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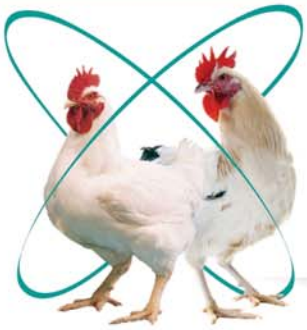

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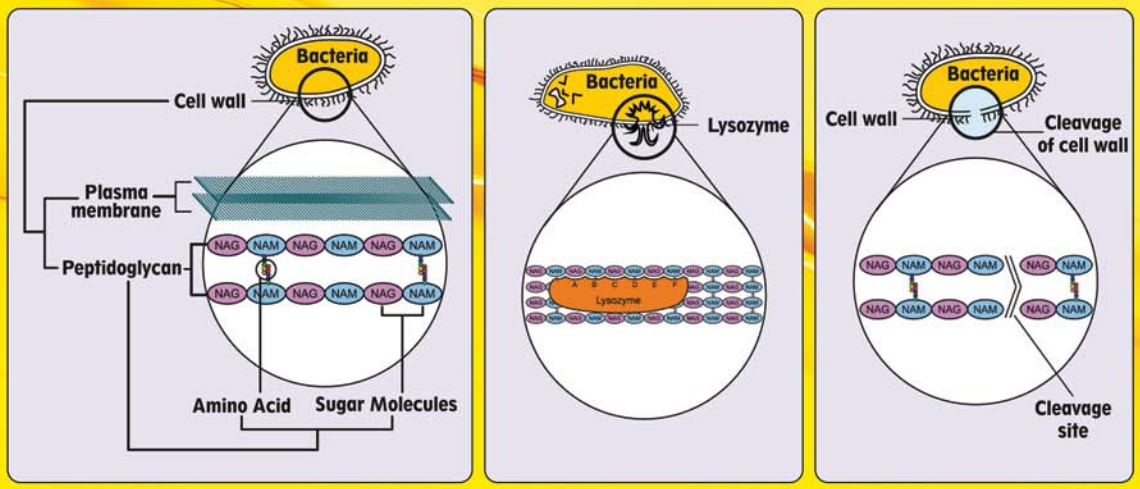

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POULTRY LINE
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Ph: 040-2761 0027, Cell : 98493 68003, 63096 77047
www.tezasvipublications.com
E-mail : tezasvipoultryline@gmail.com
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INDEX OF ADVERTISEMENTS

PRESS RELEASE

Felicitation of Dr.M.A.Mujeeb Ather, on his retirement on attaining the age of superannuation held at Administrative Block of VBRI, Hyderabad

Dr.V.Laxma Reddy, Director and Dr.Malleshwari, Joint Director of Vet.& AH Dept. presenting Memento to Dr.M.A.Mujeeb Ather and his wife

Dr. Ramchander, Additional Director, VBRI presenting Boquet to Dr. M.A.Mujeeb Ather and his wife

An overwhelming sendoff given to Dr.M.A.Mujeeb Ather, Deputy Director, Veterinary- Biological Research Institute (Vbri), Hyderabad by the staff of VBRI and Directorate of Veterinary & Animal Husbandry Department,Govt. of Telangana.

Dr.M.A.Mujeeb Ather completed (34) years of service in the department . All officers along with para and ministerial staff are present. Dr.Devender, AD and Dr.Vijaya Bhasker Reddy, AD invited the dignitaries on the dais followed by felicitation.

Dr.V.Laxma Reddy, Director of Veterinary & Animal Husbandry Department, Dr.Ramchander, Additional Director, Dr.Malleshwari, Joint Director, VBRI, Dr.Babu Beri, President, TAHOSA, Dr. Simha Rao, Secretary, TAHOSA, Mr. Sunil, VHPL, Mr. Sanjeev Chintavar, NECC, Mr. B Shiv Shankar, Editor of Poultry Line, Mr. M.A.Nazeer, Editor of Poultry Fortune, Mr.Jahangir, President of Class 4th Employees Association and many people felicitated Dr.M.A. Mujeeb Ather.

Many speakers have spoken on the occasion and praised the work done by Dr.M.A. Mujeeb Ather and said that he is an **encyclopedia** of our institute and the department will never forget his outstanding

Mr. P.Suneel Sharma, AGM, Venworld, Mr. Sanjeev Chintawar, Business Manager, NECC with Staff of VBRI & Dr.M.A.Mujeeb Ather Family

Dr.M.A.Mujeeb Ather and his wife with the staff of VBRI

Dr.V.Laxma Reddy, Director, speaking on the occasion

Dr. Ramchander, A.D., speaking on the occasion

service and contribution. They said that for every technical work, they used to take his assistance and he will be always on front foot to help them and profusely acknowledged that today what they are because of his able guidance. Further they said that he is so humble and submissive and never saw his ire on any critical situations and they are really missing such a vibrant and dynamic person and said that for the VBRI it's very difficult to find his replacement.

Dr.G.Sunitha, Deputy Director gave a detailed information about the biography of Dr.M..A.Mujeeb Ather and said that he has presented (356) technical papers and out of them 133 technical papers were published in National and international conferences and Journals respectively. He is a resource person for imparting trainings to field Veterinarians. He is very simple , down to earth person and we have not seen him becoming angry at any time and always smiling. He received many gold medals and awards and brought laurels to VBRI and his department.

Dr. V. LaxmaReddy, Director & Dr. Ramchander, Additional Director of Veterinary & Animal Husbandry and Dr. Anantham, Director spoke in detail about the dedicated involvement of Dr.M.A.Mujeeb Ather in departmental activities and said that they are really missing him and said now and then they will be disturbing him for taking technical support.

Dr.Malleshwari, Joint Director, Dr. Babu Beri, Preident,TAHOSA, Dr.Simha Rao, Secretary, TAHOSA, Dr.Sudha Rani, AD, Dr.Suhruda, AD, Dr.Sreelaxmi, Dr.Swamy Reddy, Dr.UzmaKhan,

Staff of VBRI with Dr.M.A.Mujeeb Ather and his family

Mr. M.A.Nazeer, Dr.V.Laxma Reddy, and Mr. B.Shiv Shankar with Dr.M.A.Mujeeb Ather and his wife

Mrs. M.A.Mujeeb Ather speaking on the occasion

Dr.M.A. Rafey Ather, eldest son of Dr.M.A.Mujeeb Ather speaking on the occasion

AD, Dr.Sirisha, AD, Dr.Tanju, VAS, Dr.Madhavi Latha, VAS, Dr.Koti Nagu, VAS, Smt.Mahalaxmi, LSA, Mr.Narender Goud, VLO, Mr. Firasat Ali Baxi (Retd.) Ex President of Employees Association and many others have spoken on the occasion and said they learnt many things from Dr.M.A.Mujeeb Ather and he is the person who has shown us how to conduct post mortems etc. which we will never forget in our lives.

Mr. B Shiv Shankar speaking on the occasion said that he had started his career in the industry as an Editor and Publisher, Poultry Line, since January 2001 and recollected his first meeting with Dr Mujeeb Ather soon after release of his first issue and said that he still remember the kind gesture extended by such genius and senior most scientist. His humbleness and affection was amazing. Apart from publication of Poultry Line and Livestock Line, he said that he has also started organising exhibitions and so far organised 20 editions of exhibitions throughout the length and breadth of the country which included technical seminars during the exhibitions. Whenever and where ever he needed the services of Dr Mujeeb Ather as one of the outstanding speakers, Dr. Ather never hesitated to give his consent despite his busy schedule to which he is always indebted for the kind gesture. Before concluding his speech, he wished him a peaceful and very happy retired life.

Mr. M.A Nazeer, Editor and Publisher of Poultry Fortune, also spoke on the occasion. Referring Dr. V. LaxmaReddy, Director, appreciated his services and his contribution towards the institute and industry. He also praised Dr Mujeeb Ather for

Master M.A. Malik Ather, youngest son of Dr.M.A.Mujeeb Ather

Concludig specach of Dr.M.A.Mujeeb Ather on the occasion

his career as Deputy Director since 34 years and established very cordial relationship with entire staff. He said he is known for his humbleness and wished him a happy and peaceful retired life.

Mrs. Ather said that her husband is having lot of patience and balances very well office and house work, he is a very good planner and always does the work in time and said that he is a very sincere and a humble person

Dr.M.A. Rafey Ather, eldest son of Dr.M.A.Mujeeb Ather said that his Dad is his mentor and always stood with them for their achievements. Under his able guidance, he said that he has completed his MBBS and doing his MD now. My dad is very simple, hard working and a very jolly person and we have never seen him becoming angry and enjoyed every bit in their life.

Master M.A. Malik Ather, youngest son of Dr.M.A.Mujeeb Ather given a very heart breaking speech and said that from the beginning of his school education to till now he stood with him as a friend, guide and philosopher. He said that on the occasion of becoming School People Leader his parents were invited as Chief Guests on to the dais and it was a very memorable day for him.

Dr.M.A.Mujeeb Ather, at the end in his speech thanked all the persons who spoke good words about him and having such a good respect for him. He in detail describe his life and said he belongs to a middle class and well educated family. His father was a District Manager in FCI and mother was a Teacher and all he learnt from his parents. He said that his children are very well in academics and placed well. He also said that he had assisted many post graduates and Phd scholars from different universities for part of completion of their research work. He informed the house that he is also in the ethical committee of Ayush Department ,Govt. of India and said that if any new disease occur, he enjoyed in diagnosing and finding solutions for it. At the end he once again thanked profusely all the staff for extending their warm affection during the function.

From cold storage facilities to more hygienic rearing, Poultry farmers must ensure good health of their flock post COVID19

Dr. Ramdas Kambale, Sr.VP, Vetphage Pharmaceuticals

Dr. Ramdas Kambale

The domestic poultry industry has lost an estimated Rs 1,750 crore over the past two months as the coronavirus outbreak leads to a slump in consumption and demand. It has forced many small scale poultry farmers to go out of business and even pushed some medium scale poultry farmers to the brink of bankruptcy. This downturn has been exacerbated by a flood of fake messages and misinformation on social media about chicken consumption's association with coronavirus.

With the losses cannot be retrieved, it is important that the poultry sector modernize itself and prepare to renew its supplies post the lockdown. It must also be prepared to address misinformation campaigns while improving hygiene and storage standards for its flocks that will help improve the efficacy of the business in the long term. The government must also step forward and help the sector revive itself through relief packages and support to small farmers in restarting their business.

The need for cold storage

The problem of demand slump was further compounded by lack of adequate cold storage facilities for farmers. Many small scale farmers had to resort to distress selling of their birds at prices as low as Rs 5-10 per kg as they did not have logistical support to preserve their meat in cold storage facilities. This meant that the only options for them were to either sell their lot at really cheap prices or cull their birds and bury them. Moreover, 92 percent cold storage units in India are owned by the private sector which mostly includes big companies leaving little safety for small and medium enterprises.

The government must make investment in cold storage for small and medium enterprises so that they can stock their culled birds as well as preserve their meat which can be sold later thereby cutting down their losses. Several large cold storage units that are easily accessible to small scale poultry farmers that they are able rent for specific amount of space as per their needs will be a welcome step for the poultry industry.

Push for reforms to make the sector more organized

The poultry Industry in India relies mostly on wet markets as Indians have a cultural preference for buying fresh produce which is why most customers select the bird before asking the butcher to cut it. Nonetheless, fresh does not always translate to clean and hygienic as some of these makeshift establishments are really unkempt and potential disease carriers. The poultry sector has often faced criticism for unhygienic conditions and unfriendly housing facilities for poultry birds. This is another area the poultry sector must work aggressively to improve. This will help instil confidence among consumers about the safety and healthy origin of birds.

The government on its part must implement adequate quality control mechanisms for the industry. Regular hygiene and quality checks should be done and shops that do not comply with these guidelines must be penalized.

Furthermore, government must set up a committee to monitor all poultry rearing, processing and trade in the country which oversees that poultry farming is done in good conditions thereby not causing any harm to the end consumer as well as the environment. Good hygiene practices at farm level also help in reducing the mortality or birds as well as rate of subclinical infection. Overall, better hygiene results in healthier birds and serves to improve efficacy of the business.

Need for Quality feed additives

In India poultry farmers mostly use soybean and maize which only meet minimum nutritional requirements and do not help in raising quality healthy birds. According to studies fast growing meat chickens require less than three hours to digest and absorb their feed. Since they have a short digestive tract and rapid digestion transit time they need easily digestible nutrient dense diet wherein nutrients are critical. Also, the rates of genetic change in growth and feed efficiency over the years have had a key impact on the physiology of the birds which have in turn changed their nutritional requirements to satisfy the genetic potential of the new strains. This high genetic potential of current poultry strains can only be achieved with properly formulated feeds that are protein and energy-dense.

Also poultry farmers must use regulatory approved feed additives that have been tested to destroy and prevent bacterial infections as well transmission to human by elimination of pathogenic stereotypes. Other things which poultry farm owners and managers must keep in mind are the composition and quality of feed, nutrient value, digestibility, moisture retention, palatability as well as any possible hazards that long term consumption may cause.

Bacteriophages over Antibiotics

Antibiotics are common in the poultry industry as they are used to improve meat production through increased feed conversion and prevention of rampant bacterial diseases. However, the excessive use of antibiotics can compromise the immunity of livestock by causing gastrointestinal infections as well as other diseases. More importantly, excessive use of antibiotics results in the development of anti-bacterial resistance which upon entry in our food chain is harmful to human health.

This is why it important to use alternatives to antibiotics so that farmers can grow healthy poultry as well as prevent bacterial infections. The use of Bacteriophages as a sustainable and healthy alternative has been proven scientifically which is why farmers should make the switch immediately. Bacteriophages are bacteria eaters which are not harmful as they kill the targeted bacteria within the infected cell without interacting with human and animal cells. This makes them the better alternative to antibiotics as they are safer for both poultry and human health.

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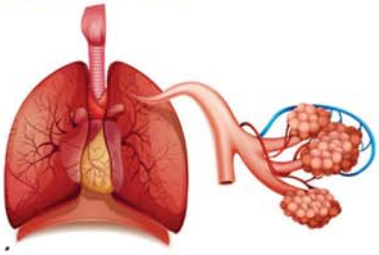

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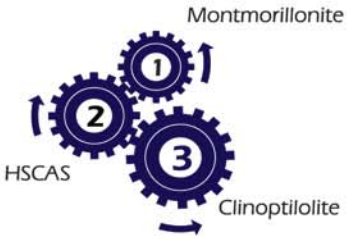

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Evaluating Protease Enzyme

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


Dr. Koushik De

Over the past 20 years usage of feed enzymes have become an important tool to increase the nutritional value of feed ingredients, reduce feed costs, improve the environment, all while maintaining or improving animal performance.Three classes of enzymes (phytases, carbohydrases, and proteases) are typically considered for use in poultry feeds. This article will briefly discuss the correct evaluation of protease enzymes and their applicability to poultry feeds.

Protease is a protein digesting enzyme that breaks down storage proteins within feed ingredients. This makes the amino acids and other nutrients from bound proteinavailable to the bird to be used for productive purposes. Proteases are also effective in removing anti-nutrients found in ingredients like soybean meal. This function of proteases makes proteins more available.

Typically, broilers are only able to digest around 80 percent of amino acids in feed. The rest make their way to the hindgut, where they serve as food for harmful pathogens that proliferate and cause inflammation, which in turn compromises the lining of the small intestine. Affected animals often have to be culled, and even those that recover lose a significant amount of weight in the effort to get well.

Since the introduction of protease feed additives in the market is fairly recentwhen compared to phytase or carbohydrase enzymes and customers have various commercial protease products from which to choose, we offer some guidance on how to evaluate the best fit protease which will work best for their operations.

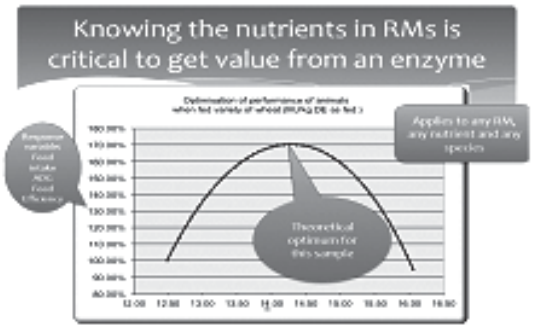
Enzymes increase nutrients available in feed ingredients. Since enzymes are substrate specific, the benefit of the enzyme in the diet is dependent on the mix of raw materials and the amount of substrate available.

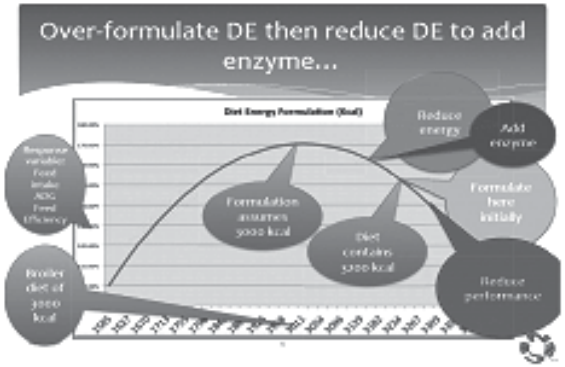
Assessment of added value of enzymes isn't simple. The most accurate method is to use in vivo techniques with animals consuming semi-purified diets. Using this method, the direct effect of an enzyme can be understood for each raw material. As this method is expensive and not available to do it for everybody, the matrix approach based on nutrients contribution values given by the supplier has been widely adopted to evaluate an enzyme.

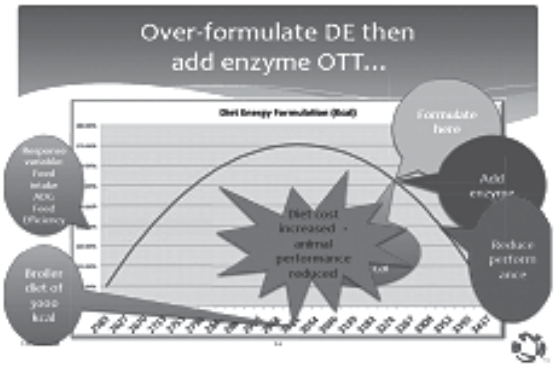
Using a set of nutrient matrix values for an enzyme is a practical approach, and providing unique matrix values to a given enzyme ensures it can be applied simply to any kind of diet, regardless of the raw materials or the amount of substrate. This approach has been easy to adopt in practical formulations, but has consistently demonstrated enzymes failing to meet expectations. These failures have been due to the lack of or an excess of substrate, and/or over-formulation.

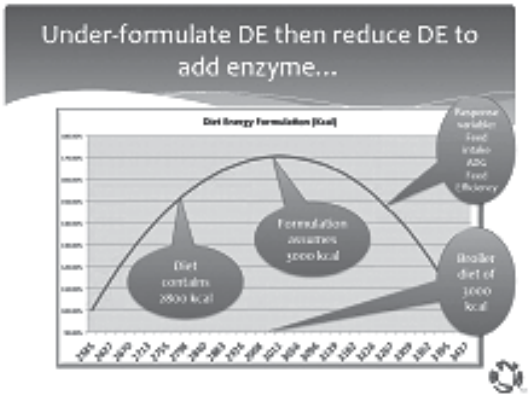
When evaluating enzymes, a few concepts need to be made clear

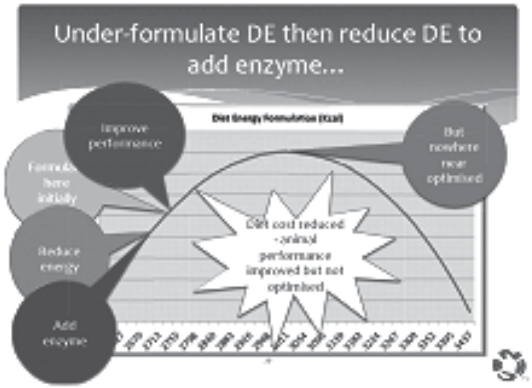
- Substrate: the specific substance on which an enzyme acts
- Enzyme Effect: nutrients that a given enzyme will make available due to the direct enzymatic effect and the additional benefits accrued by the reduction of the substrate in the diet
- Avoid over-formulation or under formulation: enzymes need "nutritional space" to express and thus diets need to be near the deficiency point to make a good estimation of the enzyme's potential.

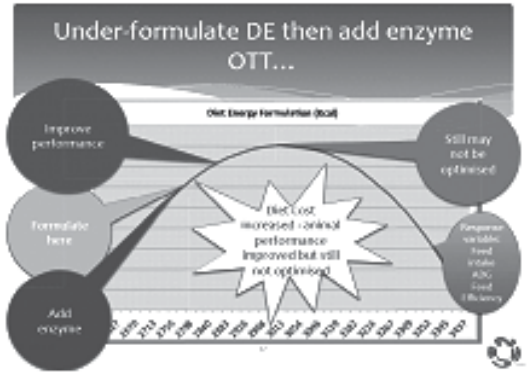


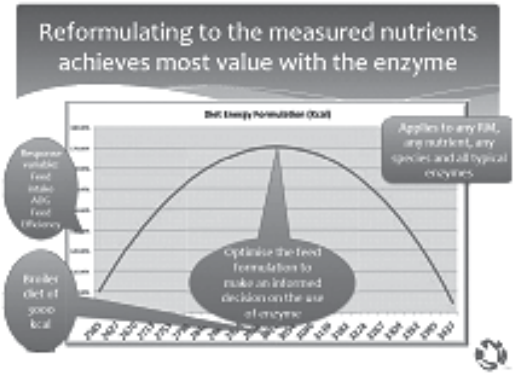


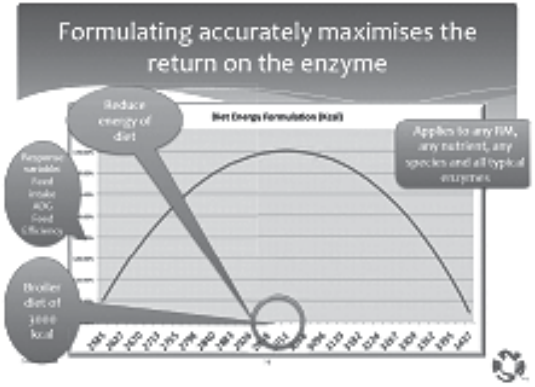


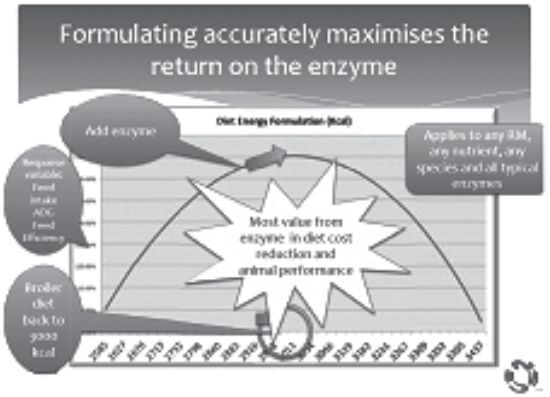












Adapted from Howard Simmins, Insci Associates Ltd, UK.

The More Accurate the feed formulation, the more consistent the response from the enzyme.

The value of any enzyme is money. But how much money one can save depends on the accurate feed formulation. Understanding the optimum nutrition for animals to perform efficiently is the key to maximise the performances. The following slides show the effect of mis-formulating (under/over) energy based on book values versus the actual energy for a sample of raw material (RM) is shown. The principle could apply to any RM, any species, any nutrient and any enzyme. How enzymes work even when we might think they are not working are illustrated and also the importance of must having negative control in any enzyme trial.

One principle to be kept in mind that Good enzymes always work.

Trials for evaluating enzymes:

The test of an enzyme requires being aggressive in the formulation and pushing the limits. Under-performing chickens will help provide a better evaluation of the enzymes and understand how accurate the formulation is.

Challenge Model: In this model, the diet with significant reduction of nutrients, that the enzyme will liberate and make available to the birds, needs to be formulated. Different enzymes can then be added on top.

Objectives of the trial:

- "AA room" is created for enzymes to show their potential.
- Each supplier has different recommendations of how proteases affect the feed. This trial allows simplifying the comparison.
- Proteases can't increase the AA digestibility 10% linearly. As a result, the AA ratio will be unbalanced and subsequently the performance of negative control as well as treatments will be lower than that of the control group.
- The most aggressive protease will have the best performance compared to T2.
- If any of the enzyme groups shows the same performance as the control group (T1), it signals some over formulation as no protease can increase 10% linearly on all the AA.

Response Model: The model is a variation of the 'Challenge model' discussed in the previous section. In this model, two control diets will be used; the current diet (this group is optional if there aren't enough treatments) and a diet group with anywhere between 5% to 10% lower AA specifications. The control 2 specifications will be used for the treatment groups. There will be a reformulation following the matrix value recommendation of each protease supplier.

Table 1: Challenge Model - Proteases - 10% Reduction of the CP and AA from the specifications.

T1	T2	T3	T4	T5
Control	**Negative Control**	**Protease A**	**Protease B**	**Protease C**
Current Diet	Reduction of CP&AA by 10%	T2 + Protease A	T2 + Protease B	T2 + Protease C

Table 2: Response Model - Diet reformulation

T1	T2	T3	T4	T5
Control	**Control 2**	**Protease A**	**Protease B**	**Protease C**
Current Diet	Reduction of CP&AA by 5- 10%	Reformulation of T2 + Protease A	Reformulation of T2 + Protease B	Reformulation of T2 + Protease C

Objectives of the trial:

- Having T1 compared to T2 will assist in acknowledging any over-formulation or amino acid imbalance.
- Having lower specifications in AA and CP creates enough space for the enzyme to express to potential.
- This design allows each supplier to give their ideal recommendations.
- If the enzyme recommendation is too aggressive, the enzyme group will clearly show lower performance than T2 as long as there is a gap of performance between T1 and T2.
- If the enzyme recommendation is conservative and the enzyme can deliver additional benefits it will be reflected in greater performance than T2 as long as there is a gap of performance between T1 and T2.

Conclusions:

When testing the efficacy of an enzyme, its logical to test the additive against some control group. There are lot of factors inherent to experiments involving animals that may influence the outcome, such as age, genetics, environment etc. it is important to be able to discount these as having influenced the results. Here lies the importance of having negative control (NC) in any enzyme experiments. NC takes out the nutrients that the additive (in this case enzyme) is expected to release. The performance of the NC is therefore expected to be significantly worse than that of Positive Control (PC). As discussed earlier we are intending to do several things here: (i) test the reduction of CP & AA have a negative impact on the outcome (say growth) by comparing the PC & NC and (ii) evaluate whether the testing protease enzyme product can regain that lost outcome by comparing the treatments to both the PC & NC, separately. In some cases, it has been seen that by there are no differences in performance between PC & NC even though we reduce the CP & AA in NC, this indicates that there is some kind of over formulation in PC diet which prevents the added enzyme to get any space to work on. In this case the NC should be a true NC with more aggressive challenge to show the reduction in performances.

Crimean - Congo Hemorrhagic Fever (CCHF) - Crucial Zoonotic Disease

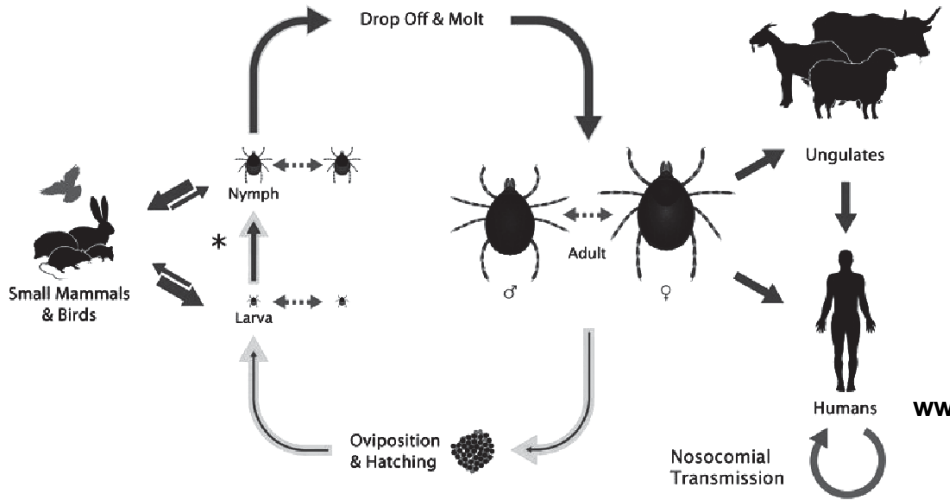
Dr. Pragya Nathiya[1], Dr. Pushpendra Singh Rathore[2] and Dr. Sandeep Kumar Sharma[3]*
Department of Veterinary Microbiology and Biotechnology
Post Graduate Institute of Veterinary Education and Research (PGIVER), Jaipur, Rajasthan
Rajasthan University of Veterinary and Animal Sciences (RAJUVAS)
[1]Teaching Associate, [2]M.V.Sc. Scholar and [3]Assistant Professor & In-charge, Veterinary Microbiology
*Corresponding Author: drsharmask01@hotmail.com

Introduction:

Crimean-Congo hemorrhagic fever is an acute viral zoonotic disease caused by **Nairovirus (tick borne virus)** of the Bunyaviridae family. Disease detected in Crimea in 1944 was named as Crimean Hemorrhagic Fever and in 1956 interestingly, the same disease was recognized in the Congo with similar clinical symptoms of hemorrhagic bleeding & high fever hence was named Crimean- Congo Hemorrhagic Fever (CCHF) in 1969. The disease is endemic in Africa, Balkans, Middle East, Western & South-Central Asia. In India, this disease was reported first in 2011 in Gujarat with three mortalities and more recent outbreak was reported in Amreli district of Gujarat in 2013 in which the virus was detected in ticks, animal and human population. The disease caused severe fatality in human, but animals remain carrier without apparent clinical symptoms. Birds are resistant for this disease but ostriches are susceptible.

Transmission: The disease is mainly transmitted by hard ticks and the genus *Hyalomma* is principal vector for the transmission. Sometime, ticks act as reservoir as well as vector also. The diseases can transmit via nosocomial infection along with contaminated blood, natural secretions, organs, body fluids and improper sterilized equipment, injection needles, and infected medical equipments. Most of the wild and domestic animal such as cattle, buffalo, sheep, goat and hares, serve as amplifying hosts and infected animals may remain viremic even after more than one week of infection.

People working in livestock industry, agricultural works, slaughterhouse and veterinarians working in the endemic areas has a serious risk of exposure. Individuals and international travelers who come in contact with livestock are also at risk of exposure. Sometime the healthcare workers may also get infection due to accidental contact with infectious blood and body fluids. The detail transmission cycle has described in Figure 1.



(Source: www.researchgate.net)

Figure 1: Depicting life cycle of CCHF and transmission of infection among human and animals

Figure 2: CCHF affected Human patient with characteristics severe ecchymoses on affected hand (www.researchgate.net)

Clinical symptoms

The incubation period depends on mode of infection - in case of tick bite infection incubation period is usually one to three days, where as infection via infected blood or tissues, incubation period varies from five to six days, sometimes can go up to 13 days. The disease has following characteristic symptoms

- Early phase of the disease known as pre haemorrhagic phase, characterized by elevated liver enzymes, an increased bleeding duration and thrombocytopenia along with clinical symptoms of headache, high fever, back & joint pain, stiffness myalgia, (muscle ache), sore eyes and photophobia. There may be changes in mood along with nausea, vomiting, diarrhoea, abdominal pain, sore throat and petechiae, red spots on the palate of affected individual.
- Second phase known as haemorrhagic phase, characterized by large areas of severe bruising, ecchymoses, severe nose bleeding and uncontrolled bleeding at injection sites.
- After the fifth days of illness sudden liver failure or pulmonary failure and evidences of hepatitis may be present. Often, tachycardia, lymphadenopathy, jaundice and a petechial rash (a rash caused by bleeding into the skin) on internal mucosal surfaces may be observed.
- Sometime death occurring in the second week of illness with 30.0% mortality rate.

Diagnosis

Since the Crimean-Congo hemorrhagic fever (CCHF) is a viral disease, its early detection and diagnosis is important. The diseases can be diagnosed by various methods:

- At preliminary stage, the disease can diagnosed by differential clinical symptoms but confirmatory diagnosis can be acgieved by laboratory tests.
- In laboratory, disease can diagnosed by serological test such as enzyme-linked immunosorbent assay (ELISA), serum neutralization and blotting technique etc.
- It can be also be diagnosed by molecular techniques such as reverse transcriptase polymerase chain reaction (RT-PCR) as well as Real time PCR (Q-PCR).
- The virus isolation and culture is a very important in diagnosis and it may be achieved via cell culture technique in laboratory.
- In the first few days of illness, patients do not usually develop a measurable antibody response so early diagnosis in such individuals is only achieved by virus isolation or RNA detection in blood or tissue samples.

Prevention and control

- In animal, disease is not so apparent hence it is very difficult to detect and control. The tick-animal-tick cycle usually goes undetected and the tick vectors are several and widespread, so tick control with acaricides is important.
- Since vaccine, is not available, so creating awareness among people and educating them about the control measures is very important to reduce risk of the exposure.
- Wearing of the protective clothing (long sleeves, long trousers) and gloves is recommended while handling animals or their tissues in endemic areas during slaughtering, butchering, and culling procedures.

- Avoidance of close contact with infected individual and wearing protective clothing and proper washing of hands after caring for or visiting ill people must be practiced.
- Use of approved acaricides and insect repellants containing DEET (N, N-diethyl-m-toluamide) is most effective in warding off ticks.
- Strict quarantine for animals should be followed.
- General supportive care and symptomatic treatment is advisable to manage the infection and sometime antiviral drug ribavirin formulations seem to be effective via oral and intravenous administration.

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BROILER LIFTING RATES FOR THE MONTH OF APRIL 2020

place	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30
Hyderabad	87	90	95	99	103	106				111	113	115	120	130	140	145	150		140		130	125	127			127		129	134	135
Karimnagar	87	90	95	99	103	106				111	113	115	120	130	140	145	150		140		130	125	127			127		129	134	135
Warangal	87	90	95	99	103	106				111	113	115	120	130	140	145	150		140		130	125	127			127		129	134	135
Mahaboobnagar	87	90	95	99	103	106				111	113	115	120	130	140	145	150		140		130	125	127			127		129	134	135
Nizamabad	87	90	95	99	103	106				111	113	115	120	130	140	145	150		140		130	125	127			127		129	134	135
Kurnool	87	90	95	99	103	106				111	113	115	120	130	140	145	150		140		130	125	127			117		129	134	135
Vizag	87	90	95	99	103	106				111	111	113	120	130	140	145	150		140		130	125	127			117		120	125	130
Khammam	87	90	95	99	103	106				111	111	113	120	130	140	145	150		140		130	125	127			117		120	125	122
Godavari	87	90	95	99	103	106				111	111	113	120	130	140	140	150		140		130	125	127			107		120	125	124
Vijayawada	80	85	95	92	100	103			100	105	105	107	115	125	135	135	135		132		122	115	117			108		112	117	125
Guntur	80	85	95	92	100	103			101	106	106	108	115	125	135	135	135		134		123	116	118			109		114	119	143
Ongole	80	85	95	92	100	103			102	107	107	109	115	125	135	135	135		135		124	117	119			143		115	120	143
Chittoor	95	98	103	96	115	115	120		120	120	120	123	128	138	143	143	143		143		143	143	143			143		143	143	143
Nellore	95	98	103	96	115	115	120		120	120	120	123	128	138	143	143	143		143		143	143	143			136		143	143	144
Ananthapur	91	94	99	104	110	117	122		122	122	122	124	129	132	134	139	142		142		142	142	142	142	136	136		140	144	144
Kadapa	95	98	103	96	115	115	120		120	120	120	123	128	138	143	143	143		143		143	143	143			143		143	143	143

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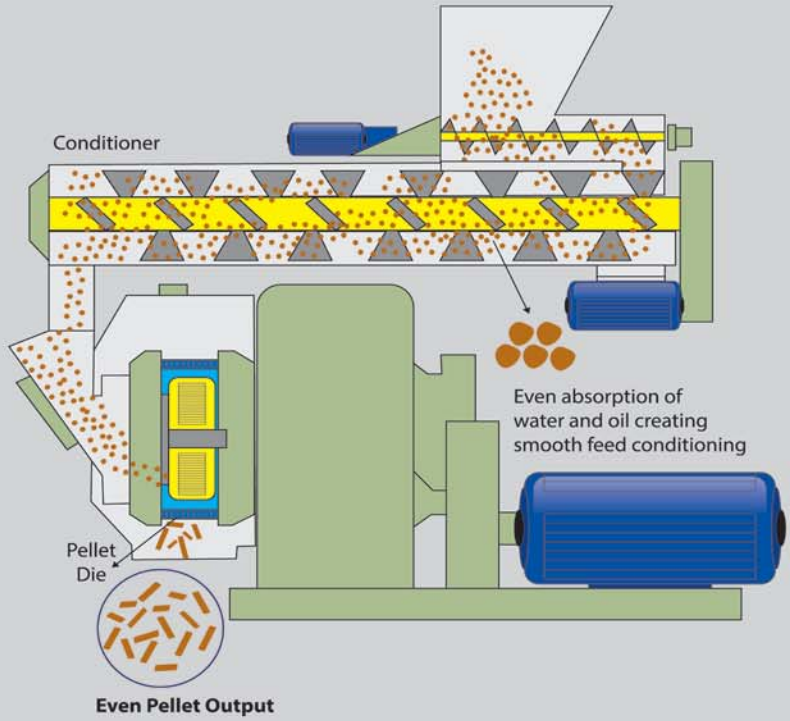

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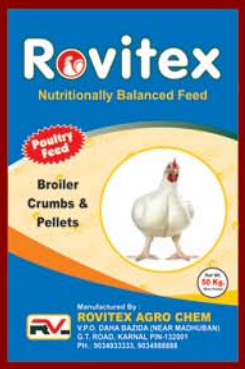

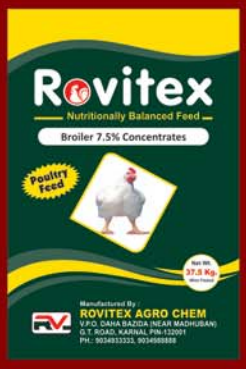

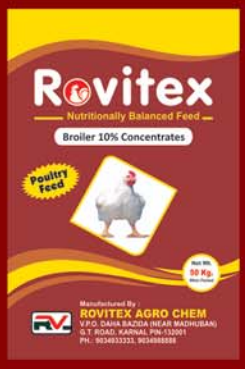

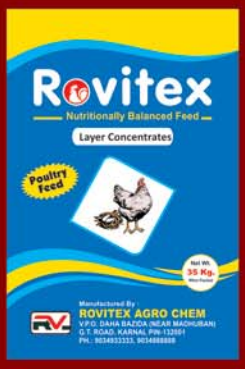

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PRESS RELEASE

Mycotoxins Contribute to Poultry Diseases and Vaccine Impairment

Several lesser-known effects of mycotoxins in poultry related to disrupting gut integrity reinforce the importance of mycotoxin risk management to protect the health and profitability of flocks.

The discovery that mycotoxins affect animal health was surprisingly recent. It was in the 1960's and it explained the sudden death of 100,000 turkeys in the United Kingdom. It turned out that Aspergillus growing on peanut meal produced small amounts of a compound called aflatoxin. The problem had been in the detection of such secondary metabolites of fungi that are often highly toxic but usually present in tiny quantities. Tiny but lethal in the case of those turkeys.

Mycotoxins and poultry disease susceptibility

Now there is growing awareness of the variety of mycotoxins, how frequently they are present in animal feed and, importantly, how much of their effect can simply be impaired performance and increased susceptibility to disease (Table 1).

Area Affected	Mycotoxin Effect	Example References
Intestinal Tract	Direct lesions formed opening pathway to infection (e.g. T-2 toxin)	Sokolović et al., 2008
	Reduced mucus protection, including reduced production of mucus producing goblet cells	Antonissen et al., 2011; Bracarense et al., 2012
	Decreased production of tight junction (TJ) proteins, weakened TJ's allow pathogen entry	Antonissen et al., 2014; Basso et al., 2013
	Faster rate of epithelial cell death (apoptosis can reduce intestinal barrier integrity)	Antonissen et al., 2014; Gitter et al., 2000
	Slower rate of cell replacement in epithelium	Antonissen et al., 2014
	Mucosal damage leading to nutrient availability for pathogen proliferation	Antonissen et al., 2014
	Intestinal inflammatory response impairing animal growth and health and interfering with appropriate immune response to pathogens	Przybylska-Gornowicz et al., 2015

Immune Cells	Protein synthesis inhibition reducing rate of immune cell production and activity	Maresca, 2013
	DNA fragmentation in immune cells reducing immune response. Also exacerbates DNA damage caused by pathogens.	Payros et al., 2017
	Faster rate of immune cell death	Pestka et al., 2008
Cytokines and Antibodies/ Immunoglobulins	Cytokine production leading to inflammation	Pestka et al., 2010
	Reduced response of antibodies when required	Grenier et al., 2011
	Also wasteful increased production of antibodies as part of inflammatory response	Grenier et al., 2011; Obremski, 2014
	Reduced vaccine response	Grenier et al., 2011 (Figure 2)

Table 1. Some known links between mycotoxins and disease susceptibility ***Source:*** *BIOMIN*

A growing trend of pathogenic diseases such as salmonellosis, necrotic enteritis, etc., are putting a pressure on poultry production, reducing productivity and increasing the cost of therapeutic treatment. While we historically link mycotoxins in poultry to classic symptoms such as reduced feed intake, oral lesions, reduced productivity, etc., producers are often unaware of the link between mycotoxins and health.

Lesser known effects in poultry

Some of the common mycotoxins are actually quite poorly absorbed in a normal poultry gut. Trichothecenes (Deoxynivalenol or DON, T-2, etc.) and fumonisins (FUM) are very poorly absorbed in poultry, approximately 10% and 1%, respectively (Grenier et al., 2016).

There is now clear evidence that even if these mycotoxins are not in the bloodstream, they can still affect the gut wall. This in turn can increase the colonization of the epithelium by pathogens, the entry of pathogens into the animal and reduce the ability of an animal to fight infection.

Energy loss

The inflammatory response to these mycotoxins is an energy cost to the animal that can result in significant loss in productivity. This overresponse of the immune system to mycotoxins also interferes with the appropriate response to disease.

Gut barrier erosion

The gut wall is the first barrier that pathogens must overcome to infect a bird. Mycotoxins compromise the integrity of this barrier in many ways. Reduced barrier integrity increases the potential for colonization and uptake of pathogens e.g. *Salmonella* spp. (Vandenbroucke et al., 2011, increased uptake of bacteria), *Clostridia* (Antonissen et al., 2014, increased necrotic enteritis lesions as seen in Figure 1) and *Eimeria* (Grenier, 2016, increased lesions and shedding of oocysts).

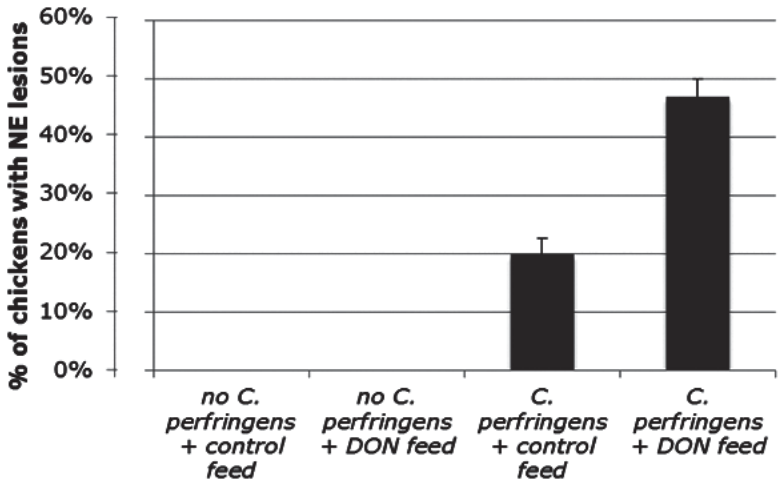

Figure 1. DON can increase the prevalence and also severity of necrotic enteritis lesions in chickens. ***Source:*** *Adapted from Antonissen et al., 2014. Error bars indicate standard error, the mycotoxin difference was statistically significant (P < 0.05).*

At the same time mycotoxins compromise the immune system causing wasteful inflammation and a reduced ability to combat mycotoxins.

Vaccine response: *Another more hidden link between mycotoxins and diseases has also been identified: that mycotoxins can impair the response to vaccines (Figure 2).*

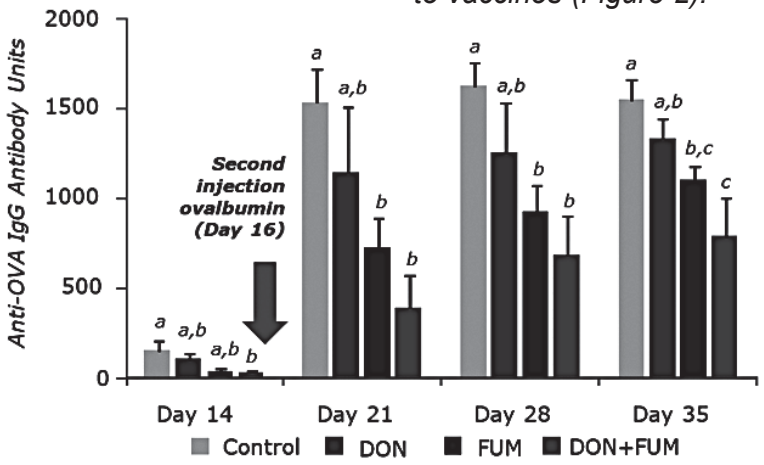

Figure 2. DON and FUM can reduce the response to vaccines with more pronounced effects seen when there is co-occurrence of DON and FUM.

Source: Adapted from Grenier et al., 2011. The response to ovalbumin vaccination (OVA, laboratory antigen) was evaluated via the measurement of anti-OVA IgG antibodies in the serum, and this response was reduced and particularly marked after the second injection. Differences due to mycotoxins remained after 19 days. Treatments not sharing the same letter (a, b or c) on the same day were statistically significantly different (P < 0.05).

Mycotoxin risk management: *Given all of the links between mycotoxins and disease, a mycotoxin risk management program is necessary to safeguard poultry health. This includes monitoring of mycotoxin levels in feed, good feed storage and hygiene as well as an effective mycotoxin deactivator product that can effectively address particularly the trichothecene mycotoxins such as DON and T-2.*

DON is not able to be bound effectively by binder products. With proven biotransformation of trichothecenes, Mycofix® is the only mycotoxin deactivator to successfully obtain the worldwide benchmark of European registration for activity against trichothecenes

Approaches to managing gastrointestinal nematode parasites of Ruminants

[1]M. Norjit Singh, [2]C.Sonia.,[3]Blessa Sailo.,[4]B.K.Sharma and [5] KhaLovingson

[1]Animal Science Division, Central Agricultural University (CAU), Imphal [2,3,4,5] ICAR- Manipur centre, Lamphelpat

Corresponding address: DrChongtham Sonia, Scientist, Animal Science Section, ICAR- Manipur centre, Lamphelpat 795004, Imphal. EMAIL ADDRESS: drsonia.vet@gmail.com

The gastrointestinal (GI) parasites are one of the most common parasites that can cause irreversible damage or even death to the animal, reduced performance, reduced growth rates and economic loss in the form of meat, fiber, or milk for the producer. GI parasites infection remains one of the greatest limiting factors in successful, sustainable livestock production throughout the world. Some of the most common GI parasites found in animals are *Haemonchuscontortus, Ostertagia (Telodorsagia) circumcincta, other Osteragiaspp, Trichostrongylusaxei, Nematodirusspp and Cooperiaspp*are all considered capable of causing clinical and subclinical disease in animals. However, *H. contortus* is the major problem worldwide.The control of GI parasitic infections still relies mainly on the use of effective anthelmintics, which often represent the simpler, safer and cheaper option. But, the prevention and control of GI parasites are becoming increasingly difficult due to overuse or improper use of the available anthelmintics, which results in increasing resistance to anthelmintics by parasites. Twenty years back, anthelmintics resistance was a devastating problem only of the Southern Hemisphere, but now it has been recognized as a global concern.In order to adopt a control measures against any parasitic infection, it is important to have a good knowledge about the life cycle of the parasites. The main goal in attempting to control a parasite is to break its life cycle, which can be done in a variety of ways like use of anthelmintics, animal management, pasturemanagement etc. But using a combination of different methods will usually give the best results to break the life cycle and ultimately in controlling the infection.

I. Pasture Management

Proper pasture management is a key aspect in breaking the lifecycle of internal parasites. Infective larvae of different GI parasites can survive for long periods of time on pasture. The grazing habits of sheep and goats make them much more susceptible to parasites than other species. Although parasite problems cannot be entirely eliminated by good pasture management, using good rotational grazing techniques combined with an efficient anthelmintics program should significantly lower the parasite problem in the herd.The different methods for pasture management are briefly summarized below:

i) Mixed grazing

Grazing of a pasture by different species such as cattle and sheep (but not sheep and goat) together may reduce the infection, as a very little cross infection of GI parasites occurs between animal species.

Grazing by different species that do not share the same parasites simply reduces the available parasites when the susceptible species is returned to do the pasture. On horse farms, cattle or sheep are often used to graze horse pastures before returning the horses to pasture. This reduces the horse parasites from the pasture without any harm to the sheep or cattle.Pasture that has had a crop of hay removed is also considered safe.

ii) Controlled grazing

This method permitsthe pastures to rest and soil life to function well, so that contamination can be reduced. If pastures remain un-grazed for more than one year, then it could be considered as a clean pasture in which there will be no contamination of worm larvae.This is because soil organisms, including earthworms, dung beetles, and nematophagous fungi will destroy the parasite eggs and larvae.

iii) Alternate grazing

Alternative grazing of two or more ruminant species has been shown to be of value in controlling some species of parasites. When the range is shared by several grazing species, the competition for nutrients is usually intra-specific that is between individuals of the same species. In other words, sheep, goats, and cattle seldom compete for the same type of grazing because the species prefer different types and lengths of forage. This affects parasite loads of each grazing species as transmission is dependent on ingesting the parasite larvae on certain parts of the forage. When sheep and goats are grazing in brushy country, sheep will tend to graze closer to ground level and goats will browse brushy herbage. In these circumstances, sheep may suffer from severe parasitic disease while the goats are relatively unscathed. On the other hand, when goats are forced to graze the same land as sheep without the opportunity to browse, the same species of parasites may devastate the goat population while the sheep are less affected.

iv) Rotational grazing

Rotational grazing means that once a pasture has been grazed, animals are rotated to another paddock and the pasture is allowed a rest period. For example cattle or horses grazing can be incorporated into the grazing system of sheep and goat; thereby the parasite contamination can be reduced even further. But pasture rotation, as a single practice for reducing parasites, is largely ineffective and may actually increase parasite loads in animals especially goats. This is particularly true for short term, rapid rotation schemes.

v) Grazing timing

Parasitic infestationsare more prevalent in some seasons of the year depending upon the climatic condition, nematode species infection and length of the grazing season. So the animals should ideally be put in a new pasture when infection is expected to be high in the previous pasture. It is preferable to restrict grazing in highly contaminated fields during infection season.

And it has also been seen that the risk of infection against the GI parasites are lowered if the animals are allowed to grazed after the dew has dried or pasture has dried out after rain. Because this will forces the larvae to stay at ground level and they are less likely to be consumed by the animals.

II. Nutritional management for parasite control

The strongest link between nutrition and parasitism has been illustrated between protein intake and resistance to GIN infection. Immunity is closely related to protein repletion. GI parasites increase the demands for amino acids for the animals. Conversely, one of the first responses of the animal is to decrease feed intake. Animals will voluntarily select a higher protein diet when infected with GIN compared to uninfected animals. Protein supplementation either in the form of by-pass protein or higher dietary protein improves resilience and expression of immunity to gastrointestinal parasites. Protein supplementation in the form of rumen un-degradable protein has been shown to increase the resistance of sheep to *Haemonchuscontortus.* It has been seen that improving the host nutrition primarily in the form of by-pass protein, increases the rate of rejection of adult parasites without affecting the rate of establishment of infective larvae.

Minerals deficiency in animals could be more prevalent in organic animal farming means those dependof home grown feeds and forages. The minerals deficiency in pastures is a characteristic of a particular area.**Zinc** plays an important role in building up a successful immune response against gastrointestinal nematodes.**Iron** has no direct effect on parasitic control; however, iron supplementation has been found to improve the host performance because it restores iron status in the body which is lost through blood during gastrointestinal parasitic infections. In certain areas deficient of **Molybdenum** in soil and pasture, supplementation of Molybdenum has been found to reduce worm burden in sheep. Molybdenum may have a role in increasing jejunal mast cells and blood eosinophil numbers. **Copper**acts as both anti-parasitic and host immunity boosting to some nematodes in goat, sheep and chicken. Adequate copper levels are necessary for development of immunity to GI parasites. Recent work suggests that treatment of lambs with copper oxide orally reduces *Haemonchuscontortus* burdens. However, copper toxicity would be a concern with these treatments. The **phosphorus level** of the diet at a level of 0.28% DM increased weight gain of lambs and decreased worm burden and fecal eggs counts infected with *Trichostrongylusvitrinus* over those lambs fed a low (0.19%) phosphorus level diet.

Deficiency of **vitamin A**, **B_{12}**(or cobalt), **E** (or selenium) have shown to delay the adult worm expulsion, more parasitic eggs in feces and increased fecundity due to changes in host intestinal physiology that promote host protection. Vellema*et al*., (1996) found that vitamin B_{12} deficient lambs had higher faecal egg counts than vitamin B_{12} supplemented one after natural infection with gastrointestinal nematodes.**Condensed Tannins**are secondary plant metabolites which are defense mechanisms against insects and herbivores. It can be detrimental to monogastrics and at high levels will decrease dry matter intake in ruminants. CT containing forages increased weight gains, wool growth and milk production while decreases the effect of GI parasites. The direct parasitic effects include decreased fecal egg counts and decreased L3 viability. The indirect effect of CT is by binding to dietary protein, which allows it to bypass rumen and thus increases protein availability in the small intestine. The most commonly investigated forages are *Lotus pedunculatus* (big or large trefoil), *Lotus corniculatus* (birdsfoot trefoil), *Hedysarumcoronarium* (sulla) and *Onobrychusvicifolia* (sainfoin). **Probiotics** may interfere with GI parasites infection through a number of mechanisms including competition for limited adhesion sites, competition for nutrients that would otherwise be utilized by pathogens (e.g., glucose) and stimulation of the immune response. Orally administered probiotics have great potential to affect the micro-flora of the proximal small intestine as this area is sparsely populated when compared to the colon or distal small bowel. The common microorganisms strain that are commonly used in preparation of probiotics are *Lactobacillus johnsonii*strain La1, *L. rhamnosus*GG, *Lactobacillus plantarum, L. acidophilus* strain LA5

III. Anthelmintics

Anthelmintics are the drugs that either kill egg laying adults, or kill larvae before they become adults and become capable of laying eggs. While some anthelmintics are very effective in killing the parasite but there are two major problems that arise when using anthelmintics. The first problem is there are very few anthelmintics that are actually effective and approved by the FDA for use in animals. The second problem is the resistance that parasites have developed to many anthelmintics. Resistance occurs when a drug is overused and the parasites develop a tolerance to the drug, making it no longer effective in killing them.Resistance of *Haemonchus* to thiabendazole and other drugs in this family is

widespread, phenothiazine, is still apparently quite effective on some ranches in west Texas, but it cannot be recommended elsewhere, resistance to ivermectin has been reported in Texas and South Africa.

Table: Some of the commonly used anthelmintics against GI parasites are listed below:

VI. GENETICS

Discussions of genetic selection of sheep include the terms resistance and resilience. Resistance is the ability of the host to prevent or limit establishment of GI parasite infection. Resilience is the ability to maintain a reasonable level of production when subjected to parasitic challenge. Resistance is as heritable as most production traits (h2=0.35) and is based on fecal egg counts. Resistant animals may not be desirable as there is a negative correlation with production traits and a positive correlation with the incidence of dag and breech soiling. Resistant animals utilize a larger proportion of their resources to developing their immune responses. On the other hand, high producing animals funnel the majority of their resources to growth and less to immunity, thus becoming more susceptible to parasitism. Under conditions of nutritional adequacy, resilience should be improved and may be more realistic that selecting for resistance. However, resilience is more difficult to identify and select for. The heritability of resilience is lower (h2=0.1- 0.19). Resilience was based on drench on demand programs that deworm based on loss of body condition. Resilience has been documented in rams. Resilience and resistance were found not to correlate well. A commercial program, WormFECTM performs fecal egg counts and calculates breeding values for rams based on several traits including presence of serum antibody to GI parasites. The best way for producers to incorporate these traits is to purchase replacement rams that have been suitably evaluated. Genetics of the GIN must also be considered. New gene silencing technology uses double stranded RNA (dsRNA) to turn off specific genes in the target organism. A free living nematode has been used as model to identify the genes of interest (embryo development, fecundity and larval development). Biological anthelmintics are also being investigated. These are phages that are carried into the parasite and either block normal protein replication or provide new binding sites for anthelmintics.

V. VACCINE DEVELOPMENT

Several natural antigens have been used to develop protection through vaccination but none have been mass produced. Vaccines have been developed to the “hidden” antigens and “natural” antigens. Hidden antigens are those which do not cause a detectable immune response in the host with natural infections and are thought to be internal antigens of the nematode. H11 is the best known and is from the intestinal mucosa of *H. contortus*. Protective immunity was achieved using H11 purified from the parasite. Recombinant H11 vaccines have not provided the same protection as the natural H11 and have not been commercialization. The interaction of immunity and hypersensitivity to parasites is complex. Many of the undesirable effects of parasitism (scouring, and reduced production of muscle, wool and milk) may be due to an exaggerated hypersensitivity reaction. This may have a genetic predisposition. Some research has looked at modifying the immune reaction using cytokines.

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PRESS RELEASE

Aviagen President of International Business Bob Dobbie to Retire

Customers in Asia Pacific benefit from his commitment, Expertise and passion

June 5, 2020 – HUNTSVILLE, Ala. – After more than 43 years of dedicated service to the global poultry industry, Bob Dobbie will retire from his role as Aviagen® President of International Business as of August of this year. The recruitment process for the right candidate to meet the unique challenges of this role is already well underway.

Due to Bob's strong leadership, expertise and commitment, Aviagen's global business has grown right along with the success of its customers. Among his strengths are the ability to build the right team to take on the developing region's unique challenges, while providing customers with excellent care. Through his closeness withthe region's producers, he has insight into their unique needs, and he and his team continually share with them the knowledge and expertise to strengthen the performance, health and welfare of their birds, while maximizing the profitability of their operations.

Rich and productive career

Bob has enjoyed a vast and well-rounded career in the industry. He started in 1977 with Ross® and Aviagen on the hatchery side of the business, and then moved to breeder farms, production, customer service and finally into commercial management responsibilities. He has been a regional manager in Europe, Middle East, Africa, Asia and Latin America, and was directly involved in acquisitions and start-ups in Turkey, Brazil, India, Australia, South Africa, and New Zealand plus the integration of the Indian River® and Arbor Acres® businesses before moving into his current role.

Commitment to training the future

Bob believes that education is key to the sustainability of the global poultry industry, and has always been an executivesponsor of the long-standing Aviagen Production Management School. He sees the School's enormous benefit in helping to build the next generation of poultry industry leaders. And, he recognizes the School's importance in providing a forum for sharing knowledge to help producers optimize the productivity of their operations at home, while at the same time forming lasting relationships with industry colleagues

Invaluable contribution to industry as a whole

Aviagen CEO reflects on Bob's immense dedication and larger-than-life personality. "Bob is well-liked by colleagues and customers alike, and we will all miss his tenacity, straightforward way of communicating, in-depth knowledge and insight, and sense of humor. He genuinely cares about people. He appreciates diversity and diverse cultures, and has the special ability to feel at home anywhere in the world," remarked Aviagen CEO Jan Henriksen. "We thank him for his contribution to our company, our customers, and our industry."

Until a new president of International Business is named, our in-country teams will keep providing excellence in service to enable customers throughout Australia, New Zealand, India and China to advance their businesses.

About Aviagen

Aviagen® is a global poultry breeding company that develops pedigree linesfor the production of commercial broiler chickens under the Arbor Acres®, Indian River®, and Ross® brand names. The Rowan Range® and Specialty Males® are specialty breeding stock from Aviagen that offer greater flexibility for customers to meet specific or niche market requirements. The company is based in Huntsville, Alabama, USA with a number of wholly-owned operations across the United Kingdom, Europe, Turkey, Latin America, India, Australia, New Zealand, and the U.S.A., and joint ventures in Asia. Aviagen employs more than 5,000 people and has a distribution network serving customers in more than 100 countries.

For further information, please visit www.aviagen.com.

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Hy-Line®

Hy-Line® Innovations

A Publication of Hy-Line International

Hy-Line Makes History with New Breeding Program in India

International Bird Now Customized for India

This Unique challenges, unique conditions, unique climate. Each phrase describes the growing country of India. To meet these challenges, egg farmers in India require a bird that has been tested and proven locally.

To meet this need, Hy-Line International recently initiated a breeding program in India for the Hy-Line W-80, customizing this international bird for India. This new approach is the first of its kind in the nearly 85-year history of the Hy-Line genetics program.

"The Hy-line W-80 is on her way to becoming a unique Indian variety", said Dr. Petek Settar, Hy-Line International's Senior Geneticist leading the India breeding program. "We chose to begin our first genetics program outside of the USA in India for the unique conditions and great potential to feed the growing population."

Select to Excel Locally

Hy-Line is genetically selecting a special version of the Hy-Line W-80 to excel under India's unique conditions. The elite birds in the India genetics program are evaluated on their ability to achieve the preferred local egg size, ever-increasing egg numbers, long persistency of lay and ideal onset of lay, with a continued commitment to superior shell quality late into lay.

Bred and Adapted for Indian Conditions

The first genetics from the breeding program will be released to the market in early 2020. All orders for Hy-Line distributor, Srinivasa, will be supplied from this program.

"We are local, we are committed," affirmed Jonathan Cade, President of Hy-Line International. We are targeting the right egg size for India and making the Hy-Line W-80 even more robust for local challenges. We succeed when the commercial layer farmer succeeds."

Comparatively, the Hy-Line W-80 already outperforms the competition with longer laying cycles. Indian egg producers can maintain the W-80 with less feed than the competition. It means more profit for producers – more saleable eggs with less money spent on resources.

Considering the projected increase in egg consumption in India and constraints in terms of availability of raw material to meet the growing demand, the Hy-Line W-80 is the best choice for the egg producer in India. This is the future for sustainable and responsible egg production.

For more details visit: https://www.hyline.com/about-us/news/innovations

NATIONAL EGG CO-ORDINATION COMMITTEE

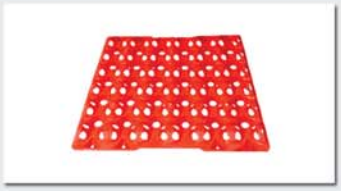
DAILY / MONTHLY EGG PRICES DECLARED BY NECC AND PREVAILING PRICES AT VARIOUS PRODUCTION CENTRES (PC) AND CONSUMPTION CENTERS (CC) MAY 2020

Name Of Zone \ Day	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31	Average
NECC Prices																																
Ahmedabad	340	345	350	353	355	355	355	340	325	325	325	325	330	335	340	345	347	347	347	347	347	347	347	347	347	347	347	347	347	350	353	343.77
Ajmer	305	310	310	310	310	295	290	275	260	260	260	260	272	290	290	290	290	290	290	270	270	270	270	270	270	270	270	270	272	282	300	281.96
Asansole	380	390	400	410	400	400	380	380	380	365	360	360	360	365	365	370	370	370	370	352	350	350	350	350	350	350	350	350	350	350	350	367
Barwala	301	310	312	312	312	290	290	275	260	305	295	295	272	285	305	290	290	290	270	263	271	271	271	257	258	261	261	261	263	266	275	281.83
Bengaluru (CC)	325	330	335	340	345	350	350	350	335	320	320	320	325	330	335	340	345	350	355	355	355	355	355	355	355	355	355	355	355	355	355	343.87
Brahmapur (OD)	336	350	355	362	362	362	352	332	322	322	322	322	322	322	332	337	337	337	337	337	337	310	300	313	313	313	313	313	313	313	313	329.38
Burdwan (CC)	390	400	410	415	415	400	380	360	360	360	345	345	350	360	370	375	375	375	350	350	350	360	360	360	360	360	360	360	360	360	360	368.87
CHENNAI	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Chennai (CC)	400	380	380	380	380	380	380	380	380	350	350	350	350	350	355	365	370	370	375	380	380	380	380	380	380	380	380	380	380	380	380	373.7
Chittoor	393	373	373	373	373	373	373	373	373	343	343	343	343	343	348	358	363	363	368	373	373	373	373	373	373	373	373	373	373	373	373	366.7
Delhi (CC)	320	330	335	335	335	335	315	305	305	280	280	280	280	295	305	305	305	305	305	285	285	285	285	285	275	275	275	275	275	278	283	297.29
E.Godavari	325	335	340	345	345	345	345	330	330	330	330	305	310	320	330	333	333	333	333	333	333	310	310	310	310	310	310	310	310	310	310	324.61
Hyderabad	325	330	337	342	345	345	345	300	300	300	300	305	310	315	320	325	330	335	340	340	340	340	340	340	340	340	340	340	340	340	340	329.96
Ludhiana	320	310	310	310	310	310	298	274	274	259	259	259	259	273	291	290	290	290	270	263	271	271	271	271	257	263	263	263	263	267	282	279.38
Midnapur (KOL)	390	400	410	415	415	400	380	360	360	360	345	345	350	360	370	375	375	375	350	350	350	360	360	360	360	360	360	360	360	360	360	368.87
Miraj	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Mumbai (CC)	360	365	370	375	380	385	385	370	355	340	340	340	345	350	355	360	365	370	375	380	380	370	360	360	365	365	365	365	365	368	371	364.48
Muzaffurpur (CC)	371	376	376	376	371	367	377	357	348	343	343	338	333	338	338	338	333	333	328	328	324	324	324	319	319	319	324	324	328	328	328	341.06
Mysuru	343	338	341	346	351	355	355	355	340	325	325	325	330	335	341	347	352	357	362	364	364	364	364	364	364	364	364	364	364	364	364	351.32
Nagpur	325	325	330	330	310	295	290	280	270	265	260	290	300	305	305	305	305	300	295	290	290	300	305	305	305	305	298	298	303	305	310	299.96
Namakkal	320	325	330	335	340	340	340	330	320	320	320	320	325	335	340	345	345	350	355	355	355	355	355	355	355	355	355	355	355	360	360	342.09
Patna	367	371	381	381	371	367	367	357	333	333	333	324	324	338	338	328	324	324	319	319	314	324	314	309	309	314	314	314	314	319	324	334.45
Pune	400	400	400	400	400	400	400	370	350	335	335	335	340	345	350	355	365	365	370	375	375	355	355	357	360	360	360	360	360	362	365	366.41
Ranchi (CC)	381	381	390	390	390	390	380	381	376	371	367	357	357	357	357	348	343	338	338	338	324	333	333	328	324	324	328	328	333	333	352	353.87
Vijayawada	325	335	340	345	345	345	345	330	330	330	330	305	310	320	330	333	333	333	333	333	333	310	310	310	310	310	310	310	310	310	310	324.61
Vizag	375	375	375	375	375	375	375	375	375	375	375	375	375	375	375	375	375	375	375	375	375	350	350	350	350	350	350	350	350	350	350	366.93
W.Godavari	325	335	340	345	345	345	345	315	315	315	315	305	310	320	330	333	333	333	333	333	333	310	310	310	310	310	310	310	310	310	310	322.67
Warangal	317	327	332	339	344	347	347	347	302	302	302	302	307	312	317	322	327	332	337	342	342	342	342	342	342	342	342	342	342	342	342	331.16
Prevailing Prices																																
Allahabad (CC)	338	343	338	333	333	328	328	328	324	319	309	309	309	324	324	333	333	324	324	324	314	314	309	309	309	300	300	300	305	309	314	319.61
Bhopal	255	295	305	305	305	305	275	275	275	275	275	260	275	285	285	305	305	305	305	285	285	285	285	285	285	285	300	295	295	300	310	289.19
Hospet	290	295	300	305	310	315	315	315	300	285	285	285	290	295	300	305	310	315	320	320	320	320	320	320	320	320	320	320	320	320	320	308.87
Indore (CC)	340	340	340	340	340	330	330	330	310	310	310	300	290	280	280	300	300	300	320	300	310	310	300	300	300	300	325	340	340	350	350	316.61
Jabalpur	312	320	327	332	332	332	315	305	300	290	290	290	300	315	320	325	325	327	327	327	320	320	320	320	320	320	322	322	324	326	333	318
Kanpur (CC)	314	324	324	324	324	300	300	300	290	290	290	290	290	300	314	314	314	314	305	295	295	295	295	295	295	295	295	295	295	295	305	302.29
Kolkata (CC)	370	380	386	386	386	365	350	350	350	350	335	330	330	340	350	355	355	355	328	325	325	325	340	340	340	340	340	340	340	340	340	347.93
Luknow (CC)	333	343	348	348	348	343	333	328	328	317	319	309	309	321	333	333	333	333	333	309	309	319	319	319	319	319	319	319	319	319	324	325.96
Raipur	330	345	348	358	355	355	330	330	320	320	320	320	325	335	335	345	345	345	345	345	345	345	345	345	345	345	345	345	345	345	350	340.35
Surat	370	375	380	385	385	385	385	370	355	340	340	340	350	355	360	365	367	367	367	367	367	367	367	367	367	367	367	367	367	370	375	366.32
Varanasi (CC)	360	367	373	373	366	360	350	343	333	320	320	327	333	343	343	343	337	327	327	320	323	330	330	321	317	313	317	317	320	323	323	335.45

SAI KRISHNA

POULTRY EQUIPMENTS

Chick Feeder



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Chick Feed Tray

Chick Drinker

Drinker
(Assemble Valve System)

Deluxe Drinker
(Standard & Large)

Feeder

Gas Brooder

Chain Link Mesh

Jumbo Drinker

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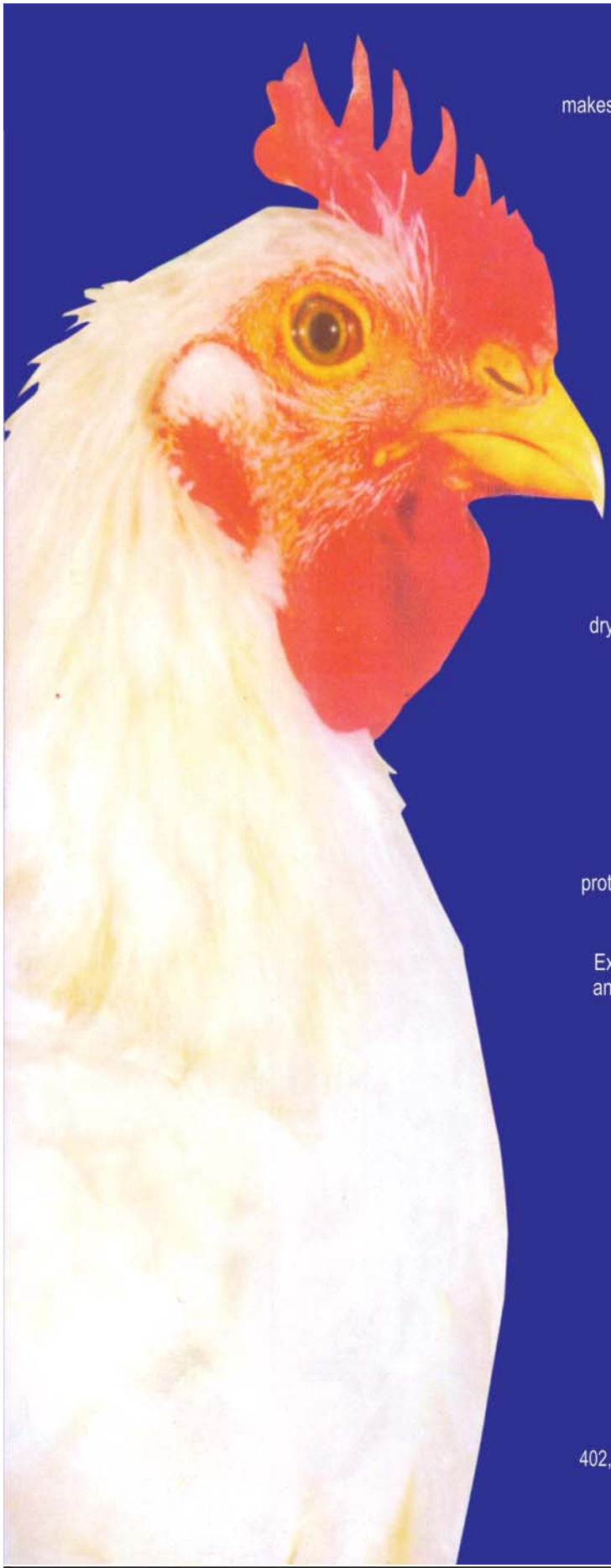

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PRESS RELEASE

Rebuilding the foundation: no more a luxury, but a necessity!

O P Singh

I am writing this at a time just when the COVID-19 news cycle is making way for African swine fever (ASF) which has been reported in India for the first time and the political manoeuvre declaring 'we are ready' to companies looking to exit China and making their way into India! Do I lament or do I cheer? I've time for neither, because I've a house to put back in order, and I better get a move on it.

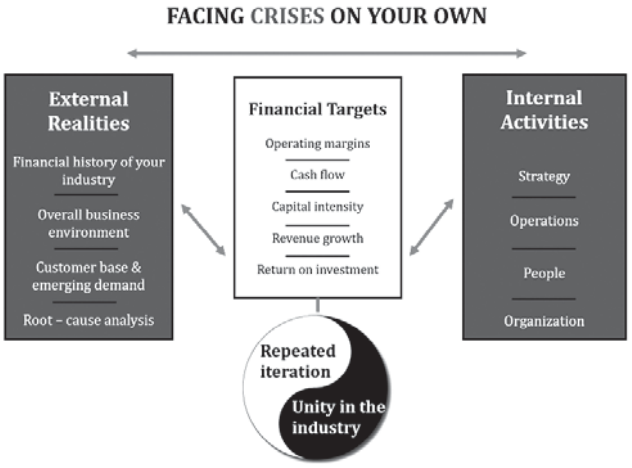
I'm not sure what percentage of Indian companies had an existing framework or a policy for 'work from home' before the lockdown precipitated by COVID-19. Since our industry is so people centric and real time, and ofcourse, because 'who does sales from home??', we didn't have one! When the lockdown was announced, I think the feeling was like when in school, an unexpected 'off day' would be announced and you would go home, only difference being, in this case you weren't returning the next day, far from it.

Since no one knew what was happening, the first potential challenge we expected was flagging employee motivation and engagement. The management team rallied and put together a daily interface comprising of technical trainings, marketing sessions, business reviews, updation of data etc.. Wellness of our team - physical and mental was a priority for us, for one, the business climate has been cloudy for a time now and for another, COVID brought with it fear of the unknown and uncertainty. The regular engagement ensured that the team remained anchored.

The second challenge was how to protect the business itself that was rendered handicapped. One team was constantly working on finding ways to reach our products to its customers to make sure we had a business to get back to on the other side of COVID-19.

The third challenge was how to continue paying salaries to our workforce. I've been an employee myself at a point in life and I understand how every penny coming in, is already spoken for, before it even hits your account. The anxiety in the employee's minds was palpable. It was a character defining moment for the organisation and we managed to work our way through, making an accommodating decision for all.

I won't be alone when I say that these past 6 weeks have altered a lot of things for us.Its made us think of things we otherwise never would have had to. It was a realisation of what was important in life and what wasn't. For the first time we were left to our own devices at a time which was clearly 'make or break'. The team was looking to each other for hand holding and support. We relied on each other to bring to the table experience and wisdom, to create our own model which helped ***evaluate*** our current situation, and also ensure that in the time to come, we not only survive , but thrive.



So far, it was each for his own. But if you ask me, going forward, it's my firm belief that the industry will have to act and work collectively, because the

revival of the industry is beyond the scope of mere corrections. Our action areas will need to be defined, because the future of this industry depends on how we understand what the market is telling us and not what we want it to be. I expect the following tenets to shape the industry:

The NEW BEDROCK of business principles

How do I say this?

Post Covid-19, there will most certainly be a change in consumption of animal protein. How consumer looks at the industry right now will change. Its likely to manifest itself through:

- Consumer behaviour
- Demand for food safety
- Demand for hygiene in supply chain & delivery

In India, social media and rumour mongering fanned anti chicken sentiments, resulting in a loss of approximately 15 billion in the past 5-6 weeks. During the lockdown, demand has been low. Those still consuming have shown a clear preference to packaged , branded poultry products that vouch for high hygiene standards. It will not be an exaggeration, if in time to come, consumers demand bar coding of such products, scanning of which will give them access to the entire supply chain stages of the product. Millennials and Generation Z are the demograpic driving meat consumption in our country. They are more aware, understand and demand 'food safety' and are sophisticated in their choices.

I don'tsee consumers lining up outside chicken shops for their sunday special lunches for some time to come. And here, the spotlight shifts to our poultry processing. Currently about 5% of poultry meat is sold in processed form, of which only about 1% undergoes processing into value-added products (ready-to-eat/ ready-to-cook). The poultry processing industry in India was expected to expand at a CAGR of ~12% between 2018 and 2023. However, taking into consideration consumers preference for packaged meat, this could go as high as 20%. Poultry is the major source of meat in our country, its share in total meat consumption is about 28%. And since we cannot allow this to change, we will need to look at the processing requirement, recalibrate our existing capabilities and capacities to prepare to match the demand.

Job losses and pay cuts are bound to lower the disposable income in the hands of urban and rural consumers alike. Over 70% of the Indian population in non-vegetarian. Eggs are the cheapest source of protein and chicken is the most loved meat! Will this change post COVID-19? While there are no statistics to support at this time, in this scenario chicken might become a luxury or once in a while eaten commodity. It will be natural behaviour for consumers to keep the focus on filling their bellies. Imagine the daily wage workers- those who are the customers for entrails, there aren't any daily wages any more! The strata of society which can still afford it are not likely to fill the consumption gap.

In this likely scenario, the industry will need to 'restructure' itself in ways more than one. Future production will have to be rationalised by re assessing the market size to establish a figure of eggs and chicken that can be sold. We might have to look at price & product customization to keep poultry and products attractive for all consumers for inclusive growth.

On another front, institutional buyers like hotels etc constitute 40% of poultry/ products sale. This demand has been close to non-existent since mid March. There are yet no clear indications when this will change. This is a big hit to industry and we have no idea where from to make up for this gap.Even when this section is back on its feet, for patrons to flock to their favourite eateries could take 6-8 months. And this is provided they are satisfied about hygiene and safety standards followed at these establishments. 'Biosecurity' hitherto not applied in this context, will become the ***new normal*** for institutional business.It will be expected and it will have to be delivered.

Chicken growers and egg producing farmers will have ***additional*** responsibilities, to include that they adhere to and comply with ***food safety***, ***biosecurity*** and ***hygiene*** standards in operations. And it cannot only be claimed. The claim will have to be legitimisedin order for the product to be acceptable. They will be expected to be able to prove the quality of protein, with full traceability. This will undoubtedly add to production cost and consequently transferred to the cost of protein delivered/kg body weight.A lot of small players might succumb to the pressures of the current situation and either perish or aggregate. If a company is in the poultry industry today and continues to see itself as part of it 10 years from now, this has to be considered as an investment.

The industry will have to step up to this challenge. Communication will be key. What worked ***against*** us, must be made to ***work*** for us. Distribution channels have to be sensitised to the need for higher degree of sanitisation.Production has to be calibrated to demand, to be managed very effectively and efficiently not just in the short term, but also in the long term. There can neither be surplus nor shortage. Availability in the right number will be key. Any mismanagement will only further perpetuate pricing issues and losses to each and every stakeholder in the integrated operation, which we can ill afford.

Its time to come out of our silos and put on a united front and take on these challenges head on. Not all of us will be of one mind, but this is an existential threat, which requires us to rise above any differences. Our industry has been put to and passed through several trying times. But we came out on the other side- stronger, smarter. This time should be no different, and I only hope we can add united to the words that are used to describe us.

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.

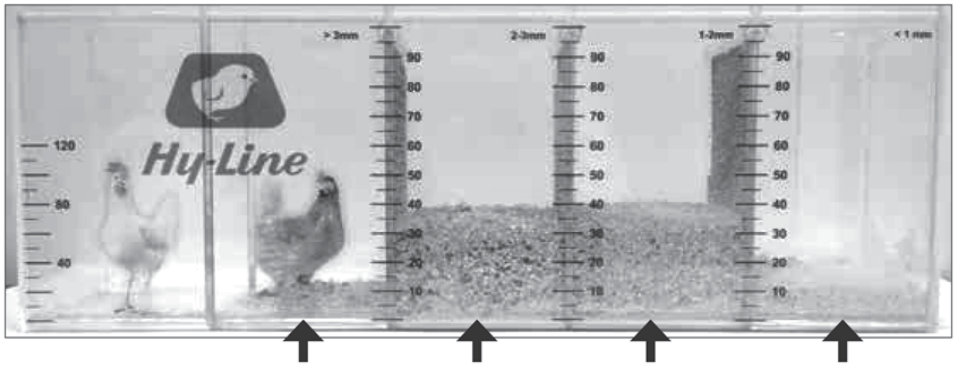
When the diet is composed of predominately fine particles these smaller feed particles quickly pass through the gizzard without grinding and pass into the proventriculus. The result is a small gizzard, enlarged proventriculus and reduced intestine length. Diets containing excessive levels of fine particles 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.

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.

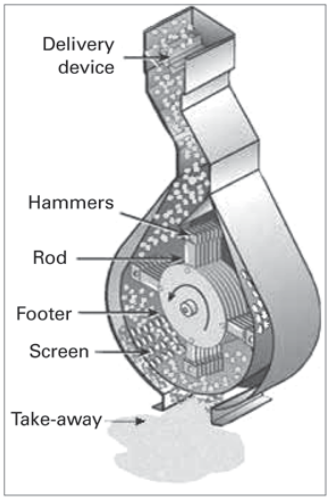


Figure 4. Hammer mill. Image courtesy CPM Roskamp Champion.

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.

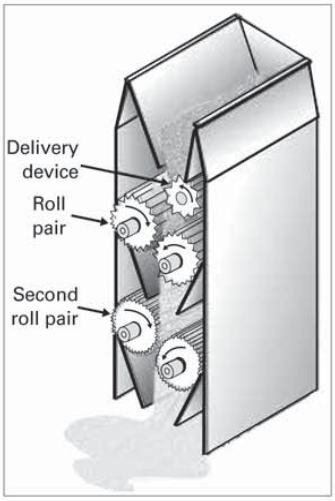


Figure 5. Roller mill. Image courtesy CPM Roskamp Champion.

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).

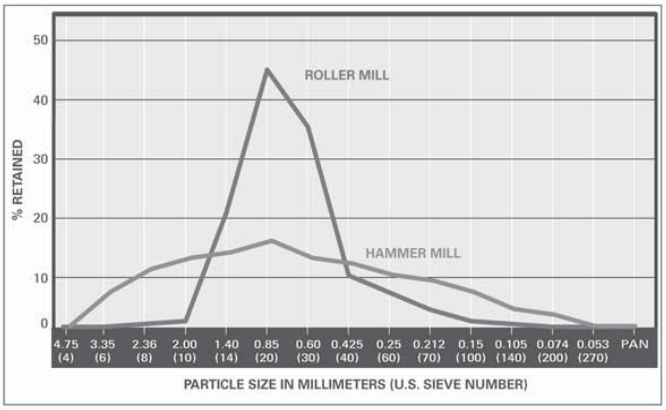


Figure 6. Difference in particle size distribution between a hammer mill and a roller mill. Generally, more uniform particles are produced in a roller mill. Data: M. Heimann, American Soybean Association, 2008.

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

Heat stress in poultry

What oxidative stress has to do with it, why it affects gut health, and how phytomolecules supportmitigation strategies*

By Marisabel Caballero (Global Technical Manager Poultry – EW Nutrition) & Guillermo Gaona (Regional Technical Manager LATAM – EW Nutrition)

Stress in animals can be defined as any factor causing disruptions to their homeostasis, their stable internal balance. Stress engendersa biological response to regain equilibrium. We can distinguishfour majortypes of stress in the poultry industry: technological or management-related stress; environmental stress; nutritional stress, including due to heavy metals, mycotoxins, and low-quality ingredients; and internal stress, which is related to health status and health challenges. All types of stress lead to molecular and cellular changes that decrease health and productivity.

Climate change, thermoregulation, and stress

High environmental temperaturesare among the most important environmental stressors forpoultry production, causing significant economic losses in the industry. Climate change has increased the prevalence and intensity of heat stressconditions in most poultry production areas all over the world.

The optimum temperature for poultryanimals' well-being and performance– the so-called thermoneutral zone –is between 18 and 22°C. When birds are kept withinthis temperature range, they do not have to spend energy onmaintaining a constant body temperature.

Heat stress is the result of unsuccessful thermoregulation in the animals, as they absorb or produce a higher quantity of heat than they can lose. It means that there is a negative balance between the net amount of energy flowing from the animal to the environment and the energy it produces.

Heat stress – contributingfactors

This energy imbalance is influenced by environmental factors such as sunlight, thermal irradiation, air temperature, humidity,and stocking density, but also by animal-related factors such as body weight, feather coverage and distribution, dehydration status, metabolic rate, and thermoregulatory mechanisms.Whenthe environmental temperature is above the thermoneutral zone, the animals activate thermoregulation mechanisms to lose heatthrough behavioural, biochemical, and physiological changes and responses.

Heat stress canbe classified into two main categories, acute and chronic. Acute heat stress refers to a short and fast increase in environmental temperature (a few hours), whereas underchronic heat stress the high temperatures persist for more extendedperiods (several days). Some studies suggest that, in some circumstances, poultry animalsshow a degree of resilience to acute heat stress.However, in the long run,their compensatory mechanisms are not sufficient to maintain tissue integrity and thus health and performance.

The animal's response to heat stress

The exposure of poultry to heat stresschanges the gene expression of cytokines, upregulatesheat shock proteins (HSP), and reduces the concentration of thyroid hormones. When heat stress persists, these cascades of cellular reactions result in tissue damage and malfunction.

The animals exposed to heat stress suffer adverse effects in terms of performance, which are widely known and includehigh mortality, lower growth and production (**Figure 1**),and a decline in meat and egg quality.

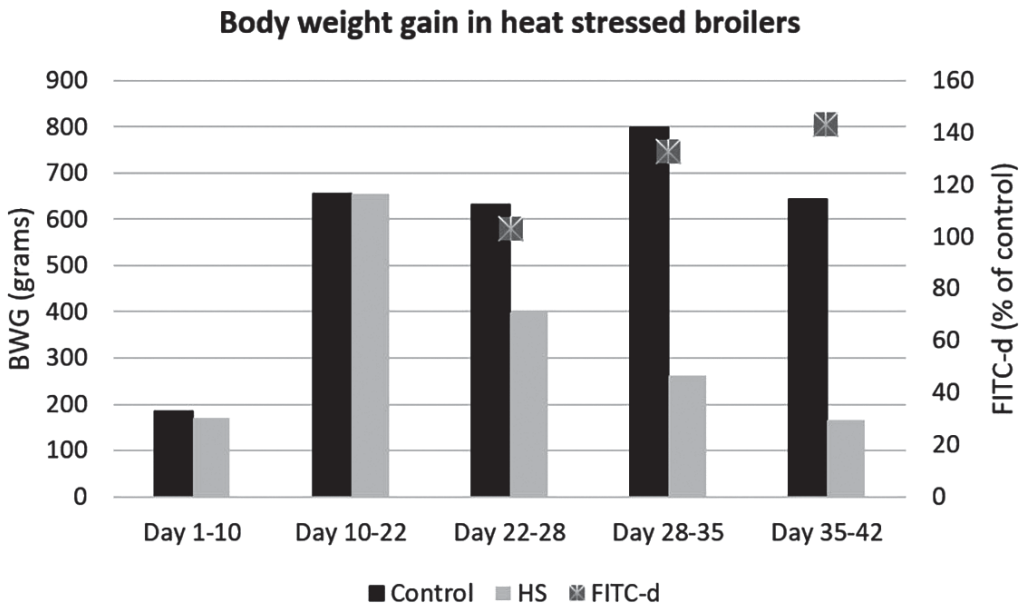


Figure 1: Body weight gain of broilers exposed to chronic heat stress (35°C continuously from day 21). A marker for tight junction permeability was added to feed (FITC-d - fluorescein isothiocyanate dextran); its fluorescence (in serum) increased with heat stress exposure time, showing higher intestinal permeability.

(Adapted from Ruff et al., 2020)

Oxidative stress– a consequence of heat stress

Oxidative stress, simply put, occurs when the amount of reactive oxygen species(ROS– such as superoxide anions, hydrogen peroxide, and hydroxyl radicals)exceeds the antioxidant capacity of the cells. Oxidative stress is regarded as one of the most critical stressors in poultry production as it is a response to diverse challenges affecting the animals.

At a cellular level, the metabolism of the animal – its energy production – generates ROSand reactive nitrogen species (RNS),such as hydroxyl radicals, superoxide anions, hydrogen peroxide, andnitric oxide. Theseusually are further processed by antioxidant enzymes produced by the cellincluding superoxide dismutase (SOD), catalase (CAT), and glutathione peroxidase (GSH-Px).Nutrients such as selenium and vitamins E, C, and A also participate in antioxidant processes.When the generation of ROS exceeds the capacity of the antioxidant system, oxidative stress ensues.

Heat stress leads to higher cellular energy demand,promoting the generation of ROS in the mitochondria, which exceed the antioxidant capacity of the organism.Consequently, oxidative stress occurs in several tissues,leading to cell apoptosis or necrosis.Among these tissues, the gastrointestinal tract can be highly affected.

Oxidative stress damages cell proteins, lipids, and DNA, and reduces energy generation efficacy. Moreover, oxidized molecules can take electrons from other molecules, resulting in a chain reaction. If not controlled, this reaction can cause extensive tissue damage.

In response to oxidative stress, all antioxidants in the organism work together to re-establish homeostasis. Several steps in the oxidative stress response have been identified. Whether they take place dependson the intensity of the stressor, with ROS and RNS acting as signalling molecules. These steps include the internal synthesis of antioxidants, the activation of transcription factors or vitagenes, and the production of protective molecules.

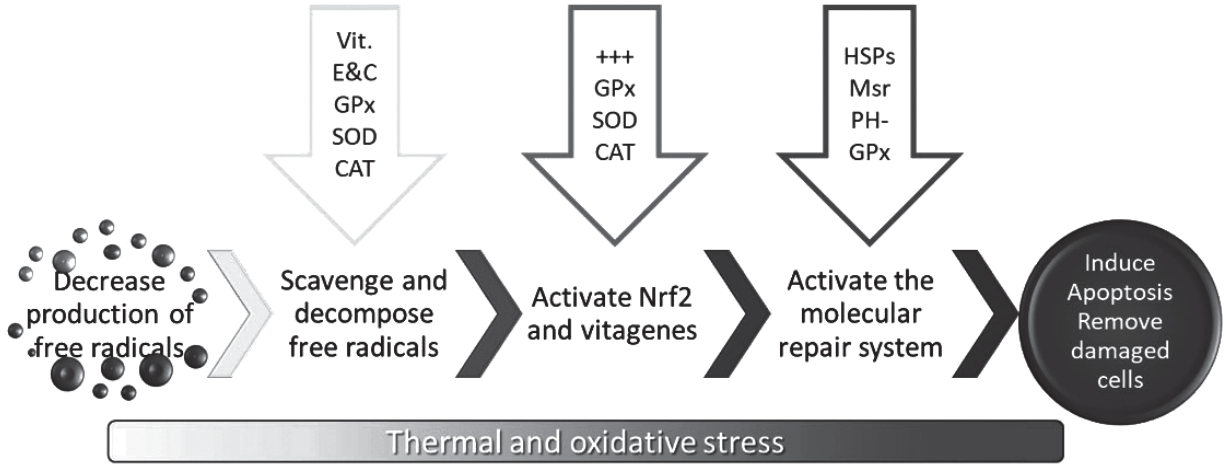


Figure 2: Summary of theantioxidant response

First, decrease free radicalproduction by decreasing oxygen availability and reducing the activities of enzymes responsible forROS production (NADPH oxidase). Second, scavenge and decompose free radicals through natural antioxidants(vitamins E & C, GSH, SOD, GPx, and CAT). Third, activate Nrf2 and vitagenes to further stimulate the synthesis of antioxidants. Fourth, activate enzymatic systemsresponsible for damaged molecule repair (HSP,Msr, DNA-repair enzymes) and removal (PH–GPx). Fifth, induce apoptosis and other processes to deal withterminally damaged cells. (Adapted from Surai et al., 2019)

Oxidative stress' effects on the gut

In the gastrointestinal tract, oxidative stress and the consequent tissue damage lead to increased intestinal permeability. This facilitates the translocation of toxins and pathogens from the intestinal tract into the bloodstream (**Figure 3**).

Under oxidative stress conditions in the gut, there is a demand for antioxidants to counteract the excess of ROS; hence, dietary antioxidants can help reduce ROS and improve animal performance. Research shows that certain phyto molecules have antioxidant properties and improve performance under conditions of oxidative stress.

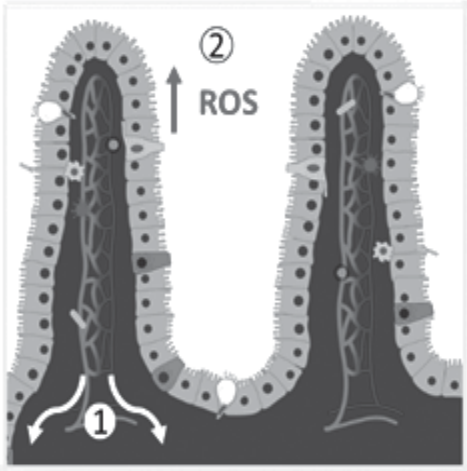
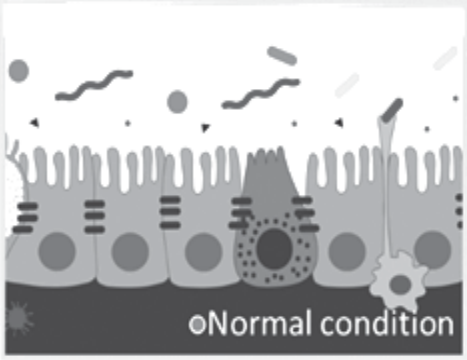
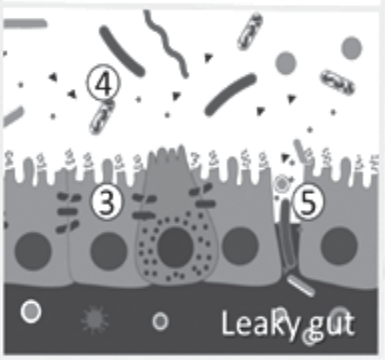


Figure 3: Simplified effects of heat stress in intestinal functions

1- Visceral blood flow is directed to the peripheria
2- Intestinal cell damage though oxidative stress
3- Disruption of tight junctions
4- Alteration of the microbiome
5- Leaky gut and translocation of toxins (mycotoxins, endotoxins) and pathogens into the bloodstream





Thermoregulation: changes in blood flow

The gastrointestinal tract is profoundlyaffected by heat stress:to help with heat dissipation, the thermoregulatory mechanism of the animal shifts visceral blood flow towards peripheral circulation. Organ ischemia and hypoxia follow,limiting gut motility, nutrient utilization, and feed intake. Enterocytes are particularly sensitive to hypoxiaand nutrient restriction,which leads to oxidative stress.

Changes in intestinal barrier's tight junctions

Several studies indicate that both acute and chronic heat stress increase gut permeability,partly by increasing oxidative stress and bydisruptingthe expression of tight junction proteins.Heat and oxidative stress in the gut result in intestinal cell injuryand apoptosis. When the tight junction barrier is compromised, luminal substances leak into the bloodstream, which constitutes the condition described as "leaky gut".

Changes in intestinal morphology

Heat stress affects intestinal weight, length, barrier function, and microbiota, resulting in animals that have lower total and relative weight of the small intestine, with shorter jejunum and duodenum, shorter villi (**Figure4**), and reduced absorption areas, in comparison to non-stressed animals.

Changes in intestinal microbiome

Due to reduced feed intake and impaired intestinal function, the presence and activity of the commensal microbiota can also be modified. Heat stress can lead to reduced populations of beneficial microbes. At the same time, it can boost the growth ofpotential pathogens and lead to dysbiosis, increased gut permeability, as well as immune and metabolic dysfunction. Burkholder et al. (2008) and Rostagno (2020) point out that pathogens such as *Clostridia*, *Salmonella*, and coliform bacteria increase in poultry exposed to heat stress, while the populations of beneficial bacteria such as *Lactobacilli* and *Bifidobacteria* decrease.

Necrotic enteritis

Heat stress causes damage in the gut microbiota, intestinal integrity, and villus morphology, as well as immunosuppression. Consequently, feed digestion and absorption decline.These factors increase the risk of necrotic enteritis outbreaks , one of the most problematic bacterial diseases in modern poultry production.

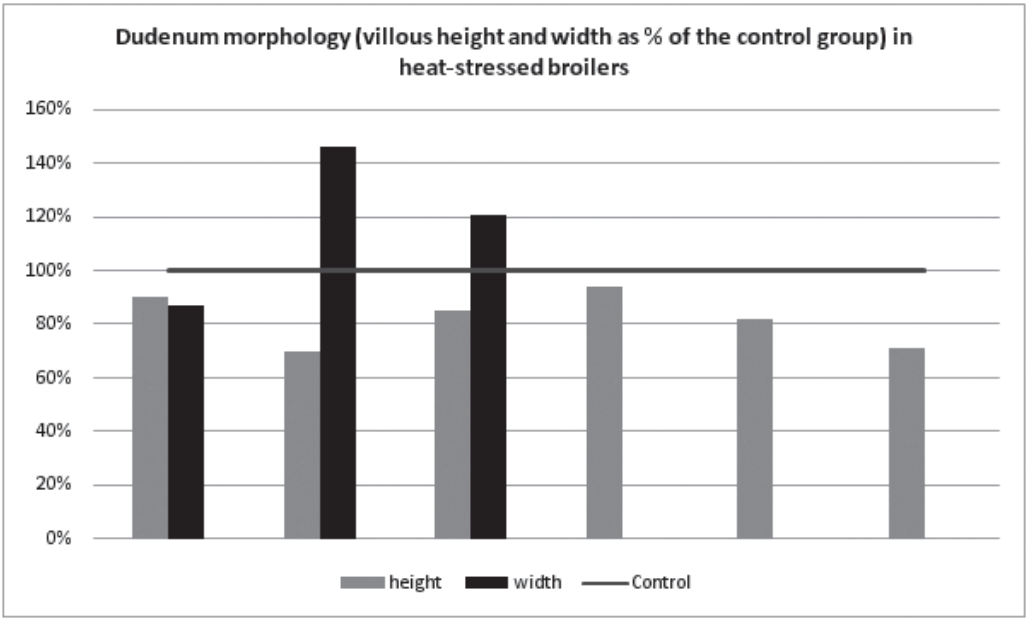


Figure 4: Villous heightand width of broilers exposed to heat stress in relation to the control group (100%). Villous height is always shorter than the control group, but width can increase when the organism shows resilience to the stressful situations and aims to recover intestinal surface. (Adapted from Jahejo et al., 2016; Santos et al., 2019; Wu et al., 2018; Abdelqader et al., 2016; Santos et al., 2015 and Awad et al., 2018 – by order of appearance in the graph, from left to right)

In a study by Tsiouris et al. (2018), cyclical acute heat stress was found to increase the incidence and severity of necrotic enteritis in broilers challenged with *C. perfringens*, and to produce the disease in animals that were not exposed to the bacteria.Other signs, such asgrowthretardation and a reduced pH of the intestinaldigesta,were also observed in the heat-stressed birds.

By lowering feed digestibility, increasing gut permeability, and compromising immunity, heat stress leavesanimals more susceptible to gut-health related issues such as dysbacteriosis and necrotic enteritis – and thusincreases the need to use antibiotics.

Mitigation strategies

Most intervention strategies deal with heat stress througha wide range ofmeasures, including environmental management, housing design, ventilation, sprinkling, and shading, amongst others. Understanding and controlling environmental conditions is always a part of heat stress management: it iscrucial for ensuring animal welfare and achievingsuccessful poultryproduction.

Feed management and nutrition interventionsare also recommended, together with environmental management, to reduce the effects of heat stress. They include feedingpelletized diets with increased energy, higher fat inclusions, reduction of total protein,supplemental amino acids, higher levels of vitamins and minerals, and adjusting thedietary electrolyte balance. Nutrition is crucial, and the use of the right diet's aids in attenuatingheat stress in birds.

Phytomolecules: powerful antioxidants

It is practically impossible to avoid stress in commercial poultry production;hence it is commonfor animals to experience oxidative stress at times.Phytomolecules are natural antioxidants with anti-inflammatory and digestive properties, which have been shown toimprove poultry performance, including during challenging periods. The antioxidant capacity of phytomolecules manifests itself in free radical scavenging, increased production of natural antioxidants, and the activation of transcription factors.

As compounds that have low bioavailability, they can remain at high concentrations within the intestine, when provided at the appropriate dosage and through encapsulation technology. Research has found that phytomolecules can effectively reduce intestinal ROS and thus alleviate heat stress in poultry,specifically mitigating oxidative stress in the intestine.

One heat stress study,for example, found that carvacrol elevates serum GSH-PX activity, compared tonon-supplemented broilers. Other studies demonstrate that cinnamaldehyde also increases the activities of natural antioxidants in heat-stressed broilers. A study by Prieto and Campo (2016) showed that dietary supplementation of capsaicin effectively alleviated heat stress, as indicated by a lower H/Lratio in supplemented animals.

Silibinin, a flavonolignanpresent in silymarin (milk thistle extract), is another powerful antioxidant. In the gastrointestinal tract, it can comeinto direct contact with cells, activating transcription factors such as Nrf2, and thus helping to upregulate the antioxidant protection.Other phytomolecules, such as menthol and cineol,also aid animals underheat stress by simulating the sensory cold receptors of the oral mucosa. This gives them a cooling sensation and reduces heat stress behavior.

Summary

- Heat stress is a common reality in poultry production, its effects are quite complex and harmful and depend on the intensity and duration of the exposure to high temperatures.
- The gut is affected by heat stress through several pathways, including organ ischemia and hypoxia, as well as oxidative stress.
- In heat stress challenges, the intestinal barrier is compromised because of lower tight junction protein expression, enterocyte damage, and microbiome unbalance, leading to gut health issues such as dysbiosis and necrotic enteritis.
- At the gut level, phytomolecules such as carvacrol, cinnamaldehyde, capsaicin, silymarin, cineol, and menthol, among others, have been found to alleviate heat stress through their antioxidant capacities, leading to improved animal health and performance.

(* References available on request)

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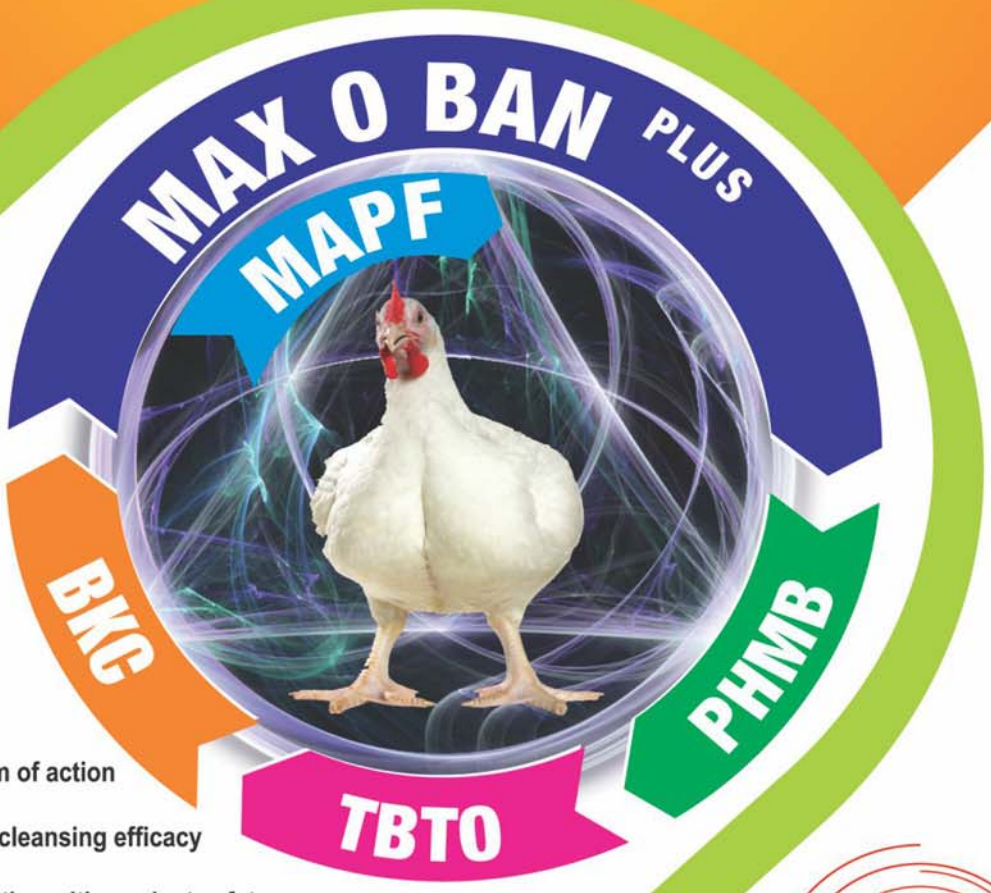

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Tel. No.: +91-22-6123 3800, Fax: +91-22-2579 6982, Email: info@rossarimail.com, Website: www.rossari.com

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