of vaccination incorporating the DIVA approach should be regarded as a component of prevention and control.

AI devastation

The epornitic in commercial flocks in the upper Midwest, which extended from early April through mid June, is regarded as the most serious and expensive animal health emergency ever faced by the USDA. A total of 211 commercial farms were affected. Almost 7.5 million turkeys, with the majority comprising growing birds close to slaughter, were destroyed; representing 7.5% of the inventory of turkeys during the period of the infection. A total of 38.5 million hens were depleted, corresponding to 10% of the US inventory. Approximately 85% of these birds were committed to the egg-breaking segment of the industry, resulting in a disproportionate impact on the availability and price of egg liquids. Concurrently, 3.5 million replacement pullets were affected, intensifying the loss experienced by egg producers. Since most of the infection occurred along the northern extremity of the Mississippi flyway, the states of Minnesota, Iowa, South Dakota, Nebraska and Wisconsin were most affected.

Economic Impact

Preliminary estimates of the cost of the 2015 HPAI epornitic can be classified according to affected segment. Losses experienced by owners of flocks, including integrators, individual farmers and independents, amounted to US$1 billion for egg producers and US$500 million for turkeys. These costs included loss of flocks for which indemnity of approximately US$300 million will be received, the costs of cleaning and disinfecting and the loss of revenue before depopulation. Losses were more extensive among egg producing flocks, since the availability of pullets and the time taken to rear them, in addition to the need to phase in placements, could take as long as 18 months, severely impacting future cash flow.

Financial losses were experienced by suppliers to the turkey and egg industries and to communities impacted by plant closures and layoffs, which could amount to US$500 million. Costs to control the disease incurred by the public sector (APHIS and states) will exceed another US$600 million, in addition to indemnity payments. The cost to consumers as a result of increased prices for eggs and foods containing egg products will attain US$2 to US$3 billion, depending on the period over which higher prices will persist.

Last but not least, broiler producers, although completely unaffected, lost as much as US$1.2 million in export revenue as a result of trade embargos imposed by some nations over the entire US, contrary to the World Organization for Animal Health (OIE) principle of regionalisation.

Epidemiology of the outbreak

A preliminary epidemiologic study was conducted by APHIS in conjunction with the Land Grant universities in affected states. An initial focus was on approximately 50 individual turkey farms that were affected in Minnesota. In addition, a few large complexes with laying hens were investigated in Iowa. It is the prevailing sentiment

PHOTO: ANP

PHOTO: WORLD POULTRY

Mallards and other migratory waterfowl are regarded as introducing the H5N2 reassortant virus to the Mississippi Flyway of North America resulting in the Spring epornitic.

PHOTO: WORLD POULTRY

Growing turkeys were severely affected when exposed to H5N2 HPAI. Flocks demonstrated a brief period of morbidity followed by acute mortality.

that the infection was introduced my migratory waterfowl into areas with a high density of poultry. Defects in biosecurity allowed virus to be introduced onto turkey farms and then later onto egg producing complexes with as many as three million hens.
Molecular analysis of isolates demonstrated clusters of infection which were attributed to deficient structural biosecurity and lapses in operational biosecurity, resulting in inter-farm spread of the virus. There is evidence that, in the case of large complexes, the virus could be disseminated by air movement over at least 1 km. This observation is consistent with previous documented cases of the spread of velogenic Newcastle disease in the UK.
AI variant H5N2 was the predominant virus affecting flocks and was concentrated in the Mississippi flyway. Approximately 68 isolates were examined and characterised. In addition, laboratory-scale infection studies were undertaken demonstrating the equal susceptibility of turkeys and chickens. Viruses were similar (99% or more) across the entire genome. Within H5N2 viruses isolated from turkeys in Iowa, Minnesota, North Dakota, South Dakota and Wisconsin, changes in the HA1 protein (antigenic site) were demonstrated, which may have contributed to increased virulence. The amino acid substitutions detected could be sustained in small virus populations affecting poultry flocks, but it is unknown whether these changes will persist in the field.

Control of HPAI

It is evident from the history of the outbreak, the testimony presented at the Senate hearing and industry conferences that the incidence rate of infections in Minnesota and Iowa, followed by Nebraska, coupled with the size of the affected in-line egg breaking complexes, overwhelmed the resources of APHIS in April and early May. Through innovation and a systematic response, involving the cooperation of federal and state agencies and the industries concerned, programmes to control the disease were intensified and became more effective. Considerable difficulty was experienced in euthanising and moving hens from houses containing multi-tier cage installations, since this is a laborious manual process. Disposal of carcasses was a second challenge facing APHIS. Initially, environmental regulations and concerns of legal liability restricted access to landfills. Following the intervention of the Secretary of Agriculture and the governors of affected states, jurisdictional disputes were resolved, emergency regulations implemented and disposal moved forward effectively.
Representatives of the egg and turkey industry were critical of the response of APHIS with respect to indemnity payments. The mortality rate from the infection was so rapid that any delay between provisional diagnosis and assessing the value of the flock markedly diminished payment for birds euthanised. This problem was resolved within weeks. Alternative procedures were developed, appropriate to the magnitude of the outbreak, and compensation was adjusted and will be reviewed retrospectively for cases in April and May.

Vaccination option dismissed

Despite the fact that the CEVA HVT-vectored H5 vaccine is available and approved in the US for administration to poults and chicks and also that a wide range of inactivated emulsion vaccines could have been administered to non-exposed flocks, the decision was made to forgo vaccination in the present outbreak. This was based mainly on the impact that vaccination would have on exports of broiler products. A number of trading nations informed the USDA that complete embargos would have been placed on the US with respect to breeding stock and products should vaccination have been introduced. Importers required the USDA to provide an assurance that there was no risk associated with the introduction of infection in the event of applying vaccination. Currently, USDA officials are working with their counterparts in importing countries to develop an acceptable protocol with regard to types of vaccines, including application of the DIVA principle, control of immunisation programmes and a defined exit strategy. The USDA has announced their intention of using vaccination should a future outbreak occur and, accordingly, will begin stockpiling vaccines.

Lessons for the future

Based on the experience gained with the current epornitic and the realisation that H5 viruses are introduced by migratory waterfowl, there is concern over a recurring outbreak in the fall of 2015. In addition, there is a likelihood that the H5N2 virus or some novel reassortant may be introduced by the northward migration of waterfowl in the spring of 2016. The APHIS has developed a 'doomsday scenario' in which the virus might be introduced into the Atlantic flyway which covers the mid-Atlantic states and the southeast. This area includes the major proportion of the egg, broiler and turkey production in the US The worst case scenario calls for 500 affected farms and expenditure of over $3 billion on control.
Undoubtedly, should the infection include the mid-Atlantic and southeast regions in any subsequent epornitic, vaccination will be employed as an adjunct to the traditional approach of depopulation and disposal. In his testimony Dr John Clifford noted "destruction is not a solution to disease." Updating and expansion of ARS research facilities budgeted for 2016 will probably be accelerated. The SEPRL will be required to expand work on vaccine development, molecular epidemiology and diagnostic capabilities. Furthermore, new protocols have been developed to expedite depletion, disposal and indemnification. The egg industry is also discussing the possibility of a Federally-supported insurance programme given the possibility of future infections so economic impact on production level can be mitigated.

Vascular fragility, carcass lesions and downgrades

Severe cases of carcass bleeding, although only a cosmetic problem, makes the product less attractive to consumers.

PHOTO'S: WIM TONDEUR

The genetic growth potential of modern broilers, combined with high quality feed with readily available nutrients and sugars results in fast growth. However, the vascular integrity of the birds is at stake. Blood vessel fragility increases the risk of carcass lesions and subsequent downgrades in the abattoir.

By Fabian Brockötter

Managers of poultry processing plants all around the world are increasingly worried about the incidence of carcass lesions in broilers. "Up to 20% of the birds are affected by bruises, muscle hematomas and vascular damage," says veterinarian Paco Fernandez Lopez-Brea with Zinpro Corporation. As a result the meat from the birds has a cosmetic defect, making it less attractive for consumers. Abattoirs have to downgrade part of the birds or trim the affected part, making it more laborious thus costly to process them. "With bleedings or hematomas in legs and wings, trimming is not an option of course. That goes also for whole birds. Another problem with whole birds is that the majority of bruises cannot be seen from the outside. Consumers see the damage only after cut-up in the kitchen, leading to complaints at supermarkets and the processors."

Veterinarian Fernandez Lopez-Brea first heard of the problem while visiting a processing plant in Spain, later he learned that the scope of the problem was a lot bigger. He said: "I asked my Brazilian and northern European colleagues and they saw the same." But what was causing the carcass lesions still wasn't identified." One of the first hypothesis was that the lesions were caused by muscle contractions during stunning. "It didn't take long to rule that option out. The methods didn't change over the years, but the number of bleedings increased. Also, birds taken out of the crates before shackling showed lesions." Fernandez states that the problems in Spain were so severe the managers of the processing plants went out in the field, overlooked every step from catching of the birds, transport until they were on the hook and they still weren't able to identify the source of the problem.

Toxins

Another hypothesis Fernandez investigated what the possibility that toxins were the cause of vascular fragility and thus the bleedings. Mycotoxins, in many cases could be ruled out, but other toxins such as endotoxins from gram negative bacteria could be the smoking gun. "The million dollar question was where the toxins

came from," says Fernandez. He found his answer in human medicine. "The problems with the birds resembled problems that occur with humans suffering from diabetes. Research in humans learned that diabetes is growing in the US , Saudi Arabia and many other countries. But it isn't caused by overweight due to unsaturated fat, but by the over consumption from mono and poly saccharides, i.e. sugars." A common problem in humans suffering from diabetes are small spots of bleeding in the skin and easy bruising, caused by capillary fragility, weakened small blood vessels, as well as vascular problems in general, such as retinopathies, nephropathies as well as cardiovascular and cerebral problems such as stroke.

Fernandez: "What we do know is that the ever increasing metabolic speed of the broilers has changed and our increasing knowledge of feed. We grind our feed very fine, expand it and do everything to make all the nutrients readily available. In essence we are giving our birds 'fast food' 24 hours a day." It is the proverbial avalanche of sugars, that could well be the culprit.

In wheat based diets the problem seems to be bigger than in corn based diets. Fernandez: "If the glucose goes up, so does the oxidative stress. The free radicals produced in the mitochondria inside the cells can destroy them as seems to be the case with pancreatic cells in diabetic people.

Apart from that, we frequently see fatty liver problems in birds 40 days old, something that is pretty shocking. According to Lopez-Brea, Free Radicals induced by the glucose excess attack the 'velcro' that keeps the enterocytes tight together, the so called 'tight junctions'. When the gut permeability is compromised, endotoxins from the intestinal lumen penetrate between one enterocyte and the other and go straight through the portal vein into the liver. In the liver, they produce an inflammatory reaction in the Kupffer cells and later in the hepatocytes, leading to their destruction and replacement by fat and connective tissue. "We have to be honest, we don't have the 100% proof that glucose and fructose are the damaging agents, but we do know that the more the feed is processed, the more bleedings we encounter."

Mitigating effects

A logical way to lessen the impact of sugars is to switch to a feed that releases the energy more slowly. "I know for a fact that some people are replacing the standard pelleted diets by going back to mash feed and they reduced the carcass lesions quite a bit. Slower digestibility of food is the answer in humans too, but in broilers that is a huge step back in time." Fernandez looked into the possibility of mitigating the problems in standard pelleted feed. "The key is to prevent the excess of free radicals from destroying cells. Zinc is known to be essential for the activation of transcription factor function of Nrf2. Nrf2, is a Transcriptional Factor that up-regulates the production of superoxide dismutase (SOD) which in turn, catalyses the dismutation of superoxide radicals during biological oxidations and environmental stress. In studies on human diabetes patients there is increasing evidence which showed the effect of zinc on diabetic complications." More importantly the use of organic zinc (zinc complexed to single aminoacids like Avaia®Zn) in broiler diets showed in field trials a reduction of 15-30% of bleedings, especially in the more severe cases.

There has also been a scientific corroboration conducted at the Scottish Agricultural College, when we have seen significant reduction on hemorraghes in wings, even with mash diets.

The true cost of necrotic enteritis

Necrotic enteritis has increased in occurrence and severity over the years. When it comes to the damage it causes, producers often adopt the figure of US$0.05 per chick derived from a US$2 billion loss on a worldwide scale estimated in 2000. Since then, parameters have changed, as have the true costs of NE, which could come close to US$6 billion in 2015.

By Ben Wade and Anthony Keyburn

PHOTO: FRANK UYLENBROEK

For those with an interest in the bacterial pathology of chickens, most, if not all, will be aware of necrotic enteritis (NE), a disease found worldwide wherever chickens are farmed. This economically significant disease, caused by the bacterium Clostridium perfringens, causes lesions in the chicken's intestine and can lead to flock mortality of 1% per day (clinical NE). The true economic impact of NE though is felt not from those birds that die from infection, but those who suffer from disease but survive subclinical NE. These birds have a reduced ability to absorb nutrients, a poorer feed conversion ratio and, as a result, are ultimately less profitable. Not only that, but as the industry increasingly turns towards the removal of antibiotic growth promotants (AGP) from feed, NE is only increasing in occurrence and severity. The Scandinavian experience of an almost immediate increase of NE after AGPs were banned is illustrative of wider trends around the world. The increase in the incidence of NE is reflected in the intensity of research in the area, as measured by journal article publication. In the last 15 years, there has been nearly a 10-fold rise in publication at a steady increase of more than 15% per year.

Subclinical necrotic enteritis

Necrotic enteritis is known to affect broilers, laying hens, turkeys, and quail. The clinical form is most commonly seen in two to five-week-old broilers, where symptoms may include severe depression, decreased appetite, dark-coloured diarrhoea, closed eyes and ruffled feathers. Symptoms are short-lived because affected birds die quickly and deteriorate rapidly from the inside out. It is the chronic, subclinical form that often goes undetected, causing large reductions in growth and feed conversion rates, and thus the largest cause of economic loss. In addition, liver condemnations at the processing plant are also not uncommon with the chronic, subclinical form of the disease. The subclinical form is the most costly one for the industry.

Costs underestimated

For many years, the cost of NE was grossly underestimated because, generally, only the effects of clinical NE were ever considered. It wasn't until 2000 that an attempt to estimate the true cost of NE was undertaken. The figure arrived at, using this data, was US$2 billion a year worldwide. A survey of poultry producers from around the world was used to generate this information and it was found that the majority of those surveyed estimated the cost of NE to be US$0.05 per bird or higher. Although the figure of US$0.05 per bird was used to reach

Broiler growers should observe birds closely at around 17–18 days of age because this is often when outbreaks of NE occur. Typically, this is also the time that diets are switched from starter feed to grower feed, causing some dietry stress.

the US$2 billion amount (coupled with 1999 poultry production figures), the majority of respondents actually said that NE was costing more than US$0.05 per bird. And two of the most costly regions, in terms of NE treatment, were Latin America and Europe, which represent roughly a third of the world's broiler production. In keeping with these findings, a later study found that the cost was closer to US$0.0625 per bird.

Original estimate too conservative

We propose here that the original estimate was probably too conservative and should instead have been at least US$2.5 billion. But this estimate is now 15 years old and in need of re-evaluation. The old estimate frequently appears when discussing NE and it would seem that we are once again understating its true cost. During these 15 years, the world poultry industry has more than doubled and, as mentioned above, the impact of NE has steadily increased. By using the revised US$2.5 billion estimate as a starting point, we can begin to speculate on what the true cost might be. If we only consider the increase in the poultry industry over these years, we reach a figure of at least US$5 billion, but this is of course a conservative approach that does not take into account the increasing incidence of NE over this time. If, instead, we factor in a modest increase of cost per bird and take into consideration that key poultry producing regions (Latin America and Europe) have historically suffered a greater cost due to NE, we can attempt to arrive at a new estimate. Reliable data on NE occurrence is difficult to come by, especially because much of the disease manifests subclinically, so we must make some assumptions. If we factor in a relatively small increase in the incidence of NE (and its subsequent cost) over these years in the range of 15%-25%, we arrive at an estimate of approximately US$6 billion per year. It would seem a reasonable supposition to state that the true global economic impact falls within this US$5-6 Billion range and only lends further weight to the importance of ongoing research into the pathology, mitigation and prevention of this serious disease.

Protease reduces environmental impact of broiler production

The main motivation so far for using protease in broiler production has been to reduce feed costs without any loss of animal performance. The reduction of soy in the diet leads to a reduction for all of the environmental impact categories associated with broiler production.

By Dr Adam Smith, market development manager, Feed Enzymes EMEA Animal Nutrition & Health DSM

Although livestock production has generally been considered to have various negative environmental impacts, broiler production has often been found to be relatively friendly to the environment. This does not mean, however, that broiler production systems do not have features that require special attention in terms of their environmental consequences. A better control of nitrogen emissions, such as ammonia and nitrous oxide that contribute to global warming and nitrate leaching is one area of concern. Such emissions can occur at many stages of the poultry production chain, including the growing of crops for feed, bird housing and during manure management (*Figure 1*). Some emissions can have repercussions that are relatively local, for example ammonia can have harmful effects in and close to poultry buildings, while others, such as nitrous oxide, have a global impact.

The popularity of poultry meat is growing steadily across the globe, with increases in world population, urbanisation and disposable income thought to be the primary contributors.

Figure 1 – Agriculture concerns insert nitrogen into a range of reactive compounds that are damaging to the environment.

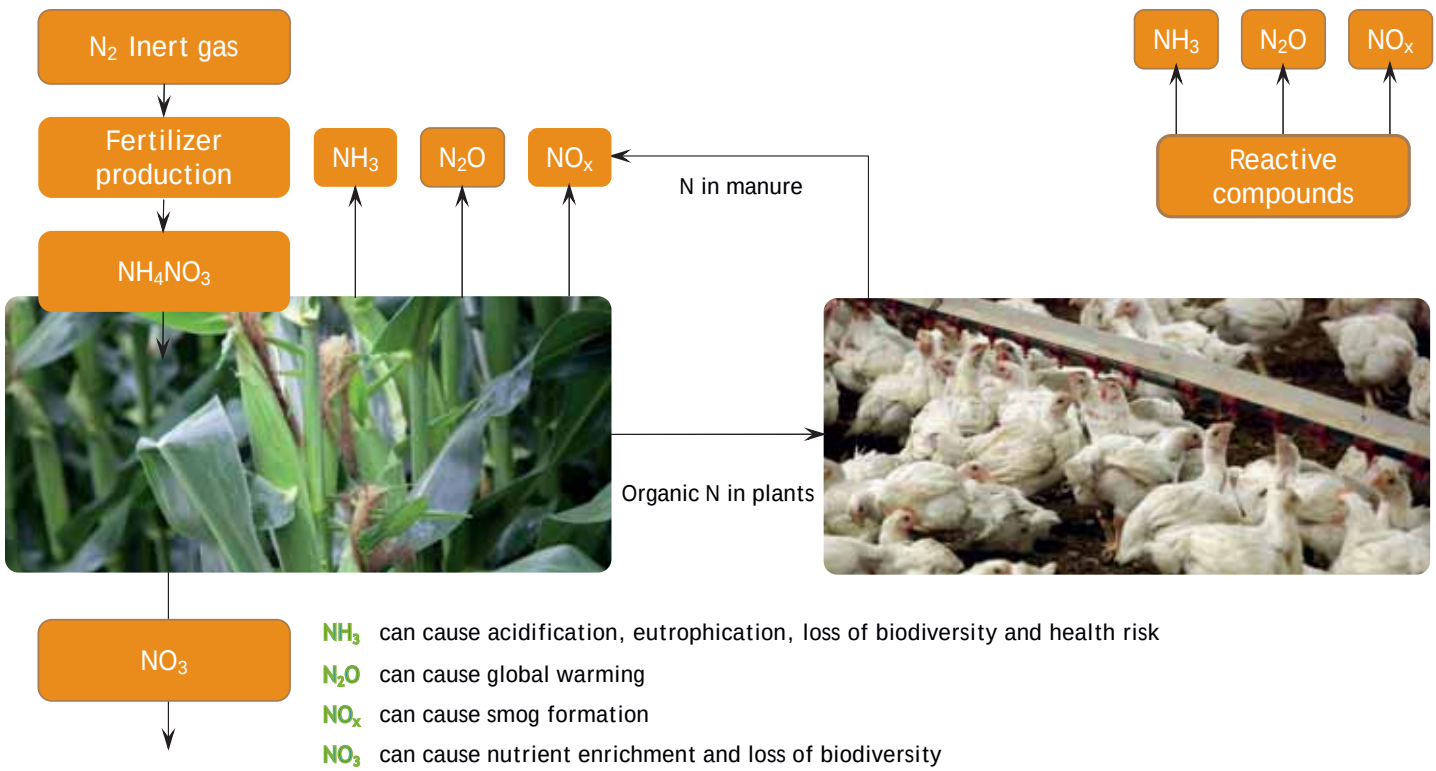


PHOTO: HENK RISWICK

With the supplementation of protease, the level of soya in feed can be reduced, effectively reducing the Global Warming potential up to 12%.

These days it is often the meat of choice for health-conscious consumers looking to reduce the animal fat in their diet. In addition, it does not pose an issue on religious or cultural grounds, unlike some other types of meat. Consequently, in order to keep up with demand and successfully increase output without damaging the environment, the broiler industry will need some operational changes. The emission of nitrogen is recognised especially as a major environmental problem and its impact is seen in three major areas; global warming potential, eutrophication potential and acidification potential.

Global Warming Potential

Global Warming Potential (GWP) is a measure of the greenhouse gas emissions to the atmosphere. Man-made greenhouse gas emissions are thought to be primarily responsible for global warming, causing the atmosphere to trap higher than usual amounts of outgoing long wavelength (thermal) radiation, translating into higher temperatures. The main sources of GWP are carbon dioxide (CO_2) from fossil fuel and land use changes, nitrous oxide (N_2O) and methane (CH_4). The sum of GWP per functional unit is more commonly known as the 'carbon footprint'. N_2O is generated from oxidation/reduction of nitrogen compounds in poultry litter during drying, storage and composting and is proportional to the amount of nitrogen excreted in animal waste.

Eutrophication Potential

Eutrophication Potential (EP) is used to assess the over-supply of nutrients reaching water systems through leaching, run-off or atmospheric deposition. Eutrophication can occur in both aquatic and terrestrial ecosystems. In terrestrial ecosystems, the nutrient enrichment of soils through agriculture can eventually lead to drinking water contamination and soil acidification. The main sources are nitrate (NO_3^-) and phosphate (PO_4^{3-}) leaching into water and ammonia (NH_3) emissions to the air. Both NO_3^- and NH_3 emissions are associated with broiler production. NO_3^- from the application of nitrogen to crops and NH_3 is released from litter in the poultry house and when spread on fields.

Acidification Potential

The Acidification Potential (AP) is predominantly an indicator of potential reduction of soil pH. The main source is ammonia emissions, together with sulphur dioxide (SO_2) from fossil fuel combustion. When SOx and NOx are released into the atmosphere, they can mix with rainwater, forming the acids H_2SO_4 and HNO_3. Agricultural NH_3 emissions also cause acidification, due to conversion of NH_3 into nitric acid in the atmosphere. Acid rain is a threat to plants, animals, humans, general soil, water biology and even buildings. The release of NH_3 from litter in both the poultry house and when spread on fields once again plays an important role.

The use of an in-feed mono-component protease, such as Ronozyme ProAct, has proven to be very successful in the fight against nitrogen emissions due to their ability to improve the amino acid digestibility of commonly used feed ingredients. Ultimately, a more efficient use of protein in feed ingredients translates into less nitrogen excretion in manure, as diets lower in protein can be followed without any loss in the economic performance of the broiler. An additional benefit of re-formulating feeds with a protease is that the amount of soybean in a broiler diet also tends to fall. This has positive consequences for GWP as normally it means the resulting diets have a lower content of ingredients grown in areas of recent land-use change, which in turn means less CO_2 emissions.

Life cycle assessment

A systematic quantitative approach is essential to effectively evaluate the environmental impact of complex livestock systems such as broiler production. A methodology called Life Cycle Assessment (LCA) is often used to assess holistically the environmental impact of changes in such systems. It takes into account all the processes in a production chain, starting from the production of the raw materials and ending with waste disposal. For each process, specific data relating to the consumption of resources and the production of potentially harmful emissions are collected. It can be used as an effective tool to compare the environmental implications of enzyme-assisted

processes compared to conventional ones. A recent LCA study has quantified the overall environmental impact when Ronozyme ProAct is added to the feed used in standard indoor broiler production.

Everything is taken into account

This LCA assessment was undertaken for typical soya-based diets without protease, containing standard protein content (control), and compared with a diet that was supplemented with protease. In the protease supplemented diets, the protein and amino acid content was also reduced, in line with the digestibility improvements seen with the enzyme. Seven separate trials were evaluated in all and two scenarios were assessed – the feed production chain and the broiler production chain. Data used for the feed production chain included feed crop production, additive production, ingredient and feed processing, ingredient transport and fertiliser production. Whereas data for the broiler production chain took into account everything related to feed production plus energy use in housing the broilers, broiler house emissions, storage and land spreading of the manure, broiler breeder production and hatching. Information for the analysis was sourced from the broiler industry, wherever possible, and it was assumed that all manure was used as a fertiliser.

The results of the analysis of the feed production chain showed that, with protease supplementation, a reduction was seen for all of the environmental impact categories evaluated (*Figure 2*). The reduction was particularly significant for GWP, reaching a 12% reduction in some cases, with an average of 5%. The main reason for this improvement was a reduced level of soya in the diet when feeding a protease. This was associated with a decrease in CO_2 emissions, stemming from land-use changes relating to soya production and its subsequent transport. Small but significant improvements were also seen in EP and larger ones in AP.

When the whole production chain was taken into account (*Figure 3*), there was a large reduction in both EP and AP. The largest improvement was seen for the AP, with a maximum reduction of 9% and an average of 5%. This was linked to lower housing and manure emissions, with a particular reduction in NH_3. By improving the digestibility of amino acids in protein ingredients, proteases can lead to a reduction of nitrogen in manure, resulting in reduced ammonia emission, which in turn affects both the AP and EP.

Effective and practical

The main difference between a normal diet and a protease supplemented diet is a reduction in the amount of soya used. The reduction of environmental impact through this approach is often higher compared with other nutritional studies aiming to reduce soya in broiler diets. For example, the use of realistic inclusions of peas to replace soya reduced the GWP of broiler production by about 4%, but with other European protein sources (beans/sunflower) the reduction was smaller or non-existent. The performance of the birds in these studies was also assumed to have remained unchanged. If, as may be expected with the use of such alternative crops, growth was reduced, the environmental benefits would be even smaller. This indicates that when aiming to improve the environmental performance of broilers, the use of a protease in feed is one of the more promising nutritional strategies, either used alone or combined with other dietary alterations or changes in animal husbandry. Compared with non-nutritional methods aimed at reducing the ammonia emissions arising from poultry, use of a protease can also be considered more practical, as it requires no change in building design or need for capital investment.

Combined environmental and economic benefits

The main motivation for using protease in broiler production has been to reduce feed costs without any loss of animal performance. It now seems clear that such economic benefits are associated with a significant reduction in environmental impact. In certain regions of the world, where regulation determines the amount of nitrogen which can be applied to land, the economic advantages may be further enhanced by the environmental benefits. Protease will not only influence the profitability of an operation, it will also allow an increase in birds reared per unit of land while complying with environmental legislation requirements. Together with improved air quality for both birds and workers through reduced ammonia emissions, the use of a protease becomes an important nutritional strategy.

Figure 2 – Effect of RONOZYME® ProAct on broiler feed production chain environmental impact (per unit of feed at feed mill gate).

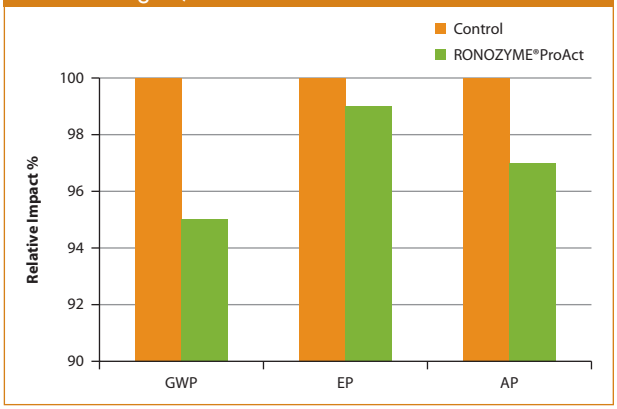
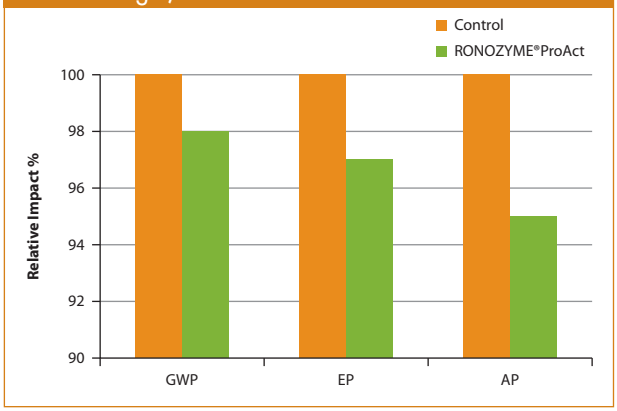


Figure 3 – Effect of RONOZYME® ProAct on broiler production chain environmental impact (per unit of expected carcass weight).

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European egg products for US

A government official overlooks the egg processing line at Bouwhuis Enthoven in the Netherlands to comply with US regulations. For the first time since 1987 the United States Department of Agriculture granted approval for five Dutch companies to export their egg. Cory Martin, of the American Bakers' Association, which campaigned for access for egg products from the Netherlands, said it was a "big step" but more needed to be done to alleviate supply issues after American producers lost 10% of the national flock after the avian influenza crisis. Dutch egg producers normally export two-thirds of their output, with the main market being Germany. One estimate suggested about 1% of its output – equivalent to 100m eggs – could be shipped to the US.

PHOTO: MICHEL VELDERMAN

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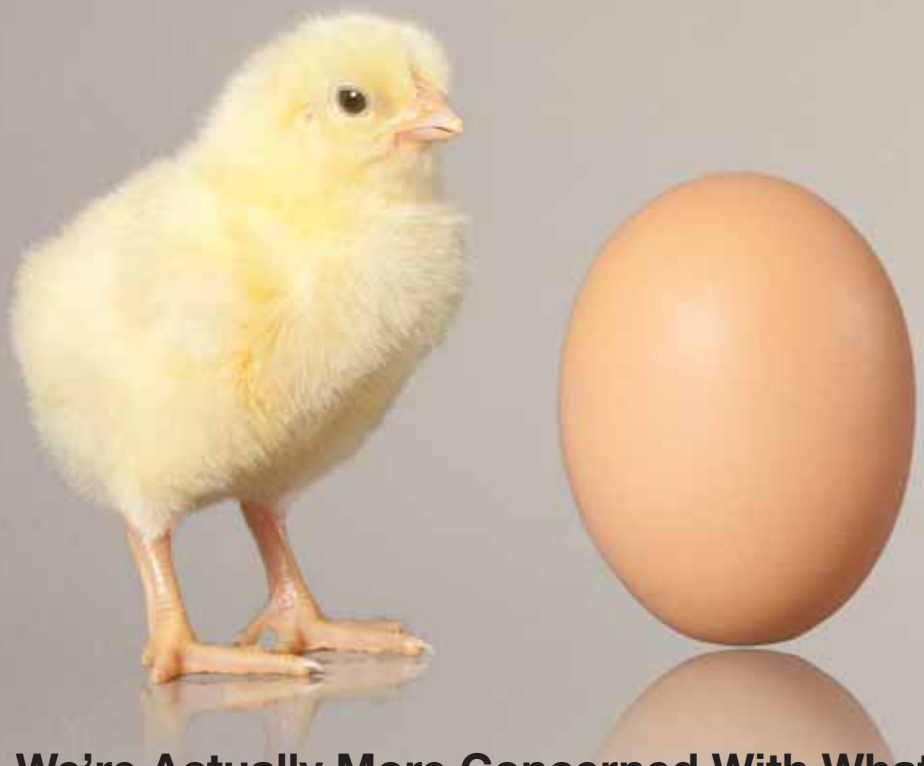

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Pro- and antibiotics in synergy against necrotic enteritis

PHOTO: HANS PRINSEN

New US field studies show that, in broilers induced with necrotic enteritis (NE), combining probiotics and in-feed antibiotics leads to better production performance than treatment with antibiotics alone.

By Chr. Hansen

Two NE challenge studies conducted at Southern Poultry Research in Athens, Georgia were designed to closely reflect conditions in commercial US poultry complexes. The purpose of the studies was to evaluate the impact on broiler performance with the addition of a probiotic supplement containing Bacillus subtilis to feed containing either BMD (bacitracin methylene disalicylate) or virginiamycin, antibiotics that have FDA-approved claims for growth promotion and the prevention of NE. "Results show that the probiotic-antibiotic combination regimens were associated with better weight gain and feed efficiency than either antibiotic alone," according to Anée Berg Kehlet, poultry scientific manager for Chr. Hansen. "This suggests a synergistic effect of combining probiotics and in-feed antibiotics in broilers at risk of developing NE."

Study design

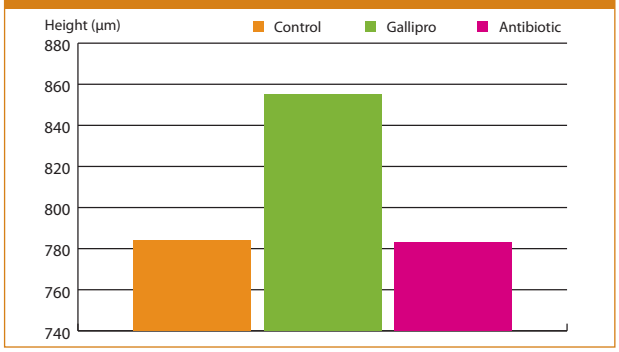
The studies were conducted in conventional US poultry houses with earthen floors, built-up litter and standard heating and ventilation systems. All birds had unlimited access to feed and water throughout the 42-day observation periods. In each study, 1,080 healthy, vaccinated, male chicks were randomised 45 at a time to one of three different feed regimens, which were replicated eight times each.

All feed regimens were corn-and-soy-based, with recommended nutrient levels and salinomycin as a coccidiostat. Both studies included two control groups: one received neither probiotics nor antibiotics (Group 1); the other (Group 3) received only antibiotics (*Table 1*). Group 2 in each study consisted of either virginiamycin or BMD, plus standard concentrations of a probiotic supplement containing B. subtilis as in GalliPro. On days 19, 20 and 21 of the studies, all birds were exposed through feed to a local isolate of Clostridium perfringens known to cause NE. On day 22, five birds from each pen were euthanised and examined for NE lesions. On days 21, 35 and 42, average weight gain (AWG) and feed conversion (FCR) were assessed for each pen. Starter feed was used until day 21 of the study, grower feed until day 35, and finisher feed until day 42.

Results

NE lesion analysis on day 22 confirmed that the disease challenge was successful in both studies and typical of subclinical infections found in commercial poultry production. On day

Figure 1 – Increased villus height using Gallipro Max



21, numerically higher weight gains and lower feed conversion ratios in both studies suggested an early benefit of probiotic supplementation (*Tables 2* and *3*). Throughout the duration of both studies, the probiotic groups continued to demonstrate the lowest feed conversion ratios. In the BMD study, the probiotic groups had consistently higher weight gain than either control group.

Enhanced intestinal performance

According to Kehlet, the better performance of the probiotic groups may be due to enhanced intestinal integrity and function. In previous studies, she said, broilers supplemented with probiotics had 9% longer villi than birds treated with only antibiotics. (*Figure 1*). "The longer the villi, the more surface area there is to absorb nutrients," she explained. "The result is better weight gain, better feed efficiency and better overall performance."

Probiotic-antibiotic synergies

Also, Kehlet said, probiotics work synergistically with antibiotics by balancing the microflora in the gut. "Probiotics complement antibiotics by keeping disease-causing bacteria in check — the more 'good' bacteria there are, the harder it is for pathogens to obtain the nutrition they need to grow," she explained. "As these studies indicate, combining probiotics and antibiotics during intestinal challenge allows producers to meaningfully improve production performance, with no diet changes necessary."

Table 1 – Experimental design: Probiotic/antibiotic combination studies during NE challenge

Group	Test Article	Probiotic dose
1	Commercial US diet	None
2	B. subtilis + 15g/t virginiamycin or 50g/t BMD	8 x 10^5 CFU/g feed
3	Commercial US diet + 15g/t virginiamycin or 50g/t BMD	None

All birds were observed throughout 42 days to detect the earliest signs of NE.

Table 2 – Probiotic/virginiamycin study: NE lesion scores, feed conversion and weight gain

	Day 22	Day 21		Day 35		Day 42	
Treatment	NE lesion	FCR	AWG (kg)	FCR	AWG (kg)	FCR	AWG (kg)
1	0.18 a	1.594 a	0.615 a	1.746 a	1.420 a	1.837 a	1.860 a
2	0.10 a	1.489 b	0.636 a	1.681 a	1.441 a	1.783 b	1.901 a
3	0.13 a	1.527 b	0.624 a	1.670 b	1.434 a	1.786 b	1.915 a

Different letters in each column indicate statistical difference.

Table 3 – Probiotic/BMD study: NE lesion scores, feed conversion and weight gain

	Day 22	Day 21		Day 35		Day 42	
Treatment	NE lesion	FCR	AWG (kg)	FCR	AWG (kg)	FCR	AWG (kg)
1	0.15 a	1.605 a	0.668 a	1.723 a	1.642 a	2.055 a	1.925 a
2	0.10 a	1.528 b	0.686 a	1.639 b	1.730 b	1.849 b	2.151 b
3	0.13 a	1.568 ab	0.673 a	1.667 b	1.698 b	1.915 b	2.092 b

Different letters in each column indicate statistical difference.

The temperature sensitivity of Campylobacter can be used successfully through physical intervention in in processing plants to reduce contamination levels, although this will increase processing costs.

PHOTO: WORLD POULTRY

Campylobacter, a European problem

Campylobacter remains a major concern throughout Europe, causing multi-million cases of food-borne illness. Unfortunately, current knowledge of Campylobacter is not as advanced as one would wish and, towards this end, much more research is ongoing to better understand the aetiology of the infection and, subsequently, ways to combat it during production.

By Andrew Robertson, poultry technical manager, Biomin GmbH

Since the 1988 announcement in the UK parliament that more than 80% of British eggs were contaminated with Salmonella Enteritidis, concerns about food safety have increased. A concerted control approach involving all levels of poultry production has reduced levels in Western Europe, knocking salmonellosis from its position as the most frequently reported cause for food-related gastroenteritis. This dubious honour has now passed to campylobacteriosis – with its major causes Campylobacter jejuni and Campylobacter coli — responsible for an estimated nine million cases per year in the EU, incurring costs, including medical intervention and lost working time, of around €2.4 billion annually.

The bacterium

Campylobacter are Gram-negative, non-spore forming bacteria comprising of 23 identified species. S-shaped or spiral in structure, they require oxygen to survive, although some species can also grow anaerobically. C. jejuni and C. coli – the main cause of human campylobacteriosis– are thermophylic (thrive at high temperatures). They will not grow below 30°C. The optimum temperature for growth is 42°C: close to the body temperature of poultry. For this reason, poultry are considered the major reservoir for the bacteria, although it is found in wild birds, all

food producing and companion animals and survives in the environment, provided it is moist. Most surface water sources that are contaminated by animal manure are contaminated with Campylobacter. Being thermophylic, Campylobacter will not multiply outside of the animal and will not further develop in meat or on the skin of chilled poultry. It is also susceptible to cold and will not survive freezing.

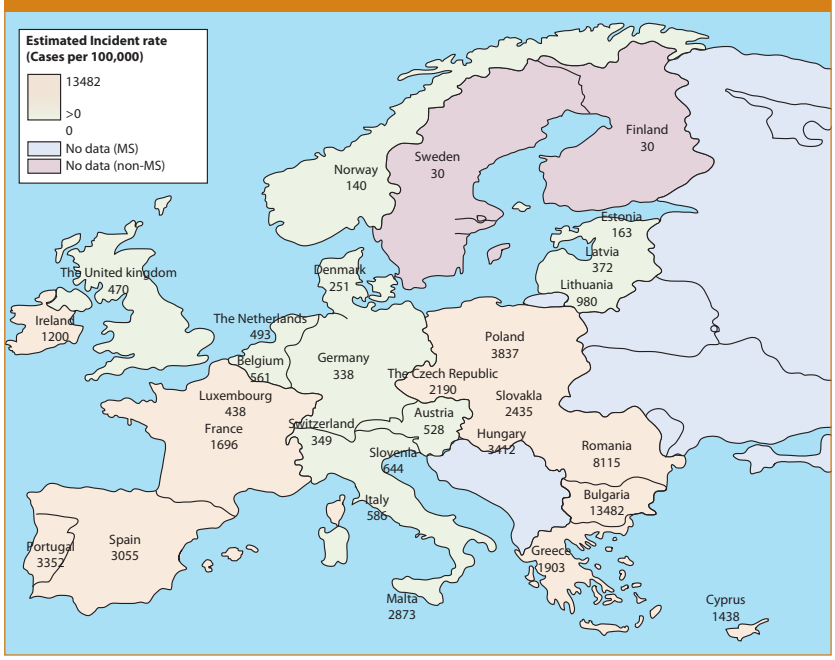
Effects in humans

Campylobacteriosis usually results in severe abdominal pains and diarrhoea, which can last for up to a week before recovery is made, although in certain cases it can result in hospitalisation. More than 100 deaths a year are attributed to campylobacteriosis each year in the UK alone, which is still lower than for Salmonella. In rare cases, it can also result in serious complications, such as Guillain-Barré syndrome, reactive arthritis, bacteraemia, inflammatory bowel disease and irritable bowel syndrome.

Poultry infection rates

The estimated incidences of human campylobacteriosis across the EU per 100,000 ranges from 30 in Sweden and Finland to 13,482 in Bulgaria and, in many cases, may be directly correlated with the incidence of Campylobacter infection in poultry. The level of direct poultry-related campylobacteriosis is approximately 20% to 30% of total cases, meaning that the majority are caused by alternative routes, such as direct animal contact and environmental sources. However, as chicken is also considered the major reservoir for indirect contamination coming from the environment, infections could still be further reduced by decreasing the incidence in commercial poultry flocks as a whole.

Figure 1- Estimated incident rate of Campylobacter.



Headline problems

More recently, the Food Standards Agency (FSA) in the UK has carried out a survey of campylobacter contamination in whole chicken taken from major retail outlets and decided to 'name and shame' the companies by publishing the results. The survey found that 72.9% of all samples taken were contaminated to a degree and nearly 20% were highly contaminated with more than 1000 cfu/g of neck flap; nearly double the FSA's 2015 target. Campylobacter have also been isolated on the outside of the package in a range of 4% to 13%, showing the potential for cross contamination in the processing plant and the potential risk from handling the finished product in the home. These data have also shown a seasonal pattern of contamination which increases in summer months—results that are in line with research undertaken in Denmark in 1999 – 2000 when contamination levels rose to 80% to 90%.

The upsurge of contamination and the negative publicity it has created have meant that many companies spend considerable sums trying to find a solution, ranging from enhancing biosecurity measures to testing physical interventions at processing plants. Unfortunately, unlike Salmonella, vaccination does not appear to be a viable option at this time. The stopping of thinning is also being studied by one of the major broiler producers in the UK, as is practised in some Scandinavian countries. In those countries, flocks are routinely tested before out-loading and any flocks found to be positive are slaughtered later in the day to reduce cross contamination in the plant; but also, importantly, the birds are then sold frozen. The desire for fresh, locally produced chicken throughout much of Europe has reduced frozen chicken purchases, exacerbating this situation.

Transmission

To date, the way in which flocks become infected is not fully understood. However, as the bacteria is not vertically transmitted, chicks test negative to the bacteria at placement. Often flocks become infected somewhere between 2 and 3 weeks of age, suggesting that perhaps there are incoming causes. Once contaminated, the spread within a flock is very rapid through faecal – oral transmission.

External intervention

The temperature sensitivity of Campylobacter can be used successfully through physical intervention in processing plants to reduce contamination levels, although this will increase processing costs. Two systems seem to be gaining some strength, with prototypes being tested in commercial plants using rapid surface chilling or rapid high temperatures applied by steam in conjunction with ultrasound.

Rapid surface chilling uses liquid nitrogen vapour in contact with the bird's skin to freeze the outer layer of dermal cells, thereby shocking the bacteria, which die once the temperature rises again. Initial results from this system have shown a reduction of 1 log10 on skin contamination. Further refinements may increase this reduction to 1.5 – 2 log10, taking contamination levels to within the UK target levels. A 2 log10 reduction in the birds is estimated to reduce the rate of carcass contamination by approximately 70%. The high temperature intervention, developed by the Danish firm Sonasteam, incorporates

ultrasound to open the pores of the skin before applying steam jets onto the skin. Again this is showing good reductions of 1 log10 in surface contaminations of Campylobacter. In the US and New Zealand, Campylobacter is well-controlled through the use of 20 to 30 ppm chlorine washes during processing. Due to concerns over the carcinogenic residues, this is not permitted in the EU, making Campylobacter more of a European problem.

While in-plant interventions may reduce the Campylobacter load sufficiently to meet FSA/EFSA standards, direct poultry infection still remains much lower than indirect poultry contamination. Efforts to reduce the environmental risks at production or farm level will be required. Three major ways of controlling Campylobacter include: improving on-farm biosecurity, stopping thinning of flocks and reducing the slaughter age to 28 days.

Biosecurity

As flocks tend to be negative when a day old but develop some contamination between 2 and 3 weeks of age, the pathogen may enter the house through one or more vectors. Increasing biosecurity could help reduce the rate of infection. Yet, as the vector is not well-understood, it is difficult to eliminate. Many vectors are considered to be potential causes of the disease, from flock to flock carryover, poor washing practices, farm staff, visitors, water and feed to flies and other insects. Biosecurity alone does not seem to be able to provide a solution. Research has shown that contamination rates can be reduced by over 50% with stringent biosecurity measures, but not eliminated. Unfortunately, it is very difficult to maintain such high standards of biosecurity under commercial conditions, therefore a much lower reduction may be more realistic.

Thinning

Thinning, or partial depopulation during the growing cycle, poses a major threat to biosecurity with the introduction of many catchers and modular crates. It has been reported that thinned flocks are eight times more likely to be contaminated with Campylobacter than those having a single out-loading. This confirms the successful intervention carried out in some Scandinavian countries where thinning is no longer permitted. For many countries with significantly higher broiler production, the removal of thinning would place huge strains on the ability to meet production requirements in the short term, as well as increase production costs. This approach is currently being tested in one particular processing plant in the UK.

Another factor in regard to thinning is the increased stress levels being applied to all the birds, not only those being caught, due to the short-term feed removal, disruption and noise during the catching process itself. Stress increases the levels of catecholamine hormones and norepinephrine, known to potentiate bacterial growth and regulate the virulence of Campylobacter jejuni in humans. Norepinephrine supplies iron in the presence of transferrin and lactoferrin in iron-limited conditions, thus aiding the bacterial growth; and if the same is happening in chickens, this may help explain the sudden surge in levels of contamination following thinning.

Age of slaughter

While impractical due to market requirements, the reduction of the slaughter age to 28 days would dramatically reduce the levels of Campylobacter contamination. It has been shown that the risk factors of contamination increase every 10 days post-infection. In birds aged 8 to 9 weeks, the levels may subside; possibly the result of acquired immunity. The common slaughter age of 35 to 42 days in Europe means that birds are likely to be highly contaminated. Combined with the inability to use chemical washes post-evisceration and the fact that the consumer is reluctant to buy frozen poultry, it tends to make Campylobacter more of a European problem than a global problem.

References available upon request.

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Improved water and feed consumption with LED lighting

PHOTO: AHPHARMA

Light at feeder and drinker attracts the broilers and ensures more uptake of feed and less risk of dehydration, especially in the first days of life.

Based on field poultry research, feeder lights, in conjunction with water lights, will help birds reach their genetic potential by significantly improving both feed and water consumption. This includes increased 7-day, 21-day and market body weights, as well as an improved market-age body weight uniformity.

By James L. McNaughton, AHPharma Energy Systems

While the eco-friendly benefits of LED lighting are well documented, the agriculture industry has been slow to transition from CFLs and incandescent bulbs for numerous reasons. The low intensity of LEDs when mounted on an 8-9' high ceiling has been cited as a potential cause for poor live performance in poultry. As a result, it's essential for poultry rearing facility managers to understand how low light intensity negatively impacts bird behaviour and animal welfare before disregarding the adoption of new LED technologies.

Current lighting problems

Modern, high-efficiency broiler and turkey production employs 20-24 hours of high light intensity (generally 30 to 40 lx or 3-4fc) per day for the first week. Recent lighting trends strive to distribute 4+ foot candles (fc) throughout the entire brooding area, resulting in the needless spread of birds into areas without feed and water. Obtaining a consistent 4fc light across an entire house has been difficult with the use of low-

intensity LEDs. Consequently, the poultry industry is now routinely using 23-55W CFLs during the first 5 to 7 days of life, then switching to LEDs from day eight to market.

For decades, live poultry production staff and animal welfare personnel considered LED lighting and the handling of complete dark-out housing—where a circadian rhythm via artificial lighting is essential for live performance. As early as 1984, researchers demonstrated that high light intensity (86 lx or 8.6 fc) allowed the maximum expression of genetic growth potential, especially in a low population bird density, as compared with 5.4 lx light intensity.

Modern research now confirms that high light intensity used during a typical 24-hr period and not photoperiod is the dominating factor in bird behaviour. Most researchers now conclude that broiler chickens prefer light intensity higher than 40 lx or 4 fc when active, but less than 5 lx or 0.5 fc when resting.

Providing a clear choice between light and dark, with distinct, contrasting differences, has been deemed humane. Research by Blatchford concluded that rearing broilers in very dim light (such as <5 lx or 0.50 fc) has adverse effects on animal welfare, such as larger, heavier eyes, diminished activity and increased lameness. Subsequently, international humane associations have indicated that four to six hours of darkness (over a 24-hour period) is essential for animal welfare.

After extensive trials, Blatchford's results indicated that light intensity has a stronger effect on bird behaviour, increasing bird activity and performance, than light duration. Birds prefer to have high light intensity when active and low light intensity when resting. For a bird to change behaviour, these researchers found that a contrast of at least 80 lx or 8 fc of change, with more substantial results deriving from contrasts of 180 lx (18 fc), were required. Finally, a comparison of low light (1 lx) with high light (200 lx) showed that birds reared in a high light environment (200 lx or 20 fc) developed a stronger circadian rhythm, have stronger and more healthy eye development, and develop fewer cases of lameness. Thus making birds eat, drink, move and then rest all in a healthy 24-hour cycle. This is in contrast with a small change in light (1 lx and 0.5 lx), in which they exhibited weaker circadian rhythms. The poultry industry has addressed these weak-light issues by increasing light intensity throughout the entire house, which also increases energy costs. High light intensity is commonly achieved by employing high powered ceiling LEDs (A-19, 8W or more), in conjunction with 23-55W CFLs or incandescent bulbs.

Birds prefer to have high light intensity when active, and low light intensity when resting.

PHOTO: RONALD HISSINK

Lighting and water consumption pattern

Troubling water consumption patterns and the ability of chicks and poults to initiate water consumption is an ongoing discussion. Camera imaging and spatial analysis software have shown that, for the first 24-hr post-hatch, only 5% of young birds gather around the nipple drinkers at any point in time. Consequently, <25% of the birds are meeting their minimum hydration requirements.

Research conducted by AHPharma also indicated that >8fc of light at the feeder, with less light toward water nipples, attracted the majority of birds to the feed troughs and not to water nipple areas; thus causing the birds to have a reduced water:feed ratio. To correct this water consumption issue, LED Water Lights are being placed around nipple drinkers, yielding a highly significant >90% bird presence. Consequently, the high intensity water light source will increase the water:feed ratio—which is especially important from the time of placement up to 48hrs.

In response, AHPharma, in conjunction with poultry and LED manufacturing industry partners, recently pioneered the development of a high intensity LED light that provides >150 lx (or 15fc) installed conveniently over feeder pans—closer to the birds. The new feeder lights attracted an average of 88% of the flock around the feed/water areas during the first 10 days of life vs. conventional 55W CFL brooding lights (55% of the flock). Using AviLighting water lights for the first 48 hours, followed by both feeder and water lights for the next 48 hours, resulted in >90% of young birds gathering around the nipple drinkers for the first 48 hours, then birds moved between watering and feeding for the 49-96 hour period. Consequently, birds ate 3.5% more feed, obtained 3% heavier 7-day weights and grew in a more consistent manner—resulting in 3% tighter body weight uniformity than birds reared in a facility with standard ceiling fixtures.

Supplementary feeding of live insects

PHOTO: KOOS GROENEWOLD

Groups of broilers are given 5%, 10% or 15% live fly larvae, which replace up to 75% of soy protein.

ForFarmers has launched a trial, together with the Department of Entomology at Wageningen University in the Netherlands, to explore the impact of live insects as a source of protein in the broilers' diet.

By Fabian Brockötter

Leon Marchal, Nutrition & Innovation Director at ForFarmers, commented, "The most important research question is whether the chicks are growing healthily and at a sufficient rate in comparison with a traditional diet. We also want to look at whether the broilers' natural behaviour will improve as a result of the addition of live insects. If this project proves to be a success, it will be an important step towards further sustainability within the industry."

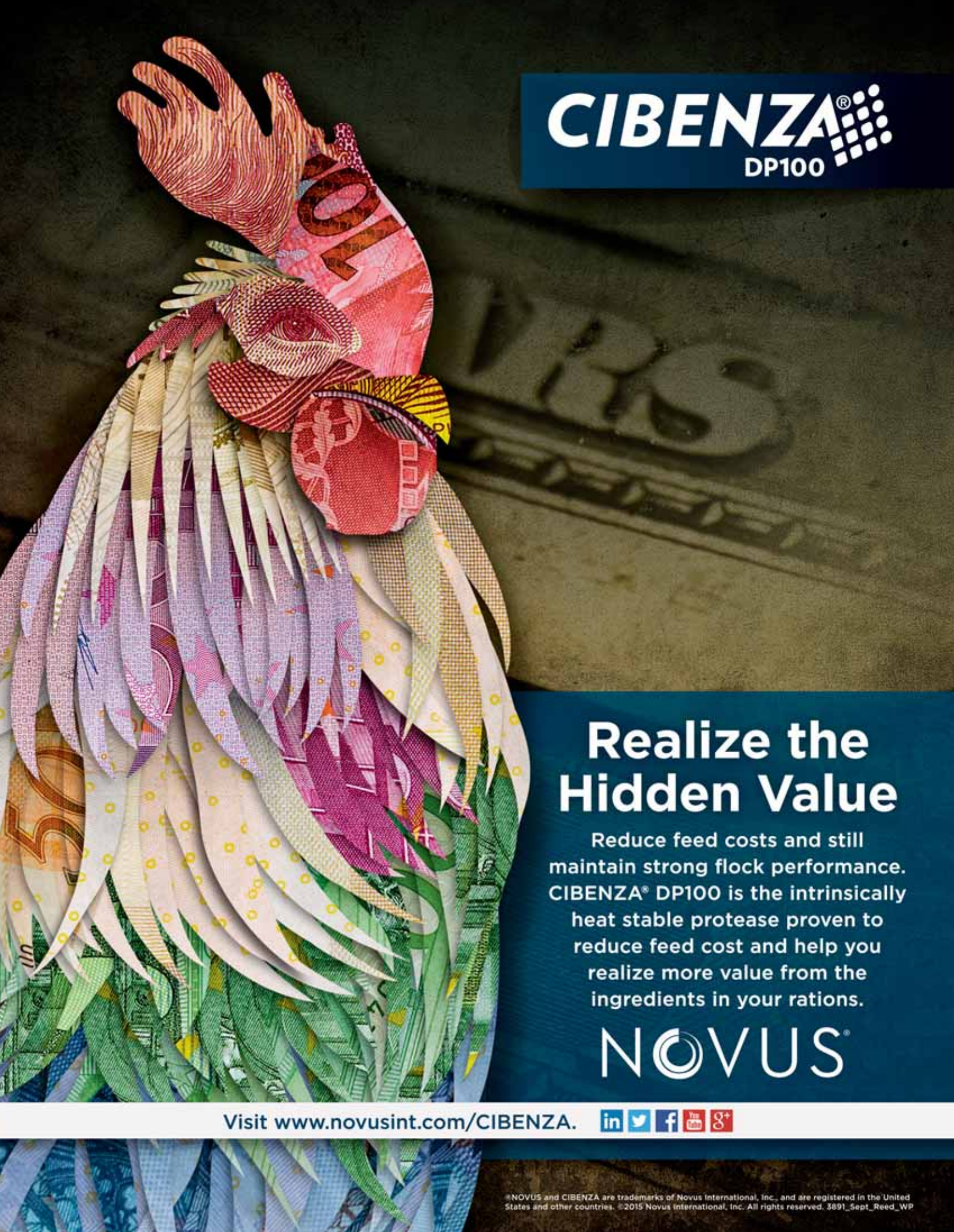
The trial is being conducted at ForFarmers' experimental farm in Nijkerk, the Netherlands, where a total of 1,000 chicks are being fed in four different groups. A control group will be given a traditional diet, while the remaining three will be given 5%, 10% or 15%, respectively, of black soldier fly larvae. The high protein content of these larvae replaces up to 75% of a protein like soya.

"The larvae from this species are truly omnivorous and are relatively easy to grow," according to Albert Dijkslag, Poultry Innovation Manager at ForFarmers. "This will also result in profit for the farmer and increased sustainability. These larvae are grown on residual flows from the food industry. These residual flows and the protein within them would otherwise end up in biomass (fuel), but now they are available as feed. And if the trial proves successful, we will have found an alternative source of protein."

Natural nutrition and behaviour

The trial with the broilers started in the summer. The initial results are expected in September. The various parties involved think it will be some time before the large-scale supplementing of diets with live insects can be introduced in practice. "The application is currently quite expensive. But it's definitely a good first step and mind-set. If we see positive results, we will continue with the further optimisation and development of the trial," Dijkslag explained. Marchal added, "The nice thing here is that chickens in the wild are naturally omnivorous and insects would feature as part of their diet. The outcome of the project, therefore, could be to help birds further express their natural behaviour."

ForFarmers wants to be a leader in sustainability, given its position in the food chain. ForFarmers is making a contribution to economically viable and sustainable food production by efficiently producing animal feeds and developing products and concepts which allow the animals to utilise the food in a healthier and better way, i.e. improved feeding efficiency. This trial with live insects indicates ForFarmers is really giving substance to its sustainability ambition.



Hubbard

Saadiqul Islam Saadi has joined Hubbard as assistant technical service manager. Based in Bangladesh, he will provide technical services to Hubbard Grand Parent, Parent Stock and commercial broiler customers across the region.

EW Nutrition

EW Nutrition has appointed **Dr Heinrich Kleine Klausing** as managing director and head of product management and production. He has over 25 years of expertise in the feed sector and in business development from managing a mineral feed subsidiary of a large feed producer in Germany.

Cobb

Lei Wang has been appointed as China sales manager for the Cobb Asia-Pacific region. He will be selling parent stock from the new Chinese grandparent operation as part of the sales and technical team which includes **Denny Chan**, director of China operations for Cobb, **Bruce Zhou**, technical service manager, and **Garrison Qi**, sales assistant.

Jansen Poultry Equipment

Jansen Poultry Equipment has appointed two new area managers in Asia to strengthen its presence and support services to all poultry farmers in the region. Firstly, **Dr Eric Brawner** will be overseeing the countries of Indonesia, Malaysia, Japan and Taiwan and, secondly, **Niranchai Tripati** will take charge of the South Asian region, including India, Bangladesh, Sri Lanka and Pakistan.

Nutriad

European feed additives manufacturer Nutriad has appointed **Ho Gim Chong** as commercial/technical manager aquaculture SE Asia. He worked previously as lecturer/researcher in Veterinary Parasitology at the University of Putra Malaysia.

AB Vista

AB Vista has appointed **Paul Han Sun Gun** as business manager for Korea, a new position created to strengthen the team in the Asia region. He will work with **Dr Yingjun Ru**, AB Vista's technical sales director in North Asia.

Delacon

Dr Mohamed Taleb has joined Delacon as sales manager Middle East. Located in Cairo, Egypt, he will be responsible for sales in Egypt and the Gulf region and reports directly to **Bernard Paumelle**.

Meat quality in fast-growing broiler chickens

During the past few decades there has been a notable increase in the demand for poultry meat due to its low cost, good nutritional profile and suitability for further processing. Moreover, current forecasts of world population growth and the demand for animal protein seems to suggest that the poultry market will continue to expand in the future. This growing demand has led to progressive improvements in genetic selection to produce fast-growing broilers, which has resulted in several spontaneous, idiopatic muscle abnormalities, along with an increased susceptibility to stress-induced myopathy. Such muscle abnormalities have several implications for the quality of fresh and processed products, as breast meat that is affected by deep pectoral myopathy is usually rejected because of its unacceptable appearance. In addition, pale, soft and exudative-like meat has a low processing ability due to its reduced water-holding capacity, soft texture and pale colour. The high incidence of abnormalities observed in chicken breast muscles, such as white striping (characterised by superficial white striations) and wooden breast (characterised by pale an bulging areas of substantial hardness), impair both the appearance and technological traits of breast meat. This review evaluates the consequences of selection on muscle traits and describes the relevance of major breast abnormalities on the nutritional, technological, sensorial and microbial characteristics of raw and processed meat.

PHOTO: KOOS GROENEWOLD

Pristeen chicken filet is the benchmark, however, the occurence of muscle abnormalities is growing.

M. Petracci, S. Mudalal, F. Soglia and C. Cavani, World's Poultry Science Journal 2015, 71, 363-375

Relationship between water-holding capacity and protein denaturation

The ability of meat to bind water is a complex trait and is influenced by structural and biochemical changes that occur during the transformation of muscle to meat. Broiler breast muscles (pectoralis major) are typically comprised of glycolytic muscle fibres. As a result, broiler breast meat undergoes a rapid post-mortem pH decline and is susceptible to developing inferior water-holding capacity (WHC) characteristics. Unfortunately, the underlying mechanisms that control WHC in broiler meat are not yet fully understood. Much of what is known about WHC in fresh meat is the result of research on pale, soft, exudative (PSE) pork and PSE turkey. Muscle pH and protein denaturation are considered to be the main determinants of WHC in meat. As muscle pH decreases with the progression of post-mortem metabolism, the net charges of the muscle proteins are reduced. This decrease in net protein charge results in diminished WHC due to the availability of fewer charged protein sites for binding water; protein denaturation due to a rapid pH decline in meat can also negatively influence WHC.

The degree of protein denaturation in post-mortem muscle is often determined by measuring protein solubility or extractability. In pork and turkey muscle, low WHC and pH are closely associated with high degrees of post-mortem myofibrillar and sarcoplasmic protein denaturation and reduced protein solubility. Myosin denaturation in particular is thought to be the key event in the development of poor WHC. Despite many similarities across species in regards to the pH effects on WHC, the available literature suggests that the relative importance of protein denaturation in controlling WHC in pale chicken muscle may be different from pork and turkey.

PHOTO: BART NIJS

The underlying mechanisms that control WHC in broiler meat are not yet fully understood.

In this study, the relationship between water-holding capacity (WHC) attributes and protein denaturation in broiler breast meat was determined in commercially processed and chilled pale and dark broiler breast fillets at different times post-mortem (6 h and 24 h). The boneless skinless breast fillets (n = 72) were collected from a commercial processing plant at 2 h post-mortem and divided into low-WHC and high-WHC groups based on muscle pH and colour (L,a,b). At 6 and 24 h post-mortem, brine uptake (%), cooking loss (%), and protein solubility (sarcoplasmic and myofibrillar) were measured and protein fractions were analysed. Drip loss accumulation (%) was measured after storage for 2 and 7 days post-mortem. WHC differences in broiler breast fillets were not due to differences in myofibrillar protein denaturation and suggested that the denaturation of sarcoplasmic proteins onto myofibrils may influence WHC in breast meat.

B. Bowker and H. Zhuang, Poultry Science 94,1657–1664

The importance of sharing knowledge and experience to maintain hatchery standards

Martin 'Tiny' Barten is senior hatchery specialist at Pas Reform Hatchery Technologies.

On returning to a South American hatchery recently, I discovered that the hatchery manager I had worked with and seen grow into his role for the past three years had left. Together, we had made changes to conditions inside the hatchery and to incubation programmes, such that the hatchery was performing very well, with consistently high chick quality, narrow hatch windows and hatch abilities well above standard.

The 'new face' that greeted me seemed very pleased to see me, admitting that since starting his new job the hatchery's management had noted a downward trend in results.

As we toured the hatchery together, I noticed little things being done differently. The new hatchery manager could not really explain why these changes had been made and, in fact, did not even realise they had occurred.

He had many questions and, when I asked him about his training and handover from the previous hatchery manager, his answer was that he had not received any, which was a surprise to me. He had simply been given the keys. It appeared that none of the existing staff had ever had the 'whys' and 'hows' explained to them either: they simply did as they were told. For example, despite the existence of many incubation programmes, nobody knew which programme was used for which type of egg.

For the rest of my visit, I went through all the hatchery's procedures with the new manager. Having graduated five years previously, he had since managed broiler farms. He was bright and, while he picked up a lot of information very quickly, he was clearly relieved when I promised to stay in touch.

This experience reinforced my conviction that hatchery managers are not 'made' in schools or universities. They may learn the basis of becoming a hatchery manager there, but good hatchery managers grow into their job, as they build their experience, attend seminars, acquire information through training and reading, and sharing knowledge with more experienced consultants and colleagues.

A good hatchery manager will not keep his knowledge and experience to him or herself, but will transfer it to colleagues for the benefit of the entire company. And when it's time to move on to a new role, the mark of a good manager is one who takes the time to work side-by-side with a newly appointed person to ensure the continuing success of the operation - and its team!

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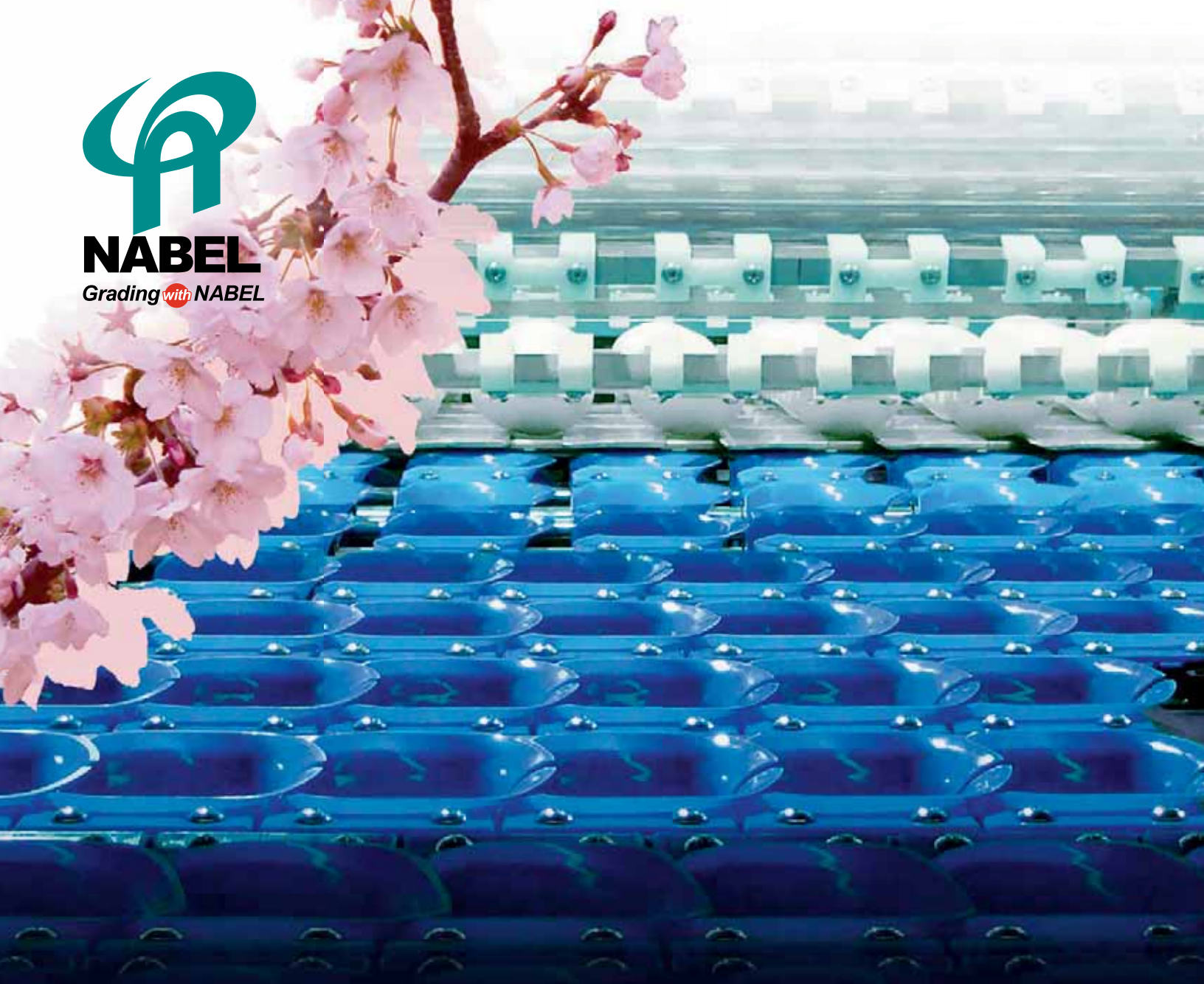

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