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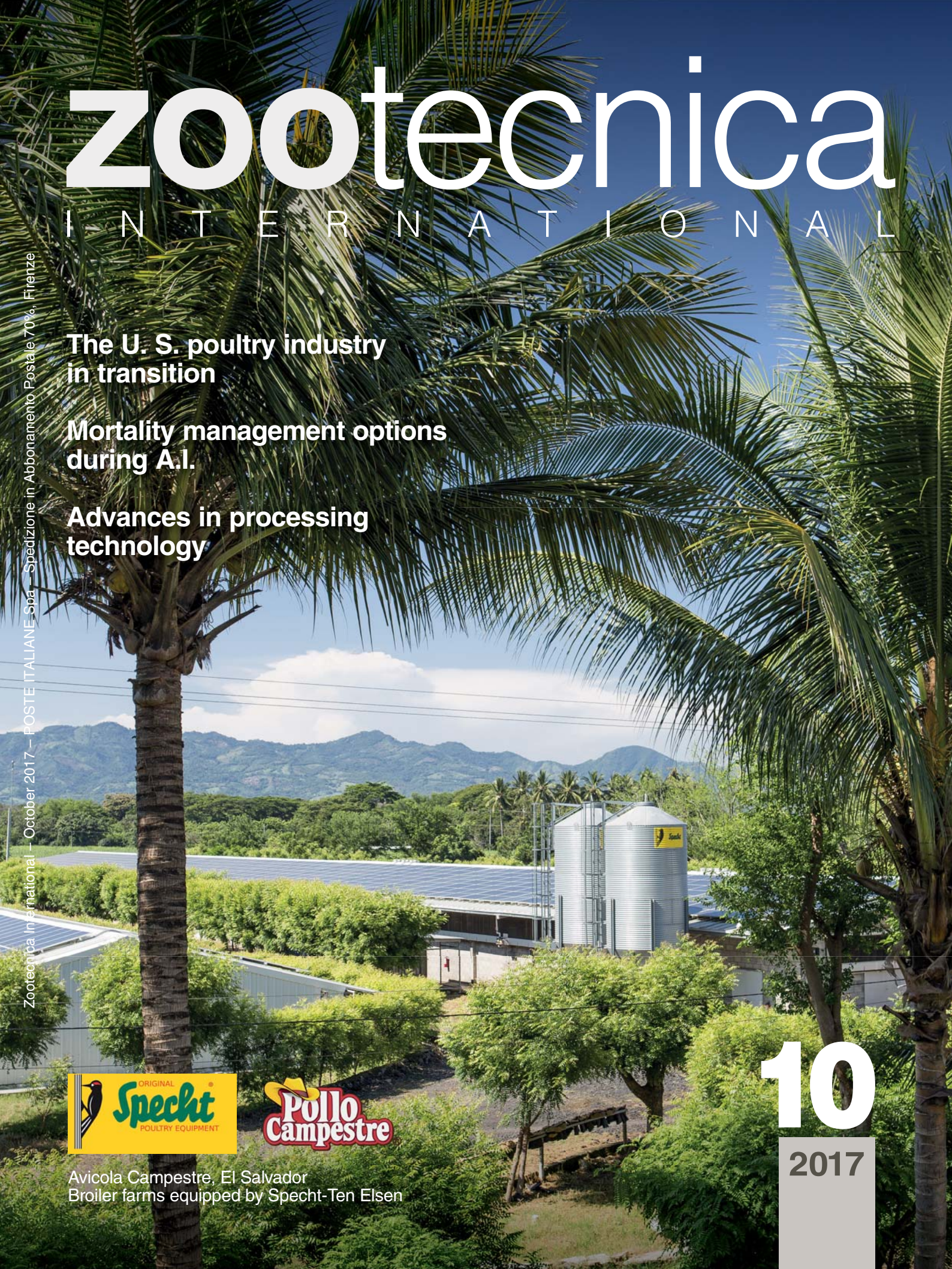
Zootecnica International – October 2017 – POSTE ITALIANE Spa – Spedizione in Abbonamento Postale 70%, Firenze

The U. S. poultry industry in transition

Mortality management options during A.I.

Advances in processing technology



Avicola Campestre, El Salvador
Broiler farms equipped by Specht-Ten Elsen

10
2017

EDITORIAL

In the 21st century, we've become completely dependent on automation. One need only think of transportation systems, household appliances and means of communication. Today microelectronics and computer science is even further changing the world of automation by the realization of 'intelligent' robots.

Fundamentally, progress can be thought of as the result deriving from market and research: the market must be receptive and accept the products of technology: research must find new products and new procedures for obtaining them.

In the economic world, we witness a race between basic research on one side, and market strategies on the other. Without being too alarmist, there is good reason to fear that man will have to pay a high price in this race. However, there is just as good reason to have hope instead.

In virtue of automation, we're undergoing a transformation of analogous significance to that which transformed the agricultural civilization of the past to the industrial era.

Thanks to the realization of new machines provided with increasingly sophisticated program sensory, man has made an ulterior step ahead. The "intelligent" machine independently individualizes work strategies, automatically selects the most valid alternative for achieving the desired results, and finally controls the entire operation. This does not mean that machine will completely substitute man, even if the advent of automation has eliminated a lot of manual labour.

Just as a tractor substituted many people with ox and plough, today we tend to reduce manual labour and optimize results. Just as an automatic feed distributor replaced the many people required in the past, today the application of computerization in automation permits the reduction of labour costs and the improvement of performance.

If agriculture, livestock production, factories and offices in recent years have experienced a greater reduction in manual labour, this does not mean that man will slowly be eliminated to make room for robots. Certainly times have changed, and it will be perfectly useless to continue to create hordes of doctors, teachers, engineers, architects and factory workers when society is changing to such an extent. It would be better to first coordinate research, schools and universities with the social system individualizing what will be the necessities of the future.

The possibilities of employing human resources are practically inexhaustible. There does not nor will ever exist a robot which equals the mind of man. The best sensor of images will always be the human eye. The telecamera will always be a more or less fortunate imitation.

The word "understand" will be never used for machines. No robot will ever be able to vehemently lift weights and in the same way, gracefully pick a flower.

Automation in factories, office operations, agriculture and livestock production is a concrete fact. The computer era has profoundly transformed the working and social activities of man.

Nevertheless, machines will always remain at man's service, that is, if man makes the correct use of them.

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SUMMARY

Newly funded network for livestock vaccines

Researchers from The Roslin Institute and Pirbright Institute lead a newly funded network to develop livestock vaccines.

The International Veterinary Vaccinology Network (IVVN) has been awarded £2.1M by the Medical Research Council and the Biotechnology and Biological Sciences Research Council to facilitate the formation of new partnerships that will contribute to the development of vaccines against livestock diseases that have major impacts on the health and productivity of animals in low-and-middle income countries (LMICs).

The IVVN will facilitate collaborations between scientists, industrial partners and others from both the UK and LMICs across the broad range of disciplines that can contribute to vaccine development by funding scientific meetings, workshops, laboratory exchanges and supporting 'pump-priming' projects.

Around 20 industrial and academic partners are already part of the Network. New members who have a scientific contribution to make or an interest in the aims of the Network are always welcome.

For further details please contact Dr Tim Connelley:
timothy.connelley@roslin.ed.ac.uk

29th Australian Poultry Science Symposium

The Poultry Research Foundation, in conjunction with WPSA - Australian Branch, cordially is pleased to announce the 29th Australian Poultry Science Symposium.

The Australian Poultry Science Symposium is the premier avian science conference in Australia, attracting delegates from right across the country and all around the world.

This years conference will focus on the theme of "**Poultry: Big Picture, Big Data, Big Future**".

The 2018 event is going to be another big one. They will again be holding the 3 day conference at Sheraton on the Park, Sydney. As was experienced last year, this venue offers access to high quality, spacious conference facilities and the inner city location allows for a vast range of accommodation options for delegates.

The main goal is to continue to grow the attendance of this conference over the coming years, from the 250 people currently, up to 300-400 delegates. To achieve this, excellent invited speakers featuring at the event are provided, as well delegates time to network and communicate offering a lively social program.

Event Dates: Sunday 4th Feb – Wednesday 7th Feb, 2018

Online Paper Submissions opened on Friday 30th June, 2017
http://sydney.edu.au/vetscience/apss/index.shtml

Major Topics

Broiler Breeder Nutrition
Low Protein Broiler Rations
Layer Hen Wellbeing

Hot Topics:

Consumer Views Big Data

Preliminary Invited Speakers

Stuart Wilkinson - Feedworks
Paul Wigley - UK Etienne Corrent - France
Nick Hover - Woolworths
Heather Bray - University of Adelaide
Rob Moore - RMIT Melbourne
John Dunn - Egg Farmers Australia
Patrick Garland - UK
Martin Krzywinski - Canada
Martin Zuidhof - USA

For more information please contact:
Tel. +61 2 9351 1656
Email: jo-ann.geist@sydney.edu.au

EAAP and FEFANA presented latest scientific research on the role of specialty feed ingredients

More than 1.000 participants registered to the 68th Annual Meeting of the European Federation of Animal Science (EAAP) from August 28th to Sept. 1st in Tallinn, Estonia, to follow the main theme of Patterns of Livestock Production in the Development of Bioeconomy.

For the first time, EAAP and FEFANA collaborated on presenting latest scientific research and application demonstrating the role of specialty feed ingredients in animal nutrition as a critically important part of the solution to address many challenges faced by livestock industries.

Dr. Emmanuelle Apper, Chair of the joint session, underlined that: "*Despite many years of research, we are still at the beginning of understanding the complexity of the animal gut and how to effectively improving conditions for sustaining animal health and welfare. New scientific findings presented during our session have demonstrated unique effects of particular special feed ingredients such as amino acids, probiotics, selenium yeasts and other trace elements to just name a few*."

FEFANA Secretary General, Joerg Seifert, adds "*It is thanks to the catalyst role of EAAP that a wealth of new scientific findings became available in most recent years. Through our organisations' partnership we stimulate further public-private research partnership into improving animal nutrition to meet key societal concerns such as mitigating environmental impacts, reducing the need for the use of antibiotics on farm and supporting animal health and welfare. Specialty feed ingredients play a key role, not only to sustain animal production but to also advance the EU agenda for innovation and growth*."

For any additional information please contact the EAAP Secretariat at eaap@eaap.org or visit www.eaap.org.

Left to right: Jan Henriksen, CEO Aviagen Broiler Breeding Group; Frederic Grimaud, CEO of Groupe Grimaud

GROUPE GRIMAUD to transmit HUBBARD to AVIAGEN GROUP

After 12 years of development in broilers genetics, GROUPE GRIMAUD transmits HUBBARD to AVIAGEN GROUP who will acquire 100% of the company shares.

GROUPE GRIMAUD made the acquisition of HUBBARD from MERIAL in 2005 and then, succeeded in its global footprint development in more than 120 countries, establishing solid positions worldwide through the main subsidiaries in the US, Brazil, France and Poland.

Over the last 15 years, the company has also sped up the development of a unique Premium products' offer (slower growing broilers) and conquered a strong position on this growing market segment.

With the on-going avian influenza outbreaks, export bans have significantly affected international genetic sales, especially in Asia and Middle East, and put at risk HUBBARD's development. In this context, GROUPE GRIMAUD seriously considered various consolidation options for the company's future. AVIAGEN`s purchase proposal has been evaluated as the best one for the future of HUBBARD's customers and employees, as well as for the global broiler industry.

HUBBARD will operate as a wholly owned subsidiary of Aviagen. It will remain an independent broiler breeding company with separate breeding and commercial activities, and will continue to be headquartered in France.

GROUPE GRIMAUD will keep on investing in its future development with more focused and specialized animal genetics and biopharmacy activities.

Frédéric Grimaud declares: *"In the circumstances faced by the industry over the past 2 years and which do not give any evidence of abating in the near future, the consolidation of HUBBARD within AVIAGEN GROUP is the best possible scenario for the future of the company, its customers and employees. It has not been an easy decision but we made it carefully and we are certain this constitutes a sound new starting point for Hubbard's development going forward. It is also an opportunity for us to refocus our business on the other species, as well as to develop our biopharmaceutical activities."*

About GROUPE GRIMAUD

Groupe Grimaud is a primarily family-owned entity, whose registered offices are located in Sèvremoine (49), France. Groupe Grimaud develops businesses in the animal genetics and biopharmacy.

Post divestiture of Hubbard, Groupe Grimaud generates 300 M€ in more than 100 countries through its subsidiaries and shareholdings employing about 1800 employees worldwide.

For more information:
www.grimaud.com - www.hubbardbreeders.com

The effect of feeding systems on feed structure and feed intake of commercial layers

Results of an independent and extensive study carried out by ABZ Diervoeding shows that more selective intake takes place with the chain than with the auger.

The purpose of the feeding system (chain/auger) is to ensure that the feed is distributed through the house as quickly as possible, providing all animals with a proportional amount of feed. Moreover, it is important that the feed composition calculated by the nutritionist is presented to the animals (across all sections). Selective eating is defined as eating a specific particle size or specific raw materials.

Results of an independent and extensive study carried out by ABZ Diervoeding shows that more selective intake takes place with the chain than with the auger. A chain gives the hens ample opportunity to pick coarse particles from the feed. As a result, the average particle size becomes smaller as the feed has travelled a greater distance in the chain. In the case of an auger, this is much more difficult for the hens, so that the effect of selective intake is significantly less (or almost non-existent).

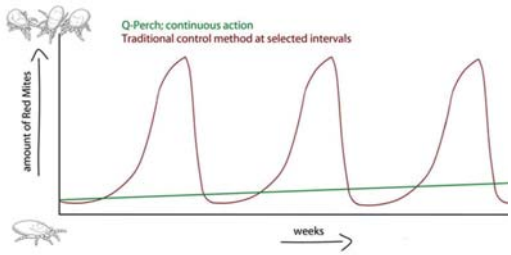
The speed at which the chain moves around during feeding has no or only a very minor effect on the degree of selective intake. The study revealed that occupancy plays a role in determining the degree of selective intake. Hens living at the bottom of the system have access to more incomplete feed than those eating at the top of the house. More selective eating results in the proportion of starch being decreased and the proportion of protein and minerals increased.

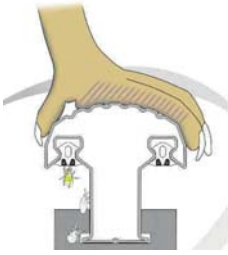
It is clear that selective intake can lead to a difference in production results. It can be concluded that selective intake with chains poses the risk of a nutritional imbalance.

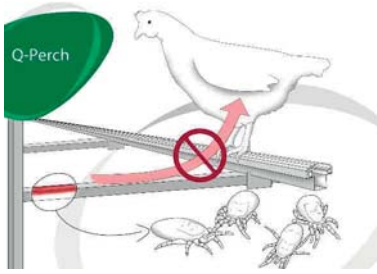
The Roxell company offers feeding systems with auger: **BRIDOlay for layers** and **BRIDOmat for broiler breeders**.

Source: ABZ Diervoeding article https://www.abzdiervoeding.nl/legpluimvee/voerstructuur-leghennen

For further information: www.roxell.com







Prevention is better than cure

Vencomatic Group launches its revolutionary Q-Perch

Vencomatic Group proudly launches their solution to control red mite. Red mite is a parasite that is on average present on 83% of European poultry farms and causes many losses. The introduction of red mite in a poultry house is almost inevitable. On top of that, trends like extending the laying cycle and a shrinking number of options in pesticides contribute to the problem. This makes the importance of fighting this parasite vital for poultry farmers.

The revolutionary Q-Perch is a mechanic solution that controls red mite based on their natural lifecycle. In short: it withholds from eating and thereby prevents them from reproducing. The Q-Perch (patented) is a perch containing two barriers that kill red mite on their journey towards the chicken. There is a small electrical current running through the barriers with which the chickens cannot come into contact, but is lethal for red mite.

Since the red mite cannot reproduce without feed, the population never increases, and thus this solution makes the use of pesticides redundant. Traditional methods of red mite treatment are reactive. Once the effects of red mite become visible, one will start treatment. The Q-Perch offers a continuous line of defence preventing the negative effects of red mite to occur, and of course, prevention is better than cure.

Maximum perching comfort

The mushroom shape of the Q-Perch is studied to be the most comfortable shape for chickens, as it offers stability and grip. Therefore the Q-Perch is beneficial for animal health and welfare, which in turn benefits the farmer as the chickens perform better.

Since 2013 the poultry specialists of Vencomatic Group have been running field tests to validate the functioning of the Q-Perch and to optimize its use. In all trials, the red mite population could consistently be controlled with the Q-Perch persistently, and use of pesticides was not necessary. The system is available in Vencomatic aviary systems.

More information
http://www.vencomaticgroup.com/en/products/layers/housing-solutions/q-perch

VAL-CO® Open House in Panama

Leading manufacturer celebrated completed tunnel ventilated broiler house with Panama's Bishop and the Mayor of Santiago.

On June 19th, 2017 the Agricultural Institute of Jesus the Nazarene held an open house celebrating the completion of their first fully VAL-CO equipped tunnel ventilated broiler house. The Agricultural Institute is a technical school sponsored by the Catholic Diocese of Santiago tasked with providing education to low income students in the management of poultry farms.

Many large Panamanian producers attended the opening including Grupo Melo, Empresas Toledano, Agro-Pecuaria Buen Pastor, Agropavas, Avicola Franz, Grupo Athanaziadis, and Cooperativa Juan XXIII. Also present were Panama's Bishop and the Mayor of Santiago.

The tunnel ventilated broiler house is completely outfitted with VAL-CO equipment: Fans, inlets, bins, fill systems, FUZE® Pro-Line pan feeders, Quencher drinkers, evaporative cool pad systems, tunnel doors, automated controls, brooders, and Bin-TRAC® weighing systems. With tunnel air speeds of over 700 feet per minute (3.5 m/s) and housing around 46,000 broiler chicks the house will serve as a model for the local poultry industries.

About VAL-CO®

VAL-CO is a leading manufacturer of production equipment for poultry and pigs, creating new and exciting products based on innovative thinking, technical research, and field experience. By controlling the manufacture of all the components, VAL-CO engineers its products to work together as complete systems, where compatibility is not only preferred but essential.

In addition to its North American facilities and extensive dealer network, VAL-CO maintains manufacturing, sales, and support operations in Europe, Asia, India, and South America. VAL-CO practices its corporate commitment – Performance You Can Count On – through a relentless pursuit of knowledge, continuous improvement, excellent field representation, and the production and distribution of the highest quality products in the industry. VAL-CO prides itself in driving innovation through product development, providing its customers with premier next generation products and systems that help to ensure success in poultry and pig production operations. Over 255 combined years of industry knowledge and corporate history, a worldwide presence, and a commitment to providing leading products and technical support make VAL-CO a key business partner, whose performance you can count on.

For more information about VAL-CO or VAL-CO products, please visit **www.val-co.com** or email **intl.sales@val-co.com**

Interview with Mr Albert Jansen, Jansen Poultry Equipment

During a recent visit to the company headquarters in Barneveld, The Netherlands, Zootecnica International had the opportunity to meet ***Mr Albert Jansen, the founder and director of Jansen Poultry Equipment****, to discuss the technical developments that have occurred in the poultry equipment sector over the past years and how his company faced them.*

Albert was responsible for designing the first automatic nests in an effort to make life easier for his father, who farmed broiler breeders. The result was the Jansen automatic nest which revolutionised egg collection.

"*My father was a broiler breeder farmer and he had about 7000 broiler breeders. I chose a career in engineering but helped on the family farm at weekends. Do you know who make the biggest innovations? Lazy people. I was really irritated by the number of floor eggs and dirty and damaged eggs laid in the hand collection nests, and so I set about developing an alternative. As a technical engineer, and by studying the behaviour of the hens, I designed the first automatic laying nest and that was the start of the Jansen Poultry Equipment company in 1986.*

Meeting the needs of birds to improve the results of poultry farming - that is my philosophy. The farmer must have the opportunity to rear his own birds in the best possible way while at the same

Albert Jansen, the founder and director of Jansen Poultry Equipment

time have the possibility of achieving good economic gains. Today this is still the main principle in the design criteria of all Jansen's poultry equipment.

My first automatic laying nest was a labour saving tool and gave cleaner eggs, with no cracks.

The success of this product opened up new possibilities for the development of complete poultry house equipment.

At the beginning, I started with one employee and we sold our products only in Holland. I remember my first time at the VIV Europe exhibition in Utrecht and my first international customer - the Swedish company Blenta."

The Jansen Poultry Equipment company expanded from 1 to 130 employees and is now a world-leader in turnkey poultry housing for broiler breeders, layer breeders, layers, pullets and broilers.

The company has started a renovation of its premises in Barneveld which will soon be completed. This improved accommodation will provide the staff of Jansen Poultry Equipment the opportunity to work in one single location including the factory and the logistic centre.

Albert, can you describe the technological evolution observed in the poultry industry over the past 40 years?

"*In the broiler industry technology has focused on improving the hygienic conditions of birds by reducing ammonia production. Every system in poultry farming has to be properly cleaned in order to remove dust, feathers and other contamination. It is very important to keep the birds healthy. This means less use of antibiotics, a higher liveability, healthy*

lungs and, in the case of broilers, good quality of the breast, legs and feet. In the past when you went into a broiler house you could smell a strong odour of ammonia and you could see thousands of birds walking on the dirty manure, damaging their feet. A way to improve the health of the broilers is to separate them from their litter by special slatted floors and manure belts. Clean slats dramatically decrease the use of antibiotics because clean accommodation is an efficient weapon towards reducing the use of medicine in farming. As I wanted to create a clean and ammonia free area for the birds, we developed the BroMaxx broiler colony system with input of Dr Nagel. With the passage of time this idea has been copied by a lot of companies.

With regards to layers, the ban of conventional battery cages in Europe has revolutionized the whole poultry sector by causing profound changes in poultry equipment. However, with the pretext of making the hens happier, we have lost sight of the fact that hens and their eggs are now less controllable from a hygienic and healthy point of view."

And what about the evolution of your products?

"*During the years, my company took out a lot of patents for its inventions and products in the breeder, layer and broiler sectors. The first aviaries were developed in the late 90's by us to meet the new ideas on animal welfare in poultry housing. We offer various types of aviary systems that meet the specific demands of farmers. Jansen Poultry Equipment has about 30 years experience in developing systems for poultry housing and this knowledge is now being applied to emission reducing products. Air-scrubbers, manure drying systems and heat exchangers decrease the emission of ammonia, fine dust and odours. For example, our AutoShov litter removal system can be turned on every day and easily removes excess litter from under the system and then drops it onto a cross conveyor belt at the end of the system. By doing this, the litter stays loose and the manure is removed out of the house, resulting in a 20% reduction of ammonia and fine dust. Besides this, the AutoShov saves you a lot of hard work by loosening the litter every day.*"

The EU egg market is penalised in comparison to the international one. What is your opinion about this?

"*The big difference between the European and the American, Asian or Australian egg industries is that in Europe the legislator has decided on how hens should be reared, while in other countries, such as the United States or Asia, it is the market and the big companies that decides how birds should be managed.*"

Which areas do you consider the most interesting for market evolution?

"*The most interesting areas for Jansen Poultry Equipment are the Far and Middle East as well as the American market. In Europe, we focus much more on the broiler sector and on emission reducing products. As regards Russia, after a couple of years on stand by, the Russian poultry industry step by step is starting up once again.*"

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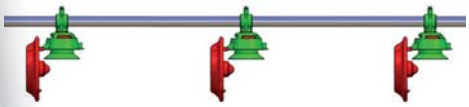
- Cage version also available.

Automatic opening of the whole line in **ONE SECOND!**



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Agritech: a big party for the 30th Anniversary

A big party recently saw 120 guests from all over the world joining together to celebrate the anniversary of Agritech, the silos manufacturing company.

Held at Villa Nember in Calvisano on June 30th the party saw 120 guests from all over the world joining together to celebrate the anniversary of the silos manufacturing company established and managed by Mr Zappettini since 1987.

English, Spanish, German, French and Chinese: for one evening, the enchanting set of Villa Nember in Calvisano has transformed into a colourful, international meeting point. Many customers from all over the world participated in the big party organized for the 30th anniversary of Agritech, the well known Italian company manufacturing fiberglass silos, feed transport solutions and modular housing systems for animal breeding. Established in 1987 as an initiative of Mr Zappettini, Mr Giambattista Tosini and the passed away Mr Andrea Mutti, the company has constantly grown, firstly developing silos in different versions and then calf shelters, horse boxes, fans, modules for weaning piglets, tanks, screw conveyors and other equipment for animal farms.

Agritech was established in the heart of the fertile Po valley in the district of Brescia (Italy), but since the very beginning the company has addressed itself to the international market. "*We immediately understood that we would have to go*

AGRITECH

beyond the borders to keep growing," - Mr Zappettini precised after the blessing prayer in the new showroom and before the dinner at Villa Nember – "*That's why we first looked at France and Germany, then to Northern America, China, Thailand, South America and, recently, to Oceania*."

85% of the company's sales revenues is generated by the export on a total turnover of Eur. 12.000.000 in 2016. Agritech serves more than 60 countries worldwide and it employs 50 people who also took part in Friday's celebration as one big family.

lished 1996 to design, manufacture and supply storage and metering plants for bulk industrial products, such as chemicals and foodstuff. In 1999 **Eltech** was founded to serve the green energy sector and soon after **Spirotech**, that has specialized in the production of bulk material conveyors.

Agritech also founded a subsidiary company in Slovakia and is a shareholder in another two joint venture companies in China and Thailand.

The group of companies coordinated by Mr Zappettini employs totally 130 persons (250 adding the participated foreign companies) and generates an yearly aggregated turnover of Eur. 29.000.000.

"Agritech, the well known Italian company manufacturing fiberglass silos, feed transport solutions and modular housing systems for animal breeding, recently celebrated its 30th anniversary"

"*We've always aimed at doing business in accordance with moral values and in full respect of the people involved in the company at all stages; of course, we've always kept an eye out for profitable results too, thus granting safe continuity to our 30-year-history*" – Mr Zappettini added.

As a consequence of this vision, some daughter companies originated from Agritech over time. We have **Poly 3** producing special paints and gel-coats for the fiberglass industry since the late 80's; **Intech,** lead by Mr. Giuseppe Tosi, was estab-

Mr Zappettini concluded: "*I want to thank all our collaborators, my family and their families, the community of Calvisano, customers and suppliers; we want to continue our history keeping at the same values that lead us to celebrate today's anniversary, that is creating job opportunities and being firmly convinced that persons must remain our core interest, and that persons come before money and all the rest.*"

Avicola Campestre chooses SPECHT

In the Central American Republic of El Salvador, the company Avicola Campestre has been working successfully for years with the world-famous well-known house equipment's of the SPECHT brand.

Thanks to the high-quality house equipment's of the brand SPECHT, produced by TeSo Ten Elsen GmbH & Co. KG, at their plant in Sonsbeck/Germany, Avicola Campestre, as a company of the Grupo Campestre, has increased their good results, which are also based on their 19 years of experience in production, processing and exploitation of poultry and poultry products, so that these products are not only used in super-markets and hotels, but also in their 37 own restaurants "Pollo Campestre" across the country.

The increase in production obtained by the SPECHT batteries and a simultaneous improvement in feed conversion are the decisive points of the future expansion of the production sites.

Avicola Campestre is well positioned for the future by the fact that all organic waste and sewage, as well as the poultry manure are processed, in a biogas plant that produces biogas fuel for steam generators. The production of biogas and the photovoltaic panel systems, which are installed on the roofs of the chicken houses, also contribute to the fact that Avicola Campestre is now one of the leading companies at national level in the sector of renewable energies.

The U. S. poultry industry in transition

The U.S. poultry industry is confronted with new challenges which ask for a reaction. One challenge is the growing demand for cage-free eggs, the other, the increasing number of food retailers and restaurants to use or sell only meat from slow-growing broilers by 2024.

Hans-Wilhelm Windhorst

Professor emeritus and Scientific Director of the Science and Information Centre for Sustainable Poultry Production (WING), University of Vechta, Germany

The egg industry in the northern Midwest has not yet fully recovered from the Avian Influenza outbreaks in 2015 and forced them to implement cost-intensive new bio-security strategies. The transformation from conventional cages to alternative non-cage housing systems will not only cost about 10 billion US-$ but can also lead to severe economic problems if the process will develop uncoordinated. The broiler industry was not affected by the AI outbreaks in 2015, a few cases in Kentucky and Alabama in early 2017 could be confined to a small area. The announcement of several food retailers, food producers and restaurants in early 2017 to switch to meat from slow-growing broilers has caught them rather unprepared, however.

In this paper, an overview will be presented on the present situation and the future perspectives.

Cage-free - the new magic word

When California decided by ballot in 2008 to prohibit conventional cages from 2015 on and also the selling of eggs from this housing system, several egg producers either transformed their hen houses to a colony nest system or built new non-cage farms. Most of the non-cage farms were built in adjacent states to supply the California market.

Between 2010 and March 2017, the inventory of hens kept in cage-free systems increased from 12.2 mill. to 39.9 mill. birds. This equals 12.7 % of the total laying hen inventory. Of the 39.9 mill hens 13.9 mill. are kept in organic production systems. Besides California, several other states will also ban conventional cages between 2020 and 2025. These initiatives will be, however, of minor importance because of the announcements of 219 grocery stores and food companies to no longer list or use eggs produced in conventional cages.

For the future development of the egg industry in the USA it is of particular interest which grocery stores and companies request which amount of cage-free eggs at what date. In *Table 1*, the projected demand of cage-free eggs in 2025 is documented. Grocery stores will request 46.9 billion eggs which equals 76 % of the total projected demand, followed by restaurants, foodservice and food manufacturers. In total 223.7 mill. laying hens, or 71.3 % of the 2017 laying hen inventory, will be needed in 2025 to produce these eggs. It is obvious that the grocery stores and restaurants will play a decisive role in the transformation process.

In a presentation at the Business Conference of the International Egg Commission (IEC) in Monaco in early April 2017, Chad Gregory, president of the United Egg Producers, declared that the present situation could only be described as “a mess” and that he was afraid that things might even become worse over the next years.

Which are the main problems that obviously prevent a coordinated transformation?

In contrast to the EU, where directive 1999/74/EC was a compulsory legal basis for the egg industry, defining as well the permitted future housing systems as the date by which conventional cages were no longer allowed, no such directives or bills exist in the USA. Presently, several non-cage systems have been or will be installed but it is a still open question if these systems will be accepted by the leading food retailers and restaurants as “cage-free”. Another problem which impedes the decision of the egg industry to switch to cage-free housing systems is the fact that the companies announced that they will no longer sell or use eggs produced in conventional cages by 2025, but they did not announce how many cage-free eggs they want to be delivered at which date. In some announcements the companies leave the door open for further negotiations depending, as they declare, on the price development for eggs and the consumer behaviour. This makes it complicated

for the egg industry to develop a strategic time table for the transformation of their housing systems.

A major problem is also the lacking experience of farm managers and employees with non-cage systems. Higher mortality rates and less marketable eggs reduce the profitability. A lot of educational work will be necessary to reach a European standard.

Another problem has already become obvious. The construction of large non-cage complexes with millions of layers has led to a sharp increase of the laying hen inventory and of egg production (*Table 2*). This will lead to lasting low egg prices if the surplus cannot be exported as shell eggs or as egg products.

From the experience in the EU one can expect that many egg producers will wait with the transformation as long as possible. This may then result in a shortage of cage-free eggs and problems in the availability of the necessary equipment for the new housing systems.

Until the ballot in California in 2008 most of the egg producers were of the opinion that a banning of conventional cages similar to the EU would never happen in the USA. Things have changed, however, completely within a few years. It will not be necessary to pass a bill which prohibits conventional cages, as was planned with the Egg Bill of 2013, which did not pass Congress. The decision how eggs will be produced in future has already been made by the grocery stores and food companies. The egg producers can either quit producing eggs or switch to alternative housing systems.

Slower-growing broilers – no longer just a campaign

Once the battle over housing systems in laying hen husbandry had been decided, animal rights activists started a new campaign to force the U. S. broiler industry to a transition from conventional fast-growing birds to slower-growing broilers. It is obvious that they have been very successful so far as already several foodservice companies and restaurants announced that they will completely switch to slower-growing broilers by 2024 raised according to the standards of the *Global Animal Partnership*.

These standards demand the use certain breeds with limited weight gain per day, sufficient space for the chickens to express their natural behaviour, enrichments in the confined houses (liter, straw bales etc.) and controlled atmospheric stunning prior to slaughter.

In 2016, already nine companies declared that they would transit their broiler supply following these standards by 2024. In the first quarter of 2017 18 more companies announced that they will only use or sell meat from slower-growing broilers by 2024 (WATTAgNet, April 6th, 2017).

As was to be expected, other animal rights organisations supported their decision, such as *Mercy for Animals* and the *Humane Society of the United States*, and appealed to other foodservice companies, restaurants and grocery stores to join them.

With the exception of Applegate Farms, a subsidiary of Hormel Foods, no other broiler companies announced that they would

Table 1 *Projected demand of cage-free eggs in the USA by 2025 (Source: United Egg Producers)*

Food Category	Requested eggs (mill.)	Share (%) in total cage-free demand	Laying hens needed (mill.)	% of 2017 inventory
Grocery stores	46,920	76.0	170,1	54.2
Restaurants	7,612	12.3	27,6	8.8
Foodservice	3,522	5.7	12,8	4.1
Food Manufacturers	2,240	3.6	8,1	2.6
Discounters	580	0.9	2,1	0.7
Hospitality and Travel	223	0.4	0,8	0.3
Others	618	1.0	2,2	0.7
Total	**61,715**	**100.0**	**223,7**	**71.3**

switch to slower-growing breeds and the standards of *Global Animal Partnership*.

Why have the animal rights organisations been so successful? At the Animal Agriculture Alliance Stakeholder Summit 2017 (Kansas City, Missouri) Ken Opengart (Keystone Foods) and Matt Salois (Elanco Animal Health) summarised the strategy of the animal rights activists as follows (WATTAgNet May 5th, 2017): They operate with the large numbers of broilers, use easy to understand words, play on the people´s emotions and force the companies to develop new brands for such broiler meat or meals.

It can be expected that these activities will develop their own dynamics and finally reach a similar result as in laying hen husbandry. The broiler industry should not underestimate the recent trend. The share of slower-growing broilers in the Netherlands, France and the United Kingdom document that consumers are willing to pay more for these broilers once they are informed about the ways these broilers are raised and the improved animal welfare.

Table 2 *The development of the table egg layers inventory and of table egg production in the USA between 1996 and 2016 (Source: U.S. Egg Industry Center)*

Year	Layers (1,000)	Index (1996 = 100)	Eggs (mill.)	Index (1996= 100)	Laying rate (eggs per hen)
1996	245,300	100.0	64,730	100.0	263.9
1998	255,392	104.1	67,446	104.2	264.1
2000	269,900	109.9	71,453	110.4	265.0
2002	278,344	113.5	73,835	114.1	265.3
2004	283,641	115.6	76,384	118.0	169.3
2006	288,223	117.5	77,936	120.4	270.4
2008	280,132	114.2	76,854	118.7	274.4
2010	283,450	115.6	78,892	121.9	278.3
2012	291,820	119.0	82,183	127.0	281.6
2014	309,162	126.0	88,385	136.5	285.9
2016	308,962	125.9	89,219	137.8	288.8

Summary

The preceding analysis could document that the U. S. poultry industry thoroughly misjudged the success of animal rights organisations until 2008. After the ballot in California, their activities developed their own dynamics. The United Egg Producers tried in vain to pass an Egg Bill in Congress in 2013 which was also supported by the Humane Society of the United States. Lobbyists from the cattle and swine industries were able to stop this initiative. But then the leading grocery stores, restaurants and food manufacturers took over the initiative announcing that they would no longer sell or use eggs produced in conventional cages and that they would switch to cage-free eggs. A bill was no longer needed and the egg producers have no choice, they can either quit egg production or transit to other housing systems within the next years. Their arguments do not count any longer. A similar dynamics can be observed presently in broiler production. Here, too, the campaigns of the animal right organisations have been very successful so far. Even though the number of companies which announced a transit to slower-growing broilers is still much smaller than in in egg production, it can be expected that it will grow fast within a few years and challenge the broiler industry to react.

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Broiler houses Wouters, St. Lenaarts, Belgium

Clima+ 3.5

Foot pad detail

Climate optimisation in poultry houses improve bird performance Agro Supply expands range of heat exchangers

Agro Supply – market leader and trendsetter when it comes to heat exchangers (Clima⁺ units) for poultry farming – expands the range of Clima⁺ units with high capacity units of 27,000 and 31,000m³/h. For more than 20 years, Agro Supply's heat exchangers are known for the highest energy efficiency available in the market, referring to the favorable ratio between fan power consumption and the amount of heat/energy recovered. Heat exchangers make an important contribution to an improved poultry house climate for all types of poultry.

Thanks to the expansion of the range, an optimal fit of Clima⁺ units is possible in poultry houses from 13,700m³/h to 31,000m³/h. From 31,000m³/h or more, two Clima⁺ units can be installed. It is not recommended to blow air into the poultry house at one place with capacities above 31,000m³/h as this would results in inefficient turbulent air flow.

Vencomatic Group
Agro Supply – Prinzen – Vencomatic

Need for measuring fans

"*Power consumption is a critical point of heat exchangers. When high pressures occur in the machine, the electrical consumption of the fans increases significantly and the overall machine's efficiency reduces*", explains **Victor van Wagenberg – Product Manager at Agro Supply**. "*By means of an aerodynamic design, the pressure drop at maximum capacity is not higher than 175 Pa at our standard heat exchangers. This allows the use of low-noise and energy-efficient fans. At higher pressures, fans need to make turns which significantly increases both power consumption and noise production*".

Agro Supply's heat exchangers always make use of measuring fans. Measuring fans are driven by the passing air flow, they determine the actual air flow and its velocity.

"*Sending a signal to the fan without measuring fan does not guarantee air is actually moving in the requested amount. For example during the first period of the broiler production cycle the negative pressure in the house, is 0 Pa because the main ventilation is off and the house is only ventilated through the heat exchanger. After switching on the main ventilation, there could be for example 20 Pa negative pressure in the house. This 20 Pa must be overcome by the exhaust fan, the measuring fan corrects this and ensures the promised capacity is actually achieved,*" Victor explains.

Guaranteed airflow is important because the heat exchanger is part of the minimum ventilation. Using the measuring fan enables us to guarantee the air output of the heat exchanger.

Birds perform better

Climate optimisation in poultry houses will improve bird performance. Air quality improves, CO_2 levels decrease and the air in the poultry house will have lower moisture level. This will uphold the quality of the litter, resulting in less footpad lesions. Various independent

Measuring fan

broiler studies also show an additional growth of 1 gram per day or more, and a 2-point lower feed conversion. The use of the Clima+ unit yields >70% savings in heating costs, however, the biggest gain is achieved through the improvement in bird performance, this holds for broilers, breeders and layers.

Opportunities in legislation

In recent years, the Clima+ unit has received recognition for ammonia and particulate matter reduction. The heat exchanger filters the outgoing air leaving 80% of fine dust in the exchanger. Together with its customers, Agro Supply invested in costly metrics which resulted in official recognition for reduction of ammonia emission and fine dust. With a capacity of at least 1.0 m^3/h per broiler, a fine dust emission reduction of 31% is reached. A few years ago, a capacity of 0.35 m^3/h per broiler was the standard for a heat exchanger. Now we see a tendency towards increasing capacities because benefits in terms of climate, energy and bird performance then increase. By expansion of the Clima+ range, it is possible to offer each customer the optimal solution.

Practical experiences

Poultry farmer Brent Wouters, St-Lenaarts Belgium:

"We are convinced that it is a sustainable and high quality product. The more air reaching the broilers, the better they grow and the lower the feed conversion."

"The litter is much drier, resulting in less footpad lesions and better paw quality."

"The Clima+ unit, I think it is the perfect product for us."

Bio-security: practical tips to minimize the human risk of contamination

All poultry operations are under a constant threat from the ever-present enemy of disease and infection. It is imperative in all operations that we teach our staff how to reduce potential risks as far as possible.

PETERSIME
INCUBATORS & HATCHERIES

Jason Cormick, Petersime Hatchery Development Specialist

In this article, I explain how diseases are transmitted and how you can reduce the risk of human transmission.

How are diseases transmitted?

One of the greatest risks to any poultry operation is the risk of contamination of disease. This not only depletes production, but can also damage the reputation of the company. The transmission of disease can be spread in two ways.

Firstly, disease can be spread vertically when bacteria such as salmonella and mycoplasma, or viruses like avian influenza etc., are spread already in the oviduct of the hen laying the egg. This means that the developing embryo will already be infected during development.

The second type of infection is through horizontal transmission which can be from bacteria spread by a vector, which could be anything from airborne dust particles, animals frequenting livestock (beetles, rats, birds etc.), equipment that moves from infected stock to clean stock or the action of people transmitting disease to your stock. It is this 'human risk' we will cover in this article.

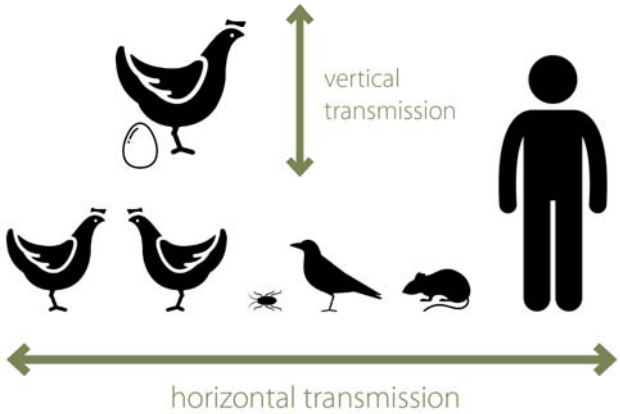
The three main sources of infections: mycoplasma, salmonella and avian influenza

Mycoplasma

Mycoplasma is one of the main culprits of infections. It is a bacteria that can be transmitted both vertically and

Jason Cormick, Petersime Hatchery Development Specialist

Jason Cormick has over 27 years of experience in the poultry industry, working in hatcheries and farms across all levels of the breeding pyramid, from pedigree through to broilers. As Petersime Hatchery Specialist, he supports Petersime customers both remotely and with site visits and has developed a specialist Hatchery Management Training.



horizontally and which is able to survive for up to four days off its natural host. Therefore it has huge potential to jump from one location to another. A thorough 'showering in' regime (staff that enters should take a shower) and change of clothing should greatly reduce the risk from mycoplasma being brought in by personnel.

Salmonella

Salmonella is another prime issue in poultry. This can also be spread both vertically and horizontally, but can also easily infect people. Breeding stock operations should have routine testing of staff and visitors.

Avian influenza

One of the biggest threats today to our operations comes from avian influenza, which has managed to spread across the world. There are many strains of avian influenza, but these are generally split into two main categories:

- low pathogenic
- high pathogenic

Low pathogenic strains can result in low impact on stock. However, strains of H5 and H7 have the potential to mutate from low pathogenic to high pathogenic which can wipe houses and can also infect other species including humans coming into contact with it. Avian influenza can also be transmitted both vertically and horizontally.

These are just three potential risks but there are many others too numerous to go into during this discussion.

Practical tips to minimize the human risk of contamination

Don'ts for poultry workers

There are some basic rules that all poultry workers should adhere to: poultry workers should…

- not own or keep any Avian species
- not come into contact with backyard chickens
- avoid live/wet markets
- not have second jobs that involve avian species
- be discouraged from wild bird hunting

All employees of a poultry operation should have an understanding of bio-security, as it is not only production workers that could be vectors for disease entering an operation.

Dos and don'ts for visitors

Likewise, any visitors are potential risks to the operation. When it comes to external visitors, the golden rule is: 'if they do not need to be there, they should be kept out'. Visitors should be screened prior to entering the site. On entering the site, visitors should fill in a visitors' record explaining why they are there, date of their last contact with poultry and where, and sign a good health declaration. Visitors should also receive explanation receiving the bio-security regulations. They should understand where they can and cannot go and sign to say they will adhere to the rules. On entering an operation, all visitors should shower in to eliminate the risk of bringing in bacteria. Equipment can also be sterilised with UV chambers or disinfectant sprays.

VISITOR REGISTRATION

By signing this document, you agree to comply with all bio-security protocol of the company

Date:	
Name:	
Company:	
Reason for visit:	
Last avian site visited:	
Date of last visit:	
Time in:	
Time out:	
Good health (No diarrhoea or sickness)	
Signature	

Example of visitors' registration form

Washing hands

Once inside, good hygiene must be adhered to washing hands after eating or going to the toilet for example. Use of hand sanitisers in every area around the operation is also good practice.

Keep 'clean' and 'dirty' areas separated

In the hatchery, it is also advantageous to keep staff to either egg side ('clean') or chick side ('dirty'). This is to avoid chick fluff

How to wash your hands to avoid contamination
(Source: http://www.who.int/gpsc/clean_hands_protection/en/)

0. Wet hands with water
1. Apply enough soap to cover all hand surfaces
2. Rub hands palm to palm
3. Right palm over left dorsum with interlaced fingers and vice versa
4. Palm to palm with fingers interlaced
5. Backs of fingers to opposing palms with fingers interlocked
6. Rotational rubbing of left thumb clasped in right palm and vice versa
7. Rotational rubbing, backwards and forwards with clasped fingers of right hand in left palm and vice versa
8. Rinse hands with water
9. Dry thoroughly with a single use towel
10. Use towel to turn off faucet
11. ...and your hands are safe.

cross contaminating other 'clean' areas. This can be helped by giving each area a designated colour of clothing. For example, blue clothing for the egg side and white clothing for the chicks side.

Egg side Chicks side

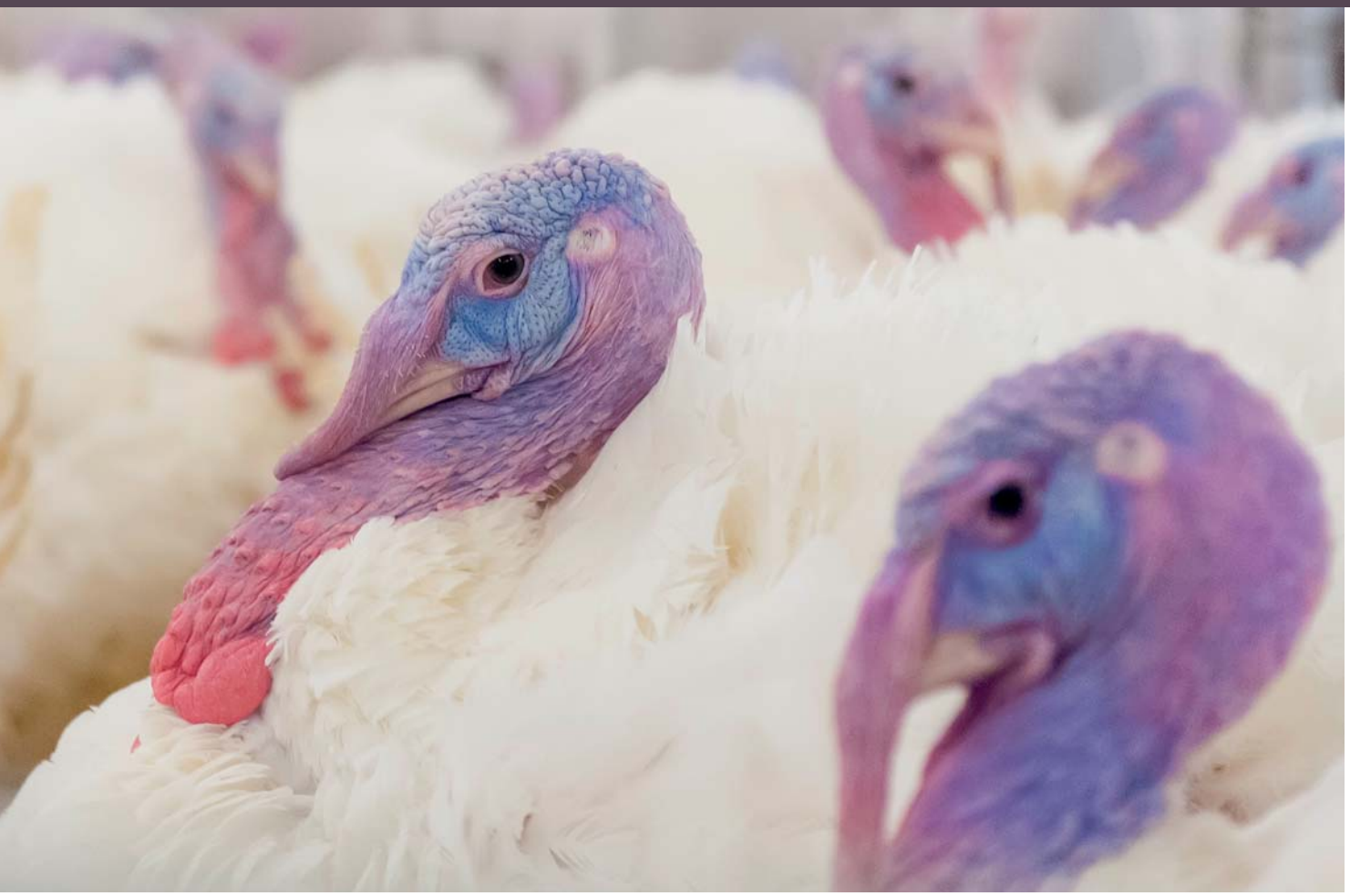
Outside Inside

Boot barriers

One of the continuous vectors of transmission comes from the soles of shoes worn outside and worn into an operation. The most effective way to eliminate this risk is with physical barriers and a complete change of footwear, commonly referred to as 'boot barriers'.

Keeping disease out from livestock operations will always be a great challenge. One that can only be achieved with cooperation of all involved. It is imperative we all keep vigilant and report any non-compliances to safeguard our operations and to ensure continuous supply to our clients.

To watch Jason Cormick's video on 'Bio-security: the human risk', visit
https://www.youtube.com/watch?v=jPzN-rrVGpo



Development of the North African Turkey Market

The 5 countries of North Africa represent a population of approximately 182 million people. The population is young and expanding. Roughly one third of the inhabitants have access to full protein consumption. The number of middle-class affluent people with disposable income is increasing.

Jean-Luc Favennec

Aviagen Turkeys Ltd, United Kingdom

The North African Market

North Africa produces circa 34 million turkeys per annum. The perception of turkey in this area is positive as the bird has been known for centuries. Turkey meat is well accepted in the area and everyone knows what a turkey is. The turkey has a specific name is these places. More than 90% of the population is Muslim and due to their religious beliefs pork is not consumed thereby offering an opportunity to the turkey industry.

Nutrition facts and fitness is becoming a concern in North Africa. Consumers are well informed about cholesterol and fat balance issues and look for a healthier choice. The new generation, with changing taste and habit, is also looking for easy products to consume. Turkey meat has versatility to blend with regional spices and the traditional methods of cooking.

The way of cooking, the variation in social strata and the development of further products helps to balance the demand between white meat and dark meat. This means a complete utilisation and demand for all the meat produced.

Currently product distribution bypasses supermarkets in mid-sized towns or in the suburbs of

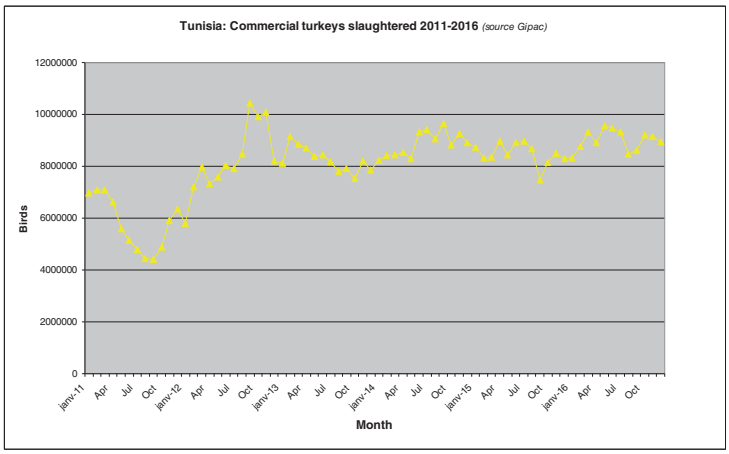
big towns. The distribution chain is short and most of the poultry producers have developed there own local branded shops spread all over the country. The demand is mainly for fresh product except in Egypt. Frozen meat is not in high demand and these countries have set poultry meat import barriers to protect local production.

Beef and mutton are very expensive meats in these dry climates, giving poultry meat a real opportunity. Weather conditions fit well for turkey production. Summer is warm but it can be handled with minimal facility investment, whilst in winter, temperature rarely reaches below zero degrees Celsius.

The regimes use for feeding turkeys are mainly based on corn and soya. Fish meal and wheat by products are used as well in some places. No many local ingredients are available locally and the industry release on imported raw material for more than 95%.

Tunisia

Tunisia has a population of around 11.4 million and Gross Domestic Product per capita (GDP) is ranked 94 out of 185 countries. Tourism has been an important part of the Tunisian development. Some years ago around 7 millions tourists would spend time in the country and were consuming turkey meat.



In the early 1980's, Tunisia was the first North African country to successfully start producing commercial turkeys. This was done at the Poulina company founded by Mr Ben Ayed. The Tunisian market places 125,000 breeders per year. It grows sexed medium turkeys targeting 13 to 14 kg males and 6 kg females. 10.1 million commercial turkeys were produced locally from domestic poults in 2016 so the country consumes almost one medium turkey per capita. The majority of the birds are processed in modern abattoirs. The production is controlled by vertical integrations which have their own breeders and commercial farms. There are also independent well organised farmers selling to local slaughter houses.

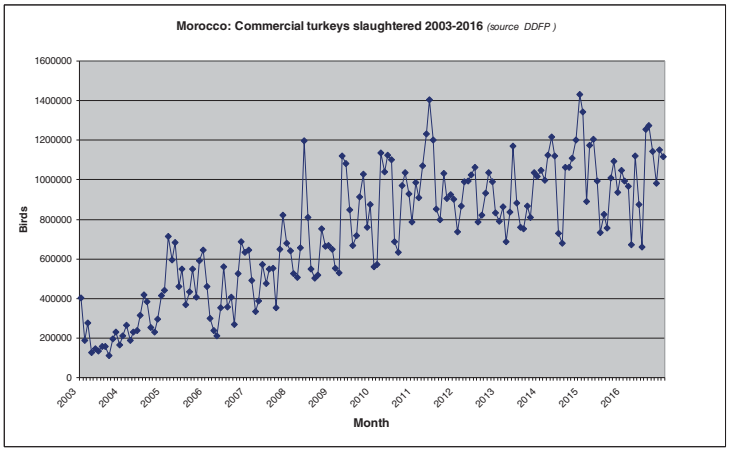
The Ministry of Agriculture is trying very hard to ban live poultry markets.

The country has an import barrier for poultry meat, chicks and eggs which is controlled by a local board (GIPAC) which is trying to regulate poultry production. The GIPAC's role is to set quotas in return for farm quality control in layer and breeder chickens. It is now starting to look at the turkey sector and trying to regulate its production as well. Tunisia used to be a major supplier of poultry meat to Libya but local turbulence has made it more difficult as borders have been closed down.

Morocco

Morocco is a stable kingdom with a good labour force and educated people. It does good work at turkey production.

Population is 34 million, the GDP is ranked 112 out of 185, between Republic of Georgia and the Ukraine.



Industrial turkey production started in the late 1990's and was clearly associated with further processing. The country produces a nice range of delicatessen products which completely uses the meat portion. Production is controlled by solid and well organised integrations. It has grown to 12.2 million sexed medium turkeys in 2016. The market is targeting 16 kg males and 7 kg females. Some companies are moving to heavier type birds producing 19 to 20 kg males with success. Morocco places 110,000 turkey breeders per annum and imports about 20% of commercial placements from Europe.

Whilst 90% of the chickens are sold to the live market, 80% of turkeys are slaughtered in modern processing plants. Morocco sees opportunities to supply other African countries (e.g. Sénégal and Côte d'Ivoire) with canned poultry products.

An interesting statement from the Ministry of Agriculture (statement 2129-05, 15 December 2005, Application of the law n° 49-99) sets the minimum distance between poultry facilities:

a. 3 km between any breeder operation and a hatchery,
b. 2 km between any hatchery and other hatchery or other commercial farm,
c. 1 km between 2 commercial farms.

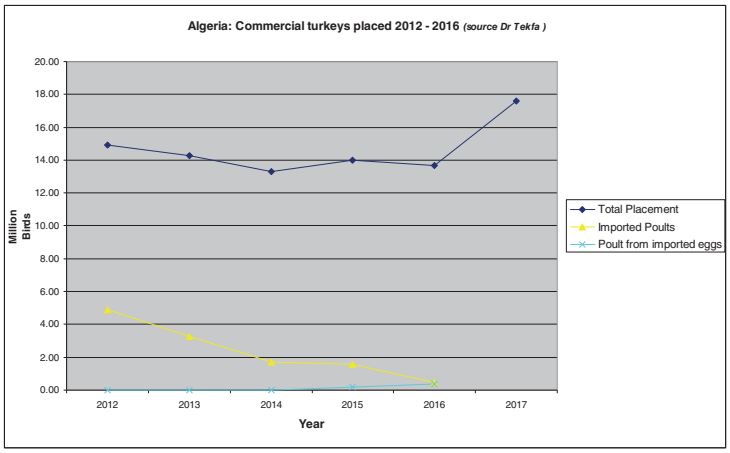
Algeria

The population is 38 million people and it is a very young. The GDP is ranked 83 out of 185, just before China. Since independence the republic has been through a range of domestic issues.

Algeria has important gas and oil reserves. The recent energy price decrease is not helping the country and reduced cash-flow has slowed the development of the turkey sector.

Development of the turkey industry started in the early 2000's and was concentrated in a few areas after privatisation started. Algeria is a vast country but the locals tend to build commercial projects in the same counties (Batna, Sétif, Constantine). Algeria places 200,000 breeders per annum and grows circa 12 million commercials per annum.

The market is looking for a heavy medium breed and also tries to grow some heavy strain turkeys.



Live markets are a major issue for poultry as a massive number of chickens and almost all the turkeys move by truck from farms to markets, increasing the risk of spreading disease. The meat is sold as portions and is processed mainly by local butchers. Further processing is not very well developed yet and uses chicken and spent layer meat which, until now, has not gained enthusiasm from consumers. Next steps will be the development of controlled processing and further processing, offering opportunity for another jump in production.

The know-how and labour force will improve with time. Algeria has never developed mass tourism so the production and consumption is exclusively for the domestic market. The country has a poultry meat import barrier.

Egypt

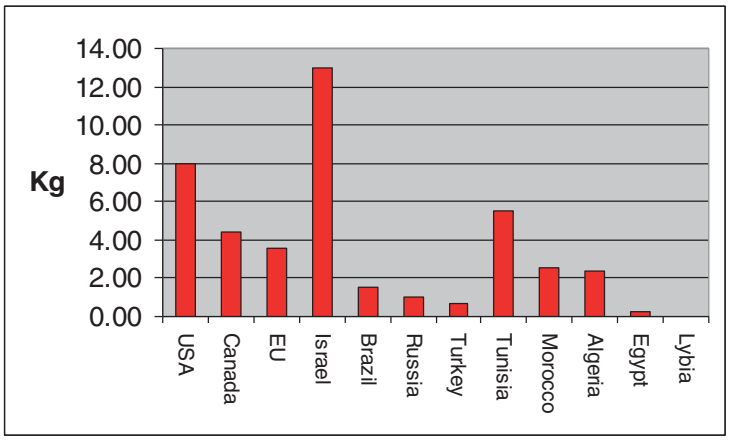
Egypt is a highly populated state consisting of 92 million people. GDP ranks 92 out of 185. There are not a lot of turkeys grown in this area compared to the size of the country or compared to the chicken or duck sectors. Most of poults are imported from Europe. The business started slowly and is in the hands of small players, a few importers and individual farmers. Major chicken integrations are not showing interest for the turkey as they face issues with its development and poultry health issues. There are no official figures available but in recent years the poult imports have been between 1.2 and 2 million per annum.

The market is looking for heavy strains and gives preference to males only. The country does not have poultry meat import barrier and the population accepts imported frozen turkey meat as well.

Libya

We are not aware of significant numbers placed there but there are a few turkeys in the country. Libya used to import poults many years ago but did not succeed. We will have to wait for better time to raise the turkey industry in Libya.

In North Africa, know-how on turkey production has improved significantly and will doubtless continue to progress. However, like every country, labour and training is a challenge and we will work with our partners in this region to provide the required training. The infra-structure for turkey production is variable, we are seeing a lot of investment in processing and cold storage facilities. Animal health is a real issue and the major threat is the traditional live market. Some states are trying to restrict the movement of live birds but the tradition is still above the laws. We are confident it will change with time.



The market for turkey is versatile in many places and varies a lot depending on festivals and seasons and that will not change. A drought period will suddenly bring cheap lamb meat to the market and prices of poultry will collapse. Politics, oil price, currencies devaluation and recent events like the revolutions or attacks are not assisting the increase of turkey production but figures show that production has been stable during the few last years. Per capita consumption will continue to increase in these countries as it did along the last decade.

From the Proceedings of the 11th Turkey Science and Production Conference.

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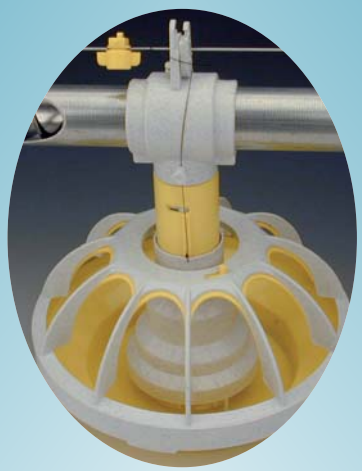


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Mortality management options during an Avian Influenza outbreak

The highly pathogenic avian influenza (HPAI) outbreak has become the largest animal health emergency in U.S. history. As of February 2016, the United States Department of Agriculture (USDA) reports 233 detections (212 commercial facilities and 21 backyard flocks) affecting approximately 50 million birds in 22 States.

Josh Payne, Ph.D.
Oklahoma State University
201G Animal Science
Stillwater, OK

Impacted farms have remained out of production for several months and trade restrictions have been imposed resulting in economic hardships to both growers and the poultry industry. To date, over $950 million federal dollars have been spent on disease control efforts and indemnities. The last confirmed cases of HPAI occurred this year; however, there is concern of future outbreaks due to the continued migration of waterfowl, which serve as a reservoir for Avian Influenza viruses.

Infected birds have either died from the disease or been euthanized to control disease spread. Proper carcass management is vital for managing nutrients and controlling disease. Improper disposal may cause odor nuisance, spread disease, and the resulting leachate (carcass fluids) could negatively impact water sources. The Avian Influenza virus may still be present within the carcass and could be spread by insects, rodents, predators, and subsurface or above ground water movement, as well as through direct contact with other birds, leading to increased disease transmission risks. For these reasons, proper mortality management practices must be implemented immediately following a catastrophic event.

Mortality management options that were used during the recent HPAI outbreak include composting, burial, incineration, and landfilling. The most commonly implemented option was mass mortality composting.

Figure 1. In-house turkey mortality compost windrow.

"Mortality management options that were used during the recent HPAI outbreak include composting, burial, incineration, and landfilling. The most commonly implemented option was mass mortality composting"

Burial is a disposal method in many states that may be conducted on-site and quickly if acceptable land mass is available. A site assessment is required to determine that local environmental guidelines are followed. Common considerations include location, soil type, depth to groundwater, and distance to waterways. Sandy soils, karst topography or areas with a high water table pose a risk of contaminating groundwater supplies. Researchers have demonstrated the potential transport of carcass leachate components, such as nutrients and bacteria, from burial pits to groundwater. Avian Influenza has been

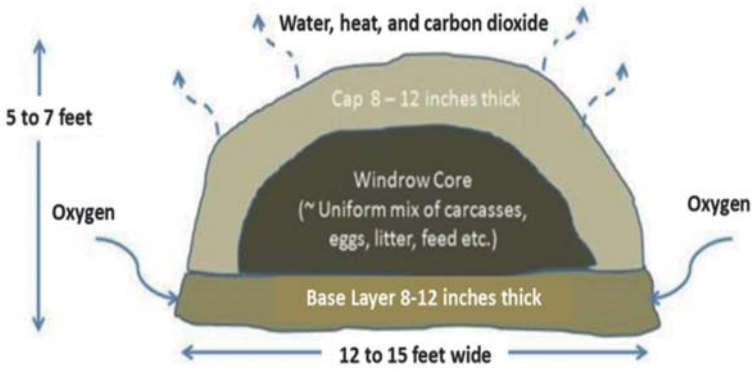

Figure 2. Cross section of a poultry mortality compost windrow. Source: USDA.

reported to survive for weeks in water depending on variables such as temperature, salinity and pH and over 1 year in manure amended soil at 5°C. Furthermore, portions of carcass can persist for years in an anaerobic environment. During construction projects on former poultry farms, old burial pits have been discovered that contain intact birds. For these reasons, burial should be given careful consideration when implementing this method of carcass disposal.

Proper incineration requires a closed air unit, can be conducted on-site and is a pathogen inactivation procedure. Depending on the state, an air quality permit may be required. Several incinerators are required during a large animal disease outbreak. Fuel cost and carcass throughput are important factors to consider when adopting this practice.

If locally available, carcasses may be disposed of at a licensed landfill. Landfilling is considered a form of burial. The landfill must be classified to accept carcasses and permission must be granted from landfill management. Landfilling can be convenient and fast for mass mortality disposal. Considerations include tipping fees, additional handling of mortalities and transportation of infected carcasses in sealed roll-off containers. Transportation off-site may increase biosecurity risks during a disease outbreak.

"Composting mass poultry mortalities is a procedure that can be implemented on most commercial poultry farms. This method requires guidance from a trained composting expert, proper equipment, experienced operators, and sufficient carbon, water and open space"

Figure 3. Final compost after 28 days with an average as received analysis of 60-46-36 (N-P-K; lbs/ton).

Mass mortality composting was successfully implemented on several poultry operations during the recent HPAI outbreak. The purpose of mass mortality composting was to use biological heat treatment methods to degrade the carcass, inactivate the Avian Influenza virus, control odors and reduce fly exposure in a safe, biosecure, and environmentally sustainable manner.

By definition, composting is a controlled biological decomposition process that converts organic matter into a stable, humus-like product. Composting animal carcasses is characterized by microbial breakdown of a large centralized nitrogen source, the carcass, which is surrounded by a carbon source, the bulking agent. The bulking agent supplies carbon for microbial energy while the carcass tissues and fluids supply nitrogen for microbial protein synthesis. Optimal conditions for carcass composting include a carbon to nitrogen ratio of approximately 30:1 and a moisture content of approximately 50%. The process begins with an initial breakdown of carcass soft tissue by naturally present microorganisms which produce heat, carbon dioxide, ammonia and volatile organic compounds as by-products. Following soft tissue decomposition, thorough mixing of the bulking agent and carcass promotes an ideal blend of carbon and nitrogen for optimum composting. The bulking agent traps leachate and odors produced during the process, therefore acting as a biofilter between the carcass and the environment. The continuous high temperatures (> 55°C) achieved through proper composting will destroy most pathogens in-

cluding the Avian Influenza virus. Microorganisms will eventually degrade the carcass leaving only a few remaining bones. This valuable by-product can then be land applied as a fertilizer source, recycling nutrients and organic matter to the soil.

Composting mass poultry mortalities is a procedure that can be implemented on most commercial poultry farms. This method requires guidance from a trained composting expert, proper equipment, experienced operators, and sufficient carbon, water and open space. During a disease outbreak, composting inside the poultry house is preferred, if possible, to minimize biosecurity risks and access by scavenging animals. Since carcasses are contained on-farm, composting can be more biosecure compared to methods that transport carcasses off-farm. The USDA Avian Influenza mortality composting protocol requires a 28 day composting process (USDA, 2015). Hence, in-house poultry mortality composting may delay poultry house cleaning and disinfection efforts resulting in extended down times as compared to other disposal methods. Finally, proper composting can degrade poultry carcasses into a useful soil amendment and fertilizer.

References are available on request.
From the Proceedings of MPF Convention.

The challenge of feeding modern broiler breeders

Broiler breeders are expected to produce about 150 chicks in 40 weeks of production and even though it is commonly believed that selection for more meat in the broiler leads to fewer chicks from the parent stock, breeding companies have actually increased the number of chicks per year while improving broiler traits like feed conversion and breast meat yield.

Broiler breeder nutrition is a challenge. We feed our hens to express their genetic potential to produce eggs, but must also ensure the eggs they produce are safe, free of contaminants and contain all the nutrients needed for hatching healthy broiler chicks.

Breeder nutrition is about consistency of feed while broiler nutrition is about economics. Experienced people regard breeder nutrition as both a science and an art, with much depending on the way we feed birds and when and how much we do this.

Broiler nutrition, on the other hand, has to provide for rapid growth. Broilers have plenty of feed all the time, and we have less time to make up for early mistakes. As nutritionists we must support the breeder production team to achieve their goals by providing innovative and consistent feeds. There are some areas of nutrition we need to re-evaluate.

Dr. Justina Caldas,
nutritionist in the Cobb World
Technical Support Team

Energy, protein and amino acids

Broiler breeder nutrition depends on managing the allowance of feed. Nutrient intake is really what counts to achieve production goals. Lower density feeds with low nutrient formulation provide a higher volume to distribute, and this is when nutritionists need to ensure availability and consistency of the ingredients.

During the rearing phase, there are three key periods where the pullet needs a different nutrition:

- From 1-4 weeks, the pullet needs to build a good frame, so this feed usually provides 2868 kcal/kg and 18.5-19.5% protein. The modern pullet achieves the four-week standard weight more easily nowadays and so some restriction of feed is usually necessary after 14 days.
- The second period is between 5-16 weeks, a maintenance period where we need to avoid overweight pullets. The energy usually drops to between 2530 and 2750 kcal/kg depending on ingredient availability with 14-15% protein, 0.58-0.63% DLys. Depending on the country and ingredients available, nutritionists can use wheat by products such as wheat middling's and shorts, rice hulls, soy hulls, DDGS, oat hulls, and other ingredients to achieve this low energy/low protein and to keep the bodyweight and uniformity of the pullets on target. Pullets have become more efficient so they need less nutrients to achieve their standard weights. Nutritionists can formulate lower density and consistent feeds to maintain feed volume and help achieve a uniform flock.
- The third phase is usually from 17-24 weeks, a preparation period for laying when the hens need to have an incremental weight gain of 30-40% from 16 to 20 weeks. Again, this can be achieved by increasing the energy and protein or increasing the allowance with the grower feed.

A transitional feed between grower and breeder feed is called pre-breeder (typically 19 to 23 weeks). There are different approaches to a pre-breeder (developer) feed, but most important is that it needs to support the management on the farm. In the past, a pre-breeder was sometimes nothing more than a grower with more calcium, but there is limited research to support the need for increased calcium levels when the hens are not laying. Moreover, supplying the pre-breeder now at 16 weeks is 3-4 weeks earlier compared to a few years back. Normally a pre-breeder feed is formulated to support the physiological changes in the hen preparing her for production.

Justina Caldas, nutritionist in the Cobb World Technical Support Team

Light stimulation and transfer of the pullet to the hen house usually occurs at 20 to 22 weeks. After the pre- breeder feed is changed to the production phase feed at first egg or 1% production, the hen is going through many physiological changes. We need to help during this transition by adjusting the nutrients

"Breeder nutrition is about consistency of feed while broiler nutrition is about economics. Experienced people regard breeder nutrition as both a science and an art, with much depending on the way we feed birds and when and how much we do this"

levels. Energy and protein/amino acids increase, but the nutrient that increases more drastically is calcium more than 3 times that of the previous phase due to eggshell formation.

Vitamins and minerals

There are about 40 essential nutrients for poultry and vitamins + minerals make up more than 70% of them, however there is limited research on these requirements. Common sense leads us to increase the vitamin premix by 10 to 20% of recommended levels, due to lower feed intakes, to achieve the standard bodyweight and improve egg production. Minerals are diverse and some of them, such as Zn and Se, are usually regulated by the government in some countries due to environment pollution and toxicity respectively. Excess minerals are excreted, increasing the contamination to the environment, so nutritionists are using more available sources of trace minerals such as organic minerals, in combination with better inorganic sources and exogenous enzymes.

Exogenous enzymes

Phytase is the most common exogenous enzyme used in poultry feeds. Since broiler breeders require high calcium levels, the use of phytase has been slowly increased based on information from table egg laying hens. Phytase activity has been shown

to decrease with high calcium levels in broiler trials; however, the calcium used in broiler feeds has higher solubility and low particle size (around 600 um) than the coarse limestone used in breeders (>1500 um). This may have changed phytase activity in breeder feeds, allowing its use, but more research is still needed. Not only is phytase used in breeder feeds, but carbohydrases are used as well, depending on the need to target specific substrates in different countries. Exogenous enzymes unlock the nutrients trapped in feed ingredients, and decrease anti nutritional factors, so constant evaluation is required to lower the feed cost and improve performance.

Additives

Feed additives are mostly used to improve the shelf life of feeds, or provide a better intestinal microflora. This is probably the largest group of ingredients in the market, and our job as nutritionists is to find the best way to evaluate and use them. With more companies switching to ABF (antibiotic free) production, more products are being tested.

The forgotten male feed

During the rearing period, males are fed with the same feed as the females. Since the normal ratio of males to females is between 8 & 10 per 100, it is more practical to feed males with the same feed as the hens; however, the male has different nutrient requirements. The modern male is becoming more feed efficient every year, so they need less feed to achieve the standard weights and keep in shape for successful mating activity. In addition, we need to maintain feed volume to allow better feed distribution and proper uniformity. In companies which use a female feed for the males, this becomes more difficult.

When males are fed hen feed, they get an unbalanced energy/protein and amino acids ratio, and high calcium is not needed. There are some disadvantages to separate male feeding, with small volumes for the mills increasing feed inventory and the need for more bins, longer time at the farms, and the risk of allocating male feed in the hen bins. However, with proper management, separate male feeding can become a reality and beneficial in improving fertility by +1.5 to 2%. Some countries use it very successfully, but others are still working on it.

Conclusion

Broiler breeder nutrition is about feed consistency, avoiding too many variable ingredients. ABF (antibiotic free) production and animal welfare concerns are changing the way we will feed broilers and broiler breeders. At Cobb-Vantress, Inc. we keep evaluating ingredients, nutrient requirements, and feed strategies to enable innovative and affordable feeds to help achieve the genetic potential of our broiler breeders.

Biotechnology in the development of improved phytases

Phytase enzyme supplements are now ubiquitous in the commercial production of a range of livestock, particularly chickens and pigs. Significant effort has been directed over the last two decades towards producing improved enzymes with higher activity, increased stability and at economic levels in industrial fermentations. As such, there are excellent products on the market, but there is a continuing demand for further improvements to drive down costs and for enzyme manufacturers to increase market share. The rapid development of DNA sequencing and gene synthesis technologies has provided ready access to a large number of new and uncharacterized potential phytases. Challenges remain however in identifying and developing those with improved properties.

Phosphate is essential for life and all organisms must have access to sufficient phosphate to survive and grow. Phytases are now routinely added to livestock feed for the removal of phosphate from the plant mol-

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ecule phytate. Use of phytase reduces the addition of inorganic phosphate to diets and decreases the anti-nutritional effects of phytate. Phytase enzymes perform a variety of roles in nature in a variety of host organisms. Nature provides a whole host of candidate phytases from a range of organisms that could be exploited as livestock feed supplements. Phytases have been identified in the past using traditional microbiology and biochemical approaches either from the environment or from culture collections. The number of different candidates that can be accessed readily has increased dramatically in recent years due to the generation of vast amounts of genomic sequence data. With the continuing demand for ever-improved phytases coupled with competition for market share through best-in-class products, generating the most efficient methods for identifying and improving the best candidates for future economic large scale production is a constant endeavour.

The three main characteristics that define the best phytase enzyme supplements are high specific activity in the gut, high stability and high levels of production in industrial microbial fermentations. Ultimately, the most important factor is optimising the amount of enzyme catalytic activity that can be realised in the animal gut, therefore releasing the optimal amount of phosphate for the desired animal growth rate and feed conversion efficiency at an appropriate financial cost. The higher the specific activity of the enzyme, the less mass of enzyme is needed to realise the same catalytic activity and so the enzyme loading (by mass) can be lower, saving on manufacturing cost. The yield (g/L) and volumetric productivity (g/L/day) of enzyme in an industrial fermentation can be optimised through recombinant microbial strain development and bioprocess engineering but will reach an upper limit. As such, to fully optimise the number of units of enzyme activity that can be realised from an industrial fermentation, the enzyme should also display a high specific activity (U/g, where 1 unit (U) is defined as the conversion of 1 micromole of substrate per minute under specified assay conditions).

Once an enzyme has been manufactured and formulated, as much of the original enzymatic activity should be realised in the gut of the animal as possible. Activity can be lost through thermal denaturation during feed pellet production, where the enzyme may be exposed to temperatures of up to 95 ºC, during storage and transportation and through degradation by proteases and the acidic conditions encountered in the gut. Further, the enzyme should display high levels of activity at gut pH (and in the most relevant part of the gut with the pH changing throughout the digestive system) and gut temperature (around 37 ºC). The requirement for stability at high temperatures during pelleting coupled with optimal activity at the lower temperatures in the gut presents a major challenge as the molecular basis for increased thermal stability (such as increased structural rigidity) typically leads to a higher optimal temperature of activity. This phenomenon is often observed in enzymes from thermophilic organisms that are stable at very high temperatures but have relatively low or non-existent activities at gut temperature. In fact, due to reaction rates increasing with temperature generally and to achieve a compromise between activity and stability, many enzymes have optimal activities above gut temperature. Ultimately, regardless of the temperature activity profile, it is the number of units of enzyme (specific activity) in gut conditions (temperature and pH) that is important. This paper will review and discuss methods to identify and develop improved phytase enzymes for animal feed applications.

New enzyme discovery

In order to discover and develop enzymes with desired characteristics a number of approaches are commonly employed. In the first instance, the enzymes that naturally display the best possible characteristics should be identified from nature, using environmental sampling and/or genomic/protein databases. The better these 'wild-type' or native enzymes are the more likely protein engineering, if required, will deliver a suitable livestock feed supplement. Nature provides a very large number of organisms or putative gene/protein sequences in databases that could be screened. Traditional approaches have relied on the direct identification and characterisation of phytases from organisms of interest, including during basic studies into phosphate metabolism in organisms such as *Saccharomyces cerevisiae* and for elucidating enzyme function in commonly used organisms such as *Escherichia coli.*

To take advantage of the wealth of available genomic information it is necessary to develop strategies to interrogate this resource in a meaningful and efficient manner to identify a subset or individual candidates that have an increased likelihood of displaying desirable properties. High throughput biochemical screening approaches can then be used to characterise as

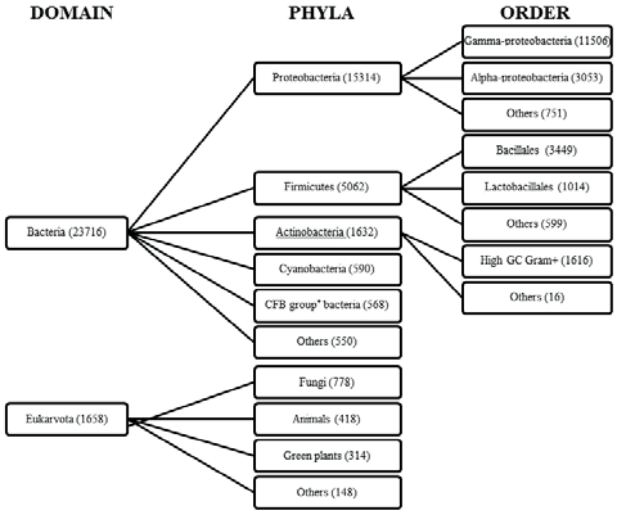


Figure 1 - Taxonomic group tree showing the origin of proteins labelled as phytase generated from the National Center for Biotechnology Information protein database (www.ncbi.nlm.nih.gov/protein) in November 2015 with the number of proteins represented in each group shown in brackets.

**Cytophaga-Flavobacterium-Bacteroides group. Other sequences are Archaea (8), viruses (7) and others (219).*

large a subset as possible. A search in November 2015 of the National Center for Biotechnology Information protein database with the term 'phytase' revealed 26,338 hits, of which 23,716 were from bacteria (*Figure 1*). A very small proportion of these hits have actually been characterised and tested to prove that they are indeed phytases and to determine their properties, the remainder are assigned as putative phytases using algorithms based on homology to known phytase sequences. However, assigning function in terms of the reaction that is performed does not provide information on the suitability of the enzyme for the intended commercial applications. Knowing that a protein is likely to be a phytase does not provide any information regarding stability or the catalytic efficiency in gut conditions. With such a large number of putative sequences available, it is significantly challenging to identify and test candidate enzymes that could be suitable for commercial application.

Along with the rapid development of DNA sequencing technologies that has led to this large number of putative phytase sequences, the ability to 'write' DNA through gene synthesis and its ready commercial availability has made obtaining and testing sequences far easier and cheaper than ever before.

Efforts to increase the throughput of protein synthesis and testing include the use of *in vitro* or cell-free transcription and translation. This method avoids the bottleneck of generating production strains through plasmid cloning and microbial transformation with the DNA.

Given the cost of gene synthesis and an upper practical limit on the number of sequences that can be tested, it is currently necessary to be smart or lucky, or both, in the initial selection of candidate sequences as well as having an initial biochemical screening system that is as high throughput as possible. The use of *in silico* methods and bioinformatics tools could be used to interrogate the databases to produce a subset of sequences that are more likely to display desirable qualities (such as high stability and catalytic activity) compared to random selection. Such an approach was demonstrated successfully for the identification of (*R*)-transaminase enzymes. Enantio-preference was predicted through the rational design of mutated variants in related enzymes that may confer the desired specificity, followed by database searching to identify natural sequences already containing the predicted mutations.

Using *in silico* approaches to reliably predict protein stability and the effects of amino acid variation in similar sequences remains a significant challenge. These challenges arise partly from the complexity of protein structure and the way proteins stably fold as well as the dependence of stability on external conditions such as buffer composition (e.g. pH and salt concentration). Four methods for predicting stability were evaluated that were based on the Gibbs free energy of protein folding and the change in Gibbs free energy upon mutation at specific positions. Each method showed limitations, especially where the mutation was at a position buried within the protein structure. The Rosetta approach was overall as good as or better than the other three but it is not ideally suited for screening databases for the prediction of the most stable orthologue. Recognising these limitations, new methods for predicting the effect of mutations on protein stability continue to be generated but these are also not yet suitable for database screening and are often limited to single mutations per protein, for example with the programs DUET and PoPMuSiC. Overall these tools are designed for the analysis of point mutations in specific proteins or to aid protein engineering strategies to improve stability through mutation. Approaches for determining catalytic efficiency and selecting sequences likely to lead to high enzyme activity are even more challenging. These approaches have mainly been targeted at designing and predicting sequence modifications for enzyme improvement.

Developing existing enzymes

Commercial Examples: The commonly used phytases in livestock production were developed using a variety of approaches, including enzyme isolation and biochemical characterisation coupled with recombinant expression. In addition, significant developments have been made to achieve economic levels of production in fermentations using a variety of recombinant microorganisms. A specific organism may have more than one phytase, such as the PhyA and PhyB phytases from *Aspergillus niger* with the Natuphos product derived from PhyA. Enzymes from certain donor organisms may be modified through protein engineering to alter their sequences and therefore properties. As such, different products based on the same wild-type sequence, for example the *E. coli* phytase, will not necessarily all have the same performance.

Regardless of the inherent specific activity of each phytase, the number of units of enzyme activity per unit mass of product can be manipulated during the enzyme formulation stage using more dilute or concentrated formulations. Enzyme stability on the other hand cannot be manipulated in this way although the enzyme can be added at larger doses to compensate for losses. One key stage for enzyme deactivation is during the feed pelleting process. Thus significant research efforts are directed at obtaining enzyme formulations where as much of the enzyme activity as possible survives. Increased stability can either be achieved through protein engineering or through

modifying the formulation of the enzyme product. Where pelleting stability data are provided in The EFSA Journal reports, this usually refers to solid formulations, with liquid formulations generally intended for post pelleting application to avoid deactivation. The availability of liquid formulations indicates that increased stability phytases, which also retain high levels of activity at gut temperature, are still needed.

In addition to pelleting stability, product registration documents also outline storage stability at various temperatures (normally up to 40 ºC) over several months. Typically, enzyme preparations are stable at lower temperatures but many products lose significant activity if stored at or above 35 ºC.

Overall, the wide variety of testing methods and assay conditions used makes a direct comparison of enzyme properties reported in the literature problematic and interpretations should be treated with caution. Whilst lab simulations of activity can be very useful guides to enzyme performance the only way to fully test efficacy is through enzyme formulation in feed pellets and subsequent feeding trials.

Optimising the E. coli phytase: There have been many attempts to improve the properties of the *E. coli* AppA phytase through mutagenesis. In a prominent example, scientists at Diversa Corporation (later Verenium and now part of BASF) produced an enzyme that was mutated at eight different amino acid positions to achieve increased thermostability. Mutagenesis of amino acids at each position in the protein sequence to every other amino acid (saturation mutagenesis) coupled with screening identified a range of beneficial mutations. These were then combined to produce a protein termed Phy9X that is also referred to as NOV9X in the patent literature and Quantum phytase registration documents (EFSA 2008). Differential scanning colorimetry showed that the melting temperature was increased by 12 ºC to 75.7 ºC with a 3.5-fold increase in stability in simulated gastric fluid.

Recently, two additional mutations were added to Phy9X (Q258N and Q349N – note the numbering starts at different places in the protein between different papers) to introduce additional *N*-glycosylation sites when expressed in *P. pastoris*. These mutations resulted in an observed increase in melting temperature of 7.5 ºC compared to the wild-type enzyme, attributable to increases in α-helix content and surface hydrophobicity. Increasing thermal stability through the incorporation of additional disulfide bonds is another common strategy in protein engineering and the basis of this effect has been examined using a range of phytases including that from *C. braakii*. The native *E. coli* phytase has four disulfide bonds and including three additional disulfide bonds increased the melting temperature by 8.5 ºC and shifted the optimal temperature for activity to 75 ºC.

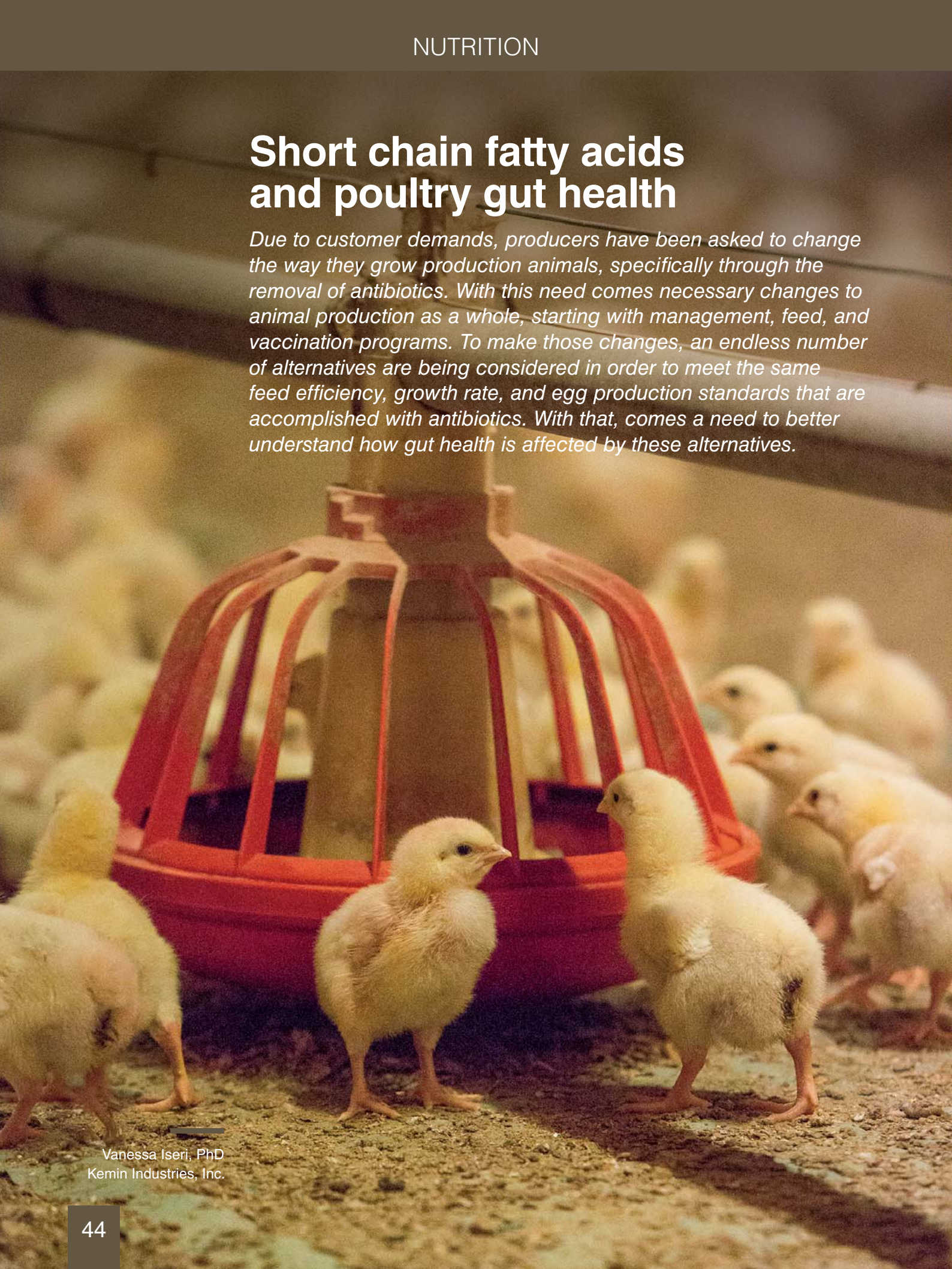
There has been significant work over recent decades on the development and production of phytases for livestock feed applications. These enzymes have resulted in commercial products with significant benefits for producers. With the recent rapid advances in DNA sequencing technology, the availability of genomic data and the ready access to synthetic biology tools there exists an opportunity to develop phytases with further improved characteristics if these data and tools can be effectively harnessed.

References are available on request.

From the proceedings of the 2016 Aust. Poultry Science Symposium.

Short chain fatty acids and poultry gut health

Due to customer demands, producers have been asked to change the way they grow production animals, specifically through the removal of antibiotics. With this need comes necessary changes to animal production as a whole, starting with management, feed, and vaccination programs. To make those changes, an endless number of alternatives are being considered in order to meet the same feed efficiency, growth rate, and egg production standards that are accomplished with antibiotics. With that, comes a need to better understand how gut health is affected by these alternatives.



Vanessa Iseri, PhD
Kemin Industries, Inc.

Factors that contribute to gut health

Gut health in both human medicine and animal health has been defined in various ways. It was initially described that good gut health was the absence of illness. However, through our development of molecular tools and a better understanding of intestinal biology, it is clear that there are many factors that contribute to gut health. The intestinal barrier, microbiota and intestinal immunity can be considered the three main factors that attribute to gut health, but more importantly the interactions of these systems.

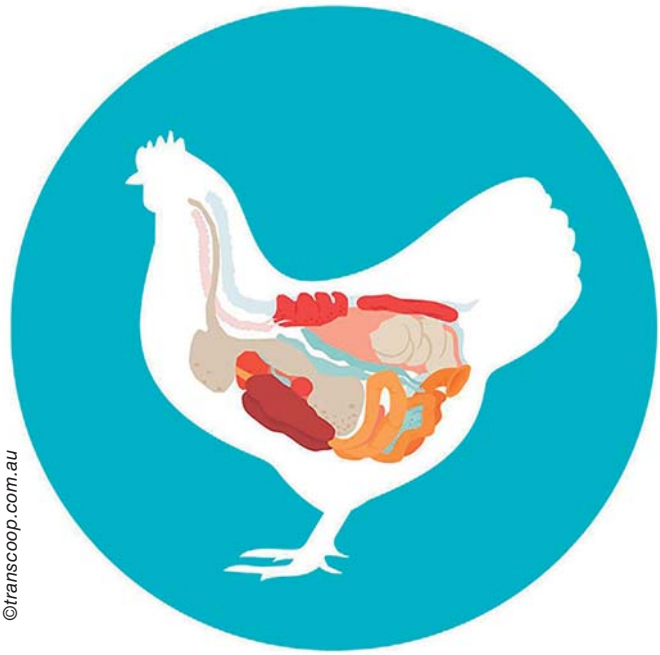
Soon after hatch, the chick's gastrointestinal (GI) tract comes into contact with exogenous microorganisms and quickly develops into a complex microbial ecosystem. Each section along the intestinal tract contains distinct microbial communities, in which multiple species of *Lactobacillus*, *Enterococcus* and *Clostridium* mostly populate the ileum as opposed to species of *Bacteroides*, *Bifidobacterium*, and *Clostridium* in the cecum.

With the continual exposure of microbiota and both dietary and environmental antigens, the intestinal immune system must balance between tolerance and responding to challenges. Thus, the intestinal immune system plays a huge role in overseeing the interactions between the host and the microbiota, through a network of immune cells, cytokines, chemokines and other immunological mediators. Hooper and Macpherson describe the intestinal immune system as having three levels of protection each with distinct mechanisms. The first layer of protection is the secretion of chemical barriers, such as secretory IgA, that minimize the ability of bacteria to adhere to the epithelial lining. The second layer is the detection and elimination of bacteria that has translocated by phagocytic cells in addition to their role in intestinal wound healing. The third layer is the network of cells and immune proteins that allow the intestinal immune system to quickly respond to infection using minimal inflammation, and containing the infection at the intestinal level.

"In general, certain organic acids have been utilized as food additives and preservatives. There has been growing interest in the use of short chain fatty acids, particularly acetic, propionic and butyric acid, in animal production due to their positive effects on human health"

The relationship between the host and microbiota can be described has a symbiotic one, in which both benefit. The host provides a protected, nutrient-rich environment which allows the microbiota to establish a diverse, yet remarkably resilient ecosystem. In return, the microbiota provides resistance to the colonization of pathogenic microbes, aid in the development and maintenance of intestinal and systemic immunity, support intestinal structure development, and produce nutritional factors. Any dramatic shifts in the microbial population due to dietary changes, or pathogens can be detrimental to the host.

The epithelial barrier has the large task of absorbing nutrients, yet at the same time protecting the host from invading pathogens, toxins, and antigens, as well as the abundant microbial populations in the intestine. Besides nutrient absorption and host protection, enterocytes are capable of acting as frontline sensors to microbial encounters in order to guide immune responses. Specialized epithelial subsets enteroendocrine cells, goblet cells, Paneth cells, and M cells also contribute to maintaining a physical (i.e. mucus) and chemical barrier (i.e. β-defensins) between the outside environment and the host. An important component to maintaining the intestinal barrier are tight junctions, which are made up of multifunctional protein complexes. Tight junctions seal the paracellular space between epithelial cells, thus preventing the translocation of microorganisms and other antigens across the epithelium. Tight junctions are highly dynamic structures, and their permeability is regulated by various factors such as diet, microbes, inflammation.



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As mentioned above, the microbiota, epithelial barrier, and intestinal immune system are key factors that affect gut health, and the interactions of all three of these systems are necessary for both the development and maintenance of gut health. Key examples that illustrate this point are the development and maturation of the intestinal immune system through its interactions with the microbiota; epithelial homeostasis is based on its interactions with the microbiota; and the interactions of the intestinal immune system and epithelial barrier allow for the containment and stability of the microbial populations.

Short chain fatty acids

In general, certain organic acids have been utilized as food additives and preservatives.

There has been growing interest in the use of short chain fatty acids, particularly acetic, propionic and butyric acid, in animal production due to their positive effects on human health. Some of the benefits of short chain fatty acids are that they are natural, an energy source for epithelial cells (butyrate mostly), and ability to inhibit histone deacetylase activity and consequently modulate gene expression.

Short chain fatty acids on gut health

Besides being an energy source, short chain fatty acids, more so butyrate, have been shown to effect epithelial barrier integrity and intestinal immunity. Specifically, with the epithelial barrier, short chain fatty acids have been shown to increase mucin production, regulate epithelial cell proliferation, and induce the up regulation and/or assembly of tight junctions. It was demonstrated in rats that butyrate administration attenuates intestinal injury and that the protective effect of butyrate may be associated with preservation of the intestinal barrier and suppression of inflammatory cell infiltration into the intestinal mucosa.

Furthermore, butyrate seems to exert a broad anti-inflammatory phenotype by affecting immune cell migration, activation, and proliferation. Short chain fatty acids as well as butyrate itself have been shown to induce host defense peptide production, a critical component of innate immunity. In the chicken, avian β-defensins and cathelicidins are expressed in a wide range of tissues, and have a wide spectrum of antimicrobial activity. Butyrate enhanced the production of host defense proteins at both the cellular and tissue level and reduced *S. enteritidis* titer in cecal contents. Furthermore, host defense peptides play an active role in intestinal immune responses by recruiting and activating immune cells, binding and neutralizing bacterial endotoxins, and promoting wound healing.

Conclusion

The microbiota, epithelial barrier, and intestinal immune system and their interactions are critical in both the development and maintenance of proper gut health. Proper gut health begins at the cellular level (i.e. bacteria, immune cells) whose interactions can affect tissue structure (i.e. villi structure) and function (i.e. absorption), ultimately effecting the animal's ability to thrive in production systems.

In order to maintain the same productivity without antibiotics, we must change the way we think about intestinal health and animal productivity; and place intestinal health at the same level of importance as other management practices.

References are available on request.

From 2016 Midwest Poultry Federation Symposium

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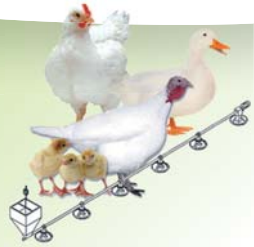

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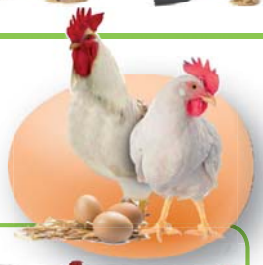

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Monitoring of IBV circulation and prevalence

Infectious bronchitis (IB) is one of the most common viral diseases in chicken production worldwide and IB virus (IBV) is considered the most contagious poultry pathogen. Its economical importance requires continuous monitoring and accurate diagnosis in order to minimize losses in chicken production. Laboratory confirmation of the IBV infection is required for proper diagnosis due to similar symptoms caused by many other poultry pathogens and conditions.

Why monitoring and diagnosis of IBV is a complex activity

Despite its suggestive name, IBV infection may result in various symptoms and gross lesions, most commonly comprising of respiratory symptoms and/or kidney lesions in young birds, permanent damage of oviduct in immature birds and reduced egg production in adult chickens. Vaccination against IB is practiced in most of the farm chicken flocks worldwide. Broilers are vaccinated using live vaccines once or twice while breeders and layers are multiply vaccinated with live vaccines and usually boosted with inactivated vaccine. It is the intention in the poultry industry to use vaccines that are antigenically similar to presumably circulating field strains or are able to induce cross-protection by using suitable combinations of vaccines. All this makes difficulties in distinguishing vaccinal from field infection antibody responses as well as in discrimination of vaccinal from field viruses.

Approaches for IBV monitoring and diagnosis

Monitoring of IBV means regular periodic laboratory testing of chicken flocks even in absence of suspicion to field infection. Such approach provides foundation for accurate and timely diagnosis in cases of current and future field infections. Depending on the causative field virus and immunity of the birds, field infection does not necessarily cause typical or obvious or sometimes any symptoms, especially in chickens at age from 6 weeks to the onset of lay. Unnoticed or unrecognized infections may result in breeding of false layers and/or in further spread of the field virus by moving of infected birds to another farm e.g. by male spiking in breeding flocks. Diagnosis of IBV means laboratory testing of chickens after suspicion of a field infection based either on results of the serological monitoring or on emergence of problems in production, clinical signs and gross lesions.Detection of field IBV infection should be followed by at least partial antigenic and/or genetic analysis of the virus. Such data can then be used for designing/adjusting of local or regional IBV vaccination programmes. Testing frequency and particularly sample size in respect to flock size, infection prevalence, test sensitivity and confidence level have been discussed and reviewed in scientific and technical publications. Generally, more frequent testing and larger samples size give higher certainty for field IBV detection, but the larger sample size also increases risk of false positive results and costs. Here is suggested a scheme for monitoring of IBV circulation and estimating its prevalence for standard chicken farms in the intensive poultry industry. It is based on the author's experience that takes into account compromise between the above mentioned factors for high certainty of field IBV detection and considerable costs of such testing.

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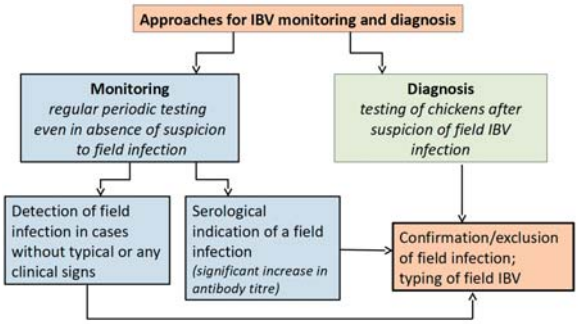
Serology

Sampling scheme

Same sampling scheme and serology testing are used for assessment of post-vaccinal immunity and for serological monitoring of IBV. The aim of such sampling scheme and testing is the establisment of IBV antibody titre baseline and monitoring of any deviation in expected antibody titres. Once the titre baseline is established, finding of lower titres indicate poor serological response to vaccination while higher titres suggest field infection in the flock.The sampling scheme depends on the local IBV vaccination programs. It should be as much as possible identical for each subsequent flock and should be adjusted if change in the IBV vaccination program occurs. Breeders and layers should be serologically tested at least twice during the rearing period and preferably every 8 weeks during production. Blood samples are usually taken 3 to 4 weeks after administration of live IBV vaccine and 4 to 8 weeks after administration of inactivated IBV vaccine.Due to the short life cycle of broilers, they are usually sampled at the end of the production cycle either at the farm or in the abattoir. Each broiler farm should be serologically tested at least once a year.At least 20 random blood samples per poultry house should be taken. If a farm consists of three or more closely situated poultry houses with birds of the same type, origin, age, management and vaccination program, it is acceptable to test chickens only in representative poultry houses. These poultry houses should not represent less than 40% of total number of the poultry houses at the farm. Representative poultry houses should be also selected on basis of their arrangement within the farm, proximity of neighbouring farms, direction of dominant winds, IBV history at the farm, etc. Sampling from the same representative houses should be conducted for the entire production cycle.Even if there is no possibility to regularly analyse samples from each blood sampling, the sera should be stored in freezer and tested retrospectively together with current samples if suspicion of IBV occurs.



Testing and interpretation

ELISA is commonly used for routine testing for IBV antibodies and many commercial kits are available. ELISA's are group specific and cannot distinguish antibodies from different types of IBV. Same type of ELISA kit should be used all the time since different types of ELISA kits give different titre values for the same sample. If different ELISA kits are used for testing of the same flocks, historical results will have no value for interpretation of current results. Once the titre baselines have been established, unusually high (> twofold higher) antibody titres will suggest the occurrence of a field infection in the flock. Such sera can be tested by serum neutralisation (SN) or haemagglutination inhibition (HI) in an attempt to determine serotype of the causative field IBV. SN and HI tests can be performed only in specialized laboratories. SN test is more expensive and time consuming but provides more confidence than HI test. The interpretation of SN and HI is not always straightforward due to limited number of IBV antigens used in the tests and relatively high level of cross reactions in vaccinated birds that have been in contact with multiple serotypes of IBV, particularly if adjuvanted inactivated IBV vaccines were used. In case of any serological suspicion of field infection, fresh samples for virus detection should be taken as soon as possible from preferably all poultry houses at the farm.

It should be kept in mind that live vaccinal viruses can spread horizontally to non-vaccinated chickens, especially if the non-vaccinated chickens are kept in proximity of chicken farms where IBV vaccination is routinely practiced. Detecting of seroconversion in such cases does not necessarily confirm field infection.

Table 1. *Scheme for serological monitoring of IBV circulation and prevalence*

	Breeders/layers	Broilers
Sampling frequency	2x rearing period Every 8 weeks in production	Each farm at least once a year
	Also in any case of suspicion to field infection	
Timing	3-4 weeks after live vaccine 4-8 weeks after inactivated vaccine	At the end of production cycle
Sample size	At least 20 blood samples per poultry house	
Number of tested poultry houses	Preferably each poultry house at the farm. In farms with ≥3 poultry houses not less than 40% of all houses	
Test method	ELISA, same type of kits should be used all the time in order to produce reliable antibody titre baseline	
Interpretation/follow up	Each significant increase in titre (> twofold from the baseline) suggests field infection. If so, it should be followed by serotype specific test (SN or HI) and/or virus detection	

Table 2. *Scheme for virological monitoring of IBV circulation and prevalence*

	Breeders/layers	Broilers
Sampling frequency	At least once in rearing period (8-16 weeks) At least once in production (second half)	Each farm at least once a year
	Also in any case of suspicion to field infection	
Timing	Avoid sampling soon after vaccination, preferably just before vaccination	At the end of production cycle
Sample size	At least 10 pharyngeal/tracheal swabs and 10 cloacal swabs per poultry house (each 5 swabs pooled in laboratory)	
Number of tested poultry houses	Preferably each poultry house at the farm. In farms with ≥3 poultry houses not less than 40% of all houses	
Test method	IBV specific Real Time RT-PCR If positive, one pharyngeal/tracheal and one cloacal pool with lowest Ct value are subjected to S1 gene specific RT-PCR and subsequent nucleotide sequencing	
Interpretation	Nucleotide sequences identical or highly similar to used live vaccine virus = recovery of vaccine strain Nucleotide sequences considerably different from used live vaccines = detection of field IBV strain	

Virus detection and typing

Sampling scheme

The sampling scheme for virus detection in absence of a suspicion of field infection (i.e. monitoring) should be also designed in accordance with the vaccination programme. This means that samples should not be taken soon after administration of IBV live vaccine, but rather as soon as possible prior to vaccination in order to avoid high load of live vaccinal virus in tested samples. Layer and breeder flocks should be sampled at least once during the rearing period and at least once during the production period. Sampling in the rearing period should be aimed at age between 8 and 16 weeks because IBV infection at this age usually does not cause clinical symptoms and therefore may remain unnoticed. Many chicken producers move pullets (replacements) from rearing farms to production farms at age of 16 to 18 weeks which is another reason to test birds at the suggested age. Adult layers and breeders should be monitored for IBV infection in the second half of the production period because specific immunity, as well as eggshell quality, declines towards the end of production. This common decline in eggshell quality can mask or can be confused with eggshell abnormalities caused by IBV infection. Broilers are normally sampled at the end of the production cycle either at the farm or in the abattoir. Mild respiratory symptoms are not unusual in broiler flocks. They are frequently caused by, and attributed to, environmental factors (e.g. ammonia build-up, draughts, excessive dust, etc) and/or vaccinal reactions. These non-specific symptoms can mask or can be confused with mild forms of IBV infection particularly in IBV immune broilers. In order to monitor IBV circulation, each broiler farm should be therefore tested for field virus presence at least once a year, preferably during the colder part of the year. At least 10 pharyngeal/tracheal and 10 cloacal swabs from randomly selected birds per poultry house should be taken. If farm consists of three or more closely situated poultry houses with birds of the same type, origin, age, management and vaccination program, it is acceptable to test chickens only in representative poultry houses as described above for the blood sampling. For testing, up to 5 swabs from the same house and from the same organ sampling can be pooled in the laboratory.In cases of suspicion of clinical IBV infection, fresh samples should be taken from affected poultry houses as soon as possible regardless the suggested sampling scheme. If possible, in such cases fresh carcasses should be sampled instead of swabbing. Organs from at least five dead birds per affected poultry house should be sampled. Tracheas and kidneys should be preferred in cases of acute IBV infection and kidneys, caecal tonsils and cloaca in cases if chronic infection is suspected. IBV is temperature sensitive and the samples for virus detection should be kept and transported at refrigerated temperature (max 4 °C) if delivered to the laboratory within a day. Otherwise the samples should be frozen at -20 °C and delivered to the laboratory as such.

Table 3. *Probability of possible IBV vaccine recovery vs. detection of field IBV strain in case of ambiguous homology of detected IBV nucleotide sequence with that of used live vaccine viruses*

Criteria	No	Yes
Locally circulating field virus(es) is (are) of the same genotype as used live vaccine(s)	vaccine	field virus
Significant increase in antibody titres, especially in older birds	vaccine	field virus
Occurrence of typical IBV signs and lesions (given that other similar diseases are excluded)	vaccine	field virus

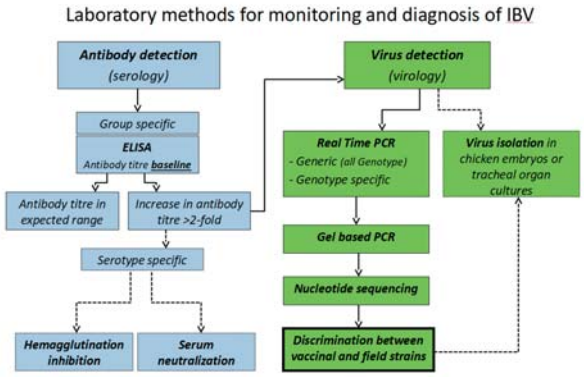
Testing

The first step includes detection of the IBV specific genome. Nowadays Real Time RT-PCR is widely used for this purpose, although classical RT-PCR can be used but with less sensitivity. These tests are based on detection of a conserved part of the IBV genome, usually 5', 3' or N gene. Most of the flocks that have been vaccinated with live IBV vaccine will give positive result even in absence of field virus, but Ct values in their samples are usually higher (meaning lower virus load) than in samples from birds with acute field infection. Therefore, positive samples with lower Ct should be used for subsequent discrimination from vaccinal strains and further typing of the field viruses. Moreover, samples with lower Ct value are more suitable for downstream molecular methods including nucleotide sequencing. At least one positive pooled sample from an organ type per farm should be genotyped. For example, in routine monitoring one pharyngeal/tracheal swab pool sample and one cloacal swab pool sample with lowest Ct values will be further analysed. This is due to fact that different types of IBV can be detected in the same bird/flock, but not necessarily in the same organ.Several IBV genotype specific tests have been developed, but their use is of a limited value, particularly if locally used vaccine is of the same genotype as locally circulating field strains. Vaccine specific molecular tests can confirm presence of a certain vaccinal virus, but the positive result does not exclude simultaneous circulation of a field strain within the vaccinated flock. Molecular tests that are developed for detection of specific field strains can be useful for monitoring and detection of only specific field strains, but either positive or negative results do not exclude circulation of other field genotypes. Furthermore, genotype specific test are prone to false negative results due to high nucleotide variability in primer/probe binding sites.Genotyping of detected IBV strains is based on the S1 gene, and it is usually done by classical RT-PCR with subsequent nucleotide sequencing of this gene. Sequencing of other genes does not give reliable genotype information. If possible, the entire S1 gene should be sequenced, although partial S1 gene sequences can be successfully used in general.

Interpretation

There are no molecular markers identified for IBV pathogenicity so far, hence the interpretation is based on discrimination of the identified IBV from vaccinal strains used in the flock. If the identified virus does not belong to genotype of any vaccine used in the flock, the interpretation is usually straightforward and indicates field infection. In very rare cases it is possible that another vaccinal strain has horizontally spread to tested flock from another poultry operation. Detection of a same genotype as the genotype(s) of vaccinal strain(s) used as live vaccine(s) in the flock requires careful analysis and interpretation since it could mean either vaccinal virus recovery or detection of a field strain of the same genotype. The following criteria should be considered:

1 - Homology of the identified sequence with sequence of the used vaccine – the high homology generally indicates detection of vaccinal strain. In broilers and young pullets this homology is usually 100% or very close to it. The longer a period from vaccination to vaccine recovery, the greater is a possible accumulation of nucleotide substitutions in the vaccine virus. To our experience partial S1 gene nucleotide homology in recovered vaccinal virus from older layers/breeders can drop below 99% if compared with its original nucleotide sequence. This percentage is not a general rule since different vaccinal strains have different nucleotide substitution traits, and different parts of the S1 gene display different nucleotide substitution rate after circulation in vaccinated birds.



2 - Local epidemiological situation – if the used vaccine strains are of a different genotype from locally circulating IBV strains, high nucleotide homology between obtained sequence and vaccine strain sequence suggests that vaccinal virus and not field virus was recovered.

3 - Serology – significant increase of specific antibody titres, especially in older birds, will suggest detection of a field and not live vaccinal virus.

4 - Clinical signs and pathology – presence of IBV typical clinical signs, poor production and eventually increased mortality with typical gross lesions suggest detection of a field virus and not live vaccinal virus. Other similar diseases and conditions should be excluded (mycoplasmosis, infectious laryngotracheitis, avian influenza, Newcastle disease, egg drop syndrome, vaccinal reactions, etc.)

In ambiguous cases, testing of ciliary activity in tracheal rings of experimentally inoculated chickens can discriminate between vaccinal and pathogenic strains. Such testing can be performed only in specialized laboratories and requires previous isolation/culturing of the detected virus. Finally, whenever new type of field strain is detected, virus isolation in embryonated chicken eggs or tracheal organ cultures should be attempted. Isolated virus can be used for detailed antigenic determination, in vivo studies of pathogenicity and cross-protection. The isolated virus perhaps can be used for a new vaccine development. Proposed testing scheme for monitoring of IBV circulation and prevalence is summarized in *Tables 1* and *2*. Criteria for considering of vaccine vs. field IBV detection probability in ambiguous cases of nucleotide sequence homology is summarized in *Table 3*.

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Strategies for Diagnosis, Surveillance and Vaccination"

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Optimizing intestinal health in birds raised without antibiotics

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A 2012 survey of the US broiler industry to determine and rank production challenges indicated that gut health management was paramount in the minds of those involved with live production. This is not surprising since intestinal integrity determines feed efficiency, the most important economic driver of the meat industry. Since then, some significant changes in the industry have sharpened the focus on managing intestinal health.

The Poultry industry is experiencing a particularly profitable period. Over the last months, a nationwide shortage of pork, beef and chicken has induced a significant strengthening in the price of meat and this has coincided with a fall in the price of corn, the primary ingredient in US animal diets. While this would normally ease focus on the intensity of intestinal health management, this has not been the case because the status quo of traditional bacterial and protozoal enteropathy control strategies have been concomitantly been shattered by three occurrences. Firstly, the inference that the prevalence of gangrenous dermatitis is associated with the use of ionophores, secondly, the voluntary removal of 3-nitro from broiler feed in 2012 and thirdly, a recent statement of intent by a leading fast food chain to only sell chicken meat raised without in-feed antimicrobials within the next five years.

From intestinal-flora to house-flora

Although poultry meat production systems are all-in-all-out in nature, they are, from a gut flora perspective, a continuous system. Members of the gut microbial community surviving in the house environment are carried over from one cycle to the next and thus serve as the "seed stock" for the gut flora of the next placement. While in-feed antibiotics can alter the gut flora within a couple of weeks, it takes several grow-out cycles to change the house (litter) flora. This is by no means a new concept, both rotation and shuttle programs have been used for decades to avoid the lack of response to in-feed antibiotics following their persistent use.

The realization that even minor changes in intestinal microbial community composition can affect long term productivity through incremental displacement and replacement of the house flora has highlighted the significance of microbial community management.

Attention to detail is more critical than ever. The efficiency of nutrient assimilation hinges on the early establishment and maintenance of a favorable gut lumen environment. In a drug free production system the emphasis shifts from fighting the unfavorable organisms with antibiotics to nurturing the favorable organisms; working with nature to ensure a favorable and stable intestinal ecology. In its simplest format this involves:

- seeding the gut with favorable intestinal microbiota,
- feeding these organisms to ensure that they rapidly dominate the intestinal microbiota and,
- weeding out the unfavorable organisms.

acids can be used to change gut flora community structure. As weak proton donors, they are able to escape inactivation in the upper intestinal tract (proventriculus and gizzard), while their presence in the small intestine modifies microbial community composition. Endogenous short chain fatty acids have a microbiota stabilizing effect and butyrate in particular has been shown to stimulate the production of host defense peptides (β-Defensins and Cathelicidins). By providing a competitive advantage to the acid tolerant organisms such as the Lactobacilli and a competitive disadvantage to the acid intolerant organisms like the Clostridia, it is possible to guide the development microbiota composition. Such manipulation of the microbiota has both short and long term implications.

Unfavorable organisms are in general much more competitive in the environment of the lower intestinal tract and their replication is normally kept in check by intense competition for a limited source of nutrients. Any factor that reduces digestion efficiency in the upper gastrointestinal tract, or increases nitrogen turnover in chickens, could potentially alter cecal ecology. Urine (uric acid) and feed (undigested protein) nitrogen are used by cecal flora to synthesize microbial protein, a process that unfortunately yields toxic metabolites and causes dysbacteriosis. In contrast, volatile fatty acids (VFA) formed during carbohydrate degradation, have antibacterial activity, which has a stabilizing effect on the cecal ecology. Since cecal ecology is adversely affected by protein maldigestion, exogenous enzymes designed for protein ingredients can be used to help stabilize cecal flora communities. The amount of protein nitrogen reaching the ceca can be further reduced if nutrient credit allocation permits a reduction in dietary protein.

"Unfavorable organisms are in general much more competitive in the environment of the lower intestinal tract and their replication is normally kept in check by intense competition for a limited source of nutrients"

Seeding the gut with favorable organisms

The first organisms to colonize the gut direct the evolution and composition of the climax flora by creating the microenvironment necessary for complex microbial community development. Colonization of the gut with pioneer bacteria species, that are able to modulate expression of genes in the gut epithelia to optimize nutrient assimilation and create favorable conditions for establishment of a stable and beneficial climax flora, should be the starting point of any gut health management program. In addition, competitive exclusion has long been recognized as a means of preventing pathogen colonization of the intestinal tract and probiotics have recently been shown to suppress colonization of the intestine with *Brachyspira pilosicoli*, *Clostridium perfringens*, *Campylobacter jejuni*, and *Salmonella enteritidis*. Since the first organisms to gain access to the hatchling gut originate from the parent, steps to control gut health should start at the parent flock level. Vertical transmission of gut inhabitants (from parent to offspring) can be transovarial (inside the egg) or as a result of contamination during oviposition.

In the artificially clean hatchery environment, even low doses of beneficial bacteria can significantly improve resistance to pathogen colonization, and artificial seeding of the gut at an early age has been shown to be beneficial.

Feeding the favorable organisms

In addition to seeding the gut with the correct pioneer species, it is crucial to enhance their ability to proliferate, compete and colonize, so as to avoid pathogen proliferation. Weak organic

Weeding out the unfavorable organisms

The traditional approach to weeding out unfavorable organisms has been through the addition of a low level of antibiotic to the diet. The consumer has, rightly or wrongly, made the link between the emergence of antibiotic resistant strains of human pathogens and antibiotic use in animal agriculture. This approach to intestinal microbiota management is rapidly falling from grace. While antimicrobial substitutes such as essential oils and in-feed bacillus probiotics have become popular, the long term sustainability/future of these products may come into question; they are after all antibiotics by a different name. Alternatives that utilize a different mechanism of action, which avoids the negative aspects of low dose antimicrobial use is, from most perspectives, a more suitable solution.

As colonization proceeds, organisms attach to one another and the epithelium by a series of fibrils, to form a tightly adherent mat over the gut surface. Pathogens are thereby precluded access to the epithelial surface and their ability to colonize is compromised by a process of competitive exclusion. Microbe attachment to host cell docking sites on the intestinal epithelium is dependent on surface molecule structure and is the pivotal first step in the colonisation and infection of the gut. Since several gut pathogens recognise and attach to specific gut epithelia glycoproteins, products that mimic these docking sites are also useful in preventing attachment and reducing the risk of pathogen colonization.

Pathogen induced inflammation of the gut lining stimulates mucus secretion, increased paracellular permeability, and accelerated feed passage (peristalsis). The cascade of events that follows is self-perpetuating. Increased permeability enhances toxin and agent penetration, which in turn stimulates inflammation, and the resulting increase in mucus production attracts mucolytic species such as *Clostridium perfringens,* which produces damaging cytotoxins; a vicious cycle ensues.

Conclusions

Strategies to improve gut health in commercial operations need to be cost effective, sustainable, farm specific and holistic. Intervention / product selection needs to be science based but practical and each intervention must address the specific objective for its inclusion. Efforts to nurture and stabilize a favorable intestinal microbiota with alternative approaches have shown promise in addressing the negative impact of in-feed antibiotic removal and use. While there are several opportunities and product options to achieve this, there are three simple interventions that have demonstrated particular promise. By *seeding* the hatchling gut with favorable organisms, *feeding* these organisms with an appropriate organic acid, and *weeding* out the unfavorable competitors with a type-1 fimbriae blocker, it is possible to improve performance by accelerating the evolution of, and maintain the stability of, a favorable intestinal microbiota.

References are available on request
From the Proceedings of the
64th Western Poultry Disease Conference.

Stork Thigh Fillet System deskinning carrousel


Stork Thigh Fillet System deboning carrousel

Stork inline thigh filleting up to high capacities

Thigh meat consumption on the rise - a global trend

The market for thigh fillet is opening up, offering plenty of opportunities worldwide. To benefit fully from this development, poultry processors can now process thighs by using the revolutionary inline Stork Thigh Fillet System.

In some countries, mainly in the Far East, chicken thigh meat has always been more popular than breast fillet. Nowadays however, there's a global consumer trend to upgrade thigh meat, especially for its taste. It's not just the big market in China; Scandinavia also has a large appetite for thigh fillets, while Latin American markets love thigh meat too. In the USA and Russia as well, thigh products are appreciated more and more. As a consequence, industrial thigh deboning solutions will be needed worldwide to produce the required amounts of thigh fillets.

Marel Poultry has developed a globally unique inline thigh filleting concept, which can handle high speed lines. The Stork Thigh Fillet System can produce deboned thigh meat of high yield and quality with minimal trim operators or inspectors required. The system can keep up with the highest hourly throughputs while processing thighs with high precision and consistency.

Butcher quality from an inline system

The Stork Thigh Fillet System makes use of five carrousel modules. From knee joint incision, via skinning and bone extraction to knee cap removal and fillet harvesting, every single task is meticulously performed. The techniques used are ingenious, though simple and easy to control.

Manual shackling or rehanging is no longer necessary, as the process remains completely inline after the cut-up process. The system mechanically mimics the manual work of a skilled operator, ensuring a consistently processed “butcher quality” thigh meat. A consistent performance can be achieved for all products entering the system, irrespective of size or quality. The inline concept is more stable and much faster than manual deboning could ever be. The reliable process requires an absolute minimum of operators to check and trim. Therefore it saves considerable labor.

Gentle handling

It is the task of the thigh deboning system to preserve the quality of the supplied anatomic legs throughout the deboning process. That’s why bone handling is gentle and far from being "aggressive". Putting too much pressure on the bone to get it out could mean the loss of a carefully harvested oyster and thus loss of quality, which is exactly what Marel Poultry wants to prevent. Instead, this system uses a unique push-pull technique which makes for long-term reliability and low cost of ownership. During the entire process, thigh bones are never subject to excessive forces but are gently handled, notwithstanding the high speeds.

A revolutionary knee cap solution

Around the knee cap of a chicken leg, there is always valuable meat which usually isn’t harvested. The new Stork Thigh Fillet System succeeds in efficiently adding the knee joint meat to the higher value thigh meat. A maximum of meat from around the knee is harvested without putting undue stress on the drumstick. What pops out – automatically and reliably, without any human labor needed – is a bare knee cap.

Yield and quality

The Stork system produces thigh fillet with highest yield. Thigh fillets now can have a maximum amount of meat attached, with almost no losses, damage or bone remnants. The final outcome of the inline thigh deboning system is a tasty thigh fillet, a completely finished end product. Meat is smooth without roughness or raggedness. Product presentation – natural or marinated – is first class, ready for retail sale and for delicious meals.

For more about the Stork Thigh Fillet System
visit www.marel.com/tfs

Meyn: a look inside the market for deboning and deskinning

The poultry processing market is still on the road to growth. A CAGR of 4.7% by 2020 in USA alone is evidence of the increase of consumption and the demand for well-presented and healthy food.

Moreover, whilst until recently white breast meat was considered to be the premium chicken meat in most parts of the world, the dark meat of thighs and legs is becoming more popular owing to its stronger and more interesting taste. Even gourmet restaurants have reacted to this trend by creating a number of creative and tasty dishes built around chicken thighs and legs.

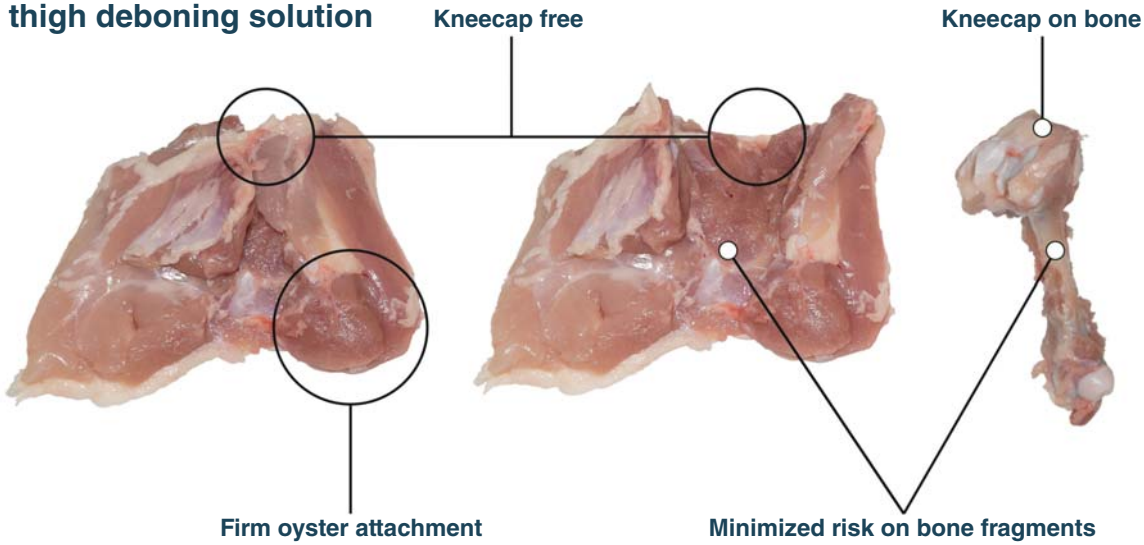
But whatever the tastes of consumers worldwide, a common theme is that they expect their chicken specialties to be free of bones, whichever part of the chicken they are eating. Meanwhile, with or without skin it remains a matter of taste and global region.

Thus the automated deboning of poultry parts is becoming increasingly important to poultry processors. And throughout the world, the figures show a steady upwards trend for deboning and deskinning equipment. At the same time, processors want to retain the possibility of laying out and designing their automation line so that it enables them to fulfil diverse consumer wishes and react quickly and efficiently to the orders of the retail chains.

Within a system such as this, extremely precise deboning and deskinning is necessary in order to ensure that the meat obtained from the carcass is in a good condition. Meanwhile, the car-

meyn
Poultry Processing Solutions

Meyn thigh deboning solution



cass should be as clean as possible, with all harvestable meat scratched off. This requires a processing method that is sophisticated enough to achieve an absolute maximum of bone-free meat. In addition, the deskinning process should leave the skin undamaged, thus adding value to the by-product. And, naturally, the processing line should be flexible and easily configurable to the processing needs and space of the plant.

Is all this possible? Or is it asking too much?

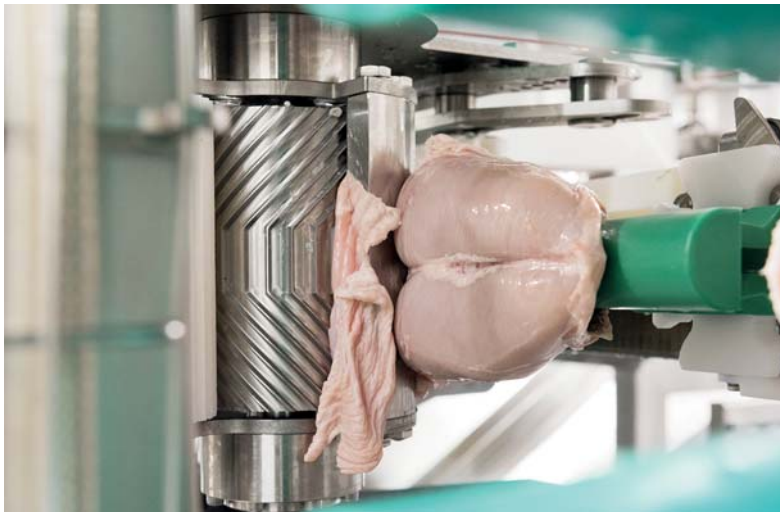
Meyn has accepted the challenge and provides the answers to these needs with a new level of modularity and flexibility in system set-up. This encompasses solutions for small and large processors and/or quantities, all of which respect the need for safety and ergonomics while ensuring optimum product quality and presentation. This is based on a long track record of innovation and service that has enabled Meyn to become the business partner for leading poultry processing companies in over 100 countries. And nowhere is our forward thinking expertise more evident than in our highly advanced solutions for thigh, whole leg and breast deboning.

This expertise is perfectly embodied in the widely installed Meyn **Rapid Plus breast deboner**. It makes possible the high-capacity (6,000 chickens p/h) harvesting of all fillet and

DEBONING & DESKINNING EQUIPMENT MARKET SIZE, BY REGION. 2013 - 2020 (USD MILLION)

Region	2013	2014	2015-e	2016-p	CAGR 2015-2020
North America	192,7	197,8	203,6	268,5	4,9%
Europe	179,9	182,8	186,3	224,9	3,8%
Asia-Pacific	138,4	142,5	147,2	189,9	5,2%
RoW	82,6	84,8	87,3	110,8	4,9%
Total	583,6	607,9	624,5	784,2	4,7%

Source: Markets and Markets, Poultry Processing Equipment Market, Global Forecast to 2020



tender products, enabling significant labour savings while processing multiple weights within one setting. In addition, at IPPE 2017 Meyn introduced the new **Rapid**, a Plug & Play version of the renowned breast deboner with a capacity of 4000 chickens per hour.

Meyn solutions can also debone thighs and legs to the same high standard with products such as the Meyn **TDS thigh deboning solution M 1.0** and the **Meyn WLD whole leg deboner M2.0**. With poultry meat consumption expected to keep growing for some years to come, manufacturers for poultry processing equipment are heavily engaged in Research and Development, finding more efficient ways to ensure their customers' profitability and success.

"*Market requirements are constantly increasing,*" states Erik Blom, Managing Director Meyn, "*and we will keep investing in intelligent solutions according to different international standards.*" With three production sites in Oostzaan/The Netherlands, Poland and the United States as well as offices all over the world, Meyn is in close cooperation and communication with their clients in over 100 countries and prepared to answer the challenges of the future.

Hatcheries

Breeders

Equipment

UPCOMING EVENTS

2017

November 28 to December 1
YUGAGRO 2017

Exhibition venue Expograd Yug

Kongressnaya Str. 1
Krasnodar, Russia
350005

Organizers:
KrasnodarEXPO
(Business unit of ITE Expo)

Tel. +7 (861) 200-12-34

Email: info@krasnodarexpo.ru
Website: www.krasnodarexpo.ru

2018

January 30 to February 1
IPPE

International Production
and Processing Expo

Georgia World Congress Center
285 Andrew Young International Blvd
NW Atlanta, Georgia USA

Website: ippexpo.com

January 30 to February 1
MVC, Cereals, Mixed Feed, Veterinary 2018

Moscow, Exhibition of National Economy Achievements (VDNH), pavilion 75

Contact:
MC "Expokhleb"
Postal address: Pavilion
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P.O. Box 34, Moscow, 129223, Russia

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Fax: + 7 (495) 755-67-69, 974-00-61

Email: info@expokhleb.com
Website: www.breadbusiness.ru
www.mvc-expohleb.ru

January 31 to February 3
113th Edition of Fieragricola Verona

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Tel. +39 045 829 8242/8285/8350/8210
Email: pressoffice@veronafiere.it
Website: www.fieragricola.it
Twitter: @pressVRfiere

February, 5 to 7
VIV-MEA 2018

Abu Dhabi National Exhibition Company (ADNEC)

Khaleej Al Arabi Street
P.O. Box 5546
Abu Dhabi, United Arab Emirates

Contact:
VIV Worldwide
VNU Exhibitions Europe
Ms. Renate Wiendels
P.O. Box 8800
3503 RV Utrecht, The Netherlands

Website: viv.mea@vnuexhibitions.com

February, 6 to 8
AgroFarm

All-Russian Exhibition Centre (VVC Grounds) in Hall 75

Moscow, Russia

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March, 14 to 16
AgroWorld Uzbekistan

Uzexpocentre, Tashkent

Contact:
ITE Group 105 - 109 Salusbury Road
London, NW6 6RG

Tel: +44 (0)20 7596 5000
Website: http://agroworld.uz

March, 25 to 27
11th Asian Pacific Poultry Conference

Paza Athénée - Royal Méridien Hotel
Bangkok, Thailand

Contact:
Dr Charoen Parchariyanon

Email: charoen@pcakinter.com
Website: www.appc2018.com

May, 9 to 12
International Poultry Congress

Cultural and Convention Center

Omer Halisdemir University
Nidge, Turkey

Contact:
Prof Dr Ahmet Sekeroglu

Email: ahmet.sekeroglu@ohu.edu.tr
Website: www.ipc2018.org

May, 15 to 16
British Pig & Poultry Fair

NAEC Stoneleigh,
Stoneleigh Park, Warks

CV8 2LGGrandstand
Stoneleigh Events Ltd
Stoneleigh Park Warwickshire
CV8 2LG, United Kingdom

Contact:
Switchboard: +44 (0) 24 7669 6969

Fax: +44 (0) 24 7685 8393
Email: teresag@stoneleighevents.com

June, 20 to 22
VIV-Europe 2018

Jaarbeurs, Utrecht, The Netherlands

Contact:
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Project Manager

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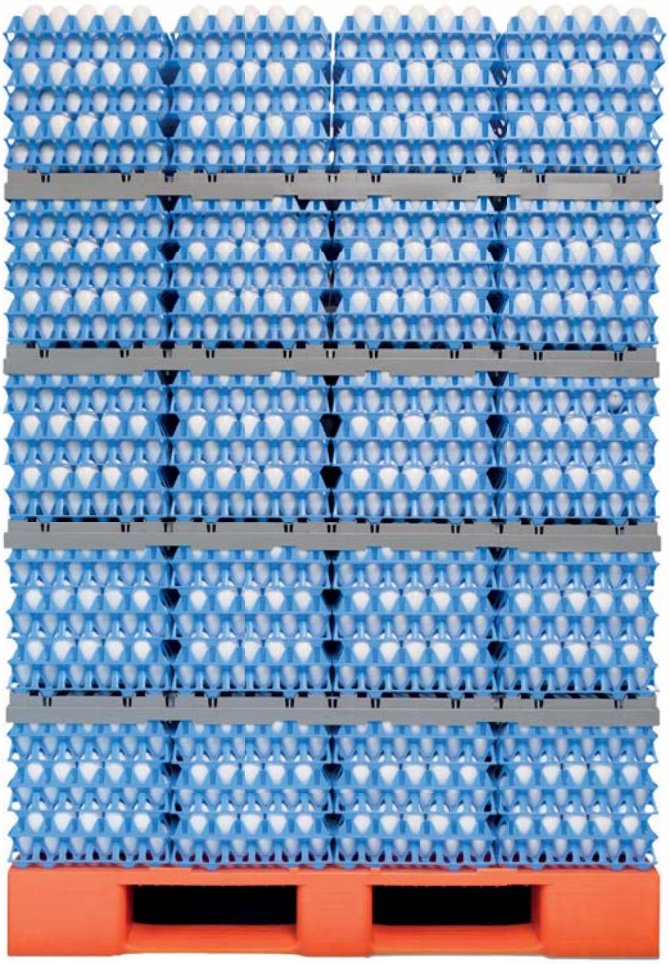

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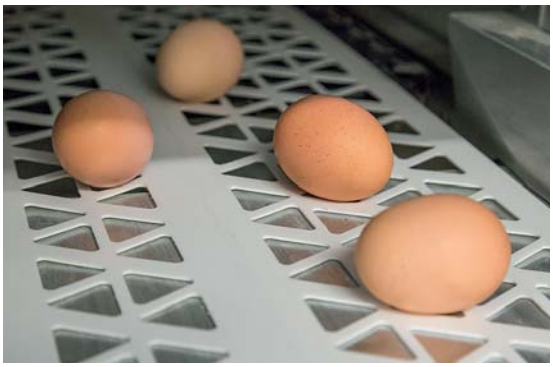

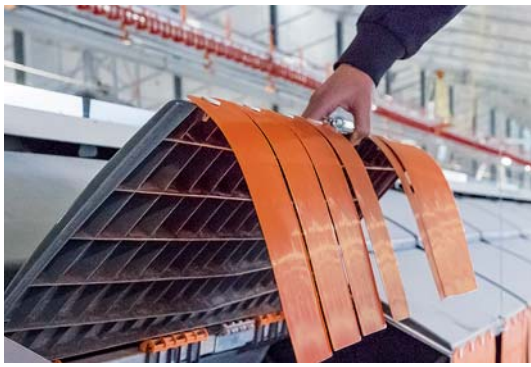

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