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Practical information for progressive poultry professionals

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Editor's Perch

Russia's new 3.5 billion rouble project to build a genetic centre in Chelyabinsk Oblast aims to boost domestic crossbreed poultry production and signifies a milestone in reducing its dependency on imported breeds, contributing to the country's food security, and enhancing the global competitiveness of Russian poultry products.

Smena 9 is Russia's first domestic crossbred chicken that was officially registered for commercial use in 2020. The Smena 9 is said to be renowned for its productivity, with an average weight gain of 75 grams per day.

This second Smena 9 genetic centre, which complements the first Smena 9 centre that has been operational in the Moscow Oblast since 2023, is designed to breed one million chicks per year and is set to introduce its first marketable products by 2025. Russia's goal is to have Russian genetics account for a quarter of the country's poultry production by 2030. But is this goal a little too ambitious? Well, it's not without its challenges.

This expansion reinforces the government's broader campaign to increase its domestic production capabilities in the meat and dairy sectors.

However, currently, Russian genetics contribute to only 5% of poultry production so a significant investment as well as efforts to help develop and promote Russian breeds both domestically and internationally is essential to help bridge this gap.

The Russian government's commitment to creating a favourable environment to help support the poultry industry's growth is shown in the planned introduction of an information and analytical system by 2026. By investing in domestic genetics and reducing import dependency, Russia aims to secure a more sustainable and competitive position in the global poultry market. But what will be the broader implications for Russia's agricultural sector?

And what will be Russia's standing in international trade? Only time will tell. In the end, the success of these efforts will depend on the ability to obtain sufficient investment and the effectiveness of strategies to increase the global appeal of Russian poultry genetics. ■

Cover Picture:

Facing challenging environments
(photo courtesy of Anparo – see page 18)

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World Focus

An executive summary of key international issues

RUSSIA

New compartmentalisation system

The Russian government has announced a new system to help the poultry industry fight against avian influenza. It mirrors the system already in place in the pig industry to help the fight against African swine fever. The system aims to increase veterinary safety, streamline export processes, and reduce poultry disease breakouts. The system classifies farms into four categories based on their level of biological protection; categories 1 and 2 are for farms with a low or poor level of protection, category 3 is for farms with a standard protection level, and category 4 is for farms complying with the strictest veterinary rules.

KAZAKHSTAN

19-year ban lifted

China has lifted a 19-year ban on poultry imports from Kazakhstan which was first imposed in 2005 following a series of outbreaks of highly pathogenic avian influenza. Kazakhstani authorities now want to launch negotiations on the veterinary requirements farmers must comply with to expand the agricultural products eligible for exports. They also plan to expand the list of Kazakhstani companies allowed to export their products to China. Russia has also lifted restrictions on imports of agricultural products from Kazakhstan after a two-year ban.

SOUTH AFRICA

Market inquiry launched

Following a report published by the Competition Commission in 2023, the Competition Commission of South Africa, has announced the launch of a comprehensive market inquiry that will seek to determine if the South African poultry industry is obstructing, misleading, or restricting competition in a way that violates the South African Competition Act. The industry has faced tough challenges in recent years with rising feed costs because of the Russian invasion of Ukraine, and disruption of national water and electricity supplies, as well as the deterioration of the road and rail network.

Assessing antibiotic resistance in Mycoplasma species

Antibiotics are one of the most powerful tools to safeguard animal health. However, when antibiotics are used improperly, this eventually leads to the selection of bacteria that develop antibiotic resistance. Therefore, safeguarding the future usage of antibiotics within animal production is mandatory and users need guidance in applying the principles of antibiotic stewardship.

by Dr med.-vet. Esther Schonewille, Global Poultry Technical Support Manager, Esp. Med Vet Javier Uriarte, LATAM Technical Service Manager, ECO Animal Health. www.ecoanimalhealth.com

The judicious use of antibiotics creates a challenge in the control of mycoplasmosis. Under these guidelines, the medication of a flock is not warranted if the flock is not exhibiting signs of disease.

Hence, for the correct use of antibiotics, proper diagnosis is required. However, for certain organisms such as Mycoplasma species diagnosis can be tricky. That is the reason why it is necessary to use all available tools. Determination of the sensitivity of mycoplasmas to different antibiotics is one of the lesser used techniques in the diagnostic toolbox.

MINIMUM INHIBITORY CONCENTRATION (MIC): NECESSARY STEPS

Isolation is needed

MICs are generally considered to be the reference point for comparison and evaluation of other sensitivity tests, such as antibiotic diffusion methods. The efficacy of all antimicrobials is described in terms of MICs.

The MIC of a Mycoplasma species is defined as the lowest concentration of antimicrobial that will inhibit the visible growth or metabolism of the strain after its optimal incubation period in vitro.

Even though it is currently the only practical available method for the determination of the MIC, isolation is not very practical as a diagnostic tool for mycoplasmas due to the time requirement involved.

Fig. 1. CCU determination in a 96 well plate for two strains. Every strain is tested in duplicate. Strain 1: observable are seven wells with colour change which equals 10^7 CCU; Strain 2: Observable are five wells with colour change which equals 10^5 CCU.

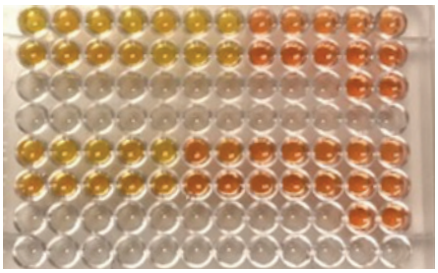


Fig. 2. MIC 96 well plate. Colour change of the wells is observed. Each horizontal line contains a different antibiotic and is read from left to right.

However, this technique provides crucial information about the sensitivity of the strains isolated from a farm to different antibiotics and treatment decisions should ideally be based on these results.

A standard medium for the isolation of all veterinary mycoplasmas currently cannot be recommended due to the diversity of nutritional requirements of different species. Some media can be used for avian mycoplasmas, like Frey medium, while others are suitable for swine mycoplasmas, like Friss medium. During the isolation process, once growth in the broth has been observed as indicated by colour change, it is necessary to inoculate an aliquot in agar and observe the typical fried egg-shaped colony appearing after a couple of days. From this colony, a clone is produced to 'purify' the culture. This step ensures that only one pure Mycoplasma colony is used for MIC determination.

Confirming strain identity

The clone´s identity is usually confirmed by PCR or immunofluorescence, as mycoplasmas don´t have strong macroscopically distinctive characteristics that allow for differentiation between species. Biochemical properties of Mycoplasma synoviae (MS) cultures may produce precipitates which are called 'film and spot'.

Film and spot may be used by experts to differentiate MS from MG.

If more than one species of Mycoplasma is present in the same sample (MS and MG or Mycoplasma hyopneumoniae and Mycoplasma hyorhinis) it is paramount to do separate MICs for each species. After ensuring that a pure culture has been obtained, a viable count needs to be done. In short, this means understanding how many viable mycoplasmas are present in each sample.

Determining the correct dilution of inoculum

There are several MIC techniques used to determine the sensitivity of a Mycoplasma species. A summary of the method described by Hannan et al. (2000) will be referred to in this article.

To ascertain the MIC, the inoculum must contain between 10^3 to 10^5 CCU (colour changing units). Once this concentration is obtained, MIC testing can be done.

To achieve this, 10-fold dilutions of the pure culture are transferred to a liquid broth and incubated for seven days at 36°C ± 1°C.

After that time point, the growth of the culture is evaluated by checking the colour change. Mycoplasmas growing in a liquid culture medium commonly ferment glucose to produce energy. M. hyosynoviae uses arginine instead of glucose to the same effect.

In this process, acids are formed which alter the pH and cause the medium to change colour from red to yellow. Hence, a visible colour change will give evidence of the isolate's growth and its concentration.

Correct dilution of antibiotics to be tested

The next step is to obtain the proper dilution of the antibiotics that are going to be tested. A correct dilution of the antibiotic stock solution in the specific Mycoplasma species medium must be done.Usually, between 11 and 12 dilutions are made for each antibiotic.

It is common practice to carry out MICs with pure drugs (Active Pharmaceutical Ingredients or API) and not final commercial products since these may contain other substances such as excipients. Also, fermentation intermediate products or stabilizers can affect the in vitro growth of mycoplasmas, resulting in inaccurate MIC values.

Inoculation of the MIC plates

Once the antibiotics have been diluted, the isolate is inoculated in the established CCU concentration and incubated at 36.5°C ± 1°C. Growth of Mycoplasma species must be checked by assessing the colour change of the medium at 24 and 48 hours.

In some cases, it may be necessary to extend the incubation period up to seven days to check for growth.

As a strain control, it is necessary to run a parallel viable count with the diluted strain. This is done to evaluate if the strain dilution for the correct CCU was made. A strain concentration outside these parameters can produce an invalid MIC result.

Reading the results

After incubation, the colour change is checked, and the cut-off point, or MIC is established. The MIC is the concentration of the antibiotic in the last well where no colour change is observed. It is important to note that the MIC value refers to one strain only.

Determining the minimum mycoplasmacidal concentration (MMC)

The minimum mycoplasmacidal concentration (MMC) for each strain, on the other hand, is defined as the lowest concentration of antimicrobial that stops the growth after subculture (in practice, approximately a 99.99% kill). This will help to evaluate the effectiveness of the tested antibiotics to exhibit bactericidal properties for the Mycoplasma species being investigated. The smaller the difference between the MIC and MMC the more effective the antibiotic product will be in achieving killing off the targeted mycoplasma, this is called the MMC/MIC ratio.

To perform an MMC it is necessary to inoculate respective aliquots of all the wells in which no growth has been observed. Aliquots are subsequently inoculated on solid media without antibiotics and then incubated for at least seven days. A daily check for the presence of the typical 'fried egg' colonies needs to be done.

The lowest dilution without growth is considered as the MMC. Hussein et al. published a study with a UK MS strain that shows an MMC 90 of 0.03ug/ml for tylvalosin, 0.06ug/ml for tylosin and 2ug/ml for tilmicosin. The MMC/MIC ratio was 1 to 3.75 for tylvalosin, 1 to 31 for tylosin and 1 to 133 for tilmicosin.

MIC50 and MIC90

MIC50 (minimum inhibitory concentration 50) and MIC90 (minimum inhibitory concentration 90) can be calculated as the concentration of antibiotics at which 50% or 90% of the strain is growth inhibited.

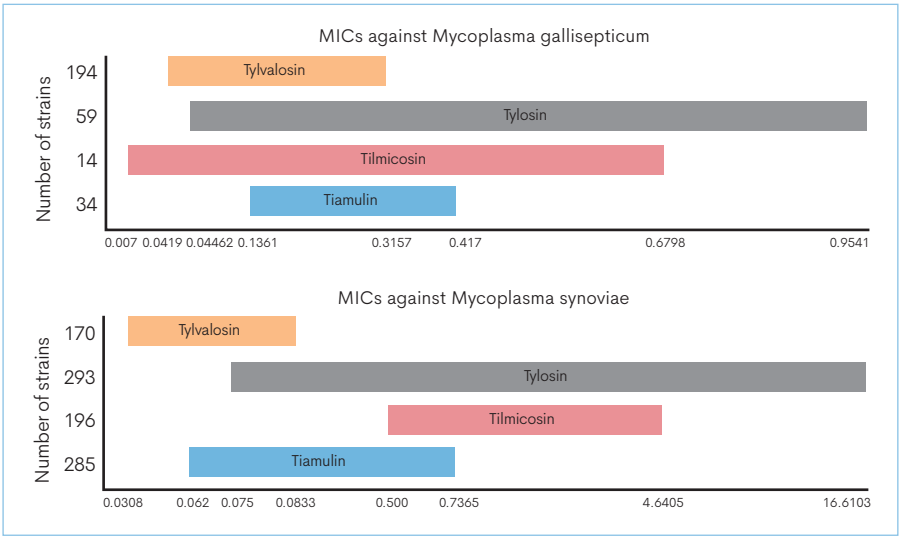
These two values will help to understand the MIC distribution of a group of strains isolated in the same area. Hence, their significance increases with the number of strains tested.

Interpreting the results

Even though the complete technique is by no means a simple one, many studies are looking MIC data of avian and swine mycoplasmas. The ECO Animal Health technical service has done a meta-analysis of this eligible published data.

Hence it has been established that Tylvalosin has the lowest and most narrow range of MIC values against MS and MG strains, followed by Tiamulin, Tylosin and Tilmicosin.

Fig.3. In this evaluation, MG and MS isolates were used to determine the minimum inhibitory concentrations (MICs) against four antibiotics (Tylvalosin, Tylosin, Tilmicosin, Tiamulin). The isolates were collected from numerous countries worldwide: Argentina, Egypt, Italy, Japan, Spain, The Netherlands and The USA.



UNDERSTANDING DIFFERENT RESULTS FOR DIFFERENT MACROLIDES

Different types of macrolides exist and not all types are indicated for the treatment of mycoplasmosis. For classification purposes, macrolides can be divided into naturally or semi-synthetically derived products.

They are further classified by the number of carbon atoms in the macrolide lactone ring, namely 13, 14, 15 and 16 atoms. Avian mycoplasmosis is treated with the macrolides of the 16-membered group. Not all of them have the same activity though. There are many examples of MG or MS strains with high MIC values for Tylosin or Tilmicosin, which may indicate a resistance development. However, these same strains may show low values for Tylvalosin. Another example is a mutation that leads to a reduction in the susceptibility of MS to macrolides and lincosamides with the substitution of amino acids in the 23s rRNA alleles. This makes MS intrinsically resistant to 14-membered macrolides.

ALTERNATIVE WAYS OF DETERMINING RESISTANCE

Other techniques can be used to determine the resistance of mycoplasmas to different antibiotics. Looking for genetic mutations, for example. For MG, PCR amplification and sequence analysis of domains II and V of the 23S rRNA genes is one approach. Based on this, in 2011 Gerchman et al. demonstrated that a single point mutation in domain V of the 23S rRNA gene was highly correlated with decreased susceptibility of MG to 16-membered macrolides.

CONCLUSION

The evaluation of antibiotic resistance in Mycoplasma species is a complex process that demands careful consideration.

By employing techniques such as MIC determination and exploring alternative methods, valuable insights into the sensitivity and resistance patterns of Mycoplasma strains may be gained. Furthermore, macrolides are a wide group of antibiotics with very different resistance patterns. Knowledge on MIC values enables users and decision makers to take all aspects into account when deciding on treatment strategies and work towards safeguarding the effectiveness of antibiotics for the future of animal health.

Furthermore, it is highly unlikely that new antimicrobials for Mycoplasma species will be available any time soon, meaning that all efforts have to be undertaken to use the currently available antimicrobials as wisely as possible to preserve their efficacy for the future (Wallmann, 2014). ■

References are available from the author on request

Comparing performance of dual-purpose chickens on 3 different feed regimes

Improved dual-purpose breeds are becoming increasingly more important in the rural areas across Sub-Saharan Africa as they supply millions of families with home-produced eggs and meat with a much higher efficiency compared to the local breeds while the appearance of the birds still fits the preference of the farmer.

by Carolien Vermeij
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Different to exotic breeds such as the fast-growing white broiler or the high egg-producing layer breeds, dual-purpose birds also thrive under feeding regimes with less commercial feed or less optimised diets.

The economic performance of different dual-purpose breeds with different feeding regimes will depend not only on growth and egg production but also on feeding costs and local market prices. For the first time, three crosses with different growth and laying performance, have been extensively tested between October 2020 and April 2022 in rural Zimbabwe by Hamara, the producer of day-old chicks of these three crosses.

The three crosses tested are Ruby C (coloured broiler: C431), T Rainbow (dual-purpose bird; TR51) and Ivory (traditional layer; SU51). The setup of the trial followed the business model of Sasso Poultry Production in Zimbabwe where day old chicks are kept at a mother unit farm (MU) under ad-lib-fed conditions for the first weeks of development.

After distribution amongst smallholder farms (SHF), the broiler and layer trial continued under three different feed regimes: full-fed, half-fed and scavenging/quarter-fed. Growth was measured on 100 mixed male and female birds of the three breeds during the broiler trial. After completion thereof, 25 female SU51 and TR51 birds were maintained for continuation with the layer trial.

This resulted in 158 SHF with records on 18000 birds for growth and 3000 for egg production. These were subdivided into three trial phases starting in October 2021, March 2022, and October 2022. As of now, this trial is one of the first to monitor the performance of these birds on different feed regimes in smallholder conditions in Zimbabwe. The results therefore paint a more realistic picture of performance for the intended market for the birds.

MU PHASE

The first few weeks after hatch are the most crucial in chick development. Good feed, hygiene and vaccination are important to reduce mortality. SHF in Zimbabwe can often not uphold the standards required for good development.

Specialised MU farmers, which have received training, house day old chicks for the first weeks. This resulted in mortality below 2.5% for the three breeds. C431 birds are transferred to smallholder farms at 28 do weighing on average 771.4g.

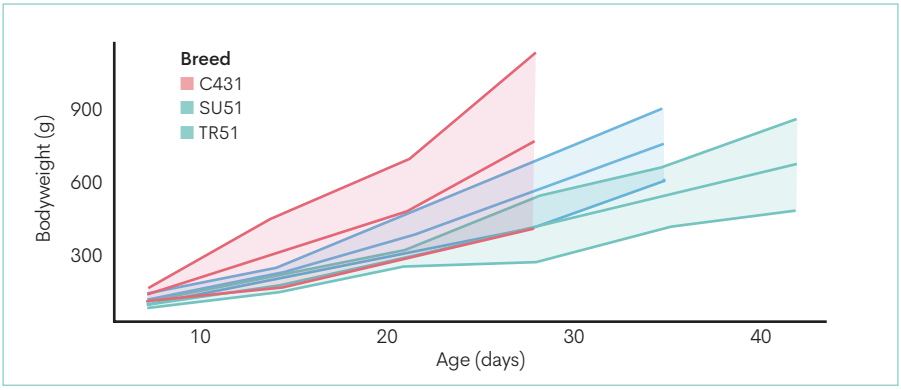
TR51 birds leave the MU at 35 do weighing 758.0g and SU51 shows the least growth potential with 675.2g at 42 do.

BROILER PHASE

After distribution to SHF, the performance of each breed was tested for three different feeding regimes. Full-fed birds received a complete diet from adapted broiler or layer feed.

Half-fed birds received half and quarter-fed birds a quarter of feed and were allowed

Fig. 1. Average growth with 2SD spread during Mother Unit phase where C431 birds shows the highest growth potential.



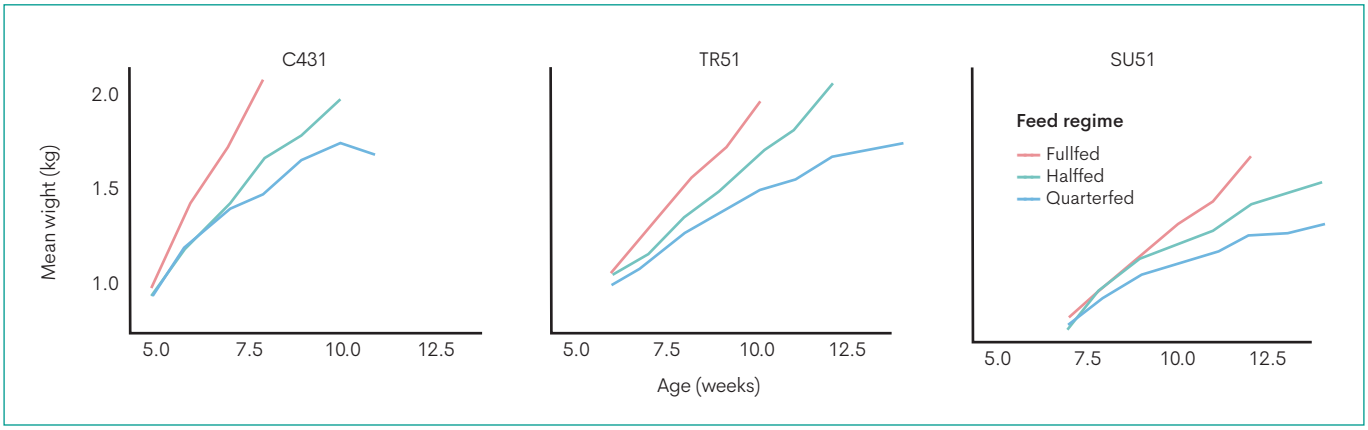


Fig. 2. Growth during Broiler phase for each breed and feed regime.

to scavenge in areas available to the farmers and received household food waste to supplement their diet.

Mortality during the broiler phase remained well under 5%, except for quarter-fed C431 birds with 5.8%. The age at which the broiler trial ended differed between breeds as C431 developed fastest and SU51 slowest, time to reach 2kg bodyweight is therefore used to compare.

C431 birds are broilers, the average weight of mixed male and female birds is therefore given. TR51 and SU51 are intended to be kept on the farm as dual-purpose breeds, which is why the age at which males on average reach 2kg bodyweight is given as females will be kept on the farm as layers.

C431 birds show the most growth potential under full-fed feeding, as expected from a coloured broiler, reaching a body weight of 2kg at 8 weeks of age and 10 weeks for half-fed.

Full-fed and half-fed male TR51 and SU51 require an additional 2 and 7 weeks compared to C431.

With scavenging as a feed regime, TR51 outperforms C431 in terms of growth as after 10 weeks of age, C431's weight fluctuates around 1.7kg. Scavenging male TR51 reached 1.7kg at 11 weeks but continues to develop and reach 2.7kg at 20 weeks old.

Scavenging male SU51 birds take 17 weeks to reach 1.7kg and weigh 2.0kg at 20 weeks. SU51 birds take longer to reach a lower weight to cope with less feed which is vice versa for C431 birds which stunt in growth, TR51 birds fall in between.

LAYER PHASE

For a year after the onset of lay, TR51 and SU51 hens were followed up to monitor egg production. The quarter-fed feeding regimes were changed to scavenging, and other feeding regimes remained the same.

Average mortality at the end of lay was respectively 5.7%, 12.9% and 12.7% for SU51 full-fed, half-fed and scavenging; and 7.3%, 10.1% and 9.8% for TR51. Laying percentages were monitored on each farm weekly, which resulted in raw egg-laying curves.

Based on polynomial models, cumulative egg production per hen is predicted per breed and feed combination. Cumulative egg production is highest for SU51 full-fed with 234 eggs per hen per year.

Half-fed SU51 produced 181 eggs per hen per year, 77% of its performance for full-fed. Scavenging SU51 hens produced on average 97 eggs which is 42% of full-fed performance. TR51 scavenging had the lowest egg production with 85 eggs per hen per year, this is comparable to SU51 performance where only 80% of egg production is reached in TR51 full-fed and half-fed birds.The onset of lay is earlier in full-fed SU51, comparable between breeds for half-fed and later for scavenging SU51.

The peak lay percentage reached is higher for SU51 in both full-fed and half-fed but lower for scavenging.

Overall SU51 is a breed with more egg-laying potential, but TR51 retains performance with less feed better compared to SU51.

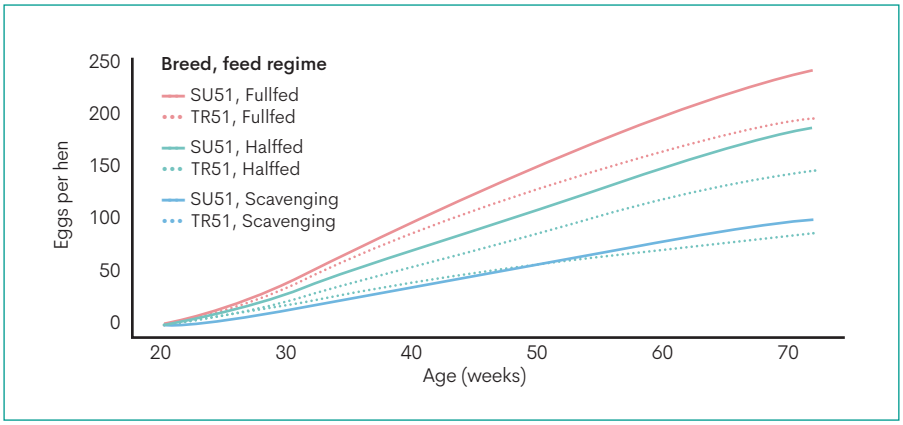
IMPLICATIONS

As the performance of birds is usually monitored under controlled environments, this research represents how these three different crosses perform under real-life farm conditions.

The information gathered is used in a business model which can be used to compare the revenue each breed can provide to a SHF. This model is used by entering parameters such as feed prices and revenue of meat and eggs and provides the profit each breed will provide for each feeding regime.

With changes in the market and different responses of breeds to a change in diet, the best practice for a farmer in terms of economic profitability can be chosen using this model. Based on performance and the model C431, is the most profitable option when a full diet can be provided. With limited access to commercial feed, as often observed in Africa, TR51 is the most suitable breed. ■

Fig. 3. Polynomial prediction of cumulative egg production.



Muramidase: enhancing broiler performance and meat yield

Optimising performance and maintaining gastrointestinal functionality is crucial for success in broiler production. Optimal performing, healthy broilers contribute most to the global growing protein demand and a reduction of antimicrobial resistance. The use of muramidase in broiler feed is a new promising solution to support gut functionality, thereby improving broiler performance and meat yield.

By Irene Eising, Philippos Fidiarakis, Jean-Paul Ruckebusch and Phokela Segobola, Poultry gut health team EMEA, dsm-firmenich ANH
www.dsm.com

In this article, we will explain the benefits and mode of action of muramidase and its impact on broiler growth, feed conversion ratio (FCR) and meat yield.

THE ROLE OF MURAMIDASE IN GUT FUNCTIONALITY

As defined by Pietro Celi in Animal Feed Science and Technology, 2017, an optimal gastrointestinal functionality is 'a steady state where the microbiome and the intestinal tract (host) exist in symbiotic equilibrium and where the welfare and performance of the animal is not constrained by intestinal dysfunction'.

Muramidase contributes to optimal gastrointestinal functionality by breaking down bacterial cell debris. Peptidoglycans (PGNs) form the structural base of bacterial cell walls. After cell death or division, PGNs are left behind in the lumen of the intestinal tract and can hinder nutrient absorption and optimal gut function. By breaking down PGNs, muramidase contributes to better nutrient digestion, -absorption and -partitioning in the body. This can be seen by birds having a higher body weight gain, a better FCR and higher meat yield.

MURAMIDASE IMPROVES NUTRIENT DIGESTIBILITY, MEAT YIELD, AND WELFARE IN BROILERS

Several studies have shown that broilers supplemented with muramidase have a higher nutrient digestibility and absorption.

Sais et al., 2019 showed 7% higher apparent ileal energy digestibility ($P<0.05$) and 4% higher apparent ileal crude protein digestibility ($P=0.09$) at day 35 of age.

The improvement of crude protein digestibility was confirmed by Goodarzi et al., 2019 who saw 6.5% higher apparent ileal crude protein digestibility ($P=0.001$) and a higher apparent ileal fat digestibility (ether extract) of 2% ($P=0.002$) at day 35 of age.

Goes et al., 2022 also saw a higher fat apparent ileal digestibility of 16% ($P=0.01$). Sais et al, also found a higher nutrient absorption on day 9 of broiler age.

The birds fed with muramidase had 18% higher amounts of vitamin A in their plasma ($P=0.04$). At the same age, the birds also had a significantly higher amount of total fatty acid apparent ileal digestibility of 2% ($P<0.05$).

Knowing vitamin A is absorbed via fat, these two findings can be linked to each other.

Goes et al, confirmed the improvement of nutrient absorption by measuring blood carotenoid levels.

The muramidase supplemented birds had 23% higher total carotenoid concentrations in

Continued on page 13

20 YEARS
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	Parameters: improvement of muramidase treatment vs. control						
	Performance		Nutrient digestibility*			Nutrient absorption	
Reference	BW	FCR	Energy	Protein	Fat	Vitamin A	Carotenoids
Sais et al., 2019	2.0%	5.0%	7.0%	4.0%	2.0%**	18%**	
Goodarzi et al., 2019	2.0%	3.0%		6.5%	2.0%		
Goes et al., 2022	3.0%	4.0%			16%		23%

** Apparent ileal digestibility ** Measured at day 9 of age*

Table 1. Summary performance, digestibility and nutrient absorption data Muramidase trials.

Continued from page 11
their blood (P=0.007). In all studies, the nutrient digestibility and absorption improvement lead to improved performance of 57g BW (2%; NS) and 7 points FCR (5%; P=0.45) in Sais et al., 2019, 45g BW (2%; NS) and 4 points FCR (3%; P=0.001) in Goodarzi et al., 2019 and 80g BW (3%; NS) and 6 points FCR (4%; P=0.004) in Goes et al., 2022.

Footpad lesions are a visual sign of reduced gut functionality and poor welfare. Muramidase supplementation decreased litter moisture and footpad lesion scores (Pirgozliev., 2020), which was confirmed in several trials.

When evaluating meat yield data from the slaughterhouse, Brugaletta et al., 2002 showed that muramidase supplementation improved breast yield% by 2.3% (>750 observations/group; 3 groups total), without increasing myopathies (wooden breast, white striping and spaghetti meat).

Other trials also showed breast meat yield improvement, with an average of 3%, including higher carcass and thigh weights (data unpublished). Table 1 shows a summary of the performance, digestibility and absorption improvements described above.

THE LINK BETWEEN GUT FUNCTIONALITY, BIRD PERFORMANCE AND MEAT YIELD

How can we explain the improved meat yield when muramidase was fed to the birds? Ni et al., 2022 found that geese with higher villus height/crypt depth ratio had improved muscle fibre density and breast muscle/body weight ratio.

Savaris et al., 2021 investigated the effects of vitamin A on meat yield and quality in broilers and found that vitamin A supplementation significantly improved breast and leg yield. There was also an interaction between vitamin A levels and duration of supplementation and the occurrence of wooden breast and white striping, with an optimum level described at 29.000 IU/kg. Cavani et al., 2009 describe the importance of oxidative stability for meat quality. Lipid oxidation can cause toxic compound formation and the loss of nutritional values. Several nutrients such as carotenoids, vitamins E and C and selenium act as antioxidants and prevent lipid oxidation. Increasing the absorption of these nutrients can improve oxidative stability and decrease lipid oxidation, leading to meat with higher nutritional value and less toxic compounds.

Increased absorption of vitamin A due to muramidase supplementation can be an indication of improved breast meat yield described above. Muramidase supplementation improves gastrointestinal functionality by removing PGNs as an irritant in the gut lumen and the effects of better gut functionality described by Ni et al. is a potential explanation for the higher breast meat yields found in muramidase supplemented birds.

CONCLUSIONS

Nutrient partitioning to protein deposition is influenced by several factors. Nutrients like carotenoids and vitamins contribute to oxidative stability and reduce lipid oxidation, ensuring better meat quality. Nutrients like vitamin A contribute to meat yield. A better gut functionality (measured by villus length/crypt depth ratios) improves muscle fibre densities

Muramidase has a positive effect on gut functionality, leading to higher nutrient digestibility and absorption and in the end shown to contribute to highly efficient birds with optimal body weight and higher meat yields.

These highly efficient broilers contribute to a reduction of two major global issues the poultry industry is facing: meeting the growing protein demand and reducing the reliance on antibiotics (reducing antimicrobial resistance). ■

Options for

Feed Sanitation Impact on Layer Health and Performance

Preliminary research suggests that feed sanitation prevents Salmonella colonisation in the hen, improves egg production and positively influences the microbiome, supporting the well-being of the birds throughout their production cycle.

anitox.com

Keeping healthy laying flocks in an antibiotic-free world calls for a comprehensive upgrade in management practices and disease prevention strategies, always relying on heightened biosecurity to minimise the opportunities for avian pathogens to access flocks during development or production phases. One of the most efficient ways of pathogen dissemination is contaminated raw materials and finished feed that can rapidly spread across the whole operation. Implementing feed sanitation in layer production not only serves to reduce the microbial loads entering the system but also aids in supporting gut development, health, and performance.

Studies conducted in broiler breeders indicate that feed sanitation influences the microbiome composition, laying the foundation for healthier birds and better livability, supporting the well-being of the birds throughout their production cycle.

Termin-8 offers producers the highest level of feed pathogen control. It is 100% effective against Salmonella in feed and provides continued protection against recontamination for up to 21 days.

Finio, a non-formaldehyde alternative, offers the next level of control and still provides 14 days of protection from recontamination.

New pullet feeder helps train young breeders

Chore-Time's Konavi Pullet Feeder for Breeders helps train young birds from day one for improved flock uniformity and less stress at feeding time.

choretime.com

It features a grill-less design with an angled cone and anti-rake fins that discourage birds from stepping into the pan. As a result, litter is kept out of the pan for improved hygiene and less feed waste. Also, birds won't get trapped in the feeder, helping to reduce bird mortality rates and labour requirements.

A low pan height combined with the patented scalloped edge attracts young chicks to the feeder.

Producers can help minimise bird migration and fighting over feeder space because indexing spreads the feed around the house evenly.

Indexing also helps get the optimum number of birds around each feeder pan. The low feeder-lip height offers greater distance between the bottom of the feeder and shavings when lifted into the grow-out position, helping to keep litter out of the pan. The Konavi System also has a floor-activated flood feature with tall flood windows for accommodating uneven floors.

The feeder easily handles mash, crumbles and other forms of feed.

Feeder lines can be looped or configured as straight-line systems. It can also be retrofitted onto existing indexing lines.

The Feeders are durable and engineered to resist the degrading effects of ultraviolet light. The eating area of the pan bottom is 0.15 inches (3.8 mm) thicker for a long life. The pan attachment features a hinge to allow the pan to swing down for easy cleaning and drying between flocks.

Advanced feeding systems for modern day genetics

VDL Agrotech is recognised across the globe for its robust and innovative feeding solutions.

VDLagrotech.com

The diverse portfolio of feeding solutions caters for the needs of all poultry species. For day-old chicks, the optimum feeding system should support the best start of production. Ensuring that all chicks have access to an equal amount of feed, gives the best uniform results. For producing hens, the focus is more on rapid feed distribution and making sure that there is minimum wastage.

Some of the products in the VDL Agrotech portfolio;

- **Valenta**, pan feeding for broilers is designed to improve animal welfare and performance. This versatile pan allows young birds to have excellent access to feed. Optimum hygiene is ensured, as our pan is designed to be easily cleaned.
- **Chainovation**, a chain feeder system for rearing pullets and laying hens. VDL has many options for their chain feeding system, including reliable winching solutions.
- **Rotra and Reflex,** spin feeders for multiple purposes. Spin feeders can improve animal welfare.
- **Feed augers**, silos and weighing solutions of VDL complete the portfolio. These flexible distribution systems allow VDL to provide a solution to any breeder farm.

Modern design and innovative materials for 60 years

For the past 60 years, Giordano Poultry Plast have been successful in developing farm equipment with modern designs and innovative materials to ensure the correct feed and water supply to your birds.

poultryplast.com

The entire range of automatic feeders is designed to follow the full growth cycle of the animal, from the chick to the adult stage, through products designed to suit all poultry species.

Automatic drinkers are solutions designed to reduce water loss, maintain a high level of hygiene and ensure animal welfare through rounded shapes that reduce possible injuries.

They are also easy to install and maintain and allow a significant reduction in management time and costs.

The importance of choosing the right drinking nipples

Clean, fresh water is the cornerstone of successful poultry farming. It's not merely a matter of hydration; it directly influences the health, productivity, and profitability of your flock.

impex.nl

With over 50 years of experience, Impex is dedicated to manufacturing high-quality drinking systems that are engineered to perfection.

Choosing the appropriate drinking nipples may appear trivial, but it's a decision that warrants careful consideration. Inferior-quality nipples can result in leaks, water wastage, and compromised bird health. Our manufacturing processes ensure that each drinking nipple closes perfectly after every use, minimising water wastage.

While low-cost alternatives may seem appealing initially, they often prove to be a false economy, leading to more problems and expenses in the long run.

Furthermore, the type of drinking nipple is crucial, depending on the age and breed of your poultry. Breeders, pullets, broilers, layers, and untreated layers each exhibit unique drinking behaviours, necessitating tailored solutions.

Whether it's a 180° or 360° drinking nipple, Impex offers options designed to meet the specific requirements of different poultry types.

Water flow rate is another critical consideration. While high flow rates may appear desirable, they can lead to water wastage and wet manure, posing health risks to the birds.

The journey to poultry excellence begins with selecting the right drinking nipples. With Impex, you're not just purchasing equipment; you're investing in the health, welfare, and performance of your flock.

Automatic control and registration of water intake

Prevent animal diseases by automatic control and registration of water intake

hotraco-agri.com

The new veterinary medicines legislation poses major challenges for poultry farmers across Europe. Animals in poultry houses will have to be kept healthy with the least possible use of antibiotics.

Hotraco Agri is prepared for this legislation and helps farmers identify sick animals at an early stage.

We do this for example through automatic control and registration of water intake. Automatic registration of water intake

Our advanced Fortica farm controller gives farmers 24/7 insight into their animals' feed and water intake. This is important because changes in feed or water intake can serve as an indicator of animal health, sick animals generally eat less and drink more.

With automatic registration of feeding and drinking behaviour, abnormalities can be detected at an early stage and any animal diseases can be quickly detected and effectively contained.

Worlds largest manufacturer of feeding chain

Technical Systems' flagship product, Poultry Feeding Chain has cemented its position as the largest manufacturer in the world

technicalsys.com

Their auger products have the highest fatigue resistance, a common failure in this application. As a result of this success, they branded our auger range in 2008 with the FATIQLESS Trade Mark – "Never breaks"! Their equipment is exported to the international market to over 50 countries around the world. They continuously strive to improve the quality of their products and to add innovations to the range, exploring new opportunities in the poultry industry.

Capacities have increased over the years to accommodate growth and to enable delivery in short periods.

The perfect water supply for your poultry

Lubing offers complete drinking systems for all species of poultry, which optimises modern animal farming.

lubing.com

All products are based on continuous developments and long-term experience. This guarantees the well-known Lubing quality.

The central element of the floor-watering system is the Lubing nipples, ensuring an optimum water flow for every animal age. The combination of nipple and drip cup ensures a dry manure.

The right height depends on the size of the animals: They should have to stretch slightly to reach the nipples.

Every delivered system includes a height table, making it easy to find the right height of the drinking line from the first day on. For turkeys, the combination of the pendulum and the different stainless steel reinforced drip cups ensures dry manure and the best results for the rearing and fattening of every age.

Advantages of the Lubing Drinking Systems

- Clean, hygienic drinking water in a closed system
- Patented nipple principle which is easy to use for the animal
- Flow rate of the nipple is adapted to the age of the animal and enables optimum provision for all climatic zones and age levels
- The stainless steel nipple valve is extremely robust and durable
- The modular system of watering and the vast range of accessories make it easy to adapt it to every house

Feed Physical Quality: an issue in the field?

The effect of feed form is well established however feed physical quality is often seen as an issue in the field (see Fig. 1).

by Marcus Kenny, Nutritionist, Aviagen Turkeys Ltd www.aviagenturkeys.com

Several evaluations were conducted in Aviagen Turkey's (ATL) facilities in the UK to assess the impact of feed physical quality on modern genotypes by assessing both crumb and pellet quality on commercial turkey performance.

EVALUATION

The first evaluation assessed the impact of crumb particle size on feed intake in turkey poults from 0 to 3 weeks of age. A standard crumbled starter diet was sieved into three different particle sizes; small (<1mm), medium (1 to 2mm) and large (>3mm) and provided free choice to male B.U.T. 6 poults. Feed consumption of each feed particle size was measured daily during the entire period of the trial.

The feed consumption data (see Fig. 2) shows poults have a clear preference for medium and larger particle sizes with a much lower preference for smaller particles (<1mm). This trend was quite consistent throughout the entire period from 0 to 21 days of age.

The proportion of each particle size consumed was measured for each period and total consumption was assessed over the entire period (see table 1).

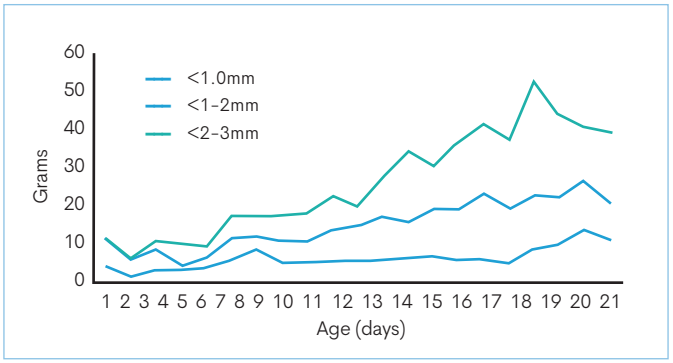


Fig. 2. Feed consumption (grams/bird/day) of different feed particles by poults offered free access to different starter feed particle sizes from 0 to 21 days of age.

The study did not include an assessment of feed particles larger than 3mm however the overall trend shows poults have a consistent preference for larger particle sizes with a much lower preference for smaller particles. This trend was quite consistent throughout the entire period with a tendency towards preference for larger particles with increasing age.

A small-scale evaluation examining the effect of different feed forms was conducted in ATL facilities in the UK. This involved feeding B.U.T. 6 males 'good' and 'poor' quality crumbs and pellets from 0 to 20 weeks. Diets were prepared according to the ATL recommended nutrient specifications and feeding programme. The starter diet was provided as a sieved crumb for the 'good' feed physical quality control and an unsieved crumb for the 'poor' feed physical treatment. The 'poor' pellet quality treatment was prepared by hammer grinding pellets to a fine consistency (fines) and then blended with intact pellets to result in a 50:50 mix of pellets and fines (see Fig. 3). The mix of fines and pellets resulted in a feed physical quality similar to poor feed physical quality which can sometimes be seen in the field (see Fig. 4).

	Total Feed Intake (g/bird/day)			Total (g)	%
Age (days)	7	14	21		
<1mm	29	39	59	127	13.1
1 to 2mm	57	101	152	310	31.9
2 to 3mm	80	167	289	536	5.1

Table 1. Weekly and total consumption of different feed particles by B.U.T. 6 male birds (0 to 21 days).

Fig. 4: Presentation of the pellet and fines blend treatment.

The results showed there was a significant depression in body weight to 20 weeks of age; the poor treatment resulted in a 12.3% reduction in body weight loss relative to the control.

FCR deteriorated by 36% in the poor treatment relative to the control at 20 weeks of age (see Fig. 5).

The negative effect of poor feed form on body weight was evident throughout the lifetime of the birds.

Fig. 1. Poor feed physical quality in the field.

Fig. 3. Preparation of the 'poor' pellet treatment.

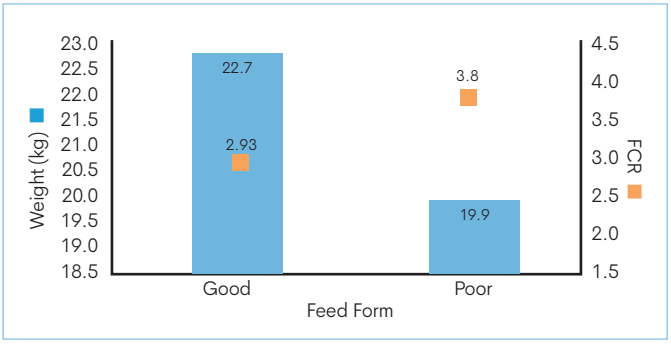


Fig. 5. The effect of feed form on bodyweight (kg) and FCR (20 weeks).

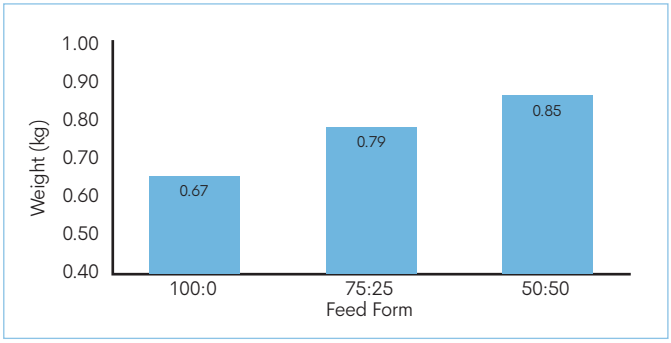


Fig. 8. The impact of feed physical form on enteric condition.

This effect was detected as early as 3 weeks of age and continued, with increasing effect, to the end of the trial period (see Fig. 6).

Breast meat yield was assessed at 20 weeks of age, the poor treatment reduced breast meat yield by 8.4% (see Fig. 7).

This effect on breast meat yield is most likely related to the effect of feed form on physiological development to this age, for example, the birds fed the poor feed form were physiologically less developed at 20 weeks of age compared to the birds fed the control, hence breast meat was not as well developed.

The effect of feed form on performance was much greater than previously observed; in particular, the magnitude of the effect on FCR was unexpected.

The data suggests that those birds fed the poor feed form ate significantly more feed than birds fed the control diet but did not convert this feed to liveweight.

Feed wastage is often evident when birds are fed poor-quality pellets.

While feed wastage was evident in some pens, this was superficial and not enough to account for the degree of difference in FCR.

Another possible explanation for the degree of effect on FCR may be related to the preparation of the 'poor' feed treatment.

The degree of fine material within the poor feed treatment was very significant and also the extent of pulverisation during the feed grinding process may have resulted in a more extreme 'poor' feed form than assessed in some other trials which compared pellets to mash diets.

Nonetheless, the poor treatment was representative of poor feed form in the field and the results reinforce the importance of ensuring feed physical quality is optimal and is adequately assessed within the organisation.

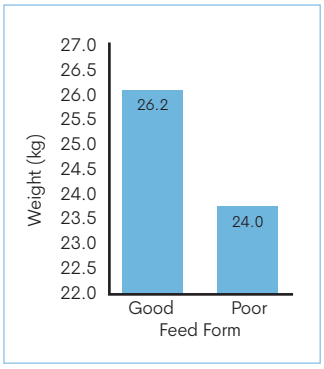


Fig. 7. The effect of feed form on breast meat yield.

Further evaluations assessed the impact of feed form on enteric condition; birds fed poor feed physical quality from day old to 12 weeks of age had poorer enteric condition (see Fig. 8) and also experienced increased incidence of gut leakage relative to those fed good quality crumbs and intact pellets. This effect was also detected in much older birds; 18-week-old birds fed with poor feed physical quality feed for a shorter period (one and a half weeks) also had poorer enteric conditions relative to those fed intact pellets.

These results demonstrate the impact of feed physical quality is relevant at an enteric level and not just from a farm or processing point of view.

Assessment of feed physical quality is usually measured by a sieving assessment of crumbs and a pellet durability index (PDI). The target particle size profile for starter diets in a crumb form is shown in Table 2.

Pelleted products must contain a minimised quantity of fines particles (<1mm), aiming for less than 10% fines (farm sample assessment) with the remainder as intact pellets. Pellet durability assessments are normally made at the mill laboratory via specialised devices such as a Holmen Tester or Tumbling Tester, a durability of >90% is realistic for most pelleted feeds.

These assessments involve placing a sample of feed through an aggressive process which is aimed at replicating the physical insults to the pellet in the field. This assessment allows the mill to know whether manufactured feeds meet physical quality standards.

Assessment of feed physical quality should not just be conducted at the mill, farm assessments give a good indication as to what is provided to the bird especially if the sample is taken directly from the feed pan.

This can be conducted via the use of a hand-sieving device, the procedure is straightforward and practical for most farms to conduct

There are many courses of action which the mill can take to improve poor feed physical quality. Behnke (1996) quantified the effect of different feed manufacturing processes on pellet durability, the main areas identified were grinding, conditioning and pelletising processes however changes in the formulation can also have an effect for example even a 5% addition of wheat-based materials can improve pellet durability very significantly. The key point is that poor feed physical quality is not acceptable and there are means to improve feed physical quality. ■

References are available from the author on request

Fig. 6. The effect of feed form on bodyweight from 0 to 20 wks of age.

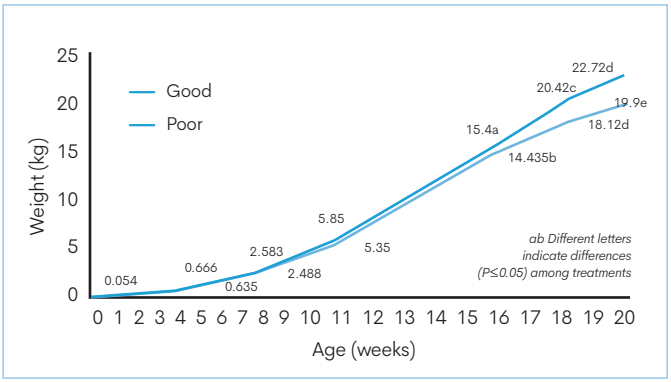


Table 2: Crumble particle size profile.

Particle size	<1mm	1 to 2mm	2 to 3mm	>3mm
Starter 1 (%)	0-10	45-55	30-40	0
Starter 2 (%)	0-10	25-30	35-45	10-15

SUMMARY

- Feed physical quality has a significant impact on turkey performance, perhaps significantly more than previously determined.
- Optimising feed physical quality not only supports farm performance but also improves processing yield.
- Communication of feed physical quality standards between the farm and the mill is vital to ensure that the needs of the modern bird are understood and met.
- There are several approaches to improving feed physical quality within the mill some of which do not involve significant investment.
- Monitoring of feed physical quality in the mill and also on the farm is vital to ensure that feed form is continuously meeting standards.

Breeder Production: producing the maximum number of viable chicks

In an increasingly challenging production environment, achieving even incremental performance improvements can have a substantial impact on final profitability. The primary goal of the poultry breeding industry is to produce the maximum number of viable, robust chicks.

Dr Alex Desbruslais, Senior Technical Product Manager, Anpario plc
www.anpario.com

This naturally relies upon optimising the quantity of fertilised eggs and the size classification of these eggs. In recent decades, genetic selection for rate of lay and egg size has substantially improved production, however, selection for high meat yield in the progeny is negatively correlated to reproductive fitness traits in the breeders increasing the complexity of optimising breeder production.

For this reason, genetic improvement may have reached its limit. Consequently, the industry must identify other areas that can impact reproductive fitness.

OPTIMAL GUT HEALTH AND BREEDER PERFORMANCE

Good gut health is increasingly recognised as essential for both health and performance. Numerous studies have found links between gut health and egg production/egg size/persistency of lay, which is thought to be related to interactions between microbiota-gut-liver/brain-reproductive tract axis.

Almost regardless of cause, a downturn in gut health is likely to result in reduced capacity to uptake nutrients. For example, coccidiosis can lead to gut lesions, damaging the villi on the absorptive surface and reducing nutrient absorption.

The presence of antinutritional factors such as non-starch polysaccharides causes digesta to be more viscous, reducing gut transit, sloughing villi and reducing nutrient availability and absorption. Imbalances of the gut's microbiota can allow the proliferation of pathogenic microbes, causing diarrhoea and/or inflammation, again reducing nutrient absorption. Unlike broilers, the breeder bird must partition of nutrients between their own maintenance and performance, and the deposition of nutrients in the yolk sack of the ova for females, or semen quality in the males. As such, optimal gut health is essential to facilitate nutrient absorption.

Historically, the use of antibiotics to both treat and prevent disease has masked many of the issues that we now recognise as factors that affect gut stasis.

However, with ever-increasing evidence of antimicrobial resistance, we need to dramatically reduce our reliance upon antibiotics and seek alternatives.

Whereas an antibiotic is designed to kill microbes, probiotics directly supply microbes believed to be beneficial to the gut, manually supporting the colonisation of these potentially beneficial microbes.

However, as with antibiotics, we know that bacteria mutate, potentially altering their function.

We are already starting to see research demonstrating potential pathogenicity and antibiotic resistance to some common probiotic strains, so maybe this is not the right approach either.

EUBIOTICS

Eubiotics provide a new approach to maintaining a favourable gut environment. Rather than manually manipulating the microbes in the gut as with anti and pro-biotics, eubiotics support the favourable microbes in the gut, facilitating the establishment of a balanced, healthy intestinal microbiome.

By achieving this, eubiotics help the host to prevent the occurrence of pathogenic colonisation and subsequent physical damage to intestinal structures, facilitating optimal functionality of the gut and therefore optimal absorption capacity.

OREGANO ESSENTIAL OIL

Oregano essential oil (OEO) is a eubiotic that has been widely researched and shown to support optimal gut function due to its antimicrobial, antioxidant and antiparasitic activities. Essential oils (EO) form the basis of a plant's defence mechanisms, acting as a type of immune system. EO is comprised of numerous compounds that each offer a function to protect the plant from microbial or physical attack.

Oregano essential oil contains over 100 different compounds including carvacrol, thymol, β-caryophyllene, linalool, γ-terpinene and ρ-cymene. The avian gastrointestinal tract is a complex and diverse organ, with both active and passive involvement in numerous systems and processes.

As such, no single compound is likely to improve every aspect. The complex composition of OEO facilitates its multi-factorial activity on multiple gut processes and immune challenges, therefore allowing the gut to function optimally, maximising absorption capacity and therefore optimal performance and minimal nutrient wastage.

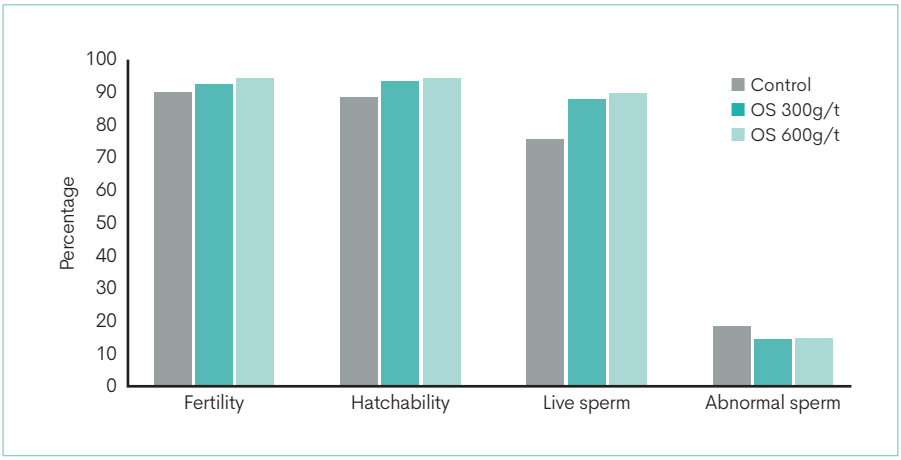


Fig. 1. Effect of Orego-Stim on broiler breeder fertility rate and egg hatchability, live sperm and abnormal sperm.

FERTILITY AND LAYING PERFORMANCE

The impact of gut health on reproductive performance is widely shown in both male and female breeders. Soliman et al., (2016) compared an untreated control to birds supplemented with Orego-Stim® (OEO-Based supplement) at 300 and 600g/t. The authors found that both inclusion rates of the OEO-based supplement significantly increased the fertility rate of the males, and the hatchability of fertile eggs compared to the control (Fig. 1).

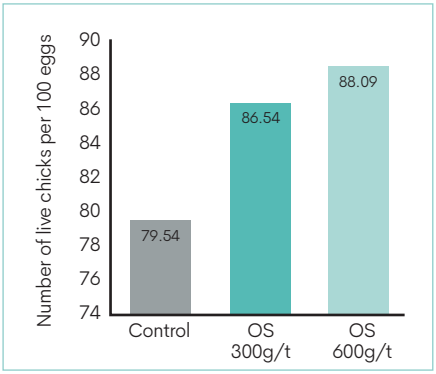
Likewise, the number of live sperm was significantly increased, and the number of abnormal sperm was significantly reduced.

The total number of sperm in the ejaculate and total volume of ejaculate were both also significantly increased compared to the control (data not shown).

Spermatozoa has a high content of phospholipids that are highly prone to oxidation.

As such, the antioxidant capacity of the oregano essential oil is likely the driving force behind improved semen parameters. Female breeder performance was also impacted with egg production per hen throughout the trial being increased by 3.8% for the 300g/t inclusion rate and 5.17% for the 600g/t inclusion compared to the untreated control.

Fig. 2. Effect of Orego-Stim on the number of live chicks hatched per 100 eggs laid.



When the number of live chicks hatched per 100 eggs laid was compared, the group supplemented with 300g/t of OS achieved an 8.8% increase, whilst the 600g/t group achieved a 10.75% increase in the number of live chicks hatched compared to the untreated control (Fig. 2).

ECONOMIC IMPACTS

The economic impact of many supplements is something that is sometimes overlooked and not fully extrapolated. However, in a market with increasingly small returns, the investment we make in both the diet and any additives utilised can make the difference between profit and loss.

Therefore, full economic analysis is essential.

When we look at the economics of these results in the context of commercial production, actual feed intake, number of eggs laid per hen and percentage of eggs producing live chicks per treatment, the results show that the supplementation of the OEO-based supplement at 300g/t resulted in an additional profit of $40.54 per hen per 16-week cycle (24-40 weeks of age).

For the 600g/t inclusion of the OEO-based supplement, the economic analysis found an additional profit of $51.42 per hen, per 16-week cycle (24-40 weeks of age) (Table 1).

This additional profit achieved, once the cost of feed and additive is fully accounted for is substantial and demonstrates the value that an effective additive can bring to production.

SUMMARY

There is no magic behind the efficacy of oregano essential oil with decades of scientific research and validation, demonstrating the role it can play in supporting health and reducing the need for traditional antimicrobials.

However, with spiralling costs, it can be tempting to remove health supplements from our management strategies.

Research consistently shows that optimal gut health not only facilitates optimal animal performance but also reduces the need for antibiotic intervention, thereby helping to reduce the threat of antimicrobial resistance. Orego-Stim is proven to support gut health, reducing the incidence of disease whilst supporting reproductive performance.

As such Orego-Stim can support the efficiency and profitability of breeder production. ■

References are available from the author on request

Table 1. Economic analysis of birds supplemented with Orego-Stim at two inclusion levels compared to an untreated control.

	Control	OS 300g/t	OS 600g/t
Total Feed Intake (Kg)	11.357	11.473	11.556
Feed Cost per kg ($)	2.640	2.667	2.693
Total feed cost per bird ($)	29.982	30.598	31.120
Total eggs per hen	67.38	69.85 +2.47 eggs	70.78 +3.4 eggs
Eggs producing a live chick (%)	79.54	86.54	88.09
Total live chicks per hen based on total eggs per hen and % of live chicks achieved	53.59 live chicks	60.45 live chicks	62.35 live chicks
Value of total breeder chicks produced per hen at $6/day old chick ($)	321.54	362.70	374.10
Net Revenue per hen after feed costs ($)	291.56	332.10	342.98
		+$40.54 per hen per cycle	+$51.42 per hen per cycle

Assumed costs: Feed $264/MT + cost of additives, breeder chick price of $6 per bird

Focus on Research

Evaluating Turkey-Derived Lactic-Acid-Producing Bacteria

Lactic-acid-producing bacteria (LAB) are widely used in the poultry industry, and they are positively associated with gut health and growth performance. Despite their wide use in poultry production, LAB appear to be highly variable in their ability to modulate poultry gut health and growth performance. Furthermore, most commercially available LAB probiotics are not host specific; thus, few poultry-specific and even fewer turkey-specific probiotics exist. The objective of this study **(Appl. Sci. 2024, 14(5), 2010)** was to use probiotic screening assays to compare relevant phenotypic differences amongst different species of turkey-derived LAB, in an effort to identify potential probiotics for use in turkey production. Different in vitro assays were used to compare the probiotic potential (phenotype) of each turkey-derived LAB isolate. Twenty-four isolates representing eight different species and five different genera were used for the experiments. These assays included acid tolerance, bile tolerance, and adhesion ability. There was variability in assay performance across many individual strains in every assay performed. Isolates between species and, in some cases, isolates within the same species, differed in their performance between the assays. Some isolates that were identified performed favourably in all the assays in this study. In conclusion, high-performing isolates were identified in this study, which hold potential for influencing turkey health and productivity.

A systematic review and meta-analysis of the sources of Campylobacter in poultry production (preharvest) and their relative contributions to the microbial risk of poultry meat

In this study **(Poultry Science Vol 102 issue 10, 102905)** a systematic review and meta-analysis were conducted to identify the relative contributions of the sources of Campylobacter in poultry live production to Campylobacter prevalence of broiler meat. The keywords prevalence, Campylobacter, live production, and broiler were used in Google Scholar to address the research interest. A total of 16,800 citations were identified, and 63 relevant citations were included in the meta-analysis after applying predetermined inclusion and exclusion criteria. A generalised linear mixed model approach combined with logit transformation was used in the current meta-analysis to stabilise the variance. The analysis revealed that Campylobacter is ubiquitous in the poultry house exterior environment including surroundings, wildlife, domestic animals, and farm vehicles, with a predicted prevalence of 14%. The recovery of Campylobacter in the interior environment of the poultry house is far less abundant than in the exterior, with a prevalence of 2%, including litter, water, insects, mice, feed, and air. A lack of evidence was observed for vertical transmission due to the day-old chicks being free of Campylobacter from 4 studies identified. Live birds are the predominant carrier of Campylobacter, with a predicted prevalence of 41%. Transportation equipment used for live haul had an overall prevalence of 39%, with vehicles showing a predicted prevalence of 44% and crates with a predicted prevalence of 22%. The results of this meta-analysis highlight the need to implement effective biosecurity measures to minimise the risk of Campylobacter in poultry meat, as human activity appears to be the primary factor for Campylobacter introduction.

Protective Effects of Carbonated Chitosan Montmorillonite on Vomitoxin-Induced Intestinal Inflammation

Exposure to vomitoxin (DON) can negatively impact the intestinal health of livestock and poultry, leading to compromised nutrient absorption and utilisation, resulting in slowed growth and reduced production efficiency. In this study **(Polymers 2024, 16(5), 715)**, the researchers synthesised carbonated chitosan montmorillonite intercalation complexes (CCM) through solution precipitation. The successful formation of intercalation complexes was confirmed by examining functional groups and surface features using infrared spectroscopy and scanning electron microscopy. To assess the impact of CCM on DON-infected mice, they established an experimental mouse model of jejunal inflammation induced by DON infection. The researchers analysed the effects of CCM on blood biochemical and conventional indices, jejunal inflammatory factors, pathological changes, and the expression of proteins in the MAPK pathways in DON-infected mice. The results indicate that CCM effectively mitigates the adverse effects of DON on growth performance, jejunal injury, and the inflammatory response in mice. CCM supplementation alleviated the negative effects of DON infection on growth performance and reduced intestinal inflammation in mice. Moreover, CCM supplementation successfully inhibited the activation of the mitogen-activated protein kinase (MAPK) signalling pathway induced by DON. These findings suggest that the mitigating effect of CCM on DON-induced inflammatory injury in the murine jejunum is closely linked to the regulation of the MAPK signalling pathway.

Synergistic Effects of Essential Oils and Organic Acids against Aspergillus flavus Contamination in Poultry Feed

Organic acids and essential oils are commonly used in the poultry industry as antimicrobials and for their beneficial effects on gut health, growth performance, and meat quality. A common postharvest storage fungal colonist, Aspergillus flavus, contaminates corn, with the highly detrimental mycotoxin, aflatoxin. Aflatoxin adversely affects poultry feed intake, feed conversion efficiency, weight gain, egg production, fertility, hatchability, and poultry meat yield. Both organic acids and essential oils have been reported to inhibit the growth of A. flavus.This study **(Toxins 2023, 15(11), 635)** evaluated if the inhibitory synergy between combined essential oils (cinnamon, lemongrass, and oregano) and organic acids (acetic, butyric, and propionic) prevents A. flavus growth. The study confirmed that these compounds inhibit the growth of A. flavus and that synergistic interactions do occur between some of them. Overall, cinnamon oil was shown to have the highest synergy with all the organic acids tested, requiring 1000 µL/L air of cinnamon oil and 888 mg/kg of butyric acid to fully suppress A. flavus growth on corn kernels. With the strong synergism demonstrated, combining certain essential oils and organic acids offers a potentially effective natural method for controlling postharvest aflatoxin contamination in poultry feed.

Efficient poultry manure management

The efficient treatment or appropriate final disposal of poultry manure (PM) to avoid serious environmental impacts is a great challenge. In this work **(Poultry Science Vol 98, Issue 12, Pages 6636-6643)** the optimization of a 2-stage anaerobic digestion system (ADS) for PM was studied with the aim of reaching a maximal methane yield with a short hydraulic retention time (HRT). The results demonstrate the technical feasibility of the two-stage ADS treatment of PM with a short HRT; the system tolerates variations in the total ammonia nitrogen concentration of PM throughout the year and achieves a high methane yield when the correct operational conditions are selected.

Determinant production factors to the in vitro organic matter digestibility and protein oxidation of poultry by-product meal

The quality of poultry by-product meal (PBM) is not standardised in the industry. Several factors are detrimental to PBM and compromise its nutritional value and shelf life. Therefore, this study **(Poultry Science, Vol 102, Issue 3, 102481)** was conducted to determine the main PBM production factors that directly affect its in vitro organic matter digestibility (IVDOM) and protein oxidation (POX). Data on the processing of PBM samples (n = 100) were recorded in a rendering plant. Two types of PBM were used: 1) Low ash (LA, n = 66) with mineral matter (MM) content of 11% and 2) High ash (HA, n = 34) with MM above 11%. Processing traits and chemical composition of PBM were considered independent variables. The IVDOM and POX were determined in each sample and considered dependent variables. Data on independent variables were submitted to factorial and principal components (PC) analyses. In vitro organic matter digestibility data were clustered (P = 0.001) in low (778.92 g/kg), average (822.85 g/kg), and high (890.06 g/kg). T
he best arrangement was composed of six independent variables distributed in two PC, which explained 82.10% of the total variation. The ash concentration, oil-to-raw material ratio, collagen, and crude protein comprised PC1 with greater relevance and explained 58.46% of the total variance. The PC2 was composed of the processing time and temperature and explained 23.64% of the total variance. Protein oxidation data were clustered (P < 0.001) in low (265.19 nmol/mg CP), average (393.07 nmol/mg CP), and high (524.40 nmol/mg CP). Based on our results, the composition of the raw material from the slaughterhouse holds most of the information on PBM composition and digestibility. Developing improvements in the slaughtering or in the screening of the raw material that will be used by the rendering process is important to obtain a more nutritionally standardised ingredient.

Bacillus amyloliquefaciens Probiotics Mix Supplementation in a Broiler Leaky Gut Model

The supplementation of antimicrobial growth promoters (AGPs) has been banned in many countries because of the emergence of antimicrobial-resistant pathogens in poultry products and the environment. Probiotics have been broadly studied and demonstrated as a promising AGP substitute. This study **(Microorganisms 2024, 12(2), 419)** is centred on the effects of a multi-strain Bacillus-based probiotic product on broiler production performance and gut microbial profile in a dexamethasone-induced leaky gut challenge.

Two hundred and fifty-six broiler chicks were hatched and randomly assigned into four groups (wheat-soybean meal basal diet (BD) = non-supplemented control (C), BD supplemented with dexamethasone in week 4 (CD), BD containing a probiotic from day one (P), and BD containing a probiotic from day one and supplemented with dexamethasone during challenge week 4 (PD)).

The production performance and caecal, gizzard, jejunal lumen and jejunal mucosa swab microbiota were studied by 16S rRNA gene sequencing. The Bacillus probiotic product significantly improved production performance and altered caecal gut microbiota ($p \leq 0.05$), but no significant impact on microbiota was observed in other gut sections.

International News

Revolutionary gradient lighting solution

Eindhoven, NL – Signify (Euronext: LIGHT), the world leader in lighting has launched Optient, a revolutionary lighting solution focused on optimising animal health and productivity, set to transform the poultry industry.

Developed in collaboration with one of the world's largest food companies and industry-leading poultry producer, Tyson Foods, Optient offers multiple unique advantages to poultry farmers.

Benefits range from improved animal welfare and feed conversion to reduced energy usage.

Drawing inspiration from nature and science, Optient uses non-uniform or gradient lighting to mimic the varied lighting environments found in the wild, promoting the natural behaviour of chickens, keeping flocks calm and stress-free and resulting in improved animal welfare.

By utilising energy-efficient LED technology, Optient can also reduce energy usage by up to 70%, making it a greener choice for poultry farmers.

"Optient is a revolutionary system. Designed with the welfare of poultry in mind, it creates lighting gradients across the barn floor enabling the birds to choose their preferred light intensity, leading to a happier and healthier flock.Our engineers, scientists and account managers have worked together to create this solution to fit Tyson Foods' need for responsible and sustainable farming. " Jeffrey Lewis, General told International Poultry Production

signify.com

VacuMite: Your Red Mite's worst enemy

VDL Jansen, a leader in innovative poultry farming solutions, unveils VacuMite, a groundbreaking tool designed to address the persistent challenge of red mite infestation in cage-free egg production.

Modern poultry farming comes with its own set of challenges, and one of the major concerns is the prevalence of red mites. In response to this issue, VDL Jansen has engineered VacuMite, an eco-friendly and animal-conscious solution that sets a new standard in the battle against red mite infestations.

VacuMite operates on a unique and efficient principle.

Specially designed perches with tiny holes create an environment where mites gather during the night.

During the day, VacuMite systematically extracts mites from their hiding spots with an airflow that is created by an under pressure in the perches, depositing them into a central collection bin in the technical room. This innovative approach not only ensures the welfare of laying hens but also supports farmers in maintaining control over red mite populations, ultimately enhancing the overall work experience for farmers.

VacuMite is designed exclusively for use with VDL Jansen's Comfort 2.0 and Comfort 2.0 Inside aviary systems, ensuring optimal performance and ease of integration.

It is possible, when building the aviary system, to prepare it for placing and installing the VacuMite system at a later time.

vdljansen.com

FDA Approval of Chromium Propionate

Kemin Industries conducted extensive research that served as the basis for the U.S. Food and Drug Administration (FDA) Center for Veterinary Medicine's approval of the use of chromium propionate as a source of chromium in growing turkey diets.

With this approval, chromium propionate is now approved for use in swine, broiler chickens, cattle, horses, and growing turkey diets. Kemtrace Chromium from Kemin is the only FDA-reviewed source of chromium propionate on the market today and has been fed to millions of animals around the globe.

Kemtrace Chromium is a highly bioavailable, organic source of chromium propionate that helps stabilise insulin receptors in animals, improving glucose utilisation and reducing the negative impacts of stress.

"We are thrilled that the use of chromium propionate in animal diets continues to expand in the U.S. and beyond," Kristi Krafka, Vice President of Regulatory Affairs and Quality Assurance, Kemin Animal Nutrition and Health – North America, told International Poultry Production.

"Kemin has spent decades advancing the nutrition and performance of livestock and poultry through novel feed ingredients and is now able to offer safe, effective Kemtrace Chromium to turkey producers, nutritionists, and veterinarians."

Results of a recent study indicate that chromium propionate (Kemtrace Chromium) supplementation can improve turkey performance and is safe when supplemented in turkey diets at five times the minimal concentration, which enhances insulin sensitivity.1 This study demonstrated:

• Over an 84-day feeding period, turkeys supplemented with chromium propionate (KemTRACE Chromium) had greater average daily gain and tended to gain more efficiently than controls.

• Body weights of turkeys supplemented with chromium propionate (KemTRACE Chromium) were heavier than controls by day 84 in studies published in the Journal of Poultry Science.

KemTRACE Chromium is manufactured at Kemin in Des Moines, Iowa, U.S. This facility has the Food Safety System Certification (FSSC) 22000, which is recognised by the Global Food Safety Initiative (GFSI) as a rigorous food safety management system, certified by approved third-party organisations.

kemin.com

New Guide for pathogen control in turkeys

Reducing the level of bacteria in poultry feed leads to a measurable improvement in gut health. Clean feed not only helps producers avoid incidences of clinical diseases but also reduces the impact of bacterial toxins and other, less visible, subclinical effects. To this end, Anitox recently released a new guide for turkey producers entitled "The Importance of Pathogen Control in Turkeys" The guide covers:

- Production stressors
- The risk of recontamination
- Implications of gut health
- Impact on productivity
- Termin-8 and Finio pathogen control for feed

Anitox continues to provide class-leading pathogen control, helping you get the most from your feed investment.

anitox.com

Non-invasive Near InfraRed technology

At the 2024 International Production and Processing Expo (IPPE) in January, Cargill launched Reveal Layers, a first-of-its-kind, non-invasive NIR technology to monitor the body condition of poultry. Cargill's Reveal Layers can help poultry layer producers get there. Using Cargill's innovative, non-invasive Near InfraRed (NIR) technology, producers and nutritionists have immediate access to body composition assessments of their hens.

Cargill's Reveal Layers uses NIR light technology to measure the bird's fat pads.

The results are then uploaded and analysed, providing producers and nutritionists with actionable data which can be used to adapt the diet to achieve the optimal layer body composition.

Not only could this trim feed costs, but it can also maximise egg production and boost profitability, setting a new standard in supporting the long-term performance of laying hens.

"Reveal Layers is part of Cargill's holistic approach to monitor body fat and egg production, supporting the producer and nutritionist to make educated decisions regarding the diet.

As we navigate the challenges of feeding a growing global population, these insights pave the way for more sustainable and efficient poultry production," Lieske van Eck told International Poultry Production.

cargill.co.uk

Devenish's sale of its North America division

Devenish Nutrition Group, the animal nutrition specialist based in Belfast Northern Ireland, announced that it has completed the sale of its North America division, Devenish LLC, and related assets to the South Korean-based agricultural and biotechnology Group, Easy Bio Corporation.

Under a licencing agreement, Devenish LLC will have exclusive use of the Devenish brand in the USA, Canada and Mexico.

The Devenish Group's other activities Internationally are unaffected by this transaction and will continue to be serviced by our Belfast-based business.

devenishnutrition.com

EW Nutrition acquires Biostabil product

EW Nutrition, a global provider of animal nutrition solutions, has acquired the Biomin Biostabil product line from dsm-firmenich.

The deal gives EW Nutrition ownership over an established and successful line of silage inoculants.

"The Biomin Biostabil line joins an innovative portfolio that has been growing tremendously in the last three years with the launch of Ventar D and Pretect D, our Feed Quality and Pigment lines acquired in 2021, and yet another momentous global launch coming up shortly," Jan Vanbrabant told International Poultry Production.

ew-nutrition.com

International New

Innovation, sustainability and collaboration

Looking ahead and forward planning have long been key elements to farmers' success – and bringing innovation and collaboration into the mix makes for a powerful combination. Producers have a fantastic opportunity to make the most of both at this year's British Pig & Poultry Fair, helping them to ensure a sustainable and low carbon future for their businesses.

Profiling exciting new technologies and advice on topics like disease management and alternative proteins, the Fair is focusing on the key themes of innovation, collaboration and sustainability.

"Ultimately, it is the job of everyone in the supply chain to work together to reduce the industry's carbon impact, and new thinking and technology provide some of the answers here," says Fair organiser Alice Bell.

Both pig and poultry producers stand to benefit from a new digital product from Livetec Systems, which will revolutionise biosecurity control and help farmers to contingency plan for any emergency, from flooding to a notifiable disease outbreak.

"This is critical when farm businesses are under pressure to respond quickly, as it details everything that those coming on to the farm will need to know, as well as informing the farmer of how these next steps will play out," says Julian Sparrey, Technical Director at Livetec Systems.

Egg producer, James Baxter, will join Livetec to speak about how a robust contingency plan saved him £45,000 in compensation alone, by saving time – and therefore mortality – before depopulation could start following an avian influenza outbreak. "What we really want to highlight is the importance of being prepared so you can react quickly to protect your business," says Julian.

Visitors to the Fair can listen to expert speakers in the specialist Pig and Poultry Theatres. "This is a chance to discuss the challenges and topical issues of the day," says Dr Charlotte Evans at AHDB. "As an industry we can tackle the road ahead together and celebrate our successes – it's all about collaboration and sharing ideas."

The headline sessions in each theatre will be the popular pig, egg and poultry meat outlooks, which will see speakers from throughout the supply chain share their views on the challenges and opportunities ahead.

Fair partner ABN will be looking at how precision feeding and finding sustainable soya replacements will be a key part of reducing carbon emissions and improving efficiencies. And lifecycle feed analysis will help them to determine their feed carbon footprint, says Danny Johnson at ABN.

"This enables them to benchmark where they are currently, before working together to explore alternatives to reduce their carbon footprint and improve their bottom line."

pigandpoultry.org.uk

New Distribution Partner for Canada

Intelligent nutrition company Novus International, Inc., today announced a new partnership with Halchemix Canada Inc., to provide amino acid and trace mineral products to the animal agriculture industry in Canada.

Halchemix will manage Novus product sales and distribution for Mintrex Bis-Chelated Trace Minerals and Mha Feed Additive.

The Novus technical services team will continue to support Novus customers as well as offer assessments to dairy customers through the C.O.W.S. Program.

Due to the complexity of its supply chain, Halchemix will manage the sale of Alimet Feed Additive but Novus will directly monitor its AIMS automated supply chain management system and the methionine source will be delivered by Novus trucking partner, Ruan.

novusint.com

Navigating Nitrogen: The Challenges

Nitrogen emissions or more specific nitrogen deposition, arising from farming practices and fossil fuel combustion, have emerged as a formidable challenge.

Stringent regulations, designed to safeguard air quality and protect sensitive habitats, have prompted farmers to navigate a complex regulatory landscape. Dutch livestock farmers find themselves at the forefront of a multifaceted battle: sustaining their livelihoods while addressing the urgent issue of nitrogen emissions.

Luckily, an increasing number of innovative technologies, insights and best practices are being developed that can be used in modern poultry farming to address emissions. The ECO Air Care solution has been developed by the Vencomatic Group and actively removes nitrogen from the stale air.

The Eco Air Care units clean the outgoing air by flushing it with process water containing sulfuric acid. The process water captures the emissions of ammonia, particle matter and odour.

This flushing water is collected in a silo and can be used on the farmland as a substitute for fertilizer and thereby contribute to circular farming. Poultry farmers are pleased not only with the demonstrably improved results in their flocks due to better air quality but also because it has been proven that 90% of the nitrogen is removed from the outgoing air.

The ammonia levels (which consist of more than 80% nitrogen) are removed from the air and are measured continuously with ammonia sensors.

This means that thousands of kilograms of nitrogen can be captured per barn per year. In the first ECO Air Care barn installation in the Netherlands, we have evidence: 7,000 kg of nitrogen was captured annually, enough to offset the construction of a thousand new homes!

Nitrogen reductions continue to challenge the Dutch farmers, industry, and political environment. Innovations like these will hopefully help to contribute ways towards a sustainable tomorrow. Discover more about the Vencomatic ECO Air Care.

Vencomatic.com

Update to the Aviapp platform

During a health monitoring session on the farm, it is very important to correctly interpret the obtained values. To further help poultry producers with this evaluation, Huvepharma has introduced the expected values in Aviapp.

The expected value is the average coccidiosis score at a certain age of the birds, month of the year, and country. This data is presented visually in Aviapp, showing the evaluation of the coccidiosis pressure in your flock against the expected value (long-term average).

With the addition of expected values to the Aviapp platform, we can now offer Aviapp users extra feedback and insights which can be used instantly to improve the performance of their flock.

huvepharma.com

Capture and destroy airborne pollutants

For the first time, farmers can capture and then destroy air contaminants using the BioOx Air Cleaning System.

BioOx Air Cleaning Systems, a system which captures and destroys airborne pollutants, today announces the launch of its patented biological technology for farmers.

BioOx Air Cleaning Systems uses the power of bio-oxidation, and there is not a single HEPA, UV or ionic based system on the market that offers complete localised air decontamination like BioOx.

While other systems struggle to filter out 0.3 microns, our bio-reactors offer complete contaminant destruction down to the 0.0001 microns and can clean air in large square footage facilities, such as poultry houses and other facilities used in animal agriculture.

"Our strategy is to use the existing, natural way the planet cleans itself and apply it and bring it indoors to where animals are, where people are, as well as open-air farms, that is our main goal," Dr Sam Sofer told International Poultry Production.

In our clinical test, we saw our Air Cleaning Systems had a significant impact on reducing the chicken mortality rate. Overall, the house which used our BioOx Air Cleaning System saw a 32% reduction in mortality over the control house without BioOx in our study.

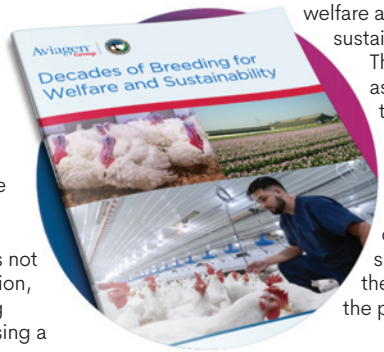
In our comprehensive, 20-day study with 20,000 chickens per house, the house with the BioOx Air Cleaning System running saw a 48% reduction of measured ammonia with the same vent time and vent box opening as the control house without our Air Cleaning System (both houses were identical in age and size).

bioox.us

Aviagen's update now available

Aviagen is pleased to introduce its latest publication, "Decades of Breeding for Welfare and Sustainability." This extensive update shines a light on the steady advancements Aviagen has made over the years.

Balanced progress in the breeding program has translated into continuous improvements observed in the field. Breeding for welfare and sustainability is not a final destination, but an ongoing journey, promising a continuous strengthening of bird health, welfare, efficiency, and sustainability. Explore Aviagen's leading-edge selection techniques that leverage the latest innovations in our breeding programs.



Most importantly, the publication highlights the inseparable connection between bird welfare and sustainability. These two vital aspects combine to ensure economic prosperity for poultry producers and contribute significantly to the preservation of the planet.

Aviagen.com

International News

NFU survey shows need for support

Producers of British eggs and poultry meat face an uncertain future without greater government support and supply chain reform, an National Farmers Union (NFU) survey has revealed.

The survey looked at the impact of the past two years on poultry production and farmers' intentions over the next two years.

It found that 24% of egg producers and 15% of chicken meat producers were either unlikely or unsure if they would still be producing poultry beyond November 2025.

The survey also highlighted some of the key concerns for both sectors, including:

- The risk of avian influenza (94% of egg producers and 92% of chicken meat producers were fairly or very concerned).
- The lack of fairness in the supply chain (90% of egg producers and 76% of chicken meat producers were fairly or very concerned).
- High energy prices (92% of egg producers and 61% of chicken meat producers were fairly or very concerned)
- Being undercut by imports (90% of egg producers and 78% of chicken meat producers were fairly or very concerned)

In order to better support the production of high quality British eggs and poultry meat, the NFU is calling for greater fairness in poultry supply chains, for poultry producers to be included in the Energy Intensive Industries scheme, and for a long-term strategy from government to be set ahead of any future outbreaks of avian influenza (AI).

nfuonline.com

Organic acid blend improves performance

Building on scientific insights about how organic acid blends influence gut health and growth, Selko conducted a study involving 646 broiler chicks evaluated the efficacy of a water acidifier containing a synergistic blend of free and buffered short-chain fatty acids (Selko-pH [SPH]) on growth performance, gut histology, and nutrient digestibility.

Birds were allocated into two treatment groups, an antibiotic-free corn-soya basal diet (control) and the same diet plus SPH supplemented at 1L /1000 L water.

Growth performance indicators, including body weight (BW), average daily feed intake (ADFI), average daily gain (ADG), average daily water intake (ADWI), and feed conversion ratio (FCR) were tracked for 35 days.

Additionally, researchers evaluated birds' gut morphology including villus height (VH) and crypt depth (CD) on day 14. Nutrient digestibility was assessed on day 35.

Findings reveal that birds receiving SPH had considerably enhanced growth performance throughout the entire production period.

Compared to control birds, the birds receiving SPH had a 5.1% greater BW, a 5.3% improvement in ADG, and a 9.3% lower FCR ($P<0.05$). Gut morphology improvements were observed in the SPH supplemented birds: significantly higher VH (1260.6 vs. 1050.8 µm, $P=0.002$) and VH:CD ratio (8.5 vs. 7.2, $P=001$).

Considering digestibility, SPH supplemented birds had an increased digestion coefficient for dry matter (78.6% vs. 73.3%, $P=0.05$), gross energy (75.6% vs. 71.5% $P=0.03$) and nitrogen (71.7% vs. 61.6% $P=0.10$) compared to birds in the control group.

There was no treatment effect on ADFI, ADWI, and mortality rate ($P>0.10$).

The study findings suggest that adding Selko-pH in water is a strategy that can enhance gut functionality and support broilers' growth performance.

selko.com

Strong exhibitor interest in EuroTier

The EuroTier 2024 exhibition, 12-15 November in Hanover, Germany, is attracting a large number of international companies. With 2,000 exhibitors from 51 countries already currently committed nine months before the exhibition kicks off, the world's leading trade fair for animal farming and livestock management is at pre-pandemic levels, according to the organiser, the DLG, (German Agricultural Society).

All leading companies from the poultry sector will be participating at the World Poultry Show, which will be part of EuroTier 2024.

Under the guiding theme "We innovate animal farming", the EuroTier innovation platform for the global livestock sector presents technical solutions and established standards for cattle, pig and poultry production.

For the first time at EuroTier, there is a focus on suppliers at a dedicated area at EuroTier for suppliers' solutions that support manufacturers of technical equipment and services.

"Supplier Industry – powered by Systems & Components", the name of the new area, is aimed at engineers and purchasing managers as well as system integrators for feeding technology, milking systems, transport wagons, presses and mixing and dosing systems.

EuroTier.com

EVENT DIARY 2024

Pig & Poultry Fair
15-16th May
Stoneleigh, UK
www.pigandpoultry.org.uk

Livestock Philippines
22-24th May
Pasay City, Philippines
www.livestockphilippines.com

Ildex Vietnam
29-31st May
Ho Chi Minh City, Vietnam
www.ildex-vietnam.com

Indo Livestock
17th July
Jakarta, Indonesia
www.indolivestock.com

Ildex Philippines
28-30th August
Manila, Philippines
www.ildex-philippines.com

AgriBITS 2024
5-6 SEPT
Utrecht, Netherlands
www.agribits.nl

VIV Select China 2024
5-7 SEPT
Nanjing, China
www.vivchina.nl

VIV Africa
Kigali, Rwanda
2-3 OCT
www.poultryafricaevent.com

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