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- Editor



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Global Halal Foods Market to Reach US \$ 3.2 Trillion by the Year 2027 Build Amaravati as the pride Capital of A.P in India



Dear Readers,

The August 2020 issue of **Poultry Fortune** is in your hands.

In the News section, you may find news about – Global Halal Foods Market to Reach US \$ 3.2 Trillion by the Year 2027, Amid the

COVID-19 crisis, the global market for Halal Foods estimated at US \$ 1.7 Trillion in the year 2020, is projected to reach a revised size of US \$ 3.2 Trillion by 2027, growing at a CAGR of 9.6% over the analysis period 2020-2027.

Novus International, Inc. today filed anti-dumping petitions with the U.S. Department of Commerce and International Trade Commission. The petitions ask the agencies to investigate imports of methionine from Spain, France and Japan consistent with the World Trade Organization Anti-dumping Agreement. Imports of methionine from the three countries are priced substantially lower than domestic producers' shipments.

In the Articles Section, article titled – "All Clays are not Created Equal" by Dr Douglas Zaviezo, Ph. D. Special Nutrients, discussed about practical methods to detoxify mycotoxins contaminated grain or feed on a large scale and in a cost-effective manner are not currently available. At present, one of the most practical approaches consists of using adsorbent materials in animal diets to reduce the absorption of mycotoxins from the gastrointestinal tract. Clays are an important group of products that have been used successfully worldwide to reduce mycotoxicosis; and all commercial anti-mycotoxin additives or mycotoxin inactivators available in the market are clay based products.

One more Article titled "Tips to Improve Broiler Feed Efficiency" by Dr Kiran Kumar, Regional Sales Manager, Vetphage Pharmaceuticals Pvt Ltd says that improved broiler feed efficiency is linked to improved profitability. The way to improve the productivity index is by balancing the ratio between energy needed and amino acids, and by improving the feed digestibility by different means. However, there are ways to improve the efficiency even after it is delivered to the farm. Let us take a look at some ways in which you can make the most out of your broiler feed.

After the bifurcation of united Andhra Pradesh into two states – Andhra Pradesh and Telangana, the way Mr N. Chandrababu Naidu started working to develop a world class state headquarter, AMARAVATI for Andhra Pradesh state, people with in Andhra Pradesh and all over the country commended him for his initiative.

People had faith that a wonderful city will be developed on the name of Amaravati, as the head quarter of A.P, as the project was planned and taken up by Mr Chandrababu Naidu who had the good record of developing Hyderabad as the delightful city with wide and clean roads, Hitech City, Outer Ring Road, International Airport etc.

The proposed Amaravati city is located on the banks of river Krishna in Guntur district and the primary city of the state's capital region and the land for Amaravati is selected close to the geographical center of the state.

Amaravati was founded by former Andhra Pradesh Chief Minister N. Chandrababu Naidu in 2014 as the Greenfield administrative capital city of Andhra Pradesh state, and its foundation stone was laid at Uddandarayunipalem by the Prime Minister of India, Narendra Modi on 22 October 2015. Narendra Modi promised to help in developing Amaravati as the Capital of A.P, but he never showed any interest on it after that. May be Narendra Modi does not want the development of Amaravati as it will make Chandrababu Naidu to emerge as a strong leader and administrator in the country, and Modi has to face competition from Chandrababu Naidu at national level. Ego and Jealousness are harming the development of a good capital for the people of Andhra Pradesh.

Y. S. Jaganmohan Reddy who is facing many criminal cases in the court should realize that people of the state voted him to come into power as he pleaded the people "to give him a chance", but not that he will pull down whatever Chandrababu Naidu took up for the state like developing Amaravati as the state capital.

With the way the Governor of A.P gave his assent on 31 July 2020 paving the way for the formation of the three capitals for Andhra Pradesh is a sorrowful thing for the region and it shows the double standards of the Central Government. Whether Visakhapatnam is made the Capital of the state or not, it will naturally become a nice city and commercial capital of Andhra Pradesh looking at the facilities Vizag has already got.

Late Dr Y. S. Rajasekhara Reddy during his tenure as the Chief Minister of united Andhra Pradesh made a mark with good work which was left behind by his predecessor Chandrababu, and Jaganmohan Reddy should follow his father's foot steps by continuing to develop Amaravati better than what his predecessor Chandrababu Naidu planned and get people's appreciation instead of destroying it.

Let us hope that the High Court will do justice for the Amaravati to come into true as the capital city of Andhra Pradesh, which is a leading state in poultry development in the country.

M.A.Nazeer
Editor & Publisher
Poultry Fortune



Poultry Fortune

Our Mission

Poultry Fortune

will strive to be the reliable source of information to poultry industry in India.

PF will give its opinion and suggest the industry what is needed in the interest of the stakeholders of the industry.

PF will strive to be The Forum to the Stakeholders of the industry for development and self-regulation.

PF will recognize the efforts and contribution of individuals, institutions and organizations for the development of poultry industry in the country through annual Awards presentation.

PF will strive to maintain quality and standards at all times.

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The \$3.2 Trillion Halal Foods Industry, 2027 - Halal Meat, Poultry & Seafood Segment will account for half of the Global Market

The publisher brings years of research experience to this 8th edition of this report. The 294-page report presents concise insights into how the pandemic has impacted production and the buy side for 2020 and 2021. A short-term phased recovery by key geography is also addressed.

Global Halal Foods Market to Reach US\$3.2 Trillion by the Year 2027

Amid the COVID-19 crisis, the global market for Halal Foods estimated at US\$1.7 Trillion in the year 2020, is projected to reach a revised size of US\$3.2 Trillion by 2027, growing at a CAGR of 9.6% over the analysis period 2020-2027.

Meat, Poultry and Seafood, one of the segments analyzed in the report, is projected to grow at a 10.9% CAGR to reach US\$1.6 Trillion by the end of the analysis period. After an early analysis of the business implications of the pandemic and its induced economic crisis, growth in the Fruits & Vegetables segment is readjusted to a revised 9.2% CAGR for the next 7-year period. This segment currently accounts for a 7.9% share of the global Halal Foods market.

The U.S. Accounts for Over 27% of Global Market Size

in 2020, While China is Forecast to Grow at a 12.8% CAGR for the Period of 2020-2027

The Halal Foods market in the U.S. is estimated at US \$ 450.4 Billion in the year 2020. The country currently accounts for a 27.01% share in the global market. China, the world second largest economy, is forecast to reach an estimated market size of US \$ 678 Billion in the year 2027 trailing a CAGR of 13% through 2027. Among the other noteworthy geographic markets are Japan and Canada, each forecast to grow at 6.5% and 8.2% respectively over the 2020-2027 period. Within Europe, Germany is forecast to grow at approximately 7.5 % CAGR while Rest of European market (as defined in the study) will reach US \$ 678 Billion by the year 2027.

Dairy Products Segment Corners a 17.7% Share in 2020

In the global Dairy Products segment, USA, Canada, Japan, China and Europe will drive the 7.7% CAGR estimated for this segment. These regional markets accounting for a combined market size of US \$ 222.6 Billion in the year 2020 will reach a projected size of US \$ 375.2 Billion by the year 2027. >>

T. Natesan is the new Managing Director of Virbac AH, India



T. Natesan, Managing Director, Virbac AH, India

Mumbai: After serving 9 Years 6 months in South East Asia, Taiwan and Korea, Virbac Board appointed Mr T. Natesan as the Managing Director, Virbac Animal Health India Pvt Ltd with head quarters at Mumbai with effect from 1 July 2020, which is the 3rd biggest operation for Virbac Group. He expressed his pleasure over coming back to his mother land, India.

Natesan started his journey in Animal Husbandry industry in India during

March 1987 with DeeJay Hatcheries, and then joined GSK Vet division in April 1990 as a Business Officer, after working in various capacities for 20 years in India, had an opportunity to work in SEA, Taiwan and Korea, which gave him different experience with different people, culture, market dynamics and challenges.

On this occasion in a communication to the stakeholders of the industry, he thanked colleagues, customers and mentors who supported him all along. Now I will be starting a fresh innings by re-connecting to my Indian colleagues and customers to serve them better, said Mr T. Natesan.

Mr Satish Pasrija recently retired from service as the Managing Director of the company in India.

>>

close of the analysis period. China will remain among the fastest growing in this cluster of regional markets. Led by countries such as Australia, India, and South Korea, the market in Asia-Pacific is forecast to reach US\$452.3 Billion by the year 2027, while Latin America will expand at a 9.7% CAGR through the analysis period.

Competitors identified in this market include, among others:

- Al Islami Foods
- Al-Falah Halal Foods Ltd.
- BRF SA
- Cargill, Inc.
- Janan Meat
- Kawan Food Berhad
- Nestle SA
- QL Foods Sdn. Bhd.
- Saffron Road Food, an American Halal Company
- Tahira Foods Ltd.

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The Future of Meat is Chicken

- ▶ Meat production seen rising 12% by 2029: OECD-FAO report
- ▶ Emissions from agriculture set to increase 6% over same period

A deadly swine disease and the corona virus pandemic may be hurting meat production for now, but they won't stop the industry's expansion over the next decade, largely thanks to the world's continued appetite for chicken.

Global meat production will rise by 12% in the decade to 2029, with poultry output driving half of the growth, as countries such as Brazil and China expand output, according to a report from the Organization for Economic Cooperation and the United Nations' Food and Agriculture Organization.

Production will gradually recover by 2025 after hitting a "low point" this year due to the African swine fever and a likely impact from corona virus, the organizations said recently. Expansion of meat production is bad news for the environment. Carbon emissions from the agricultural industry are set to rise by 6% over the next decade with livestock seen

countries to switch to plant-based diets, people in emerging markets are still adding more meat and dairy products onto their plates.

Lower and middle-income countries won't switch en masse to plant-based diets in the next decade, according to Holger Matthey, an economist at the FAO's trade and markets division. "This shows us we need to do more in terms of sustainability, advocating, and so on," he said on 16 July 2020 on a webcast.

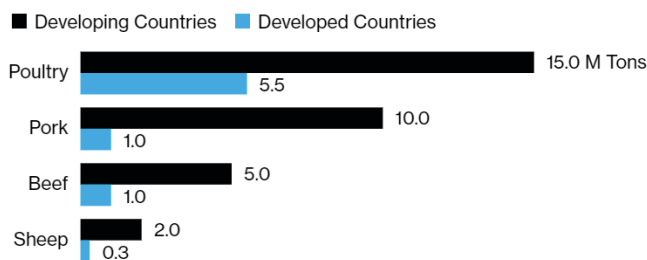
Poultry is the top choice for consumers in developing countries thanks to lower prices, according to the OECD-FAO report. Still, while global meat consumption is set to rise, it will grow at much slower pace than it has in the past.

OTHER REPORT FINDINGS:

- Agricultural commodities supply growth is going to outpace demand growth, causing prices of most products to remain at or below their current levels.
- A drop in disposable incomes in some countries

Ramping Up

Growth of meat production by region and meat type



accounting for most of the sector's polluting footprint, the report showed. While environmental and health concerns are pushing more consumers in high-income

and households, caused by Covid-19, is expected to depress demand in the early years of the decade. This could further undermine food security.

Novus International files Methionine Antidumping Petitions with US Government

SAINT CHARLES, MISSOURI (29 July 2020) – Novus International, Inc. today filed antidumping petitions with the U.S. Department of Commerce and International Trade Commission. The petitions ask the agencies to investigate imports of methionine from Spain, France and Japan consistent with the World Trade Organization Antidumping Agreement.

Imports of methionine from the three countries are priced substantially lower than domestic producers' shipments. Illegal dumping of methionine in the United States at an artificially low price can hurt the U.S. agriculture industry.

"We believe fair and competitive business practices are integral to the health of our industry and are necessary to protect our customers and consumers everywhere," said Dan Meagher, president and CEO, Novus International, Inc. "Today we took steps to ensure those fair practices."

The volume of methionine imports into the United States from the three countries (Spain, France and Japan) increased by more than 200% from 2017 to 2019, and another 29% between the first quarter of 2019 and first quarter of 2020.

Access to domestically-produced methionine is critical for U.S. animal protein producers. Illegal dumping can result in the

reduction or elimination of domestic production. The animal protein industry benefits from having domestic and foreign supply options available.

"The coronavirus pandemic has reminded us of the vulnerability of global supply chains and the impact on highly integrated industries, such as agriculture and food production, when disruptions occur," said Meagher. "We are simply asking the U.S. government to ensure Spain, France and Japan are abiding by international trade laws."

The government investigation will determine whether illegal dumping of imported methionine has occurred. The investigation is expected to take approximately 13 months. If the government determines importers did illegally dump foreign products, those importers may have to pay a duty on imports, which would be collected by the government as a tax.

The International Trade Commission is expected to make its preliminary determination by September 14, 2020. The U.S. Department of Commerce is expected to make its preliminary determinations and impose any remedial duties by January 5, 2021. These timelines may adjust depending on the course of the investigations.

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Poultry farmers in India seeking \$ 2.7 billion after virus scare

India's poultry industry is in dire need of cash after prices slumped earlier this year on speculation fanned by social media that chickens could spread the coronavirus, according to one of the nation's top producers.

Chicken prices at the farm gate plummeted as much as 70% in March from January, forcing farmers to cull large numbers and causing huge losses, said Suresh Chitturi, Vice Chairman and Managing Director of Srinivasa Farms Pvt Ltd. Prices have now recovered to just above production costs, but banks are still not willing to lend, he said in a phone interview.

Farmers need up to 200 billion rupees (\$2.7 billion) in loans, Chitturi said. Bank financing is crucial to the \$14 billion industry which directly or indirectly employs 5 million people and supports 25 million producers. With an annual output of 95 billion eggs, India ranks second in the world, according to Chitturi.

The novel coronavirus is thought to have originated in bats and spread to humans via a yet-to-be identified intermediate mammalian host. Almost two dozen animal species are known to be susceptible to infection. Still, health authorities say there's no evidence that animals play a significant role in spreading the virus, and consider the



risk of them doing so to be low.

"We don't want any freebie," said Chitturi, who is also the chairman of the International Egg Commission. "We just need the cash to expand and we will pay back the money. We have seen an increase in demand recently and prices are also good because of a shortage in supplies," he said.

The industry won't survive if it doesn't get the funding as there is a risk of default on existing loans totaling as much as 250 billion rupees, Chitturi said. "We were beaten by rumors which almost killed the poultry business. I'd be making good money if I were in the U.S. or China as people there are consuming more poultry to have good protein intake," he said.

Chicken meat consumption in India is seen shrinking about 8% from a year earlier to a three-year low of about 4 million tons in 2020, according to the U.S. Department of Agriculture. By contrast, demand in China will probably climb by 11% to a record of more than 15 million tons, while U.S. consumption is forecast to rise to an all-time high of over 17 million tons, it said.

Poultry farmer doubles profit during pandemic

Ramanathapuram: Ramalakshmi attributes her success to the sale of Kadaknath chicken, known for its nutritional value



Making gains: Ramalakshmi says the COVID-19 pandemic has given her farm a new lease of life.

Hard work and perseverance seem to have paid off for N. Ramalakshmi, a poultry farmer from Venthoni village in Paramakudi block of Ramanathapuram district. While businesses up and down the country have been reeling from COVID-19-induced losses, she has managed to double her profit in the midst of the pandemic.

The 43-year-old, who has studied up to Class X, attributes her success to the sale of Kadaknath chicken, the jet-black bird known for its nutritional value.

Fifteen years ago, Ms. Ramalakshmi started rearing cows to financially support her family. "My husband, who was working abroad, did not earn much money. But we wanted to make sure that our three sons got a good education. So, I decided to do my bit to support our family," she says.

Her sons have now become professionals — a software engineer, a physiotherapist and a civil engineer. Ms. Ramalakshmi currently rears cows, goats, country chicken, Kadaknath chicken and pigeons. She also cultivates millets to supply them as fodder for her cattle.

She says she has been making a profit of Rs 60,000 each month for the past four months, which is double the amount of profit she used to make prior to the lockdown. "The COVID-19 pandemic has given my farm a new lease of life," she adds.

N. Ajith Kumar, her youngest son and a civil engineer, has been helping her run the business since the lockdown began. "In fact, poultry farming has fetched a higher income than a job in an organised sector," he says.

Mr Kumar says the sales of Kadaknath

Contd on Page 16

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Need stricter meat industry rules to prevent another Covid — 100 doctors write to Harsh Vardhan

The letter, by doctors who are part of a WHO initiative, seeks a ban on wet markets and closure of slaughterhouses that do not follow FSSAI guidelines.



Caged ducks at a wet market in China

New Delhi: Hundred doctors from across India, who are part of the World Health Organization's 'One Health' initiative, wrote a letter to Union Health Minister Dr Harsh Vardhan on 5 August 2020 demanding stricter meat industry regulations in order to avoid another pandemic in future.

Stating how Covid-19 is thought to have spread from an animal host to humans at a wet market in China's Wuhan, the letter seeks a ban on such market places.

It also demands closure of slaughterhouses that do not follow Food Safety and Standards Authority of India (FSSAI) guidelines or norms under the Prevention of Cruelty to Animals (Slaughter House) Rules, 2001.

"Several studies reported

that banning the storage of live poultry in live markets at least for a short period of time for overnight drastically reduced the ability to isolate the avian influenza viruses by 84 per cent compared with the standard procedures. Such studies show that a permanent ban on the live markets will help in the prevention of such zoonotic diseases," the letter stated.

One Health is a collaborative and multidisciplinary approach by WHO for designing and implementing programmes to achieve better public health outcomes.

Doctors from reputed institutes such as AIIMS, Lady Hardinge Medical College and Maulana Azad Medical College, among others, work in collaboration with the

Federation of Indian Animal Protection Organisations (FIAPO), to endorse the One Health approach in India.

Varda Mehrotra, executive director at FIAPO, said, "The One Health approach is not only a smarter and more holistic initiative, but, with the unified voice of Indian healthcare professionals, also a powerful catalyst for change. The goal behind our collaboration with doctors is to facilitate a safe and sustainable world that is free of zoonotic viruses and a more robust health infrastructure."

Dr Rajanikant Nayak, a member of the Odisha-based Krupasindhu Ayurvedic Seva Sadan and one of the signatories in the letter, said, "It is high time we move towards a scientific approach that recognises the unmitigated potential of connecting human, animal and environment wellness. These are no longer detached, but related to each other."

'Ban consumption of wildlife'

Along with wet markets, the

letter also urges stringent rules to end unsustainable intensive animal farming and ban on consumption of wildlife.

Doctors under the One Health approach work towards endorsing the undeniable connection between the environment, human and animal health.

Dr Anil Kumar, an Ayurvedic medical officer at the Department of Ayush, Health and Family Welfare, Odisha, pointed out how the collaboration between multiple organisations has the potential of bringing tremendous change in healthcare systems.

"The introduction of 2019-nCoV into livestock animals could pose a potential threat to both agriculture and public health. Emergence of COVID-19, after MERS-CoV and SARS-CoV, represents a third major emergence of a novel coronavirus. It is now time to learn from the lessons of these two previous outbreaks to prevent the spread of further disease from 2019-nCoV," the letter to Harsh Vardhan also stated.

Poultry farmer doubles profit during pandemic

Contn from Page 14

chicken, locally known as karung kozhi in Tamil, and its eggs have contributed significantly to the rise in their income. He says they have sold around 500 Kadaknath chicken during the lockdown period. "We have been selling 150 eggs of Kadaknath chicken every day," he adds.

"Due to the spread of COVID-19, people have become more health-

conscious and are opting for Kadaknath chicken for its high nutritional value," Mr Kumar says.

Ms Ramalakshmi says many marginal farmers buy these chicken from her to start their own business. She also sells 30 litres of milk per day. "Poultry farming is a highly remunerative business. Consistent efforts will definitely yield benefits," she adds.



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Are insects and microalgae the broiler feed of the future?

Investigations into the feeding of insects and microalgae to broilers has found that both sources of protein represent a suitable sustainable alternative to soymeal.

The Germany study, carried out by researchers from the University of Gottingen, found that meat quality of chickens fed with certain insects or microalgae was suitable for human consumption.

Despite vegan and vegetarian diets becoming increasingly popular in Western Europe, worldwide there is growing demand for animal products for human nutrition, which takes up a considerable amount of high-protein feed for farm animals. However, the cultivation of animal feed is often accompanied by land-use changes such as deforestation and scientists are therefore looking for future feed to be independent of arable land. “...sustainability necessitates the incorporation of waste products in the production of insects.”

The research team looked at what happened when broiler chickens were fattened using feed with the main protein sources being soybean meal, spirulina, or insects. Animal growth, meat quality (in particular shelf life) and eating quality were investigated. Their results of laboratory testing and sensory (taste testing)

across 132 broilers found:

- Black soldier fly larvae meal and spirulina can be included in poultry feed without negatively impacting quality
- Chickens fed with black soldier fly larvae meal produce meat equivalent to the status quo
- Chickens fed with spirulina produce meat with a more intensive colour and flavor

Dr Brianne Altmann, lead researcher, said: “Overall, both prove to be potential soybean meal alternatives in the search for new protein sources for animal feed.”

Insect Protein:

The popularity of insect meal as a new protein has taken off – find out about new developments, regulations and innovations.

Microalgae were currently produced globally for biofuel, animal feed and human consumption but remain much more expensive than soybean meal. Currently, in the European Union, insects are only authorised for human consumption and for fish feed but are likely to be approved for poultry feed in the near future. Professor Daniel Morlein, professor for the Quality of Animal Products at the University, added that in the EU all insects must be produced using certified animal feedstuffs: “However, sustainability necessitates the incorporation of waste products in the production of insects,” he argued.

Hatchery tips for successful transition to NAE production

Preventing birds from getting sick is perhaps the biggest challenge encountered when transitioning from conventional to “no antibiotics ever” (NAE) production, Tony Newsome, division manager, Fieldale Farms, told *Poultry Health Today*.

Fieldale Farms was one of the first poultry companies to transition to NAE production. It’s been a long process, Newsome said, but the company has figured out how to raise healthy NAE flocks.

“We basically started from the ground up,” first with pullets and breeders, he said.

When no antibiotics are used, essentials such as biosecurity and bacterial loads play a far greater role. Eggs going into the hatchery have to be clean, the hatchery has to be kept clean and chicks sent to the grower house have to be clean, Newsome emphasized.

“I don’t think there’s any great secret to how to run a hatchery and what needs to be done. I think the problem is all of us get caught up in lack of help, or whatever the case may be, and we let things go that we really know need to be done every day. So to run antibiotic-free, you can’t let them go...” he said.

In ovo vaccination without gentamicin, for instance, requires that hatchery surfaces are as clean as

possible. Swabbing to check for bacteria is done frequently. “I think as long as [everything is] clean and everything is done by the book, you can get by without gentamicin. We’ve done it now probably 15 years with really good success,” he said.

Optimal immunity

Newsome said optimal immunity is likewise important when raising NAE flocks, and that includes maintaining vaccination against Marek’s disease. Companies that quit vaccinating may suddenly wake up one day to find they’re “in the worst trouble you’ve ever been in” due to condemnations. It can take 6 to 8 weeks to remedy the situation.

“I don’t want to be without vaccinating for Marek’s for any length of time. We grow a premium product, and we don’t want to take a chance with something like that interfering with the flow,” he said.

The vaccination plan in general will vary depending on the location, “but we try our best to vaccinate for everything that we can to try to keep from compromising the immune system,” Newsome continued. For infectious bronchitis, Newsome added that Fieldale uses a multitude of segregated vaccines instead of a combined vaccine, and the condemnation rates are about as good as anybody’s in the

Contd on Page 24

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Veterinarians play critical role in backyard poultry and livestock welfare, as well as human health

Backyard poultry and small-scale livestock agriculture are a growing trend in the U.S., even in large cities such as Seattle, Portland, Denver and San Francisco. Residents raising backyard poultry and livestock do so for a variety of reasons such as access to locally sourced food, companionship and sustainability. But how often do these owners seek veterinary care in these urban and peri-urban areas (UPAs)?

A Western Regional team of collaborators, including CSU and UC Davis researchers, conducted a survey of veterinary practitioners to better assess their engagement with owners of these animals. They received responses from 880 veterinarians in California, Colorado, Washington and Oregon. Most respondents reported working in companion animal only or companion animal predominant practices. Although most of the veterinarians perceived an increase in backyard poultry and livestock in their practice areas, few were actively treating such animals primarily because of a lack of facilities, interest or experience.

Their findings, published in the July 15th issue of the *Journal of the American Veterinary Medical Association*, indicate an increasing demand for veterinary services for



poultry and livestock in peri-urban areas, and a need for ongoing continuing education of practitioners, as well as the animal owners.

"This segment of agriculture has been largely overlooked by the veterinary community in North America," said Dr Alda Pires, University of California cooperative extension specialist in the UC Davis School of Veterinary Medicine and co-principal investigator in the study. "Due to the potential for public health issues and the spread of zoonotic disease, veterinary professionals need increased training and better awareness of the health and welfare of these animals."

Dr Ragan Adams, veterinary extension specialist at Colorado State University and a co-principal investigator emphasized that the animal owners also need better awareness of the importance of regular veterinary care and a willingness to pay for that medical expertise.

"Many of these owners are unfamiliar with the responsibilities and challenges of owning poultry and/or livestock,"

Adams said. "County Extension personnel can teach the new animal owners as they have taught youth in 4-H programs for more than 100 years. With enhanced knowledge about animal husbandry, the new owners will understand the importance of seeking veterinary services when their animals show signs of illness."

Disease spread from these peri-urban areas can spell disaster for other animals. For example, the 2015 outbreak of highly pathogenic avian influenza, traced to backyard poultry flocks, had severe economic and trade consequences for the commercial poultry industry. Recent outbreaks of virulent Newcastle disease in California also posed significant threats to commercial poultry flocks and the agricultural economy.

"The health and welfare of animals in UPAs are of concern because their owners often lack the knowledge or expertise regarding safe handling and animal husbandry," said Dr Dale Moore, Washington State University Veterinary Medicine Extension specialist and co-investigator.

"A previous survey found that the owners want more access to livestock and poultry medicine. This follow-up survey highlights the need for veterinarians, along with extension specialists to work with small-scale poultry owners to improve biosecurity measures, better detect disease and mitigate potential future outbreaks." The original study ideas for these surveys came

from Washington State University Veterinary Medicine Extension (Drs. Dale Moore and Amos Peterson) as part of Peterson's Master's Thesis project. The project was then extended to Veterinary Medicine Extension in California (Drs Pires, Jerome Baron and Beatriz Martinez-Lopez), and at Colorado State University (Dr Ragan Adams). Extension educators at Oregon State University and the Oregon Veterinary Medical Association helped with contacts in their states.

The increase in popularity of backyard and peri-urban agriculture provides both challenges and opportunities for veterinarians. Providing veterinary service to owners of backyard poultry and livestock, who often view their animals as pets rather than production animals, requires a different approach and some different skills than providing veterinary service to owners of conventional or commercial livestock operations.

Study authors suggest a new model of practice might be envisioned for urban and peri-urban poultry and livestock clientele to ensure the health and welfare of their animals, and to safeguard public health. Specific opportunities for the veterinary profession are to identify local or regional veterinary service needs for these owners, become equipped to address exotic or zoonotic disease detection and husbandry questions, and provide medical care as well as food safety advice.



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Can probiotics consistently improve broiler performance?

Many individual studies demonstrate the production benefits of probiotics in broilers. But can they deliver these benefits consistently?

According to a new analysis, the answer is yes.

A statistical meta-analysis of data from 14 research trials revealed that GALLIPRO — a probiotic feed supplement containing a unique strain of *Bacillus subtilis* — consistently improved broiler performance. The results were presented at the 2016 Poultry Science Association (PSA) annual meeting.

“These studies show that probiotic supplementation significantly increased weight gain and feed

efficiency,” says Alfred Blanch, DVM, PhD, poultry consultant for Chr. Hansen. “The strength and consistency of these data confirm that GALLIPRO® is a reliable choice for producers wishing to boost the health and performance of their flocks, whether used alone or in combination with other feed additives.”

Improved weight gain, feed efficiency

The studies were conducted in a total of 14,828 male broiler chicks from hatch to market weight at 42 days of age. The birds were fed basal diets of corn and soy or wheat, corn and soy, with or without GALLIPRO supplementation

according to manufacturer instructions (8 x 10⁵ CFU/g feed).

Compared to control, birds in the GALLIPRO group were significantly heavier and demonstrated significantly lower feed conversion

ratios, regardless of basal diet composition (Figure 1).

Improved digestibility, intestinal function

According to Blanch, the consistency of the study data reflects the proven mode of action of the *B. subtilis* strain in GALLIPRO, which works by increasing enzyme activity, while improving intestinal function.

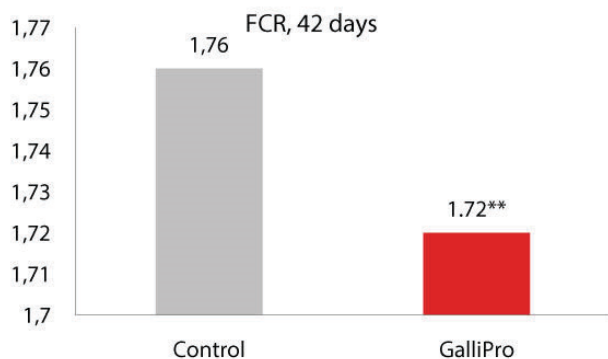
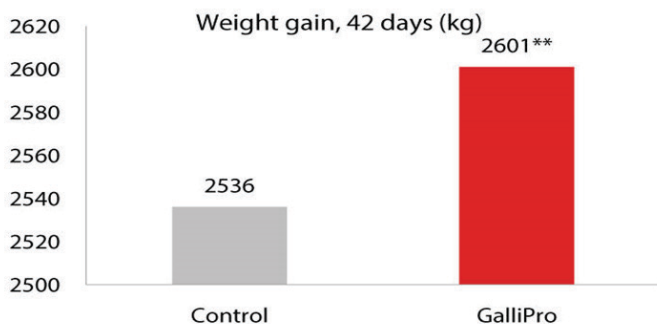


Figure 1. GalliPro® supplementation significantly improves production performance.

**P<0.01

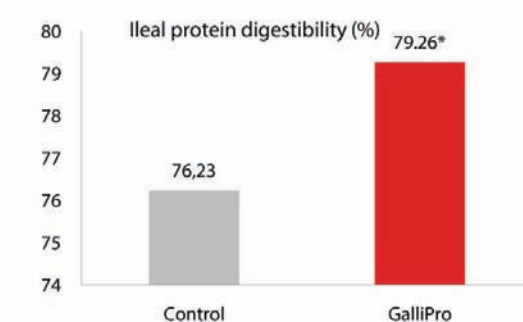


Figure 2. GalliPro® increases ileal protein digestibility by avg. 4%. *P<0.05

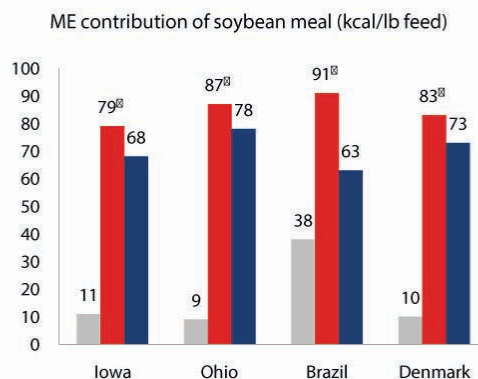


Figure 3. GalliPro® increases metabolizable (ME) energy of soybean meal by avg. 70.5 kcal/kg feed.

[§] n=3, CV=2 -3%

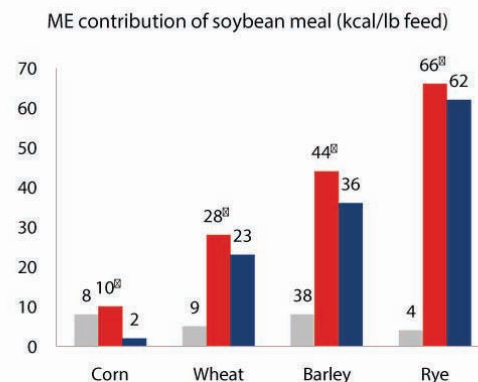


Figure 4. GalliPro® increases energy digestibility regardless of basal diet composition.

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Previous studies have shown that the probiotic significantly increases ileal protein digestibility (Figure 2). Using a proprietary in vitro tool known as reducing-sugar release (RSR) analysis, Chr. Hansen scientists have also demonstrated that, by breaking down fiber and making more sugars available to birds, GALLIPRO® increases metabolizable energy contribution of feed ingredients (Figures 3, 4).

"B. subtilis enhances carbohydrate, protein

and lipid metabolism by producing digestive enzymes that birds don't produce on their own. This results in increased availability of dietary energy and feed nutrients," Blanch explains.

"In addition, GALLIPRO has been shown to promote healthy microbial diversity in the gut, while reducing gut inflammation. These properties contribute to healthier intestinal function, which improves absorption of feed nutrients."

- Courtesy Chr. Hansen Holdings A/S

Higher demand of non-vegetarian food leading to increase in animal feed imports by 70%

Pune: Import of oilmeals, used as animal feed, rose 70% in 2019-20 because of higher demand, stagnant local production and lower duty of shipments from some African countries, trade body Solvent Extractors Association (SEA) said.

"India imports oilcake/meal for domestic processing and or direct usage in cattle/poultry feeds. During the financial year 2019-20 (Apr.'19 to Mar.'20) India imported 1,142,902 tons of various oilcake/meal/feed valued at Rs. 3218.09 crores against 670,709 tons valued at 2558.20 crores during previous year 2018-19, sharply increased by 70% in terms of quantity and 26% in terms of value," a release from SEA said.

Demand of oilmeal is rising year as the feed industry is growing at 8% to 10% per annum, while oilseed production in the country is more or less stagnant.

"The current duty on import of oil bearing material is 19.6%. However, large quantities of oilcake/meals are being imported from certain African countries under India- African agreement of Least Development Countries at nil duty or at lower duty from SAARC countries," the SEA release said.

According to SEA, import of oilcake/meal/feed in 2016-17 was 838,811 tons valued at Rs. 2341.85 crores which increased to 1,142,902 tons valued at Rs. 3218.09 crores in 2019-20.

Hatchery tips for successful transition to NAE production

Contn from Page 18

industry.

Another important step to take with NAE flocks includes attention to litter. "The big one that we fight every day is trying to keep houses as dry as we can, because that moisture obviously just aids the bacterial load that much more," he said, and noted that Fieldale uses a lot of litter amendments.

Ensuring food safety,

particularly containment of *Salmonella*, also requires sanitation such as good rodent control in breeder and broiler houses. The nutritionist is always looking for ways to keep the level of *Salmonella* down in the feed supply, Newsome said. He added that Fieldale pelletizes everything including the breeders' feed to help knock down *Salmonella* levels in the hen flocks before they produce.

Courtesy: Cargill

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Youth flock to Georgia 4-H poultry judging contest

Eighty youth participated in the online 2020 Georgia 4-H state poultry judging contest hosted on July 6 in collaboration with the University of Georgia Poultry Science Department.

This evaluation competition is a culmination of many months, and sometimes years, of studying Georgia's top agricultural industry. The event encourages youth to learn and understand the standards used in poultry and egg production. In addition, they learn the importance of marketing to the public and how to apply those learned skills in a realistic decision-making process. The poultry judging program teaches animal husbandry fundamentals as well as life skills including critical thinking, teamwork and oral communication.

"The virtual judging format this year, while a bit more challenging, is still a great way for us as a university to interact with Georgia youth interested in agriculture and, specifically, poultry," said Casey Ritz, UGA poultry science professor and Extension coordinator. "Unique opportunities such as these will hopefully be remembered by our youth and help to shape their futures. Even in trying times as we have, these events give us the opportunity to share with students the great programs and events available to them here at the UGA Department of Poultry Science."

In the virtual format, senior participants in grades nine through 12 evaluated classes



through a PowerPoint presentation and online test of their evaluation skills. This contest includes nine classes for youth to apply egg and carcass grading as well as place live bird classes based on egg-laying productivity. In addition, participants must provide oral arguments justifying their decisions. The senior high individual and first place senior team will earn Georgia Master 4-H'er status. The state winning team will represent Georgia 4-H at the national 4-H poultry judging contest in Louisville, Kentucky, in November.

The winners of the 2020 Georgia 4-H state poultry judging contest are:

First place team: Leopold Joh, Alexa Hillebrand, Nicole Hillebrand and Lexi Koenig — Coweta County

Second place team: Clayton Adams, Sophia Merka, Alyssa Goldman and Kaylie Goldman — Madison County

Third place team: Whitley Gatch, Joleigh Butler and Kate Vaughn — Bulloch County

Senior High Individual: Whitley Gatch — Bulloch County

This event is sponsored

by Mike Giles and Carla Abshire. To learn more about the Georgia 4-H Livestock Program, visit georgia4h.org/livestock. Georgia 4-H empowers youth to become true leaders by developing necessary life skills, positive relationships and community awareness. As

the largest youth leadership organization in the state, 4-H reaches more than 242,000 people annually through the University of Georgia Cooperative Extension offices and 4-H facilities.

For more information, visit georgia4h.org

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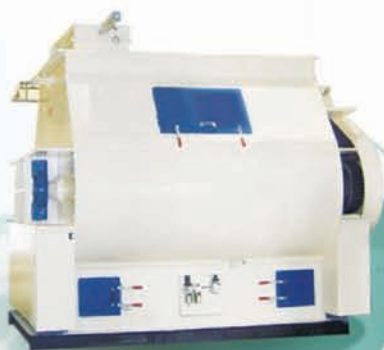
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RESULT PERIOD	FLOCK SIZE	MEAN AGE (IDAYS)	LIVABILITY
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AVG B WT (KG)	CFCR	DAILY GAIN	EPEF
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Poultry Parasites

– A major factor in Malnutrition

Dr Ansari M. Mazher

Ansari Poultry Farm, Burhanpur, Madhya Pradesh, India.

Chickens are susceptible to infestation, by different types and species of parasites both Endo and ectoparasites represents a major economic problems for poultry industries and ectoparasites are major cause of malnutrition when they are young, most species of parasitic worms penetrates the lining of the intestines and after further development emerge in the intestinal tract. This penetration cause injury to the intestinal wall and subjects it to possible bacterial infection such as fowl typhoid, pullorum, fowl cholera, infectious coryza and chronic respiratory diseases.

Deep Litter system provide favourable conditions, conditions for parasitic infestation and consequent bacterial and protozoal diseases. The large size and shape of round worms make them easy to recognise. They are 1 – 4 inches in length and found below the gizzard in the gut.

Several drugs are available and with proper use they can completely eradicate the problems from the flock, proper hygiene practices can prevent the worms from returning. Cecal worms are similar to round worms except they are smaller $\frac{1}{4}$ - $\frac{1}{2}$ inch long.

Capillary worms are small too, they are hair like and colourless and difficult to detect with the naked eye. They can be found in the crop, oesophagus, small intestine or ceca.

The worms attach themselves to the organ lining causing severe inflammation and thickening. The damaging effects are extensive. Tape worms are flat, white, segmented, ribbon like parasites. The Scoleces (head) of tape worms have hooks and suckers which attach themselves to the intestinal walls, several vermifuges are only effective against detached segments and, if the head remains, new segments can develop. In India, this worm can be medicated by a homeopathic treatment. Folix mother tincture (30ml for

100 birds) is effective against the scoleces but the remedy should be repeated after 10 days. When chickens are infested with internal parasites they are prone to developing Protein-Energy Malnutrition, Iron-deficiency anaemia and Vitamin A deficiency.

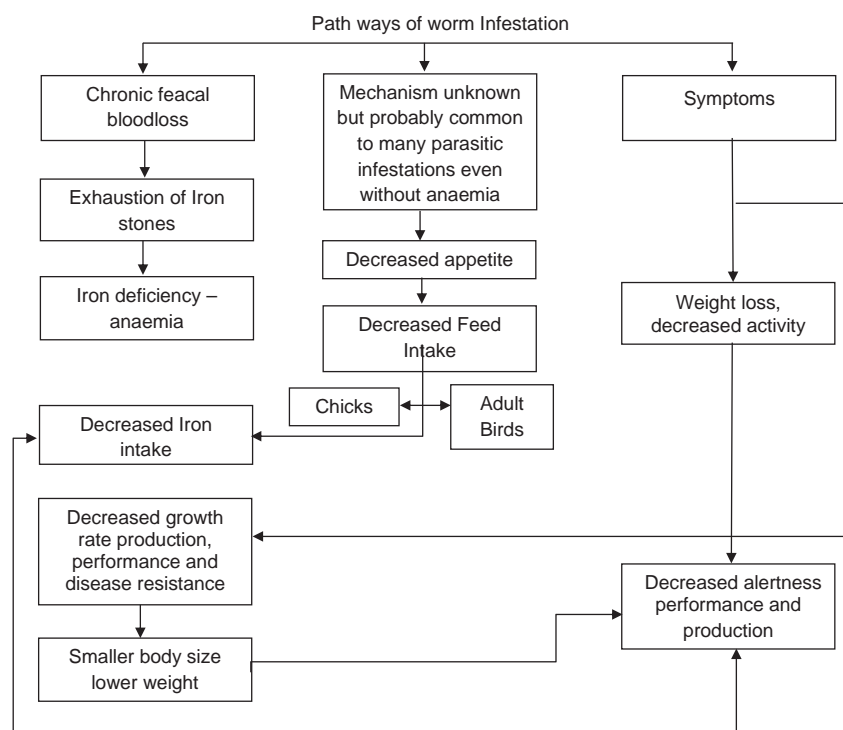
Signs of Vitamin A deficiency:

In chickens due to vitamin A deficiency by parasitic infestation or result of malnutrition with parasitic infestation chickens become emaciated and weak and then feathers are ruffled, egg production decreased sharply and length of time between clutches increases sharply and hatchability is decreased. A water discharge from nostrils and eyes and sometimes

eyes are destroyed in chicken as well as turkeys also, and blood spots are in eggs cessation of growth, drowsiness, weakness, incoordination emaciation and ruffled feathers or plumages, increase testes weight, spermatogenesis may occur in cockerels reduced sperm motility and abnormal sperms in great grand parents and big losses from commercial stock due to parasitic infestation.

Iron Deficiency:

Results in a hypochromic, microcytic anaemia and reduced concentration of non-haem Fe in plasma and prevents normal feather pigmentation in breeds having coloured plumage. A deficiency in laying hens also causes anaemia in developing chick embryo and reduce hatchability and great economic losses due to parasitic infestation and infections anaemia in chicken if at 2 – 4 weeks age, mortality generally between 10 – 20% in flock by this decreased infection and infestation heavy losses occur to poultry enterprises. □





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All Clays are not Created Equal

Douglas Zaviezo, Ph. D.
Special Nutrients

INTRODUCTION

Practical methods to detoxify mycotoxins contaminated grain or feed on a large scale and in a cost-effective manner are not currently available. At present, one of the most practical approaches consists of using adsorbent materials in animal diets to reduce the absorption of mycotoxins from the gastrointestinal tract. Clays are an important group of products that have been used successfully worldwide to reduce mycotoxicosis; and all commercial anti-mycotoxin additives or mycotoxin inactivators available in the market are clay based products.

CLAYS

Clays are complex and widely diverse aluminosilicates with a variety of functional properties, but they are often grouped into a single category. This is very misleading since there are many types of clays, which are completely different from one another.

Many types of clays do not capture mycotoxins; some can absorb water, others can absorb ammonia, and only certain clays can adsorb mycotoxins. The first effective mineral adsorbent was described as hydrated sodium calcium aluminum silicate (HSCAS), and others have subsequently used this nomenclature. Because HSCAS is a generic description, it does not specifically define the material of use. The majority of mycotoxin binding products are classified as montmorillonite, belonging to the phyllosilicate group, which is composed of layers of aluminum and silicon connected in a 1:1 or 2:1 arrangement.

Not all clays that adsorb mycotoxins are equally effective in protecting animals against the toxic effects of mycotoxins. Even some montmorillonite adsorbents are not always the best binders. Furthermore, the adsorption ability of similar clays may vary from one geological deposit to another.

Besides their origin, formation and structure, clays can vary in chemical composition, surface acidity (pH), electrical charges (polarity), distribution of exchangeable cations, and porosity and expansibility characteristics. Despite all these differences, there is no significant correlation between any single physical or chemical property and the mycotoxin binding capacity of clays.

Therefore, the effectiveness of a mycotoxin adsorbent is tested by conducting evaluations *in vitro* and *in vivo* to demonstrate a statistical significant response in preventing mycotoxicosis. The dosage of the adsorbent and the level of the mycotoxin used in these tests must always be reported. Also, it is important to demonstrate the innocuity of the product when it is evaluated without the presence of mycotoxins.

ANTI-MYCOTOXIN ADDITIVES (AMA) EVALUATION

The *in vitro* test must be conducted with high performance liquid chromatography (HPLC) using a methodology using two types of solutions: one of pH 3 and another of pH 6, mimicking the gastric and the intestinal juices. For the *in vivo* test

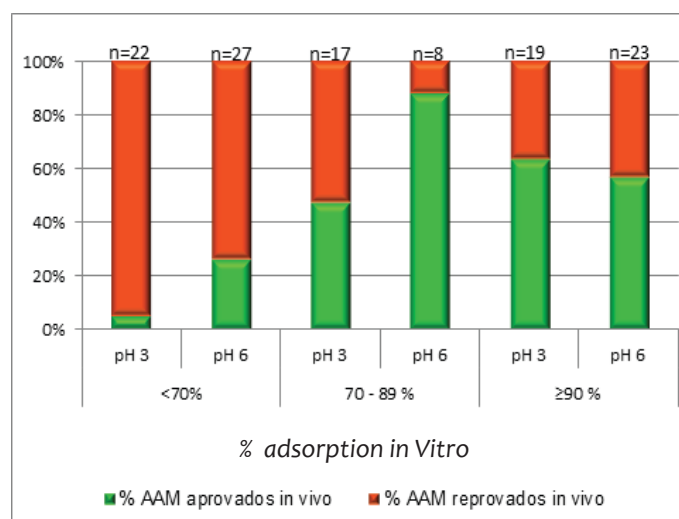
there is a standard experimental protocol consisting of four treatments: a control without mycotoxins; a control with adsorbent; a control with mycotoxin; and one with mycotoxin plus adsorbent. Additional treatments can be added to this experimental design, such as different testing levels of the adsorbent.

The amount of an adsorbed mycotoxin is difficult to calculate; therefore in the *in vivo* trial, the efficacy of adsorption has to be determined by the animal performance (body weight gain, feed consumption and feed efficiency) and the target organ protection.

It is important to evaluate the target organ(s) since they reflect the specific damage of the mycotoxin. It is also necessary because some adsorbents base their effectiveness on a positive effect on performance, which is a result of the presence of enzymes, beneficial bacteria, yeast and /or immuno-stimulant in the composition of those products, and not mycotoxin adsorption.

The relation between *in vitro* evaluation and *in vivo* effectiveness cannot always be confirmed. In evaluations done by Dr Mallmann and collaborators in LAMIC on 58 AMA for different toxins and species, little more than 55% of AMA approved *in vivo*, had an adsorption greater or equal to 90% at pH 3 and 6. For AMA approved *in vivo*, more than 50% had an adsorption less than 70% at pH 3 and 6 (Figure 1). There was no significant correlation between *in vitro* and *in vivo* evaluations when the data of those 58 *in vitro* and *in vivo* evaluations were submitted to a linear regression analysis. The greatest correlation found was in broiler chickens, at pH 6 with fumonisins ($P < 0.07$ and $R = -0.55$), followed by correlation for swine at pH 6 with aflatoxins ($P < 0.1$ and $R = 0.55$). These analyses showed that some products that were not very effective in laboratory conditions can often function satisfactorily in the *in vivo* trials.

Figure 1 - *In vitro* adsorption of 58 approved or rejected AMA *in vivo*. (LAMIC)



Mallmann and Dilkin (2011)

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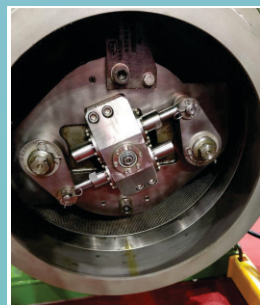


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It is evident from this data that the results obtained from *in vitro* evaluations are not sufficient to prove the efficiency of an AMA. Therefore, statistical satisfactory results from the *in vivo* test are necessary to determine the efficacy of an AMA.

CLAYS AND AFLATOXIN ADSORPTION

During the last 20 years, various scientific studies have demonstrated that some aluminosilicates are very effective in preventing aflatoxicosis. In the program for approval of anti-mycotoxin additives, conducted by LAMIC in Brazil, 16 out of 32 products evaluated were proven to be efficacious against aflatoxin in broiler chickens and only 4 out of 12 in swine. All the effective products are or contain clays.

The majority of the clays that significantly ameliorate the toxic effects of aflatoxins have been reported to be effective at an inclusion rate of 5 or 10 kilos per metric ton of feed. Only a few, including Myco-Ad, significantly prevented aflatoxicosis at 2.5 kg/mt of feed. Recently, Myco-Ad has become the first and only product approved by LAMIC against aflatoxin in three different species: poultry, swine and cattle.

Very few products are effective against more than one type of mycotoxin; among these, Myco-Ad is exceptional because it has been scientifically proven that Myco-Ad ameliorates the deleterious effects of aflatoxin, in the three species mentioned above; and prevents the toxic effects of ochratoxin, T-2 toxin and fumonisin in broiler chickens.

PURIFIED PHYLOSILICATES

In recent years, special proprietary processes have been developed for the production of purified and activated phylosilicates with the objective of producing adsorbents capable of binding fusariotoxins such as zearalenone (ZEA), deoxynivalenol (DON), fumonisins, and T-2 toxin, which are especially toxic for swine. After the process, these phylosilicates become very light, showing a much lower density and particle size than regular clays. Normally, these products have been effective when added to animal diets at a very low dosage (0.5 to 2.0 kg/mt).

One of the few purified phylosilicates is Myco-Ad A-Z which has been scientifically proven to be efficacious in preventing the toxic effects of T-2 toxin in broiler chickens, and fumonisin and zearalenone in pigs.

Recently, the efficacy of Myco-Ad A-Z in reducing the natural toxicity caused by ZEA + DON contaminated feed was evaluated in gilts. Results of this experiment indicated that the deleterious effects of ZEA+DON in prepubertal gilts were completely independent from each other. ZEA caused hyperestrogenism and DON resulted in poor performance with reduced liver size. The addition of 1 kg of Myco-Ad A-Z per metric ton of feed prevented both the toxic effects of DON and the estrogenic effects of ZEA in prepubertal gilts. (Table 1, Table 2, and Figure 2).

Table 1. Effects of Myco-Ad A-Z on body weight gain, total feed intake, and feed conversion ratio of 40 day-old gilts exposed to test diets for 21 days.

a, b Means within columns with no common letter differ significantly ($P \leq 0.05$)

* Waste of feed was noticeable in pigs from ZEA+DON treatment. Pigs from other two treatments (Control and ZEA+DON+MYCO-AD A-Z) imitated that behavior.

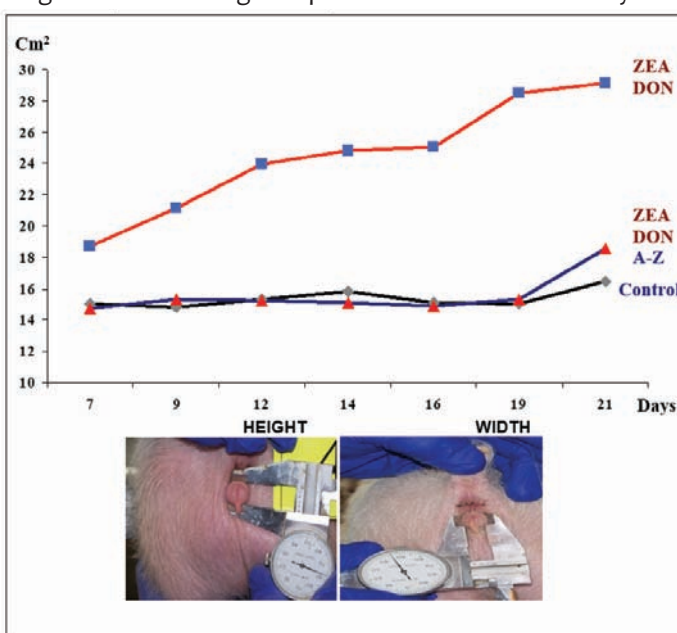
TREATMENT	BODY WEIGHT GAIN kg	ESTIMATED FEED INTAKE kg	FEED INTAKE + WASTE * kg	FEED + WASTE CONVERSION RATIO
Control	2.94 a	6.76 a	14.06 a	4.77 a
1.2 ppm ZEA + 6 ppm DON	1.04 b	2.39 b	13.33 a	12.82 b
1.2 ppm ZEA + 6 ppm DON + 1 kg/mt Myco-Ad A-Z	2.22 a	5.11 a	12.25 a	5.53 a

Table 2. Effects of Myco-Ad A-Z on the relative liver and internal reproductive system weight of 40 day-old gilts exposed to test diets for 21 days

TREATMENT	LIVER g/100 g Body Weight	REPRODUCTIVE SYSTEM g/100 g Body Weight x 1000
Control	3.76 a	53.9 a
1.2 ppm ZEA + 6 ppm DON	2.89 b	104.5 b
1.2 ppm ZEA + 6 ppm DON + 1 kg/mt Myco-Ad A-Z	3.12 c	89.5 c

a, b, c. Means within columns with no common letter differ significantly ($P \leq 0.05$)

Figure 2. Effects of Myco-Ad A-Z on the vulva measurements of gilts at different ages exposed to test diets for 21 days.



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CONCLUSIONS

Clays based products are the most effective mycotoxin adsorbents. However they are diverse aluminosilicates with a variety of properties. Many types of clays do not capture mycotoxins; some can absorb water, others can absorb ammonia, and only certain clays can adsorb mycotoxins.

There is no significant correlation between any single physical or chemical property and the mycotoxin binding capacity of clays. Therefore, the effectiveness of a mycotoxin adsorbent has to be evaluated by conducting *in vivo* test using a scientific experimental design which measures the beneficial effects of the product on animal performance and on the target organ(s) affected by the mycotoxin being studied.

Scientific studies have demonstrated that some aluminosil-

icates are very effective in preventing aflatoxicosis at an inclusion rate of 5 or 10 kilos/mt of feed; and only few, can do it at 2.5 kg/mt. Very few products are effective against more than one type of mycotoxin. Recently, special purified phyllosilicates have been developed, which are capable of binding fusariotoxins such as zearalenone, deoxynivalenol, fumonisins, and T-2 toxin at very low inclusion rate (0.5 to 2.0 kg/mt).

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How to prepare for an on-farm poultry audit

Monique Parais-Garcia , Brooklyn Wagner and Rachel Park

To demonstrate a strong commitment to prioritizing animal welfare, many retailers now require that their suppliers participate in on-farm audit programs as part of an external verification program. These programs are developed using science-based recommendations and provide minimum standards of care that must be met by participating producers. External audits are performed on a regular basis by a third party (e.g. an individual with no financial connection to the farm) to verify that outlined standards are consistently upheld.

Preparing appropriately for an upcoming audit is a multi-step process that, if done correctly, will decrease the likelihood of experiencing avoidable non-conformances. Thoroughly understanding the requirements of your specific audit program, which can be found online or provided upon request, is the key first step to adequate preparation. The entire production team, including managers and animal care providers should be involved in reviewing the standards and have the background knowledge to answer questions posed by the auditor. Potential inquiries include:

- Can you demonstrate how you would euthanize a bird?
- What would you do in the event of an emergency (e.g. fire, flood, power shut down)?
- Please explain to me, step by step, how you perform daily walk-throughs of your barn.

Any farm undergoing an audit should conduct a self-assessment of facilities and birds prior to the audit itself. Self-assessments help groups identify areas that need improvement and will cover the three main categories used in the audit:

- Animal-based measures are direct indicators of animal welfare examined through observation of individuals, which include such measurements as feather condition, feet condition and behavior.
- Resource-based measures assess the environment and

facilities and include such measurements as feeder and drinker space, litter quality and stocking density.

- Protocol-based measures evaluate current policies and protocols that are in place on the farm. This includes reviewing standard operating procedures, outlined emergency and euthanasia protocols and mortality and culling records.
- It is also important to keep in mind that audits are only a snapshot in time. This means that auditors may not be able to view every aspect of your farm and will not be able to know what happens on your farm for the other 364 days of the year. Auditors and audits are often limited to evaluating a subpopulation of the farm and may not observe all individuals or houses but auditors are able to gain a clear picture of the farm, as they will select a representative subpopulation of the flock to assess. Although utilizing subpopulations is typical for an external audit to save time, it is recommended that all self-assessments evaluate the entire flock, as this will help you understand if your flock is meeting the requirements. This proactive approach to improving bird welfare ahead of time by making decisions based on the results of your self-assessment (e.g. moving animals to the sick pen, adjusting environmental conditions to decrease feather pecking) may also minimize your chances of experiencing a non-compliance.
- While animal-based measures evaluate the bird itself, resource-based measures can be assessed during barn walk-throughs. These indirect measures have an impact on the bird's welfare while in your housing system. The auditor is responsible for verifying that birds are stocked at a proper density in regards to floor, feeder and perch space, as well as number of drinkers and nest boxes per bird. Air quality is an important consideration for bird welfare and will be assessed during the audit as well as

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areas of your facilities that may cause immediate harm to an animal or be aversive, such as protrusions or sharp edges. Any facility repairs should occur in a timely manner and prior to the audit.

- Lastly, protocol-based measures are an area that require particular attention and foresight before an auditor arrives. Standards that require documentation and operating procedures to be evaluated commonly result in non-conformances. However, this can be avoided with full comprehension of these standards and diligent preparation. To begin, confirm that written documentation of updated policies, procedures and records are available to the auditor on site. Such documents should be readily accessible or posted for employees and auditors to be reviewed at any time. For operations with non-native English speakers, make sure there is a copy of these documents translated into the staff worker's primary language. It is vital that all workers are equally able to comprehend and communicate animal welfare policies.



Non-conformances related to protocol based measures can often be avoided by confirming that all specifications related to documentation are satisfied per the standards set forth by the audit. Unfortunately, these details are commonly overlooked when preparing for an audit. For example, under the Humane Farm Animal Care Animal Care Standards for egg laying hens, causes of mortality and culling must be documented. Therefore, if a producer recorded the number of mortalities and culling without providing reasons, this would result in a non-conformance. Full comprehension of standards and what each entail is vital to the farm's success when it comes to the auditing process. Some questions that may be beneficial to ask yourself and/or staff when preparing the necessary paperwork include:

- Do my records date back far enough?
- Can I explain any abnormalities in my data (e.g. production, mortality / culling records)?
- Do I have a visitor's log and complaints log?

Working towards a thorough understanding of the standards and communicating those standards effectively to all individuals involved with the daily care of the animals and farm documentation can lead to consistent conformity. In addition, preparing for your audit by performing the steps outlined above will result in a more efficient audit from a time standpoint. Overall, audits enable producers, processors, retailers and consumers to work together towards improving animal welfare and these programs demonstrate an overall commitment by the poultry industry to this mission. □

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“Be Vocal for Local”

Dr Mridu Pawan Hazarika¹, Dr Smita Bordoloi²

¹MVSc, ²MVSc, Ph. D (Pursuing)

“Be vocal for Local” the slogan inspired by our respected Prime Minister Sri Narendra Modi to the nation is of great strength. India is a nation of multiple cultures, language, ethnic groups & religion. It is one of the oldest civilization of the world. We Indians are very adoptive to all these diversities being ourselves integrated to one nation's believes in spite having all these diversities. Simultaneously we have adopted food habits of different cultural civilizations which intermingled to form great Indian cultures & its food. Indian peoples have food habits of both types non vegetarian & vegetarian. Data released by Govt. of India has thrown some interesting insights into what the majority of the Indian population prefers to eat, close to 70% Indians are non-vegetarian (Times of India, June 13, 2016). The Indian states with highest non vegetarian community are North eastern states (95%), Telangana, West Bengal, Andhra Pradesh (98%), Tamilnadu, Odisha, Kerala (97%), Jharkhand (96%), Goa (90%), Chhattisgarh (82%). If we observe the reason behind the more non vegetarianism of these areas, we will find due to availability of non veg source from natural resource like abundant rivers (north east states), coastal region (southern states) are the contributing factor. In addition to this, the reason behind non vegetarianism in north east is Anemia. Hemoglobin E gene disorder is one of the major reason of anemia in North eastern region. Mostly the female community affected with this disorder. In this medical condition the person is unable to transform Fetal hemoglobin (HbF) to Adult hemoglobin (Hb A) even after birth. In the newborn the levels of hemoglobin F gradually decrease and reach adult levels (less than 1% of total hemoglobin) usually within 1 year of life, as adult forms of hemoglobin begin to be produced. In the Indian subcontinent, this Hemoglobin E disorder is observed highest frequency in the Northeast regions, but relatively rare in rest of the country (Sunitha S Kiran kiranetal; Journal of laboratory physician 2016). In the Indian subcontinent, Hemoglobin E gene disorder is mostly restricted to North-Eastern states, i.e., West Bengal, Assam, Andhra Pradesh, Nagaland, Manipur, Tripura, and Meghalaya with an average allele frequency of 10.9%. While previously rarely diagnosed in South India, increasing migration of population from highly affected areas is resulting in rising prevalence in South and other parts of India (Sunitha S Kiran kiran; etal, Journal of laboratory physician, 2016). These sort of people are unable to utilize inorganic Iron source like dietary supplements of iron supplements. So they are fully dependent on organic iron source like fish & meat of different animals & birds. As the iron present in meat is called heme iron, which is most easily absorbed by the body compared to iron found in plant or dietary supplement. So it is not merely the religion which determines the non-vegetarianism, rather natural resources & physical health requirement created the food habit of the people.

The chickens that are raised for meat are called “Broilers.” These chickens are typically white, and are bred specifically for optimal health and size to produce a quality product for the consumers. Out of all non-vegetarian protein sources, broiler chicken is the most affordable, healthy & nutritious protein (contain 24% crude protein) option for customers. Fat content in poultry meat is relatively low (2.8gm/100gm breast & 13gm/100gm thigh) and with a positive unsaturated /saturated fatty acid ratio, from a human health point of view (Barroeta A.C, 2007-World poultry science Journal). It indicates broiler chicken meat is quite healthy for the growth of the growing children & often suggested for heart patients or elderly peoples due to its low saturated fatty acid, cholesterol content & higher unsaturated heart friendly fatty acid level. The broiler chicken meat contains very good source of Minerals & Vitamins. Most essentially Vit B12, Vit E, Zinc, Selenium which has tremendous role in boosting the immunity of a person at present like Covid-19 crisis.

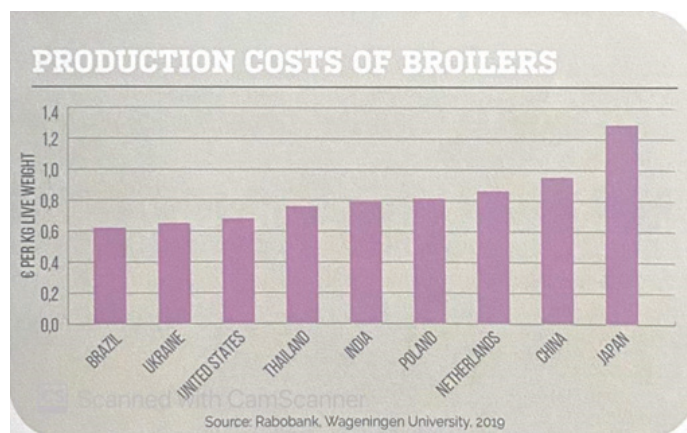
Table-Nutritional content of chicken meat (Source-World poultry science Journal 2007)

	Whole	Breast		Whole	Breast
Water (g)	70.3	75.4	Vitamins		
Energy (kcal)	167	112	Vitamin B ₁ (mg)	0.1	0.1
Protein (g)	20.0	21.8	Vitamin B ₂ (mg)	0.15	0.15
Total fat (g)	9.7	2.8	Niacin eq. (mg)	10.4	14
SFA (g)	2.6	0.76	Vitamin B ₆ (mg)	0.3	0.42
MUFA (g)	4.4	1.3	Biotin (µg)	2.0	2.0
PUFA (g)	1.8	0.52	Folic acid (µg)	10	12
PUFA/SFA	0.69	0.69	Vitamin B ₁₂ (µg)	0.4	0.4
Cholesterol (mg)	110	69	Vitamin C (mg)	—	—
Minerals			Vit. A: Eq. Retinol (µg)	9	16
Calcium (mg)	13	14	Vitamin D (µg)	0.2	0.2
Iron (mg)	1.1	1.0	Vitamin E (mg)	0.2	0.29
Iodine (µg)	0.4	0.4	Vitamin K (µg)	—	—
Magnesium (mg)	22	23			
Zinc (mg)	1	0.7			
Selenium (µg)	6	7			
Sodium (mg)	64	81			
Potassium (mg)	248	320			
Phosphorus (mg)	147	173			

The poultry industry in India is highly organized & very well managed. The industry has a great service group of Trained Veterinarians, Animal Genetician, Animal nutritionist, Animal Pathologists, Animal Microbiologist who always play very pivotal role to attain maximum production. Simultaneously continuous effort is going on for protection of broiler birds from diseases & help them to grow according to the food safety of the customers. Broiler birds grow to 1kg in 21 to 22 days and 2kg at 32 to 33 days. This is genetic potentialities of this breed and this great leap in performance is acquired over decades, in which large scale of genetic selection is taken place. You can better understand by the example of milk production of a non-descript local cow and a Jersey or Holstein Friesian cow. A non-descript local cow produces hardly 1 to 1.5-liter milk whereas an exotic high yield cow breed produces 30 to 40-liter milk per day. It is called Genetic potential of the breed. Many times some miscreant's spreads fake allegation like growth of broiler chicken hastened by use of Hormones and try to create panic among the chicken

consumers. This is a very groundless allegation as the growth of broiler chicken is achieved by its natural genetic potentiality, which is fortified by nutrition to support its growth. Broiler chicken requires 20-23% crude protein and 3000-3200 Kcal /kg in its feed. Broilerchicken is fed with feed produced from blending of Maize, Soya bean de oiled cake, Rice bran, Rice polish, Mustard oil cakes some of the agriculture byproducts. In addition to these major feed ingredients feedalso constitutes of all source of rich Vitamins (Vitamin A, D, E,C, K, B groups), major & minor minerals (Iron, Copper, Cobalt, Selenium, Zink, Molebdenum, Manganeease), essential Amino acids, Enzymes, Essential oils, Probiotics, Prebiotics are added . These whole feed manufacturing process is very well organized & well supervised by Veterinarian or Animal nutritionist. So whatever enriched feed is fed to chicken in farm, finally reaches to human fork which is quite healthy, highly nutritious & off course yummy.

India's poultry industry size is estimated at Rs 1,20,000 crores. Most of us know & feel proud that India is the biggest Milk producing nation in the world. But how many us know the fact that India 3rd biggest egg producing & 5th biggest chicken meat producing nation in the world. Poultry industry contributes 6-7% to the GDP. It also provides livelihood to nearly 5 crore Indian population. Comparing to other nations Indian poultry industry is very competitive in production cost parameter. In 2004-05 India stands 2nd most low cost chicken production country of the world followed by Brazil. Today India stood 5thcheapest chicken producing country followed by Brazil, Ukraine, USA, Thailand. The reason behind these 4 countries ahead of India is GMO crops they use to formulate the feed of poultry whereas Indian poultry is fed with non GMO grain produce.



Recent Indo American agreement reduced import duty on American Chicken leg piece Americans are highly fond of Chicken breast part and consider Chicken leg piece as waste. So finally they are in the process of dumping Chicken legs to Indian market which is fed with GMO feed crops. "Protein used in the US poultry feed contains meat scraps (lysine), blood meal (lysine, methionine), liver and animal tankage. These products are derived from beef and pork. Use of beef and pork by-products are prohibited in our country to be used as poultry feed," P Chengal Reddy, Chief Advisor of CIFA, told BusinessLine.(Kurmanath, K. V;Business Line, July 21, 2016). Still all these positive facts of Indian Poultry / broiler Industry have not penetrated significantly in the knowledge

base of its customers. Many times a strong Vegan lobby or some overseas NGOs claiming their propaganda against Indian poultry industry & their farmers. The motive is vivid to reduce confidence of Indian customers on its own native chicken produce & gradually creating a pleasant environment to dump overseas Chicken produce. For a country like India where unemployment is on its Zenith 15.9% these overseas NGOs are trying to demolish economy by creating unethical Hoax.

Social Media Covid 19 hoax –Indian poultry industry faced a massive hit after social media hoax that corona virus could be spread through commercial poultry (chicken) consumption. As a consequence, sales dropped by 90% across Indian markets and clarifications put out by the industry have failed to stem the panic.

Later on, the Ministry of Fisheries, Animal Husbandry& Dairying issued several notifications describing Indian Chicken is safe for consumers. But, due to huge panic spread out among consumers the chicken price came down to INR 5-10 a kg in wholesale market at the end of Feb,20; whereas the cost of production per kg chicken was INR 75-80. The effect was so severe that the poultry industry made total losses of INR 24,000 crores in Feb&March,20 and the activity crashed to ground. Whatever remained got completely collapsed in prolonged lockdown.

Poultry feed constitutes 60% of maize, and 30% of Soya-Doc, the commercial poultry sector requires almost 12 million MT of maize and 4.6 million MT of soya bean meal (Soya DOC) for the total poultry feed of 22 million MT required in the country (2017)

Now that as a result of huge losses and working capital crunch across poultry industry, production has significantly reduced to 15-20%, which resulted in huge drop in ingredients demand like Maize and Soya Doc. Maize prices have reduced to INR 10-12 (43% drop) from INR 21.50 when compared with last year, and Soya-Doc prices dropped to INR 31 (16% drop in prices) from INR 36.80 when compared with last year. Now the maize farmers are even finding it difficult to sell their produce in Mandi. If the present situation persists long, this will be resulting in huge losses to the lacs of agriculture farmers as well.

Unless the Government and responsible authorities take appropriate measures to revive the commercial poultry sector, the situation can't improve soon and this will surely jeopardize livelihoods of lacs of poultry and agriculture farmers, besides businesses of so many associated parties involved in poultry and Agri value chain

Today, commercial poultry farming sector is almost collapsed after incurring huge losses by the poultry farmers. This will significantly reduce the feed requirements to the extent of 70-80% as poultry production is dropped to below 20%. This will have a huge impact on reducing the demands of the listed ingredients, and accordingly the prices of these commodities especially of Maize, Soya DOC, and broken rice are likely to collapse further in coming times.

So at last it is the responsibility of the Govt to create a positive environment to revive the Poultry Industry **Contd on Page 45**

Tips to Improve Broiler Feed Efficiency

Highlight Points

Improved broiler feed efficiency is linked to improved profitability. The way to improve the productivity index is by balancing the ratio between energy needed and amino acids, and by improving the feed digestibility by different means. However, there are ways to improve the efficiency even after it is delivered to the farm. Let us take a look at some ways in which you can make the most out of your broiler feed:

Dr Kiran Kumar

Korla, Regional sales manager, Vetphage Pharmaceuticals Pvt Ltd

Improved broiler feed efficiency is linked to improved profitability. The way to improve the productivity index is by balancing the ratio between energy needed and amino acids, and by improving the feed digestibility by different means. However, there are ways to improve the efficiency even after it is delivered to the farm. Let us take a look at some ways in which you can make the most out of your broiler feed:

- **Avoid silo hot spots** – Mold consume valuable nutrients and also produce mycotoxins. If the broiler feed is moldy, it is unpalatable at best and toxic at worst. In a lot of cases, feed is dumped into dirty silos. In warm and humid climates, mold grows easily, and it is not uncommon to find patches of moldy feed stuck to the silo surface. Adding a mold inhibitor and mycotoxin binder to the feed is not enough. You must inspect and clean the silos periodically. The dosage rates that are usually recommended for mycotoxins do not take this into account, and it is an issue that can be quite serious if left unchecked.
- **Use feeders properly** – Feeder management is essential to minimizing feed wastage. In the case of both straight and round feeders, feed wastage can be prevented by using the feeder with a lip and ensuring that the feeder is not more than half filled. Make sure you hang the feeder at the level of the birds' backs, and it is at least 7 cms deep. Clean them regularly and make sure that the bird capacity is just right. This will ensure that feed consumption is neither a fight to eat nor a chance to beat boredom. One way to maximize feed efficiency is to make sure that the drinkers are placed close to the feeders so that there is no spoilage.
- **Use the right lighting** – Keeping the lights on is not good for feed digestibility. If the lighting is constant, the birds overconsume feed, which in turn increases the feed passage rate. Since birds are usually fed at their maximum genetic potential, the extra feed they end up consuming does not interact with the digestive enzymes and this reduces the feed digestibility. In contrast, an alternate lighting system, where the birds are exposed to one hour of light followed by three hours of darkness gave them a chance to digest the feed during the resting period, also improving the feed efficiency by curtailing their movement. The only catch in this system is you need enough feeding spaces for all the birds to eat at the same time, which requires careful pre-placement of feeders.
- **Make sure the body weight is market friendly** – If you want your birds to attain a certain market weight or market age, you should follow your contracting partners' guidelines. If you are going to sell your birds on the open market, then you need to keep in mind that the efficiency of the feed gets worse as they age. This is on account of the fact that they have to maintain a greater body mass every day, and this requires both amino acids and energy. So finding the minimum acceptable weight will also minimize the feed efficiency. Although the market rates keep fluctuating, it falls anywhere between 1100 and 1200 grams. It goes without saying that this does not ensure maximum profitability and other parameters, such as cost per kg of weight gained, and weight gain per floor surface, should also be consulted.
- **Keep your birds healthy** – Although this is also obvious, it is worth mentioning. Sick birds are usually kept in isolation, but what most poultry farmers forget to pay attention to is cases of subclinical diseases. They usually go unnoticed and steal the performance by causing malabsorption and diverting energy to the immune response instead of growth. On top of that, they might even break down the muscle proteins, which reduces the body weight and brings down the feed efficiency. Subclinical coccidiosis is one of the most common causes of performance loss in broilers. Poultry producers must monitor the coccidiosis status of their flocks throughout the growth cycle and collect sequential fecal samples, which should be tested for oocyst counts per gram of faeces. Successful programmes to maximize broiler productivity must include a coccidiosis control strategy that should be formulated after discussion with a poultry veterinarian.

Not all of the aforementioned pointers are applicable to every poultry farm, but by taking at least one into consideration, breeders can improve their feed efficiency and this translates to increased profitability, which is something breeders across the country need to recover from the sales loss due to the pandemic. □

Importance of the type of adjuvant and emulsion for Salmonella vaccines and its effect on reproductive potential in poultry breeder flocks

Livia Soares and Fabiano Fabri

Inactivated vaccines containing bacteria are naturally more reactive compared to vaccines that contain viruses due to the structural composition of pathogens. For this reason, the type of adjuvant and emulsion technology contained in a Salmonella vaccine are extremely important to modulate inflammation at the application site and activate the immune response, all in balance.

Adjuvants are substances added to the formulation of bacterins to enhance the immune response, to promote selective stimulation to a certain type, or even to increase its duration.




The general objectives of an adjuvant are:

- Modulate post-vaccine reactions
- Promote selective immune responses
- Stimulate the production of memory cells

The types of adjuvants most used in poultry farming are: mineral oil, vegetable oil and aluminium hydroxide. **Adjuvants containing mineral oil stimulate the immune response for a longer period** due to their release kinetics. However, **if this type of adjuvant is not formulated in an appropriate emulsion, it may cause significant post-vaccination reactions.**

Therefore, it is necessary to consider not only the type of adjuvant, but also the type of emulsion when evaluating inactivated vaccines against Salmonella.

The adjuvant + emulsion set is totally related to the efficacy and safety of the vaccine, i.e., the quality of the immune response generated and the modulation of adverse reactions after application depends on it.

			
	SINGLE OIL water in oil	AVISAN® SECURE DOUBLE EMULSION water in oil in water	Oil in water
Post vaccination reaction	+++	+	+
Duration of immunity	+++	++++	+
Antigen Release Speed	+	++	+++
Vaccine Stability	+	++++	+
Vaccine viscosity	+++	++	+

Double emulsion

This type of emulsion is characterised by having water as a continuous phase, oil as a dispersed phase, and within the

oil are droplets of water. In this way, the advantages of each of the other types of emulsion are combined.

The process of making a double emulsion is much more complex than that of a single emulsion. It is necessary to add several components respecting specific order and proportions.

Features of the double emulsion contained in AVISAN SECURE:

VERY LOW POST VACCINATION REACTION

The first phase to be in contact with the bird's tissue is responsible for generating inflammatory reactions at the application site. With AVISAN® SECURE, the phase that comes into direct contact is aqueous, producing very low inflammatory reactions that can go completely unnoticed by birds.

This is an important detail, as exacerbated reactions affect the metabolic balance and can result in economic losses due to:

- Loss of batch uniformity
- Decreased fertility
- Decreased hatchability
- Death of the bird in the event of inoculation in an inappropriate location

LONGER DURATION OF IMMUNITY

The double emulsion allows a balance in the release of antigens. On the one hand, the antigen in the external aqueous phase of AVISAN SECURE is promptly released, allowing the immune response process to begin shortly after vaccine injection. On the other hand, antigens present in the internal aqueous phase will be released later, thus modulating the duration of the immune response.

- External aqueous phase: first release of antigen = rapid immune response

- Internal aqueous phase: second antigen release = prolonged immune response

STABILITY AND VISCOSITY

Vaccine stability is also an essential factor. For a bacterin, phase separation even after mechanical agitation, is an indicator that the vaccine may not work properly.

AVISAN SECURE is very stable because its emulsion is produced with small particles, distributed evenly and using a suitable surfactant.

Field study

In order to prove the best safety of application for a double-emulsion vaccine, a field study was carried out in breeders in the interior of the state of São Paulo - Brazil, comparing fertility results from two groups vaccinated at 19 weeks of age in the breast. Three batches were evaluated in each group, under similar experimental conditions:

- AVISAN SECURE: Birds vaccinated against Salmonella SE and ST in double emulsion, 0.5 ml/bird
- Oily vaccine: birds vaccinated against Samonella SE and ST in single oil emulsion 0.3 ml/bird

Hatchable eggs incubated for 3 to 5 days were broken via the air chamber and examined individually.

Four trays containing 96 eggs were collected per batch per week.

The regular weekly sampling generates a graph showing the flock fertility trend, which is more important than analysing fertility at an isolated point in time.

Differences in the fertility rate were observed between the two groups studied throughout the experimental period (figure 3). The greatest differences were seen up to 10 weeks after vaccination:

Age (weeks)	AVISAN® SECURE	Oily vaccine	Difference
25	89.50%	74.67%	+ 14.83%
26	94.00%	81.40%	+ 12.60%
27	93.41%	87.47%	+ 5.95%
28	96.21%	90.22%	+ 5.99%

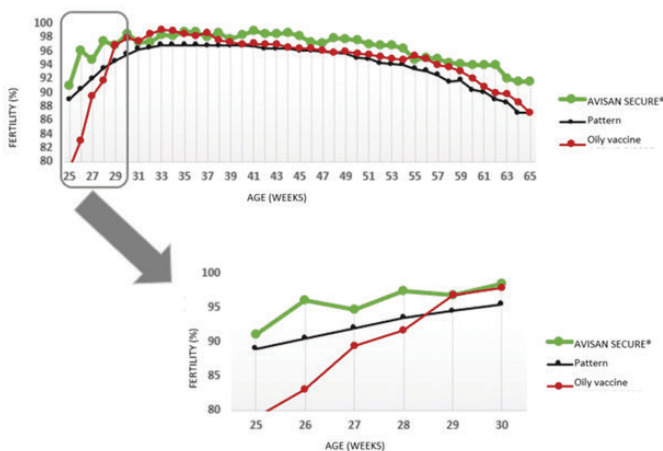


Figure 1: Fertility associated with the age of the hen

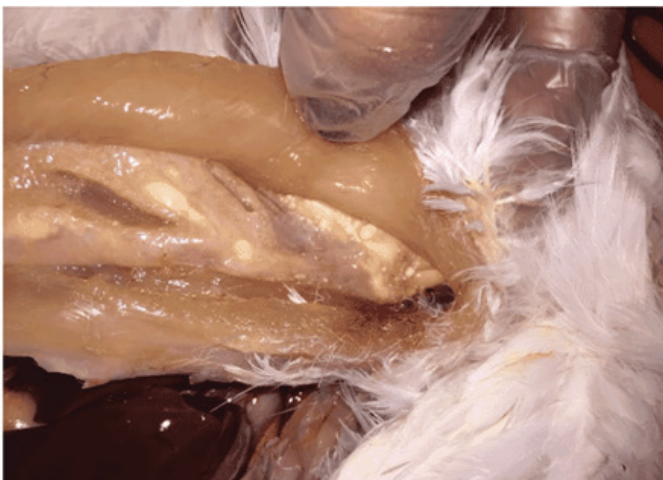


Figure 2: 4 weeks after oily vaccine injection



Figure 3: 4 weeks after AVISAN SECURE injection

The reproductive potential of males and females is influenced by several factors, and it is important to remember that the impact of the male on the fertility is about ten times greater than the impact of the female.

The most important point related to flock fertility is the growth profile of the males. Any situation that causes stress and consequently weight loss between 16 and 22 weeks of age will directly affect testicular development and uniformity of weight.

Between 19 and 25 weeks of age, the male is expected to increase approximately 35% in weight. With that in mind, it is essential that vaccination management be considered when assessing factors that affect fertility, as it is carried out at a crucial moment that determines the reproductive potential of the flock.

Conclusion

Administering a single oil emulsion vaccine at this very delicate moment in sexual development increases the probability of inflammatory events in the breast, with the formation of oedema and pain. Consequently, there are several changes in the animal's activity that contribute to loss of fertility:

- It reduces food intake increasing weight variation coefficient in the flock, which is hard to recover
- It decreases copulation activity, as the bird feels pain and discomfort in the breast (figure 2)
- There is interference in the structural development, particularly in regard to the shape of the breast, which affects the quality of copulation (figure 2)
- Loss of fertility translates to fewer chicks per bird, directly impacting on the economic results.

In the study conducted, relevant differences in fertility were observed and it was demonstrated that the type of emulsion is important when it comes to vaccination management of breeding flocks. AVISAN SECURE has proven to be a safe alternative. □

पशुपालन और डेयरी विभाग
Department of Animal Husbandry and Dairying

DID YOU KNOW?

India's per-capita availability of egg was 79 eggs per annum in 2019!

Non-chemical approaches to controlling red mite - what works ?

Jon Walton

Control of poultry red mite (PRM) has traditionally relied upon use of synthetic pesticides that specifically target ticks and mites – otherwise known as acaricides.

However, in Europe there are currently very few chemical acaricides available for use, as many have been withdrawn due to consumer safety regulations. Resistance to chemical products has also been widely reported, which means that relying on stand-alone chemical treatments is no longer satisfactory.

Increasing attention is being paid to non-chemical-based treatments for the control of PRM. Here, we review the non-chemical products which are now available to poultry farmers and the promising new products in development.

Plant-derived products

Mite-control measures made from plants have a great deal of potential as they mostly have low toxic effects on mammals, short environmental persistence and a relatively low impact on the environment. Several plant extracts and essential oils are proven to have toxic and repellent effects on PRM.

Essential oils – for example cade, manuka, pennyroyal and thyme – have proved to be effective under laboratory conditions against PRM, although their effectiveness in the field is yet to be investigated. It has been suggested that some volatile compounds of essential oils have both a repellent and short-lived toxic effect on the mites.

These plant derived products can be applied either as spray – for example Mite Stop, a commercially available product based on neem-seed extract, which has shown to be effective under both laboratory and commercial conditions – or as a feed or drinking-water supplements. Lentypou+ is an additive supplied in the hen's drinking water and is available under several commercial names. It is based on thyme, burdock and tansy and renders the blood of the hens indigestible for mites, eventually leading to the parasites' death. Nor-Mite is an additive which can be administered in the drinking water or feed and has been shown to make hens much less attractive to PRM. Both these products are used preventively throughout the whole production period.

Vaccination

Several studies have demonstrated the potential of vaccination against PRM. Development of a vaccine against PRM has focused on using “concealed antigens” – proteins found



in the mites' midgut which cause a natural immune reaction in hens. In cattle farming, the strategy of using a concealed midgut-related antigen led to the development of an effective vaccine against the cattle tick called TickGARD (though its uptake in that sector was limited). In the poultry sector, so far an autogenous (native) vaccine against PRM has been developed from crude extracts of the mite's protein set – this was seen to cause an up to 78 percent reduction in the mite population under field conditions. Producing autogenous vaccines is very labour intensive, however, as mites from every house that will be treated need to be sampled to make a house-specific vaccine. The efficacy of autogenous vaccines can also vary between batches. Recombinant vaccines are cheaper and quicker to produce, but to date no suitable candidate protein has been isolated to control PRM.

Biological control

The use of natural predators to regulate pest populations is a technique widely applied in horticulture. They may be mass-reared at lab, then released in farms to increase the effect of natural predatory populations. Predatory mites which feed upon PRM are emerging as a promising control method. Currently in Europe, mass-reared *Androlaelaps casalis* and *Cheyletus eruditus* are available under their respective commercial names Androlis and Taurus and are produced by Koppert. Androlis and Taurus are often used together and released in hen houses as a preventative measure against PRM. Androlis mainly feeds on red mite that are in their juvenile stages and is a highly mobile predator, while Taurus

is more voracious and preys on all stages but is slower to disperse. The protocols for dosages and frequency of releases are available from Koppert. Although unlikely to eradicate PRM if used on its own, together with other treatment approaches it offers a promising solution.

Heat treatment

Temperatures over 45°C are lethal for PRM. The Thermokill method developed by Van Eck Industrial Hygiene BV takes advantage of this. The method involves gradually heating hen houses during the empty period to above 45°C for at least two days. By heating up the poultry house gradually, mites are lured out of their hiding places, which improves the killing efficiency of the heat. It has been reported that this method can be very efficient in eliminating PRM, however it is expensive and some housing systems can be damaged by the heat.

Inert dusts

Inert dusts like silica and diatomaceous earth are claimed to work by cutting the outer layer of the mite's exoskeleton causing desiccation and death. Numerous products are commercially available and widely used. Variability in effectiveness has been noted between different silica-based products. They are best used preventively and applied as a liquid, although silica is often not sufficient as a stand-alone product for controlling PRM. Farmers have reported improved efficacy when previous layers of silica are removed from the housing systems before a fresh silica layer is applied.

Q-Perch

The Q-Perch, developed by Vencomatic, is a perch which has two electrical wires and insulators installed underneath the perching bar. A small electrical current runs through the wires, killing mites as they travel from their hiding places to feed on the hens. Although expensive to install, it offers a continuous method of control and is promising, particularly when used as part of a combination of non-chemical treatment approaches.

Entomopathogenic fungi

Entomopathogenic fungi (parasitic fungi) are a long way from being commercially available as treatment products against PRM, but they do show some potential. Studies under laboratory conditions have shown that PRM is susceptible to a number of entomopathogenic fungi species. However, they have not proven effective in trials in semi-commercial conditions. Part of the problem in replicating the success of the laboratory experiments in the field lies in the specific environmental conditions fungi require, which are difficult to replicate in a commercial context. Additionally, as these fungi species do not solely target PRM, there is a risk that they could have negative effects on other species.

Mite Control

The MiteControl project is testing the efficacy of combining several non-chemical treatments for controlling red mite on farms across the UK, France and Belgium. To find out more please see the project website. MiteControl is part funded by the Interreg North-West Europe Programme and in the UK is generously supported by BFREPA, the BEMB Research and Education Trust and Noble Foods.



Courtesy: NECC

"Be vocal for Local"

Contn from Page 40

which is taking its last breath. Govt can revive the industry with different relief package such as price regulation of major raw materials so that it supports poultry industry's growth, subsidization on electricity bills of hatchery, feed factory & poultry farms, promotional scheme to establish poultry processing plant and cool storages of chicken products, compulsory licensing of retail chicken shop with hygiene audit, engaging state veterinary dept. to create awareness programme, waive off loan interest of the farmer's / poultry companies with restructuring of moratorium loan repayment period atleast for a year. Apart from all these Govt responsibility it is the responsibility of each & every Indian chicken consumer to analyses & authenticate to all types of miscreant hoax against Indian poultry industry which finally destroying Indian rural economy. Consumers patronage is highly requiring to save this huge employment generating sector. Your one silly move may make you popular in different Chinese app like TIKTOK, HELO etc, but it will ruin the livelihood of 5 crore fellow Indians associated with this poultry sector. Lastly with great aspiration with the slogan "Be vocal for Local". □

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Technical Update

Thiamin Deficiency in Pullets

BACKGROUND

Thiamin, also known as vitamin B₁, is an essential vitamin involved in metabolic energy supply and critical for normal growth and development of poultry. While cases of thiamin deficiency are rare, it is important to recognize the clinical signs and resolve the issue quickly in order to avoid mortality. Deficiency is caused by three primary routes: omission from the diet, inhibition of thiamin absorption, or destruction of the thiamin molecule. Omission from the diet usually occurs from complete failure to either add the vitamin to the premix or add the premix to the ration. Inhibition of thiamin absorption may occur from intestinal disease, amprolium toxicity, or mycotoxins. Destruction of the molecule can occur from thiaminase enzymes present in poor quality fish meal (3,6).

Many issues related to the feed milling process can lead to thiamin deficiency. Improper storage of the premix relating to temperature, humidity, length of storage, and packaging is most common. Failure to include thiamin in the premix or improper mixing procedure may also contribute to deficiencies.

Evaluation of the feed milling process should be the primary step when managing suspected cases of vitamin origin.

Amprolium is a commonly used coccidiostat or treatment for active coccidiosis. Amprolium is very similar in structure to thiamin and can competitively exclude absorption of the vitamin from the intestinal tract. Further, amprolium is known to block phosphorylation of the vitamin which is required for proper function (4).



Figure 1. Late stage deficiency with large numbers of affected birds.

Thiamin availability is affected by breaking down the vitamin B₁ molecule due to naturally present thiaminase enzymes. Poor quality fish meals can contain high levels of amines (potentially caustic compounds derived from nitrogen) and / or thiaminases (3). High amine concentration in the meal often impacts the lining of the gizzard, causing erosions and is a more common indication of poor quality fish meal. Signs of gizzard erosions warrant an investigation of the fish meal source and usually occur before the clinical signs of thiamin deficiency develop. Fish meals can vary greatly in their concentration of thiaminases, and raw ingredients should be tested before inclusion as a protein source in the diet.

CLINICAL SIGNS

In pullets and adult birds, clinical signs of thiamin deficiencies take approximately six weeks to develop and represent a chronic problem. For chicks, the onset of clinical signs is more rapid due to low carry over of thiamine from the breeding hen.

Eggs derived from parent stock fed low levels of thiamine will have compromised levels of thiamin. This will result in high 18-day embryonic mortality and subsequent hatch. Surviving chicks will have compromised levels of thiamin, resulting in polyneuritis typically demonstrated as muscle paralysis which causes extended legs and retraction of the head (1,5).

In older pullets, early



Figure 2. Affected bird exhibiting squatting posture (paresis).



Figure 3. Affected bird with full paralysis.

signs of thiamin deficiency present as decreased feed intake, lethargy, and head tremors (6). As the condition worsens, a polyneuritis causes paresis, which progresses to eventual paralysis of the birds (Fig. 1–3).

Due to the association with feed supply, manifestation of thiamin deficiency tends to occur across the entire farm as opposed to one single house.

Morbidity can vary greatly depending on the level and chronicity, but has been observed in excess of 60%. Starvation and dehydration are sequelae of paralysis and the level of mortality related to culling is significant.

Thiamine deficiency is typically a diagnosis of exclusion. Primary differentials to address first include Marek's

disease, influenza, Newcastle disease, monensin (ionophore) toxicity, peripheral neuropathy, and other vitamin deficiencies including riboflavin.

NECROPSY

Necropsy of culled birds or mortality is unrewarding, showing no specific gross lesions. Severely impacted birds will show signs of starvation and dehydration. Histopathology may show degeneration of the cells lining the duodenal crypts of Lieberkühn, with dilation and filling of the crypts with cellular debris and necrotic cells, and vacuolation of the pancreatic acinar cells with hyaline body formation (2).

TREATMENT

When a diagnosis of thiamin deficiency is suspected, quick action is advisable. On farms with progressive disease showing paralysis and paresis, it is possible to give birds an injectable form of thiamine. While exact dosages for intramuscular injection of thiamin in poultry have not been determined, successful recovery of mildly and moderately paralyzed birds was achieved with 5–8 mg/kg body weight. Severely affected birds are unlikely to recover due to extreme starvation and dehydration and should be euthanized accordingly.

Given that thiamin is typically considered a multiple farm concern, it is recommended that all farms receiving feed from the same source be immediately supplemented in the water with high doses of thiamin, either in combination with other water-soluble vitamins or alone. Excess thiamin is readily excreted through the urine or feces in poultry. Over supplementation is not a concern, as

the toxic dose is 700 times the requirement level. Maintain regular supplementation in the water until the source of thiamin deficiency has been determined and corrected.

Removing old feed and replacing with a fresh batch of adequately supplemented feed will also help to ensure a rapid return of thiamine to the flock. Treating the birds in this manner will help the flocks to recover quickly. In cases of thiamine deficiency shortly after hatch, this same procedure should be utilized in affected parent flocks.

PREVENTION

Thiamin requirements for poultry range between 2.2–3.0 mg/kg (2.2–3.0 g/ton) of diet (Hy-Line, 2019). A minimum of 2.2 mg/kg feed in rearing phase and 2.5 mg/kg of feed during the laying period is recommended for commercial birds. Ensure breeder diets are adequately supplemented with thiamin, providing 3.0 to 3.5 mg/kg feed. Although microbial synthesis of thiamin occurs in the intestine, this is not a dependable source and should not be relied upon during feed formulation.

Ensure the thiamine supplemented in the diet is in a suitable form (typically thiamine mononitrate [98%] is used), and adequately mixed in a vitamin premix. The vitamin premix should be from a reputable source and provided at a suitable inclusion rate to reflect the capability of the feed mixing system. Thoroughly mix the premix with other feed ingredients to ensure even distribution of thiamin and other vitamins. Do not use old or improperly stored premix. Thiamin is particularly sensitive to heat, trace minerals, and a high pH. When heat treatment is utilized, consider adding additional premix as thiamine is sensitive to thermal processing. Store premixes in cool facilities and away from direct sunlight. When possible, provide vitamins in a separate premix relative to trace minerals. Keep retention samples of the premix and finished feed for future reference in the event of feed-related problems in the flock.

The presence of mycotoxins and parasitism can also contribute to thiamin deficiency. Minimize mycotoxin levels in feeds, as some *Fusarium*-based toxins have been associated with thiamin deficiency. The presence of endoparasites such as coccidia and helminths (worms) compete with the host for thiamin; therefore, reducing the susceptibility of the bird to parasite infestation can be critical to preventing nutrient deficiency.

– Courtesy: Hy-Line International

Autonomous robotics for the poultry shed

Andrew Amelinckx

Two American entrepreneurs want to change the way poultry producers interact with their flocks. Poultry Patrol is an autonomous robot designed for use in poultry barns to improve animal welfare and cut down on a producer's need to constantly walk the barns doing surveillance.

"It can be a constant helper in the barns," says Jack Kilian, who designed the robot. "I don't think it would ever replace a person because a farmer can do things a robot never could, but it will definitely be able to help them keep an extra eye on their flock."

Kilian is an electrical engineer who recently completed his graduate studies at the University of Minnesota. His business partner, Jack Buendorf, is a maths and economics student still at university at St Olaf College, also in Minnesota. He handles the business end of things – both are in their twenties.

While still in its developmental phase, the sturdy four-wheeled robot that stands a little more than 60cm tall will be able to turn bedding, detect poultry disease and mortality through video and audio devices and alert the farmer to any problems it comes across – remotely and automatically. Eventually, they plan to add a mechanism for moving mortalities to an area selected by the farmer for disposal. Currently, operators can remotely log into the robot and drive it from anywhere that internet is available. The system can determine where it is in the barn and has video capabilities, and the tiller is being tested, says Buendorf.

How it all started

In January, Kilian competed against more than 50 other entries to win \$12,500 (£10,267) in the Ag Tech Challenge put on by Red Wing Ignite. The non-profit organisation "fuels economic development by working with key sectors of the community to spur innovation by supporting entrepreneurs, businesses and students," according to the organisation's website. This provided seed money for the prototype.

Kilian was joined by Buendorf in the spring. The pair were brought together by Adam Gettings, a serial entrepreneur who co-founded Rover Robotics, the company that designs the robotic platform on which the Poultry Patrol robot is built. Kilian used the Rover's chassis and built a new computer hardware system on to it. The project spun off from a robot called



The Wild Goose Chaser that did exactly that: chased geese off lawns. It was a project from Digi Labs, a tech incubator, where Kilian works.

Now, Poultry Patrol is among 21 finalists in a worldwide competition by the Foundation for Food and Agriculture Research and the McDonald's Corporation to automate farms and improve animal welfare. Kilian and Buendorf will find out in November if Poultry Patrol is one of the four projects selected to receive a \$500,000 (£410,680) grant. The competition is aimed at the broiler chicken industry and is focused on gait scores.

"We're going to be using computer-vision techniques to track the gait of the bird," says Kilian. "With the robotic platform we'll have more opportunities to look at the birds compared to something like a stationary camera, and since the robot could do all these other things it seems like it would be an easy sell."

It can also be used to detect disease and mortalities through thermal imaging, says Kilian. If a broiler chicken's legs are hot, it could indicate a bacterial infection. If the bird's temperature is particularly low, it's a mortality. And this could all be done while the rover is going about its business tilling the bedding, or doing other activities, he says.

The fact that the robot gets the birds moving is also a plus since "the only way to evaluate a bird's health is to get it to move," says Buendorf, and their robot "can autonomously measure that movement and tell you if it's a healthy bird". The robot is a good size for poultry barns because it can easily manoeuvre along the feed lines without issues, but is large enough to get the birds moving.

The robot could also detect disease through other methods like feather discoloration, missing feathers, burns on their breasts and even respiratory issues via audio recording. "If a bird is coughing due to a respiratory issue all of a sudden you have a robot that can immediately say there's a biohazard in the barn," says Buendorf.

While there are a few other companies working in the robotics space that are focused on the poultry industry – Octopus Robots, Metabolic Robots and Tibot Technologies – Kilian and Buendorf believe Poultry Patrol will differentiate itself because of its ruggedness, maximised utility and affordability. Multitasking is a key. "We plan to have our robot conduct multiple tasks all at once," says Buendorf. "Octopus is focused on sanitation and tilling, TIBOT is focused on movement and Metabolic is focused on FCR improvement. We hope our robot can do all these tasks and more, such as mortality removal and computer vision welfare reporting."

Additionally, by building onto the "extremely rugged" Rover

Robotics chassis they were able to skip years of mechanical and electrical engineering development, which will translate to a lower price point, according to Buendorf. "We have no idea what our pricing model will be, but we can be sure it will be lower than our competition," he says.

Real-world testing

Their prototype is currently being tested at the turkey farm of John Zimmerman, outside of Northfield, Minnesota. "I like to be open to trying out different things," says Zimmerman on a phone call. "I like to experiment. I like technology. I offered my barns and assistance if they wanted to test things out, so we ended up with a robot in the barn."

There were concerns early on about how the turkeys would react to having a robot driving around the barn, but the birds seemed unphased. "The turkeys aren't bothered by it at all," says Zimmerman. "We thought it would take some getting used to but they're not scared of it in any way shape or form. They move out of its way and don't scatter or pile."

Zimmerman sees the robot first and foremost as a management tool. "As we move towards antibiotic-free production our management has to be stepped up," he says. "Having another set of eyes and ears through sensors in the barn at all times would be incredibly valuable in detecting diseases or other issues earlier than before because you don't have the luxury of time any more. We have to catch things incredibly quickly if we're going to treat [the birds] with something other than antibiotics."

Zimmerman is also interested in the potential for physical actions tilling, moving mortalities – believing that's where there would be a measurable return on investment. "I think they're going to get there," he says. "It's just a matter of how and when and what the price point is going to be. I'm very interested in it."

The future of poultry production

Buendorf and Kilian get that they're "newbies" to the poultry industry, which has given them a sense of responsibility to produce their technology "correctly", which means relying on the expert guidance of seasoned industry professionals to "develop a product that is going to maximise their utility and efficiency," according to Buendorf.

"That is where our team feels responsibility: to deliver reliable technology that has the ability to make production more efficient, safe and enjoyable for all parties involved, especially the birds," says Buendorf.

He believes Poultry Patrol can expand across the entire poultry industry – from measuring angular limb deformities for breeders to automatically collecting eggs for the egg industry. "We want to solve as many problems as we can," he says. Kilian sees the potential across agriculture.

"Being from the Midwest and being from the technical side I think there are a lot of opportunities [for things] that could be improved through robotics," says Kilian. "We really like the idea of robotics in ag in general. We just want to keep finding other applications."

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Dietary supplementation with Selenium-enriched earthworm powder improves anti-oxidative ability and immunity of laying hens

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Abstract

Selenium (Se) has been recognized as an essential dietary nutrient for decades, and organic Se sources rather than inorganic ones are increasingly advocated as Se supplements. Earthworms have been studied as a feed additive and animal protein source for many years. The aim of this study was to evaluate the effect of Se-enriched earthworm powder (SEP) on the anti-oxidative ability and immunity of laying hens. A total of one 120, 27-week-old laying hens were randomly divided into four groups (30 hens per group). Laying hens were fed diets supplemented with SEP having 0, 0.5, or 1 mg/kg of Se or with earthworm powder alone. After 5 weeks of supplementation, serum from the hens was tested for nutritional components (protein, globulin, albumin, triglycerides, total cholesterol, and glucose), anti-oxidative properties (glutathione peroxidase, superoxide dismutase, catalase, and nitric oxide), and immune responses (lysozymes, immunoglobulin G, interleukin-2, and interferon γ). We found that SEP with 1.0 mg/kg of Se upregulated the hens' total protein, albumin, glutathione peroxidase, superoxide dismutase, immunoglobulin G, and interleukin-2 and downregulated triglycerides, total cholesterol, glucose, and nitric oxide. These results indicate that SEP improves antioxidative levels and immune function of laying hens, indicating potential benefit from use of SEP as a feed additive in the poultry industry.

Introduction

Selenium (Se) is an essential trace element for animal health, as it is involved in many biological functions, including those related to anti-aging (Papp, Holmgren et al. 2010), reproduction (Harrison, Hancock et al. 1984), neurobiology (Schweizer, Schomburg et al. 2004), muscle metabolism (Brown and Arthur 2001), chemoprevention (Combs Jr and Gray 1998), and immune functions (Hoffmann and Berry 2008). The beneficial and protective properties of Se and mainly due to its anti-oxidative activities against carcinogenic factors and free radicals (Kieliszek and Błażej 2016). Se deficiency has been shown to be associated with reduced productivity and dysfunctional reproductivity in the poultry industry (Surai 2002). Thus, support has grown for dietary supplementation with Se as a means of maintaining poultry health and an effective way to increase the Se content of carcass meat and eggs (Register 2002).

Sodium selenite, one of the inorganic forms of Se, has been widely used as an Se source in major feed ingredients over the last 50 years (Surai 2006). However, the bioavailability

and safety of inorganic Se are generally lower than those of organic Se (Daniels 1996). For example, organic forms are more effective than inorganic Se from sodium selenite in increasing blood Se concentrations and GSH-Px activities in lambs and in increasing Se content in the carcass meat of broilers (Mahan and Parrett 1996). Organic Se sources include microorganisms and plants that have the ability to transport and accumulate organic Se from selenate or selenite. Microorganism-derived Se sources include Se-enriched yeast, probiotics, and algae (Skrivan, Simane et al. 2006). Plant-derived Se sources include Se-enriched bean sprouts (Chinrasri, Chantiratikul et al. 2009), broccoli (Bañuelos et al. 2015), garlic (Yang 2002), and cabbage (Seo, Spallholz et al. 2008).

The findings cited above demonstrate that microorganism-derived Se and plant-derived Se are good organic Se sources for the poultry industry. However, there is little reporting on organic Se from animal sources. Hu extracted Se-enriched amino acids and selenoprotein from Ziyang silkworm cocoons and studied the effects of Se-enriched amino acids on hepatoma cells (HU, LIU et al. 2004). Hall et al. (2014) demonstrated that Se-yeast supplementation improved anti-oxidative activity and immune responses without impacting other micronutrients or energy status. Similarly, selenoprotein W has an important protective function against H_2O_2 -induced oxidative damage (Han, Zhang et al. 2012). Previous studies have reported that organic Se can be accumulated in earthworms and can reach concentrations as high as 332.5 mg/kg of Se dry weight (Liu et al. 2001; Sun et al. 2014). However, the effects of Se-enriched earthworms on poultry production have been completely unknown. In this study, we investigated the effects of Se-enriched earthworm power (SEP) on laying hens, including its effects on anti-oxidative activities and immune responses.

Materials and Methods

The production of earthworm powder

Earthworms (*Eisenia foetida*) were fed with cow dung and divided into two groups. Sodium selenite at 60 mg/kg was added to the feed of Se-enriched earthworm group (SEP group), and the same amount of sodium chloride was added to the feed of non-Se-enriched earthworm group (control group). After 60 days of feeding, earthworms and worm casts were collected, freeze-dried, and ground into powder (in a weight ratio of 2:3). The Se content of the SEP was 57 mg/kg, while the concentration of Se in the control group was 5.85 mg/kg. To ensure all treatment groups got the

same amount of exogenous supplement, we first mixed the SEP with powdered earthworms without Se enrichment to a given amount and then added the same amount (1.8%) of supplement into the hens' basal diet. The diet concentrations of exogenous-source Se (not including the basal Se content) for the treatment groups were 0 mg/kg for the T2 group (1.8% control earthworm powder addition), 0.5 mg/kg for the T3 group (1.8% SEP addition), and 1mg/kg for the T4 group (1.8% SEP addition).

Main reagents and test instruments

The kits were obtained from Nanjing Jiancheng Bioengineering Institute for biomedical research, including GSH-Px, SOD, CAT, NO, lysozyme, IgG, IL-2, and IFN- γ . The instruments applied in our test included TU-1810 Ultraviolet and visible spectrophotometer (Beijing Purkinje General Instrument Co. Ltd.), HH-2 thermostatic water bath with digital display (Shanghai Techeng mechanical equipment Co. Ltd.), IEC Micro micro-centrifuge and Mk3 ELISA (Thermo company, USA), AU2700 automatic biochemical analyzer (Olympus Company, Japan), 96 holes MPP oscillator (Beijing Jiayuanxingye Technology Company) and incubator (Beijing Fuyi electrical equipment company).

Experimental Procedures and Dietary Treatments

One hundred and twenty adult laying hens (27 weeks old; Lohmann type) were randomly assigned to four groups (with three replicates of 10 hens for each group). All hens were acclimated to a basal diet for 3 weeks. No significant difference in feed intake was observed among experimental individuals before treatment. Hens were fed diets supplemented without supplementation (basal diet, T1 group), earthworm powder alone (1.8% added to basal diet, T2 group), 0.5 mg Se per kg SEP (T3 group), or 1 mg Se per kg SEP (T4 group) three times per day at 6 am, 11 am, and 6 pm for 5 weeks. The basal diet (Table 1) was formulated to meet the nutrient requirements of hens (Nutrition 1971) without Se supplementation. The hens were housed under a 16:8-h light-dark cycle at a constant temperature (20 ± 4 °C), and the relative humidity changed between 60% and 78% during the experiment. All animal handling protocols used with experimental individuals were reviewed and approved by the Institutional Animal Care and Use Committee at China Agricultural University.

Table 1. Ingredients and nutrient Level of control diets

Ingredients	Percentage (%)	Nutrient Level	Content
Corn	62.50	Crude Protein(Cp) %	16.70
Soybean Meal	20.00	Crude Fibre %	3.35
Limestone	8.50	Lysine %	0.75
Bran	5.00	Methionine %	0.39
Vitamin-Mineral premix ^a	4.00	Cystine %	0.32
		Digestible energy(ME)/kJ·kg ⁻¹	11.43
		Phosphorus/ %	0.74
Total	100	Calcium %	3.50
		Selenium/mg·kg ⁻¹	0.012

Note: The nutrient content in feed formulation is theoretical calculation values.

^a Vitamin-mineral premix provide (per kg diet): 25300 IU vitamin A, 7000 IU vitamin D₃, 270 IU vitamin E, 45mg vitamin K₃, 32mg vitamin B₁, 110mg vitamin B₂, 30mg vitamin B₆, 0.6mg vitamin B₁₂, 40mg niacin, 13mg pantothenic acid, 13mg folic acid, 0.8mg biotin, 100mg choline chloride, 60mg Fe, 1.4mg Cu, 60mg Mn, 13mg Zn, 0.012mg Se, 0.098mg I.

Sampling and Biochemistry Analysis

Samples from the diets were randomly collected for the determination of chemical composition at the end of the experiment. On the 35th day of the experiment, the hens fasted for 3 hours and were then electrically stunned. Then 5-mL blood samples were obtained into sterile test tubes from the brachial vein of the wing. The samples were centrifuged at 3000 r/min for 20 min, and the supernatants were harvested, aliquoted, and stored at -80 °C prior to testing.

The levels of serum protein, globulin, albumin, triglycerides, total cholesterol, and glucose were tested using an AU2700 automatic biochemical analyzer. The activity of glutathione peroxidase (GSH-Px) and superoxide dismutase (SOD) were investigated by means of dinitro benzoic acid, xanthine oxidase, ammonium molybdate colorimetry, and nitrile reductase. The instrument used was a TU-1810 ultraviolet and visible spectrophotometer. The levels of lysozyme, immunoglobulin G (IgG), interleukin-2 (IL-2), and interferon γ (IFN- γ) were measured by immunoturbidimetry and enzyme-linked immunosorbent assay.

Statistical Analysis

Statistical analyses were conducted as previously described (Sun, Yang et al. 2017). Each animal was considered as an experimental unit. The experimental data were analyzed using one-way ANOVA and represented with average value \pm standard deviation (mean \pm SD). Statistical analysis was performed using Prism 6 software (GraphPad Software, Inc., La Jolla, CA, USA). The differences among the groups were determined using Duncan's multiple range tests. Significance was accepted at $P < 0.05$.

Results

The impacts of Se-enriched earthworms powder (SEP) on serum biochemistry profile

To determine the effects of SEP on the health status of laying hens, we tested the biochemistry profile of chicken serum, including the content of protein, globulin, albumin, triglyceride, total cholesterol, and glucose (Table 2). Of note in this study, earthworm powder alone (T2 treatment) increased protein, globulin, and albumin by 8.02%, 8.53% and 11.60% respectively, but decreased triglycerides, cholesterol, and glucose by 11.24%, 5.61%, and 4.78%, respectively, suggesting that earthworms could be a potential dietary substitute for laying hens. SEP with 1.0 mg Se per kg (T4) positively and significantly affected the protein content in serum in a dose-dependent manner, possibly due to the upregulation of globulin and albumin, as compared with the serum protein content from hens fed the control diet (T1) and the control diet plus earthworm powder alone (T2) ($P < 0.05$). SEP with 1.0 mg Se per kg (T4) significantly reduced the

concentration of triglycerides, total cholesterol, and glucose compared with the control diet (T₁) ($P < 0.05$). SEP with 0.5

mg Se per kg (T₃) significantly increased the concentration of globulin and decrease triglycerides compared with the control diet (T₁) ($P < 0.05$).

Table 2. Effects of selenium-enriched earthworms power (SEP) on the biochemical index

Dietary treatments	Protein(g/L)	Globulin(g/L)	Albumin(g/L)	Triglyceride (g/L)	Total cholesterol (g/L)	Glucose (g/L)
T ₁	49.90±1.27 ^c	29.75±1.34 ^b	20.15±0.07 ^b	20.46±0.11 ^a	3.04±0.08 ^a	15.07±1.08 ^a
T ₂	53.90±0.57 ^{bc}	33.20±0.42 ^{ab}	20.70±0.14 ^b	18.16±0.37 ^{ab}	2.89±0.14 ^{ab}	14.22±0.04 ^{ab}
T ₃	58.50±0.42 ^{ab}	37.45±0.78 ^a	21.05±0.35 ^b	17.14±0.47 ^{ab}	2.81±0.35 ^b	14.17±0.30 ^{ab}
T ₄	61.95±4.88 ^a	39.15±4.60 ^a	22.80±0.28 ^a	15.22±3.42 ^b	2.75±0.01 ^b	13.60±0.17 ^b

Note: T₁=control group (basal diet); T₂: control diet earthworm powder alone (no Se enrichment); T₃: control diet plus 0.5 mg Se/kg from selenium-enriched earthworms powder (SEP); T₄: control diet plus 1.0mg Se/kg from SEP, respectively

Different letters in the same column indicate significant difference ($P < 0.05$; ANOVA and Turkey's test)

The impacts of SEP on serum antioxidative capacity

Selenium is known for its antioxidant properties. The activity of antioxidative enzymes including GSH-Px, SOD, and catalase were tested to evaluate the antioxidative role of SEP in laying hens (Table 3). SEP with 1.0 mg Se per kg (T₄) significantly increased the activity of antioxidative enzymes (GSH-Px and SOD), while it downregulated the generation of nitric oxide in serum compared with the control diet (T₁)

and the control diet plus earthworm powder alone (T₂) ($P < 0.05$). SEP with 0.5 mg Se per kg (T₃) significantly increased the activity of GSH-Px and SOD and decreased the generation of nitric oxide in serum compared with the control diet (T₁) ($P < 0.05$). Earthworm powder without Se pretreatment had the potential to eliminate free radicals by activating antioxidative enzymes.

Table 3. Effects of selenium-enriched earthworms power (SEP) on the antioxidant ability

Dietary treatments	Glutathione Peroxide Enzyme(U·mL ⁻¹)	Superoxide Dismutase (U·mL ⁻¹)	Catalase (U·mL ⁻¹)	Nitric Oxide(μM·L ⁻¹)
T ₁	148.32±6.34 ^b	100.06±9.44 ^b	2.09±0.64 ^b	30.03±0.95 ^a
T ₂	150.26±7.90 ^b	103.37±2.31 ^b	2.37±0.30 ^{ab}	26.87±1.74 ^{ab}
T ₃	188.08±9.17 ^{ab}	106.79±2.04 ^{ab}	2.25±0.85 ^{ab}	24.36±9.75 ^{ab}
T ₄	208.45±10.25 ^a	107.24±1.62 ^a	2.90±0.69 ^a	22.03±3.28 ^b

Note: T₁=control group (basal diet); T₂: control diet earthworm powder alone (no Se enrichment); T₃: control diet plus 0.5 mg Se/kg from selenium-enriched earthworms powder (SEP); T₄: control diet plus 1.0mg Se/kg from SEP, respectively

Different letters in the same column indicate significant difference ($P < 0.05$; ANOVA and Turkey's test)

The impacts of SEP on the immune response

It has been reported that Se supplements improve the immune response, whereas Se deprivation causes an impaired immune response (Marsh, Dietert et al. 1981, Xu and Tian 2015). In this study, we found that lysozyme, IgG, IL-2, and IFN-γ levels did not respond to treatment with the control diet plus earthworm control powder (T₂) ($P > 0.05$), whereas they were significantly increased in serum in response to treatment with SEP with 0.5 mg Se per kg (T₃) or SEP with 1.0 mg Se per kg (T₄) when compared with treatment with the control diet (T₁) or the control diet plus earthworm control powder (T₂) ($P < 0.05$), suggesting that SEP improved the immune response of laying hens.

Discussion

Se supplementation is indispensable for hens' performance in regions where Se in the environment is low, which can be reflected in serum protein content (Payne and Southern 2005). We studied the effects of SEP on hen serum in this study. Our results show that SEP can improve serum protein content. This may be because the metabolism and utilization of protein and amino acids are greater in response to Se supplementation (GUO, HAO et al. 2010). It would also be an interesting study to measure the Se contents in both plasma and tissue to test the dose responses in hens.

Albumin acts as a nutrition carrier, and globulin is one of

the immune proteins. The ratio of albumin to globulin in serum could be used as an important indicator of animal nutrition and immunity performance (Bunchasak, Poosuwan et al. 2005). Serum albumin plays an important role in keeping the plasma colloid osmotic pressure, adjusting the hydrodynamic equilibrium between the organs and the blood vessels (Kaneko 1997). The downregulation of albumin levels could be a disease indicator related to dysfunction of the liver, heart, or kidneys (Honda, Qureshi et al. 2006). SEP significantly increased the content of serum albumin, which might suggest a method to alleviate these diseases.

Serum total cholesterol and triglycerides are two commonly used indexes in reflecting body lipid metabolism, abnormal elevation of which is a reflection of a lipid metabolism disturbance. Cows fed an Se-yeast supplement during the last 8 weeks of gestation had lower serum cholesterol concentrations compared with control cows (Hall, Bobe et al. 2014). SEP with 1 mg Se per kg decreased the content of serum total cholesterol and triglycerides, providing a clue that earthworm powder enriched with Se plays a significant role in adjusting hens' body lipid metabolism and reducing blood fat.

Oxidative stress is a condition that refers to an imbalance between levels of Reactive Oxidative Species and their antioxidants. Oxidative stress can come from exogenous

sources (such as in pathogen-induced or chemically induced stress) or endogenous sources, such as endogenous metabolism from mitochondria, peroxisomes, cytoplasm, or plasma membrane (Biller and Takahashi 2018). The antioxidant defense system of the organism mainly uses GSH-Px, SOD, and catalase for removal of excess free radicals: namely, O_2^- , H_2O_2 , and $ROO\cdot$. Selenium deficiency could lead to the decline of antioxidative activities and an increase in free radicals, causing damage to lipid peroxidation, proteins, and nucleic acids, thereby inducing pancreatic necrosis in birds and animal reproductive dysfunction (Wu, Zhan et al. 2010). Our results found that SEP improved the serum levels of GSH-Px and SOD, whereas earthworm powder alone failed to enhance the activity of these antioxidative enzymes, indicating that Se might play a major role in promoting the generation of GSH-Px and SOD. Similarly, Wang et al. found that antioxidant status greatly improved in broilers in an L-Se-Met-treated group, which was illuminated by the increased glutathione concentration in serum (Wang, Zhan et al. 2011). Furthermore, GSH-Px activity was higher in broilers supplemented with hydroponically produced Se-enriched kale sprouts than in those supplemented with Se from sodium selenite and Se-enriched yeast (Chantiratikul, Pakmaruek et al. 2015). The GSH-Px levels of weaned piglets in a 0.5 mg/kg nano-selenium group were significantly higher than those in the control group (Li, Zhang et al. 2017). Supplementation of Se can also improve serum antioxidative status in the blood of growing male goats (Shi, Xun et al. 2011). Administration of Se-polysaccharide at levels of 0.30, 0.45, and 0.60 mg/kg significantly increased activities of serum GSH-Px and SOD in weaning piglets (Liu, Pan et al. 2013). In a 0.3 mg/kg DL-selenomethionine group, the activities of GSH-Px and SOD in broiler serum increased significantly (Zhang, Zhan et al. 2010). The addition of 0.25 or 0.5 mg/kg Se yeast in the diet significantly improved layer serum GSH-Px activity ($P < 0.01$) and the trend of T-SOD activity (Gao, Huang et al. 2006). With a diet with 0.1–0.5 mg/kg Se (yeast Se), the activities of T-AOC, GSH-Px, T-SOD in the serum of geese were increased significantly in different feeding time, and the optimal supplemental level of Se was 0.3 mg/kg (Wang, Wang et al. 2009).

Dietary Se incorporates into selenoproteins that are important for immunity initiation and the synthesis of antioxidant enzymes (Huang, Rose et al. 2012). One study investigated the effects of sodium selenite on the mRNA expression of glutathione peroxidase 1, an important antioxidant enzyme (Ren, Chen et al. 2012). Ren et al. found that splenocytes without any stimulation start to synthesize the transcriptome of antioxidant enzymes in response to Se treatment. Similarly, we found in our study that Se addition alone causes immune

activation. Lysozyme participates in a variety of immune responses (Saurabh and Sahoo 2008). For example, it repairs and regenerates cells during the process of inflammation, and it has the vital function of maintaining physiological balance. In this study, SEP significantly increased the level of lysozyme in the serum, suggesting its higher activities of phagocytes. IgG, mainly involved in the humoral immune response, is one of the active constituents in mediating humoral immunity to resist infections, participating in the process of antineoplastic, resistant parasites, and some abnormal reaction (Vaezirad, Koene et al. 2018). In this experiment, SEP significantly increased the layer serum content of IgG, in line with observations of increased serum IgG in piglets after supplementation with 0.3 mg/kg of Se yeast (Xu, Wang et al. 2018). Furthermore, a high concentration of added selenomethionine can stimulate lymph cells to produce more immune globulin when the lymph cells are cultivated outside the body (Wu, Tang et al. 2015). Yoon found that 0.3 mg/kg yeast Se and sodium selenite can improve the content of serum IgG of newborn piglets (Yoon and McMillan 2006).

IL-2, one of the cellular immune responses, is an important immune regulatory factor for adjusting the growth, differentiation, and proliferation of cells and reduces viral or bacterial infection. SEP had the ability to significantly improve the level of serum IL-2 compared with that in the control group. Se supplementation with both sodium selenite and Se-enriched probiotics can significantly increase the serum IL-2 level of chickens (Pan, Zhao et al. 2011). Moreover, the serum concentrations of IL-2 also showed positive responses in chicken fed with Se-ECZ-EPS (Liu, Pan et al. 2013). Interferon- γ , produced by T-cells, has multiple effects in resisting tumors, bacteria, viruses, and parasites and plays an important role in helping mammals and birds fight pathogen infections (Harada, Taniguchi et al. 1998). We found that SEP positively stimulated IFN- γ levels in serum after the hens were fed for 35 days. This effect was similar to the generation of IFN- γ seen when human peripheral blood lymphocytes were cultivated with Se (Watson and Leonard 1986).

Conclusion

In this study, Se-enriched earthworm powder (SEP) was served as a feed additive to laying hens. The effects of SEP on nutrition metabolism, antioxidant activity, and immune response were investigated. Earthworm powder enriched with 1.0 mg/kg Se significantly increased the content of serum protein, albumin, and globulin and decreased the levels of serum glucose and triglycerides. Furthermore, SEP appeared to significantly increase the levels of GSH-Px, SOD, and catalase, decrease the level of nitric oxide, and enhance the immune response, including levels of IgG, IL-2, and IFN- γ . Table 4

Table 4. Effects of selenium-enriched earthworms power (SEP) on the immunity

Dietary treatments	Lysozyme/($\mu\text{g}\cdot\text{mL}^{-1}$)	Immunoglobulin G/ ($\mu\text{g}\cdot\text{mL}^{-1}$)	Interleukin-2/ ($\text{ng}\cdot\text{mL}^{-1}$)	Interferon- γ / ($\text{ng}\cdot\text{mL}^{-1}$)
T1	6.85 \pm 0.81 ^b	4.98 \pm 0.55 ^b	2.17 \pm 0.26 ^b	70.12 \pm 11.56 ^b
T2	7.37 \pm 0.86 ^{ab}	5.42 \pm 0.84 ^b	2.45 \pm 0.33 ^b	80.30 \pm 3.99 ^{ab}
T3	8.13 \pm 0.77 ^{ab}	7.18 \pm 0.95 ^a	3.20 \pm 0.31 ^a	99.08 \pm 8.10 ^a
T4	8.66 \pm 1.07 ^a	9.08 \pm 0.83 ^a	3.66 \pm 0.06 ^a	105.50 \pm 8.87 ^a

Note: T1=control group (basal diet); T2: control diet earthworm powder alone (no Se enrichment); T3: control diet plus 0.5 mg Se/kg from selenium-enriched earthworms powder (SEP); T4: control diet plus 1.0mg Se/kg from SEP, respectively

Note: References can be provided on request.

A beam of infrared light for the well-being of poultry

Benjamin Ruiz

We have published a news item about a study by Canadian researchers using a Mid Infrared Spectromicroscopy beamline from a high brightness infrared synchrotron light. This beamline takes advantage of its high brightness, millions of times greater than the sun, which provides a state-of-the-art spectrophotometer and microscope that supplies diffraction-limited spatial resolution.

It sounds like something of the sidereal space. But no, it is a reality with which these researchers – Andrew Olkowski and colleagues – try to understand why fast-growing broilers suffer from heart disease. With the help of this technology from the Canadian Light Source at the University of Saskatchewan, it was possible to identify misfolded and damaged protein aggregates that accumulate in the heart: an approach to a subtle problem of the heart muscle's own proteins, which is not so evident with other technologies.

Olkowski will continue to study poultry health and the

main causes of diseases, which could improve the health of millions of chickens. I wonder: Is this not animal welfare? Does this mean we do not worry that birds could be better and therefore the industry could be more efficient and provide more food readily available?



When I see the level of these and other research projects not only in avian health, but in genetics, equipment, facilities, nutrition, use of alternatives additives, precision poultry production, environmental sustainability, use and production of alternative energies, and so on, I get more surprised.

At the same time, however, I am more annoyed and frightened by the simplistic and mediocre criticism from

those who do not know poultry production. Everything is reduced to the "happiness of a hen." Can anyone tell me how can they evaluate this? Have they used a beamline from an infrared synchrotron millions of times brighter than the sun to find out if a chicken is happy?

Trace minerals could improve broiler breeder productivity

Elizabeth Doughman

There are many variables that contribute to broiler breeder flock performance. Trace mineral supplementation is one way to help improve broiler breeder weight gain, feed conversion egg shell and chick quality, hatchability, overall immunity and other productivity measures.

"Trace minerals are essential nutrients required in small daily amounts. They are vital in every aspect of life, deeply involved in many enzymatic reactions, acting as catalytic elements. They are a fundamental part of the formation, development and maintenance of organs and tissues in the body, such as skin, collagen, membranes, bones, etc. Among other functions, trace minerals play crucial roles in immune response, hemoglobin formation, the metabolism of glucose and thyroid hormones and as part of antioxidants and stress controllers," explained Dr. Leonardo Linares, Global RNS Species Leader – Poultry at Zinpro.

It's all about the egg

Egg quality can be one of the most important performance tools when it comes to broiler breeders. Shell breakage is the cause of 80-90% of downgraded eggs, so finding ways to improve shell quality is paramount.

What kind to use?

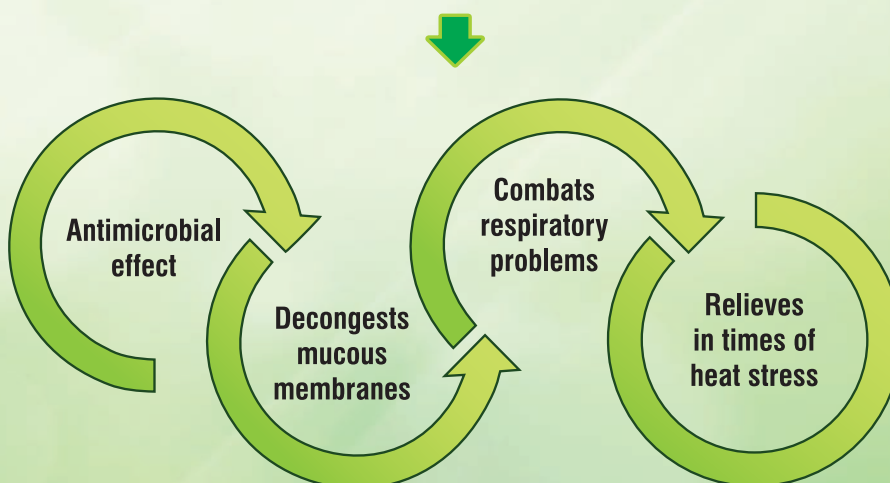
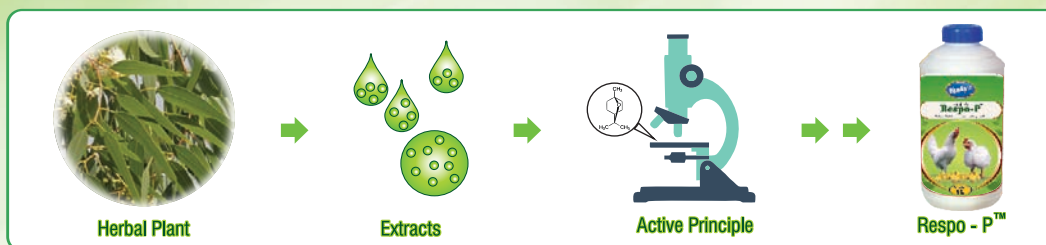
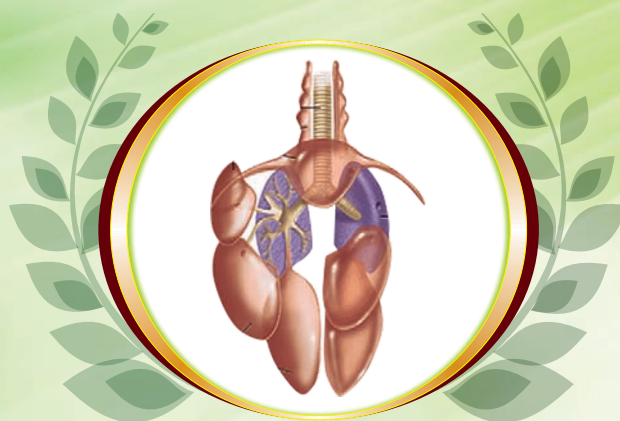
Organic minerals in a chelated form are typically preferable compared to their inorganic compound. They more closely resemble minerals found in nature, resulting in better bioavailability, stability and movement across the gut.

Each mineral offers something different to a layer's diet, so it's important to pick the one that's right for your farm. Selenium is used for cellular protection of the reproductive tract. Copper is used for eggshell development, pigment and collagen formation. Manganese is important for the eggshell membrane and helps with the formation of bone and the organic matrix of eggshells. Zinc can be used for bone and eggshell calcification, keratin shell membrane formation and eggshell carbonate production.

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