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Poultry Fortune

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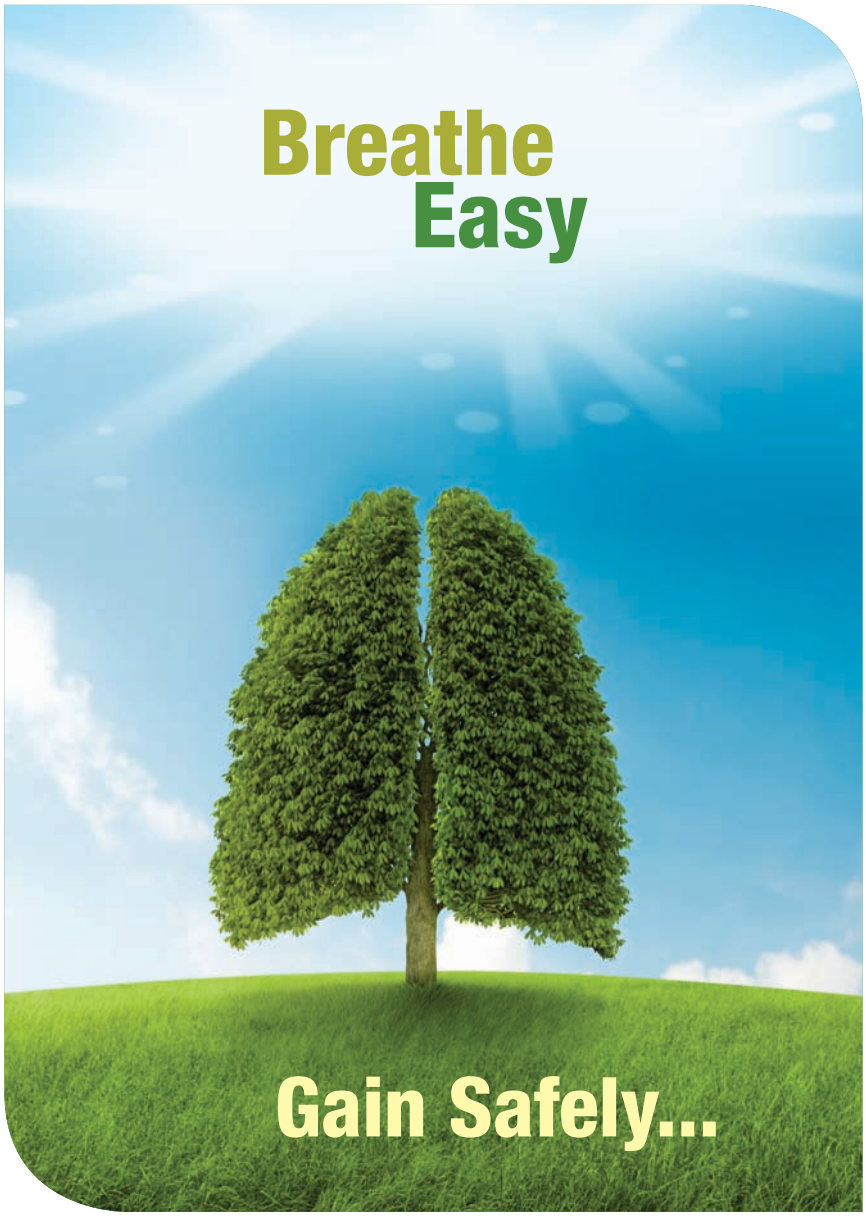

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Poultry Fortune

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M. A. Nazeer

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John L. Sebastian was a humble, kind and a dignified Statesman

I do not see any problem to Poultry as it produces nutritious food for people; Ensure to produce Antibiotic-free quality Eggs and Chicken Meat !

Dear Readers,

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

Even if Covid-19 pandemic continues, I do not see any problem to poultry sector as this industry produces nutritious food like eggs and chicken meat for the people, and the people all the time need these food products. Farmers, Hatcheries, Feed – Nutrition – Healthcare products producers, Processors, Equipment suppliers and Dealers should play their role properly and effectively, and ensure supply of quality inputs for the production of antibiotic-free healthy eggs and chicken meat. All these segments should work sincerely and do not give any chance to be pointed out at the quality of eggs and chicken products for the consumers. Besides, there is a need of timely supply of inputs for the farming with smooth transport system for the transport of eggs and chicken to the processing plants and to consumer centers as well as to the export zones.

Help the needy people at this critical period

If Covid pandemic scare continues like this, people will in near future may find it difficult to have sufficient meal, particularly the poor and lower middle class category. Let us all try to check and help the needy people as much as possible and see that no one is empty stomach and in hungry. If things continue the same way, number of people die due to hungry will be more than the pandemic.

The Prime Minister now left this issue to the State governments, and many of the state governments are not working with a commitment to check whether people are infected with Corona virus. If it is positive, it is the responsibility of the government to protect the health and safety of the people. It would be better that the concerned government team go door to door and test people for the virus, and help people if found positive with virus.

The Central and State Governments are not spending any money from their own pocket, it is the public money collected through taxes and contributions which they are spending. The Govt should be liberal in taking care of the needy people for food, healthcare, education, housing and other infrastructure facilities.

****

Tributes to John L. Sebastian

Mr John Leslie Sebastian, Promoter and Owner of Bangalore-based The India Poultry Farm passed away on 19 July 2020 at Bangalore due to old age. Mr J.L. Sebastian was born on 22 July 1933 in Sri Lanka (formerly Ceylon).

During his first visit to India in 1965-66, he met Mr General Nehra of Rani Shaver who was breeding and supplying Shaver stock in India and became a franchisee of Rani Shaver, Gurgaon, Haryana, and later became an associate of Kasila Farms Pvt Ltd, Hyderabad for Hubchix. Soon, he made Hubchix from The India Poultry Farm a house hold name with poultry farmers in South India.

Sebastian, with his keen interest in expansion of breeding activities pan India, floated IPF Breeders and entered in a bilateral technical tie up with Avian Farms Inc (Maine), USA.

Names of "Sebastian" and "The India Poultry Farm" were always associated with sound technical expertise, high product quality, ethical business practices and enviable reputation.

His humility was his best quality. Sebastian was down to earth and moved with all and treated one and all the same, very soft spoken and caring minded person.

Both his companies The India Poultry Farm and IPF Breeders were sold to Godrej Agrovet Ltd in May 1999. Since then Sebastian graciously retired from active poultry business.

Sebastian was a great leader and patient teacher, and his team never hesitated to give of their best to him. To him, his Company was his family and the staff were treated with respect, affection and generosity. He was very humble, kind and a dignified statesman.

The way a group of people lead by Dr S. P. Ganpule responded sincerely on my telecon for information about Mr Sebastian on knowing his demise on Sunday, July 19, it showed Sebastian's goodness and credibility with the people, and people's love and respect for Sebastian.

One has to live like that, and people will remember such great personalities forever.

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 India Poultry Farm promoter

John L. Sebastian Passes Away

Bangalore: Mr John Leslie Sebastian, Promoter and Owner of The India Poultry Farm passed away on 19 July 2020 at 12:45 hrs at St John's Hospital, Bangalore due to old age.

Mr J. L. Sebastian was survived by his wife Thangamma Sebastian, daughter Geramin Sebastian (La Brie), son in law David La Brie, sisters Kamala Johnny and Dr Prema Sebastian, grand children Roshini Neduvelil and Deepak Neduvelil.

When and where was he born ?

Mr J.L. Sebastian was born on 22 July 1933 in Sri Lanka (formerly Ceylon) where his father was a Teacher (English language) at Mannar. He was educated in Sri Lanka and obtained his graduation, B.Sc, in Agriculture from College of Agriculture, University of Peradeniya, Kandy, Sri Lanka.

He worked in National Livestock Development Board (NLDB) as Poultry Development Commissioner, Sri Lanka. He was deputed to USA for further studies in Poultry Husbandry and sexing day old chicks. On his return he worked relentlessly till Sri Lanka was self sufficient in Egg production.

John L. Sebastian with his wife Thangamma Sebastian

John L. Sebastian
1933 – 2020

How he took up poultry activity with Rani Shaver in India ?

He first visited India in 1965-66 and met Mr General Nehra of Rani Shaver who was breeding and supplying Shaver stock in India. He then decided to retire from his government service and shifted to Bangalore. He established a modern breeding farm and hatchery at Mundur village near Bangalore in the name and style of "The India Poultry Farm (IPF)" in partnership with his close friend Mr T Manavalan, who conceived the whole idea of starting a poultry venture in India. IPF was one of the earliest commercial hatcheries in India.

On 5 May 1966 he started his activities as a Franchisee of Rani Shaver, Gurgaon, Haryana.

He successfully continued with Shaver Layer and Broiler activities till 1985 - 1986.

Expanded with Hubchix of Kasila Farms

In 1985 he left Rani Shaver and became a franchisee of Kasila Farms Pvt Ltd, Hyderabad of Mr Shaik Imam. Soon, Hubchix from The India Poultry Farm became a house hold name with poultry farmers in South India. He established a largest broiler breeding operations in South India with several breeding farms

Obituary Messages

Sebastian, a reformist in poultry

"It is with great sorrow that I received the news of Mr John L. Sebastian's sudden demise. We lost one more valuable soul at these unprecedented times. He was a leader of wonderful presence and aura and a reformist in the industry. His thoughts and landmark reforms lead to the various growths in India's poultry farming. We were all his beneficiaries of his enthusiasm, thoughts, kindness and energy which were contagious. Mr Sebastian always strove to do his very best, to live the life fullest and appreciated the richness of human experience. We mourn his untimely death, but he will be always remembered and celebrate the way he lived his life.

There are no words to express my heartfelt sympathy to Mrs Sebastian and the family members.

With Love & Respect"
– B. Soundararajan, Chairman, Suguna Group, Coimbatore.

We missed a great person

"KPFBA expresses its sincerest sympathy and condolences on the sad demise of Mr John L. Sebastian, Owner of The India Poultry Farm. It is an honour to have known such a great person and we will truly miss him. His sudden departure saddens all of us in the entire poultry fraternity"

– Members, Management and Staff, Karnataka Poultry farmers & Breeders Association, Karnataka.

John L. Sebastian in 1990s

and satellite hatcheries from Trivandrum to Hyderabad marketing about 1.9 million (19 lakhs) commercial day old chicks per month in 1993 – 1994, which was very big figure those days.

Grand Parents operator

Mr Sebastian, with his keen interest in expansion of breeding activities pan India, floated IPF BREEDERS and entered in a bilateral technical tie up between

Poultry Fortune Editor M. A. Nazeer (extreme left) with John L. Sebastian (extreme right) and Suthep, the then Vice President of Avian Farms Inc. when Sebastian launched Grand parents in operations in 1994 at Bangalore.

The IPF Breeders Bangalore and Avian Farms INC (Maine), USA.

First batch of Avian 34 GPs (Broiler) arrived in India on 26 July 1994. Several batches of GPs were imported and this tie up continued till 2003. Hatcheries and breeding farms were expanded during this period with emphasis on sound management practices, one age group facilities, strong biosecurity back up, hygiene, high quality inputs and modern equipments like Petersime (Belgium) hatchery machines. This ensured consistently high quality products – hatching eggs and day old chicks - the main stay of any poultry production business.

Sebastian's contribution to Indian poultry

Names of Sebastian and The India Poultry Farm (IPF) are always associated with sound technical expertise, high product quality, ethical business practices and enviable reputation.

He played a major role in providing direct and indirect employment to thousands of people in and around Bangalore which included huge number of poultry farmers joining hands with him in growing poultry and earned their livelihood.

His humility was his best

May his soul Rest in Peace

"It's really sad that we lost one of our own to COVID 19. May his soul rest in peace. Our heartfelt condolences to his family and the team. As an author said, "Some people come into our lives, leave footprints on our hearts, and we are never the same"

– Suresh Rayudu Chitturi,
Chairman, IEC & Managing Director,
Srinivasa Farms Pvt Ltd, Hyderabad.

He was punctual, organised & disciplined

"I know him as uncle Sebastian. Contemporary of our father, who with many others in 1960s built Indian poultry industry. Uncle was punctual, organised and disciplined. He never looked at others as a competitor, but looked at them as a colleague and as a part of poultry fraternity. He was very humble, kind and a dignified statesman. Sad to loose another poultry uncle of ours"

– Naveen K. Pasuparthy,
Director, Nanda Group, Bangalore.

John Leslie Sebastian
A Tribute to a Great Man

"Many centuries ago, the British invented a word which, when used by a Britisher, confers high praise and respect. The Indian Armed Forces use the word to describe the best qualities in their Officers. Yes, you guessed it - the word is "Gentleman". If I had to describe John Leslie Sebastian in one sentence, it would be, "He was a true Gentleman."

I came into the poultry industry in 1980 and it was not long before I met Leslie Sebastian, who headed his own company, The India Poultry Farm and later, IPF Breeders Pvt. Ltd. He was soft spoken and gentle, but I was immediately struck by the respect he commanded in any group or company. I soon realized that under the gentle and smooth velvet glove was an iron fist. He would never compromise in matters of ethics and doing what he felt was right, even at a high cost to himself. He was scrupulously honest and got upset with unfairness and injustice in any form.

Sebastian possessed deep wisdom, not only about his industry but about life and how it should be lived. He was a great leader and patient teacher, and his team would not hesitate to give of their best to him. To him, his Company was his family and the staff were treated with respect, affection and generosity.

Sebastian also had a great sense of humour, something that was very essential in a roller-coaster industry like Poultry where you could be on top of the world one day, and then down in the dumps the next. Sebastian had a blackboard in his office on which every morning he would put down a Thought for the Day - something wise, clever, humorous, or just plain common sense. I remember his message one day when the industry was going through a bad patch and everyone was looking for inspiration on how to plan for the future. He wrote, "Poultry forecasting is the ability to say what will happen tomorrow, next month and next year, and then, the ability to explain why it did not happen!"

I knew and respected Leslie Sebastian from 1980, joined the IPF Group in 1995, and spent five wonderful years with the Company. I was shocked, and really distressed to hear of his passing. To me, John Leslie Sebastian was not only a great boss but a well loved friend, and a true Gentleman. I will miss him deeply but am comforted in the thought that this world's loss is Heaven's gain"

– Keith J. Rosario, Bangalore.

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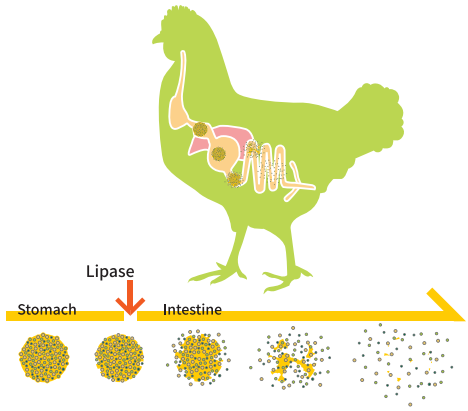

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quality. He was down to earth and moved with all and treated one and all the same, very soft spoken and caring minded person.

His contribution to the progress and success of poultry industry in India has been widely recognised and appreciated.

He began his career in poultry farming in Sri Lanka and made Sri Lanka self sufficient in poultry products, particularly eggs.

Sebastian was one of the oldest poultry entrepreneurs and leading personalities in Indian poultry industry. He carried with him an awesome experience, spanning decades, across several countries. Under his stewardship, IPF has grown into the largest broiler breeding organisation in southern India.

Mr Sebastian's keen sense of foresight and vision backed by sound technical expertise made him to venture into Grand Parent operations for the AVIAN – 34 in technical collaboration with Avian Farms Inc., USA in 1994.

During this period, he interacted with leading poultry experts in different countries on various aspects of poultry farming.

Mr Sebastian started the deep liter system of poultry farming way back in 1952.

He was the author of numerous articles and literature that provided valuable insight into poultry farming.

How he retired from poultry ?

The India Poultry Farm and IPF Breeders were officially sold to Godrej Agrovet Ltd (GAVL) in May 1999. Since then Mr Sebastian has graciously retired from active poultry business.

Courtesy and Source of information:

Dr S. P. Ganpule,
M.V.Sc, Ph. D, Post Doct INRA (France),
Chief Geneticist and General Manager (Production),
The India Poultry Farm,
Bangalore, India.
IPF Breeders, Bangalore, India.
Godrej Agrovet Ltd, Bangalore, India.
(from 1987 - 2003).
Poultry Fortune also thank Dr Umesh Devurkar, K.C. Koshy and Dr G. Gopal Reddy for their cooperation in getting information.

Karnataka Goats swabbed isolated after goatherd tests +ve

Karnataka, 1 July: Forty-seven goats were quarantined on 30 June 2020 after a goatherd tested positive for coronavirus in Godekere village in Tumakuru district, about 127km from Bengaluru. Sources said the village in Chikkanayakanahalli taluk has around 300 houses and a population of 1,000. Two villagers, including the goatherd, tested positive recently. Following this, four goats of the goat-rearer died, causing alarm in the village.

District health and veterinary officials visited the village on 30 June and collected swab samples of the goats before putting the livestock in quarantine outside the village. The team faced huge resistance from the villagers, who suspected they had arrived to cull the goats. The officials convinced them that there is risk of the livestock getting infected by coronavirus and have to be tested.

Swab samples sent to institute

P Manivannan, secretary of animal husbandry department, said they will look into the matter and postmortem will be conducted on the dead goats. The swab samples were sent to Institute of Animal Health and Veterinary Biologicals in Bengaluru.

Dr S.M. Byregowda, director of IAHVB, said there is no record yet of Covid-19 spreading from humans to animals. Anyhow, we are sending the samples to Bhopal for Covid tests as the kits are not available with us. Dr B.L. Chidananda, professor at UAS, GKVK said zoonotic viruses, such as novel coronavirus, generally spread from animals to humans. Agency reports quoted veterinary experts as saying the animals are suffering from Peste des petits ruminants, and mycoplasma infection, which require quarantine.

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Govt approves Rs 15,000 cr Animal Husbandry Infra Development Fund

New Delhi, Jun 24: The government on 24 June announced a Rs 15,000 crore infrastructure development fund with an interest subsidy scheme to promote investment by private players and MSMEs in dairy, meat processing and animal feed plants, a move which is expected to create 35 lakh jobs.

The fund is part of the Rs 20 lakh crore stimulus package announced in May to help people affected by the lockdown to prevent the spread of COVID-19.

An interest subvention of 3 - 4 per cent will be provided to farmer producer organisations, MSMEs and private players for setting up of dairy, meat processing and animal feed plants, an official release said.

The Animal Husbandry Infrastructure Development Fund (AHIDF) was approved in the Cabinet meeting, chaired by Prime Minister Narendra Modi.

Briefing about the Cabinet decisions, Information and Broadcasting Minister Prakash Javadekar said: "A Rs 15,000 crore fund has been approved by the Cabinet that will be open to all and will help in increasing milk production, boost exports and create 35 lakh jobs in the country."

Animal Husbandry Minister Giriraj Singh said the government had earlier approved the Dairy Infrastructure Development Fund (DIDF) worth Rs 10,000 crore for incentivizing investment by the cooperative sector for development of dairy infrastructure.

"However, the MSMEs

and private companies also need to be promoted and incentivized for their participation in processing and value addition infrastructure in the animal husbandry sector," he said.

The AHIDF would promote infrastructure investments in dairy, meat processing and animal feed plants. Farmer producer organizations (FPOs), MSMEs, Section 8 companies, private companies and individual entrepreneurs would be eligible to benefit from the fund, he added.

The minister said the beneficiaries will have to contribute 10 per cent margin towards the proposed infra project and the rest 90 per cent would be a loan component to be made available to them by scheduled banks.

"For the first time, we will give interest subvention up to 3 per cent to private players for setting up of processing infrastructure for dairy, poultry and meat," he added.

In an official statement, the government said that 3 per cent interest subvention will be given to eligible beneficiaries from non-aspirational districts. About 4 per cent interest subvention would be given to beneficiaries from aspirational districts.

Aspirational districts are those that are affected by poor socio-economic indicators. There are about 115 such districts in the country.

The government said that there will be a two-year moratorium period for repayment of loans with six years repayment period thereafter.

Besides, the Centre would also set up a Credit Guarantee Fund of Rs 750 crore to be managed by National Bank for Agriculture and Rural Development (NABARD) which would provide credit guarantee to the projects which are covered under the MSME defined ceilings. The guarantee coverage would be upto 25 per cent of the credit facility of the borrower, it added.

Highlighting the benefits of the new infra fund, the government said there is huge potential waiting to be unlocked through private sector investment in the animal husbandry sector.

"The AHIDF with the interest subvention scheme for private investors will ensure availability of capital to meet upfront investment required for these projects and also help enhance overall returns/ pay back for investors," it said.

Such investments in processing and value addition infrastructure by eligible beneficiaries would also promote exports. Since almost 50-60 per cent of the final value of dairy output in India flows back to farmers, the growth in this sector can have a significant direct impact on farmer's income, it said.

Size of the dairy market and farmers' realization from milk sales is closely linked with development of organized off-take by cooperative and private dairies.

Thus, investment of Rs 15,000 crore through AHIDF would not only leverage several times more private investment but would also motivate farmers to invest more on inputs thereby driving higher productivity leading to increase in farmers income, it added.

Avitech Nutrition launches PERFORMINS – organic mineral glycinates

Avitech Nutrition has recently launched Performins–Avitech's brand of Organic trace mineral glycinates.

Avitech Nutrition has been producing inorganic trace minerals since 2002 and the latest offering of Performins is part of it's commitment to provide the animal feed industry a comprehensive solution in the field of trace minerals.

Performins comes with a distinct 4S advantage of Size, Specificity, Solubility and Stability and is designed for enhanced bio-availability, absorption, and animal performance. Performins has been launched in 4 variants - Performins Broiler, Performins Layer, Performins Breeder and Performins Dairy. It is available in 25 Kg HDPE bag.

Performins represents the optimum solution amongst various organic trace minerals available in the market today.

The Man Behind India's First COVID-19 Vaccine is a Tamil Farmer's Son

India has made its first COVID-19 vaccine.

Dr Krishna Ella who helped in creating the Covid-19 vaccine

Hyderabad: The developers of the drug, the Hyderabad-based firm Bharat Biotech in collaboration with India's National Institute of Virology and Indian Council of Medical Research, have received approval from the drug control authorities to conduct human clinical trials of the vaccine christened 'COVAXIN'.

This is the same firm that created the world's cheapest Hepatitis vaccine and was the first in the world to find a vaccine for the Zika virus.

Dr Krishna Ella was born to a middle-class family of farmers hailing from Thiruthani, Tamil Nadu. He first set out into the world of biotechnology through agriculture.

In an interview with Rediff, Krishna, who is currently the Chairman and Managing Director of Bharat Biotech International Ltd. (Bharat Biotech) said, "My initial plan was to keep farming after studying agriculture, but due to economic pressure, I joined Bayer, a chemicals and pharmaceuticals company as part of their agricultural division. This was the time that I got a scholarship from the Rotary's Freedom from Hunger Fellowship and went to study in the United States."

After completing his Master's at the University of Hawaii and his PhD at the University of Wisconsin-Madison, Krishna returned to India in 1995.

In the same interview, Krishna points out, "I did not have any intention to return to India. It was my mother who asked me to return and pursue whatever I wanted. So I came back to India with a business plan to create a cheaper hepatitis vaccine as there was a heavy demand for it in India."

Krishna set up a small lab in Hyderabad with the medical equipment he had and that was the beginning of Bharat Biotech. The company submitted a project proposal for Rs 12.5 crore with the hepatitis vaccine rate at 1 dollar while the contemporaries were priced at 35 and 40 dollars.

"We didn't get the funding we expected so finally we turned to IDBI bank who funded us with Rs 2 crores," he explains. In just four years time, the vaccine was launched in 1999, by then President Dr A. P.J. Abdul Kalam.

The company supplied 35 million doses for the National Immunisation Programme at a price of Rs 10 per dose and has supplied 350-400 million doses in total to more than 65 countries.

Covaxin

Genome Valley – Giving the Medical World India's First COVID-19 Vaccine

In 1996, Krishna Ella had put forth an idea to the then Andhra Pradesh Chief Minister, Chandrababu Naidu to set up a biotech knowledge park devoid of polluting industries. Soon, he received approval and land from the Andhra Pradesh Industrial Infrastructure Corporation to create the knowledge park — Genome Valley.

The first industry to be set up at the Park was Bharat Biotech's Hepatitis vaccine plant, followed by the ICICI Knowledge Park. Today it is home to more than 100 knowledge-based industries with multinationals like Novartis India Limited, Bayer Biosciences to the Indian Giant ITC.

"Genome Valley has become very important as far as biotech parks are concerned in India. It has catalysed the very idea of such parks which are now seen in Bengaluru and Pune," he explains.

"But the first, second and third positions in knowledge-based industries

THE ORIGINAL ALPHA D3

1980s
Research at University of Georgia

1989
Patent granted for the Alpha D3 metabolite

2010
Alura launches Alpha D3 in poultry

2010
Alura bring Alpha D3 to India

1α OH-D3

AlphaD3™
Vitamin

Revolutionising poultry performance since 1989

Ever since 1989, the miracle metabolite Alpha D3 has been a catalyst in helping the poultry industry attain sustainable higher production performance rates with increased profitability. Alura is the only company to have brought the original and patented vitamin Alpha D3 to market.

WHAT MAKES ALURA ALPHA D3 UNIQUE?

- Increased bioactivity in comparison to regular Vitamin D3 and other metabolites
- Improve body weight gain and FCR
- Prevents black bone syndrome
- Improves egg shell quality and maximises production of saleable eggs
- Synergetic and Complementary effects with Phytase
- Proven ROI in Broilers & Layers
- Thermostable for palletisation
- Extensively studied product dosage rates for optimum performance.

USAGE

LAYER | BROILER | BREEDER

THE ORIGINAL VITAMIN ALPHA D3 SINCE 1989

EXTENSIVELY TESTED & VALIDATED

We are the only company to have extensively tested the efficacy of this metabolite through academic papers, clinical trials, and field tests. More than 40 published reviews in scientific journals proves Vitamin Alpha D3 produces more chicken protein, with a better quality at a lower cost.

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sapience

Dr Krishna Ella with PM Modi and Dr Harshavardan

are given to the United States mainly because

public problems are not given due importance in the academic research done in India. This is an area that we must focus on," he adds.

Bharat Biotech has now become the first company to manufacture a preservative-free vaccine (Revac-B mcf Hepatitis B Vaccine), launch India's first cell-cultured swine-flu vaccine, manufacture the world's cheapest Hepatitis vaccine and was the first in the world to find a vaccine for the Zika virus. The company has also in total supplied 3 billion doses of vaccines globally.

Dr Ella has been awarded more than 100 National and International awards which include Bio Spectrum Person of the Year in 2013, University of Wisconsin Distinguished Alumni Award (2011), Business Leader of the Year 2011, Best Technology and Innovation Award from the Prime Minister of India in 2008.

"When the company makes vaccines affordable to the common man we often get accused of creating something of low quality but we make vaccines believe that technology should reach the common man and no citizen should be deprived of healthcare solutions. This is the same reason why my company has been able to produce several vaccines at an affordable rate," he explains.

While the world searches for an answer for the COVID-19 conundrum, we take pride that Bharat Biotech has come out with a vaccine. We hope the efforts of all the scientists will be instrumental in putting an end to the pandemic.

Dear Stakeholders in Poultry,

As COVID-19 pandemic crisis are continuing all over, we are waiting for the situation to come to normalcy, so that we can announce dates for India International Poultry Expo (IIPE) to be held in Mumbai, India.

Over viewing the current situation with deep concern on the health of the exhibitors, delegates and visitors, we are not convinced that organizing the event during this period will bring suitable results to our exhibitors and the delegates if the pandemic fear continues. Our primary objective remains to deliver a successful market place and to become the gateway for the exhibitors to explore Indian poultry market.

If things are clear and favourable for the event, we are planning to organise IIPE in Mumbai in January 2021.

Wish you good health and prospects in your business activity.

Best Regards,

M. A. Nazeer
Chief Executive – IIPE
Editor & Publisher - Poultry Fortune

I P Marketing Services ban China products

I P Marketing Services, a partnership firm and production hand of Volschendorf has always been a trusted name for its customers in Indian poultry industry.

With the current ongoing crisis with the China, we at I P Marketing Services has decided to stand strong with our country and try to do the best at our level as Indian citizens.

In a move towards the anti China products we assure all our associate customers and industry mates that we have BANNED CHINA RAW MATERIALS and stopped using them in our finished goods and strict measures have been taken to follow it. The purchase and production department has also been informed to check the manufacturing country before buying any raw material.

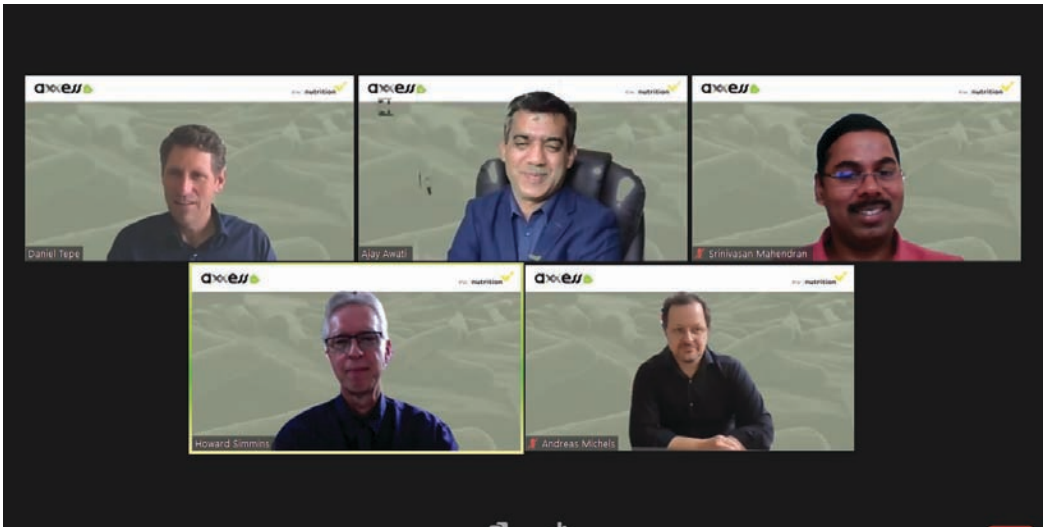
We now proudly announce that we are with our Indian government in its mission "MAKE IN INDIA" and also extend our gratitude toward our country by further extending the mission "PURELY MADE IN INDIA".

I P Marketing Services is engaged into the business of manufacture and marketing of poultry feed additives and supplements for Indian poultry industry and also for supply to certain Asian and European countries.

I P Marketing Services has involved in identifying quality conscious, genuine and reliable raw material suppliers. Initially started with only one product, the company has now more than 30 products in its portfolio. The company is now a proud manufacturer of many poultry feed additives and supplements like cocktail enzymes, toxin binders, pellet binders emulsifiers etc.

I P Marketing Services has also received ISO 22000:2005, ISO 9001:2015 and FAMIqs certifications. FAMIqs has made IPMS a more reliable and quality partner for many industry mates and also to many others who wants to get associated nationally. I P marketing Services is now one of the most trustworthy suppliers of poultry feed additives and supplements nationally and globally, informed Dr Onkar Pawaskar and Dr Mangesh Sagar through a note.

EW Nutrition Launches revolutionary Axxess XY through digital platform



On 7th July 2020, EW Nutrition officially launched Axxess XY, a novel, intrinsically thermostable enzyme that delivers top performance to feed producers and the livestock industry. The revolutionary product was launched at an online customer-centric event organized for South Asian Region.

In its effort to improve animal gut health, control toxin risk, and reduce antibiotic use, EW Nutrition has long supported the South Asian livestock industry with its holistic, science-backed solutions. The company has now introduced a revolutionary solution to improve feed cost savings to the customers. This enzyme comes with the highest level of intrinsic thermostability and is active against both soluble and insoluble arabinoxylans. The top benefit of Axxess XY is an unparalleled flexibility in feed formulation, resulting in significant feed cost savings.

The mechanisms and derived profits of the new product were discussed during the e-launch of Axxess XY. The key speaker was Dr Howard Simmins, Independent KOL, InSci Associates Ltd, a leading world-renowned authority on enzymes. Dr Simmins is an accomplished global communicator and his expertise is focused on feed additives development for animal nutrition and health. Dr Simmins highlighted the limitations of previous generation carbohydrase enzymes and also guided audience on how to optimize use of xylanases to get maximum benefits.

Daniel Tepe, Managing Director, EW Nutrition shared the vision and mission of organization and reinforced the modus operandi of EWN operation as Partner in Progress with the customers.

Dr Andreus Michels, Head of Biotechnology, EW Nutrition highlighted the strength of its research and development facilities in various global research centers. EWN invests the highest percentage of its revenue on innovation in the feed industry. He highlighted the fact that EWN enzyme development laboratory is the only fully equipped laboratory dedicated exclusively to animal health industry.

Dr Ajay Awati, Global Category Manager, Enzymes, highlighted the need for such a revolutionary solution in serving animal feed industry. He further described Axxess XY'sunique value proposition along with the origin of molecule, structure of novel molecule and functionality that sets it apart from currently available xylanases in the market.

Dr S. Mahendran, Regional Technical Manager, South Asia threw light on feed formulation optimization and explained how the addition of Axxess XY can help release additional energy from feed, which results in optimum performance and production.

The unparalleled thermostability of Axxess XY became a talking point among the audience and various integrators showed their interest in using the new enzyme in their formulations. Also, EW Nutrition's efforts to bring everyone together on a knowledge-sharing platform was highly applauded by the attendees. Industry partners also iterated the need for more detailed sessions in future.

The e-launch program was a great opportunity to reach to a wider array of breeders, broiler integrators and consultants across South Asia. Major key stakeholders – technical consultants, university professors, farm managers, integrators etc. – attended the e-launch and benefitted from the information provided during the event.

"We are pleased to bring our revolutionary enzyme solution to our South Asian partners, thus enriching our portfolio of products and services to the benefit of the local livestock industry," says Michael Gerrits, Managing Director, EW Nutrition. "We are confident that Axxess XY will be a break through for our customers, and we look forward to providing and servicing our comprehensive animal nutrition solutions in South Asia, a most valuable and respected market."

A Surgical Strike on Bacteria

eXolution Bacterphage F

For millions of years, bacteriophages have been hunting down and killing bacteria. **eXolution Bacterphage F** uses a cocktail of these ancient killers to purge disease-causing bacteria in a formulation created specifically for use in poultry.

Each bacteriophage is a virus that has evolved to target and eliminate only a specific bacteria; leaving other beneficial bacteria completely unharmed.

This natural surgical strike on disease-causing bacteria is the safest, non-toxic, and **effective prophylactic alternative to antibiotic growth promoters.**

FOR USE IN BROILERS, LAYERS & BREEDERS

BENEFITS TO THE FLOCK

Natural:
No Toxins, No Residues, No Side-effects, No Withdrawal Time

Surgical:
Targets and eliminates specific bacteria, even those resistant to antibiotics

Protective:
Maintains gut bio-balance by retaining beneficial bacteria

Probiotic:
Enriched with Bacillus Subtillis

Flexible:
Compatible with all Performance Enhancers, Growth Promoters, Acidifiers, Anti-Oxidants, Minerals & Enzymes

Stable:
Thermostable and suitable for Pelleting

BACTERIA IT CONTROLS

Salmonella
Typhimurium, Gallinarum, Choleraesuis, Derby, Dublin, Enteritidis, Pullorum

E. Coli
F4 (K88), F5 (K99) , F6 (987P), F18, F41

Clostridium Perfringens
Type A, C, B, D, E

Staphylococcus Aureus

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Novus: We Strive to be the Industry's Gut Health Leader

International feed additive company announces new structure, plans in animal agriculture industry

SAINT CHARLES, MO (10 July 2020) – When Dan Meagher returned to Novus International, Inc. to become CEO and president last year, he said it was the people that brought him back to the company after a six-year hiatus. Now he's putting his trust in the hands of his employees.

"Since my return to Novus in October I've been evaluating what the company needs to do to become the gut health leader I know that it can be," Meagher said.

This evaluation led to implementing a new corporate structure and establishing a regional operating model that aims to create a lean and agile company with decision-making closer to the customer. These changes are part of a multi-phase strategic plan called "Project Destiny."

Meagher also announced his new Executive Leadership Team to lead the company in its pursuit to become "a leader in gut health solutions for the sustainable production of protein through nutrition." Meagher said that in assembling the new structure and the leadership team, Novus remains resolute in its vision: "To help feed the world wholesome, affordable food and improve the quality of life."

Meagher said that by implementing the changes outlined in Project Destiny, the company will reduce complexity, simplify processes, as well as provide higher autonomy and accountability.

"We have a team of highly motivated and intelligent agriculture professionals working for us around the world," Meagher said. "The Executive Leadership Team's goal is to give them the tools and the support that they need so they can make a difference with our customers. Under this new structure we are demonstrating the respect and trust that we have in our people."

He said that one example of this is in Novus's research and development department.

"We have a fantastic team of innovative scientists, researchers, and research partners, and we have a powerful foundation in the HMTBa molecule. All of this puts Novus in a position to develop new technologies and expand on our current solutions."

Methionine hydroxy analogue, or HMTBa [2-hydroxy 4-(methylthio) butanoic acid], is a form of methionine, an essential amino acid and necessary nutrient in commercial animal agriculture. Along with its methionine products, the versatility of the HMTBa molecule has allowed Novus to create a line of organic trace minerals, nutritional feed acids, and other solutions that positively affect animal's gut health and ultimately impact growth and development.

Novus is already well recognized for its organic trace minerals solutions and expertise and Meagher wants the company to also be the industry's go-to for gut health products and services.

"What happens in an animal's gut affects every part of its development," he said. "An animal with a healthy gut requires less intervention. A healthy gut ultimately helps an animal meet its growth potential in a sustainable way, which is what all of our customers want."

Meagher and his team will continue to implement the new strategic direction over the coming months.

"Through these changes we are improving our business and expanding our ability to serve our customers effectively and efficiently," Meagher said. "As a part of the animal agriculture industry, we have a commitment to help feed the world and these changes allow us to better fulfill that commitment."

Novus International develops, manufactures and commercialized health and nutrition solutions for the animal agriculture industry globally. Headquartered in Saint Charles, Missouri, U.S., the company is privately owned by Mitsui & Co. (U.S.A.), Inc. and Nippon Soda Co., Ltd. Learn more about Novus at www.novusint.com.

The new Executive Leadership Team is:

Dan Meagher
PRESIDENT & CEO
(EFFECTIVE APRIL 1, 2020)

David Dowell
EXECUTIVE VICE PRESIDENT AND CHIEF OPERATING OFFICER

Maria Burt
VICE PRESIDENT AND CHIEF HUMAN RESOURCES OFFICER

Randy Khalaf
EXECUTIVE VICE PRESIDENT AND CHIEF FINANCIAL OFFICER

Carla Martin
VICE PRESIDENT, GENERAL COUNSEL AND CHIEF COMPLIANCE OFFICER

Ed Galo
VICE PRESIDENT, CHIEF COMMERCIAL OFFICER - AMERICAS

Vaibhav Nagpal
VICE PRESIDENT, CHIEF COMMERCIAL OFFICER - ASIA

Uwe Ranft
VICE PRESIDENT, CHIEF COMMERCIAL OFFICER - EMEA

COVID-19 on Indian Poultry Industry – A Worst Hit ?

Rumors & conjecture on India's social media associated with novel Corona virus hit consumption of poultry meat & eggs, resulting in a price crash. This false rumor has slashed Indian Poultry industry sales by almost 50% and the losses were pegged at INR 22,000 – 25,000 Crore. AIPBA has urged Central Government to seek support to prevent upheaval.

The novel Corona virus has had a prodigious bump on all walks of life to businesses. As the COVID-19 pandemic continues to spread its wrath globally, with no signs yet of slowing down, the poultry sector in India is one amongst the many being severely hit.

Rumors and fake news associated with novel Corona virus hit consumption of poultry meat and eggs, resulting in a price crash. A lot of misleading posts on social media from mid¬ January have created a false impression that human can contract Corona virus by consuming chicken. This false rumor has slashed Indian poultry sales by almost 50%. Indian Poultry industry suffered heavily as a consequence of false rumors and subsequently due to problems in supply chain during the period of lockdown. Total loss to the Indian Poultry industry was pegged at INR 22,000-25,000 crore.

Poultry sector in India contributes INR l.3 Lakh crore to the country's GDP and considered as most organized sector among all livestock and agriculture sectors in India. Before COVID- 19, Indian poultry industry was doing well and producing about l .25 Lakh Crore value of products per year with a production of about 27-28 crores eggs a day and 40 crore broiler chicks per month.

Owing to rumors & lockdown, farm-gate prices were ruling at 15-35 per kg of live bird in various regions against the production cost of 80-85 per kg and the price of egg dropped from INR 4 to INR l .5-2 per egg. A knock-on fall in prices has hurt poultry farmers and as a result, they had to start cutting down on the production to trim losses. With such a present scenario, there could be around 20-25% reduction in total placement or availability of the birds or eggs for the entire year.

The overall impact on the poultry sector had spillover effects on allied sectors such as feed manufacturers, medicines and vaccine manufacturers, equipment providers, agricultural crops, logistics & exports, which show widespread economic implications of this crisis.

In view to curb crisis in the Poultry sector, vigorous campaigns were started to stop misleading information, creating consumer awareness, improving chicken meat consumption to restore gaining the consumer confidence. Also, the All India Poultry Breeders Association (AIPBA) has submitted a memorandum to Central Government, on March 30, seeking "urgent financial assistance and rescue package" for the industry. The association has requested a restructuring of loans, allowing conversion of existing working capita l loans cash credit (CC) limits to term loans with two years moratorium. The association has also mentioned that all small poultry farmers with less than 20,000 capacity farms should be provided with a compensation of INR lo0 per bird based on their chicks' purchase bill paid through banking transactions. It further sought exemption of GST on soya seed and soya meal, which has added to the input cost on poultry feed to the farmers. Looking at today's circumstances, now the consumer fear on linking chicken with corona is on much lower side. Poultry players are still waiting for the response from government.

The situation of poultry sector is now getting normal, the rates are better, demand is coming and in all probability the recovery is going to be on the positive side.

Covid-19 has caused disruption in market in terms of supply, demand, production or logistics; however, the biggest disruption is on consumer behavior. The ongoing lockdown to combat COVID-19 has altered consumers' purchase decisions -higher spends on health and hygiene products, adapting to limited product availability, and preferring home deliveries over store visits. In terms of industry dynamics, the Indian poultry market is predominantly of fresh meat and processed meat accounts for just 5 to lo percent depending on the geography. With social distancing becoming a norm, the need for hygienically packed meat untouched by hand will increase. Thus, the COVID-19 outbreak could trigger the growth of the processed meat segment both from the demand and supply per se. Going forward, industry's transition to a chilled or frozen market would be crucial for increasing value addition as well as international trade.

– Courtesy Vamso Biotech Pvt Ltd.

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How to install poultry processing plants in Covid-19 times ?

Boxmeer, 23 July, 2020: ***Marel's remote teamwork connects on-site engineers and experts on either side of the world***

More than ever, poultry processors around the world have to guarantee their production or even increase it to keep the entire food supply system operating. In many cases, processors had already planned an expansion or start-up long before Covid-19 struck. However, such projects usually need the involvement of International Marel engineers on-site, which was impossible in times of closed borders and travel restrictions. Via remote support, Marel succeeded in connecting on-site technicians and experts on either side of the world to ensure the high service level Marel customers are used to.

While 30 local Marel offices around the globe keep serving customers in the best way possible, on-site field support has become a challenge in corona times. Teamwork is the strong asset that Marel brings in. Now that Marel's field service engineers can't always be physically present on-site, local technicians might not have all the necessary high-tech know-how on board. However, they can call in the high-value remote assistance of their expert Marel colleagues on the other side of the world to execute installation, repair, service or training jobs. This way of collaboration may be even more efficient, more sustainable and cost-saving with much faster response times.

A baptism of fire in China

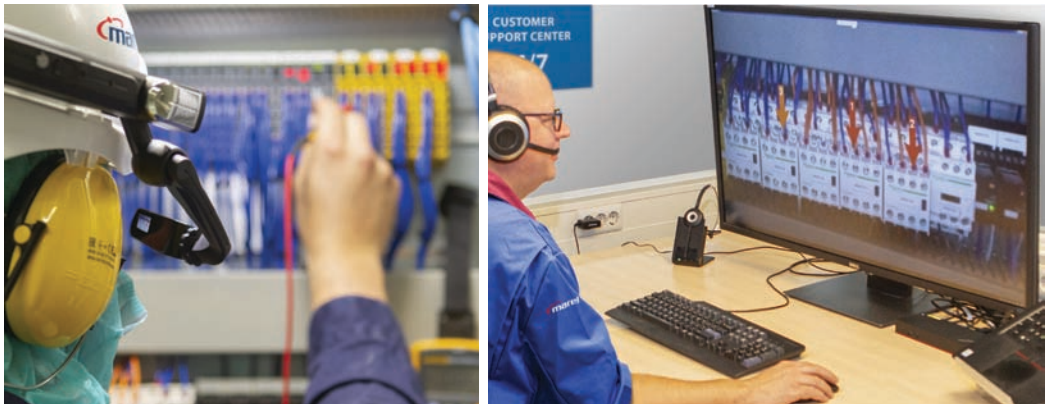
Installation and commissioning of equipment on-site in parts of the world such as China, Australia and Vietnam, usually requires European engineers to guide the project and support local engineers. In China, a record number of new projects was won by Marel China recently, and they all had to be commissioned. Fortunately, Marel's Chinese engineering workforce just completed a thorough training, which was just in time. They immediately had their baptism of fire. With the help of remote support by Marel's experts in Europe, the Chinese engineering team overcame all difficulties and succeeded to complete multiple projects, while respecting service quality and time schedules. This allowed the processing plants of Jinan Yufei, Hebei Juxing, Shenyang Huamei and Changchun to expand and run without production delays. These customers were impressed by the efforts and the responsible attitude of the Chinese Marel team.

Perfectly in time in Australia

In Australia, poultry processor Hazeldene's was close to commissioning a greenfield secondary poultry processing plant in Bendigo. As the Covid-19 crisis had resulted in an enormous increase in retail sales, Hazeldene's wanted to proceed with as little delay as possible. Originally, this was to involve up to thirty European engineers, some of whom were on-site when the Covid-19 lock-downs struck. They all had to return home at short notice. This left no other option than to call in the competence of Hazeldene's own engineering team, together with locally-based Marel engineers and remote support by Marel's specialists in Europe. This remarkable remote cooperation resulted in a successful outcome of the project. The desired short-term realization allowed Hazeldene's to expand its production and respond to the growth in demand perfectly in time.

Cooperation spirit in Vietnam

In Vietnam, Green Chicken/ De Heus wanted to install and commission its Hanoi greenfield in spite of the lockdown. Travel restrictions prevented Marel engineers from completing their job on-site. A remotely assisted install would mean a huge challenge, as the local team of technicians never worked with Marel equipment before, in addition to timezone and language barriers. Marel's engineers in the Philippines, however, were enthusiastic to accept this challenge. Pictures, videos and drawings were shared over Teams and Whatsapp, even webcams were placed in the departments to monitor the situation remotely. Supervising the Vietnamese project fully remotely from the Philippines and Boxmeer was an incredible effort, but with a successful result. Helen Hanh, Project Manager of Green Chicken/ De Heus, says, "Respecting the win-win cooperation spirit, like we all kept doing during this project, has certainly brought all parties more closely together, despite the distance. It



Marel's remote support options connect on-site engineers and helpdesk experts on either side of the world

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...and an ideal feed acidifier
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Evonik to enhance the exclusive sales and distribution of ProPhorce™ SR 130 for the Indian subcontinent

- *Expansion of sales and distribution of ProPhorce™ SR 130 from sub-Saharan Africa to the Indian subcontinent*
- *Butyric acid product complements Evonik's gut health portfolio*
- *Announcement comes following R&D collaboration between Perstorp and Evonik*

To further strengthen the partnership between Evonik and Swedish manufacturer, Perstorp, the sales and distribution of ProPhorce™ SR 130 have been expanded to the Indian subcontinent: India, Nepal, Sri Lanka, Bangladesh and Pakistan. The move follows the announcement in May of Evonik's exclusive distribution of the product in sub-Saharan Africa. The latest development will intensify the sales, marketing and distribution of the product in the new target markets.

ProPhorce™ SR 130 is a butyric acid product that is a safe, easy to handle and cost-efficient solution for in-feed application in livestock management. Butyric acid is a key ingredient for optimal digestion as it favours gut wall integrity which is important for performance. The product complements the mode of action of Evonik's probiotics and shows beneficial effects that can bring added value to customers when the products are used together.

There are many similarities between human gut health and condition and that of animals like chickens. To highlight bacterial cells' impact on the body of both species, the two companies hosted a webinar themed as "Let Food and Feed be thy Cure"on July 16, 2020. Almost 300 Evonikcustomers in the region participated.

The participants received valuable insights from a world-renowned and eminent poultry expert and veterinarian poultry consultant, Dr Marteen De Gussem. In his presentation, Dr De Gussem highlighted the vicious circle of gut health and the importance of impact assessment and solution selection to cost effectively manage gut health.

Attendees who participated in the quiz after the webinar had the chance to win a copy of Dr Gussem's best selling practical guide to broiler focused management,"Broiler Signal"as an e-book.

"This partnership will help us to offer a full gut health portfolio in the region" said, Dr Shreedhar Patel, Vice President for Evonik Animal Nutrition in Asia Pacific South region.

Dr Saikat Saha, Regional Business Director for Evonik Animal Nutrition for India, Bangladesh,Nepal, Sri Lanka & Myanmar added, "In our continuous effort to provide our customers more value-based solutions, this partnership enables us to bring another unique opportunity aimed at resolving chicken gut health related issues more efficiently in the Indian subcontinent."

"ProPhorce™ SR 130 is a unique gut health product with unrivalled butyric acid power because of its special formula and advanced esterification technology. It will reach more customers and create more value for the livestock industry in the Indian subcontinent through our distribution partnership with Evonik," said Jim Ren, Vice President for Perstorp Animal Nutrition for Asia Pacific.

Butyric acid's activities are well researched and go beyond simple manipulation of gut pH. Butyric acid has been shown to improve pathogen control, provide energy for cells lining the gut wall, enhance secretion of enzymes and improve intestinal cell proliferation, differentiation, and maturation.

All of these attributes mean that ProPhorce™ SR 130 has great potential to assist animal producers in reducing the impact of enteric challenges; in maximizing utilization of the nutrients provided in feeds; and both improving animal welfare and reducing environmental impact.

Company information Evonik

Evonik is one of the world leaders in specialty chemicals. The company is active in more than 100 countries around the world and generated sales of €13.1 billion and an operating profit (adjusted EBITDA) of €2.15 billion in 2019. Evonik goes far beyond chemistry to create innovative, profitable and sustainable solutions for customers. More than 32,000 employees work together for a common purpose: We want to improve life, day by day.

About Nutrition & Care

The focus of the business of the Nutrition & Care division is on health and quality of life. It develops differentiated solutions for active pharmaceutical ingredients, medical devices, nutrition for humans and animals, personal care, cosmetics, and household cleaning. In these resilient end markets, the division generated sales of around €2.92 billion in 2019 with about 5,300 employees. It is part of Evonik Operations GmbH.

Company information Perstorp

Perstorp believes in improving everyday life – making it safer, more convenient and more environmentally sound for billions of people all over the world. As a world leading specialty chemicals company, our innovations provide essential properties for products used every day and everywhere. You'll find us all the way from your car and mobile phone to towering wind turbines and the local dairy farm. Simply put, we work to make good products even better, with a clear sustainability agenda.

Founded in Sweden in 1881, Perstorp's focused innovation builds on more than 135 years of

experience, representing a complete chain of solutions in organic chemistry, process technology and application development. Perstorp has approximately 1,350 employees and manufacturing units in Asia, Europe and North America. Sales in 2019 amounted to 11.6 billion SEK.

About Perstorp Animal Nutrition

Perstorp has been involved with developing a range of highly effective additives for the agricultural industry for nearly 60 years. As a producer of key raw materials such as propionic, formic, butyric and valeric acid, we focus our efforts on organic acid-based solutions for gut health and preservation and take pride in being the first to provide you with the next generation of acid-based products. Perstorp Animal Nutrition consists of a dedicated team of agricultural specialists within Perstorp that are committed to delivering optimal solutions and service.

Learn more at www.perstorp.com

Disclaimer

In so far as forecasts or expectations are expressed in this press release or where our statements concern the future, these forecasts, expectations or statements may involve known or unknown risks and uncertainties. Actual results or developments may vary, depending on changes in the operating environment. Neither Evonik Industries AG nor its group companies assume an obligation to update the forecasts, expectations or statements contained in this release.

How to install poultry processing plants in Covid-19 times ?

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contributed to the best possible result."

High-tech and augmented

In almost all of the cases above, the experts on either side of the world were able to achieve their projects by connecting via a Teams video call. This means of communication allowed for live streaming and sharing of high-resolution images, drawings, descriptions and instructions. When needed, remote assistance could be upgraded by using a high-tech helmet with a little screen, integrated camera, headphones and microphone. At the other end of the world, the helpdesk expert can hear and see exactly in real-time what the engineer on-site experiences. This dramatically reduces errors, overcomes language barriers, increases collaboration and proves to be very efficient for problem-solving and installation support. In addition, augmented reality can enable real-time transmission of technical directions right to the on-site engineer's screen, enhancing the remote assistance even more.

High standard

All these examples go to show that Marel is committed to guaranteeing first-class support under all circumstances. By combining teamwork and well thought-out remote assistance solutions, Marel succeeds in maintaining its renowned high standard of customer service.

Dr Gupta presents Homeo Covid Kit to Health Minister, TS

G. Srinivas Gupta, Proprietor, Poultech India presenting Homeo Covid Kit to Etela Rajender, Health Minister, Government of Telangana recently.

Dr G. Srinivas Gupta, Srinivasa Homeo & Wellness Center has presented Homeo Covid Kit to Telangana Health Minister Mr Etela Rajender after thorough and continuous treatment of patients suffering from COVID infections. Dr Srinivas Gupta is a senior Homeopathic practitioner and wellness consultant for more than 28 years and he has been trying to develop an ideal combination of Homeopathic Medicines with home remedies for effective treatment of patients suffering from COVID infections. In the process he has been trying with many patients since two months and developed a Combo kit in homeopathy and home remedies, informed a note from him.

After trying in many positive COVID patients since two months in and around Hyderabad, he said, many patients expressed their happiness and relief that they are feeling much better after 3 to 5 days of treatment and their general wellness is also improved drastically.

He handled and tackled those patients who came to him with primary symptom of loss of smell and taste with respiratory complaints and feverish conditions, Gupta stated. This treatment is very useful for home quarantine patients, he added.

Kit contains: Anti Viral drops, Fever drops, Cough drops, Immunity booster, Steam drops and Respiratory vaporizer.

Note: Govt of India, Ministry of Health, is recommending Homeopathy or Ayurveda as an alternative, he told.

For more details on the subject, please contact:
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Secunderabad.
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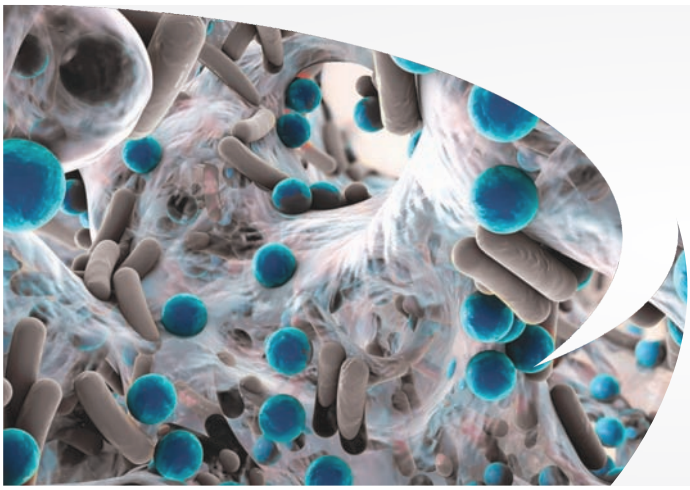


TECHNO VIEW

Introduction

Gut health of poultry has broad implications for the systemic health of birds, animal welfare, the production efficiency of flocks, food safety, and environmental impact.

Gut health is necessary to maintain efficient and sustainable gastrointestinal tract (GIT) physiology. The GIT has digestive, absorptive, metabolic, immunological and endocrinological functions This means that disruptions of Gut health can affect one to several systemic functions. There is no doubt that healthy avian guts are essential to optimize digestibility, minimize nutrient excretion, and consequently mitigate the environmental impacts of ammonia, odours, and other gas emissions with health and welfare impacts inside and outside the poultry house that can impactthe health and welfare of birds and human workers.

High litter moisture and ammonia production may impact the incidence and severity of footpad dermatitis, hock burns, carcass quality defects and respiratory diseases. No doubt, gut health is one of the most important factor which influences performance of the bird. Being the largest immune organ of the body, it's health impacts the overall immune status of the bird. Gut is the first line of defence and combats a number of things like that of disease-causing bacteria, mycotoxins, poor quality feed and water etc. Hence, modifying gut health in a way to strengthen its immune function and

improving nutrient absorption should be the primary goal of every producer. In this context, the structure and functionality of the gut microbiota is crucial for the health of poultry since the process of acquisition and maturation of the gut microbiota throughout the growth cycle of the birds has a strong influence on the development of the intestinal epithelium and the modulation of the physiological functions

Microbiota of Poultry Gut

Gut is structurally a complex system with primary role of digestion and absorption of nutrients and water. It is major site of development, residence and entry portal for disease causing microorganisms. Therefore, any change in the gut morphology and physiology often leads in disease condition and further into decrease in performance of the bird. The morphological and physiological changes in the gut are often caused due to the effect of imbalance in the number of resident bacteria which is called as dysbacteriosis.

Dysbacteriosis can be a serious concern during the early phase of life. In broilers, first 15 days are crucial since the maximum organ development takes place during this phase. In breeders and layers, first 7 weeks are crucial. These phases of life are also associated with faster growth rate which demands optimum availability of nutrients. If the birds gut is experiencing dysbacteriosis, this can lead to deficiency of the crucial nutrients along with excessive expenditure of energy to tackle the sub clinical infection. This dysbacteriosis can be tackled by various means like that of antibiotics, prebiotic, probiotics, acidifiers, herbs, essential oils, and combination of organic acids and essential oils.

Role of Organic Acids in Gut Health

Organic acid treatment to tackle and prevent dysbacteriosis includes mixture of various acids which have been found to have antimicrobial activities similar to that of antibiotics. The antimicrobial activity of organic acids is pH dependent. The primary action of these acids are on acid intolerant bacteria like Salmonella, Campylobacter, Clostridium and E. coli. This also helps in improvement of protein and energy digestibility by reducing microbial competition with the host for nutrient and endogenous nitrogen losses. Organic acids decrease the pH of digesta and increase pancreatic secretion and also have beneficial effect on intestinal mucosa. They reduce the colonization of microbes on intestinal walls and thus prevent damage to epithelial cells. Apart from its beneficial effects on gut health, organic acids also help in lowering down the uncontrolled variables such as buffering capacity of dietary ingredients.

Essential oils and Gut health

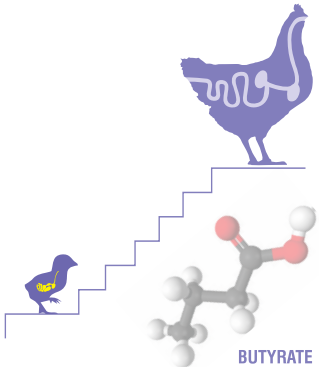
In recent past, Essential Oils (EO) have gained attention from poultry industries. This is due to visible benefits of EO's after addition of it in feed. Essential oils are not simple compounds. They are mixture of various compounds which majorly comprises of terpenes and terpene derivatives. It helps improve nutrient digestibility. Decreased numbers of pathogenic bacteria in the gut may improve the

ability of epithelial cells to regenerate villus and thus enhance intestinal absorptive capacity. As far as the safety is concerned, EO's are generally considered as safe and do not posses any noted side effect on birds health.

Improvement of growth indices was observed along with increase in villus height in chickens significantly in Clostridium perfringens challenged birds supplemented with essential oil.

Tributyrin in Gut Health

Butyrate is an active molecule of Tributyrin, a SCFA that is produced by bacteria in the gut. Tributyrin is a valid alternative to butyrate, as one molecule of tributyrin releases three molecules of butyrate directly in the small intestine, thus butyrate is rapidly adsorbed. Aside from its primary function as an energy source for colonocytes, it is a strong mitosis promoter and a differentiation agent for intestinal epithelial cells, as it acts as a histone deacetylase (HDAC) inhibitor. Moreover, it has a strong antibacterial activity against both Gram-negative and Gram-positive pathogens and therefore proves to be a valid aid for gut health maintenance. Butyric acid exhibits bactericidal activity when the acid is undissociated. This undissociated acid is absorbed by bacterial cell led to change in the intracellular pH and results in death of bacteria. Multiple studies showed the improvement of growth performance, the repair of damaged intestinal tissues and the improvement of protein digestibility. The higher growth performance and the improvement of protein digestibility suggest that tributyrin could modulate protein and lipid metabolism. Thus, blood metabolites, insulin and leptin, which are positively correlated with body weight and with adipose and also muscle mass, could be modulated by tributyrin supplementation.



Buty BLASTER
THE GUT WAY OF PERFORMANCE

ButyBlaster is Gut Health Management (GHM) program by OPTIMA LIFE SCIENCES which optimizes gut health throughput the life cycle of the bird. ButyBlaster is a unique program comprising of products with proven performance and economical benefit to the poultry producer. It promotes gut health in most crucial stage of life of the bird. ButyBlaster comprises of following products with excellent health benefits to birds and poultry producers:

ButyESTER™ Advance

ButyEster Advance is a innovative product comprising of Tributyrin prepared by unique GEH technology. With GEH technology, Butyric acid efficiently released into hind Gut even in absence of lipase in young as well as in adult bird.

As a AGP replacer:

- It controls pathogens, promotes gut health and development
- Enhances intestinal barrier functions
- Enhances immune system by reduces release of pro-inflammatory cytokines
- Helps in proliferation and maturation of intestinal cells

Benefits in Broilers
Controls pathogen without antibiotic resistance
Increases cellular integrity in hind gut
Optimizes FCR
Helps in preventing coccidiosis

Benefits in Breeders
Promotes gut health
Enhances immunity
Helps optimum nutrition uptake
Helps reduce subclinical gut infections

BACTOCID EO

Bactocid EO is a powerful combination of organic acids and essential oil. This synergistic effect of organic acids and oregano oil various disease causing bacteria. Organic acids ensure acidic pH in gut which have bacteriostatic effect while the oregano oil decreases the crypt depth and boost villus height.

- Optimizes intestinal health
- Reduces gut pH thereby inhibiting growth of pathogenic bacteria
- Improves FCR and body weight
- Combats subclinical gut infections like that of Salmonella and E. coli.

Benefits in Broilers
Reduces buffer value of feed
Optimizes gut health
Improves FCR
Helps control *Clostridium and E.coli*

Benefits in Breeders
Helps maintain acidic pH in gut
Helps in optimum feed digestion
Improve immunity
Reduces subclinical infections like *Salmonella & E.coli*

Suggested Program of : Buty BLASTER THE GUT WAY OF PERFORMANCE

Broilers:

Day 1 to 15 : ButyESTER Advance @ 300 gm/ton of feed
Day 15 to 35 : BACTOCID EO @ 1kg/ton of feed

Breeders:

Week 1 to 3 : ButyESTER Advance @ 300 gm/ton of feed
BACTOCID EO @ 500 gm/ton of feed

Week 3 and above : ButyESTER Advance @ 300 gm/ton of feed week a month program
BACTOCID EO @ 1kg/ton of feed

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Corona virus rumours cost India's poultry dearly

Speculation and rumours on India's social media platforms over a possible avian link to the deadly coronavirus has dented poultry sales and put the industry in a pickle. Government help is needed to prevent a catastrophe.

Jun 19, 2020: Millions of small poultry farmers reeling

Millions of small poultry farmers across the country are reeling after poultry meat sales crashed by 80% following false claims that chickens are carriers of the coronavirus. The states of Maharashtra, Karnataka, Odisha and Andhra Pradesh appear to be worst affected with farmers resorting to panic sales and some even going as far as culling chickens.

India's weekly production of broilers is in the range of 750,000 live birds, or 300 million a month."

India's poultry sector lost US$ 1.5 m per day

First estimates are that India's poultry industry has been losing US$ 1.5 million a day due to lower prices since early January. More than 25 million farmers earn their income in some form of poultry business in India. The Indian poultry sector produces about 4 billion broilers and 93 billion eggs a year and has been growing at between 6-8% per annum. However, the recent crisis has severely destabilised the sector.

Poultry farms seek government assistance

Amid cries for help, poultry farmers are seeking government assistance, stating that the Covid-19 crisis appears to be more widespread in India than the bird flu outbreak of 2006 which was restricted to the western part of the country. Many farmers say it has become untenable to keep any of their livestock since they are unable to feed them. That led several farming bodies to ask the government to extend some form of subsidy to poultry farmers who are unable to pay electricity bills and local taxes. Some chicken shop owners with more than 2 outlets have closed 2, saying it has become difficult to pay employees' salaries.

"India's weekly production of broilers is in the range of 7,50,000 live birds, or 300 million a month," says Shankar Waghmare, a poultry farmer in Dahanu district in Maharashtra. "With average production costs of US$ 1 per kg and realisations at US$ 0.33, the losses now work out at US$ 1.35 per 2-kg bird or US$ 405 million per month," he said.

Comparing Covid to H5N1 outbreak

A similar crisis was last witnessed in 2006-2007 when chicken consumption was affected by the H5N1 avian influenza, Waghmare notes. At that time, the Maharashtra government had paid farmers US$ 0.54 for every bird culled. "This crisis is worse. The government should instruct banks to come to the rescue of the industry. This is an ideal time to announce a one-year interest holiday, as opposed to a mere restructuring of loans through rescheduling payments," he added.

The poultry industry in the state of Maharashtra has incurred losses to the tune of US$ 1.5 billion due to the coronavirus scare. Sales have slumped, especially since 4 February when rumours linking the coronavirus to chicken consumption started to gain ground on social media. Daily sales of chicken crashed from 3,000 tonnes a day to less than 2,000 tonnes a day. The situation is similar in the city of Mysore in Karnataka, where the city and surrounding villages in a 30 kilometre radius produce around 3 million birds annually. Sathish Babu, MP and zone chairman of the National Egg Coordination Committee reports that egg production accounts for 80% of this, so the city boasts around 2.5 million eggs on an annual basis. "Poultry growers have been suffering huge losses due to the deadly virus that originated in China," Babu says. "Hundreds of poultry farmers are facing tough times. The year has started on a bad note for the industry," he adds.

Hike in poultry feed ingredient prices

A report by ICRA Research states that operating margins in the poultry industry are expected to decline sharply during the 2020 financial year due to increased prices of key ingredients – maize and soymeal – coupled with the inability of players to fully recover these price rises from end-customers. The cost of maize and soymeal – the main ingredients of poultry feed – constitute about 70% of the variable costs (other than veterinary,

labour and energy costs) and for various reasons have seen a sharp increase. The ICRA Research report paints a dismal picture for the industry in the coming year and notes that the profitability and coverage indicators of industry participants are expected to weaken substantially. It adds that the credit profile of industry participants has deteriorated significantly for the current book year, with some industry participants registering operating losses due to high input cost and devalued realisation.

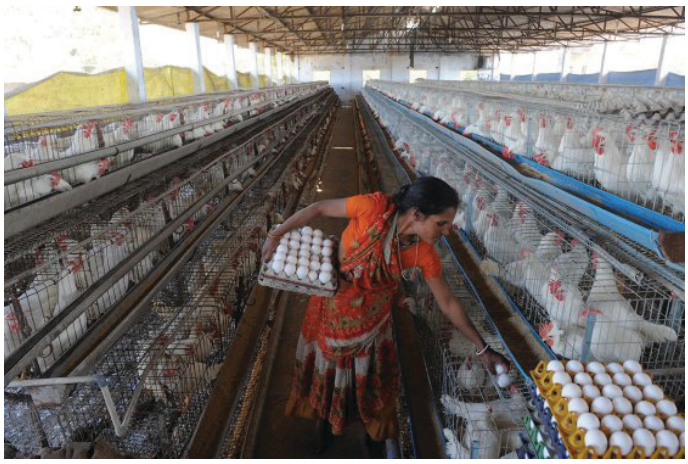
Rumours of poultry being vectors for Covid

The ICRA report further states that following the outbreak of the coronavirus pandemic, 18,000 chickens were culled in the Hunan province of China further to a H5N1 Asian avian flu outbreak in the province. Certain rumours associating the culling of chicken with coronavirus and suggesting that chicken could be a possible vector of the coronavirus resulted in a decline in domestic demand in early January 2020.

Despite a myriad of efforts by poultry players and the Ministry of Animal Husbandry to try to douse the rumours and spread awareness about the safety of poultry meat consumption, the situation does not seem to have improved. The ICRA report notes that impact is likely to be contained by the 4th quarter 2020, although the profitability of industry participants in the current quarter will be harmed.

States stare at losses

Suresh Chitturi, Vice Chairman of the All India Poultry Breeders Association and Managing Director of the Hyderabad-Headquartered Srinivasa Farms operating in 16 states across India and which



supply 50 million chicks a year to farmers, asserts that the Indian poultry industry is losing more than US$ 148 million every week. He says the industry has made a representation to India's finance Minister Nirmala Sitaraman asking for help for farmers in this time of crisis. In a letter to Ms Sitaraman, Bahadur Ali, Chairman of the Association and also Managing Director of the IB Group, says the recent outbreak of coronavirus in China and related developments in India have crippled the poultry sector and is forcing the industry in the direction of bankruptcy. The letter adds that the situation is far worse than the last two bird flu incidents of 2006 and 2010.

Seeking a rescue package for the poultry sector, the letter to the finance minister has requested that the government provide "an interest subvention, conversion of existing working capital loans to term loans with a 2-year payback moratorium and the issue of fresh working capital" which, it states, will help the industry to tide over the current crisis. The letter adds that the Indian poultry sector contributes US$ 1200 billion to India's GDP and is a major provider of livelihoods and therefore crucial to the country's economy. Another delegation of poultry growers from Maharashtra have also submitted a status report to the government and the ministry of Animal Husbandry and Dairy Development demanding a revival package for poultry owners. Drawing comparisons with the crisis faced by the industry during the bird flu incident when the central and state governments sanctioned compensation per bird for poultry players, farmers have demanded a similar package to curtail losses during the current crisis.

Threat to future growth plans within India's poultry sector.

The delegation has said that the current crisis threatens the Indian government's National Action Plan for the Egg and Poultry industry. The action plan launched by the government is intended to double farmers' incomes by 2022, feed the growing population and help raise the socio-economic status of India's rural economy. Putting forward measures to enhance poultry production targets by 2022-2023, the action plan states that the 3.26 million tonnes (MT) of chicken meat available (baseline data for 2015-2016) needs to be bumped up to 6.20 MT by 2022.

"one of the great challenges currently facing us is how to feed an estimated 9 billion people worldwid by the year 2050..."

The plan states that 5.167 billion commercial broilers would be required by 2022, instead of 3.326 billion commercial broilers (2015-2016 data). An additional 1.840 billion broilers would be required over the base period, with an additional 31-32 million chick placements each week. Similarly, the plan notes that egg production is currently at 5-6% per annum (compound annual growth rate). With newer scientific advances the plan suggests a substantial increase in egg production – like 500 eggs in 100 weeks compared with the current 320+ eggs in 72 weeks – could be achieved by 2022-2023 provided there is adequate government policy support for the poultry industry. It also suggests the government could use fiscal measures to support rural backyard poultry which accounts for about 29% of total egg production.

The plan notes that there is a need to increase egg production. The white paper states: "one of the great challenges currently facing us is how to feed an estimated 9 billion people worldwide by the year 2050, 40% more than presently inhabit the planet; even more formidable is the challenge of achieving this without damaging the environment. The challenge is how to increase the food supply, particularly food of animal origin. While rural backyard poultry systems play a pivotal role in achieving nutritional security in rural areas". The current crisis affecting the poultry sector, however, has compromised many of these plans and is expected to further undermine growth unless the government intervenes.

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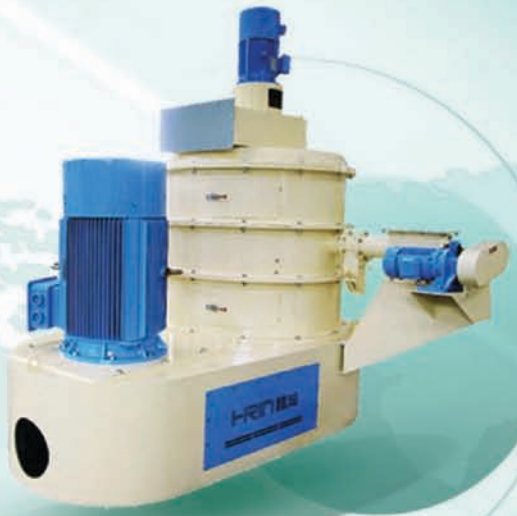

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Role of Fibre in Layer Diet

Dr Koushik De
Director, Technical Services. SCA, Novus International

In the recent past Fibre was not so much important particularly in commercial layer diet, though it was a part of feed formulation depending on the raw materials used around the world. The most common raw materials used in layer diets are corn and soya, but other grains like different brans, MDOC, SFDOC etc are also being used in different countries depending on availability. In recent times new scientific work shows that fibre and structured materials have a lot of benefits in layers' diets and should be used as a tool to improve nutrition of layer breeds under varying circumstances and under probably varying raw material availability.

Digestible Fibre (DF) is generally defined as the non-digestible fraction of plant cell walls in food and feed ingredients and typically includes oligosaccharides, pectin polysaccharides, hemicellulose, cellulose, lignin, gums, and some minor associated plant cell wall substances. Vegetable roots and fruits like apple, beetroot, oranges provide mainly soluble fibre which is pectin whereas all kinds of cereal brans like rice bran, rice polish, wheat bran etc provide higher amount of insoluble fibre which is cellulose. In order to more accurately predict the nutritive effect of fiber from raw materials, a better characterization of fiber fractions, their degradation in the chicken, and their physiological effects are required. Traditional analytical methods to analyze fiber, as crude fiber (CF) and neutral detergent fiber (NDF), recover only a variable part of the fiber fraction and are hence unfit to evaluate fiber fractions in raw materials and poultry diets. In the chicken, solubilization is a prerequisite for fermentation, but even if solubilized during the digestive processes, a substantial part of non-starch polysaccharides (NSP) may remain undegraded.

There is some evidence that insoluble fibres have a positive effect on selected parameters in poultry production. Thus, digestibility of starch is higher and digesta passage rate faster when a moderate level of insoluble fibre is present in the diet. Due to the faster passage rate there is less accumulation of toxic substances in the intestinal tract. The effect of insoluble fibre on gut function stems from its ability to accumulate in the gizzard, which seems to regulate digesta passage rate and nutrient digestion in the intestine.

Differences in Soluble and insoluble fibre fractions.

Soluble fibre:	Insoluble fibre:
- Dissolve or swell (gel formation) in water - Pectins, gums, soluble NSPs - Decrease Intestinal Passage rate - Energy source for monogastrics - Bind bile acids, enhance viscosity - Fermented in small intestine (pathogen multiply)	- Not soluble in water - Mainly lignin, cellulose & hemicellulose - Faster Intestinal passage rate, - No energy source for young monogastrics. - Prevents cannibalism. - Stimulation of intestinal villi, poorly fermentable or inert.
Fermentable Fibre	***Non Fermentable Fibre***
-Resistant to digestion & absorption in small intestine. *-broken down by bacteria in the large intestine.* *-act as a prebiotic*	*-improves starch digestibility* *- not broken down by bacteria in the large intestine.* *-support peristalsis, increases faecal bulk.*

Fibre in layer diet:

Now a days many breeding companies are emphasizing in their feeding guidelines importance of fibre in layer diets. Insoluble NSP used in the later part of the rearing period can positively influence the development of the digestive tract, the crop size and the appetite of the pullets. This is the reason why breeding companies implements a minimum recommendation of crude fibre (5-6%) in the developer feed. During the second half of the rearing period it is highly recommended to increase crude fibre in the developer feed with the aim to create a good and sufficient feed intake capacity for a pullet which is able to start with sufficient daily feed intake and high performance after transfer to the layer house and to show up the real genetic potential. Although high density diets can be used to improve body weight gain, the sustained feeding of diets with higher than recommended energy contents or with a low fibre content can result in inadequate development of the birds' capacity for feed consumption leading to low feed intake and low egg production during early lay. According to Lohmann Tierzucht, cereals and their byproducts (bran) or oil seed byproducts (meal of sunflowers) can be used as a source of crude fibre. They point out that the recommended crude fibre content is difficult to achieve with a classical corn-soya formulation. In such cases crude fibre products based on lignocellulose are an option, as they are high in fibre (50- 65%), free of mycotoxins and do not consume too much space.

Cannibalism and Fibre in Layer diet:

Mortality caused by cannibalism continues to be a major problem in the layer industry. Up to 20% mortality from cannibalism has been noted insome strains, depending on the production system and management strategies. Beside the management, the genetics and the lighting program, dietary factors like low protein diets, low sodium intake as well as a lack of some essential amino acids are seen as othe causes of cannibalism. More and more trials also show the importance of an adequate level of insoluble fibre in the formulations to prevent cannibalism. Insoluble fibre has a positive impact on performances in terms of laying percentage as well as on animal welfare. Soluble fibre on the other hand depress the digestibility of protein, starch and fat due to their negative impact on digesta viscosity. Layer farmers all around the world know the problem that sometimes layer flocks in non-cage housing systems tend to eat litter and feathers. With regard to the new knowledge and experience in terms of crude fibre the question may come up if litter and especially feathers are taken up as sources of structure and fibre. If those flocks have access to roughage and other sources of coarse crude fibre, eating of feathers and litter will decrease. A trial at the University of Hohenheim established that strains with high incidence of feather pecking ingest more feathers than strains with low incidence of feather pecking. Moreover, the authors discovered that feathers have the same effect in the intestinal tract as insoluble fibre, which is the acceleration

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of the intestinal transit period. A logical conclusion is that the animals ingest the feathers to overcome a deficiency of insoluble fibre.

Fibre and Gut health:

Crude fibre has no obvious nutritional value and all raw materials with increased content of crude fibre have less energy compared to corn. Because of this traditional fibre sources do not calculate by linear programming into high energy poultry feed. In the literature some information about feeding trails can be found where scientists tried to evaluate the benefits of increased content of crude fibre in layer nutrition together with sometimes excessive energy dilution of the feed. In those trials the benefits of crude fibre could be confirmed but performance was compromised. This information has contributed to the bad reputation of fibre in layer diets even up to now. But most customers are facing the situation that the energy of the feed is a kind of fuel for nowadays modern layer birds. Due to this situation different kinds of fat and oil are standard raw materials nowadays as high dense energy raw materials and being an ideal solution to compensate the lower energy content of all the alternative raw materials compared to corn. countries like SCA where the alternative grains are being used together with added fat and oil it can be stated that 'fibre and fat are feeding well´. Feed with added fat and oil with a certain content of crude fat is additionally a tool of feeding for liver health and to counter act the incidence of the so called 'fatty liver syndrome´.

Fibre and Gizzard size:

For optimum feed intake during the onset of laying, gizzard size plays a very important role. This is important particularly during the heat stress period as well. One of the important roles of whole grains has been associated with their ability to stimulate the activities of the gizzard. This, in turn, is believed to be related to physical structures of whole grains. The major chemical component important to the structural integrity of grains is the insoluble fiber, which makes up the main part of the cell wall architecture. Indeed, insoluble fiber itself has shown beneficial effects on nutrient digestion and gizzard activities. Recent research has shown that digesta passing through the gizzard have a remarkably consistent particle size distribution with the majority of particles being smaller than 40 µm in size regardless of the original feed structure. The fact that gizzard contents have higher fiber content than the feed illustrates that fiber is harder to grind than other nutrients and thus is accumulated in the gizzard . For layers on floor and in modified cages, litter can be a significant source of insoluble fiber.

In addition, recent studies indicate that structural components of the feed or litter ingesta may play a role in preventing cannibalism among layers. If so, such components as wood shavings may also be an important enrichment of housing systems.

Performance and characteristics of the gizzard in birds fed wheat diets, 23 to 28 wk of age
(Hetland et.al.2005 J. Appl. Poult. Res. 14:38–46)

	Wheat diet	Wheat diet + paper	Wheat diet + wood shavings	$\sqrt{MSE}$[1]
Feed consumption excluding fiber, g/d	108	113	114	9.48
Egg production, g/d	55.6	58.6	57.7	4.37
Egg to feed, kg/kg	0.51	0.52	0.51	0.033
Empty gizzard, g/kg of live weight	8.9[b]	9.9[ab]	11.2[a]	1.52
Gizzard contents, g/kg of live weight	3.3[b]	3.6[b]	5.1[a]	1.33
Neutral detergent fiber in gizzard, g/kg of DM	250	269	341	100
Bile acids in gizzard, mg/g of DM	8.3	7.3	6.6	2.00
Total bile acids in gizzard, mg	15.1	12.3	20.6	7.39
Live weight, g	1,751	1,739	1,753	95

[a,b]Means in a row with different superscript are significantly different ($P < 0.05$).
[1]$\sqrt{MSE}$ = Square root of mean square error in the analysis of variable.

If the gizzard size is inadequate there will be a negative impact on performance as well. The aim should be, therefore, to make sure the gizzard at the end of the pullet stage is as big as possible. It is well established that particle size of feed has impact on the gizzard size.

Relative weight of empty gizzard and gizzard contents in 36-wk-old birds fed pellets with whole or ground wheat or oats in conventional 3-hen cages or on litter floor *(Hetland et.al.2005 J. Appl. Poult. Res. 14:38–46)*

	Conventional cages				Litter floor				Pooled standard deviation
Item	GW	WW	GO	WO	GW	WW	GO	WO	
Empty gizzard, g/kg of live weight	11.7	11.6	13.3	16.0	18.4	17.9	15.6	16.8	2.43
Gizzard contents, g/kg of live weight	4.3	5.4	5.5	6.1	6.5	7.1	6.5	6.1	1.29

[1]GW = ground wheat; WW = whole wheat; GO = ground oats; WO = whole oats.

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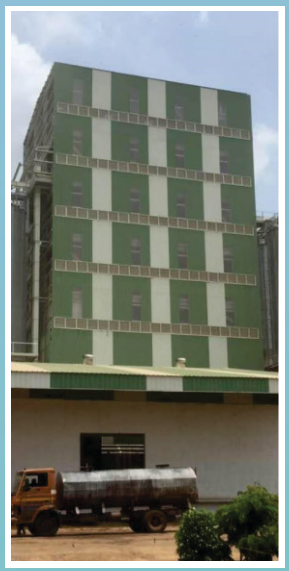

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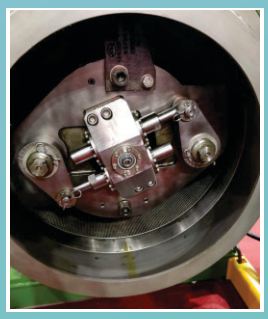

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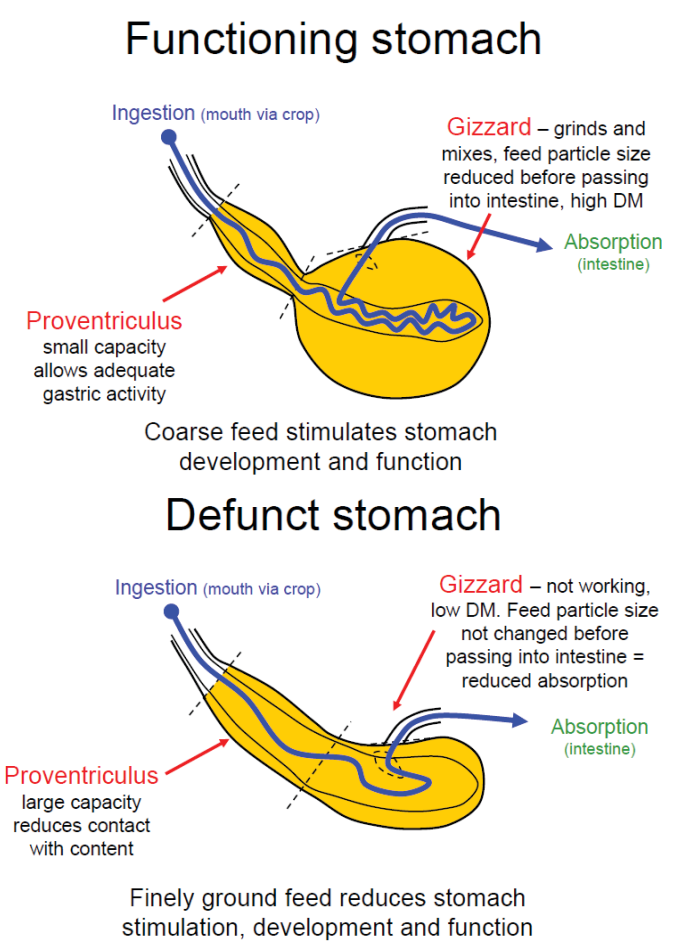
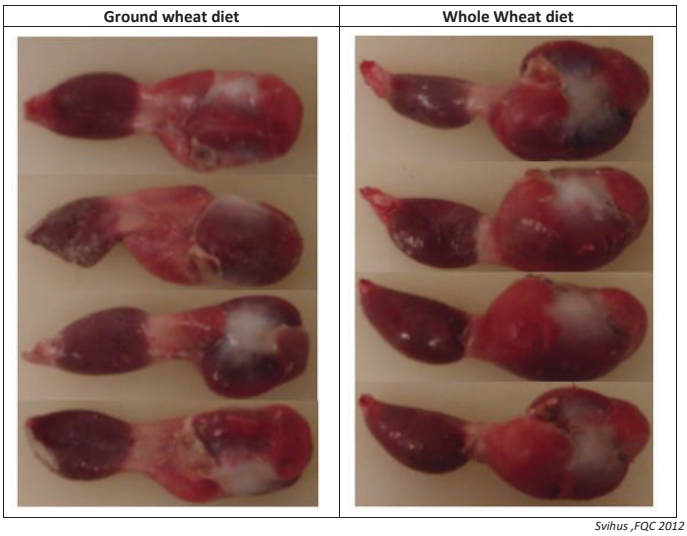


Svihus,FQC 2012



Svihus ,FQC 2012

Fibre and layer Performances:

In many university trials a positive impact of insoluble fibre on performance has been observed. The animals that received crude fibre in the formulation including some amount of crude fibre from the insoluble crude fibre showed increased hen day egg production (average production in the first 16 weeks) compared to the animals that received crude fibre only from traditional fibre sources. This demonstrates that the nature of the fibre has a major impact on performance. In poultry, insoluble dietary fiber has shown beneficial effects on starch digestion. Insoluble fiber increased total bile acids in the gizzard. That insoluble fiber decreases the nutrient concentration may also play a role by increasing digestive juices and substrate relationship. The current data and previous experiments show that the fiber level of the gizzard contents is about twice that of the feed. This means that fiber structures accumulate in the gizzard and that retention time of insoluble fiber is longer than for other nutrients. Fibers, such as cereal hulls, are very solid and can probably be retained for a longtime in the gizzard. In contrast, whole cereals that mainly consist of starch granules and protein will be dissolved very fast in the acidic gastric fluid in the gizzard. Thus, the gizzard activity is more strongly stimulated by fiber structures compared with whole cereal structures. The gizzard has been found to play a major role for gastroduodenal reflux of digesta. An empty gizzard will not have feed stimuli and as such will not be able to regulate downstream digestive processes. This, once again, supports the hypothesis that birds may have a requirement for fiber for stimulation of the anterior digestive tract and that a functional gizzard needs contents with structural components.

Conclusions:

Crude fibre in layers' feed may be a new and challenging topic for poultry nutritionists. An increased content of crude fibre in layers' feed never will harm any bird. Increased content of crude fibre should never dilute the energy content of the feed. When these preconditions are emphasized, a lot of layer flocks will show positive effects getting a diet with higher content of insoluble crude fibre. A lot of raw materials instead of corn and soya can be used for layer feed, as practical experience is showing in several countries. The gizzard has an excellent ability to grind coarse components. Coarse particles are selectively retained in the gizzard until they are ground to a certain critical size. Structural components in the form of whole cereals and coarse water-insoluble fiber can improve feed use in birds fed highly concentrated diets. Formulations high in insoluble fibre result in better performance, a bigger gizzard, better intestinal health associated with drier litter, and in a reduced incidence of behavioural disorders like cannibalism. Lignocellulose products may be a good tool to use the benefits of insoluble crude fibre in layers' feed.

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More References can be provided on request

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Fatty Liver Kidney Syndrome (FLKS) in Poultry

Highlight Points

▶ Fatty liver and kidney syndrome (FLKS) is metabolic disorders of carbohydrate metabolism with complex aetiology involving dietary defects leading to death. ▶ It affects both broiler and layer-type chicks occurred in much younger and much older flocks. Therefore dietary management is crucial to prevent disease in flock. ▶ Here FLKS described including causes, clinical sign, pathological aspect and prevention and control.

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Introduction

Metabolic disorders in poultry are those conditions associated with increased metabolism, rapid growth rate or high egg production, which result in the failure of a body system due to an increased work-load on that organ or system. Among which Fatty Liver and Kidney Syndrome (FLKS) is an important metabolic disorder affects young birds and the main manifestations, lipid infiltrations into the liver and many other organs.

It is due to the secondary effects of the primary lesion that lies in carbohydrate metabolism. Although several nutritional and environmental factors influence FLKS, the main factor is the vitamin, **biotin**. In the absence of an adequate supply of biotin, the hepatic activity of pyruvate carboxylase, a biotin-dependent enzyme, becomes so low that gluconeogenesis in the liver via pyruvate becomes negligible. When the bird is then subject to mild stress or short term fasting, liver glycogen reserves become rapidly depleted and progressive hypoglycemia develops that ultimately proves fatal.

Synonyms

The fatty liver and kidney syndrome (FLKS) has at various times been referred to as fat nephrosis, pink disease, fatty liver and kidney disease, and Q disease.

History & Geographic distribution

The condition was first recognized in Denmark in 1958 and the disease was later reported in Germany, England, Australia, Canada, India, and New Zealand. Mortality generally does not exceed 6% but may reach 20% or more. The syndrome also shows some similarities with a condition described as ' six-day chick disease' (Pearson *et al*., 1976)

Clinical features

This syndrome affects immature chicks and its incidence is greatest between 3-4 weeks of age although it can occur as early as 7 days and as late as 56 days of age (Whitehead & Blair, 1976). Genetic factors may also influence susceptibility. When the birds were subjected to mild stress caused by high or low temperatures, and/ or short term fasting, liver glycogen reserves become rapidly depleted and progressive hypoglycemia develops that ultimately proved fatal (Whitehead, 1979).

Well, grown chicks become lethargic and aphagic, sometimes show signs of paralysis and lie on their breasts with their necks extended. Death usually occurs within a few hours. Biotin has been suspected of having a role in sudden death syndrome in broiler chickens. Biotin deficiency alters the unsaturated fatty acid profile in tissue lipids in a manner suggestive of impaired conversion of linoleic acid to arachidonic acid. Possible reasons for a high initial incidence of FLKS in broilers produced from young breeding stock include avidin consumption from soft-shelled eggs combining with dietary biotin and the change to a breeder diet at point of lay adversely affecting intestinal biotin synthesis. Biotin is normally synthesized in the intestine (McDonald *et al*., 1988).

Gross pathology

The most conspicuous macroscopic abnormality is the pale, blotchy and swollen appearance of the liver and kidneys (Riddell *et al*., 1971). Small hemorrhages are occasionally present on the periphery of the liver and kidneys and the adipose tissue often has a pinkish tinge due to congestion of the small blood vessels. The heart is sometimes pale and flabby and there may be excess pericardial fluid. A blackish-brown fluid of unknown significance is frequently present in the gizzard and the anterior small intestine. The body weight and the relative weight of the thymus are reduced (Blair *et al*., 1974)

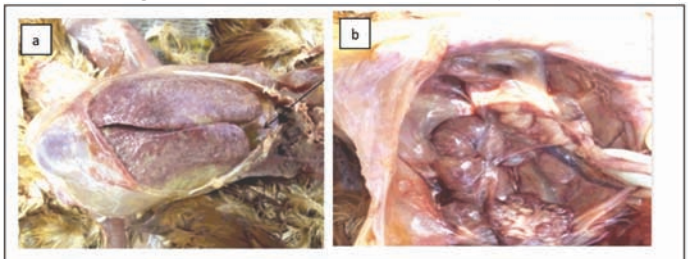

Fig.1: FLKS affected bird Showing **(a)** Enlarged liver covering the whole peritoneal cavity, along with serosanguinous fluid (⇧). **(b)** Enlarged and pale kidneys (Jyothi Priya *et al*., 2018).

Histopathology

Hepatocytes show cytoplasmic vacuolation due to the accumulation of large amounts of lipid and this is particularly marked in cells that are close to the afferent blood supply. The reticulin pattern is normal. Massive deposition of lipid also occurs in the epithelial cells of the proximal convoluted tubules which are swollen to such an extent that other renal structures are compressed. Degenerative changes have been observed in the liver and kidney. but do not appear to be a constant feature.

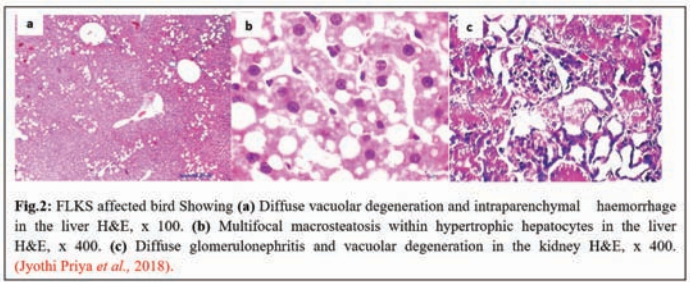

Fig.2: FLKS affected bird Showing **(a)** Diffuse vacuolar degeneration and intraparenchymal haemorrhage in the liver H&E, x 100. **(b)** Multifocal macrosteatosis within hypertrophic hepatocytes in the liver H&E, x 400. **(c)** Diffuse glomerulonephritis and vacuolar degeneration in the kidney H&E, x 400. (Jyothi Priya *et al.*, 2018).

Biochemistry

Affected chicks are hyperlipidaemic showing increases in the free fatty acid and triglyceride levels in the plasma and the lipoproteins with a high triglyceride content. There is a 2- to 5-fold increase in the lipid content of the liver and kidneys which is due almost entirely to an increase in the amount of triglyceride. This has an abnormal composition in that the proportion of mono-unsaturated fatty acids (mainly palmitoleic) is increased at the expense of the saturated acids mainly stearic. Death appears to be due to hypoglycemia caused by a failure of hepatic gluconeogenesis and the virtual absence of glycogen rather than by a defect in carbohydrate absorption (Bannister *et al.*, 1975).

Prevention and control

- Lowering the energy value of the feed and ensuring that sulfur-containing amino acids and choline are at an appropriate dietary inclusion rate.
- Supplementing diets with adequate amounts of biotin can prevent the syndrome.
- Principal causes of fatty liver kidney syndrome can be controlled by proper feed ingredient quality and appropriate feed formulation in the ration with good control of body fat and reducing heat stress to the birds.
- However, control of body fat is the only successful remedy for this condition and is best accomplished by regulation and reduction of total energy intake.

References:

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****More References can be provided on request***

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Rise in demand for processed Meat due to Pandemic ?

Highlight Points

The coronavirus pandemic and the ensuing safety scare could end up triggering the demand and supply of processed meats, with the right nudge from the government and active participation from private players. India has over 10 lakh poultry farmers who breed close to 800 million birds annually. The sector contributes 4.5 percent to the national GDP. The market is predominantly driven by the production and sale of fresh meat, and processed meat accounts for slightly over 5 percent. If you look at countries like France and Russia, processed meats take up over 30 percent of the market share. There is clearly a lot of scope to double the current market share of processed meats.

Dr Krishna Chandra Sahoo
Global Product Manager, Vetphage Pharmaceutical

The coronavirus pandemic and the ensuring safety scare could end up triggering the demand and supply of processed meats, with the right nudge from the government and active participation from private players. India has over 10 lakh poultry farmers who breed close to 800 million birds annually. The sector contributes 4.5 percent to the national GDP. The market is predominantly driven by the production and sale of fresh meat, and processed meat accounts for slightly over 5 percent. If you look at countries like France and Russia, processed meats take up over 30 percent of the market share. There is clearly a lot of scope to double the current market share of processed meats.

A live market puts a lot of pressure on producers as the meat process are affected by the economics of supply and demand as well as unpredictable market shocks. The rearing process and the gestation period make it difficult for farmers to vary the supply with the demand. This is compounded by the fact that the cycle of meat consumption is not constant in India. Producers end bearing reduced margins and even sustain losses to keep up the farming volumes. To give a fair idea, the loss suffered by the industry due to the current crisis is upwards of INR 20,000 crores.

The benefits of processed meat

A mature processed meat market will be beneficial to producers and customers alike. Processing technology will increase the shelf life of all meat products, which will make it easier for farmers to absorb any shocks due to the improved control over the inventory. Also, the fact that the product can be stored will shield them from unexpected crashes in prices. Social distancing is going to be the norm for the foreseeable future, and the need for hygienically stored meat which is not touched by hand is going to go up. Customers are going to educate themselves and start looking for traceability, t, and fresh and hygienic meat. Processed meat is the logical answer to all the above demands, and it will allow producers to adhere to the strict quality requirements. Players who can integrate themselves into a brand-driven processed meat market could gain a lot from this trend.

What are the challenges?

The main challenge in hastening this transition is Indians' preference to buying fresh food. We are used to buying fresh vegetables, fruits, and poultry. To bring about a large-scale behavioral change, we need to seriously invest in customer education. It will be quite challenging to convince them that the taste of the meat and the nutrient value will remain undisturbed due to the processing.

The second biggest challenge is the fears of unemployment among wholesale meat traders and butchers, who will become redundant with the growth of the processed meat market. However, as processed meat gains a greater market share, such intermediaries in the supply chain can adjust to different roles in the new network. For instance, there will be plenty of new employment opportunities in processing plants.

The final challenge lies in upgrading the infrastructure of processing plants and the supply chain. At present, the capacity utilization in our processing plants is slightly over 50 percent, and is therefore not a pressing problem. On the other hand, we need heavy investment to improve the infrastructure of the supply chain. We need an efficient cold chain from processing plants to storage units extending all the way to retail refrigeration. We need favorable policies from the government if we want to attract lucrative foreign investments.

The road ahead

In the long run, both producers and customers will benefit

from the move to processed meats. Wet market will continue to operate alongside. To ignite a behavioral change, we need to create more awareness and change the public's perception towards processed meats. There are plenty of factors that will accelerate a change in consumption patterns – changing demographic profiles and lifestyles, exposure to a wider variety of cuisines, and growth of modern restaurants and retail chains.

Once we start to see an increase in customer acceptance, we will be able to come up with strategies to create and use more capacities. Players in the market can seize the opportunity to strike international ties, and boost our exports. Central regulations will play a key role in attracting investor interest and promoting the consumption of processed meat. While the transition is not going to happen overnight, we can expect to see a mature processed meat market in five years.

Ionophores - Past, Present and Future

Coccidiosis, caused by protozoan parasites of the genus Eimeria, is still one of the most widespread and difficult to manage poultry diseases, causing considerable economic losses especially in the broiler industry.

Intensification of commercial poultry production has relied on effective prophylactic control of coccidiosis. The sequential introduction of sulfa-drugs, synthetic anticoccidials and then ionophores changed this, facilitating rapid increases in the scale and intensity of poultry production. Current levels of poultry production would not be sustainable in the absence of effective anticoccidial control.

Synthetic compounds

Synthetic compounds were the first actives to be discovered that controlled coccidiosis. Different synthetic products have different working mechanisms, although their exact mode of action is not always clear. In general, these products enter the intestinal cells and interact with the parasite, even when in an intracellular phase (for example in the schizont phase). Synthetic products are very strong anti-coccidial products which result in a significant reduction of the coccidiosis infection pressure.

Ionophoreanticoccidials

The introduction of ionophoreanticoccidials in the 1970s proved to be critical for the development of modern poultry production. Ionophores interact with ion transportation within the parasite, hence their name which is derived from the Greek 'ion phoros', meaning 'ion carrier'. Ionophores transport ions (e.g. sodium (Na+), potassium (K+), hydrogen (H+) etc.) across hydrophobic membranes, in this case, the parasite wall (Figure 1). This increases the concentration of these ions inside the parasite, eventually resulting in the uptake of water through osmosis causing the parasite to swell and burst.

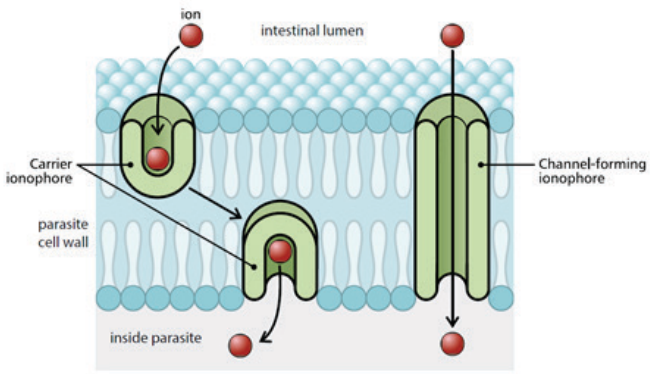


Figure 1.Illustration of ion transport by ionophores. Ionophores have two ways in which they transport ions into the parasite: by forming a channel or by acting as a carrier to pass the cell membranes. The carrier pathway (left) is used by ionophores applied in poultry

Slow resistance

One of the main characteristics of an ionophore product is the slow selection for resistance. Some parasites will always escape the effect of the product, known as 'ionophore leakage'. This is an inherent property of all ionophores, linked to their mode of action. The consequence is that, besides the parasites with reduced sensitivity, some completely sensitive parasites will survive the effect of the ionophore. The competitive advantage for the resistant parasites is less pronounced and the shift to an increasingly resistant parasite population is a much slower process in comparison to synthetic compounds (Figure 2)

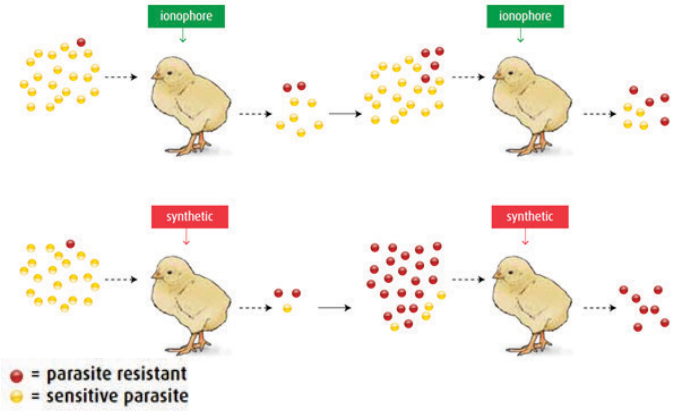


Figure 2.Resistant and sensitive parasite strain population following treatment with ionophore and synthetic coccidiosis control products. In contrast to synthetic products, ionophores will allow some parasite multiplication. This will result in higher shedding of sensitive parasites which will compete with the resistant parasites. As a result, the house will not be flooded by resistant strains.

Categorizing ionophores

The mode of action of ionophores makes them unsuitable for use as curative products. Ionophores will not enter the intestinal cells and are only able to destroy the parasite during the motile stages of the life cycle (sporozoites and merozoites). This means that, to be effective, the

ionophoremust be present in the intestinal lumen at the time of the motile stages. It is therefore important to avoid interrupted medication since birds kept on litter ingest oocysts continuously.

It is very important to state that ionophores are antiparasitic products which also exert an antimicrobial activity. In parallel with their mode of action againstEimeriaas described above, the lipophilic ionophore attaches to the lipid-rich cell membranes of Gram-positive bacteria. Ionophores bind Na+. K+and H+and facilitate their transfer across the bacterial cell membrane, resulting in an increase in H+concentration inside the Gram-positive cell which eventually leads to the death of the bacteria. Different studies have demonstrated that the different ionophores all possess antibacterial properties which inhibit the growth of poultryClostridium perfringensstrainsin vitroand reduce lesions in a necrotic enteritis modelin vivo. The parasitic and antimicrobial modes of action however, are not related to any drug used for human medicine.

Ionophores and resistance

Till today, there is no proven evidence that the use of ionophores and cross-resistance or co-selection of resistance to antimicrobials critical in human medicine has been demonstrated. Since their discovery almost 50 years ago, ionophores have been the most popular products for coccidiosis control worldwide.

A coccidiosis toolbox without ionophores

When removing ionophores from the coccidiosis toolbox, awareness of the potential threats must be heightened. Coccidiosis is ubiquitous and it is generally accepted that, under current production systems, coccidiosis control remains necessary. When ionophores are withdrawn, there is an increased risk of sub-clinical and clinical coccidiosis because resistance issues caused by synthetic anticoccidial products will be more prevalent. The more products that are available for poultry producers means that an optimised rotation can be applied in a correct and responsible way. Coccidiosis vaccination might also prove beneficial here to manage resistance development.

Coccidiosis is one of the main triggers for other gastrointestinal disorders like necrotic enteritis and dysbacteriosis. Therefore, an increase in sub-clinical and clinical coccidiosis might also result in increased occurrence of these intestinal disorders which, in turn, might increase the use of therapeutic antimicrobials via the drinking water. Animal welfare and sustainable poultry production will be compromised.

Conclusion

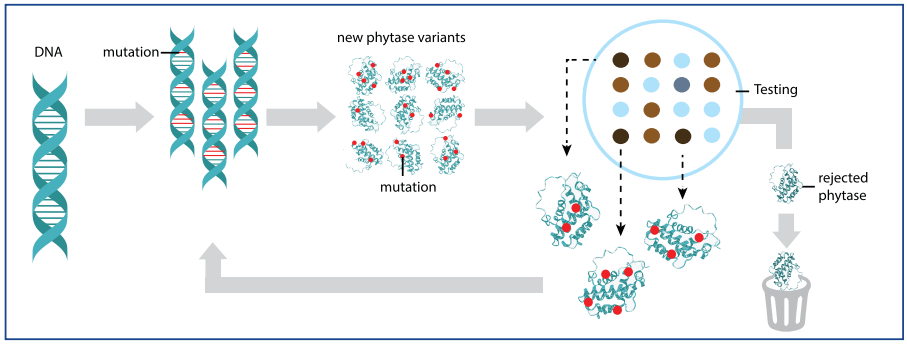
In summary, poultry production would not have evolved into the highly efficient meat production industry it is without the help of ionophores for the prevention of coccidiosis. Removing this crucial element of the coccidiosis control toolbox will unavoidably mean a reduction in poultry production performance, giving lower outputs and jeopardizing animal health and welfare. Due to the nature of poultry production and the features of coccidiosis, prevention of coccidiosis is crucial in order to remain competitive and ensure animal welfare and health. Prevention can only be achieved using all the available tools which includes chemical products, vaccines and ionophores in rotation programs. Using these tools at different time points will bring the most efficient and long-term viable strategy.

Are all phytase products the same ?

Dr Sachine Patil
AGM-Key clients-Huvepharma SEA (Pune) Pvt Ltd

No. Each commercial phytase molecule is different. Even products derived from the same bacteria (such as E. coli) ultimately differ based on their amino acid sequences. These sequences, similar to DNA, mark important differences For example, a chicken and a turkey share most of the same DNA - but their DNA sequence makes them different animals. OptiPhos Plus was developed by Cornell University (USA), it is derived from a specific E. coli micro organism isoled from the intestine of normal pig then it's fermented in Pichia pastoris and produced under precise specifications producing a very potent 6-phytase. This process gives Optiphos Plus its potency as well as peak activity at pH levels found natrually in the upper digestive tract of the chicken. Other phytase manufacturers can make claims about similarity. However, at the molecular level each product is different and that difference makes OptiPhos Plus the most potent molecule.

Newest technology for protien engineering



Criteria for selecting a fast phytase - PPS

What are the criteria to select a good phytase? why select the fastest phytase?

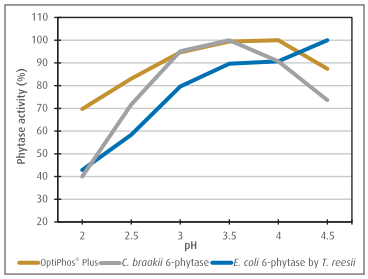
The importance of pH profile, pepsin resistance and speed (PPS) has shown to be critical to yield a fast phytase with reliable matrix values and super dosing properties

The main reason for using an exogenous added phystase in feed is to liberate phosphorous (P), bounded as phytate, in raw materials. This does not only lead to a

lower feed cost by reducing the amount of added inorganic P, but also exerts a positive effect on performance by degradation of phytic acid, which is a known anti-nutritional factor in feed. In practical animal nutrition, a fast acting phytase has two major benefits. First of all, the higher the speed, the higher the P release from the phytate will be, and the less extra inorganic P needs to be added to the feed Secondly, as phytate also exerts anti-nutritional properties linked to the binding of minerals, protein and even fatty acids its faster destruction will thereby improve the digestibility of these nutrients and increase animal performance.

pH profile

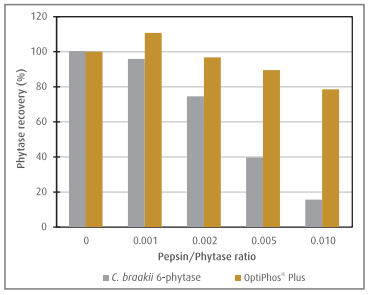
It is well-known that phytic acid must be in solution for the exogenous phytase to be able to hydrolyse the phosphate groups. Phytic acid is largely soluble at pH levels below 4.0 (gizzard/ stomach). However, at higher pH levels (as in the small intestine), it forms complexes with postively charged ions, like calcium. A good phytase therfore needs to be active in vivo in the upper digestive track through out the complete acid pH range from pH 2 to 4.



(Fig-1 Relative phytase activity at different pH levels)

Pepsin degradation

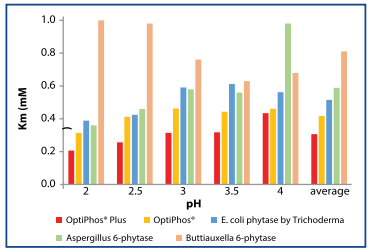
Pepsin is protease present in the stomach / gizzard, responsible for the degradation of proteins. As phytases, like any other enzymes, are proteins, they can be broken down by pepsin which obviously leads to the loss of their efficacy OptiPhos Plus is resistant to this degradation by pepsin, so no losses of efficacy due to the pepsin breakdown of OptiPhos Plus will happen and the full quantity of OptiPhos Plusz dosed into the feed is efffective!



(Fig-2 Phytase recovery after prolonged exposure of different phytases at different low pepsin levels during 2 h)

High affinity and speed

The speed of hydrolysis of phytate by a phytase (the Vmax) is largely dependent on its pH profile and pepsin resistance and can be determined during in vitro enzymatic studies (the so called Michaelis Menten Kinetic studies). In view of the short duration of feeding in the gastric region where the phytic acid is soluble and degradable, it is obvious that the Vmax of a phytase needs must be as high as possible and will influence the greater efficiency of phytase (Figure 3).



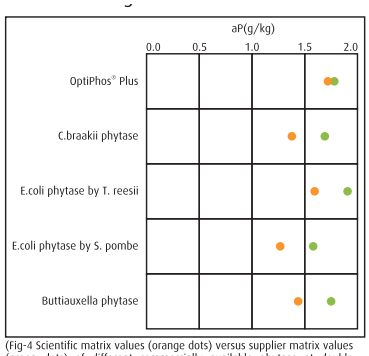
(Fig-3 OptiPhos® Plus has a higher affinity (lower Km) than other phytases at different pH values)

In practice, the Vmax/Km, or the Kcat/Km ratio, is used as criteria to compare phytases: the higher the value (a high Vmax (Kcat) and a low Km), the more phytate will be broken down, and the higher the P matrix value of the phytase will be.

The speed of phytate degradation by OptiPhos Plus is maintained even when phytate concentration in the gizzard/ stomach drop to very low levels. This is called the affinity, and is determined by the Km value, which is the concentration of phytate at which the phytase still works at 50% of its maximum speed. OptiPhos Plus has shown to have a low Km value, indicating it can keep its high speed up long even when phytate concentration drop to a low level. This is also why OptiPhos Plus has high P matrix values and is especially well suited for superdosing applications.

Scientifically proven P matrix values

In order to calculate how much the addition of inorganic P to feed can be reduced by a phytase, each phytase supplier provides their specific P matrix values. The higher these matrix values are, the more interesting the phytase becomes for a nutritionist when calculating with best cost formulation. It is however of the utmost importance for the nutritionist to be able to 100% relying on the correctness of these supplier's matrix values. Trials done by independent research institutes which are published in scientific peer reviewed journals, form an adequate and solid base for determining (and comparing) matrix values. These matrix values might be refered to as the scientific matris values' and may be differentiated from the matrix values provided by the manufacturer which we might call the 'supplier matrix value'. Such research in this scientific literature over the period 2002-2017 for poultry, for instance, have revealed that most phytase suppliers except OptiPhos Plus overestimated the matrix value by up to 25% and might thereby lead to under performance of the animals (Figure 4).



(Fig-4 Scientific matrix values (orange dots) versus supplier matrix values (green dots) of different commercially available phytase at double dose in broilers.

Superdosing effect at double dose

Phytate is know to exert anti-nutritional aspects by binding minerals, proteins and even fatty acids, hindering their digestion and absorption by the animal. A fast working phytase like OptiPhos Plus thereby will yeild faster postive effects on improvement of performance, and will yield super dosing effects at double dose. other phytases will need three to four times the normal dose to yield this effect.

Conclusions

It can be concluded that the intrinsic characteristics of a phytase source is determined for a large part by its in vivo activity and its speed of action. The choice of a phytase, active at all relevant pH ranges, resistant to pepsin and showing a high speed of phytic acid degradation is therefore of the utmost importance to secure adequate and reliable P release from phytate. The better the phytase scores at these three points, the better and more reliable its P matrix values will be and the stronger the chicken performance will be enhaced through super dosing.

- OptiPhos Plus achieves its greater aP release at a lower level than other Phytase products
- Highest savings of inorganic phosphate (MCP and DCP) sources, so Reducing feed cost
- Faster elimnation of the anti-nutritional factor phytate, so demostrating superdosing effects already at double dose

Diformates: A most suitable replacement for antibiotics

Anant Deshpande and Christian Lückstädt
ADDCON Asia Ltd. India

Introduction

Discovery of antibiotics is one of the greatest benefits to mankind. Millions of lives have been saved across the world ever since the use of antibiotics came into practice. Initially the use of antibiotics was restricted only to humans, until the practice of intensive farming came into existence in the 1950'S and their routine use in animals for prophylactic purposes began. In 1963, the emergence of the first resistant bacteria was described (Watanabe et al., 1963). In 1969 a committee of government experts in the UK concluded that the use of antibiotics in animals had contributed to antibiotic resistance in humans. In 1975, further UK research linked the prolonged use of antibiotics to shedding of Salmonella typhimurium and its development of resistance to: Virginiamycin, Bacitracin, Flavomycin, Nitrovin, Tylosin, Sulphaquinoxaline, Ampicillin, Chloramphenicol and many more antibiotics. These resistant bacteria proliferate in the animal and are transmitted to other animals. Transfer of the bacteria from animal to human is possible through many routes. Humans can also get infected by eating meat from animals with resistant bacteria. In 2015, antibiotic-resistant pathogens were estimated to cause over 50,000 deaths a year in Europe and the USA. The toll is projected to rise to 10 million deaths per year worldwide by 2050 (O'Neill et al., 2016). Sensing trouble, some countries have already imposed a ban on the use of prophylactic antibiotics in livestock feed and many more are in the process. However, without the use of antibiotics in animal farming, the productivity of the animal is compromised and hence there is an absolute necessity to look into suitable replacements. The following review deals with the use of effective replacements to antibiotics in the form of diformates - the double salts of formic acid; phytogenic compounds and their efficacy against bacterial pathogens. Available data show that these substitutes not only effectively control pathogenic bacteria but also improve productivity far more effectively than antibiotics.

Review

Overuse of antibiotics, the development of resistant bacteria and its ill effects on the human population eventually leading to the ban on prophylactic use of antibiotics in animal farming, is currently the hottest topic of discussion everywhere. The ban on prophylactic use of antibiotics in animal farming is well deserved, however, looking at the bacterial challenges in the animal farming, it is imperative to have some kind of a tool to control the bacterial infections and improve the performance of the farmed animal. Organic acids are looked upon as the most promising alternative to the antibiotics (Papatsiros and Billinis, 2012), as in addition to its antimicrobial property, organic acids provide many extra benefits such as improving the intestinal health, optimising the intestinal pH and thereby improving the nutrient digestibility. Organic acid controls the development and growth of mold and bacteria by the virtue of its inherent antimicrobial property and are in use as a preservative in food industry since ages. Since half-a-century they also have been used in the animal industry, much of it to control the mold and bacteria in the feed, in order to improve the hygiene of the feed and thereby to improve the performance of the animal. The current article focuses more on to the role and advantages of organic acid in the control of pathogenic bacteria in the gastro-intestinal-tract (GIT) of chicken/swine.

The antimicrobial mode of action of organic acid is explained as a two-way action; one is the bacteriostatic effect by the dissociated molecule of organic acid, which inhibits the growth of microbes due to lowering of the pH in its surrounding area and the other is bactericidal action by un-dissociated molecule of organic acid which occurs when the organic acid molecule penetrates through the cell wall of the gram-negative bacteria and then dissociates inside the bacteria altering the pH in the bacterial cytoplasm. Though this mode of action is well documented by various scientists, the information on the various other aspects of organic acids which influence its efficacy is not so widely disseminated up to the end user, leading to the inaccurate use of organic acids, subsequently resulting into the inconsistency in the results as compared to the antibiotics.

Knowing that the pH in the GIT of the animal is different in different areas and that the pathogenic bacteria like E. coli and Salmonella spp. thrive and multiply in the lower GIT where the pH is favourable for their growth, the efficacy of the organic acids to control the bacteria depends on various factors such as the type and the form of organic acids used, the concentration and amount of acid reaching to the small intestine and the method of application. Though there are many organic acids available, each has a specific molecular structure and varied efficacy and a different MIC (Minimum Inhibitory Concentration) for different bacteria. Formic acid has the strongest antibacterial activity as compared to the other acids and has the lowest MIC compared to other acids (Table 1; Strauss and Hayler, 2001).\Table 1: Minimal inhibitory concentration (MIC) of formic acid (modified after Strauss and Hayler, 2001)

Bacteria	MIC (%)
Salmonella typhimurium	0.10
Escherichia coli	0.15
Listeria monocytogenes	0.10
Campylobacter jejune	0.10
Clostridium botulinum	0.15
Clostridium perfringens	0.10
Pseudomonas aeruginosa	0.10
Staphylococcus aureus	0.15

It has been seen that the liquid acids have very little or no role when the focus is the control of pathogenic bacteria in the lower gut, as more than 90-95% acid gets digested before reaching the small intestine. It has been seen in such a study, that only 5.5% of the formic acid reaches to the small intestine when used at a dosage of 0.5% liquid formic acid (85% active ingredient) in compound feed (Kirsch 2010).

Similar results were observed earlier by Maribo et al. (2000) when the authors only detected 4.4% of active ingredients in the small intestine by using a dosage of 0.7% liquid formic acid in the diet. Moreover, the liquid acids are corrosive so it is not practical to use these acids as such. All pure liquid organic acids are corrosive products. Even if these liquid acids are sprayed on a carrier, the product can remain corrosive.

Salts of organic acids, like calcium propionate, sodium formate or sodium benzoate generally referred to as single salts, as it has one molecule of mineral and one molecule of acid in its structure, seemed to be a good option to add active ingredients in a solid and non-corrosive form, it also helps in reducing the buffering capacity of the compound feed. Studies have shown that organic acid salts led to lower E. coli counts in the ileum and higher Lactobacillus counts in the colon of piglets (Bosi et al. 1999)

Although no much data is available on the amount of acid reaching to the small intestine when used in the form of single salts, quite encouraging data is available on the diformates- the double salt of formic acid (one molecule of mineral and two molecules of formic acid), which shows about 85% of the formic acid enters the small intestine when used in diformate form (Figure 1).

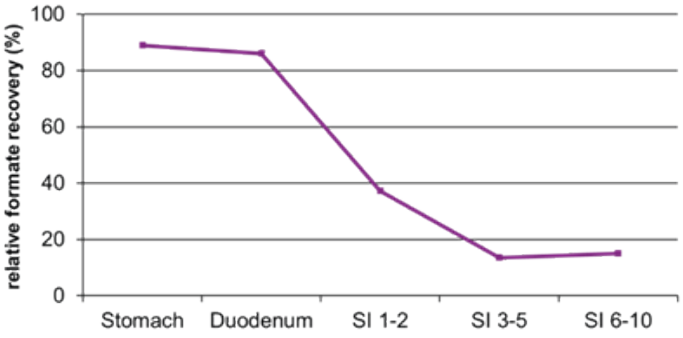


Figure 1: Recovery of diformate in the GIT (after Mroz et al., 2000)

As the amount of formic acid reaching the small intestine (SI) is quite high, one can see well documented results with diformates at much lesser dosage as compared to the single salts.

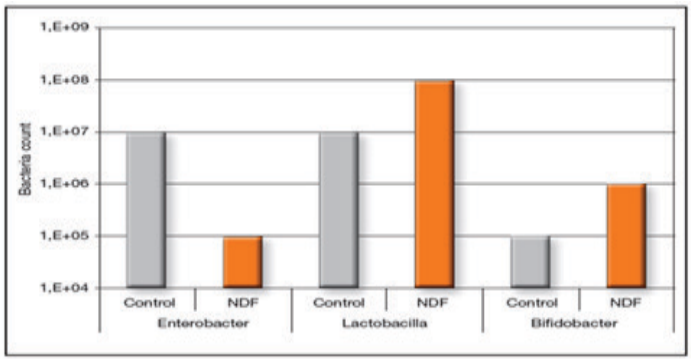


Figure 2: Effect of sodium diformate (traded as Acidomix DF +) on gut microflora in poultry (after Lückstädt and Theobald, 2009)

The availability of higher amounts of active ingredients in the gut will have an influence on the overall gut microflora. Such a study showed (Figure 2) that the number of pathogenic bacteria has been lowered by about 99% whereas the number of beneficial bacteria is improved by one log (Lückstädt and Theobald, 2009).

Tests against intestinal pathogens, including Salmonella, have shown that diformates have significant antimicrobial activity in broiler chickens (Table 2). Keeping bacterial pathogens under control reduced the probability of causing a disease outbreak.

Table 2: Salmonella profile (in % positive) in naturally contaminated broiler in Spain fed with or without sodium diformate (NDF) – after Lückstädt and Theobald, 2009

	Control	AcidomixDF+ 0.3%
Crop (microbiol.)	20	0
Intestine (microbiol.)	20	0
Faeces (microbiol.)	25	0
Meat (serol.)	0	0

In further studies with 0.3% of sodium diformate, carried out at a university in Taiwan, the positive effects on pH in the upper GIT and the improvement in digestibility of protein and fat were seen (Table 3).

Table 3: pH-values and digestibility coefficients in broiler fed with or without sodium diformate (NDF) till 35 days (after Lückstädt and Mellor, 2013)

	Control	**AcidomixDF+ (0.3%)**	**Difference (%)**
pH in crop	4.24	3.96	-0.28 units
pH in stomach	2.94	2.58	-0.36 units
Protein digestibility (%)	61.6	63.3	+2.7
Fat digestibility (%)	90.5	91.1	+0.7

A subsequent trial in the Ukraine, with the addition of 0.2% / 0.1% kg of sodium diformate showed an improvement of 6% in the average daily weight gain against a positive control consisting of an acid blend on carrier with the same dosages, while the FCR was improved by more than 5% (Table 4). Furthermore, this NDF-inclusion reduced the mortality by more than 21%. Finally, the productivity index (EBI) was increased by almost 13%, thus leading to a more cost-effective production.

Table 4: Sodium diformate vs. positive control in commercial broiler in the Ukraine (2013)

	Positive control	AcidomixDF+ (0.2/0.1%)	Difference (%)
Weight, day 20 (g)	931	970	+4.2
Final weight (kg)	2.550	2.700	+5.9
ADG (g)	60	63	+6.0
FCR	1.84	1.74	-5.4
Mortality	2.8	2.2	-21.4
EBI	315	356	+12.8

Though it has been well established that the diformates by the virtue of high formic acid content and with an ability to reach the small intestine in maximum concentration, exhibits excellent antibacterial and growth promoting results, the fact remains that the organic acids are more efficient in controlling the Gram-negative bacteria and show limited activity on the Gram-positive pathogenic bacteria.

In order to have a true antibiotic replacement agent, the combination of diformates with some other sustainable resources which show efficient antibacterial activity against Gram-positive bacteria would be of great advantage.

Work on such 3rd generation acidifier is currently carried out. The data available on the combination of diformates with the plant extracts (traded as Formi Alpha), containing different alkaloids (which show excellent activity against the Gram-positive pathogenic bacteria) are quite encouraging.

From a trial done in Germany in 2015 it was seen that the combination of diformates with the plant alkaloids can, next to the regular impact of diformates on performance and digestibility, considerably reduce Streptococci spp. incidences – and have therefore also a demonstratred impact against Gram-positive bacteria. Futhermore, data are available which show a positive impact on intestinal health, in such a form that the lesion score caused by Clostridia infection is significantly improved.

This and some more data that is available until now, assures that the antibiotics can be definitely replaced with safe and sustainable alternatives for prophylactic use. Such sustainable products will be helpful in improving the performance of the animals with no disadvantage to mankind and environment.

Water – the neglected nutrient

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Water is the most critical nutrient for poultry. In addition to being a nutrient, water aids in digestion and absorption and respiration in birds. Water also helps to remove waste, lubricates joints, and is a major component of blood and a necessary medium for many chemical reactions within the bird's body. Although the importance of providing enough water as per the bird's requirement and adequate access to water is well accepted, the importance of water quality on poultry performance is often overlooked.

Water Quality:

Water quality is important across all livestock species; more so in poultry as, the water intake is on an average 2-3 times that of the feed intake in birds. Quality of water may vary with factors like source of water, the season, the water management processes etc. The drinking water for poultry should be fit for its consumption and should bechecked at regular intervals for various parameters to assure of its quality. Often, it is the pH that is measured as an indicator of water quality; instead, pH along with parameters like hardness, microbiology, ORP, TDS etc. need to be given due importance as well. The various parameters and their relevance is as below,

pH:

pH in simple terms is the level of free H+ ions in water, that determines the acidity or alkalinity of water. Acidification of water is an established concept that helps in keeping all the pathogenic microbes at bay, if optimum acidic levels of up to 3.8-4.0 pH is achieved in the water. pH meters can be used to check the water pH.

Hardness:

Hardness is an indication of the amount of inorganic minerals in water in the form of carbonates/sulphates. Hardness and pH do have a correlation, which is not proportional all the time. Equivalency of high pH to hard water and the vice-versa of low pH to soft water need not essentially hold true. Hardness is a crucial parameter to be checked when we are considering acidification and stabilization of water pH. Water softeners can reduce water hardness but not necessarily the water pH, in which case, water acidification should be the resort.

Microbiology:

Presence of microbes in water specifies possible faecal contamination, pipeline contamination, presence of biofilms etc. E.coli, clostridium and salmonella, should be practically absent in water. Improper pipeline cleaning will lead to

Fig. 1: Biofilm clogging the pipeline

biofilm formation in the pipes, reducing the quantity and quality of water that is being offered to birds, as shown in Fig. 1.

Oxidation Reduction Potential (ORP):

ORP is a measure of tendency of a molecule to acquire electrons and thereby be reduced. It is measured in millivolts and is directly related to the disinfection of water in terms of killing of microbes. Optimal ORP is 650-700 mV, as shown in Table 1. Lesser than 650 mV will lead to microbial growth and not disinfect the water optimally and more than 700 mV ORP could reduce the water intake.

Table 1: Relation between ORP and microbiology

Free chlorine	ORP	Bacterial count	Pseudomonas
4	**805**	0	0
4.4	**730**	0	0
4.9	**668**	0	0
2.3	**653**	0	0
1.2	618	170	12.400
1.2	296	640	1.600
0.8	590	310	2.400
0.7	480	15.000	2.400

Total Dissolved Solids (TDS):

TDS represents the total concentration of inorganic salts and organic matter in water. A TDS value of >3000 ppm is not satisfactory for poultry. TDS is often confused with hardness, it should be borne in mind that the latter is a measure of inorganic salts alone, whereas TDS of both inorganic and organic matter.

Management of water:

Following steps need to be considered with respect to water management

1. Test the water regularly for required parameters
2. Maintain hygiene of tanks, canisters, pipelines, waterers etc.
3. Maintain proper temperature – too hot and too cold a water, will reduce water intake.
4. Use adequate water treatments

Water treatments can be like,

1. Acidification
2. Sanitization
3. Disinfection
4. Medications (vaccinations) as and when required

Few key points to be stressed upon whilst talking of water quality are,

1. Your money invested on water sanitation would go as a waste, if the water were not adequately acidified. Chlorination is the widely used method of water sanitation. Chlorine will be available in two forms when dissolved in water – as hypochlorous acid and hypochlorite. The former is a fast acting compound as compared to the latter, which is quite slow in killing action of microbes, as shown in Fig. 2. The optimal pH for efficient killing of microbes when sanitation is practiced, as per the below figure is 4-5.

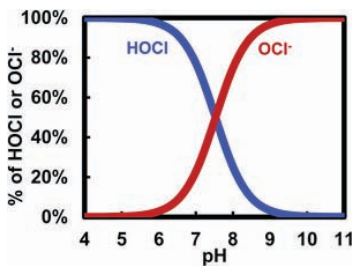


Fig.2: Relation between pH and forms of chlorine

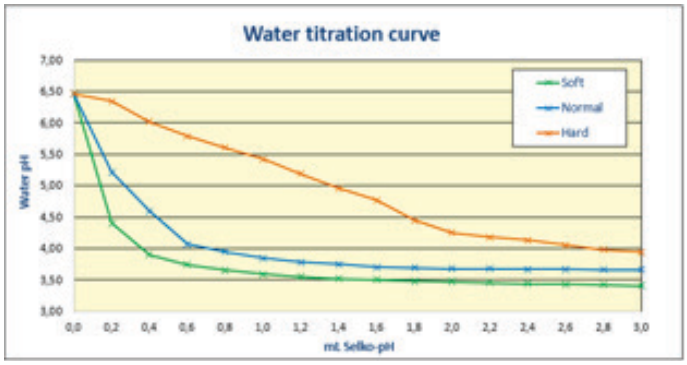


Fig 3a: Water titration curve as a measure to judge water quality

Fig 3b: i-Dip – on-farm tool to judge water quality

2. Maintain optimal ORP to kill microbes effectively. As indicated in Table 1 above, an optimal ORP of 650mV needs to be maintained.
3. Stability of pH is the main criteria to be given emphasis rather than transient drop in pH, while judging the water quality. The immediate drop in pH can be achieved with any acidifier;nevertheless, the aim should be to maintain that specific pH for a longer duration to preserve water quality throughout. Measurements like water titration, use of on-farm technologies like i-Dip need to be adopted, to ensure that optimal water quality is achieved, as shown in Fig. 3a and 3b.
4. Flush and clean the water pipelines adequately. Pipelines are for conducting the water to birds and not the microbes, so ensure to have a cleaning protocol in place and for its effective implementation, if we want clean water to be taken up by birds. Water quality should be measured at all the levels, as shown in Fig. 4 below, nevertheless, the most critical, is to measure it at the bird level.

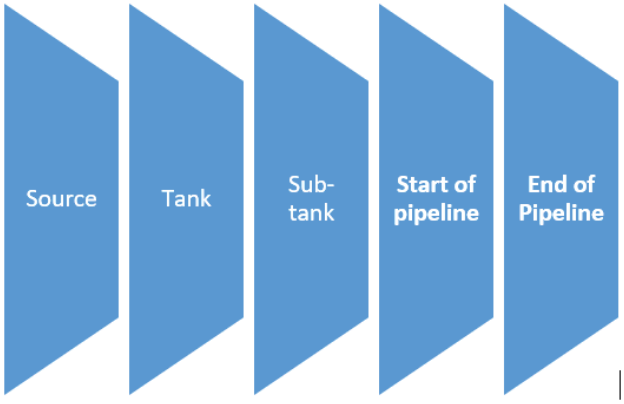


Fig. 4: Water quality measurement points

5. Check the compatibility of medicines when water acidifiers are used. Acidifiers and sanitizers are recommended not to be used, a day before and after vaccinations that are intended through water route. Not all antibiotics are compatible with acidic water, their efficiency might be reduced when water is acidic, including water that naturally have a pH less than 7.
6. Last but not the least, water can act as one of the potential sources of infection that impacts gut health. Strategies to achieve optimal gut health should cover water route as well. One such concepts is inclusion of water acidifiers that are capable of protecting both water quality as well as effective in promoting gut health.

Conclusion:

Water is a critical and crucial nutrient. Water is available to us, almost free and is taken as granted for its quality, with no due emphasis being placed on it. Water quality keeps changing from season to season, from source to source and from farm to farm. Additionally, in few instances, when there is severe scarcity of water, water is purchased from outside, which places a major threat on its quality aspect. Water needs to be checked on a regular basis for required parameters from an authentic laboratory and/or using on-farm technologies. Water is an indispensable natural resource and as responsible citizens, we all should take steps to preserve its quantity and quality. Poultry producers should put in efforts to provide safe water to birds, which would then ensure healthy gut conditions that would consequently improve the overall bird performance.

Technical Update

FEED GRANULOMETRY AND THE IMPORTANCE OF FEED PARTICLE SIZE IN LAYERS

INTRODUCTION

Feed particle size is an often-overlooked aspect of poultry production. Producers should not assume that feed is of a uniform size and homogeneously mixed, or that the feed mill is providing the ideal mix of particles in a ration. Feed particles range in size from very fine to coarse, and different grinding methods will result in different particle size distributions. Differences in particle size within a ration can affect both the digestive system and the performance of the bird, even if the overall nutrient values are similar. Producers, therefore, should frequently evaluate feed particle size distribution and be mindful of the many variables that can affect it.

THE EFFECT OF FEED PARTICLE SIZE ON THE DIGESTIVE SYSTEM

Digestive tract development is influenced by feed particle size. Birds consuming feed with large particles will develop larger and more muscular gizzards and longer intestinal tracts. Larger feed particles require more time in the gizzard to grind feed into smaller particles before they can enter into the small intestine. Larger feed particles have a longer transit time through the intestine. The length of microvilli in the intestine is greater, which increases the absorptive surface area, and thereby positively affects digestibility and nutrient absorption. Some researchers have speculated that the inclusion of larger feed particles in the diet increases localized digestive enzyme secretion in the small intestine, which benefits overall nutrient digestibility.

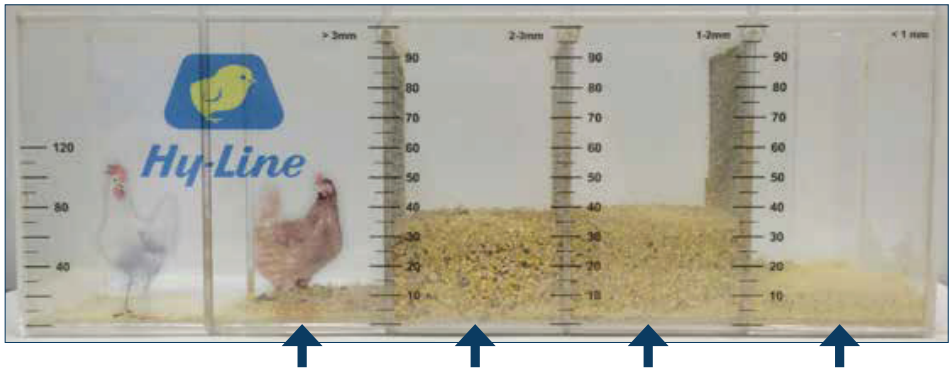
When the diet is composed of predominately fine particles these smaller feed particles quickly pass through the gizzard without grinding and pass into the proventriculus. The result is a small gizzard, enlarged proventriculus and reduced intestine length. Diets containing excessive levels of fine particles should not be fed.

OPTIMAL FEED PARTICLE SIZE

Feed particle size of the diet plays an important role in regulating the feed intake by the bird. Optimal feed particle size increases with age with development of the beak, gizzard and digestive tract. The laying hen has a preference for larger particles, and the preference grows stronger with age.

For the first six weeks, a starter diet is generally given as a crumble, which is made by breaking up pellets consisting of fine particles into a crumble size of 1–3 mm. Crumbled feed is ideal for young chicks because each crumb is a composite of different constituents of the diet. Continued provision of crumbs beyond the starter diet reduces the length of the small intestine and size of the gizzard.

After the starter diet, a well-textured mash (meal) diet is preferred. This ensures proper development of the digestive tract. Well-textured mash (meal) diet has 55–85% of the feed particles between 1 and 3 mm in diameter, with an approximate Geometric Mean Diameter (GMD) of 1200 microns (see Figure 1). Beginning with the pre-lay diet, a well-textured mash diet includes large particles of limestone (2–4 mm diameter). Large particle limestone is needed to maintain good eggshell quality.



	> 3 mm	2–3 mm	1–2 mm	< 1 mm
STARTER	1–3 mm diameter; crumble feed should contain <10% fine feed particles			
GROWER	–	10–25%	45–60%	< 15%
DEVELOPER	5–10%	25–40%	25–35%	< 15%
PRODUCTION	10–15%	30–40%	20–30%	< 15%

Figure 1. Optimal feed particle profile using the Hy-Line Sieve Shaker.

Technical Update – FEED GRANULOMETRY

SELECTIVE EATING BY BIRDS

Mash (meal) feed is generally a mixture of coarse and fine particles. Birds preferentially consume larger feed particles. These large particles are frequently coarse-ground corn, which is an important source of gross energy. Fine feed particles usually contain the synthetic amino acids, phosphorus, vitamins and trace minerals. The vitamin/mineral premix is usually fine particle. Birds that overconsume larger feed particles generally have high energy intake and low intake of other important nutrients, such as Vitamin A, vitamin D, riboflavin, sodium, lysine and methionine. Many egg production and shell quality problems are due to inconsistent nutrient intake caused by selective eating.

Birds that are fed too often or in excessive amount are not encouraged to eat the fine feed particles. Fine particle feed can accumulate in the feeders if not properly managed. Encourage the consumption of fine feed particles by leaving a gap of 2–4 hours mid-day. This allows birds to clean the feeders and consume fine particles during this time. Farmers should monitor the feed bins and feeders to assess feed disappearance to determine the appropriate feeding frequency and feed depth that optimizes the daily consumption of both large and small feed particles.

It is important that birds consume both large and fine feed particles on a daily basis to ensure a balanced nutrient intake.

GRANULOMETRY (DETERMINING FEED PARTICLE SIZE)

The standard method for determining particle size is The American Society of Agricultural Engineers (ASAE) procedure S319.1. (*http://animalscience.unl.edu/Research/RumNut/RumNutLab/21-ParticleSizeAnalysis.pdf*). The procedure involves passing feed or ingredients through a series of 14 screens (sieves) of progressively smaller diameter for 10 minutes. The results are reported as Geometric Mean Diameter (GMD) and a measure of particle size uniformity (standard deviation or coefficient of variation [CV]). Properly manufactured feed should have a CV of less than 10%. This procedure is normally only done by large feed mills.

Figure 2. Test sieves. Image courtesy Gilson Company, Inc.

http://www.globalgilson.com/test-sieves

For evaluation of feed particle size on the farm Hy-Line has its own hand-held sieve shaker that can determine particle distribution of mash feeds (Figure 1). This is a useful tool for farmers to check feed deliveries from the feed mill and check particle size in the birds' feeder.

THE EFFECT OF MILLING PROCESS ON FEED PARTICLE SIZE

Raw material particles undergo multiple changes through the feed milling process. The biggest factor affecting particle size is how the diet is milled. Raw materials, such as soybean meal, fishmeal and premixes, are usually in a form that do not require further particle size reduction. Cereal components (i.e. corn, wheat and other whole grains) of diets always undergo a grinding process. Different ingredient types will behave differently when ground. For instance, wheat will produce a different particle size than corn run through the same grinder.

Figure 3. Sieves of varying sizes used to separate a mash feed sample by particle size. Image courtesy Gilson Company, Inc.

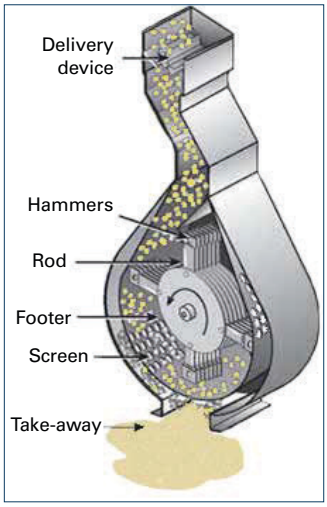


Figure 4. Hammer mill. Image courtesy CPM Roskamp Champion.

Hammer and roller milling are two of the most common methods used to grind raw materials.

Hammer mills (Figure 4) are comprised of rotating sets of hammers that use impact force to break down the grain. The hammers rotate at high velocity and break down the material until it can pass through the surrounding screen. Particle size and uniformity produced by a hammer mill depends on the size, shape, speed and wear of the hammers, as well as the type and diameter of the screen used. Hammer mills are able to produce a wide range of particle sizes. They work well with fiberous materials like wheat by-products.

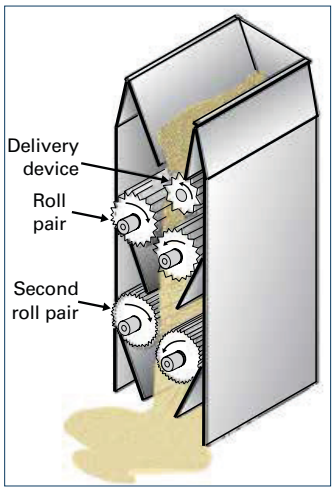


Figure 5. Roller mill. Image courtesy CPM Roskamp Champion.

Roller mills (Figure 5) utilize cylindrical rollers, usually in pairs, to compress and sheer (tear) grains into smaller particles. Feed passes through a series of 2–6 roller pairs which have corrugations or grooves cut into the surface. One roller typically rotates faster and in the opposite direction to create sheering force. Particle size is determined by the number of rollers, distance between rollers, roller diameter, speed and corrugation pattern. Generally, roller mills grind grain into more uniformly sized particles than hammer mills (Figure 6).

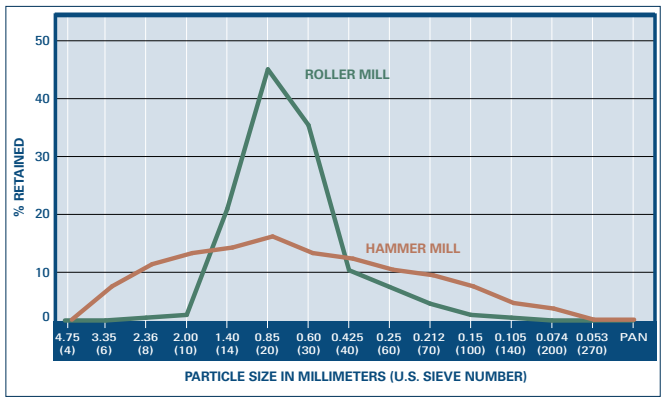


Figure 6. Difference in particle size distribution between a hammer mill and a roller mill. Generally, more uniform particles are produced in a roller mill. Data: M. Heimann, American Soybean Association, 2008.

FEED DELIVERY SYSTEMS

There are three methods of delivering feed in automated feeding systems.

Chain type feeders (Figure 7) - feed is distributed by dragging feed around the feed system with a chain. Chain feeders can cause feed particles to separate by size as it moves feed. The chains can grind the feed particles while being conveyed through the system, although new chain type systems minimize this effect. Slow-moving chain feeders might be problematic as birds at the beginning of a feed line can select out the larger feed particles.

Figure 7. Chain feeder.

Figure 8. Auger feeder. Image courtesy Chore-Time.

Auger type feeders (Figure 8) - an auger is used to distribute the feed. The auger moves feed more rapidly with less feed particle separation and grinding than with chain feeders. Auger feeders typically deliver less feed volume than chain feeders with each feeding.

Hopper type feeders (Figure 9) - a traveling hopper distributes feed by moving down the feed line, dropping feed by gravity. This system causes minimal separation and grinding of feed particles compared to other types of feeders.

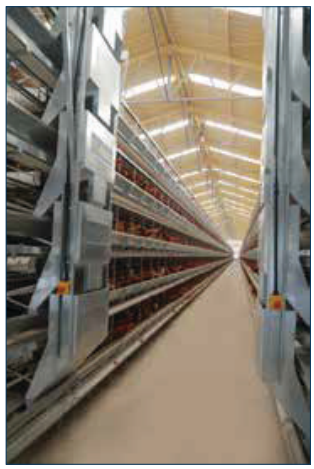


Figure 9. Hopper feeders drop feed directly into the feed trough. Image courtesy Alaso.

Management of the feeders is important to minimize the negative effects of feed particle separation and prevent the accumulation of fine feed particles. Frequent feedings of smaller quantities minimizes the accumulation of fine feed. Chain feeders generally deliver a larger volume of feed, making the accumulation of fine particles possible. Allowing the birds to clean the feeders daily will prevent the accumulation of fine particles. Ensuring that there is enough feeder space for all birds to eat at one time will create more uniform nutrient intake in the flock.

Each system has potential feed particle segregation issues that must be monitored by farm managers. Drag chain systems have more side-to-side segregation, where the fine particles are concentrated in the middle of the trough, but the larger particles congregate near the trough walls. In auger systems, there is more top-to-bottom segregation, with fine particles settling at the bottom of the trough and the larger particles remaining near the feed surface. Repeated cycling of the auger can reduce this separation.

TROUBLESHOOTING

Problem	Cause	Result	Remedy
Feed won't auger into the house	Excessive use of bulky feed materials (rice bran, wheat bran); excessive fine feed particles	Feed does not move properly in feed system; poor feed distribution in feeders; reduced feed intake	Avoid excessive levels of bulky materials; match amounts of bulky materials with auger size; avoid grinding materials which are already a small particle size, additional grinding creates excessively fine material in the end product
Sticky feed	Feed is too finely ground	Bridging of feed in bins and feed manifolds; sticky feed puts extra work on feed motors and feeder chains, resulting in electrical overload	Grind cereal grains in mash feed to 1000 to 1200-micron average particle size, increase screen size in hammer mills, or change from a hammer mill to a roller mill (or from a single-stack roller mill to a double-or-more-stack roller mill)
	Too much added fat or poor mixing of fat within the mash	Potential fat oxidation; lower feed palatability	Reduce the quantity of liquid fat added to the diet and/or ensure better distribution of fat within the mix; use good mixing technique when adding fat or liquid ingredients to mixer; excessive fine particles exacerbate the effect of feed sticking and form large aggregates
Selective feeding by birds	Excessive levels of large particles in the feed; drinkers and feeders on same side of cage, resulting in dominant birds occupying feeder space	Dominant birds consume too many coarse feed particles, leading to uneven nutrient intake	Provide optimum feed particle size distribution (see Figure 1); CV of feed particles should be < 10%; uniform feed is less likely to desegregate; place drinkers away from feeders to encourage bird rotation between feeders and drinkers; provide more feeder space per bird
Poor particle size distribution in the feed	Excessive conveying of mash diet resulting in separation of dense and bulky materials; additional grinding of feed in feed trough by some feeder systems; slow feeder speed	Separation of feed particles according to density	Use a minimum of 0.5% liquid oil/ fat in mash diets to incorporate fine particles and improve particle size distribution
Accumulation of fine feed particles in feed trough	Too many feedings; poor feeder management where birds do not "clean up" fine particles daily	Uneven nutrient intake; fine feed increases house dust; dust can lead to poor air quality and increase respiratory disease	Ensure there is adequate time daily for birds to "clean up" feed between feed runs; do not use feed ingredients which are too dusty; do not grind material which does not need to be ground; remove accumulated fine particle feed refused by birds weekly

– Courtesy Hy-Line International

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For further information please contact :

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