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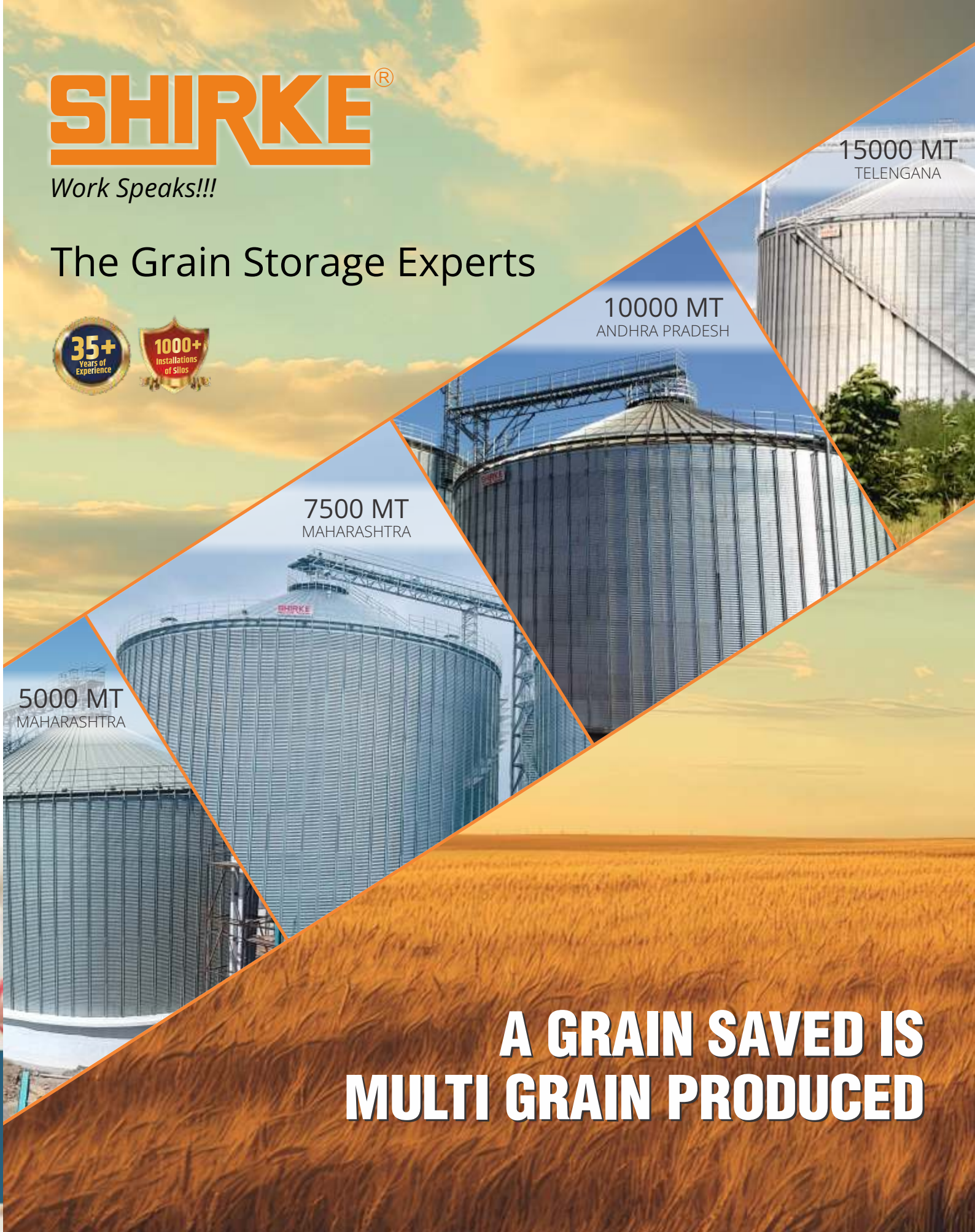

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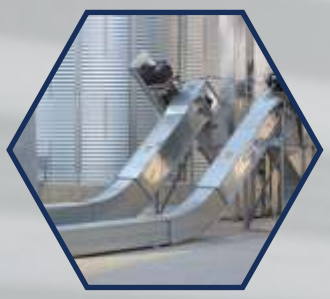

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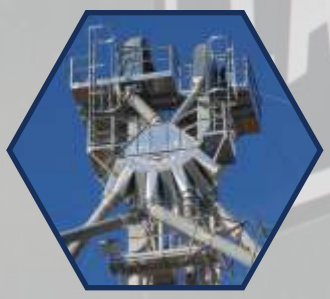

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Monthly Magazine for Feed Technology

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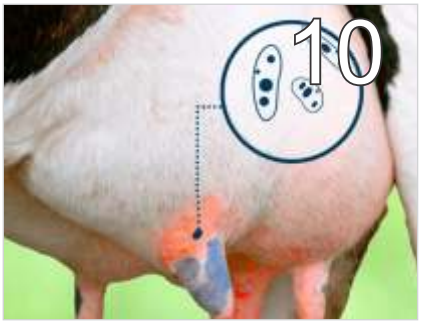

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Indonesia's Sago and Cassava “Corn Analogue” Feed Offers Affordable Solution for Poultry Industry

Indonesian researchers have developed an innovative poultry feed made from a mix of sago and cassava, which has proven to be as effective as conventional corn. Termed a “corn analogue,” this new feed promises to reduce costs for farmers and potentially stabilise chicken prices across the country, addressing one of the major challenges facing the nation's poultry sector.

Laboratory trials conducted on native chickens have shown that birds fed with the sago-cassava blend perform just as well as those on traditional corn-based diets. The feed offers similar nutritional value while being more cost-effective, providing tangible economic relief to local poultry farmers. “Cheaper feed costs will reduce chicken production prices, so consumers can also benefit from more affordable meat,” said Dr. Heri Ahmad Sukria, project head and lecturer at the Faculty of Animal Science at IPB University.

Indonesia remains heavily dependent on corn, which accounts for about 50% of poultry feed. Domestic production is insufficient to meet national demand, and the country currently faces restrictions on corn imports. As a result, corn prices continue to rise, reaching up to Rp 7,000 (USD 0.43) per kilogram in some remote areas, significantly increasing the cost of poultry feed and, consequently, chicken prices. Dr. Heri noted that sago has strong potential as an alternative energy source for poultry feed, helping to reduce reliance on imported corn.

The country has approximately 5 million hectares of sago plantations in Papua, offering a locally available and sustainable feed source. Researchers emphasize that environmental considerations must be maintained while harvesting sago to ensure ecological balance. In addition, new high-yield cassava varieties developed by IPB University can produce at least 40 tons per hectare, meeting the productivity requirements for economical poultry feed production.

The project has received support from the Indonesian government through the Community Empowerment Program under the Ministry of Higher Education, Science, and Technology, enabling wider promotion of the feed among farmers. With increased production and adoption, the corn analogue is expected to become a viable solution for small-scale poultry operations, helping farmers reduce costs while maintaining animal performance and production quality.

Unlike countries such as the United States and Europe, which utilise diverse feed energy sources, Indonesia has largely relied on corn. By integrating locally abundant sago and cassava into poultry diets, the new feed not only addresses the rising costs of corn but also encourages the sustainable use of domestic agricultural resources.

In conclusion, the development of the sago and cassava-based corn analogue represents a promising step for Indonesia's poultry industry. It provides a sustainable, cost-effective alternative to corn, supporting both farmers and consumers while showcasing the potential of local crops as innovative solutions for agricultural challenges.

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Mastitis and Metabolism: The Overlooked Connection

"During mastitis, immune cells accelerate glycolysis to support defence, while invading bacteria exploit host metabolism to drive their growth."

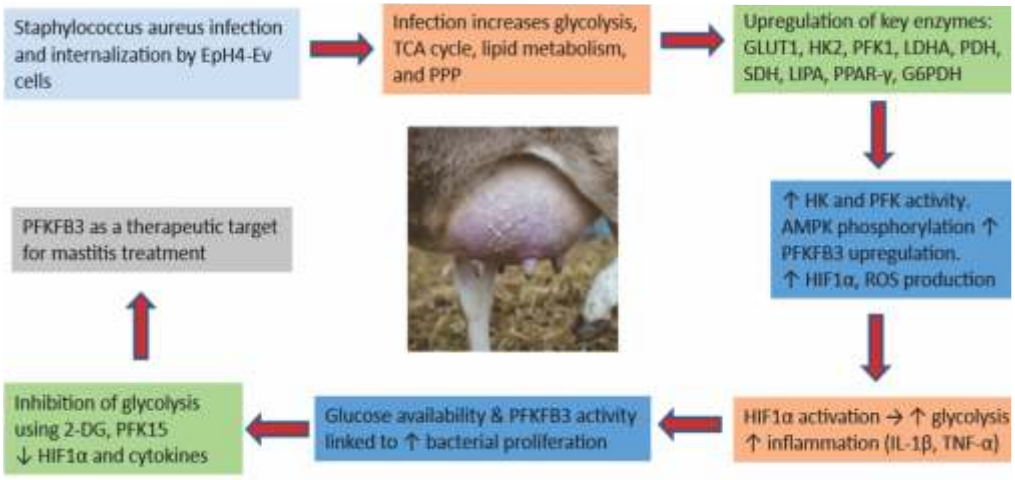
by **Sundram Singh** and **Swati Sangolgi,** Master's (Animal Biochemistry), ICAR-NDRI, Karnal

Abstract

Mastitis, one of the costliest diseases in dairy herds, is increasingly recognized not only as an infectious disorder but also as a metabolic one. During infection, mammary and immune cells undergo profound metabolic reprogramming that fuels both defence and inflammation. Glycolysis is rapidly upregulated, driven by key enzymes such as hexokinase (HK), phosphofructokinase (PFK), and pyruvate kinase (PK), which amplify inflammatory signalling through HIF-1α–mediated cytokine production. At the same time, disruption of the tricarboxylic acid (TCA) cycle leads to the accumulation of succinate—a pro-inflammatory metabolite—and itaconate, which exerts antibacterial and anti-inflammatory effects.

The pentose phosphate pathway (PPP) is also redirected to produce NADPH, sustaining reactive oxygen species (ROS) generation that contributes to pathogen clearance but also causes tissue damage. These interconnected

Fig. 1. Metabolic reprogramming during mastitis and the role of PFKFB3.



pathways highlight the immune metabolic basis of bovine infectious diseases. Integrating these insights with epitope mapping for diagnostic development, along with the design of potential inhibitors using in silico docking, could further advance both detection and therapeutic strategies. Emerging evidence on these enzymes in mastitis and sepsis highlights their potential as targets for innovative diagnostic and metabolic interventions, offering new opportunities for earlier disease detection, reduced dependence on antibiotics, and more sustainable approaches to udder health management.

Introduction

Mastitis has long been seen as an infectious disease. New research shows it is also a metabolic disorder. During infection, immune and mammary epithelial cells shift from oxidative metabolism to aerobic glycolysis —a rapid but less efficient method of generating energy. This is similar to the Warburg effect described in cancer cells (O'Neill et al., 2016).

Glycolysis on overdrive: HKII, PFKP, and PKM2

Glycolysis is initiated by hexokinase (HK), which phosphorylates glucose and thereby traps it within the cell. In the context of mastitis, HK functions as the critical gateway enzyme that secures a continuous energy supply. Its expression and activity are closely regulated by signalling pathways such as PI3K/Akt/mTOR, which are activated by insulin and growth factors. This regulation enhances HK transcription and promotes its association with mitochondria, thereby supporting elevated glycolytic flux in proliferating or metabolically active cells. In mastitis, HK activity is increased to secure a continuous supply of

metabolic fuel.

Phosphofructokinase (PFK) catalyzes the key commitment step of glycolysis. Increased PFK activity drives glucose deeper into the pathway, sustaining rapid energy production. Under stress conditions such as hypoxia or oxidative stress, upregulation of PFK activity promotes a metabolic shift toward anaerobic glycolysis, ensuring continued ATP production when mitochondrial oxidative phosphorylation is impaired. This metabolic plasticity is particularly important in rapidly dividing cells, including tumour cells and proliferating follicular cells.

A central regulator of this step is PFKFB3, which produces fructose-2,6-bisphosphate, a potent allosteric activator of PFK. In mastitis, PFKFB3 expression in mammary cells is elevated, and its inhibition has been shown to reduce reactive oxygen species generation, suppress HIF-1α signalling, and alleviate Staphylococcus aureus-induced inflammation, underscoring its importance as both a metabolic driver and a potential therapeutic target (Gao et al., 2024), as shown in Fig.1. Targeting glycolytic regulators has therefore emerged as a promising strategy to control this metabolic overactivation.

Pyruvate kinase (PK), produced downstream of PFK, plays a special role. Instead of only working in the cytoplasm, PK can translocate into the nucleus, where it binds to hypoxia-inducible factor 1-alpha (HIF-1α). This complex enhances transcription of pro-inflammatory cytokines, particularly interleukin-1β (IL-1β) (Krawczyk et al., 2010; Rodríguez-Prados et al., 2010; Liu et al., 2022).

The TCA Cycle Stalls and Makes Trouble

Under normal conditions, pyruvate from glycolysis is fed into the TCA cycle, producing a steady supply of energy. But mastitis disrupts this cycle, leading to metabolic bottlenecks that generate inflammatory metabolites.

Succinate accumulates when the cycle is impaired. Succinate acts as a pro-inflammatory metabolite, stabilizing HIF-1α and promoting sustained IL-1β production (Tannahill et al., 2013; Mills & O'Neill, 2014). Itaconate is produced as an alternative pathway product. Itaconate has direct antibacterial effects against pathogens such as Mycobacterium tuberculosis and also reduces inflammation by activating the Nrf2 pathway and restraining type I interferon responses (Michelucci et al., 2013; Mills et al., 2018). Thus, the TCA cycle doesn't just slow down in mastitis but also actively shapes whether the immune response escalates or resolves.

The Pentose Phosphate Pathway: Fuelling ROS and Inflammation

The pentose phosphate pathway (PPP), which branches off from glycolysis, is also reprogrammed in mastitis. In activated macrophages, PPP activity increases, producing NADPH (Yu et al., 2019). NADPH drives NADPH oxidases, which generate reactive oxygen species (ROS). While ROS are essential for bacterial killing, their overproduction damages mammary tissue and prolongs inflammation (Saito et al., 2021; Ushio-Fukai et al., 2021).

Dysbiosis in the gut has similarly been associated with PPP upregulation, linking gastrointestinal microbial imbalance to mastitis at the immune-metabolic interface (Horst et al., 2021; Kheirandish et al., 2022).

At the same time, the PPP contributes to antioxidant defence. Sedoheptulose kinase (Shpk), a unique enzyme of this pathway, generates sedoheptulose-7-phosphate, which supports NADH production and enhances cellular antioxidant capacity (Haschemi et al., 2012; Nagy & Haschemi, 2015). These findings emphasize the dual nature of the PPP: depending on context, it can exacerbate oxidative stress and

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inflammation or help restore redox balance and limit tissue injury.

Linking Infection and Metabolism: The TLR4–NF-κB Axis

Pathogen-associated signals are key drivers of the metabolic rewiring observed during mastitis. In particular, Gram-negative bacteria release lipopolysaccharide (LPS), which is recognized by Toll-like receptor 4 (TLR4) on mammary epithelial and immune cells.

LPS binds to LPS-binding protein and CD14, then activates the TLR4–MD2 complex. This recruits MyD88 and activates NF-κB, which enters the nucleus and switches on genes for cytokines such as TNF-α and IL-6 (Chow et al., 1999; Medzhitov, 2009; Akhtar et al., 2020). Beyond its role in cytokine production, NF-κB also stimulates glycolysis, establishing a feed-forward loop in which infection amplifies metabolism and heightened metabolism further sustains inflammation (Sordillo, 2018; Zhao et al., 2022a, 2022b). This tight coupling of immune signalling and metabolic flux highlights why mastitis should be viewed not merely as a localized udder infection but as a systemic metabolic–immune disorder.

From Computational Leads to Farm Solutions

Epitope mapping of HK and PFK isoforms (HK II and PFKP) expressed in mammary epithelial cells offers a promising route to designing multi-epitope vaccines and diagnostic constructs that specifically target key glycolytic enzymes in cattle, forming the basis of affordable diagnostic strips or ELISA kits for early mastitis detection.

Parallel computational docking has highlighted small molecules such as 2-deoxy-D-glucose, Lonidamide, Metformin, and sugar analogs as potential metabolic inhibitors with strong predicted binding affinities. These leads resonate with experimental findings showing that inhibition of PFKFB3, for example with PFK15, can reduce both inflammation and bacterial burden in mastitis (Gao et al., 2024) and in sepsis (Xiao et al., 2023).

Together, these strategies suggest that metabolic enzymes may serve dual purposes: as diagnostic biomarkers for subclinical mastitis and as therapeutic targets for precision interventions. This approach paves the way toward farm-ready solutions that move beyond antibiotics, combining early detection with therapies designed to fine-tune glycolysis and restore immune–metabolic balance.

Conclusion

Mastitis should be understood not only as a bacterial infection but as a metabolic disease. During infection, glycolysis intensifies, with HK, PFK, and PKM fuelling both energy supply and inflammatory signalling. At the same time, the TCA cycle becomes disrupted, releasing metabolites such as succinate, which amplifies inflammation, and itaconate, which tempers it. The pentose phosphate pathway (PPP) accelerates to generate NADPH, feeding both antimicrobial defences and damaging bursts of ROS. Among various regulators, PFKFB3 stands out as a central switch that links infection-driven metabolic rewiring to inflammation. Emerging tools such as epitope mapping and in silico docking provide a foundation for translating these molecular insights into practice, designing diagnostics that detect disease earlier and metabolic interventions that reduce reliance on antibiotics. Taken together, this integrated view of infection and metabolism points toward a new paradigm in mastitis management: shifting from symptom control to proactive monitoring and metabolic modulation, enabling earlier detection, more precise therapies, and sustainable improvement in udder health.

References are available upon request.

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Poultry Nutrition Demystified

Dr. Hugo Romero Sanchez

Dr. Hugo Romero Sanchez is a poultry nutrition specialist with deep expertise in broiler and layer physiology, trace mineral nutrition, and feed formulation. At NOVUS International, he works with the Research and Development team to develop practical, science-based nutritional solutions that enhance animal performance and support sustainable poultry production.

Before joining NOVUS, Dr. Romero held senior technical roles at Hybro BV, Cobb of Brazil, and Trouw Nutrition, focusing on nutrition management and performance improvement. He holds degrees in Zootechnics (La Salle University, Colombia), Animal Health and Production (National University of Colombia), and a Ph.D. in Poultry Science (North Carolina State University, U.S.).

In this interview with Think Grain Think Feed, Dr. Hugo Romero, Ph.D., Executive Manager and Global Poultry Technology Lead at NOVUS, shares his expert insights on the future of poultry nutrition amidst rising feed costs, ingredient variability, and sustainability challenges. Drawing on over a decade of global experience in broiler and layer nutrition, Dr. Romero discusses the potential of alternative feed ingredients, the importance of fiber and fat quality, precision enzyme strategies, and practical approaches to optimizing bird performance while supporting sustainable poultry production.

Hugo Romero, NOVUS

With fluctuating costs, inconsistent availability, and growing environmental concerns surrounding traditional feedstuffs like corn and soybean meal, which potential alternative ingredients do you see shaping the future of poultry nutrition?

In our global, integrated production system, challenges with cost, availability, and environmental impact will exist to some extent for any raw ingredient. There's no magic cure to these challenges; it's about finding ways to operate within them. Impact can be minimized through careful supply chain planning, identifying multiple sources of ingredients, and reducing environmental impacts on our own farms.

Consistent quality and availability of alternative ingredients remain a major challenge for the industry. Which countries are leading in adopting and integrating these alternatives effectively?

Due to its strong environmental and welfare policies, Europe seems to lead the way. The aquaculture market in Southeast Asia is also an early adopter of alternative feeds. As for production, while China may lead in insect meal, markets globally produce protein, fat and carbohydrate alternatives from their own produce, meal and grain harvests.

What are the primary challenges in evaluating the nutritional value of alternative feed ingredients, and how does their variability impact

diet formulation and bird performance?

Evaluating the nutritional value of alternative feed ingredients is difficult due to their high variability in composition and quality. Factors such as raw material origin, processing methods, and storage conditions create wide nutrient fluctuations that affect digestibility and bird performance.

Moreover, NIR calibrations for these ingredients can be less precise, leading to outliers and inaccurate nutrient estimates. This uncertainty forces nutritionists to apply larger safety margins in formulations, which increases feed costs and reduces the economic advantage of using alternative ingredients. In short, variability and analytical imprecision limit confidence and consistency, making it harder to realize the full value and sustainability potential of alternative feed sources.

Your review emphasizes the importance of accurately characterizing fiber fractions and non-starch polysaccharides. How do these components influence gut health, nutrient digestibility, and the strategic application of enzymes?

In poultry nutrition, starch digestibility is already very high—often close to 100%—¬so while it is important to measure, it provides limited opportunity for further improvement through enzyme use. The real focus should be on non-starch polysaccharides (NSP) and fiber fractions, which have a much greater impact on gut health and nutrient digestibility.

Soluble NSP can increase intestinal viscosity, impairing nutrient absorption, while insoluble fiber can help maintain gut motility and microbiota balance. By accurately characterizing these fractions, nutritionists can strategically apply NSP-degrading enzymes (such as

xylanase or β-glucanase), depending on the ingredients, to reduce viscosity, unlock nutrients and increase oligosaccharides that improve overall gut function and feed efficiency. In short, precise fiber and NSP profiling enhances both enzyme effectiveness and bird health and performance consistency.

Can you elaborate on how fat quality—particularly fatty acid profile and degree of saturation—affects metabolizable energy and overall bird performance? Are there specific tools or metrics you find especially reliable for assessing fat digestibility?

Fat quality strongly influences metabolizable energy (ME) value and overall bird performance. Fats rich in unsaturated fatty acids are more digestible and provide higher ME than saturated fats, particularly for young birds with limited fat digestion capacity. The unsaturated/saturated (U/S) ratio is therefore a critical factor for correcting fat energy values.

However, other quality aspects, such as non-elutable material (impurities) and oxidative deterioration measured by peroxide and anisidine values, also affect digestibility and gut health. Reliable evaluation tools include fatty acid profiling, oxidative stability tests, and digestibility assays. Together, these parameters determine the true energy contribution and consistency of fats in poultry diets.

In your opinion, how well are current feed evaluation systems (such as international nutritional tables and standards) adapted to regional ingredient variability and emerging feedstuffs? What improvements would you advocate for?

Current feed evaluation systems often fall short in reflecting regional, seasonal, and processing-related variability, especially for emerging or alternative feedstuffs. To achieve more accurate formulations, it's essential to complement table values with local wet chemistry analyses or updated NIR data that capture the actual nutrient composition of ingredients used in each region and season.

Additionally, feed evaluation systems should better account for anti-nutritional factors, such as trypsin inhibitors, tannins, or NSP content, which can significantly affect nutrient availability and bird performance. Incorporating these variables into predictive models would make energy and digestibility estimates far more reliable. Adjusting amino acids digestibility according to trypsin inhibitor is a good tool to improve uniformity and the successful use of enzymes like proteases.

Looking ahead, what innovations or enzyme strategies do you believe will be game-changers in unlocking the full nutritional potential of alternative feed ingredients—particularly in terms of cost-effectiveness and sustainability?

While the future will provide options, we need to push using more of the solutions we have today. Protease enzymes have historically been under-leveraged in poultry diets. We can change that. For instance, birds fed CIBENZA® Enzyme Feed Additive have demonstrated better growth performance and health, especially in challenging field conditions or when the trypsin inhibitor level in soybean meal is high. Next-generation proteases and precision enzyme blends are expected to further unlock the potential of alternative ingredients, improving cost effectiveness and sustainability of poultry production.

Do you have any final message or advice for the Indian poultry industry as it navigates changing nutritional landscapes and feed challenges?

Regardless of what you're feeding, it's vital you understand the nutrient makeup of your ingredients. For instance, many alternative feed ingredients (e.g., oilseed meals, local by-products, lower-grade grains) carry anti-nutritional factors that impact digestion or are simply less digestible. Enzyme supplementation can help, but it is essential to understand the nutritional foundation of the birds' diet to get the most from the enzymes.

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Nutritional Perspectives and Innovations in Alternative Feed Resources for Sustainable Poultry Production

by **TR Bhosale[1], SA Dhage[2], US Gaikwad[2], SB Adangale[2], DR Birari[3]**

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Introduction

The global poultry industry is expanding rapidly due to rising demand for affordable and high-quality animal protein. However, feed accounts for 60–70% of total production costs, primarily dependent on maize and soybean meal. This heavy reliance creates economic strain and ecological pressure, including deforestation, biodiversity loss, and greenhouse gas emissions from crop cultivation and transportation.

To reduce this dependence, researchers are exploring alternative feed resources that are nutritionally balanced, cost-effective, and environmentally sustainable. Promising candidates include plant-based residues, insect meals, agro-industrial by-products, and food waste, all of which support the principles of a circular economy.

The focus of modern poultry nutrition is shifting toward such sustainable feeding strategies that maintain productivity while minimizing environmental impact.

Objectives of Developing Alternative Poultry Feeding Practices

Traditional poultry diets use corn and soybean meal as main energy and protein sources. While nutritionally effective, their high price volatility and environmental footprint pose challenges.

The key objectives of developing alternative feeding systems include:

- Lowering dependence on conventional crops.
- Reducing feed costs and production risks.
- Enhancing nutrient efficiency and poultry health.
- Promoting eco-friendly, regionally sourced diets.

Alternative feed ingredients—such as legume by-products, oilseed meals, fruit pomace, and herbal supplements—can improve digestion, immunity, and overall performance. Sustainable feeding also contributes to resource efficiency and reduces waste generation, strengthening local agricultural systems.

Novel Feeding Approaches for Sustainable Poultry Production

Sustainability-oriented feeding practices integrate non-conventional feed sources to reduce costs and environmental pressures. Studies highlight the potential of materials like legume residues, oilseed by-products, algae, and insects as replacements for conventional ingredients.

The advantages include:

- Economic efficiency: Agricultural by-products are inexpensive and reduce waste.
- Nutritional diversity: Alternative feeds can meet poultry requirements for energy, protein, and micronutrients.
- Resilience: Using diverse

ingredients protects against market volatility and supply chain disruptions.

These innovations not only support productivity but also improve the sustainability and resilience of poultry food systems.

Categories of Alternative Feed Resources

1. Plant-Derived Ingredients

Plants remain the foundation of poultry nutrition. However, competition between feed and human food crops necessitates new options.

Alternative plant sources include:

- Legumes: Lupins, faba beans, chickpeas, and peas offer rich protein and amino acid content with a lower environmental footprint than soybeans.
- Oilseed Meals: Canola, flax, and rapeseed meals provide high-quality protein and energy.
- Agricultural Residues: By-products like rice bran and wheat bran reduce food waste and support circular economy goals.

Processing methods such as fermentation, enzyme treatment, and genetic selection can improve nutrient availability and digestibility, making these feeds viable substitutes.

2. Insect-Derived Ingredients

Insects like black soldier fly larvae, mealworms, and crickets are gaining global attention as sustainable protein sources. They efficiently convert organic waste into nutrient-rich biomass containing 30–80% protein and essential amino acids.

Benefits:

- Comparable or superior to fishmeal and soybean meal in amino acid profile.
- Support circular economy through waste recycling.
- Offer high feed conversion efficiency and low carbon footprint.

Challenges include regulatory restrictions, high production costs, and scaling issues. However, with ongoing research and infrastructure investment, insect protein has strong potential as a mainstream poultry feed.

3. By-Products and Waste-Derived Ingredients

Agro-industrial residues such as fruit peels, vegetable trimmings, and food processing wastes can be converted into valuable feed materials. They supply essential nutrients—proteins, carbohydrates, fats, vitamins, and minerals—required for poultry growth.

Typical nutrient needs for poultry include:

- Protein: 16–23%
- Lysine: 0.9–1.3%
- Methionine: 0.4–0.6%
- Fats: 3–6%
- Vitamins & Minerals: Balanced levels to support growth, egg production, and health.

Repurposing agricultural residues supports circular food systems, reduces disposal costs, and mitigates environmental pollution.

4. Azolla – A Promising Fodder Source

Azolla, an aquatic fern, is rich in crude protein (20–30%) and essential micronutrients. Studies show that including Azolla up to 10–15% in poultry diets:

- Improves growth and feed conversion efficiency.
- Enhances yolk pigmentation and egg production.
- Reduces feed costs with minimal land and water use.

Azolla cultivation aligns well with smallholder and backyard poultry systems seeking low-cost, sustainable feed solutions.

Impact on Poultry Performance

Inclusion of alternative feed ingredients can maintain or enhance poultry performance:

Apiaceae family (e.g., carrot leaves, coriander, parsley): Improves egg quality and immunity.

- Asteraceae family (e.g., chicory, calendula): Reduces abdominal fat and enhances meat quality.
- Brassicaceae family (e.g., rapeseed, hempseed): Improves fatty acid profiles and antioxidant capacity.
- Fabaceae family (e.g., alfalfa, peas): Lowers yolk cholesterol and mortality rates.
- Allium and Zingiberaceae families (garlic, ginger): Support gut health and immune function.

These examples show that diverse plant-based ingredients can provide nutritional, functional, and economic benefits while supporting sustainable production.

Environmental and Economic Benefits

The adoption of alternative feed resources contributes significantly to both environmental and economic sustainability:

- Environmental gains: Reduced carbon emissions, better waste management, and resource conservation.
- Economic gains: Lower feed costs, diversification of inputs, and resilience to market fluctuations.
- Circular economy: Utilizing agricultural waste as feed minimizes disposal problems and adds value.

As awareness of climate change and ethical food systems grows, consumers increasingly prefer poultry raised with sustainable feed practices—potentially allowing producers to access premium markets.

Limitations and Challenges

Despite their promise, alternative feeds face several challenges:

- Nutrient variability: Composition varies with crop type, harvest conditions, and processing.
- Anti-nutritional factors: Compounds like tannins, phytic acid, and saponins can affect digestibility.
- Palatability issues: Some waste-derived ingredients may reduce feed intake.
- Digestibility: High-fiber residues may lower energy availability unless properly processed.

Advanced formulation models, enzyme supplementation, and standardized processing are essential to ensure nutritional consistency and safety.

Future Directions and Policy Support

To accelerate adoption, several steps are needed:

1. Research investment to optimize processing and inclusion levels of novel ingredients.
2. Life-cycle assessments to quantify sustainability impacts.
3. Economic and market analysis to evaluate profitability.
4. Long-term feeding trials to assess health and productivity outcomes.
5. Supportive policies and incentives—such as tax benefits and grants—to promote insect and plant-based protein industries.
6. Capacity building and farmer training programs.
7. Clear regulations for safety and quality assurance of new feed types.

Collaboration between research institutions, government agencies, and industry players is key to scaling these innovations globally.

Conclusion

The transition to sustainable poultry feeding systems is essential for balancing productivity, profitability, and environmental stewardship. Alternative feed resources—ranging from plant residues to insect proteins and Azolla—offer promising pathways to:

- Lower production costs,
- Reduce ecological footprint,
- Strengthen local feed self-sufficiency.

While technical and regulatory challenges remain, continued innovation, policy support, and awareness among farmers and consumers will drive the shift toward sustainable poultry nutrition. Integrating these approaches will not only support food security but also foster resilient, circular agricultural ecosystems for the future.

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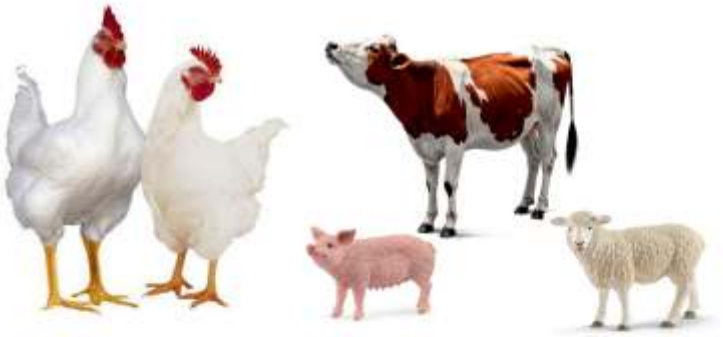

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Think Grain Think Feed - Volume 11 | Issue 12 | Oct 2025

De Heus Brings Global Expertise to Indian Livestock

Rutger Oudejans

With a rich heritage spanning more than three centuries, Royal De Heus has grown into one of the world's most respected names in animal nutrition. Headquartered in the Netherlands, this family-owned company operates over a hundred production sites across twenty countries, supplying feed, premixes, and nutritional solutions to farmers in seventy-five markets. Guided by a commitment to quality, innovation, and sustainable growth, De Heus has steadily expanded its global footprint—including a strategic focus on Asia.

In an exclusive interaction with Think Grain Think Feed, Rutger Oudejans, Managing Director, De Heus India, discusses the company's legacy, its new Rajpura facility, the evolving Indian feed market, and how De Heus is shaping the future of sustainable livestock production in the country.

Could you briefly introduce De Heus and its global footprint, and how De Heus India fits into the company's broader vision?

De Heus is a family-owned company with a legacy that traces back more than 300 years to our milling roots in the Netherlands. Over the centuries, we have evolved from a local miller into a fully integrated global animal nutrition group—offering compound feed, premixes, concentrates, and feed specialties for a wide range of species.

What makes De Heus unique is the combination of entrepreneurial agility, short decision lines, and deep technical expertise that comes with being a family-run business. We are driven by a single mission—to contribute to the progress of the agricultural sector and improve food security by supporting independent farmers worldwide.

Today, De Heus operates over 100 production facilities in more than 20 countries, employing 13,000 people and producing over 13.5 million tons of feed annually. Our products are distributed across 75 countries, supporting farmers in poultry, ruminant, swine, and aquaculture sectors.

De Heus India represents an important chapter in this global story. We began operations here in 2017 with a small rented plant in Rajpura, Punjab, and have steadily expanded—through toll-milling partnerships in Assam and Maharashtra, and now our own greenfield factory in Rajpura. India's growing population, rising protein demand, and government focus on modernizing agriculture align perfectly with our long-term vision of enabling sustainable, efficient livestock farming.

What were the key drivers behind De Heus India's decision to expand with a new manufacturing facility in Rajpura?

India is at the heart of De Heus' global growth strategy. It is the world's most populous nation and one of the fastest-growing major economies, with GDP growth expected around 6.9 percent in 2025. The country is already the eighth-largest animal feed market globally, and the total feed demand is forecasted to grow at a 6.3 percent CAGR to 2030.

We see enormous potential in India's livestock sector. The factors are compelling—an expanding middle class, increasing health and protein awareness, government support for agri-industries, and a young, dynamic workforce.

Punjab offers several advantages: strong agricultural infrastructure,

excellent logistics connectivity, and a large base of dairy and poultry farmers open to innovation. Our investment in Rajpura reinforces our commitment to localizing production, sourcing raw materials domestically, and creating jobs within the regional economy.

The new facility allows us to deliver high-quality, customized nutrition faster and more efficiently to farmers across North India—one of the most attractive multi-species markets in the country. The region's population—about 350 million in 2019 and growing at a CAGR of roughly two percent—represents a vast and diverse consumer base. While North India's GDP per capita (around USD 1,480) is slightly lower than the national average, it includes both high-income states like Punjab and lower-income states like Uttar Pradesh. This diversity makes it a balanced and dynamic market for livestock feed. The region also holds some of India's largest populations of dairy cows, broilers, and layers, offering immense potential for growth across multiple species.

How do you assess the current scope and potential of the Indian livestock and poultry feed market? Which trends are most significant right now?

The Indian livestock and poultry feed market offers enormous potential, driven by the country's growing population, rising incomes, and evolving consumer preferences toward protein-rich diets. Urbanization, increased per-capita consumption, and government initiatives supporting dairy, poultry, and aquaculture sectors are fueling demand for commercial feed, while feed quality and efficiency are becoming key differentiators.

Overall Trends:

- India has the largest and one of the fastest-growing populations in the world. Combined with low but increasing per-capita consumption, this drives strong local demand.
- Feed adoption varies by species: high in poultry, medium in aquaculture and ruminants, and low in swine.
- The country is a net exporter of animal protein—especially shrimp, buffalo meat, and some poultry products—which provides additional growth opportunities.
- Regions differ in growth potential: the North and East offer high addressable markets due to medium-to-large farms, while the South and West are more mature but stable markets.

Poultry:

- Broilers (CAGR 4.7%) – India is the 5th largest chicken producer. North and East are key addressable markets, while the South and West are more integrated and mature. Growth is driven by professionalization of farms and increasing use of commercial feed.
- Layers (CAGR 4.4%) – Egg consumption per capita is about one-third of the global average, leaving significant room for growth. North and East are expanding, while South houses integrated large-scale farms. Feed is largely price-driven, focused on concentrates, basemix, and pelleted rearing feed.

Dairy / Ruminants:

- Dairy (CAGR 8.6%) – Medium and large farms are the main users of commercial feed, particularly in North and West India. Increasing milk prices and focus on yield, fertility, and animal health are driving compound feed adoption. Smallholder farms dominate but are gradually transitioning to commercial feed usage.

Ruminants – With a very large cattle and buffalo population, there is strong potential for feed adoption, especially among medium-to-large farms. North and West India lead in commercial feed usage due to larger farm sizes and organized dairy operations.

Swine:

- CAGR 1.7% – Smallest sector, with most pigs fed on starter feed and hotel waste. North and East show slightly higher feed adoption. Growth comes from gradual conversion to commercial feed.

Aquaculture:

- CAGR 7.9% – Driven by rising shrimp and fish consumption. East and South coasts dominate production. Many small and medium farms are still non-users of compound feed, representing a significant growth opportunity.

Key Regional Drivers:

- North India is a highly attractive multi-species

region with a total addressable market of 4 million MT/year. Population ~350 million (2019) with ~2% CAGR. GDP varies across states—Punjab is affluent, while Uttar Pradesh is below the national average. Large populations of dairy cows, broilers, and layers make it a strategic growth area.

Market Dynamics:

- The sector is shifting from fragmented backyard farming to more professional, integrated operations.
- Modern technology adoption, processed products, and specialty feeds are growing rapidly.
- Sustainability, product quality, and feed efficiency are becoming key decision factors.
- Early movers in emerging segments like pig feed or shrimp have a strategic advantage.

Overall, India is at an exciting stage: commercial feed adoption is accelerating across species, regions differ in maturity and growth, and opportunities remain vast for international and domestic feed producers who focus on quality, efficiency, and farmer support.

What is the production capacity of the new Rajpura facility, and what technologies ensure feed quality and safety?

Our Rajpura feed mill represents a significant milestone for De Heus India. The facility has an installed capacity of 180,000 metric tons per year, with the potential to expand to 240,000 tons in the future. It is designed with two dedicated production lines—one for monogastric animals (poultry and swine) and one for ruminants (cattle and buffalo).

We've invested heavily in European equipment and automation technologies from leading suppliers such as Van Aarsen, PTN, and Prado. The plant features a fully automated production control system, precision dosing, pre-grinding, hammer mills, pellet mills, micro-ingredient bins, premix dosing, and advanced quality monitoring.

Automation minimizes human error and guarantees product consistency, while real-time process control ensures accuracy in every batch. These technologies allow us to produce safe, nutritionally balanced feed that meets both international and Indian quality standards.

What is De Heus India's strategic vision for the next five years?

Our strategy is built on a multi-tier approach. First, we want to consolidate and expand our presence in North India, leveraging the Rajpura facility to serve the region's large and diverse livestock base. This region will remain the cornerstone of our operations in the near term.

Second, we aim to scale our activities in the Northeast, particularly in Assam, where we entered through toll-milling in 2023. The region has strong demand for poultry and swine feed, and we see opportunities to introduce layer, aqua, and dairy lines in the coming years.

Third, we plan to extend our reach into western and southern India through new brownfield and greenfield projects. Over time, we envision a pan-India network of modern feed plants that will enhance access, reduce lead times, and ensure consistent quality nationwide.

Beyond feed, we are also exploring value-chain opportunities—including breeding, genetics, and possibly processing—where we can leverage our international expertise to strengthen the entire livestock ecosystem.

De Heus recently made headlines with its acquisition of CJ Feed & Care's operations across Asia. How does this strengthen the company's position regionally?

Yes, this is indeed a major milestone for De Heus globally. On the same day we inaugurated our Rajpura feed mill, we also signed a Share Purchase Agreement to acquire CJ Feed & Care's operations in Vietnam, Indonesia, South Korea, the Philippines, and Cambodia.

This acquisition adds 17 feed mills and a network of breeding and livestock operations to our portfolio, making it the largest transaction in De Heus' history. It significantly strengthens our footprint in Asia and aligns perfectly with our vision to improve access to safe, affordable, and sustainable animal protein.

For India, this regional expansion creates synergies in technology, R&D, and operational expertise. It allows us to share best practices across markets and bring even more advanced nutritional solutions to Indian farmers in the years ahead.

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CLFMA of India Deepens Engagement with the U.S.

The Compound Livestock Feed Manufacturers Association (CLFMA) of India successfully concluded a week-long delegation visit to the United States, aimed at strengthening bilateral cooperation in agriculture, livestock feed, and dairy production. Invited by the U.S. Grains Council, the delegation was led by Mr. Divya Kumar Gulati, Chairman, CLFMA of India, and included key office bearers and industry representatives.

The delegation visit focused on studying advanced sorghum, corn, and dairy farming practices, and engaging with U.S. policymakers, industry leaders, and farmers. Beginning in San Antonio, Texas, the delegation participated in technical sessions conducted by the United Sorghum Checkoff Program, Kansas State University, Clemson University, and the U.S. Grains Council. Discussions covered sustainable feed production, grain quality standards, and sorghum's potential in Poultry and Livestock diets.

CLFMA Delegation Field visits across Amarillo, Texas, and Iowa offered the delegation firsthand exposure to modern cultivation, feed processing, and integrated dairy operations. CLFMA team visited farms, feed mills, ethanol plants, and seed processing units—gaining insights into mechanization, traceability, and supply chain efficiency. In Iowa, meetings with the Governor and Agriculture Secretary of Iowa, along with representatives from the Iowa Corn Growers Association, focused on policy collaboration, technology transfer, and opportunities for joint research in feed and dairy sectors.

Key outcomes of the visit included:

- Strengthening of existing MoUs between CLFMA and the State of Iowa (2024) and the Maharashtra–Iowa Sister-State Agreement (August 2025) to promote agricultural innovation and knowledge exchange.
- Identification of collaborative projects in sorghum-based feed development, feed efficiency benchmarking, and dairy nutrition enhancement.
- Exploration of training and exchange programs for Indian feed technologists, nutritionists, and farmers to learn from U.S. best practices.
- Initiation of dialogue on joint research and sustainability partnerships between Indian feed industry members and U.S. institutions.

The delegation comprised senior CLFMA office bearers including CLFMA Chairman Mr. Divya Kumar Gulati, Dy. Chairmen Viz. Mr. Abhay Shah, Mr. Abhay Parnekar, Mr. Naveen Pasuparthy, Mr. Sumeet Surekha, CLFMA Hon. Secretary Mr. Nissar F. Mohammed, CLFMA Treasurer Mr. R. Ramkutty, CLFMA President – East Zone Mr. Sameer Chotai & CLFMA Immediate Past Chairman Mr. Suresh Deora.

Europe Faces Early and Rapid Surge of Bird Flu Outbreaks as Countries Tighten Controls

Europe is confronting an early and aggressive resurgence of highly pathogenic avian influenza (HPAI), commonly known as bird flu, prompting several nations to reimpose strict biosecurity measures to contain the spread. Belgium, France, and the Netherlands have all ordered poultry to be kept indoors after new outbreaks of the H5N1 strain were confirmed in multiple regions, according to reports from the World Organisation for Animal Health (WOAH) and European news agencies.

Belgium's Federal Agency for the Safety of the Food Chain announced that from Thursday, October 23, all poultry must be confined indoors after an outbreak on a turkey farm near Diksmuide in the north of the country. The virus killed 319 birds, and authorities culled the remaining 67,000 to prevent further spread, WOAH said in a statement.

Neighboring France has raised its national alert level to "high" following the detection of several cases in both farm and backyard flocks. This move mandates the indoor confinement of poultry and intensifies monitoring along migratory bird routes. The Netherlands has also detected new cases in its central-eastern region and plans to cull around 161,000 chickens at an affected farm, government officials confirmed.

Elsewhere in Europe, Slovakia has reported an outbreak of H5N1 at a poultry farm, underscoring how rapidly the virus is spreading across the continent. The WOAH described this current wave as "unusually early," warning that the scale and speed of infections are greater than those seen in the same period last year.

The bird flu virus is primarily spread by migratory wild birds but can devastate domestic poultry populations once introduced. Since 2021, successive waves of the disease have forced European authorities to cull hundreds of millions of birds, disrupting the poultry industry, straining food supplies, and driving up prices of eggs and poultry products.

Although the risk of transmission to humans remains very low, experts from the European Centre for Disease Prevention and Control (ECDC) caution that the virus's persistence in animal populations increases the possibility of mutations that could enhance transmissibility. "Every new infection is a chance for the virus to adapt," said one ECDC spokesperson, urging

countries to maintain strict vigilance.

Beyond Europe, Japan has also reported a fresh outbreak of avian influenza on an egg farm in Shiraoi, located on Hokkaido Island. According to WOAH, the virus killed 46 birds before authorities culled the remaining flock.

European authorities have responded by tightening surveillance, expanding testing in high-risk zones, and advising farmers to strengthen hygiene and limit contact between wild and domestic birds.

With colder months approaching, experts warn that Europe could face its most challenging bird flu season in years. While human infections remain rare, the economic and animal health toll is already mounting — reinforcing that early containment and robust monitoring are essential to curbing the disease spread.

Ethanol Policy and Its Impact on Soybean Farmers

Authors: Siraj Hussain, former Union Agriculture Secretary & **Garima Jain,** Commodity Expert

The National Policy on Biofuels (NPB), announced by the Ministry of Petroleum and Natural Gas in June 2018 and amended in June 2022, targeted 20% ethanol blending with petrol (E20) by 2030. Subsequently, in June 2021, NITI Aayog released its 2020–25 roadmap for ethanol blending, prepared under Dr. Rakesh Sarwal, Additional Secretary, NITI Aayog. Few could have predicted that a small by-product of ethanol production would later disrupt agricultural markets and severely impact soybean farmers.

Sources of Ethanol: Grains Surpass Sugarcane

NITI Aayog initially projected that 54% of ethanol would come from sugarcane-based feedstock and the rest from food grains. However, by the Ethanol Supply Year (ESY) 2024–25, this ratio is expected to reverse. Of the 10.77 billion litres of ethanol contracted by public sector oil marketing companies (OMCs), about 3.5 billion litres (32%) will come from sugarcane and 7.3 billion litres (68%) from food grains.

Corn Takes the Lead

Corn alone will contribute around 5 billion litres (46%) of ethanol, consuming 13.1 million tonnes of the nation's 42 million tonnes of corn production. Additionally, 1.2 billion litres will come from rice supplied by the Food Corporation of India (FCI) at INR 22.50/kg, though its economic cost is INR 4,173/quintal. The government has allocated 5.2 million tonnes of rice for ethanol manufacture, entailing a subsidy of roughly INR 10,000 crore.

Rise of DDGS: The By-Product Changing Markets

A key by-product of ethanol production from maize and rice is Distiller's Dried Grains with Solubles (DDGS)—a protein-rich feed ingredient. DDGS from maize contains 28–30% protein, while that from rice has about 45%. India is projected to produce 3.9 million tonnes of maize DDGS and 1.25 million tonnes of rice DDGS in 2024–25, adding 5.15 million tonnes of new protein feed to the market.

Soybean Market Under Pressure

Before the ethanol boom, the main source of livestock protein was de-oiled cakes (DOCs) from oilseeds like soybean, mustard, and groundnut. Soybean meal, with 40–45% protein, was the preferred poultry and cattle feed and a major export. Now, cheaper DDGS—priced at INR 15,500–20,000 per tonne versus INR 31,000–32,000 for soybean meal—has displaced soybean DOC.

Consequently, soybean prices have dropped below the MSP of INR 4,892 per quintal, with market rates between INR 3,200–4,200 in 2023–25. The MSP for 2025–26 is INR 5,328, yet farmers expect less. The area under soybean has declined from 12.7 to 12 million ha, while maize cultivation has expanded from 7.9 to 9.5 million ha due to higher demand from distilleries.

Experts at Globoil India emphasized that government policy should incentivize protein crops to reduce pulse imports and ensure food security takes precedence over mobility security.

Source: Money Control

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Oilmeal Exports Stay Flat in H1 FY2025-26 Despite Strong September Surge

India's oilmeal exports remained nearly unchanged in the first half of FY2025-26, despite a sharp 40% rise in September shipments. According to the Solvent Extractors' Association of India (SEA), exports stood at 20.93 lakh tonnes (lt) during April–September 2025-26, marginally higher than 20.82 lt a year earlier — an increase of just 0.5%.

In September alone, exports touched 2.99 lt, up from 2.13 lt in September 2024, driven by higher shipments of soybean, rapeseed, groundnut, and castorseed meals. However, soybean meal exports for the six-month period fell to 8.39 lt from 9.08 lt last year, pressured by global price competition and increased availability of DDGS in the feed market, which has reduced domestic demand.

Groundnut meal exports surged nearly threefold to 15,967 tonnes, supported by increased groundnut production. SEA's survey indicated that Gujarat's groundnut acreage rose to 22.02 lakh hectares this kharif season, with output expected at 46.07 lt.

Among key buyers, China emerged as the top importer with 4.95 lt, followed by South Korea (2.32 lt) and Bangladesh (2.12 lt). Europe also showed steady demand, with Germany and France importing 1.43 lt and 56,959 tonnes of soybean meal, respectively.

SEA welcomed the government's recent decision to lift the ban on de-oiled ricebran exports from October 3, noting that it will support the rice milling and solvent extraction industries, improve returns for farmers, and enhance ricebran oil processing.

Silage Revolution: Maize Hybrids Emerge as Key to India's Fodder Security

Agricultural experts and stakeholders have identified silage maize as a game-changer for India's livestock and dairy sectors, capable of boosting farm incomes, ensuring year-round fodder availability, and enhancing animal productivity. This consensus emerged at a recent workshop in Ludhiana focused on strengthening the maize-based silage value chain in Punjab and Haryana, organized by the ICAR–Indian Institute of Maize Research (IIMR).

Delivering the keynote address, ICAR–IIMR Director Dr. H. S. Jat highlighted the potential of silage maize to bridge India's widening green fodder gap. "By promoting silage maize, farmers can achieve better land-use efficiency, maintain soil health, and secure higher returns within a shorter duration," he said.

Silage — a fermented, high-moisture fodder — was promoted as a climate-resilient and sustainable alternative to traditional green feed, providing consistent nutrition even during dry seasons. IIMR is developing region-specific maize hybrids and promoting farmer-centric value chain models to strengthen the country's fodder ecosystem.

Experts emphasized the importance of developing silage-specific maize hybrids, optimizing crop management, and improving ensiling techniques through microbial inoculants. The growing demand for silage is also fostering rural entrepreneurship, opening new opportunities for FPOs, dairy cooperatives, and agri-startups.

Participants called for capacity building, policy support, and large-scale demonstrations to accelerate adoption. The workshop concluded that silage maize represents a pivotal step toward sustainable crop–livestock integration and long-term fodder security for India's dairy and livestock sectors.

China Navigates Soybean Supply Amid High Brazilian Premiums and Trade Tensions

China's soybean imports remain in focus as the world's largest buyer navigates high Brazilian premiums and ongoing trade tensions with the U.S. In September 2025, China imported 12.87 million metric tons of soybeans, the second-highest monthly volume on record, largely sourced from South America. Brazil alone supplied around 6.5 million tons, accounting for 93% of its total exports to China, while Argentina also contributed significantly under its temporary tax holiday. These imports ensured China's soybean supply remained robust, with total imports from January to September reaching 86.18 million tons, up 5.3% year-on-year.

However, looking ahead to December-January shipments, Chinese buyers have been hesitant to secure new cargoes. High Brazilian premiums of $2.8–2.9 per bushel—compared with U.S. premiums of around $1.7—have squeezed crush margins, discouraging processors from locking in near-term supplies. China still needs approximately 8–9 million tons for year-end and early 2026, and industry sources suggest the country may tap its state reserves before the new South American harvest arrives.

U.S. soybeans remain largely sidelined due to ongoing trade tensions, though buyers may return if a deal is reached during potential Trump-Xi talks in South Korea. Historically, China has diversified imports, sourcing only 20% from the U.S. in 2024, down from 41% in 2016. Analysts note that trade developments, South American weather, and domestic demand for soybean meal will continue to shape China's purchasing patterns.

With a record Brazilian harvest of 177.64 million tons expected in 2025/26, Chinese crushers hope that supply abundance will ease prices. Meanwhile, strategic sourcing decisions, market diversification, and careful management of reserves remain critical for Beijing to maintain a stable soybean supply in the face of global price volatility and geopolitical uncertainties.

Shrimp Squeeze: India's Seafood Industry Struggles Under New US Tariffs

India's seafood sector has been hit hard by the recent US decision to impose a 50% tariff on Indian exports, citing trade imbalances and Russian energy imports. This move, combined with existing anti-dumping (3.96%) and countervailing duties (5.76%), has raised total effective duties to nearly 60%, making shipments to the US — India's largest seafood market — increasingly unviable.

The US accounts for one-third of India's $7.45 billion seafood exports, valued at $2.71 billion in FY 2024–25. Early signs of stress include declining shipments, closed processing units in Andhra Pradesh, and a 30–35% drop in September exports. Experts warn that India could face a 20% fall in overall seafood exports in FY26, affecting millions of livelihoods.

Industry leaders urge urgent market diversification toward Europe, Russia, Japan, and Southeast Asia, but note that compliance standards, species-specific demand, and long certification timelines make this shift slow and costly. Shrimp — which makes up 70% of India's seafood exports — poses a particular challenge, as 40% of these shipments historically went to the US.

Exporters are also facing severe working capital shortages as inventories pile up, banks tighten lending, and interest costs surge. Many are seeking soft loans, interest subsidies, and moratoriums similar to pandemic-era relief.

Government officials have initiated consultations with banks and exporters to mitigate financial distress and promote new trade routes. However, industry observers warn that the combined pressures of tariffs, liquidity constraints, and compliance challenges could permanently alter India's seafood export landscape unless swift, coordinated action is taken.

Bangladesh Achieves Egg Surplus, Small Farmers Face Market Pressures

Bangladesh has surpassed its national egg requirement, producing a surplus of 59.65 crore eggs above the FAO-recommended annual intake of 185 crore eggs, ensuring a per capita availability of 137 eggs, up from just 35 a decade ago. The Department of Livestock Services reports total annual production of 244.65 crore eggs, with commercial farms contributing 3.5–4 crore eggs daily and rural households 2–2.5 crore.

Despite this progress, small-scale farmers remain highly vulnerable. Last year, rising feed and medicine costs, low egg prices, and a shortage of day-old layer chicks forced many producers to shut down. Industry sources estimate 20–25% of farms closed in the past year, following about 30% closures during the Covid-19 pandemic. Of over 50,000 registered and unregistered farms, only 10–12% are corporate-owned, leaving many small entrepreneurs exposed to market volatility and high production costs. Raozan-based farmer Debashish Bhattacharya noted that nearly 30% of his chicks died last year due to poor quality, highlighting persistent risks for smaller operators.

Taher Ahmed Siddiqui, president of the Bangladesh Egg Producers Association, stressed that policy support is critical to safeguard farmers and employment. The Department of Livestock Services aims to raise per capita egg availability to 165 by 2031 and 208 by 2041, but experts caution that production growth alone is insufficient. Protecting small farmers, regulating markets, controlling costs, and ensuring fair prices are essential to sustain the sector and secure long-term food and livelihood security.

Soybean Output Set to Drop by 20.5 Lakh Tonnes Amid Weather Woes

India's soybean production is expected to decline by 20.5 lakh tonnes this year, reaching 105.36 lakh tonnes, the Soybean Processors Association of India (SOPA) has reported. The fall is attributed to reduced acreage, lower productivity, and adverse weather conditions, including heavy monsoon rains in Rajasthan and Madhya Pradesh.

During the current Kharif season, soybean was sown on 114.56 lakh hectares with an average yield of 920 kg per hectare, compared to 118.32 lakh hectares and 1,063 kg per hectare last year. SOPA chairman Davish Jain noted that rainfall damage significantly affected crop output, while executive director D. N. Pathak highlighted the impact of the yellow mosaic virus on several regions.

To support farmers, the Madhya Pradesh government has introduced a price difference payment scheme, ensuring that those selling below the centrally declared Minimum Support Price (MSP) of ₹5,328 per quintal receive compensation. This MSP is ₹436 higher than last year's rate, aiming to cushion farmers from market volatility.

SOPA emphasized that India imports over 60% of its edible oil requirements, costing around ₹1.7 lakh crore annually. To achieve self-sufficiency in edible oils, soybean production must increase through improved seeds, better agronomic practices, and effective pest management.

The decline in soybean output underscores the vulnerability of oilseed crops to climate variability and pest outbreaks, highlighting the need for policy support, crop insurance, and investment in resilient agriculture practices to stabilize supply and reduce dependence on imports.

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