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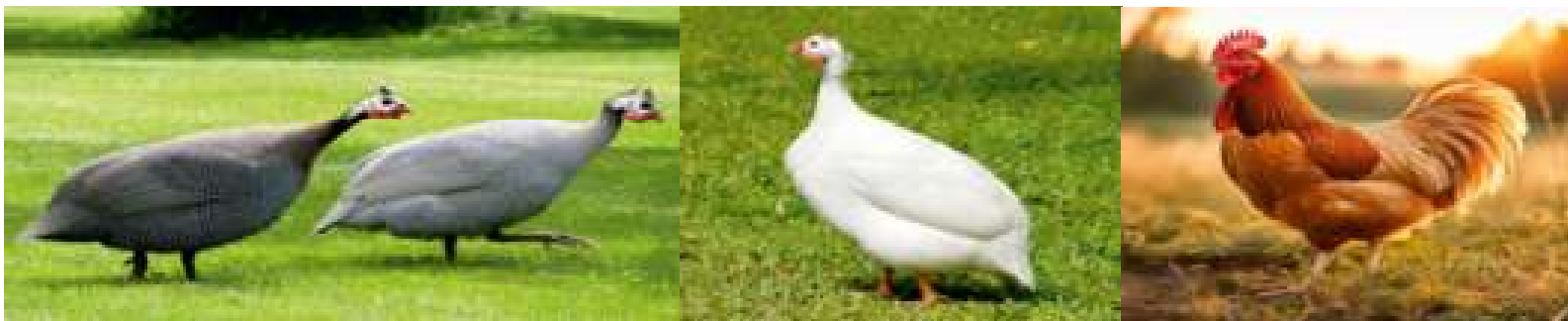
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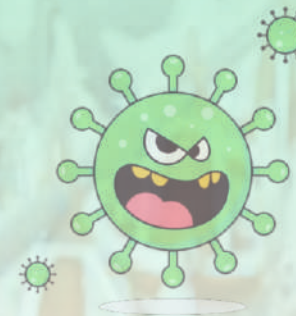
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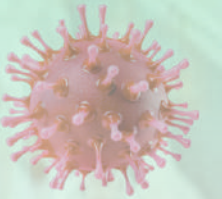
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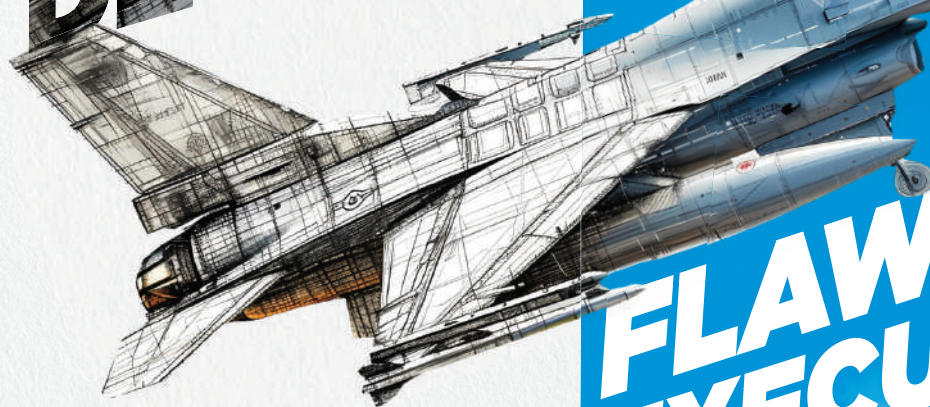
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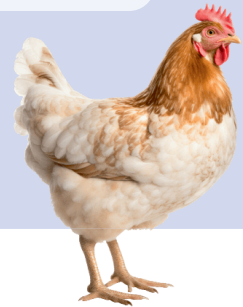
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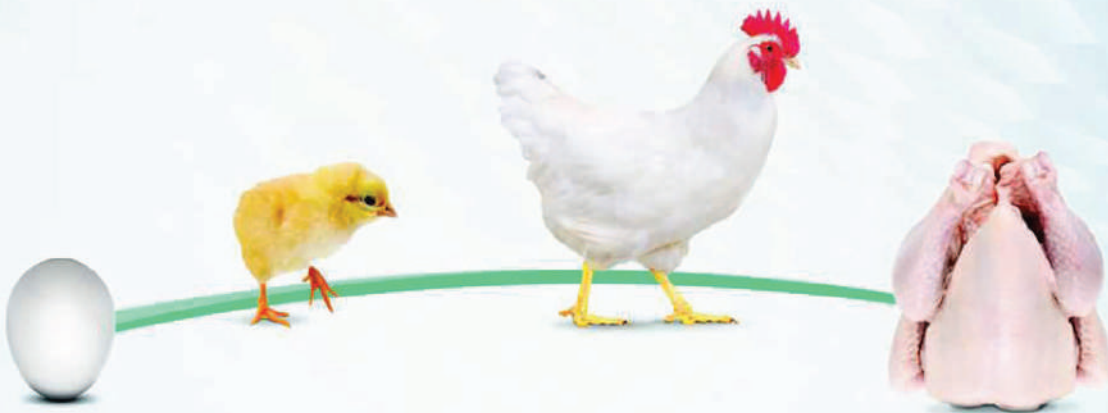
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## **“EGG CELLENT FARMERS DAYS!”**

Bharat under the principle of Vasudaiva Kutumbakam has rushed medical and food supplies to Srilanka as soon as it was hit by a deadly cyclone. Bharat now has food supplies that it can cater to the entire world for over six months.

Bharat works and acts towards the principles. It believes that world is one family. whether it is earthquake in Nepal, Myanmar, Fiji, Maldives, or Afghanistan – Bharat stands in support of humanity without blinking. This is Indian philosophy.

The terror vibrant Neighbourhood has created a serious crisis within the country by not confirming the real status of the Prime Minister Imran Khan who has been jailed for long. The current military and the ruling government have kept him under arrest as a political strategy. Imran Khan is a very popular leader of the masses and has been kept under arrest forcibly under several charges, framed by the current government. Any untoward news about Imran Khan can lead to a turmoil in this neighbouring country.

The illegal cross border migrants in the eastern borders of India are quite challenging. Due to political reasons millions have been encouraged to crossover, causing a massive disruption in the demography and peace of the country and the stronger measures are taken. The country will have disturbances and problems from time to time the fake Aadhar card and free rations abuse should be stopped immediately. Illegal citizens should be approved and people responsible for such promotion should be dealt with firmly so that it does not happen again.

In spite of Trump's Tariff policy to collapse the Indian economy, the GDP growth is at 8.2% for INDIA. This is not only astounding, but a fitting reply to the enemies of Bharat who wish negative growth for this country. The actions are stronger than the words as being proven by INDIA.

The all-time high egg prices have come as a joy for the egg producers. The farmers will do well to use the surplus money for marketing and branding instead of building an additional shed. To keep the prices, sustainable money must be invested in promotion of consumption and invest in value addition. It has been for the first time that the egg farmers are enjoying such good prices maybe with hope that this is sustainable and remain so for long.

The editor has always believed in being flexible and offering best services to the farmers. After careful review and necessary adjustments, the dates 4–5–6 April 2026 have been finalized for the upcoming popular show at Lucknow. The Editor respects the popular demand from the exhibitors and farmers to continue hosting the event in Lucknow.



## NOVUS Introduces New Logos for Enhanced Brand Cohesion and Visibility

CHESTERFIELD, MO (November 18, 2025) – NOVUS is proud to unveil its refreshed product logos, designed to improve visibility and align with the intelligent nutrition company's corporate identity. These updates reflect NOVUS's continued commitment to delivering high-quality products that exemplify the company's philosophy, Made of More™.

The new logos and colors can already be seen on company brochures, trade show booths,



and website.

An example of the new logos and brand colors on product packaging.

Senior Director of Global Strategic Marketing Laura Muñoz says the new look is in service of the company's diverse customer base, which includes nutritionists, poultry, swine, and cattle producers, veterinarians, as well as feed mills and distributors.

"Following a comprehensive brand evaluation last year, we identified an opportunity to enhance the readability and recognizability of our product logos in warehouses, feed mills, and on farms," she says. "The result is a new lineup of bright, eye-catching colors and bold logos that are easier to distinguish, making them more user-friendly for crews handling NOVUS products daily."

This change has been years in the making. Many of the product logos were unchanged since their launch, some going back as far as the 1990s. As part of NOVUS's broader rebranding initiative that began in 2020, the company saw an opportunity to unify its product branding.

"The redesigned logos create a cohesive identity across our product line, reinforcing the connection to the corporate brand," says Megan Hayes, senior manager of marketing communications. "Customers can now easily recognize NOVUS products at a glance, with a look that reflects the company's clean, bold, and strong brand persona."

Some may wonder why the product logos were not released simultaneously with the corporate rebrand in 2023. The answer is careful planning.

"Updating product packaging is a global effort requiring compliance with local regulations, trademark laws, and copyright protections," Hayes says. "Additionally, NOVUS is prioritizing sustainability by using as many pre-existing product bags as possible to reduce waste. The phased approach also allowed customers to acclimate to the new corporate branding before integrating product-level changes."

The transition to new packaging will vary by region based on existing inventory levels, ensuring a smooth and efficient rollout.

To see the new logos and colors, visit [www.novusint.com](http://www.novusint.com)



## China Agricultural University's Professor Honored with NOVUS International Teaching Award



CHESTERFIELD, MO (November 18, 2025) – NOVUS is proud to unveil its refreshed product logos, designed to improve visibility and align with the intelligent nutrition company's corporate identity. These updates reflect NOVUS's

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# Poultry Federation of India Team interacts with 12 Members Nuffield Scholarship Delegation from 10 Countries.

## FEATURE



As part of a Nuffield Scholarship, 12 scholars participated in a five-week 'Global Focus Program' world tour to develop understanding of local and international agricultural and livestock best practice and meet with progressive businesses, organisations and government officials. This delegation of 12 scholars from 10 countries toured Canada, Scotland, Italy, Spain, Australia and visited India along with Ms. Parminder Kaur. During Nuffield Scholars visit to Delhi, the group had good interaction with Poultry Federation of India Team followed by visit to Khushboo Feed Mills Pvt. Ltd., and Khushboo Broiler EC Farms near Gurgaon. Nuffield scholars group interacted with Mr. Sanjeev Gupta, Vice President (HQ), PFI and Managing Director, Khushboo Feed Mills Pvt. Ltd. During the feed mill visit, the team members also had good interaction with Mr. Rajeev Gupta, Director and Mr. Harsh Gupta, Director and Mr. Ashish Gupta, VP, Khushboo Feed Mills Pvt. Ltd.



Mr. Ricky Thaper, Joint Secretary, Poultry Federation of India briefed the delegation about current scenario of Poultry Industry in India and shared the poultry figures. The group asked several questions related to Indian poultry and livestock sector, which were answered by Mr. Sanjeev Gupta and Mr. Ricky Thaper. The delegation appreciated the modernisation and the growth of the Indian poultry sector.



In this group of 12 scholars from 10 countries, Mr. Jon Pemberton from New Zealand is a dairy farmer and sector leader with a strong interest in governance, environmental stewardship, and the future of rural communities. Dr. Jonathan Richetti, from Australia is exploring how data driven modelling can improve agricultural decision-making under increasing climate variability. Ms. Trudi Oxley from Australia is researching ways to build soil organic matter in tropical environments. Ms. Trudi and her family operate Oxley Grazing, which runs 1,500 breeders across 17,000 hectares of owned and 26,000 hectares of leased land, supplying steers to the live export market. Mr. Ruben Exterkate from The Netherlands, is focused on how pig farmers can adapt to societal expectations while maintaining a viable, future-proof business model. Mr. Ruben and his family run an organic pig farm with 220 sows and 500



finishers, supplying premium meat to the De Groene Weg organic chain. Mr. Lucas Ingold from Brazil, is an agronomist and rancher. He manages his family's livestock operation, which is integrated into a crop-livestock production system, balancing productivity with environmental stewardship. Ms. Beth Goodwin from Zimbabwe, is an ecologist and seed specialist with a passion for reforestation and practical innovation. With a diverse background that includes work in plant nurseries, seed banks, reforestation projects and education. Ms. Jenny Matthiesen from Germany, is a plant breeding scientist specialising in organic agriculture. Mr. Shoshiro Yamamoto from Japan is the founder of a thriving plum farming and processing enterprise in Japan. For the past five years, he has managed a 100,000 square meter plum farm, producing premium-quality Umeboshi, a traditional Japanese pickled plum. Mr. George Mailat, from Romania, is a third generation farmer managing a 200-hectare farm in central Romania, where he grows wheat, barley, corn, rapeseed, alfalfa, oats & beans. Ms. Emma Canepa from California, USA, is exploring how artificial intelligence can enhance precision agriculture and improve on-farm decision-making. Mr. Ignacio Jose Lopez Cruzat from Chile, manages a company that sells agricultural materials and inputs while assisting his father with their family's hazelnut orchard. Mr. Tyson Cattle from Australia, has built a career as a journalist, editor, and industry advocate, and now works in a major agribusiness, focusing on agricultural representation and policy.



Discussions during the meeting were on strengthening collaboration to advance India's poultry sector. It was highlighted that in future Artificial Intelligence (AI) Tools would Drive and Sustain the Growth of the Indian Poultry Sector in the Next Decade.

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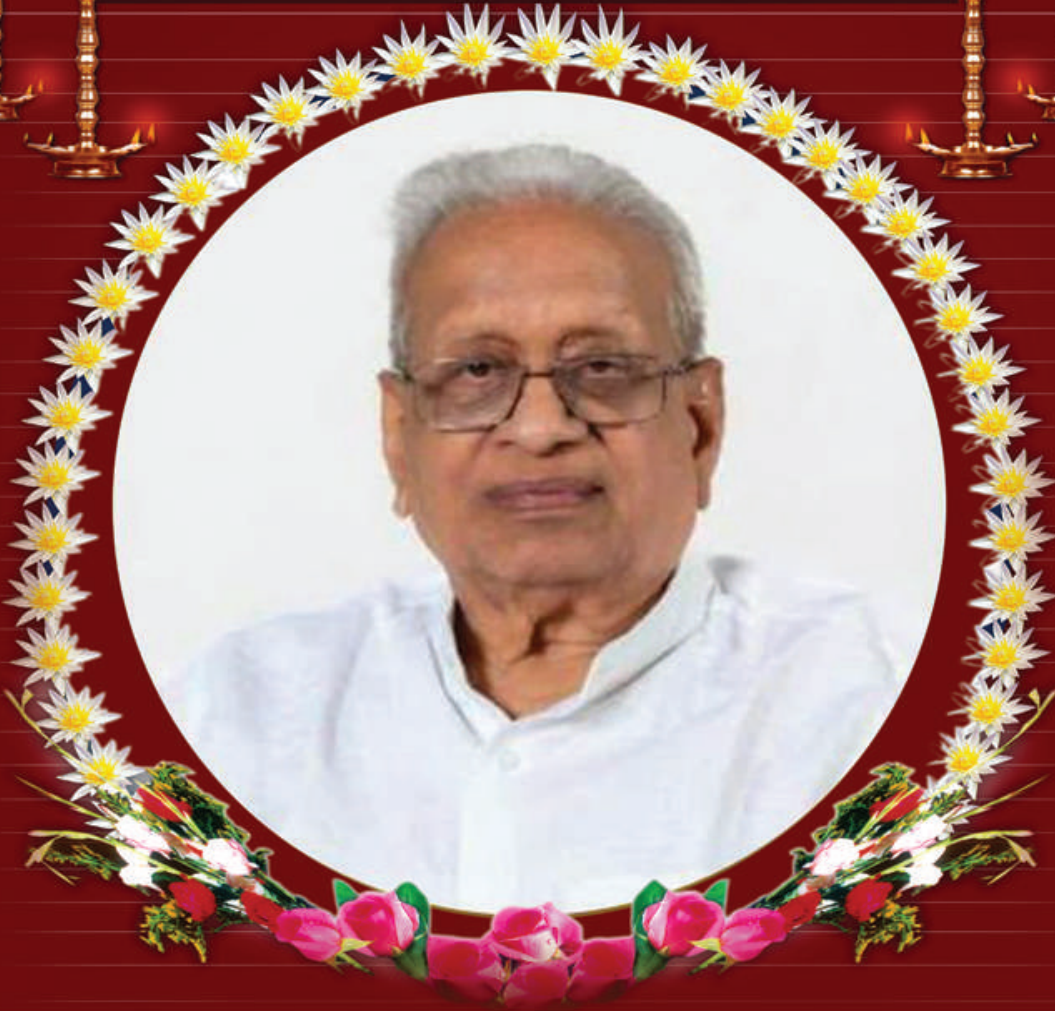
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## *Heartfelt Condolences*



**Shree Jagapathi Rao Chitturi**  
**Chairman of Srinivasa Farms Pvt Ltd.**  
( 1933 - 2025 )

The sad demise of Shri Jagapathi Rao, a contemporary legend alongside late Shri B. V. Rao Garu, is a profound loss to the Indian Poultry Industry. His unprecedented and vital contributions in building a strong and resilient poultry sector remain truly remarkable. His passing is an irreparable loss to the industry and to all who admired his vision and dedication.

We convey our heartfelt condolences to the bereaved family members of late Shri Jagapati Rao. The entire team of Tejasvi Publications and Tejasvi Events pays homage to this legendary figure and prays to the Almighty to grant eternal peace to the departed soul.

– Tejasvi Team





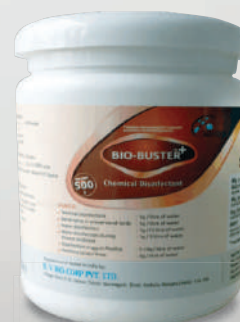
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01

Improves immune status of bird

04

Enhances overall growth performance in broiler & egg production in layer

07

Improves performance under heat stress

02

Improves vaccination titer against ND & IBD

05

Improves hatchability in breeders

08

Improves normal absorption & metabolism calcium & phosphorus

03

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09

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**Inclusion Rate per ton of feed:** 10 Kg/Ton of feed or as recommended by Veterinarian

Always keep the bag tightly closed in a cool, dark and dry place away from sun light

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500 ml (1000 Doses)

Contains highly antigenic strain of Newcastle Disease vaccine virus (Lasota Strain) vaccine virus grown in embryonated hen's eggs inactivated and emulsified EID 50, not less than  $10^6$  per dose.

Recommended for the vaccination of breeders, broilers and replacement pullets against Newcastle Disease in poultry.

Dose: 0.5 ml S/C injection in the back of the neck or IM in the breast or thigh muscles

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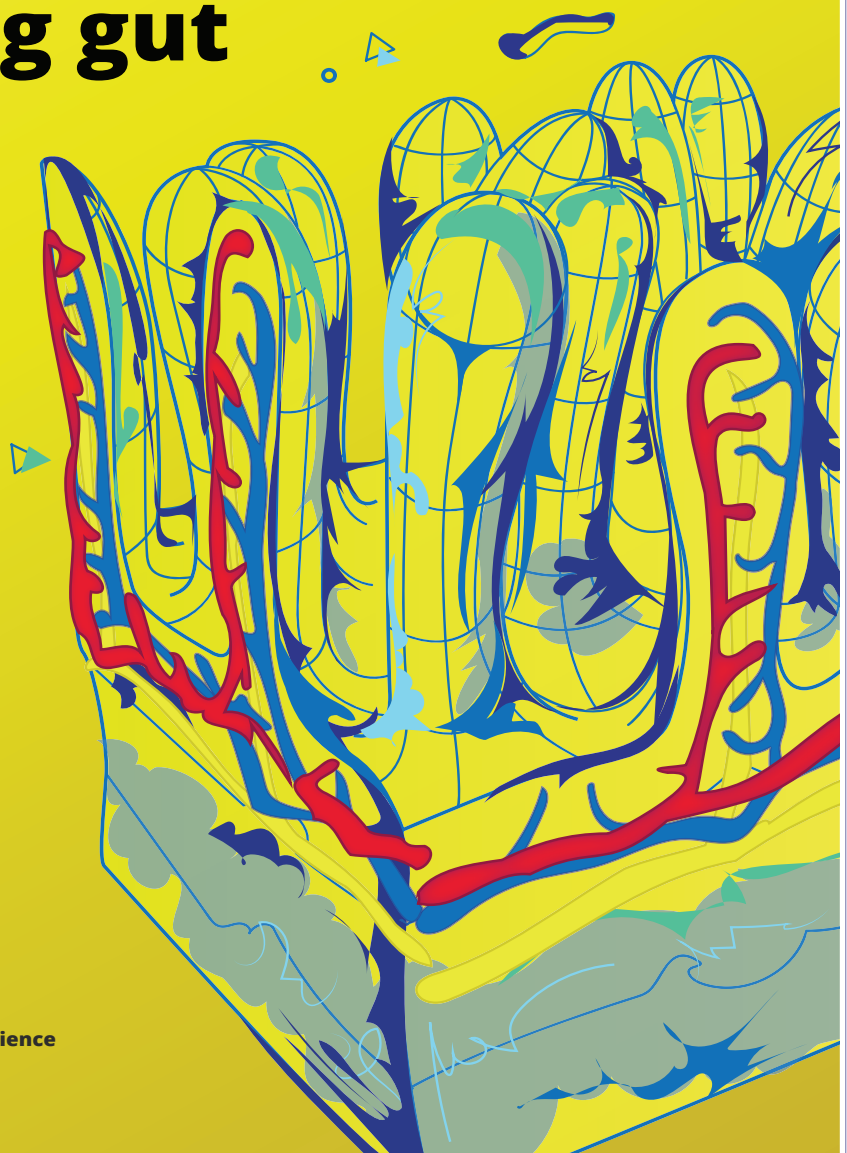


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## **“Technology for the Small Farmer: F-DATAL Established to Build a Healthier, Safer & Prosperous Livestock Future”**

Professionals from government, academia, and the private sector have taken the lead in establishing the FOUNDATION FOR DIGITAL & AI TRANSFORMATION IN LIVESTOCK (F-DATAL) — a pioneering institution designed to put technology directly in the hands of India’s livestock farmers, especially small and marginal producers across rural India.

The Foundation brings together some of the country’s most respected former bureaucrats, academic leaders, practising veterinarians, animal health and nutrition experts, and livestock entrepreneurs to build a unified national platform for digital advancement in animal agriculture.

F-DATAL is India’s first dedicated initiative to democratise AI tools, digital systems, disease prediction technologies, and precision livestock solutions — ensuring that farmers benefit directly from modern innovation.

### **Leadership Team**

#### **Office Bearers**

- President: Dr. Shirish Nigam
- Treasurer: Dr. Sushanth Rai



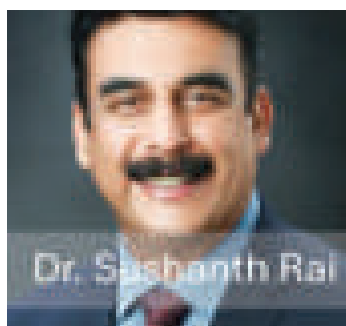
- Vice President: Dr. K. Jayaraman



- Secretary: Dr. Sandeep Gupta



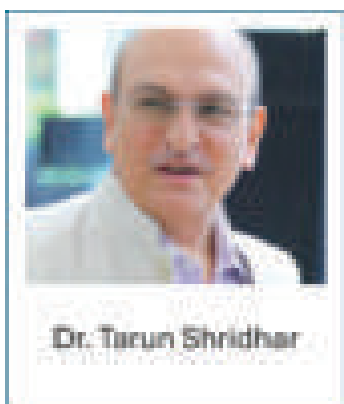




## Patrons

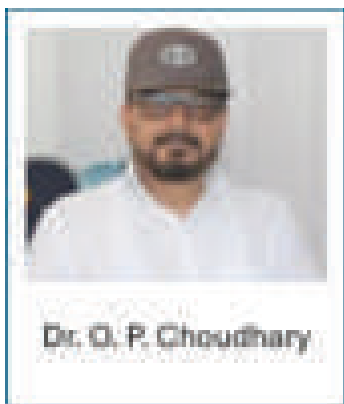
- Dr. Tarun Shridhar

Former Secretary, Department of Animal Husbandry & Dairying, Government of India



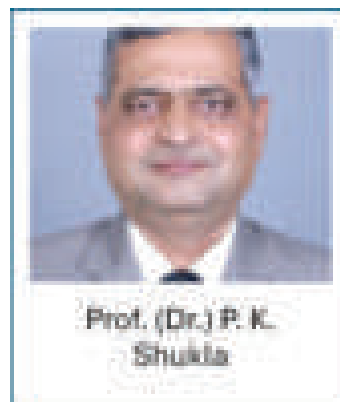
- Dr. O. P. Choudhary

Former Joint Secretary, Department of Animal Husbandry & Dairying, Government of India.



- Prof. (Dr.) P. K. Shukla

Former Joint Commissioner (Poultry), Government of India & Former Dean DUVASU, Mathura.



## Why F-DATAL Matters to Farmers

India's 7.5 crore livestock farmers — especially smallholders — face daily challenges such as disease outbreaks, climate variability, rising feed costs, and income unpredictability.

F-DATAL aims to bridge this gap by offering access to:

- AI-based disease early-warning systems
- Smart nutrition and feeding tools
- Digital health records and farm-level dashboards
- Training and skilling programs for rural youth
- Traceability & food-safety technologies
- Village-level innovation pilots

F-DATAL's work is committed to building a healthier, safer and more prosperous future for the farming community.

### Vision & Purpose of F-DATAL

F-DATAL supports the Government of India's vision of Viksit Bharat 2047, aiming to make India a global leader in AI-led livestock development.

### Core Objectives

- Promote AI, ML, IoT and data-science adoption in livestock systems
- Build a national digital architecture for disease surveillance & traceability
- Support startups via innovation hubs & accelerator programs
- Enable evidence-based policy advocacy
- Build training ecosystems for farmers & veterinarians
- Strengthen industry-academia-government partnerships

Dr. Shirish Nigam, President, F-DATAL, said:

"Our farmers deserve the best tools the world can offer. With F-DATAL, we are placing the power of AI and digital innovation directly in the hands of livestock keepers. This mission is about safer animals, stronger rural families, and a more prosperous India."

### About F-DATAL

The Foundation for Digital & AI Transformation in Livestock (F-DATAL) is a not-for-profit organisation established in November 2025 and headquartered in Noida, Uttar Pradesh. It works across dairy, poultry, livestock, aquaculture and allied sectors to advance digital transformation for national impact.

For Media Enquiries

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**DAILY/MONTHLY EGG PRICES SUGGESTED BY NECC AND PREVAILING PRICES AT VARIOUS PRODUCTION CENTRES (PC) AND CONSUMPTION CENTRE (CC)**

**FOR THE MONTH OF NOVEMBER- 2025**

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 SUGGESTED EGG PRICES																																				
Ahmedabad	605	605	605	605	605	605	605	605	605	605	605	605	615	620	625	630	640	645	650	660	665	670	675	675	675	675	675	675	675	675	-	-	634.66			
Ajmer	603	593	593	593	605	605	605	605	605	605	605	611	621	623	625	631	638	645	651	665	668	668	668	668	668	651	651	640	640	658	-	-	628.76			
Barwala	596	596	596	596	601	603	603	603	603	603	603	608	615	618	621	626	635	642	649	662	666	666	666	666	666	650	650	650	650	657	-	-	627.59			
Bengaluru (CC)	595	595	595	595	600	605	610	615	620	625	625	630	635	640	645	650	655	660	665	670	675	675	675	675	675	675	675	675	675	675	-	-	641.55			
Brahmapur (OD)	600	590	590	590	605	605	620	620	620	620	620	625	625	635	635	640	645	645	655	660	665	665	665	665	670	670	650	640	650	-	-	633.62				
Chennai (CC)	600	600	600	610	610	620	620	620	630	630	630	640	640	650	660	660	670	670	670	680	680	680	680	680	680	680	680	680	680	670	-	-	647.93			
Chittoor	593	593	593	593	603	603	613	613	623	623	623	633	633	643	653	663	663	663	663	663	673	673	673	673	673	673	673	673	673	663	-	-	640.93			
Delhi (CC)	623	623	623	623	630	635	635	635	635	635	635	635	650	650	660	665	670	680	680	700	700	700	700	700	700	690	680	680	680	690	-	-	660.07			
E.Godavari	580	580	580	580	585	590	595	600	600	600	600	600	605	610	615	620	625	625	630	638	645	645	645	645	645	645	645	645	615	620	-	-	614.07			
Hospet	535	535	535	535	540	545	550	555	560	565	565	570	575	580	585	590	595	600	605	610	615	615	615	615	615	615	615	615	615	615	-	-	581.55			
Hyderabad	570	570	570	570	575	575	580	585	590	590	590	590	595	600	605	610	615	620	625	630	635	640	645	650	650	650	650	630	630	-	-	607.93				
Jabalpur	595	595	595	595	605	605	605	605	605	605	605	605	615	625	635	645	655	660	665	680	690	695	695	695	695	665	665	655	655	-	-	636.9				
Kolkata (WB)	650	635	635	635	655	655	665	665	665	665	665	675	675	685	685	685	690	690	705	710	710	710	715	715	715	715	690	680	670	675	-	-	678.28			
Ludhiana	598	598	598	598	603	603	603	603	603	603	603	603	609	613	615	623	628	637	643	653	665	665	665	665	665	665	650	650	650	650	-	-	626.1			
Mumbai (CC)	635	635	625	625	630	640	645	650	655	655	655	660	665	670	675	685	690	695	700	705	710	715	720	720	720	710	700	700	690	-	-	672.93				
Mysuru	595	595	595	595	600	605	612	617	622	627	627	632	638	643	648	653	658	662	667	670	675	675	675	675	675	675	675	675	675	675	-	-	641.46			
Namakkal	540	540	540	540	545	550	555	560	565	570	570	575	580	585	590	595	600	600	605	605	610	610	610	610	610	610	610	610	610	610	-	-	582.76			
Pune	631	631	631	631	641	645	651	651	651	651	651	651	656	661	666	671	680	690	701	710	710	715	715	720	720	720	710	700	700	-	-	673.83				
Raipur	585	575	560	560	565	560	585	590	595	595	595	595	605	620	620	630	645	655	660	670	675	675	675	675	675	675	665	655	655	655	-	-	623.1			
Surat	610	610	610	610	615	625	610	630	630	630	630	635	640	645	650	655	660	665	670	675	685	695	695	695	695	695	695	695	685	685	-	-	652.07			
Vijayawada	575	575	575	575	575	585	585	600	600	600	600	600	600	600	625	635	640	650	660	660	660	660	660	660	660	660	660	660	640	640	-	-	620			
Vizag	570	570	570	570	575	575	580	585	585	585	585	585	590	595	600	605	610	610	615	625	635	635	635	635	635	635	635	635	610	610	-	-	601.55			
W.Godavari	580	580	580	580	585	590	595	600	600	600	600	600	605	610	615	620	625	630	638	645	645	645	645	645	645	645	645	615	620	-	-	614.07				
Warangal	572	572	572	572	572	577	582	582	592	592	592	592	597	602	607	612	617	622	627	632	637	642	647	652	652	652	652	632	632	-	-	609.76				
Prevailing Prices																																				
Alahabad (CC)	629	629	619	619	619	633	638	638	638	638	638	638	652	657	662	671	686	690	690	700	705	705	705	700	700	690	681	676	695	-	-	662.97				
Bhopal	610	600	600	600	600	610	610	615	615	615	615	615	615	640	645	660	670	675	690	695	700	700	700	700	700	700	670	670	650	650	-	-	645.17			
Indore (CC)	595	595	595	595	600	605	610	615	615	615	615	620	630	650	660	665	665	665	675	680	685	685	685	685	685	675	660	655	650	660	-	-	641.03			
Kanpur (CC)	629	629	629	629	629	643	643	643	643	643	643	643	657	657	657	671	671	686	685	700	700	700	700	700	700	690	690	676	676	686	-	-	663.72			
Luknow (CC)	648	648	648	648	648	667	667	667	667	667	667	667	676	676	677	690	693	700	700	714	714	714	714	714	714	714	714	714	700	710	-	-	683.76			
Muzaffarpur (CC)	655	655	655	655	660	665	665	665	665	665	665	668	675	678	681	685	695	700	710	723	726	726	726	726	726	726	710	710	717	-	-	688.34				
Nagpur	610	610	570	600	600	600	620	625	625	625	625	630	630	640	650	655	675	690	701	710	710	710	710	710	710	710	680	680	675	660	-	-	650.9			
Patna	655	655	655	655	660	665	665	665	665	665	665	668	675	678	681	685	695	700	710	723	726	726	726	726	726	726	710	710	717	-	-	688.34				
Ranchi (CC)	633	633	633	633	642	642	642	642	642	642	642	642	657	657	657	667	680	686	704	704	714	714	714	714	726	726	725	714	704	704	-	-	676.79			
Varanasi (CC)	640	640	640	640	640	646	650	650	650	650	650	650	660	667	677	683	693	700	707	710	713	713	713	713	713	707	707	707	700	-	-	676.66				



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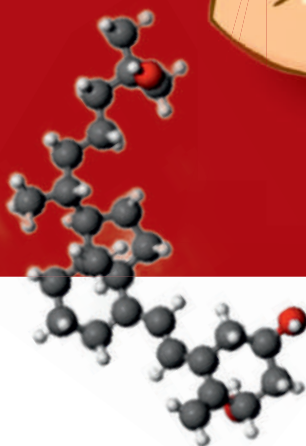
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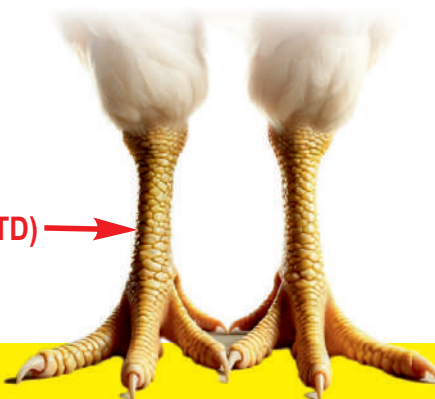


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# Sapodo – Setting New Standards in Natural Ammonia Control for Poultry Going beyond Yucca for ammonia management

PhyGeno, the plant-based feed ingredient division of Avitech Nutrition is dedicated to enhancing the safety and nutritive value of animals through plant-based innovations. Drawing on its legacy of working with animals and combining ancient Ayurvedic knowledge with modern evaluation and manufacturing techniques, PhyGeno offers solutions that lead to healthier products for human consumption and minimal environmental impact. Sapodo, a polyherbal formulation is rapidly emerging as a natural choice to address critical ammonia challenges in poultry farming.

## Understanding the Impact of Ammonia in Poultry Production

Ammonia, a natural byproduct of animal waste and decomposition, poses significant threats in poultry farms when present at high concentrations. Elevated ammonia levels are harmful to both animal health and the environment, leading to a cascade of negative effects on poultry production. These include reduced body weight gain, impaired feed conversion, decreased survivability, and a weakened immune response. Furthermore, high ammonia can cause respiratory illness, eye irritation, increased susceptibility to pathogens, and compromised immune responses in birds, ultimately impacting overall performance and profitability for farmers. Effectively controlling ammonia is therefore crucial for fostering healthy living conditions and improving bird performance.

## Sapodo: A Comprehensive Strategy for Ammonia Management

Sapodo is a natural phyto-genic feed additive specifically formulated for efficient ammonia control. It is a polyherbal formulation containing saponins and glycosides, among other bioactive compounds, which collectively enable a multi-pronged approach to ammonia management. Sapodo's strategy involves two key mechanisms:

- Direct Binding: Sapodo contains bioactive

compounds that directly bind lower gut and environmental ammonia levels. This immediate action helps to neutralize existing ammonia, reducing its toxic effects on animals and improving air quality within the farm.

- Urease Inhibition: Beyond direct binding, Sapodo's bioactive compounds also control ammonia production by inhibiting the urease enzyme. Urease is responsible for converting urea into ammonia, so by inhibiting this enzyme, Sapodo addresses the root cause of ammonia generation, providing a more sustainable and long-term solution.

This dual-action approach ensures a comprehensive reduction of ammonia in the poultry environment, creating a healthier and more productive setting for animals.

Unlocking Superior Ammonia Management: Sapodo's Proven Advantage Over Yucca Schidigera Products

## Comparative Efficacy: Sapodo's Demonstrated Superiority

To validate Sapodo's effectiveness, comprehensive in-vitro evaluations were conducted at the Avitech Centre for Nutrition Science (ACNS), comparing its ammonia binding capability against a commercially available Yucca product. The results unequivocally demonstrate Sapodo's superior performance.

### Study 1: Quantitative Evaluation (B50 Value)

The first trial focused on estimating the B50 value, a key indicator quantifying the amount of an ammonia-binding substance needed to reduce ammonia concentration in an aqueous solution by 50%. A lower B50 value signifies a stronger ability of the product to bind ammonia.

### • Methodology:



The ammonia control agent was weighed, mixed with phosphate EDTA buffer, stirred for 10 minutes, and centrifuged. The supernatant was then used to prepare aliquots for B50 estimation. Samples were treated with ammonium sulfate solution, nitroprusside, and hypochlorite, followed by incubation, and optical density measurement at 630 nm to determine the percentage of free ammonia.

#### • Results:

The study revealed that only 3.6 mg of Sapodo was required to achieve a 50% reduction in ammonia in the solution, compared to 5.4 mg of Yucca. This critical finding indicates that Sapodo is 50% more effective in binding ammonia than Yucca.

#### Study 2: Qualitative Evaluation (Colorimetric Study)

The second trial employed a colorimetric study, utilizing the salicylate method based on the Berthelot reaction, to visually assess ammonia binding efficiency at different dosages.

#### • Methodology:

Stock ammonia solution was prepared. A reaction mixture was used to assess ammonium concentration with varying levels of ammonia binder (25 mg, 50 mg, 100 mg, and 150 mg). The color variation was then compared against an ammonia color chart.

#### • Results:

- At 25 mg and 50 mg dosages, Sapodo-containing test tubes exhibited a light-yellow hue, indicating a significant decrease in ammonia levels, whereas Yucca tubes showed a light green hue.

- More strikingly, at 100 mg and 150 mg dosages, the Sapodo test tubes demonstrated a complete reduction of ammonia concentration, evidenced by a dark yellow color. In contrast, Yucca only showed a slight reduction, presenting a light-yellow hue at these higher concentrations.

The color variation clearly shows that Sapodo is more effective as an ammonia control agent compared to Yucca at different concentrations, demonstrating a superior performance in reducing ammonia production.

#### Beyond Binding: The Multifaceted Benefits of Sapodo for Poultry Productivity

Sapodo's superior ammonia control translates into a multitude of benefits for poultry farmers, directly impacting productivity and animal welfare:

- Improved Nutrition: Optimizes feed intake and ensures better nutrient utilization.
- Enhanced Health: Reduces susceptibility to respiratory infections and decreases the incidence of Ascites. Sapodo addresses issues more effectively than Yucca, improving bird performance.
- Increased Productivity: Improves overall performance and efficiency, leading to enhanced growth and productivity.
- Farm Hygiene: Significantly improves air quality and reduces offensive odor generated by manure.

Furthermore, Sapodo is 100% natural and safe, cost-effective, and compatible for inclusion in premixes or complete feeds, demonstrating excellent stability through pelleting and extrusion processes.

#### Conclusion: A Cleaner, Healthier Future with Sapodo

Sapodo's proven superior efficacy in binding and inhibiting ammonia, as demonstrated by rigorous in-vitro trials, positions it as the premier plant-based solution for ammonia management in poultry farming. By effectively addressing ammonia-related challenges, Sapodo not only safeguards animal health and the environment but also significantly boosts farm productivity and profitability. With Sapodo, PhyGeno offers a clear path towards clean feed, a clean conscience, and a clean planet for generations to come.



# Botulism poisoning in Poultry Birds

Dr. Suraj Amrutkar<sup>1</sup>, Dr. Bharti Dehmukh<sup>2</sup> and Dr. Suhas Amrutkar<sup>3</sup>

1. Assistant Professor, Dept. of L.F.C., F.V.Sc. & A.H., SKUAST-J, Jammu, J & K

2. Assistant Professor, Dept. of AGB, College of Veterinary Science., GADVASU, Ludhiana, Punjab

3. Assistant Professor, Dept. of Animal Nutrition, PGIVAS, Akola, MAFSU, Maharashtra

## Introduction:

Botulism is one of the most common causes of death in poultry. Chickens, ducks, geese, guinea fowl and many other birds are susceptible. It can affect free-range and caged birds, as well as wild birds. Botulism is a toxic disorder resulting from ingestion of the exotoxin produced by botulinum neurotoxin-producing Clostridia. It affects a wide variety of birds and mammals and has a worldwide distribution. Initial clinical signs include leg weakness and paresis that develops into a flaccid paralysis progressing from the legs to the nictitating membranes. Diagnosis is based on clinical signs and identification of botulinum toxin in serum or digestive contents or on identification of the toxin-producing clostridia. Intoxications are sporadic in poultry, but an increased number of cases associated with free-range systems and decreased antimicrobial use has been recently observed. Massive mortality events can occur in waterfowl.

## Causes:

Clostridium botulinum is a gram-positive, spore-forming, rod-shaped anaerobic bacterium. Nine types of BoNTs are produced by the proteolytic C botulinum group I strains (toxin types A and B and their variants and type F); the nonproteolytic C botulinum group II (types B, E, F) and group III (types C, D, and their mosaic variants C/D and D/C); and the proteolytic C argentinense group IV (type G). All strains can produce neurotoxins that cause flaccid paralysis.

Botulinum toxins are neurotoxins with an

affinity for motor neurons. After absorption, the toxin binds irreversibly to the presynaptic membrane of cholinergic nerve terminals. It enters the cell and blocks release of acetylcholine across the neuromuscular junctions, resulting in flaccid paralysis. Death results from cardiac and respiratory failure.

Toxin types A, B, E, and F botulinum neurotoxin-producing clostridia are associated with human food-poisoning disease while toxin types C and D BoNT-producing C botulinum are linked with avian and nonhuman mammalian botulism. Outbreaks in poultry and waterfowl are caused by the mosaic C/D, mosaic D/C, D, and C toxins and, infrequently, type E toxins.

Botulism occurs when birds eat food or drink water containing botulism toxin. The toxin is produced by bacteria called Clostridium botulinum. These bacteria are commonly found in the soil, and thrive in rotting vegetation, food or carcasses, where they produce a very potent toxin. The toxin is also taken up and concentrated in maggots. The consumed toxin acts on the nervous system, causing weakness and paralysis. Botulism tends to be more common in the wet season, because birds are more likely to have access to wet, decomposing feed. Examples of situations where botulism can occur include birds pecking at rotten food scraps or the body of a dead bird or small animal (such as a dead mouse), or when the water level of dam or pond drops and the vegetation around the edge dies off and rots.

C. botulinum and other BoNT-producing

clostridia strains are saprophytic bacteria, inhabiting soils and freshwater wetland (lake, marsh) sediments as well as decaying organic matter. Botulinum neurotoxin-producing clostridia are commonly found in the intestine of wild birds, but presence in the intestine of healthy poultry is variable.

Spore germination and bacterial growth with toxin production require an anaerobic environment that must also provide the necessary substrates as well as a temperature of 25°C or higher. This might explain why most outbreaks of botulism in waterfowl occur during the summer and fall.

### **Symptoms:**

Usually affected birds are found sitting or lying on the ground, hunched over and unable to stand. They are floppy and weak, and cannot hold their heads up. Sometimes birds may just be found dead, with no evidence of struggling. There is no diarrhoea or nasal discharge and no signs of injury. Often several birds in a group are affected at the same time, particularly the largest and healthiest. This reflects the feeding habit of the birds, which tend to congregate and peck at something they find interesting, with the smallest birds being pushed away.

### **Diagnosis:**

Botulism may be suspected when there is a sudden onset of floppy paralysis in one or more birds in a group. A careful search should be made for a potential source of the toxin in the area where the birds can roam. With botulism, the body appears normal on a post-mortem examination. Laboratory confirmation of botulism is difficult and not routinely done. However, laboratory submission of sick or recently deceased birds is encouraged to rule out other causes of illness.

### **Zoonotic Risk of Botulism in Poultry:**

The zoonotic potential of type C botulism is minimal. Botulism in humans is caused by toxin types A, B, E, and F, and is mostly foodborne in origin. Rare cases of human botulism have been identified or suspected to be linked to toxin types C, D, C/D, and D/C. However, botulism caused by type C toxin has been confirmed in several nonhuman primates. The CDC lists botulinum toxin as a category A agent due to the potential for use in bioterrorism or agroterrorism.

### **Treatment of botulism:**

There is no specific treatment for botulism. Most affected birds will die. Death occurs due to paralysis of the muscles needed for breathing. Birds that have ingested only a small amount of toxin may survive, but they need careful nursing until the toxin wears off. The birds cannot swallow, so do not try to give them food or water. Putting food or water in the mouth, for example with a syringe, may cause pneumonia because it will end up in the lungs. Wait until the birds are able to lift their heads and make clucking sounds before offering water. Protect the birds from the sun and from other birds or animals that might attack them. Provide the birds with soft bedding. If there is no improvement in 24-48 hours, the birds are unlikely to survive.

### **Prevention of botulism:**

To reduce the risk of botulism, it is important to prevent birds from having access to possible sources of the toxin. Feed only fresh food. Do not discard old or wet food where birds can peck at it. Check the area where birds can roam and remove any rotten food scraps or carcasses regularly. Clean water containers daily, and prevent the birds from drinking or swimming in water where there is rotting vegetation. If birds start to show signs of weakness or floppy paralysis, pen the remainder of the flock in a clean area until a diagnosis has been made, and the range has



been thoroughly checked. Botulism antitoxins matching the toxin type can neutralize circulating botulinum toxins in birds.

Birds with botulism may recover without treatment or with supportive care, depending on their susceptibility and BoNT (botulinum neurotoxin) dose.

- Disposal of dead birds
- Cleaning and disinfection
- Biosecurity measures



Botulism in chicken



Botulism in duck

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As a strategic partner, Poultry Line wishes Dr. Shukla every success in his new assignment

**Broiler Lifting Rates for the month of OCTOBER\_2025**

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	31
Hyderabad	110	115	110	110	115	115	115	110	105	102	102	102	102	102	105	105	110	110	112	112	112	112	112	112	112	112	117	117	117	117	112
Karimnagar	110	115	110	110	115	115	115	110	105	102	102	102	102	102	105	105	110	110	112	112	112	112	112	112	112	112	117	117	117	117	112
Warangal	110	115	110	110	115	115	115	110	105	102	102	102	102	102	105	105	110	110	112	112	112	112	112	112	112	117	117	117	117	117	112
Mahaboobnagar	110	115	110	110	115	115	115	110	105	102	102	102	102	102	105	105	110	110	112	112	112	112	112	112	112	117	117	117	117	117	112
Kurnool	110	115	110	110	115	115	115	110	105	102	102	102	102	102	105	105	110	110	112	112	112	112	112	112	112	117	117	117	117	117	112
Vizag	122	122	122	122	127	127	127	127	127	127	127	127	127	127	127	127	129	129	129	129	129	129	124	119	119	119	119	119	119	119	116
Godavari	117	119	119	119	124	124	124	124	124	124	119	119	119	119	119	119	124	124	126	126	126	126	126	121	121	123	123	123	123	123	120
Vijayawada	117	119	119	119	124	124	124	124	124	124	119	119	119	119	119	119	124	124	126	126	126	126	126	121	121	123	123	123	123	123	120
Guntur	122	125	125	125	125	125	122	119	114	114	114	114	114	114	114	114	121	121	121	121	121	121	121	121	121	126	126	126	126	126	124
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# Constraints and Remedy of Horse Management



SurajAmrutkar<sup>1</sup>, SuhasAmrutkar<sup>2</sup>, Bharti Deshmukh<sup>3</sup>, Vinod Gupta<sup>4</sup> and S. K. Gupta<sup>5</sup>

1. Scientist, Poultry Science, SKUAST-J, Jammu.
2. SMS, Animal Nutrition, Parbhani Veterinary College, Parbhani, MAFSU
3. Assistant Professor, GADVASU, Punjab
4. Senior Scientist & Head, KVK Samba, SKUAST-J
5. Professor & Librarian, Medicine Division, SKUAST-J

## Introduction:

Horses are adapted for run to quickly escape from predator. They possess an excellent sense of balance and strong fight or flight response. Related to this need to flee from predator in the wild is an extraordinary trait. Horses are able to sleep both ways i.e. standing up and lying down. Horses and humans interact in a wide variety of sport competitions and non-competitive recreational pursuit, as well as in working activities such as police work, agricultural, entertainment and therapy. Horses were historically used in warfare, from which a wide variety of riding and driving techniques developed using many different styles of equipments and methods of control. Many products are derived from horses, including meat, milk, hide, hair, bones, and pharmaceuticals extracted from the urine of pregnant mares.

Unit of measurement of Horse is Hand (1 Hand= 4 inch). NRC equine situated at Hissar, Haryana. Mares may give milk up to 18 litres daily. Famous donkey sanctuary situated at Devon in U.K. In India, there are 6 well known distinct breed of horses i.e. Marwari (Origin: Rajasthan), Kathiawari (Origin: Gujrat), Spiti (Origin: Tibet and Himachal Pradesh), Zankari (Origin: Jammu and Kashmir), Manipuri (Origin: Manipur and Assam) and Bhutia (Origin: Sikkim and Darjeeling). Besides these, FAO also recognized 3 more breeds: i.e. Chummarti (Origin: Tibet), Deccani, Sikang.

## Life span:

Depending upon breed, management and environment, the modern horse has a life expectancy of 25-30 years. Uncommonly, a few animals live into their 40 years and occasionally beyond.

Table 1: Distribution of Livestock population in India:

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Type of animal	Percentage	Chart
Cattle	35.94	
Goat	27.80	
Buffaloes	20.45	
Sheep	13.87	
Pigs	1.69	
Mithun, Yak, Horses, Ponies, Mules, Donkeys and Camel	0.23	



## Horses, Ponies, Mules & Donkeys:

Total population of horses, ponies, mules and donkeys in the country in the country is 0.35 million during 2019. Total population of horses, ponies, mules and donkeys has decreased by 51.9 % over previous livestock census (2012).

Table 2: Horses, Ponies, Mules and Donkeys population 2012 and 2019

**Table 2: Horses, Ponies, Mules and Donkeys population 2012 and 2019**

Category	Population (Million) 2012	Population (Million) 2019	% Change
Horses & Ponies	0.62	0.34	-45.58
Mules	0.20	0.08	-57.09
Donkey	0.32	0.12	-61.23
Grand Total	1.14	0.54	-52.63

**Table 3: Horses & Ponies population 2012 and 2019 of Major states:**

Sr. No.	States	Population (Million) 2012	Population (Million) 2019	% Change
1	Uttar Pradesh	1.52	0.76	-50.14
2	Jammu & Kashmir	1.44	0.63	-56.17
3	Rajasthan	0.38	0.34	-10.85
4	Bihar	0.49	0.32	-34.13
5	Gujrat	0.18	0.22	19.42
6	Maharashtra	0.37	0.19	-49.33
7	Punjab	0.33	0.14	-56.66
8	Madhya Pradesh	0.19	0.13	-29.48
9	Assam	0.14	0.13	-9.68
10	Haryana	0.37	0.10	-73.58

Table 4: Mules Population 2012 & 2019 of major states

Sr. No.	States	Population (Million) 2012	Population (Million) 2019	% Change
1	Uttarakhand	0.27	0.26	-2.25
2	Himachal Pradesh	0.23	0.20	-12.44
3	Jammu & Kashmir	0.37	0.17	-54.20
4	Uttar Pradesh	0.43	0.09	-79.06
5	Madhya Pradesh	0.07	0.03	-63.61

**Table 5: Donkey population 2012 and 2019 of Major states:**

Sr. No.	States	Population (Million) 2012	Population (Million) 2019	% Change
1	Rajasthan	0.81	0.23	-71.31
2	Maharashtra	0.29	0.18	-39.69
3	Uttar Pradesh	0.57	0.16	-71.72
4	Gujrat	0.39	0.11	-70.94
5	Bihar	0.21	0.11	-47.31
6	Jammu & Kashmir	0.17	0.10	-44.55
7	Karnataka	0.16	0.09	-46.11
8	Madhya Pradesh	0.15	0.08	-45.46
9	Himachal Pradesh	0.07	0.05	-34.73
10	Andhra Pradesh	0.10	0.05	-53.22

**Classification of Ass (Donkey):**

- Nubian wild ass of Africa
- Somali wild Ass
- Asiatic wild Ass

**Characteristic of Donkey:**

- Longer and much larger ears
- Hair on mane and tail are very scanty and there is a brush like switch at the end of the tail
- Jack has broader lions and long well sprung ribs than in horses.
- Donkeys lacks apparent muscling, have larger joints and bone and smaller rounder feet than the horse.
- Mule is hybrid between Donkey stallion and horse mare.

**Characteristics of Equine breeding:**

- Puberty age: 12-15 months
- Types of estrus; Seasonally polyestrous
- Interval of cycle: 21-23 days

- Estrus (heat) length duration (days): 5-7 days
- Time of ovulation before the end of oestrus (hrs): 24-28 hrs
- Average length of gestation period: 340 days
- Time of foal heat after foaling (days): 9-11 days

Factor affecting low reproductive efficiency in the mare:

- Seasonal occurrence of estrus
- Erratic and expanded estrus behavior in the early spring
- Uncertainty of the time of ovulation
- The arbitrary (1 January) date of birth in registering horses in racing industry causing people to attempt to breed mares during low fertility month and incorrect heat detection in the mares.

Sign of heat:

- Raising of the tail without switching

- Spreading of hind legs apart
- Flexing of pelvis
- The labia of the vulva contracts and relaxes, and there is eversion of the clitoris, commonly referred as winking.
- Mares in heat usually urinate quite frequently when teased.
- On an average, heat period is of 7 days.
- Besides observing the signs of heat, help of a teaser i.e. castrated pony horse or donkey male is taken.

Irregular or prolonged estrus cycle caused due to:

- Length of day light exposure
- Estrus cycles are shorter between months of April and October and longer between December and February in the northern hemisphere.
- Prolong corpus luteum (secrete enough progesterone to suppress the sign of estrus)

#### **Silent heat:**

Mare has a normal ovary function, but shows no sign of heat. This is often referred to as a silent heat. Often, mares that have nursing foals are very possessive and protective. These mares may be cycling normally, but will not show signs of heat.

The Stallion: Puberty age: 11-15 months

Breeding soundness:

There should not be any injury or deformity in the hind leg that may impair a stallion from mounting. The stallion should not be too fatty or overweight.

#### **Table 6: Semen quality:**

Volume of semen	:	50-70 ml
Concentration of sperm	:	30-800 million spermatozoa/ml
Progressive motility	:	60-100 %
Morphology of sperm	:	70-80% normal
pH	:	7.4-7.6

#### **Pregnancy checks:**

- If a mare shows no signs of heat for 23 days after breeding, she has approximate 90% chance being pregnant.
- 14-15 days by Ultra sound scanner
- 30-35 days by Rectal palpation

#### **Equine Nutrition:**

Lack of basic understanding on equine nutrition often results in an improper diet for the horse. The system of feeding in India includes stall feeding; grazing. Feeding bags are often used in India. Balancing of rations depends upon the availability of fodder, cereals and their byproducts. Since, the horse is very sensitive animal, feed good quality food and fresh water always. All natural feed stuffs are made up of six basic constituents, carbohydrates, proteins, fats, oils, minerals and vitamins.

#### **Equine Health:**

The average respiration rate for a horse at rest is 8-16 breath per minutes. The normal body temperature of a mature horse at rest is 100-101°F. Heart rate or pulse varies with the age of the horse. To determine the pulse rate, press your fingers against an artery located at a convenient place.

Parameters	Pulse
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New born foal	: 80-120
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Weaning	: 60-80
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Yearling	: 40-60
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Mature Horse	: 28-40
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#### **Common diseases and their control:**

Cost of preventive health care such as vaccinations, deworming and obtaining equine infectious anaemia test done is very high. If the horse contract any disease or illness and require medication or surgery, the cost would be at least 200% higher than the annual cost of keeping a horse. Therefore, it is important to practice preventive medicine.



- **Tetanus:**

Tetanus is very common occurs in horse when a wound becomes infected by a bacterium called clostridium tetani. Tetanus bacteria spores are present in most soils and especially the horse manure. The bacteria produce toxin that affects the nervous system. Symptoms occurs about 7-10 days after infection and includes stiffness, lameness in all four legs, inability to eat and chew (lock jaw) and protrusion of the third eyelid. The horse is unable to walk and may stand like a saw horse. Muscle spasm and twitches occurs. All muscles seem to control. Diseases can be diagnosed easily by demonstration of organism as well as growing in suitable media. Two types of prophylaxis are available: i) Antitoxin serum & ii) Tetanus toxoid

- **Strangles:**

It is caused by streptococcus equi bacteria. It is highly contagious and often occurs in young horses after influenza outbreak or other respiratory viral infection. It is prevalent where management practices are not good. After an incubation period of 2-6 days, the animals may shows symptoms of coughing, failure to drink, fever and nasal discharge. The lymph glands on the sides of the face near throat may be swollen creating difficulty in swallowing. Several cases may result into pneumonia and/or internal or superficial abscesses. The condition resulting in internal abscesses is refereed as bastard strangles. There are two vaccines available, one is a bacterial vaccine and second is M-protein extract. Pregnant mares should be vaccinated one month prior to foaling.

- **Glanders:**

Glander is a disease of zoonotic importance. It is caused by Pseudomonas mallei, a gram negative bacteria. The disease was authenticated in India 100 years ago. Skin form of the disease is called farcy. Lesions are confined chiefly to the hind legs. Farcy bud in the skin of extremities is a common feather. Ulceration of the lining membrane of the nostrils, with an adhesive discharge at first at

semitransparent character and later of purulent nature with a swelling of the glands under the jaw, are among the most characteristics symptoms. Differential diagnosis from epizootic lymphangitis is important. Glanders can be diagnosed by mullein testing, by intradermal palpabral test (IDP) using 0.1 ml of mullein injected into the lower eyelid of the eye. There is neither vaccine nor any treatment is advised as the animals are destroyed under the Glanders and Farcy Act, 1889. The last sporadic case of Glanders in India was recorded in 1990.

- **Brucellosis:** Brucella abotus infection in horse is reported occasionally. Symptoms include intermittent fever, laziness and general weakness. Diagnosed is based on the isolation of brucella abortus in pure culture from the foetal stomach and demonstration of antibodies in the sera either by serum agglutination test or by Rose Bengal Plate Test. Cattle is considered to be an main source of infection for horse. Vaccine is not practices due to local severe reaction. Broad spectrum antibody therapy could be used.

- **Equine babesiosis:**

It is an infectious haemo-protozoan disease caused by Babesia caballi and Babesia equi. It manifest as a prolonged haemolytic anemia with haemo-globinuria. Various species of tick are responsible for transmitting the disease. During the acute stage of the disease, parasites are observed in the erythrocytes in stained blood smear. Treatment of Babecia caballi can be achieved by using suitable drug like Diminazene aceturate or Buparvaquone or Imidocarb.

- **Trypanosomiasis:**

This is an protozoal disease affects the erythrocytes leading to anaemia. It is caused by Trypanosoma equiperdum (called Dourine) or Trypanosoma evansi (called Surra). Dourine is a venereal disease of horses, which is transmitted by coitus and the parasites, is seldom seen in the blood. It is a notifiable disease in India. In dourine, clinical signs

include fever, in appetite, oedema of the genitalia, especially in male horses. Testes are enlarged and are visible from a distance. Incubation period is 2 to 10 weeks. Disease is diagnosed by demonstration of parasites in exudative fluid or by incultation in rats or by C.F. test or ELISA test. The last case in the country was detected in 1920-21. Clinical signs of Surra include anaemia, intermittent fever and oedema. It is transmitted by tsetse fly. Diagnosis can be given in the early stage of disease when trypanosomes can be seen in the blood smear. Later on, the parasites can be detected in the fluid obtained by puncturing lymph nodes. It is difficult to differentiate between Trypanosome evansi and Trypanosome equiperdum by serology. Sporadic cases of Surra are recorded in India from time to time.

#### Internal parasites:

The horse becomes infected by ingestion of egg or larva which has been passed in its own manure or other horses. The main clinical symptoms are weakness, emaciation or manure of other horses. Main clinical symptoms are weakness, emaciation. Sometimes distension of abdomen, unthrifty appearance and rough hair coat has been observed. There are different types of worms among them, Strongyles, Strongyloides, Ascarids, Bot (Gasterophilus), Pin worm (Oxyuris equi), tape worms (Habronema megastoma) are common.

- Strongyles (Blood worm): Among various species a Strongyles; *S. vulgaris*, *S. equines*, *S. edematus* are more damaging to the horse than others.
- Oxyuris equi (Pin worm): Present in the colon of the horse.
- Strongyloides (Thread worms): Strongyloides westeri commonly known as intestinal thread worm inhabits in the small intestine of fowl.
- Ascarids (Round worm): Parascaris

equorum is known as round worm of horses and is of concern in horses under two years of age.

- Bots: Bots is not a worm, but larval stage of Gasterophilus fly
- Tape worm: Anoplocephala Perfoliata
- Stomach worm: Habronema megastoma

#### Other health problems of Horse:

##### • Colic:

Colic can originate from the stomach, the small intestine or the large intestine. Colic of various types is considered to be the number one killer of horse. Obviously because of the organs involved in colic, there are many causes of colic. One main cause of colic is intestinal distension. Second main cause may be due to reduced blood supply to the intestinal tract. Peristalsis of the intestine is reduced movement and absorption of water and nutrient. Distension and reduced blood flow may be due to :

- ✓ Digestive disturbances
- ✓ Intestinal obstruction
- ✓ Internal parasites
- ✓ Twisted intestines (torsion and volvulus)

Incidence by following of colic is minimized by following some important management practices such as:

- o Supply of plenty of fresh, clean, clean drinkable water
- o Avoid sudden changes in diet
- o Feed at regular times and intervals
- o Feed good quality and intervals
- o Feed good quality forage, free of mold, weed and foreign objects
- o Plan a proper de-worming program
- o Know that is abnormal and normal for your horses





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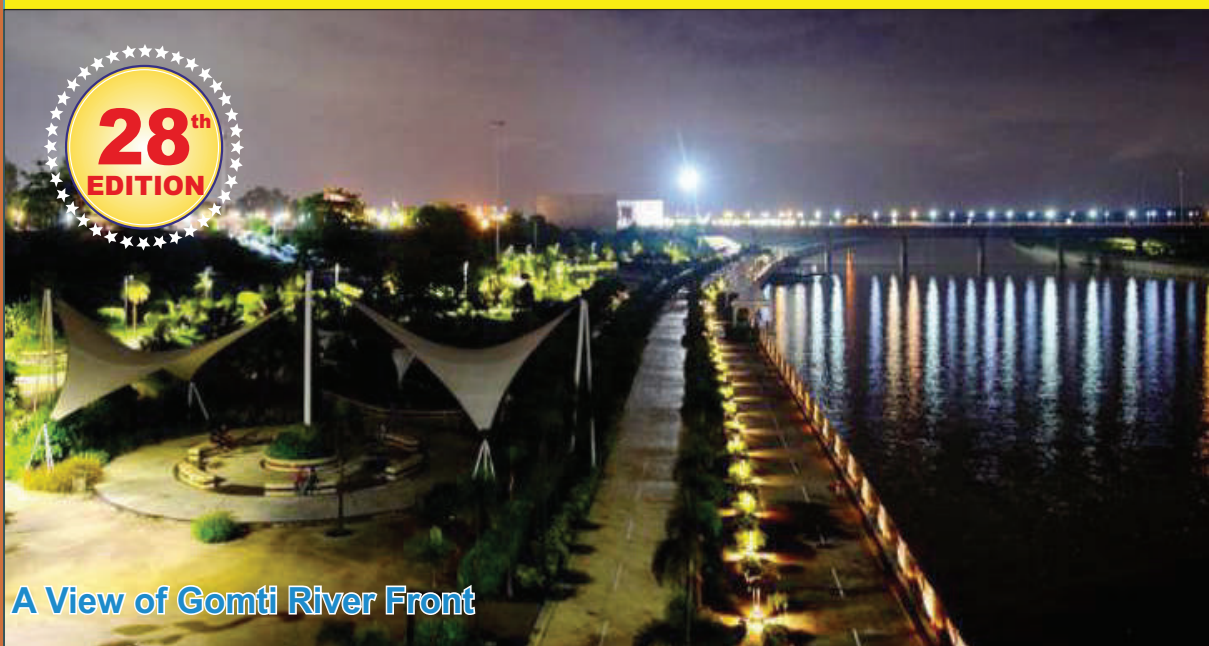
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# Essential Traits for Profitable Poultry Farming

Supriya Kumari<sup>1</sup>, Jay Prakash Gupta<sup>2</sup>, Suchit Kumar<sup>3</sup>, Soni Kumari<sup>4</sup>, Ramesh Kumar Singh<sup>5</sup>,  
Post Graduate Scholar, Department of Animal Genetics and Breeding, Bihar Veterinary College, Patna (Bihar)<sup>1</sup>  
Associate Professor, Department of Animal Genetics and Breeding, Bihar Veterinary College, Patna (Bihar)<sup>2</sup>  
Assistant Professor, Department of Animal Genetics and Breeding, Bihar Veterinary College, Patna (Bihar)<sup>3</sup>  
Assistant Professor, Department of Animal Genetics and Breeding, Bihar Veterinary College, Patna (Bihar)<sup>4</sup>  
Assistant Professor, Department of Animal Genetics and Breeding, Bihar Veterinary College, Patna (Bihar)<sup>5</sup>

## Introduction

Poultry farming has evolved far beyond the traditional practices of providing feed and collecting eggs. In the context of modern agriculture, the selection of birds with desirable traits is central to achieving productivity, profitability, and sustainability. Whether the objective is egg production, meat yield, or a dual-purpose system, identifying and prioritizing relevant traits is essential across both commercial and small-scale production systems. Each bird possesses a distinct set of characteristics that influence performance. Parameters such as growth rate, egg-laying capacity, feed conversion efficiency, disease resistance, and adaptability to environmental conditions serve as critical indicators of flock potential. Careful evaluation and management of these traits directly determine the long-term success and economic viability of a poultry enterprise.

In India, poultry farming has witnessed remarkable growth and has emerged as a leading component of the agricultural sector. During 2023–2024, the country produced approximately 143 billion eggs, positioning itself as the world's second-largest producer. The commercial poultry industry contributes the majority of this output, playing a critical role in national food security, livelihood generation in rural communities, and economic development. The success of poultry enterprises is closely linked to an understanding of economically important traits. Key parameters such as growth rate, feed conversion efficiency, reproductive performance, and disease resistance significantly influence flock productivity and sustainability. Careful evaluation of these traits enables farmers to maintain robust, efficient bird populations that can adapt to local production environments and meet market demands. Here, we explore these essential traits with specific reference to layers, broilers, and backyard poultry systems, providing a framework to support informed decision-making and enhance profitability within India's poultry sector.

## Traits for High-Performing Layer Birds

The productivity and efficiency of layer flocks are determined by several measurable traits. Careful monitoring and evaluation of these parameters provide critical insights into flock performance, guiding management strategies and enhancing profitability. The major egg production traits are described below:

**Hen-Housed Egg Production (HHEP):** This trait represents the total number of eggs obtained from the original cohort of hens, regardless of subsequent mortality or culling. Expressed as a percentage, HHEP provides an overall measure of lifetime flock productivity, typically monitored up to 72 weeks of age.

**Hen-Day Egg Production (HDEP):** HDEP reflects the daily egg output relative to the number of live hens present on a given day. This measure accounts for mortality and offers a more accurate estimate of the laying performance of the surviving flock, particularly useful for detecting sudden drops in production or underlying health challenges.

**Clutch Length:** Defined as the average number of consecutive days a hen lays eggs without interruption, clutch length is a measure of laying consistency. Longer clutches indicate sustained productivity and overall stamina in egg laying.

**Pause Days:** These are the intervals between clutches when hens temporarily cease egg production. A reduced number of pause days is indicative of greater production efficiency.

**Egg Mass:** Egg mass integrates both egg number and average egg weight, representing the total weight of eggs produced over a specific period (e.g., weekly or monthly). This parameter serves as a practical indicator of total nutrient and protein yield, which is directly linked to economic returns.

**Rate of Decline Post-Peak:** After reaching peak

production, generally between 30 and 40 weeks, the rate at which egg production decreases is a vital parameter. A gradual decline is more desirable, as it extends the productive life of the flock and reduces the frequency of replacement.

**Peak Production Percentage:** This denotes the maximum laying rate achieved by the flock during the peak period. In high-performing commercial flocks, peak values often range from 90 to 95 percent. This parameter illustrates both the genetic potential of the birds and the adequacy of management practices.

**Persistency of Laying:** Persistency refers to the ability of the flock to sustain high levels of egg production following peak performance, typically monitored between 35 and 72 weeks of age. Prolonged persistency minimizes the need for early flock replacement and enhances overall profitability.

Collectively, these traits provide a comprehensive framework for evaluating the performance of layer birds. Their systematic assessment supports more informed decisions in breeding, nutrition, and management, ultimately contributing to higher productivity and economic sustainability in layer poultry farming.

#### Reproductive Traits Influencing Poultry Flock Performance

Reproductive efficiency in poultry is determined by a set of measurable traits that critically affect the productivity and sustainability of flocks. The following parameters are widely recognized in evaluating reproductive performance:

**Age at Sexual Maturity (ASM):** Age at sexual maturity is defined as the number of days from hatching until the hen lays her first egg. This milestone, generally occurring between 140 and 180 days of age, marks the onset of the hen's reproductive phase. ASM is influenced by genetic background, nutritional management, and environmental conditions. Early sexual maturity is generally associated with increased lifetime egg production, extending the hen's productive period and enhancing overall flock efficiency.

**Body Weight at First Egg:** The body weight of a hen at the time of first lay is a critical trait. Suboptimal body weights can negatively influence subsequent egg

production. Birds that are underweight at the onset of lay may exhibit reduced productivity, while overweight hens may allocate excessive metabolic energy to body maintenance rather than egg production. Achieving optimal body weight at first egg is, therefore, essential for maximizing laying performance throughout the production cycle.

**Fertility & Hatchability:** Fertility represents the proportion of fertile eggs among all eggs set for incubation, whereas hatchability denotes the percentage of healthy chicks hatched from fertile eggs. These parameters are fundamental indicators of reproductive efficiency in breeder flocks. High fertility and hatchability rates signify effective mating management, sound reproductive health, and favorable incubation practices, thereby ensuring the continuity and genetic progress of poultry populations.

#### Egg quality traits

Egg quality is a multifaceted trait of economic and biological significance, encompassing both external and internal characteristics. These traits directly affect marketability, consumer acceptance, transportability, and hatchability in breeder flocks. Major egg quality traits are described as follows:

**Egg Weight:** Egg weight serves as an important indicator of both hen performance and flock health. It is typically recorded as the average egg weight of a flock on a weekly basis, beginning at 28 weeks of age. Egg weight has a direct impact on market preferences, economic returns, and total egg mass yield. Consistency in achieving heavier yet uniform egg weights enhances profitability by ensuring consumer satisfaction and by increasing the cumulative productivity of the flock.

**Egg Shell Quality:** Eggshell traits; primarily thickness, strength, and pigmentation, play a decisive role in egg integrity. Monthly evaluations are generally conducted by sampling 10–20 eggs per flock. Stronger shells reduce breakage during handling, transport, and storage, thereby minimizing commercial losses. In breeder flocks, shell quality also enhances hatchability, as sturdy shells improve embryonic protection and gas exchange during incubation.

**Albumen Quality (Haugh Unit):** The quality of the albumen constitutes a key measure of internal egg quality, directly associated with both egg freshness and



nutritional value. It is commonly assessed through the Haugh Unit (HU), which standardizes albumen height relative to egg weight using the following formula:

$$HU = 100 \times \log_{10} (H + 7.57 - 1.7W^{0.37})$$

Where:

HU = Haugh Unit value

H = height of thick albumen (mm)

W = egg weight (g)

Values are usually recorded monthly. Higher HU values indicate superior albumen quality, reflecting better protein content and longer shelf-life.

**Yolk Color:**Yolk pigmentation is assessed monthly using standardized grading tools such as the DSM yolk fan or objective colorimeters. Yolk color is influenced by genotype and carotenoid intake from the diet. It strongly affects consumer preference and market demand, with deeper pigmentation often being associated with higher nutritional and aesthetic quality.

**Egg Shape Index:** The egg shape index, calculated as the ratio of egg breadth to egg length multiplied by 100, provides a measure of egg form:

$$\text{Shape Index} = (\text{Egg Breadth}) / (\text{Egg Length}) \times 100$$

An index between 72 and 76 is generally regarded as optimal. Eggs within this range exhibit greater structural stability, are easier to grade and package, and demonstrate reduced susceptibility to breakage. Eggs with ideal shape index values also tend to show higher hatchability, making this parameter relevant in both table egg and breeder production.

Systematic evaluation of egg quality traits, including egg weight, eggshell strength, albumen integrity, yolk colour, and shape index, provides critical information for flock management. These parameters collectively determine product quality, enhance consumer confidence, and contribute to the biological efficiency and economic sustainability of poultry enterprises.

#### Feed Efficiency Traits in Layer Poultry

Feed efficiency constitutes one of the most critical

determinants of economic viability and sustainability in layer production. Efficient utilization of feed not only reduces costs but also contributes to enhanced nutrient management and environmental sustainability. Several key parameters are employed to assess feed efficiency in laying hens:

**Feed Conversion Ratio (FCR):**FCR is defined as the quantity of feed consumed to produce a dozen eggs or one kilogram of egg mass. It is generally estimated on a weekly or monthly basis by recording both total feed intake and egg output. A lower FCR value indicates superior efficiency, reflecting reduced feed costs per unit of product.

**Feed Intake:**Feed intake refers to the amount of feed consumed per bird on a daily or weekly basis throughout the laying cycle. It is a fundamental parameter for assessing appetite, health status, and energy balance. Feed intake data also serve as the basis for calculating FCR and other efficiency indices.

**Residual Feed Intake (RFI):**RFI is defined as the difference between actual feed intake and the expected feed intake based on body weight and egg production. Measurement is typically undertaken between 28 and 40 weeks of age for a duration of 4–6 weeks. Birds with negative RFI values are considered more efficient, as they consume less feed than predicted for a given level of production. RFI is independent of production traits, making it a robust indicator of true feed efficiency and a valuable trait in selection programs aimed at reducing feed costs and improving sustainability.

**Metabolizable Energy Efficiency (MEE):**MEE represents the proportion of dietary metabolizable energy utilized for egg production and maintenance. It is generally evaluated during the stable mid-laying period. Higher MEE values indicate superior energy utilization, with implications for lowering feed costs and reducing nutrient losses to the environment.

**Feed Efficiency for Egg Mass (FEM):**FEM is expressed as the ratio of egg mass yield to feed consumed. Typically recorded during the mid-laying phase, when production stabilizes, FEM provides a direct measure of how efficiently ingested feed is converted into saleable egg output. Higher FEM reflects improved production efficiency and lower cost per unit of egg mass.

**Protein Efficiency Ratio (PER):**PER is defined as the amount of egg mass produced per unit of dietary protein consumed. It is assessed during stable laying phases. High PER values are indicative of efficient protein utilization, with direct benefits in terms of reduced feed costs and lower nitrogen excretion, thus contributing to sustainable production practices.

**Methionine–Lysine Efficiency:**This parameter measures the egg mass produced per unit of dietary methionine and lysine consumed. It is generally calculated during stable mid-laying phases. Higher efficiency suggests optimal utilization of these limiting amino acids, reducing feed costs while simultaneously minimizing nutrient waste.

Feed efficiency traits, including FCR, RFI, FEM, and nutrient utilization indices, provide a comprehensive framework for evaluating and improving economic and environmental sustainability in layer poultry production. Their systematic assessment supports precision feeding strategies, genetic selection programs, and long-term profitability.

#### Health, Welfare and adaptability Traits

Health and welfare traits represent critical indicators of the overall productivity, longevity, and management quality of poultry flocks. These parameters serve as proxies for disease resistance, physical robustness, and animal welfare standards, all of which are important for sustainable poultry farming.

**Livability / Mortality Rate:**Livability is expressed as the percentage of birds that survive from the onset of rearing to the completion of the laying period. Conversely, mortality rate represents the proportion of birds lost within this period due to disease, stress, or management-related factors. High livability indicates overall flock health, genetic robustness, and appropriate husbandry practices, and it directly contributes to increased flock profitability by extending productive life.

**Bone Strength and Leg Quality:**Skeletal integrity is an essential welfare trait, particularly in layers subjected to prolonged production cycles. Key measurements include tibial breaking strength, bone ash percentage, and bone mineral density, often evaluated post-mortem or at the end of lay. Strong skeletal structures prevent osteoporosis, cage layer fatigue, and locomotor

problems. Hens with robust bones demonstrate improved mobility, better health, and sustained productivity throughout the laying cycle.

**Feather Score:**Feather cover is assessed as an indicator of welfare and protection against environmental factors. It is generally evaluated on a scale ranging from 0 (poor/denuded) to 5 (excellent/fully feathered). Optimal feather condition reflects good health, housing, and nutrition, while feather loss may result from nutritional deficiencies, environmental stressors, or behavioral issues such as feather pecking.

**Plumage Color and Comb Type:**Plumage pattern, pigmentation, and comb morphology are secondary traits often associated with breed identification and genetic purity. These parameters are generally recorded between 6 and 12 weeks for plumage development and during maturity for comb type differentiation. In addition to their aesthetic and breed-standard relevance, these features can contribute to thermoregulation and mate selection in certain production systems.

By systematically monitoring health and welfare traits—such as survivability, skeletal strength, feather condition, and breed-specific characteristics—poultry producers contribute not only to flock productivity and longevity but also to the development of sustainable and ethically responsible production systems. Attention to these parameters ensures higher animal welfare standards, enhances economic outcomes, and preserves the genetic and cultural value of poultry breeds within modern farming systems.

#### Adaptability Traits

Adaptability traits describe behavioral parameters that determine how efficiently birds cope with their production environment. They reflect temperament, social structure, and responses to management systems, all of which influence productivity and welfare.

**Temperament and Behavior:**Temperament traits, such as docility, aggression, nervousness, or feather pecking, typically become evident during peak production (30–50 weeks of age). Calm and docile birds are easier to manage, exhibit fewer injuries, and maintain higher welfare and productivity levels. Conversely, aggressive or nervous flocks may experience stress-

related performance declines. Behavioral monitoring thus represents a valuable approach for enhancing flock manageability.

**Broodiness:** Broodiness refers to the maternal instinct in hens to incubate eggs, accompanied by cessation of egg laying. While biologically significant, broodiness is undesirable in commercial layers as it interrupts egg production cycles and reduces economic efficiency. Characterization and management of broodiness are essential for maintaining consistency in egg output, particularly in intensive production systems.

**Other Behavioral Traits:** Additional behavioral traits include social hierarchy (dominance-subordination),

nesting preferences, and pecking behaviors. These behaviors are evaluated at maturity and throughout the production cycle. Such observations enable improved housing designs, enrichment strategies, and management interventions that reduce stress and improve flock harmony.

Health, welfare, and adaptability traits—including livability, skeletal strength, feather cover, temperament, and broodiness—serve as critical determinants of flock performance and sustainability. Systematic evaluation of these parameters enhances animal welfare, ensures compliance with breed standards, and promotes a balance between productivity and humane poultry production practices.



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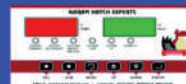
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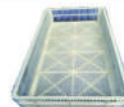
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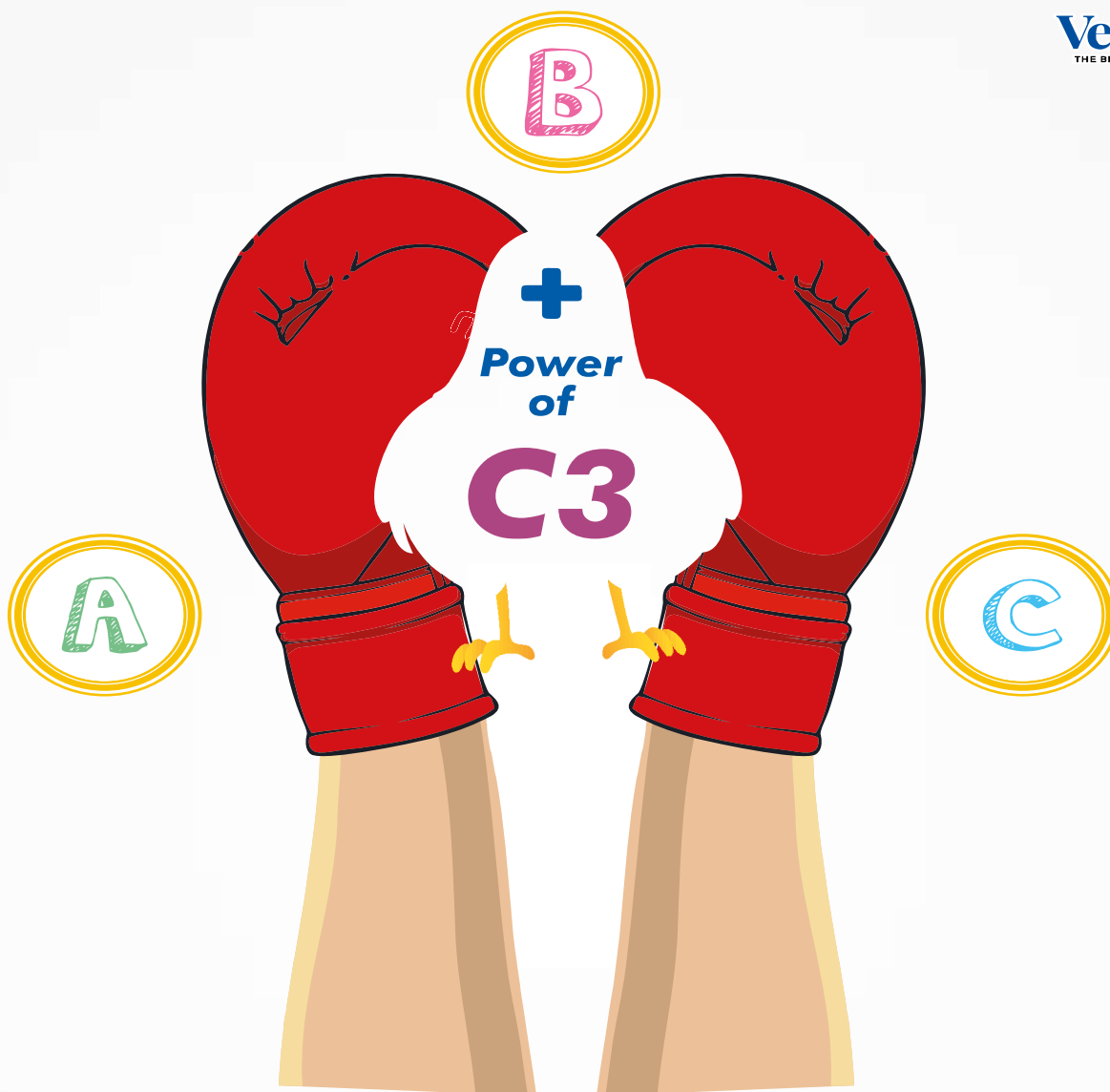


### VENKATESHWARA B.V. BIOCOPR PRIVATE LIMITED

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Venkateshwara House', S. No. 114/A/2, Pune-Sinhagad Road, Pune-411030

Tel.: (020) 24251803, Fax: +91-20-24251060/24251077, Website: [www.venkateshwarabvbiocorp.com](http://www.venkateshwarabvbiocorp.com)



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