

International Poultry Production

Volume 26 Number 3 (2018)

Practical information for progressive poultry professionals

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A new probiotic to tackle enteric problems

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The best possible start to maximise flock productivity

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editor's perch

When it comes to training there are many choices in the marketplace, but when it comes to quality training these choices become relatively limited. So, how do we differentiate the good training from the rest and how do we decide what training we require?

As a general rule, the lower down the management tree you go, hands-on or practical training becomes more important. For example, it is far more important that the farm manager understands how to vaccinate his birds, whereas the veterinarian needs to understand the theoretical minutiae of vaccination.

Needless to say, both scenarios require very different training and trainers. The first can probably be done in-house using a senior member of the agricultural team or your veterinarian, whereas the latter is going to be best satisfied by attending an international training course or a conference with international experts as speakers.

First of all you must decide what training you want and then define its objectives. In defining training requirements you will need to

identify deficiencies in your staff knowledge or skills and then determine the potential of those deficiencies to harm the business. Those that could harm the business should be prioritised in any training plan or programme. Then you can use a matrix with training need and staff members on the two axis to define who would benefit from which training the most.

But how do you decide who is going to give the training required?

By their very nature trainers have the 'gift of the gab' so with an outside supplier the challenge is to find out whether as well as 'talking the talk, they can 'walk the walk'!

Ask to see feedback from recent courses and find out who attended previous training sessions. If they are running a course near you in the future see if you can sit in on a session or two to see for yourself how good it is.

Then you need to gather feedback from your staff who attend any training courses to gain an overview of what they did and what they learnt. You can then decide for yourself whether or not you would use that course or that training supplier in the future. ■

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worldfocus

An executive summary of key international issues

Vietnam

A changing world!

It is amazing how quickly a country can change. Ten years ago in Ho Chi Minh City, when you tried to cross the road, you were greeted by a marauding mob of scooters and their riders who were apparently intent on ridding their city of foreigners. How different it is today. You still have just as many scooters but now every rider wears a helmet and the scooters flow in organised streams that are respectful to pedestrians wishing to cross their tracks. You could say this also applies to the poultry industry as thousands of small farmers, hatcheries, breeding farms and processing plants are now driving down the route of consolidation. Is this a second Thai poultry industry in the making?

Victam

At a crossroads?

The recent Victam show in Thailand raised some interesting questions. It would appear that there has been a subtle change in focus with the event becoming more focused on the future in terms of exhibitors coming from the testing and accreditation sectors. As one attendee told me – 'it is becoming more of a thinking-nutritionist's event, rather than a practical feed mill manager's event'. But surely this is way that our great poultry industry has been moving for more than a decade? Reading between the lines, one can see a feed industry that does not quite know its way – should it be the proactive leader in moulding the future for our industry or should it positively respond to customer requirements?

Veterinarians

Gathering for Asia's own meeting?

Asia's poultry veterinarians are beginning to focus on attending the WVPA's biennial Asia Meeting which will be held in Kuala Lumpur, Malaysia at the beginning of October. This meeting, which has previously been held in Bangkok and Manila, is now at its 4th edition and has become the meeting point for Asian poultry veterinarians and their colleagues in academia, research and industry. On the first day veterinarians from industry will focus on current problems and their solutions and on the second day members will share their experiences. With a strong local organising committee, everything looks set for another successful WVPA Asia Meeting.

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A new probiotic to tackle enteritic problems in a post-antibiotic era

Despite the use of many solutions, clostridiosis is still prevalent globally impairing growth rate and feed conversion and resulting in high condemnation rates at the slaughterhouse. Pathogenic strains of *Clostridium perfringens* in the gut are responsible for different ailments in poultry and other livestock.

by **Dr Kiran Doranalli, Dr Rose Whelan and Dr Stefan Pelzer, Evonik Nutrition and Care GmbH, Germany.**
www.evonik.com

Among these, it is common to find bacterial enteritis, necrotic enteritis, and colangiohepatitis. Specifically concerning is bacterial and necrotic enteritis in poultry.

Necrotic enteritis (NE) is caused when toxins produced by *C. perfringens* damage the gut mucosa.

Further, it affects the digestion and absorption of nutrients, most often leading to dysbacteriosis. In addition, gut health issues such as bacterial enteritis or subclinical NE can increase litter moisture and therefore the risk of broilers developing footpad lesions.

The cost of subclinical NE to the global poultry industry is estimated to be \$4-6 billion per year, making it a significant issue worldwide.

Dietary inclusion of probiotic bacteria is one effective strategy for preventing intestinal bacterial dysbiosis as is seen in NE.

However, for probiotics to be considered as an effective alternative solution to antibiotic growth promoters (AGP), the mode of action should be proven for different criteria, primarily:

- The inhibition of the target pathogen.
- The modulation of the intestinal microbial population.
- The improvement of animal performance.

Bacterial strains within the species *Bacillus subtilis* are widely used as direct fed microbials (probiotics).

However, the strains of *B. subtilis* have unique characteristics that help define their function and efficacy as probiotics. Therefore, mode of action characteristics of a particular strain cannot be generalised to all *B. subtilis*.

A probiotic based on the spore-forming *B. subtilis* DSM 32315 strain was selected for its ability to inhibit the growth of enteric pathogens, in particular *Clostridium perfringens* and support the maintenance of intestinal microbial balance. From a practical standpoint, the efficacy of a probiotic may be limited by certain factors, which can affect its application under commercial conditions.

Therefore, the selection procedure resulting in the final *B. subtilis* DSM 32315 strain (GutCare) was a multi-parameter step process to ensure the efficacy and activity of the probiotic within the animal.

These factors include:

- Gut fitness.
- Safety assessment.

Fig. 1. Growth of *B. subtilis* DSM 32315 in veal infusion broth (VIB) with or without bile.

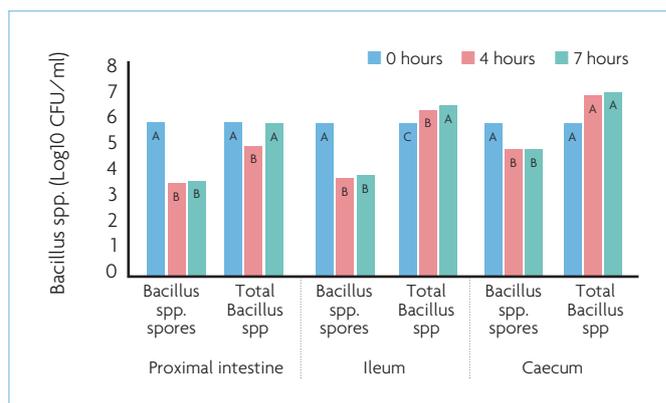
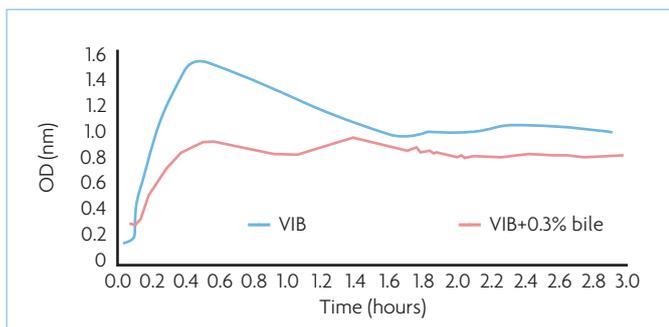


Fig. 2. Enumeration of *Bacillus* spp. from broiler digesta at different time points after ex-vivo incubation with *B. subtilis* DSM 32315 spores.

- Feed processing and storage.
- Inhibition of *C. perfringens* in vitro and in vivo.
- Broiler performance under NE challenge conditions.
- Microbial modulation within the gut.

Gut fitness

Bacillus subtilis spores must be able to survive, and germinate into metabolically active vegetative cells in the gastro-intestinal tract (GIT).

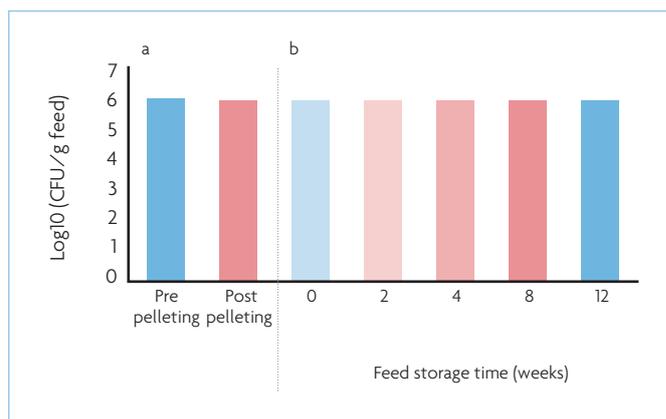
In general, *B. subtilis* probiotics are

selected for their ability to withstand low pH and high concentrations of bile acids in the chicken GIT, however this ability may vary by strain.

The effect of bile on probiotic bacteria may include oxidative stress, which damages bacterial proteins and DNA. In this context, two separate studies were conducted to evaluate *B. subtilis* DSM 32315 spores for bile resistance activity, as well as their ability to germinate and proliferate as vegetative cells in the digesta of broiler chickens.

Continued on page 9

Fig. 3a. Recovery of spore after mixing (n=10) the feed with *B. subtilis* DSM 32315 spores and after pelleting (n=5) of feed at 85°C. 3b. Recovery of spores after pelleting the feed (n=3) at 85°C and sampling after 0, 2, 4, 8, and 12 weeks of storage at 40°C and 80% humidity.



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Well diffusion assay using strains grown in LB Kelly media (mm clearance of pathogen)

Strains tested	C. perfringens type A (NE outbreak field isolates)		C. perfringens (Library collection)
	α - and netB-toxin	α - and β 2-toxin	ATCC 13124
B. subtilis DSM 32315	16.50	18.00	15.00

Table 1. Bacillus subtilis DSM 32315 inhibits pathogenic Clostridium perfringens.

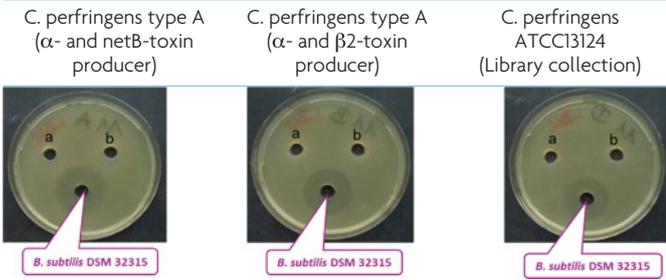


Fig. 4. Inhibition of various pathogenic strains of Clostridium perfringens in well diffusion assay using LB Kelly media (mm clearance if pathogen). a. competitor Bacillus spp. strain and b. negative control.

Continued from page 7

In the first study, B. subtilis DSM 32315 was grown in veal infusion broth (VIB) alone or VIB + 0.3% bile. The growth measured over a three hour period showed that B. subtilis DSM 32315 is able to grow in the presence of bile (Fig. 1).

A germination study was conducted to investigate the ability of B. subtilis DSM 32315 spores to germinate in GIT conditions. B. subtilis DSM 32315 spores were incubated in digesta samples collected from the proximal intestine, ileum and caecum of broiler birds in conditions mimicking the intestinal sections.

Total Bacillus spp. cells significantly increased within four hours of incubation in the digesta from ileum and caecum, while spores of Bacillus spp. decreased significantly in all sections of the intestine (Fig. 2).

This indicates that germination of spores occurred in the digesta from all sections of the gut, but perhaps that proliferation of vegetative cells is optimal in the ileum and caecum.

Safety assessment

For commercial application purposes, it is important to establish the safety of the micro-organism used as a probiotic. The most serious risk posed by probiotic microbes in feed are:

- The transfer of antibiotic resistance due to the presence of transmissible antibiotic resistance genes.
- The presence of toxin genes.
- The presence of plasmids or mobile genetic elements.

B. subtilis DSM 32315 was analysed for toxin related genes and was shown to contain no haemolytic enterotoxin genes (nheABC), no haemolysin genes (hblCDAB), no cytotoxin gene (cytK), and no cereulide gene (cesA).

In addition, B. subtilis DSM 32315 was tested for antibiotic resistant genes. No plasmids were identified on a gene level which was validated by culturing the probiotic in the presence of antibiotics deemed important for medical use. From this profiling, it is concluded that B. sub-

Fig. 5. Isolation and structure elucidation of active principle in B. subtilis DSM 32315 inhibiting C. perfringens.

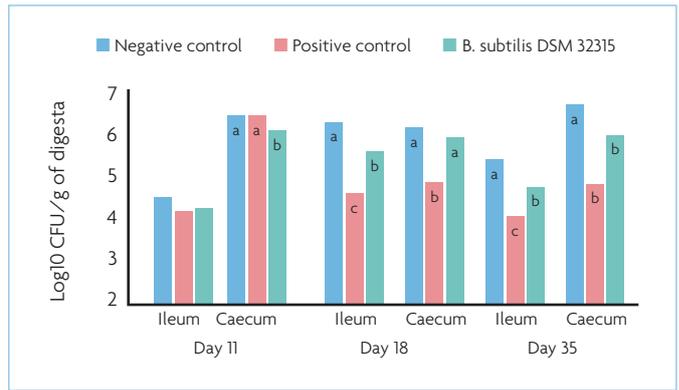
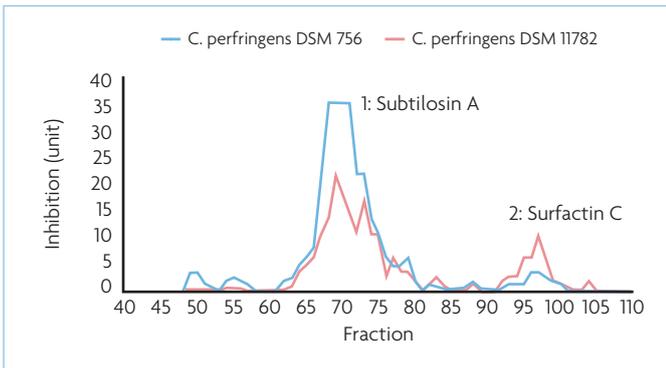


Fig. 6. Effect of B. subtilis DSM 32315 (GutCare) on C. perfringens populations in ileum and caecum of broiler chickens.

tilis DSM 32315 is safe to be added in the food chain.

Feed processing and storage

In order to verify the potential of B. subtilis DSM 32315 as a probiotic for in feed applications, the ability of B. subtilis DSM 32315 spores to remain viable after pelleting and feed storage was tested. There was no significant loss of B. subtilis DSM 32315 spores in broiler feed during feed pelleting (Fig. 3a).

Additionally, B. subtilis DSM 32315 spores showed excellent mixability in the feed. There was also no significant loss of B. subtilis DSM 32315 spores in pelleted broiler feed stored for up to 12 weeks at high temperature and humidity (Fig. 3b).

Inhibition of Clostridium perfringens

An in vitro study was conducted to test the inhibition of pathogenic strains of C. perfringens. Three strains of C. perfringens that are capable of producing α , β 2, and netB toxins were used. Growth of all C. perfringens strains tested were

inhibited by adding supernatant from the culture of B. subtilis DSM 32315 (Table 1 and Fig. 4).

Furthermore, by applying a multi-step fractionation approach, the distinct fractions of the supernatant with C. perfringens inhibiting activities were identified (Fig. 5).

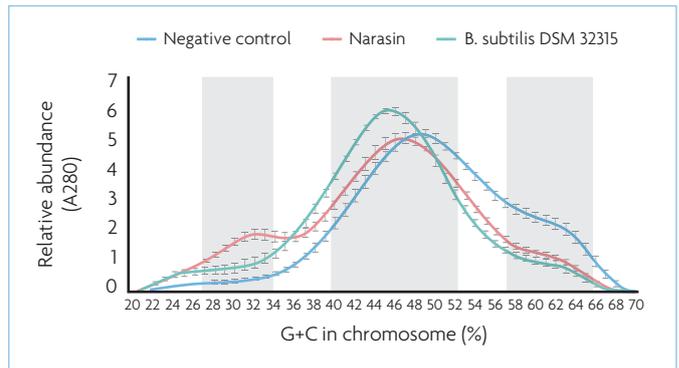
Structure elucidation of the fractions with nuclear magnetic resonance spectroscopy confirmed that two compounds were responsible for the inhibition activity the bacteriocin Subtilisin A and Surfactin C. These results were successfully validated in experiments using novel knock-out Bacillus strains where strains missing the genes for Subtilisin A and/or Surfactin C had impaired ability to inhibit C. perfringens growth (data not shown).

Several studies were conducted to validate the ability of B. subtilis DSM 32315 in broiler feed to inhibit C. perfringens induced NE.

In one study, the NE challenge was induced in each bird with an oral inoculation of Eimeria maxima oocysts at 12 days of age as a predisposing factor for the inoculation of the birds with a pathogenic field strain of C. perfringens at 16 days of age. The challenged broilers were

Continued on page 11

Fig. 7. The average %G+C profiles from the caecal microbiome of broilers fed diets either without additive (negative control), positive control (Narasin) or supplemented with B. subtilis DSM 32315 (GutCare). Vertical columns show the fractions of the curve low (27.0-34.5%), mid (40.5-54.0%) and high (59.0-68.9%) where significant differences (p>0.05) in relative abundance were determined between.



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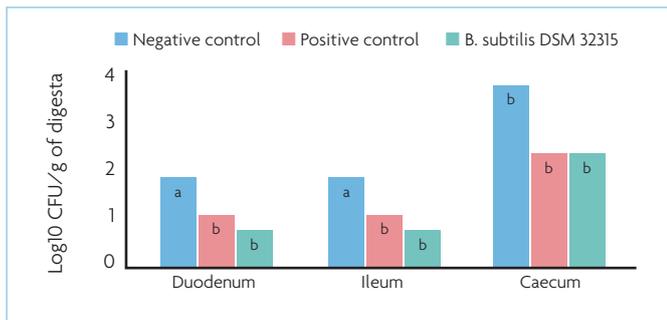


Fig. 8. Effect of *B. subtilis* DSM 32315 (GutCare) on *C. perfringens* populations in duodenum, ileum and caecum of broiler chickens.

Continued from page 9
either fed a control diet or a diet supplemented with *B. subtilis* DSM 32315 (GutCare) at 500g/MT (1×10^6 CFU/g feed) for 35 days. Narasin (650g/ton of feed) was used as a positive control.

Molecular analysis of microbial populations in the ileum and caecum of birds at different time points showed that feeding *B. subtilis* DSM 32315 consistently and significantly ($P < 0.05$) decreased populations of *C. perfringens* (Fig. 6).

Caecal digesta samples from day 18 were utilised to investigate the effects of dietary *B. subtilis* DSM 32315 on the microbiome of broilers during the peak of the NE challenge.

For this purpose the %G+C profiling method was utilised which differentiates microbiome samples based on two essential points;

- Each bacterial species has a characteristic guanine-cytosine (G-C) content in its chromosomal DNA.
- G-C-rich DNA is denser than adenine-thymine (A-T)-rich DNA.

The different bacterial chromosomes within a sample can be separated based on these density differences with high speed centrifugation and relative abundance of chromosomes with different %G+C determined from the fractionated samples.

Comparison of the resultant profiles from individual samples with statistical analysis reveals microbial population changes between treatments. The exact families and species of bacteria contributing to the profile changes

can then be identified using sequencing techniques.

This technique identified significant ($p < 0.05$) differences between dietary treatments on the caecum microbiome %G+C profiles in three regions; a low (27.0-34.5%), mid (40.5-54.0%) and high (59.0-68.9%) region (Fig. 7). These regions were then fractionated and chromosomal DNA collected for next generation sequencing to determine the treatment effects on specific families and species of bacteria represented in these fractions.

The results of the %G+C profiling and subsequent sequencing revealed that dietary inclusion of *B. subtilis* DSM 32315 in broiler diets significantly altered the intestinal microbiome, increasing bacterial taxa with potential health benefits, such as specific Lactobacillaceae species, while decreasing potentially detrimental populations in the families Lachnospiraceae and Ruminococcaceae.

The results lead to additional hypotheses to be tested regarding the potential for *B. subtilis* DSM 32315 stabilisation of the broiler intestinal microbiome to subsequently inhibit other bacterial infections of broilers (salmonellosis, colibacillosis) and reduce reservoirs of foodborne pathogens (campylobacter spp.).

In another study, NE challenge was induced with an inoculation of each bird at nine days of age with sporulated *Eimeria* spp. oocysts as a predisposing factor, followed by the inoculation of a pathogenic strain

Fig. 9. Feeding *B. subtilis* DSM 32315 (GutCare) improves performance of broilers chickens under NE conditions across the world.

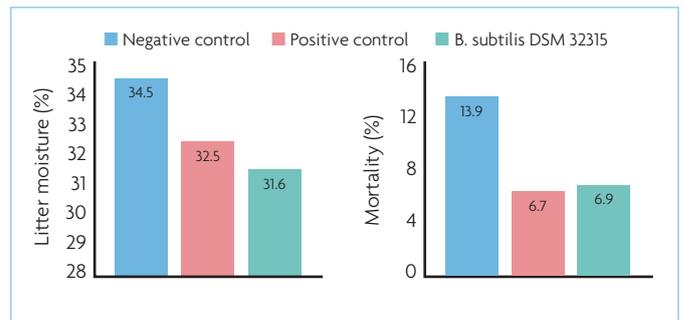
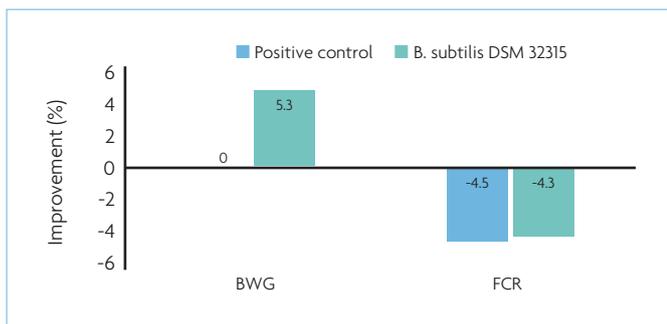


Fig. 10. Feeding *B. subtilis* DSM 32315 (GutCare) decreases litter moisture and mortality in broiler chickens.

of *C. perfringens* on days 14, 15 and 16. Zinc-Bacitracin (20g/ton of feed) was used as a positive control. Feeding *B. subtilis* DSM 32315 significantly ($P < 0.05$) decreased populations of *C. perfringens* in the duodenum, ileum and caecum, at day 35 (Fig. 8).

Performance of broilers under NE challenge

Probiotics have been reported to have the ability to improve intestinal microbial balance in broilers, resulting in growth performance improvements.

More specifically, the efficacy of Bacillus-based probiotics in face of a challenge is related to several factors such as the metabolic activity of specific strains, survivability and persistence in the gastrointestinal tract, and concentration administered.

The *B. subtilis* DSM 32315 strain is a patented probiotic produced by Evonik (GutCare). This strain has shown in vitro and in vivo activity against toxin producing strains of CP and the proposed mechanism of action for such inhibition is the inherent potential to express different secondary metabolites and lactic acid, which in turn, favours the growth of beneficial bacteria present in the intestinal microflora.

In total, five trials were conducted under NE challenge (Table 2). The severity of challenge was different across the trials, however all models were successful in inducing the

enteritis challenge. Across the trials, feeding the *B. subtilis* DSM 32315 strain improved body weight by 5.3% and decreased FCR by 4.3% over the negative control (Fig. 9).

Even the mildest form of clostridiosis can lead to microbial imbalance in the gut resulting in diarrhoea and wet litter, which in turn leads to associated conditions like foot-pad dermatitis.

These conditions can further impair the growth rate and feed conversion causing economic losses to poultry producers.

GutCare has also been shown to support good litter quality and livability (Fig. 10) in broiler chickens, which indirectly improves growth performance (Fig. 9).

Conclusions

- GutCare is a superior probiotic product consisting of bacterial spores that are stable during feed processing and storage.
- It may reduce the threat of pathogenic bacteria colonisation of the gut, especially *C. perfringens*, resulting in a more balanced intestinal microbial population and improved growth performance.
- GutCare offers an effective and sustainable replacement to AGPs in the maintenance of healthy flocks and the optimisation of performance in poultry.

References are available from the authors on request

Table 2. Brief description of trial set up at five stations.

Research station	Breed	Challenge model/ Positive control	Duration (days)
Alimetrics Ltd, Finland	Ross 308	11 reps, 14 birds/rep Narasin	35
Animal Research and Consultant Co, Samutprakan, Thailand	Ross 308	8 reps, 12 birds/rep Zn Bacitracin	35
Virginia Diversified Research, Corp. Harrisonburg, USA	Cobb 500	12 reps, 30 birds/rep BMD	42
Southern Poultry Research Inc, Athens, Georgia, USA	Cobb 500	10 reps, 8 birds/rep BMD	28
Northwest A&F University, Xi'an, China	Arbor acres	10 reps, 12 birds/rep BMD	42

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9:45	Getting the best possible start <i>Mark Foot, Cobb-Europe, UK</i>
10:15	Break
10:45	IB – Current situation and challenges <i>Kostas Koutoulis, Ceva, France</i>
11:15	AI – current status and future prospects <i>Timm Harder, Friedrich-Loeffler-Institut</i>
11:45	Respiratory diseases <i>Alan Pearson, Consultant, UK</i>
12:15	Lunch
13:15	The role and management of the gut microbiome in health management <i>Daniel Petri, Biomin, Austria</i>
13:45	Campylobacter <i>Phil Hammond, Crowshall Veterinary Services, UK</i>
14:15	Coccidiosis – latest thinking on control strategies <i>Monita Vereecken, Huvepharma, Belgium</i>
14:45	Break
15:15	Poultry Red Mite: New, breakthrough treatment resulting in improved bird welfare and performance <i>Rik Koopman, MSD, Netherlands</i>
15:45	Good immunity – The cornerstone to healthy broilers <i>Stephane Lemiere, Boehringer Ingelheim, France</i>
16:15	Turning big data into smart data for broilers <i>Maarten de Gussem, Vetworks, Belgium</i>
16:45	DISCUSSION AND CLOSE

Giving chicks the best possible start to maximise future flock productivity

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by **Dr David Harrington,**
Anpario plc, UK.
www.anpario.com

When newly hatched chicks are first introduced into the house, there are a number of critical factors that need to be considered to ensure the young bird has the best start. These include water, feed, temperature, ventilation and humidity.

Associated with a number of these is the development of the early gut microbiota, a key factor in ensuring birds will achieve good performance in later life.

Environment

For the first 10-14 days after hatch, the chick is unable to sufficiently regulate body temperature. A one degree decrease in temperature can have a significant effect on performance.

If the chick has to use vital energy resources to stay warm, it increases the risk of compromised immunity, leading to disease.

Consequently, maintaining floor and environmental temperature are

critical to avoid chilling. Ventilation is a key tool to help manage temperature, humidity and air quality in the house, ensuring chicks are kept at the ideal temperature and waste gases such as carbon dioxide are removed.

Light intensity should be sufficient to encourage chick activity including feeding and drinking behaviour.

Feed and water

Easy access to good quality, palatable feed is important to get chicks feeding as soon as possible. Feed consumption and water intake are directly related, therefore ensuring feeding and drinking behaviour is not compromised, will benefit feed and water consumption.

Water is often referred to as the 'forgotten nutrient'. Water quality, temperature and availability are essential for chick start. Water restriction in early life can significantly impact later performance; every 1% restriction in water can result in an 8.5g reduction in body-weight up to 21 days.

If water sanitation is performed incorrectly, drinkers can become contaminated with biofilm and water borne organisms such as pseudomonas.

Remembering that formation of a healthy gut microbiota in the chick is critical for health and performance, avoiding the introduction of unwanted micro-organisms as far as possible should be a priority.



The gut microbiota and intestinal development

The gut microbiota is essential for bird health and performance, with roles in nutrition, gut development and host physiology. Bacterial numbers range from 10³CFU/g, predominantly Lactobacillus spp. in the foregut to 10¹⁰CFU/g in the hindgut, mostly Lactobacillus, Enterococcus, and various Clostridiaceae.

Estimates suggest as much as 50-85% of the identity of bacteria in the gut are still unknown.

Development of the microbiota

The newly hatched chick gut is largely considered sterile, although there is some evidence to suggest that caeca of embryonic chicks can be colonised by bacteria from the mother. However, development of the intestinal microbiota is generally considered to begin upon

hatching, where bacteria are picked up from the environment, people handling etc.

After one day post-hatch the ileum and caeca are both dominated by bacteria with densities up to 10¹⁰ bacteria/g digesta respectively. Within two weeks the typical adult small intestinal microbiota will be well established and after 30 days the caecal flora has developed.

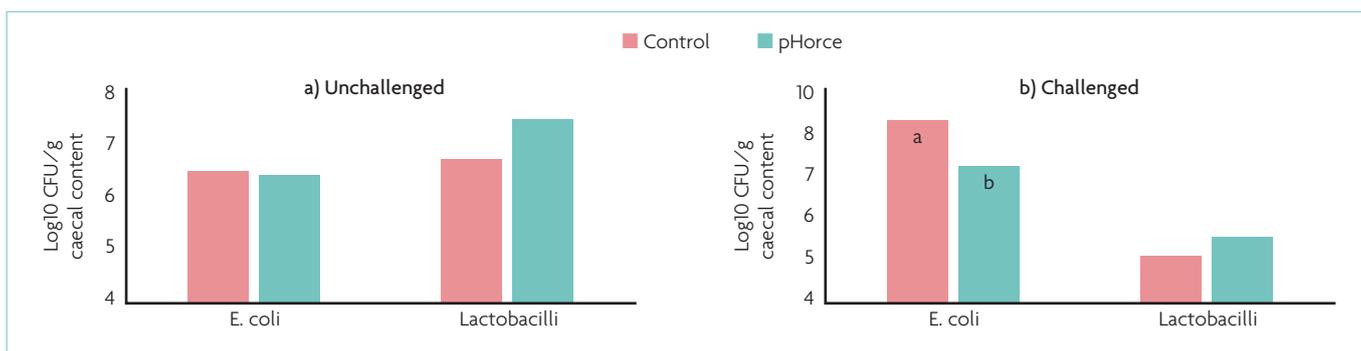
The taxonomic composition of the intestinal microbiota demonstrates a temporal effect, the diversity of bacterial populations increasing with age, while nutritional influences are also apparent.

The role of additives in the developing microbiota

The use of additives in drinking water or feed to help the development of a stable, mature microflora has received considerable focus in recent years, driven in part by the

Continued on page 14

Fig. 1. Changes in number of E. coli and lactobacilli in the caeca in 10 day old chicks either a) unchallenged or b) challenged with E. coli K88+ at seven days of age. Different letters denote significant difference (P<0.05) within a category.



Continued from page 13
recognition of the importance of the gut microbiota to the avian host.

The diversity of additives is extensive, from pre and probiotics, to bacteriocins, short chain fatty acids (SCFA) and phytotherapeutics.

While there is no 'one size fits all' approach, additives can be used strategically depending upon the situation and many additives have overlapping modes of action.

SCFA presented on mineral carriers have broad scope as eubiotics – products that contribute to eubiosis, the healthy balance of the gut microbiota. When fed to broiler chicks from day-old, a mineral carrier eubiotic based on the SCFAs formic and propionic acid (pHorce, Anpario plc, UK) increased the number of caecal lactobacilli at seven days of age as compared to birds that did not receive SCFA (Fig. 1a).

When seven day old chicks were challenged with *E. coli* K88+ at a sub-clinical dose, those chicks receiving SCFA had lower *E. coli* numbers than chicks not fed SCFA (Fig. 1b).

At 35 days of age *E. coli* numbers were still lower and lactobacilli numbers higher in those birds fed SCFA. Furthermore, propionate and butyrate levels (energy sources for intestinal cells and other bacteria)

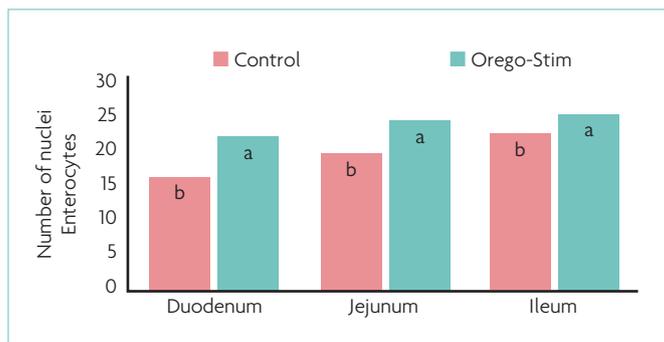


Fig. 2. Oregano increases enterocyte proliferation. Different letters denote significant difference (P<0.05) within a category.

in-situ were higher in the birds fed SCFA, accompanied by improved bird performance.

This example highlights the important role that additives, such as SCFA eubiotics, can have on the development of the early microflora and the subsequent benefits that can be seen in the flock at the end of the production cycle.

Development of the early gut and the benefits of additives

The first week of life is a critical period in the physical development of the avian gut. Not only is the microbiota developing at a rapid

rate, but the morphology of the gut is developing as well. Villus volume increases substantially in the first four days post hatch, while crypt depth increases until around 10 days of age.

The first week post-hatch therefore is a critical period for intestinal development. The gut microbiota is important for intestinal development. At seven days, conventional chicks can have twice the number of proliferating enterocytes compared to germ free chicks (with minimal gut microbiota).

Given the rapid development of the gut in this first week, it is noteworthy that chicks will experience significant intestinal stress in this

early period from ingestion of feed, water and bacteria in addition to those typical pathogens found in the litter, such as *Eimeria*.

While SCFA support the microbiota, eubiotics such as those comprising oregano such as Oregano-Stim (Anpario plc, UK), can support the young chick in dealing with intestinal stress. Increases in antioxidant status, regulation of immune responses, for example inflammation and stimulation of enterocyte proliferation (Fig. 2), are all observed with Oregano-Stim.

This holistic activity can also ameliorate early impact of circulating parasites such as *Eimeria*, leading to less intestinal damage mid flock and improved later flock performance.

Summary

Giving chicks the best possible start in the first week of life requires a multifactorial approach. The key factors of brooding are essential but the importance of supporting the early developing microbiota cannot be emphasised enough.

Eubiotics, such as mineral carrier based SCFA blends, or phytotherapeutics, such as those based on oregano, have a key role to play in ensuring that newly hatched chicks get off to the best start possible. ■

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New strategies in coccidiosis control to meet customer demands

In 2014-2015, the US broiler industry saw press releases from some of their top retail customers announcing that they would serve only chicken produced without antibiotics.

by **Linnea Newman, Global Poultry Technical Service Director, MSD Animal Health.**
www.merck.com

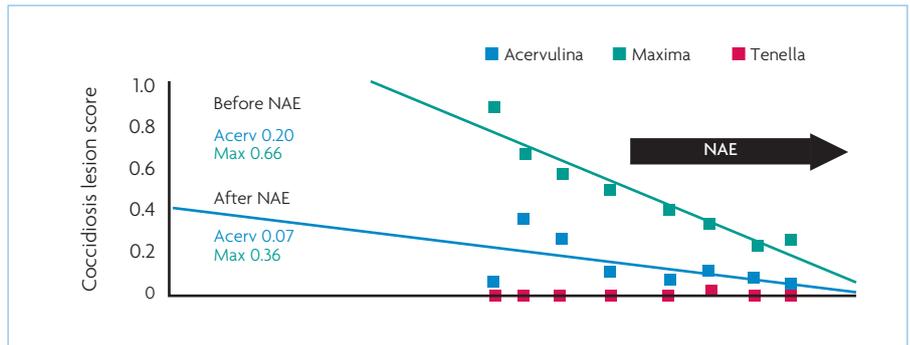


Fig. 1. Coccidiosis lesion score.

The announcements represented different positions: Restaurant Chain A (the largest US chicken restaurant chain based on revenue) stated in February of 2014 that by 2019 their product would contain 'No Antibiotics Ever' (NAE), while Restaurant Chain B (one of the largest fast-food retailers in the world) quickly followed with an announcement that by 2017, they would serve only poultry raised without medically important antibiotics (RWMIA) and Restaurant Chain C, producing sandwiches worldwide, initially announced in early October of 2015 that they would serve only RWMIA poultry, only to quickly change that position on October 20, 2015 to the use of only NAE poultry by March of 2016.

What does this mean to coccidiosis control? The RWMIA designation allows for the use of ionophores. Although they are

technically antibiotics based upon the strict definition of 'antibiotic', ionophores are not a shared class with any antibiotic used to treat humans.

RWMIA flocks may also use chemical anticoccidials and coccidiosis vaccines, but they may not use antibiotics that are shared-class with humans, such as bacitracin, virginiamycin, enramycin, tetracyclines, penicillins, gentamicin, cephalosporin, sulfas, etc.

The NAE designation does not allow the use of ionophores. Courts in the US had previously ruled that companies could not make a 'raised without antibiotics' label claim and still use ionophores because it was misleading to the consumer.

The NAE label still allows for the use of chemical anticoccidials and coccidiosis vaccines, but not ionophores, and, of course, none of the antibiotics that are shared class with humans.

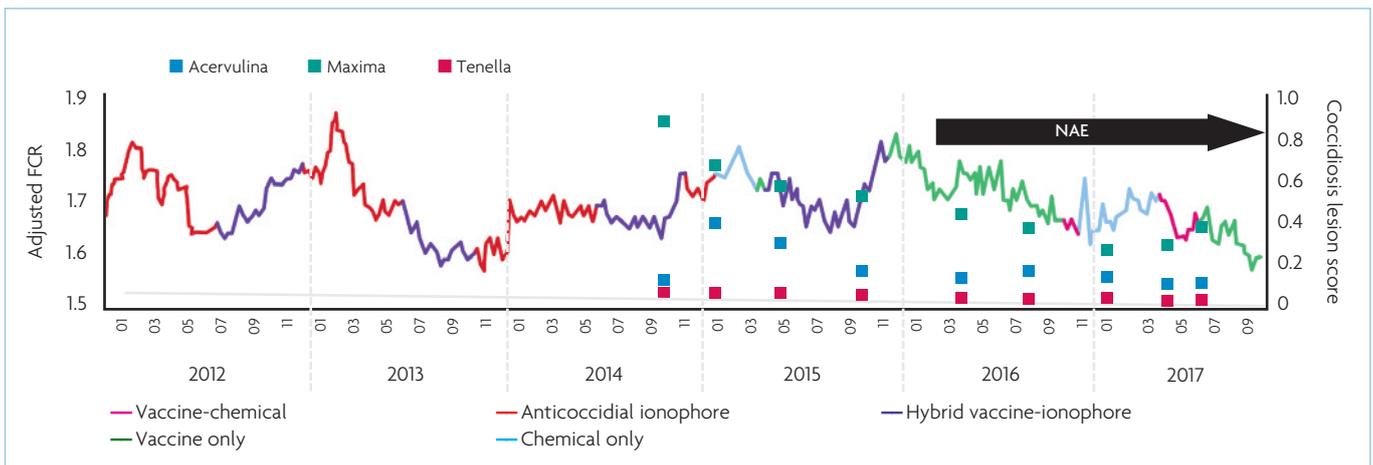
Rising to the challenge

Most US broiler producers have risen to the retail customer's challenge, changing all or part of their production to accommodate the RWMIA or NAE labels.

RWMIA strategies include regular chemical-ionophore shuttle programs or straight ionophore programs that have long

Continued on page 17

Fig. 2. Adjusted FCR (1.8kg broiler) vs. coccidiosis lesion score and coccidiosis control program. Field data from a US 1.8kg broiler complex representing 1.3 million broilers slaughtered per week.



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Continued from page 15

been used by the industry, but they have also given rise to new 'hybrid' strategies that utilise both a coccidiosis vaccine and an ionophore. NAE strategies include all-chemical anticoccidial programs, coccidiosis vaccination programs and even hybrid coccidiosis vaccine-chemical strategies. Coccidiosis vaccines were used in 40% of all US broilers placed in 2017, either in hybrid programs or as stand-alone vaccination programs.

Hybrid programs

A hybrid program uses a coccidiosis vaccine as an anticoccidial-sensitive seed stock, not as a 'vaccination'. Day-old broiler chickens are given live, sensitive oocysts at the hatchery (the coccidiosis vaccine). These oocysts are allowed to complete at least two life cycles in the flock, shedding sensitive oocysts into the litter until about 14 days of age.

After that, an ionophore (RWMIA) or a chemical (NAE) is included in the feed to complete the growth cycle of the poultry flock like a regular anticoccidial program. The goal is to seed the house with sensitive oocysts to out-compete with the wild, less sensitive, cocci and to allow the anticoccidials to perform better. Integrators using this program claim 50 to 100g improvement in feed conversion ratio (FCR), and have called this a 'performance program'.

When an ionophore is used in this way, it is also in a position to help prevent dysbacteriosis or necrotic enteritis without using any medically important antibiotics. These programs do not renew sensitivity for subsequent flocks, but they may reduce late oocyst shedding and reduce the overall *Eimeria* spp. load on the farm.

Integrators using all-chemical anti-coccidial programs have had variable success. Chemical anticoccidials prevent coccidiosis, but they have no antibiotic effect. Peaks in subclinical *Eimeria* spp activity can correspond to outbreaks of necrotic enteritis, dysbacteriosis or poor FCR performance. This is especially true if the peak in subclinical coccidiosis occurs at the same time as a feed change.

Chemical anticoccidials must be monitored and rotated as needed to maintain low coccidiosis levels, particularly at critical stress periods.

Companies using these programs have had significant success in the control of their coccidiosis challenge. When necessary, vaccination programs can be interspersed to maintain sensitive field populations. All-chemical programs are consistent with the US NAE designation.

Integrators using true coccidiosis vaccination programs are also consistent with the US NAE designation. Some integrators use vaccination on a year-round basis.

Others augment vaccination programs with a cycle or two of a vaccine-chemical hybrid program or all-chemical programs during the high humidity winter months.

The use of at least three to four flock cycles of coccidiosis vaccination (not hybrid) serves to maintain a more sensitive *Eimeria* population on the farm.

In addition to these strategies, US integrators have been working to increase the down time between flocks, aiming for a 16-day average.

Each of the strategies, used correctly, can serve to reduce overall coccidiosis challenge on the farm. Matching coccidiosis lesion scores (as determined by regular post-mortem sessions) and comparing to FCR performance demonstrates the impact of improved coccidiosis control strategy on

profitability and performance. When the cost of an additional seven days' down time is calculated vs. the return in FCR at today's feed prices, the result is a 50% return on the input cost, largely due to the reduction in coccidiosis challenge.

It should be noted that the coccidiosis lesion scores are not clinical. Lesion scores studied in the industry average less than a +1 in the traditional scoring systems based upon a score of 1-4. But average microscopic *E. maxima* scores greater 0.6 correlated to 50-100g more feed per kg of weight compared to lesion scores of less than 0.4. Small reductions correspond to significant improvements in performance.

Some integrators are using a vaccine-ionophore program to initiate the reduction in *Eimeria* spp challenge prior to implementing an NAE program.

Once the overall challenge level is reduced, it is easy to be flexible, using hybrid ionophore or vaccine alone to adjust to sales demands for RWMIA or NAE.

The reduction of overall *Eimeria* spp. challenge also means that dysbacteriosis and necrotic enteritis are significantly reduced, even on the NAE program.

Conclusion

New coccidiosis control strategies to reduce coccidiosis challenge on the farm compared to the traditional chemical-ionophore shuttle or full ionophore program are helping the US broiler integrators to successfully accommodate their customer's requirements while remaining profitable.

It is still easier to produce cost-effective broiler meat in an RWMIA system that allows the use of ionophores, but the NAE producers are demonstrating significant success as well. ■



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NSP enzymes save on total protein and digestible amino acids

Ave Biochem's research has shed a new light on the potency of NSP enzymes to save on total protein and digestible amino acids in broiler feed.

avebiochem.com

In this study, high dosing of AveMix XG 10 and AveMix O2 CS were compared with a concentrated protease in a broiler performance test.

A standard diet (PC) and negative control (NC, relative -3% total protein and -3% digestible amino acids) diet were formulated. NC was supplemented with one of three enzyme concepts:

- AveMix XG 10 (xylanase and glucanase concept at double advised dosage).
- AveMix O2 CS (xylanase, glucanase and pectinase concepts at double advised dosage).
- Neutral protease (PRO, advised dosage).

400 broilers were randomly allocated to five feeding groups of 80 birds for a period of 42 days: PC,

NC, NC+XG 10, NC+O2 CS, NC+Pro. As expected, the reformulated diet (NC) resulted in lower body weight gain and a higher FCR than NC+XG 10, NC+O2 CS or Pro. Feed intake was unchanged among the treatments. AveMix XG 10 and AveMix O2 CS at double advised dosage allowed a relative reduction of 3% total protein and digestible amino acids, without impairing broiler performance compared to the standard diet (PC) or NC+Pro.

This reformulation on protein and digestible amino acids allows for considerable cost savings of common broiler feed.

	BWG (g)	FI (g)	FCR
PC	100	100	100
NC	97	101	103
NC+XG 10	100	100	100
NC+O2 CS	102	101	99
NC+Pro	101	100	99

Enzyme solutions for poultry production

Anpario's enzyme product range contains non-starch polysaccharide (NSP) enzymes and phytase, which constitute a unique combination of both carbohydrase and phytase to help degrade NSPs and phytate present in most plant-based feed ingredients.

anpario.com

Their combination products allow the use of more economical or non-conventional feed ingredients at higher levels due to the enzymes action enabling more nutrients to be released.

Degradation of dietary NSP and phytate, a known anti-nutritive factor, can allow significant improvements in gut health and performance, while reducing phosphorus

and other nutrient excretion into the environment.

Their enzyme range utilises the synergy between NSP enzymes and phytase, enabling significant feed cost savings to be achieved by improving gut health and nutrient availability in the bird.

Numerous trials at universities, private research sites and commercial facilities worldwide, have

shown that using Anpario enzymes allowed significant savings in feed costs, without impacting animal performance in broiler chickens.

A recent trial at IMASDE in Spain showed that by including Anpario's enzymes when formulating feed at the recommended matrix value, broiler producers can save up to 21/MT of feed, with no impact on broiler performance.



Unlocking the nutritional value of dietary protein

The first ever feed protease specifically developed for animal nutrition, Ronozyme ProAct unlocks the nutritional value of dietary protein.

ronozymepract.com

The DSM-Novozymes Alliance has a wealth of experience in protease technology, which has led to great insight into how proteases work under practical conditions.

The complexity of dietary matrices means a multi-enzyme approach is often preferred to extract maximum value from the diet – having protease as part of this solution is now well accepted in many markets.

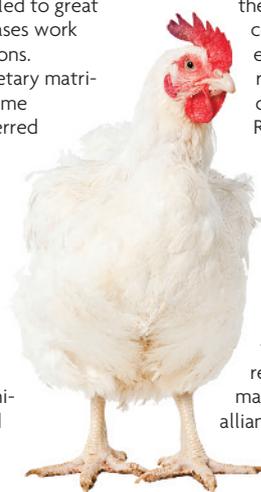
Significant investment has been made in developing Ronozyme ProAct and generating extensive animal data on amino acid digestibility improvements for the major feed ingredients.

This data can now be accessed by DSM-Novozymes Alliance customers to use specific ProAct contribution values for essential and non-essential amino acids, based on their local diet composition.

It continues to be refined with universities and research institutes to allow customers to determine

the precise amino acid composition that exactly matches the requirements of their diets.

Ronozyme ProAct results in better animal performance as well as more efficient conversion of feed and improved cost savings. With the vision of getting more from feed ingredients while reducing costs, the market leading enzymes alliance continues to bring significant innovations to the industry.



The AGP ban and the importance of enzymes

The industry trend is clearly marked by the latest developments, namely the primal purpose of reducing antibiotic treatments and the ban of AGPs.

xvetgermany.com

Actual conditions in the field, challenges in management and diverse disease pressure unfortunately makes the task difficult, however not impossible.

The use of technical additives, better protein sources, optimising beneficial flora, and increasing the rate of absorption of nutritional factors are crucial, and have to be applied collectively to reach the maximum benefits from the animals, as well reducing treatment costs.

Many feed grains are rich in NSPs (non-starch polysaccharides). These NSPs create a 'dilution' effect over the energy levels of the feed, and they also have 'trapping' activity over fractions such as starch, fats, proteins, calcium, phosphorous, or

other important nutrients. Additionally, usage of enzymes ensures optimum viscosity management, which optimises intestinal absorption of these trapped nutrients. Moreover, optimum viscosity of digesta decreases the risk of wet litter and watery droppings. This helps with litter management, which is a crucial subject in relation to disease control.

XVET Germany propose diverse enzyme mixtures. Special formulas are available upon request, that can be customised with xylanase, phytase, amylase, β -glucanases, protease and cellulase.



Bringing innovation to liquid enzyme application

Huvepharma, a leading feed enzyme producer, has developed an alternative concept to replace the use of liquid enzymes supplied in IBCs: the Huvematic concept.

huvepharma.com

This concept brings together unique instant water soluble enzyme (WSP) formulations and state of the art specialised equipment, allowing on-site production of small volumes of liquid enzyme using the WSP enzymes.

There are technical, economic and logistic advantages in producing liquid enzymes on-site:

- The possibility to work at any desired enzyme concentration.
- The end of concern with loss of activity during liquid enzyme storage.
- Reduction in transport, storage and handling costs of liquid enzymes supplied in IBCs.

The Huvematic concept has been successfully implemented over the last three years in the USA and in several European and Asian coun-

tries, while installation in many other countries is foreseen in the near future.

Huvepharma has used its enzyme production know-how and formulation expertise to develop a range of enzyme powders, OptiPhos WSP, Hostazym X WSP and Hostazym P WSP brands, which are commercially available in boxes of 2x10kg (10kg WSP can replace 1.0-1.5 IBC of 1,000 litres).

The WSP powders are sold in a box of 2x10kg.



Improving the digestibility of all feed nutrients

Rovabio Advance is the result of a 10-year research program in bio-engineering and animal nutrition. It is a feedase as it improves the digestibility of all feed nutrients, including starch, fat, amino acids, phosphorus and calcium, whatever the type of diet.

adisseo.com

Rovabio Advance is produced by a unique micro-organism: *Talaromyces versatilis*. It contains a range of 19 different enzymatic activities; amongst them the key

ones are xylanases, arabinofuranosidases and beta-glucanases.

The efficacy of Rovabio Advance is largely explained by the synergistic action of xylanases and arabinofuranosidases to degrade non-starch polysaccharides. Robust testing across a variety of diets shows that Rovabio Advance provides an improvement of 3% in the overall digestibility of organic matter.

As a consequence, Rovabio Advance offers a large potential for feed reformulation, taking into account the uplifts in energy, digestible amino acids and available phosphorus.

It can significantly reduce feed cost by enhancing the global feed digestibility without compromising animal performance.

Rovabio Advance is available under various presentations: powder for mash feeds, liquid for spraying after thermal treatment and thermostable powder (T-Flex) for pelleted feed up to 90°C.



Release the full phytase potential to ensure maximum commercial return

Ensuring maximum commercial return is a challenge. Did you know that the effective use of phytase matrix values can have a significant impact on feed formulation performance – resulting in savings?

animalnutrition.dupont.com

To realise its full potential, several factors need to be taken into account: diet composition, the behaviours of different ingredients in combination, as well as a detailed understanding of the highly influential role of full matrix values.

In a recently published paper, Dr Dersjant-Li examines the latest research carried out to further explore the issue – with a particular focus on calcium and phosphorus ratio in the presence of phytase.

She further sets out recommenda-

tions for achieving the optimal nutritional balance and cost reductions.

The series of studies explores the benefits of Axta PHY, which is known to have the highest activity at low pH compared to other commercial phytase products.

It works quickly in the digestive tract, and doubles the rate of phytate destruction to release phosphorus and overcome its anti-nutrient effects.

Dupont's data-driven dosing recommendations ensure you always deliver the right dose of phytase for your specific needs.

Applying Axta PHY matrix values in your poultry feed formulation can improve performance, reduce costs, minimise phosphorus waste and also boost production efficiencies.

Measuring phytate to optimise phytase application

More in-depth analysis of feed and raw materials can help producers and nutritionists gain a deeper understanding of anti-nutritional factors, such as phytate.

abvista.com

Knowing the phytate content of ingredients and feed helps producers exploit the extra-phosphoric effects of phytases, such as Quantum Blue, by targeting the complete breakdown of phytate in the diet and tapping into margin opportunities that may otherwise have been lost or not realised.

To further assist, animal nutrition technology company AB Vista has produced the animal feed industry's first

phytate reference guide. The guide contains details of average phytate levels for a range of raw materials available across the world.

"We understand the pressure on producers to get the most value out of their operations. Scientific advancements continue to shed more light on the role of nutritional factors and our ability to measure these within diets, opening possibilities for incremental improvements in energy and nutrition efficiency," says AB Vista's Global Technical Manager, Gilson Gomes.

"We have developed this phytate reference guide to provide companies with an improved nutritional picture or 'feed intelligence' to help them with formulating to meet the demands of the industry."





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Four reasons producers are rethinking copper sulphate in poultry feed

The supplementation of copper has become commonplace among poultry producers thanks to its well-known beneficial effects on bird performance. Copper acts as a critical cofactor in multiple enzyme systems integral to energy metabolism, tissue growth, red blood cell formation, oxidative defence and immunocompetence.

by Kurt Perryman, Technical Sales Manager, Micronutrients.
www.micronutrients.com

Copper has also been demonstrated to positively affect the composition of gastrointestinal microflora. As producers reduce their dependence on antibiotics, alternative feed additives like copper show great promise to maximise production efficiency while maintaining bird health.

Although the benefits of copper as a feed additive are widely acknowledged, not all sources of copper are equally effective due to inherent differences in molecular structure. For example, copper sulphate has weak ionic bonds resulting in high water solubility.

This means the bonds break easily in the presence of moisture, releasing positively charged copper ions. Reactive copper ions can reduce feed palatability, damage vulnerable tissue in the digestive tract, and bind with other nutrients in the feed, reducing their availability to the bird.

Despite these negative attributes, copper sulphate has been consistently employed as a feed additive in poultry production since the 1930s. Scientists have since seized on the opportunity to develop new sources of dietary copper without the negative characteristics of copper sulphate.

During the 1980s, chelated copper sources with lower reactivity were introduced to the market; however, their manufacture requires relatively expensive protein feedstocks, resulting in a higher cost product.

In the 1990s, technological advances in applied chemistry allowed for the development of hydroxy copper. Hydroxy copper has many of the same beneficial characteristics as chelated copper (low

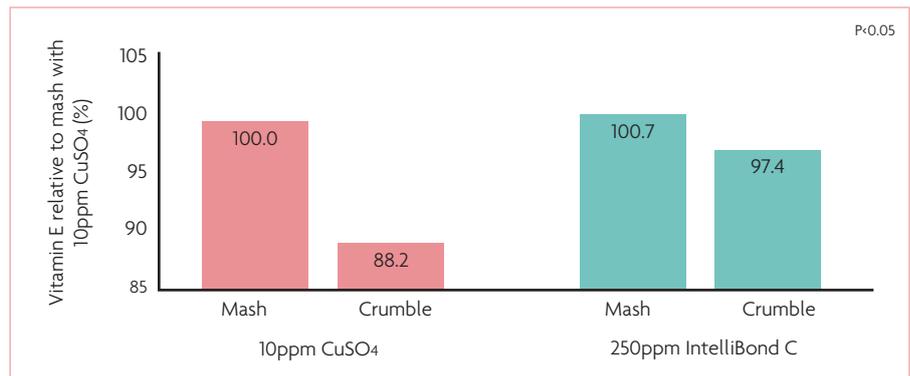


Fig. 1. Effects of pelleting (crumbling) on feed vitamin E levels when diets have either 10ppm copper sulphate or 250ppm IntelliBond C.

reactivity and high bioavailability) but at a considerably lower production cost.

Nonetheless, the small price difference between hydroxy copper and copper sulphate still precludes the complete replacement of copper sulphate in some production environments.

Poultry producers, integrators and nutritionists must acknowledge cost differences while still carefully considering the many advantages of using advanced copper sources to replace copper sulphate for the four following reasons:

1. Reduced feed intake

Where permitted, copper is commonly added to poultry diets at concentrations above the nutritional requirement to maximise performance. Prior to the development of less reactive sources of copper (hydroxy copper), supplementation with more reactive sulphate sources was generally limited to levels at or below 125ppm. This is because research indicates feed intake decreases with increasing concentrations of dietary copper sulphate.

Conversely, sources of copper with lower water-solubility allow for higher supplementation levels without corresponding drops in feed intake. Therefore, feeding less reactive copper sources gives producers the flexibility to increase dietary concentrations to optimise the performance of their flocks.

The underlying basis for the difference in

feed intake comes from copper sulphate's high water solubility. Free copper ions are generated any time feed encounters moisture, during either the feed manufacturing process or feed consumption.

These charged copper ions can damage the mucous membrane of the gastrointestinal tract. Birds will voluntarily reduce their feed intake if they have copper-induced lesions in their mouth, proventriculus or gizzard.

Moreover, ions generated by copper sulphate and water produce free radicals that oxidise dietary fat and vitamins, reducing feed palatability, and further reducing feed intake.

2. Reduced vitamins in feed

Regulations on copper supplementation to poultry feed vary widely across different regions of the world. Research has demonstrated that even nutritional levels of copper sulphate (10ppm) can have detrimental effects on valuable dietary components.

Prices for fat-soluble vitamins A and E have increased dramatically and are expected to remain high throughout much of 2018. Again, low levels of copper sulphate have been shown to have negative effects, accelerating vitamin degradation when compared to less reactive sources like hydroxy copper.

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The risk of oxidation increases when the combination of copper sulphate and fat soluble vitamins encounters moisture and heat during the feed manufacturing process. Free copper ions participate in oxidation reactions, generating free radicals. These free radicals interact with fats and fat soluble vitamins, denaturing them in a rapid chain reaction. To test the effect of copper source on vitamin E levels in feed, researchers compared pelleted diets supplemented with copper sulphate and hydroxy copper. The results indicated that the combination of 10ppm copper sulphate, water and heat during the pelleting process resulted in the destruction of more vitamin E than pelleting diets supplemented with 250ppm hydroxy copper (Fig. 1).

3. Reduced vitamin E in birds

These researchers also reported reduced levels of vitamin E measured in the bird itself, as a consequence of copper sulphate's oxidative destruction.

When the pelleted diets (10ppm copper sulphate vs. 250ppm hydroxy copper) were fed to broilers over a 21-day period, those receiving 250ppm of hydroxy copper had 21% more serum vitamin E and 55% more liver vitamin E compared with birds fed the copper sulphate diet.

In addition to the oxidative damage copper sulphate does to expensive vitamins, producers should also consider the health and performance consequences of reduced vitamin E levels in the bird. Vitamin E is a powerful antioxidant that supports safeguarding the structural integrity of cell membranes, reproductive health, immunity, and normal neurological functions in poultry.

4. Reduced mineral and nutrient digestibility

It is important to remember that the charged copper ions released from the combination of copper sulphate and water do harm to dietary constituents beyond the oxidation of fats and vitamins.

Any negatively charged nutrient (phytate, phosphate, amino acids, fats, sugars) is susceptible to a chelation reaction with positively charged copper. Some of these reactions are irreversible, leading to the loss of both the copper ion and nutrient.

Unlike copper sulphate, which releases its reactive copper ions in the upper gastrointestinal tract, hydroxy copper ions are released slowly and consistently throughout the entire length of the small intestine due to their strong bonds and crystalline structure.

Therefore, feeding hydroxy copper

instead of copper sulphate not only improves mineral digestibility, but also does not impede the digestibility of other nutrients.

A strategy for moving forward without copper sulphate

In response to the concerns associated with using copper sulphate as a feed additive, scientists have developed novel forms of copper supplementation, including both chelated and hydroxy trace minerals.

Although chelated copper sources avoid many of the consequences associated with copper sulphate, their costs (up to 10 times the cost of sulphate) are prohibitive for many producers.

For this reason, some producers have compromised by supplementing a small fraction of chelated copper in combination with copper sulphate. As research continues to emphasise the various negative consequences of feeding copper sulphate, complete removal of copper sulphate from the diet becomes more appealing.

With the advent of hydroxy copper, producers now have an option to gain all the benefits of completely replacing copper sulphate with a less reactive copper without compromising the economic viability of their feeding programme. ■



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Carbohydrase complex exerts prebiotic effects in broilers

Carbohydrases are added to poultry diets to improve performance. Whilst their main effect is to improve digestibility and nutrient availability there are other ways they influence poultry physiology, which are not yet fully understood. Carbohydrase enzymes degrade the non-starch polysaccharides (NSPs) found in cereals.

by **N. Yacoubi, M. Ceccantini and E. Devillard, Adisseo; L. Saulnier, E. Bonnin, INRA Nantes; and R. Ducatelle and F. Van Immerseel, Ghent University.**
<http://feedsolutions.adisseo.com>

The result of this degradation is the production of short chain arabinoxylans. A recent study showed that these molecules have prebiotic effects in broilers. Beneficial effects on the gut microflora were evidenced, along with improvements in bird performance.

Enzyme effects

NSPs are the main constituents of plant cell walls and play a role in the encapsulation of nutrients,

including amino acids, starch and lipids. It is well known that NSPs negatively affect access of endogenously secreted enzymes to their substrates, reducing digestibility (the so-called cage effect). They induce high viscosity of the intestinal content and increase intestinal inflammation.

The ability of an efficient enzyme solution to improve global feed digestibility is known as the feedase effect. By reducing the indigestible fraction of feed, as well as antinutritional factors, more nutrients are released.

This is due to the inclusion of a wide range of NSP-degrading enzymes, including xylanases (Xyn), arabinofuranosidases (ABF) and beta-glucanases.

They have the effect of reducing the viscosity of the intestinal content and release oligosaccharides from NSPs in the digestive tract.

Prebiotic action

Prebiotics are described as being selectively fermented and allow specific changes, both in the composition and/or activity of the gastrointestinal microbiota. This in turn confers benefits on host well-being and health.

Table 1. Characterisation of the wheat fractions. By more efficient degradation of NSPs the carbohydrase complex significantly increased the quantity of short-chain arabinoxylans, as demonstrated by the lower molecular weight and degree of polymerisation.

	Positive control	Rovabio
Protein (dry weight %)	14.0 ^a	21.0 ^a
Sugars (dry weight %)		
Arabinose	19.1	19.3
Xylose	32.2	34.5
Mannose	0.2	0.5
Galactose	3.2	4.4
Glucose	5.2	5.4
Degree of polymerisation (DP)	270 ^b	54 ^a
Molecular weight (kDa)	178.6	49.6
Intrinsic viscosity (ml/g)	215.7	54.1

Parameters	NC	PC	Rovabio
FI (g/bird)			
0-14 days	547 ^b ±29	559 ^b ±33	591 ^a ±31
BWG (g/bird)			
0-14 days	425 ^b ±26	430 ^b ±25	458 ^a ±26
FCR			
0-14 days	1.29±0.18	1.30±0.19	1.29±0.18

Table 2. Performance of broilers at 14 days of age. Both body weight gain and feed intake were significantly higher in broilers fed the carbohydrase complex treated fraction.

The prebiotic effects of some of the oligosaccharides released by NSPases, including arabinoxylans (AX), arabino-xylo-oligosaccharides and xylo-oligosaccharides; have been studied.

Some of these polysaccharides have also been shown to enhance the production of short chain fatty acids (SCFA), particularly butyrate, by the gut microflora.

These effects are dependent on the efficient degradation of the xylan backbone – to produce short-chain arabinoxylans. ABF are debranching enzymes; they facilitate the enzymatic activity of Xyn on AX, by removing the arabinose on the side chains.

As a result, Xyn have better access to the xylose backbone for hydrolysis. It is this synergistic effect of carbohydrase complex that improves the prebiotic action.

The importance of gut health

In the first two weeks of life broilers are particularly sensitive to NSPs, their digestive systems are not yet physiologically mature and their microflora not fully established.

Their immune system is activated and the gut wall becomes inflamed – reducing nutrient absorption and increasing the risk of infection. The gastrointestinal tract (GIT) of all animals is a key site in the prevention of infection.

SCFAs are known to have a positive impact on broiler digestive

health, including stimulation of digestive enzyme production, enhanced development of intestinal villi, reduction of acute inflammatory responses and optimised GIT retention time.

SCFAs, butyrate in particular, is an important energy source for cells of the colon.

It has recently been shown to enhance synthesis of endogenous antimicrobial host defence peptides, which are critical components of the animal's innate immunity.

In vitro experiments

In order to characterise NSP fractions in wheat following treatment, wheat was incubated both with and without a carbohydrase complex (Rovabio, Adisseo).

The water-soluble fractions were then isolated using an extraction procedure. These were further fractionated into ethanol-soluble and ethanol-insoluble fractions.

In terms of chemical composition, both fractions contained mainly xylose and arabinose; with the enzyme treated fraction containing significantly more protein (Table 1). It is thought that a more complete breakdown of NSP results in increased nutrient availability and reduced 'cage effect'.

Importantly, the average degree of polymerisation of the xylan backbone was significantly lower in the enzyme treated wheat; the molecu-

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lar weight and intrinsic viscosity were also reduced. The enzymes thus reduced the size of the polymers present in wheat and produced short-chain arabinoxylans.

In vivo trial

To evaluate the effect of the enzyme treatment on the gut health of broilers, a pen study was carried out.

Day-old broiler chicks were fed one of three diets for 14 days and performance measured. Diets containing the enzyme treated wheat fraction (Rovabio), the untreated fraction (Positive Control) and a non-supplemented diet (Negative Control), were fed.

Feeding the enzyme treated fraction increased both body weight and feed intake, with FCR unaffected by treatment (Table 2).

The mucosa of the ileum and caecum in birds fed the enzyme treated fraction were shown to have less T-cells, than in those fed the negative and positive control diets.

This implies that the effects of the enzyme treatment on the gut microflora and SCFA production resulted in less inflammation of the mucosa.

This effect was echoed in the level of T-cell infiltration, which was significantly lower in birds fed the enzyme treated wheat fraction (Table 3).

This further suggests that these birds had better gut integrity and hence a stronger intestinal barrier.

Table 3. T-cell infiltration in ileum and caecum. The significant reduction in T-cell infiltration in the treatment group suggests greater gut integrity.

Parameters		NC	PC	Rovabio
T-cells	Ileum	16.1 ^a ±1.1	15.9 ^b ±0.6	8.1 ^a ±0.6
Labelled area (%)	Caecum	16.8 ^a ±0.9	15.7 ^b ±0.7	7.0 ^a ±0.6

An assessment of the ileal microbiota revealed that in those birds fed the enzyme treated wheat fraction there were significantly greater numbers of Enterococcaceae and Clostridiaceae species of bacteria (Table 4).

It also showed an increase of *Enterococcus durans*, which has a probiotic effect as well as antimicrobial and antioxidant activities and *Candidatus arthromitus* which is a commensal bacterium, helping to develop gut immune functions.

In the caecum more lachnospiraceae and ruminococcaceae bacteria were found. These bacterial species are able to metabolise poly- and oligosaccharides into SCFA.

This effect was confirmed by a significant increase in acetate and butyrate production in the caecum of birds fed the enzyme treated wheat (Table 5).

It was concluded that the enzyme treated wheat fraction provided more substrate for beneficial gut bacteria. They in turn produced more SCFA enhancing the function of the epithelial cells.

The researchers also hypothesised that a butyrate-associated reduction in inflammation, may have contributed to the increase in feed intake – effects that together improved weight gain.

Conclusions

The treatment of wheat grains with a carbohydrase complex resulted in a distinct short-chain arabinoxylan fraction.

	NC (%)	PC (%)	Rovabio (%)
Enterobacteriaceae	2	2	1
Erysipelotrichaceae	2	2	1
Ruminococcaceae*	9	8	12
Lachnospiraceae*	43	46	52
Clostridiaceae 1	0	0	0
Lactobacillaceae	40	38	29
Enterococcaceae	1	1	1
Bacteroidaceae	1	1	3
Coriobacteriaceae	1	1	0

Table 4. Caecal microbiota composition. The caecal microbiota of treatment group has significantly higher levels of key beneficial bacteria (* = P<0.01).

Lower molecular weights, a lower degree of polymerisation and a higher protein level, were observed.

Both broiler performance and gut microflora were improved. The greater number of beneficial bacteria in turn produced a higher quantity of SCFA, butyrate, in particular. Both inflammation and T-lymphocyte infiltration were reduced, all adding up to a measurable improvement in gut health.

The effect of better microbial diversity in young broiler chicks will help gut development, optimising future performance.

Good intestinal health is important to the performance and overall

health of poultry, particularly with the challenges faced by high performing animals reared without the use of antibiotics. Gut health status is a result of interactions between intestinal integrity and a balanced gut microflora. Therefore, feed additives that can support these areas will have a positive effect on health and performance.

This new research has highlighted further the value of this carbohydrase complex to poultry production. ■

References are available from the author on request

Table 5. Caecal concentration of lactic acid and short chain fatty acids. The carbohydrase complex treated fraction significantly increased acetate and butyrate production in the caecum (* = P<0.01).

	NC	PC	Rovabio
Lactic acid (mM/g)	2.99	2.49	3.65
Butyric acid (mM/g)	6.26	5.26	10.7
Propionic acid* (mM/g)	0.77	1.1	2
Acetic acid* (mM/g)	32.28	30.59	49.74

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Coccidiosis and microbiome

This British research (PloS ONE e0184890) looked at the effects of caecal coccidiosis (*Eimeria tenella* infection) on the chicken caeca microbiome by focusing on the structure of the caecal microbiome in the presence or absence of a defined coccidiosis challenge in Cobb 500 broilers.

The severity of the coccidiosis challenge in individual chickens was quantified by caecal lesion scoring and the microbial changes associated with challenge dosage determined.

Following caecal challenge with *E. tenella* the diversity of bacteria taxa in the microbiome remained

relatively stable. Although the coccidiosis challenge did induce change in the abundance of certain taxa, the greatest changes were seen in the birds showing the most severe lesion scores.

Enterobacterial numbers were increased and numbers of bacilli and lactobacilli were decreased with increasing lesion severity. Significant changes were also seen in birds that were infected but had no or minimal lesion scores with bacteroides number increased and lactobacilli numbers decreased.

These findings support the view that the caecal microbiome dysbiosis associated with *Eimeria* infection contributes to disease pathology and could be an intervention to minimise the impact of coccidiosis on bird productivity and welfare.

The work also highlights that *Eimeria* infection can have an effect on the abundance of some caecal bacteria.

The notable differences detected between lesion score categories highlights the importance of accounting for differences in caecal lesions when investigating the relationship between *E. tenella* and the poultry caecal/intestinal microbiome.

Chelated minerals and limestone particle size

The objective of this Brazilian study (Revist. de Brasil. de Saude e Prod. An. 18 103-112) was to evaluate performance, egg quality and bone quality in commercial white egg laying hens in their second production cycle fed diets containing organic and inorganic minerals and two sizes of limestone particles.

The treatments were:

- Inorganic minerals + 100% fine limestone.
- Inorganic minerals + 50% fine and 50% coarse limestone.
- Organic minerals + 100% fine limestone.
- Organic minerals + 50% fine and 50% coarse limestone.

No significant interaction occurred between the studied factors for any variable.

Egg production, egg mass, bone resistance and bone deformity were higher with organic minerals. Eggshell weight and percentages and specific gravity were higher in the treatments receiving the 50:50 limestone mix.

It was concluded that the limestone mix improves eggshell quality, whereas the use of organic minerals improves bone quality of layers in their second production cycle.

Effects of bone growth on broiler performance

This Israeli study (Poult. Sci. 96 2301-2311) looks at maternal and genetic effects on broiler bone growth during incubation.

This was done by comparing fast and slow growing broiler embryos and understanding the effects of genetic and egg size on these differences.

Four egg groups were created:

- FST – laid by fast growing hens inseminated by fast growing males.
- H-FST – laid by fast growing hens inseminated by slow growing males.



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- H-SLW – laid by slow growing hens inseminated by fast growing males.
- SLW – laid by slow growing hens inseminated by slow growing males.

Embryos from these four groups were sacrificed on days 17, 19 and 21 and their tibia were collected.

The groups with larger eggs (FST and H-FST) had higher body and tibia weights than the groups with smaller eggs (SLW and H-SLW) but they had lower tibia:body weight ratios.

There were many other findings but, in essence, faster growing hatchlings, especially those from relatively small eggs, have inferior bone mechanical properties compared to slower growing hatchlings.

This suggests that faster growing chicks hatching from small eggs are at a higher risk of developing bone pathologies.

Accordingly, selecting for increased egg size may lead to improved mechanical performance of the skeleton in fast growing broilers.

Paprika and marigold for layers

This Brazilian study (Revist. de Brasil. de Saude e Prod. An. 18 293-302) assessed the effects of including paprika (0 and 6g per kg of diet) and marigold extracts (0 and 1g per kg diet) in sorghum based diets on the productivity and egg quality of commercial layers.

There were no effects on weight, specific weights, the Haugh values of eggs or production but the addition of paprika resulted in lower egg pH. There was no effect of any treatments on egg weight, specific weight and Haugh unit.

The interaction between paprika and marigold was significant in increasing height and colour of the yolk.

It was concluded that the inclusion of paprika in sorghum based diets was viable as a means of improving egg quality.

Alleviating the effects of heat stress

This Egyptian study (Environ. Sci. and Poll. Res. 24 10708-10717) looked at how to alleviate the negative biohazards of high ambient temperature on the productive performance and physiological status of laying hens.

The basal diet was supplemented with 0, 250 or 500mg per kg of diet and at each vitamin E level each diet was supplemented with 0, 0.25 or 0.50mg selenium per kg of diet.

Supplementing birds with vitamin E at the highest (500mg) level resulted in the lowest feed consumption and best FCR.

The interaction between vitamin E and selenium only exerted significant effects on feed consumption and FCR. Insignificant differences were seen in egg quality criteria.

In the blood increasing the vitamin E level was associated with a gradual decrease in the basophil count and an increase in monocytes.

A gradual decrease in the counts of each of heterophils, monocytes and eosinophils was seen with the elevation of selenium levels.

As vitamin E increased there was a marked decrease in AST and a gradual increase in total lipids, total cholesterol and calcium.

Reducing the environmental footprint

This Polish review (J. of Appl. Genetics 58 487-498) was written to present the genetic aspects of feed efficiency related to traits in meat type chicken and possible ways to reduce the environmental impact of poultry meat production through effective breeding.

Basic measures of feed efficiency are defined and the genetic background of these traits, including their heritabilities, are described.

In addition, a number of genomic regions and candidate genes determining feed efficiency traits of broilers in recent decades are described.

Classic and genomic selection strategies for feed efficiency in the context of its relationship with other performance traits are also discussed.

The review concludes by describing future strategies to improve feed digestibility and how it should improve, decreasing waste and greenhouse gas emissions.

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Monitor temperature and relative humidity

Information gathered when monitoring the temperature and relative humidity (RH) in a broiler house will help to ensure that the best environment for optimum bird performance, uniformity and welfare is achieved at all stages of the flock's life.

Making the correct decisions on the comfort of the birds can only be made if the relationship between temperature and RH is understood. The temperature being felt by the bird (the effective temperature) is dependent on the dry bulb temperature and RH.

Variation in RH will influence effective temperature:

- Higher RH reduces evaporative heat loss, increasing effective temperature.
- Lower RH increases evaporative heat loss, decreasing effective temperature.

The table below illustrates the relationship between temperature and RH. If RH is above or below 60%, the temperature of the house at chick level should be adjusted in line with the figures given.

Age (days)	Dry bulb temperature at RH% °C (°F)			
	40	50	60	70
Day-old	36.0 (96.8)	33.2 (91.8)	30.8 (84.4)	29.2 (84.6)
3	33.7 (92.7)	31.2 (88.2)	28.9 (84.0)	27.3 (81.1)
6	32.5 (90.5)	29.9 (85.8)	27.7 (81.9)	26.0 (78.8)
9	31.3 (88.3)	28.6 (83.5)	26.7 (80.1)	25.0 (77.0)
12	30.2 (86.4)	27.8 (82.0)	25.7 (78.3)	24.0 (75.2)
15	29.0 (84.2)	26.8 (80.2)	24.8 (76.6)	23.0 (73.4)
18	27.7 (81.9)	25.5 (77.9)	23.6 (74.5)	21.9 (71.4)
21	26.9 (80.4)	24.7 (76.5)	22.7 (72.9)	21.3 (70.3)
24	25.7 (78.3)	23.5 (74.3)	21.7 (71.1)	20.2 (68.4)
27	24.8 (76.6)	22.7 (72.9)	20.7 (69.3)	19.3 (66.7)

Dry bulb temperatures, at the ideal RH are coloured blue.

Procedure

Information gathered from the electronic sensors should be monitored closely for any unexpected or unusual readings. In the event of any such readings, the cause should be investigated and the electronic and manual equipment checked and calibrated if necessary. Faulty equipment must be replaced immediately.

Step 1: Take one thermometer and one hygrometer and place at the centre of the house beside the electronic sensors. Two additional thermometers should be placed half way between the centre and the end walls of the house. They should be located where the birds cannot touch them and should not be

in the direct line of any heat sources. Calibrate the electronic sensors before the birds are placed.

Step 2: One manual thermometer and one hygrometer must be outside of the house in a shaded area away from direct sunlight to establish climatic conditions.

Step 3: All sensors should be checked at the same time every day as part of the daily routine. Minimum and maximum readings should be recorded. The manual thermometers should be reset. Hand held temperature and humidity meters can be used to provide instant temperature and humidity measurements. They are a quick and reliable method of providing additional checks inside and outside the house.

Interpreting results

The behaviour of birds must always be considered when making decisions relating to temperature and RH. Observe birds and determine if their behaviour is correct for their age. Enter the house and spend five minutes watching and listening to the birds (see table below). Pay close attention to bird behaviour and activity, and house environment.

- How many birds are feeding, drinking and resting?
- What is respiration like?
- What is litter quality like?

Observation	Temperature	Action required
Noisy, huddling, wet litter	Cold	Check actual temperature and RH and compare to set point. Increase temperature. Check ventilation.
Quiet, spread out	Warm	Check actual temperature and RH and compare to set point. Decrease temperature. Check ventilation
Panting, wings out to the side	Warm	Check actual temperature and RH and compare to set point. Decrease temperature. Check ventilation
Evenly spread out, feeding and drinking	Correct	No action required

During brooding, in addition to monitoring bird behaviour, the following traits should also be assessed:

- Crop fill. If chicks do not have the desired crop fill levels (i.e. if they are more than 5% below target for each age).
- Vent temperature. Lower or higher than recommended (39.0°C-40.0°C).

If targets are not achieved, check temperature and RH levels and adjust if necessary.



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The use of avian influenza vaccines

Avian influenza vaccination in the field needs to meet four criteria:

- Induce a complete resistance in birds exposed to the disease in the field.
- Prevent virus replication and excretion in exposed birds.
- Prevent clinical disease and deaths.
- Allow the identification of vaccinated birds in accordance with the DIVA principles.

Today few, if any, vaccines fulfil all four of these requirements. Most avian influenza viruses provide consistent protection against death and clinical disease but they do not always give absolute protection against mucosal infection or shedding of virus from the oropharynx and cloaca.

The risk of infection of vaccinated birds and the excretion of challenge or field virus is greatly reduced and thus transmission and spread of disease are reduced. However, the absolute prevention of infection is not feasible under most field conditions.

Effective reduction of virus excretion is linked to a shortened period of viral shedding.

If birds receive poor vaccines (low quantities of HA antigen, poor adjuvant system or poorly matched antigen seed) deaths and clinical disease may not be seen, but significant amounts of field or vaccine virus may be shed into the environment.

At the very minimum, avian influenza vaccines should meet the following criteria:

- They must be pure and contain only the desired immunogen(s) and adjuvant. They must not be adulterated.
- They must be safe to the bird and show no side effects, as well as being safe to the environment.
- They must be able to protect and that protection must be demonstrable against a specific avian influenza virus.
- They must have a potency that indicates that there is sufficient HA antigen in inactivated vaccines or dose in live and live vector vaccines to ensure protection under commercial conditions.

Protection of vaccinated birds against avian influenza depends upon the antigenic relatedness of field and vaccinal viruses, vaccine dose, its route of administration, management conditions of the recipient flock and method of application and its percentage coverage of the flock. Of these, potency and application are the most important.

New range of LED lighting

 Greengage has released a new range of Agricultural Lighting Induction System (ALIS) LED lights that yield greater production, environmental and welfare improvements for livestock farmers.



The new range harnesses the latest technology in order to create the most efficient, safe and comfortable conditions for the broilers – leading to increased productivity and profitability.

● ALIS Barn Lamps (wide and narrow beam) has a rated lamp life of 100,000 hours and provides opti-

mum lighting conditions for your flock.

● ALIS Nest Lamp provides poultry farmers with more control over their flocks, such as directing birds towards nests and reducing eggs on the floor.

● ALIS Tube Lamps deliver optimum lighting conditions in layer systems using patented induction technology – keeping the power supply front of house for safety.

● ALIS Blue Lamp creates calming conditions in poultry sheds for the catching phase.

Broiler farmers can now see the financial benefits of all the production, environmental and welfare improvements which the ALIS platform delivers through Greengage's new Return On Investment (ROI) calculator. The online ROI tool is easy to use and highlights the incremental improvements which will drive out costs.

greengage.global

VIV MEA confirms regional hub status



Good reviews from exhibitors and visitors has set the seal on a successful second edition of regional feed-to-food trade show VIV MEA.

Their comments about the February 2018 event confirmed the value of having a truly professional and international show in the region that extends from the Middle East and Africa to Iran and the countries of the Indian sub-continent.

Held in the United Arab Emirates, VIV MEA 2018 was already going to be bigger than the 2016 edition because the show had spread into a

fourth hall at the Abu Dhabi National Exhibition Centre (ADNEC) to satisfy the extra demand for stands.

Final statistics for the 2018 show confirm that it was also bigger on attendance figures. Its three day total of 6,660 visits represented a 6.7% increase compared with the first edition.

Many exhibitors commented on the high quality of the VIV MEA visitors in 2018, confirming the evidence from registration details for visitor job title, function and decision-making power.

People attending VIV MEA 2018 could meet a total of 368 direct and



ILDEX Vietnam 2018 was recently held in Ho Chi Minh City and attracted 300 leading companies from 28 countries.

With six international pavilions to showcase livestock technologies, ILDEX Vietnam has become the leading trade exhibition in the Asia region with strong attendance and plentiful business opportunities. "ILDEX Vietnam has seen tremendous growth this year. The exhibition space has grown by 40% and more than 87% was occupied by international companies," Nino Gruettke, the Managing Director of VNU Exhibitions Asia Pacific Co Ltd, told International Poultry Production.

ildex.com

indirect exhibitors from 46 countries in the trade fair, join the on-site networking events and discover the information on offer at a series of conferences and seminars held over the three days.

Conference themes included respiratory viruses in poultry, modern ways to market eggs, fly control on farms and actions against mould toxins in feed grains. Knowledge in a professional and relaxed setting, was how one delegate described the special atmosphere that VIV MEA created around the conferences.

VIV MEA is held every two years and Abu Dhabi in the UAE will again be the location when it returns on 9-11th March 2020. Planning has started already on an enriched programme to reinforce the event's position as the premier regional hub for knowledge and networking in animal protein production and processing, from feed to food.

viv.net

Aviagen invites customers to download the full suite of technical documents, including performance objectives, nutrition specifications and management advice.

aviagen.com



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Poultry Focus Asia 2018 was recently held in Bangkok, Thailand. Focusing on management, breeding, health and nutrition, the event was a great success and attracted delegates from around the world with many thought-provoking and stimulating presentations.

positiveaction.co.uk



Guides for optimal management



Aviagen continues to develop its portfolio of slower-growing and coloured birds, and has released comprehensive management documents for the Rowan Range brand.

Rowan Range options for the unique needs and preference of the European market include the Ranger Classic, Ranger Gold, Rowan Ranger and Rambler Ranger.

For the North American market there is the Rowan 708, Ranger Premium, Ranger Classic and Rowan Ranger birds.

Farm of the future network



Lallemand Animal Nutrition is joining Neovia's 'Farm of the Future' network as an 'Innovative Company'. The label recognises Lallemand Animal Nutrition's work in developing microbial-based solutions to improve animal environments.

The launch of Neovia's Farm of the Future Network.



The selected innovative solution, LALFILM PRO, is a protective biofilm for farm buildings that helps support the development of beneficial microflora – reducing the risk of contamination with undesirable bacteria.

A high level of hygiene and bio-security can significantly improve production costs.

LALFILM PRO is a mix of selected and concentrated Bacilli and lactic acid bacteria that establishes a positive and protective biofilm after chemical disinfection. The biofilm helps create a safer microbial environment before the entry of the animals and contributes to improved hygiene conditions.

Neovia's Farm of the Future network aims to develop tomorrow's tools and models of R&D in animal nutrition and health by generating and valuing new data as well as testing the value of smart farming solutions under farming conditions.

lallemandanimalnutrition.com

New fund for animal health and nutrition



Seventure Partners, one of Europe's leaders in financing innovation and a world leader in life science microbiome investment, has launched AVF, an innovative venture capital fund, targeted at supporting companies in the field of animal health, feed and nutrition.

The first close of AVF at €24m is cornerstoned by Adisseo, an industry leader in the animal feed sector.

"This new thematic fund was created to address a very specific and expanding need in the market: preserving animal health, gaining a better understanding of the entire food value chain as well as developing technologies to cultivate and produce food in a better way," Isabelle de Cremoux, CEO and Managing Partner at Seventure Partners, told International Poultry Production.

Jean-Marc Dublanc, CEO of Adisseo, added "Adisseo is a unique company committed to strategic investments in new disruptive technologies, in order to enrich our portfolio of R&D innovations while respecting a mode of sustainable growth. Our ambition is to become one of the leaders in Feed Ingredient Specialties and the expe-

rienced partner of choice in animal nutrition. For this reason, we have been investing significantly for many years in our research programs and industrial development projects.

"With AVF, our goal is to invest in strategic collaborations combining the agility of start-ups with Adisseo's expertise. As such, Seventure was a natural partner of choice and we are pleased to become a strategic investor in AVF."

adisseo.com

New Cobb agent in Uzbekistan



Kefayat General Trading Company has been appointed by Cobb Europe as its agent for Uzbekistan, strengthening the breed's position in the growing market.

The agreement was signed at the VIV MEA 2018 show in Abu Dhabi where Mark Sams, Cobb Europe general manager, said the Uzbekistan market is important for the breed. The country has been expanding chicken production to meet increasing domestic demand and particularly export sales which are the main driver of growth.

cobb-europe.com



Our new Conference Manager Jojo (right) and our Africa representative Nduta Mbutia were both on hand to welcome the speakers to Poultry Focus Asia 2018. This leading poultry conference was recently held in Bangkok, Thailand alongside Pig Focus Asia and Dairy Focus Asia.

positiveaction.co.uk



As an addition to the proven technology of the direct drive 56" MagFan, Dacs have now introduced a 2.2 kW motor. This high output version will run continuously at static pressures of 100 Pa (0.4") and flow rates up to 80.000 m³/h (47,000 cfm) at neutral pressure, beating every other fan in terms of efficiency, pressure capabilities and flow rates.

dacs.dk

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LARRY BLACKSTONE

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Manager
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New nutritional solution



Already sold in many different countries around the world (such as the USA, Brazil, China and Australia), Selsaf 3000 has now been launched in Europe thanks to its new registration.

This new Phileo nutritional solution enriched in selenomethionine and selenocysteine is a natural source of organic selenium for poultry. Selsaf 3000 is based on an evolution of the manufacturing process which allowed Phileo to increase the selenium concentration to 3000ppm. It is produced from a specific yeast strain CNCM I-3399 (the same as for Selsaf – 2200ppm), and through a mastered manufacturing process. Likewise, Selsaf 3000 offers a high stability with its long shelf life of three years.

A major characteristic of the product is its consistent composition in two active seleno-compounds: selenocysteine and selenomethionine.

“Our standardised production process and quality certifications guarantee a high concentration of organic selenium and a consistent

active seleno-compound profile, with two thirds selenomethionine and one third selenocysteine and other active seleno-compounds,” Aurore de Vienne, Phileo Global Product Manager, told International Poultry Production.

Thanks to its excellent bioavailability, Selsaf 3000 allows better selenium assimilation via an active transport in the intestine and increases selenium levels in the blood compared to other mineral and organic selenium sources.

It helps the body against oxidative stress (which is detrimental to animal performance), both in the short term (thanks to the selenocysteine) and in the long-term (due to the selenomethionine) and boosts natural defences of animals.

This dual protection leads to dual benefits for farmers and consumers. For farmers, Selsaf 3000 supports animal health and increases animal performance. In reducing the oxidation, and therefore the rancidity of animal-derived end-products, Selsaf 3000 also brings a lot of benefits to consumers.

phileo-lesaffre.com

Acquisition for Church & Dwight



Church & Dwight Co Inc, the parent company of Arm & Hammer Animal and Food Production, has acquired Passport Food Safety Solutions Inc of West Des Moines, Iowa, USA.

Passport Food Safety Solutions is a leading provider of innovative, systems approach to help meat and poultry processors consistently address food safety standards.

With the integration of these two entities, ARM & HAMMER now becomes a worldwide leader in providing the most comprehensive portfolio of nutritional, microbial and pre- and postharvest food safety solutions to optimise the health of production livestock and reduce the risk of common pathogens, while reducing the incidence of pathogens in animal protein products.

“We are very excited about this integration because it further supports our long-term plan to grow, evolve and diversify our business through industry-leading advancements in animal agricultural produc-

tivity and food safety,” Scott Druker, general manager of Arm & Hammer Animal and Food Production, told International Poultry Production.

This union is a positive development for both companies.

“We are now able to offer deep expertise in food safety innovations, technologies and services to our customers,” added Scott. “For Passport Food Safety Solutions, the acquisition provides the established ARM & HAMMER brand and the considerable resources of a reputable, trusted global corporation in Church & Dwight Co Inc.”

“Our mission has always been to create sustainable food safety solutions that create value for our customers,” said Tom Nicholson, CEO, Passport Food Safety Solutions.

AHanimalnutrition.com

Please mention

International

Poultry Production

when sourcing further information

Livestock Asia Expo and Forum

19-21st April

Kuala Lumpur, Malaysia

www.livestockasia.com

Pig & Poultry Fair

15-16th May

Stoneleigh, UK

www.pigandpoultry.org.uk

International Symposium on Turkey Diseases

31st May-2nd June

Berlin, Germany

hafez@vetmed.fu-berlin.de

PIX/AMC

3-5th June

Brisbane, Australia

www.pixamc.com.au

6th Mediterranean Poultry Summit

18-20th June

Turin, Italy

www.wpsa.com

Broiler Health 2018

19th June

Utrecht, The Netherlands

www.positiveaction.co.uk

VIV Europe

20-22nd June

Utrecht, The Netherlands

www.viveurope.nl

Dairy, Livestock & Poultry Expo

20-22nd June

Nairobi, Kenya

www.dlpxpo.com/africa

European Poultry Conference

17-21st September

Dubrovnik, Croatia

www.epc2018.com

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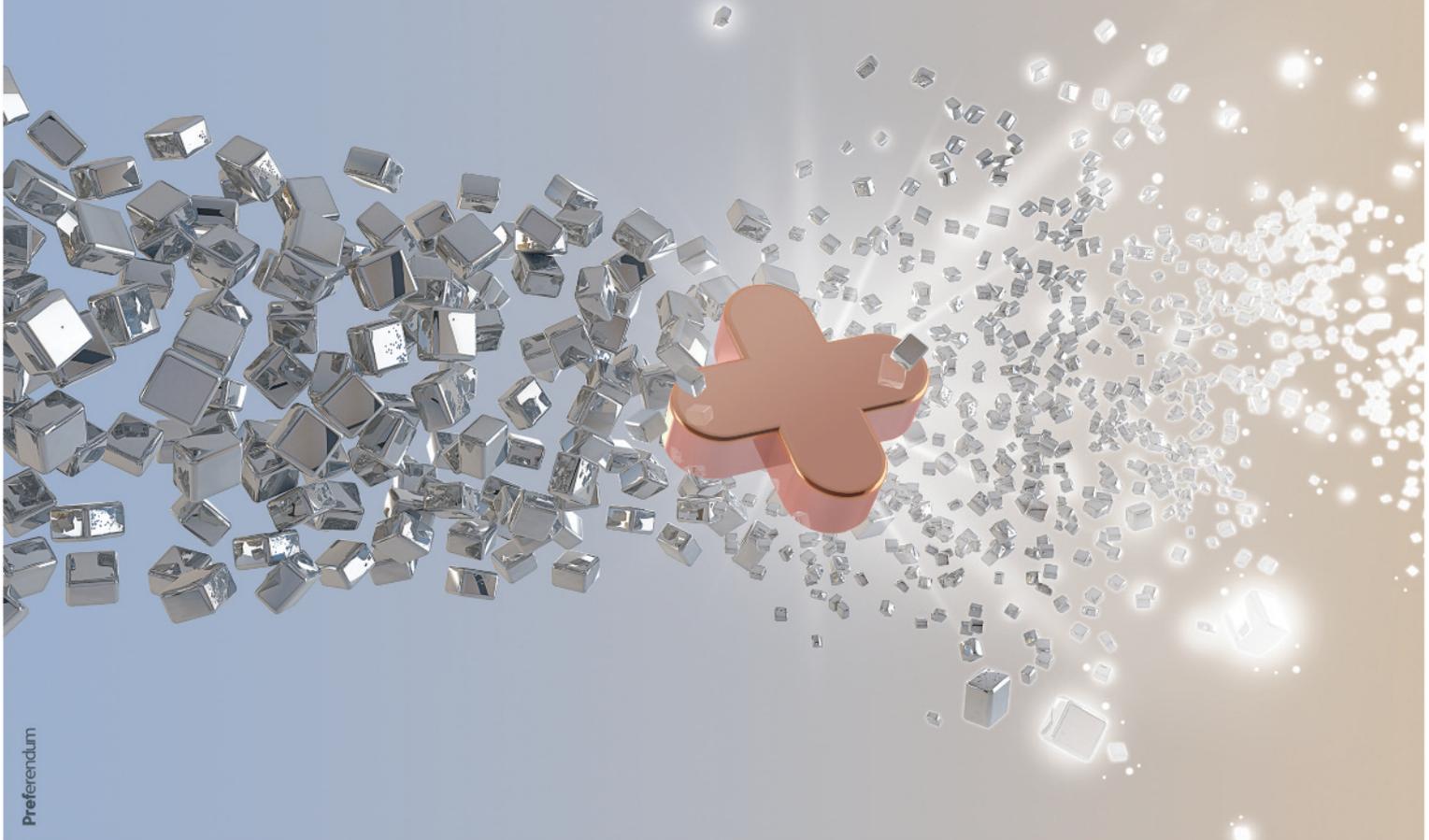
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