Livestock & Feed Trends

VOLUME - 21 • NUMBER - 4 • JANUARY - MARCH 2024

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From the Chairman's Desk.....

Dear Friends,

Warm greetings!

We are delighted to share that the last quarter of the financial year, from January to March 2024, has been marked by significant progress and engagement for CLFMA OF INDIA. Our efforts have been directed towards safeguarding the interests of the Livestock industry, and we are thrilled to see positive outcomes.

We extend our sincere gratitude to all CLFMA Members for your unwavering support throughout this period. Allow me to provide you with a brief overview of the key activities undertaken by CLFMA, outlined under the "CLFMA Activity Updates":

To list a few, In January 2024, CLFMA had a productive meeting with the USGC Team to explore collaboration opportunities. CLFMA actively participated in the Industry–Academia Meet, with Dr. Devender Hooda representing our organization. CLFMA supported the India US Meet. Mr. Divya Kumar Gulati, CLFMA Dy. Chairman engaged with Mr. Brent Crafton, Director of Feed Ingredient Utilization at United Sorghum Checkoff Program to explore opportunities for collaboration and exchange ideas. The Government of India launched the realigned AHIDF scheme in the month of February 2024, Mr. Naveen Pasuparthy, Dy. Chairman, and some of the CLFMA members graced the event. CLFMA OF INDIA's Treasurer Mr. Nissar F. Mohammed participated in the National Workshop on Harnessing Potential Fisheries in Inland States, he shared his views on the Challenges of the Fish Feed Industry, in the month of February 2024 in Andhra Pradesh. CLFMA OF INDIA got an invitation for the meeting scheduled on 20th February, 2024 at 11:00 am for all the stakeholders of Coastal Aquaculture including stakeholder associations such as All India Shrimp Hatcheries Association, Prawn Farmers Federation of India, Society of Aquaculture Professionals. Dr. Devender Hooda, CLFMA OF INDIA's North Zone President-I & Ms. Shilpa Utekar, Manager of CLFMA attended the said meeting. CLFMA OF INDIA participated in Fodder Symposium 2024, New Delhi organized by DAHD, under the Ministry of Fisheries, Animal Husbandry and Dairying, GOI. It was attended by CLFMA Representative Dr. Someshwar Zadbuke, Vice President, Technical, Noveltech Feeds Pvt. Ltd. The symposium was the first of its kind in India focussed solely on forage production and associated technologies. On behalf of CLFMA OF INDIA, Mr. Suresh Deora, Chairman of CLFMA OF INDIA attended a meeting scheduled on the topic to discuss various action plans including a vision of the Department of Animal Husbandry and Dairying on 21st March, 2024. CLFMA OF INDIA Delegation Meeting with Soybean and Corn Grower Farmers from USA dated 22.03.2024 at New Delhi. Participants were CLFMA OF INDIA Chairman

Suresh Deora, Gary Berg from United Soybean Board, Kimberly Atkins, Director - Strategic Partnerships, USSEC, Jerry Slocum, Director, USB, Courtney B. Kingery, CEO, Indiana Soybean Alliance, Mike McCranie, US Farmer and Board Director, USSEC, Dennis D. Hupe, Director of Field Services, Kansas Soybean Association, Tom Griffiths, Director, USB, Kevin Roepke, USSEC Regional Director, South Asia and Sub-Saharan Africa, Jaison John, Managing Committee Member, CLFMA OF INDIA & Team Lead-India, USSEC. The US farmers provided updates on the US soybean and corn crops. CLFMA OF INDIA Chairman Mr. Suresh Deora briefed the delegation on the status of the Indian Poultry Industry and the current and projected consumption of grains and soybean meal in poultry, dairy, and aquaculture. The US farmers extended an invitation for the CLFMA delegation to visit agricultural farms in the USA that cultivate soybeans and corn crops. Also, Mr. Suresh Deora visited Kathmandu, Nepal on 23rd March, 2024 to witness the Right to Protein Run Organised by the Veterinary Association of Nepal and supported by USSEC. This event likely aimed to raise awareness about the importance of protein in the diet and promote health and nutrition in the community.

Your feedback and input are invaluable to us as we strive for continuous improvement. Please feel free to share your thoughts at any time.

Thank you once again for your ongoing support and dedication to the Livestock industry.

With warm regards,

For **CLFMA OF INDIA,**

Suresh Deora

Chairman

CONTENTS

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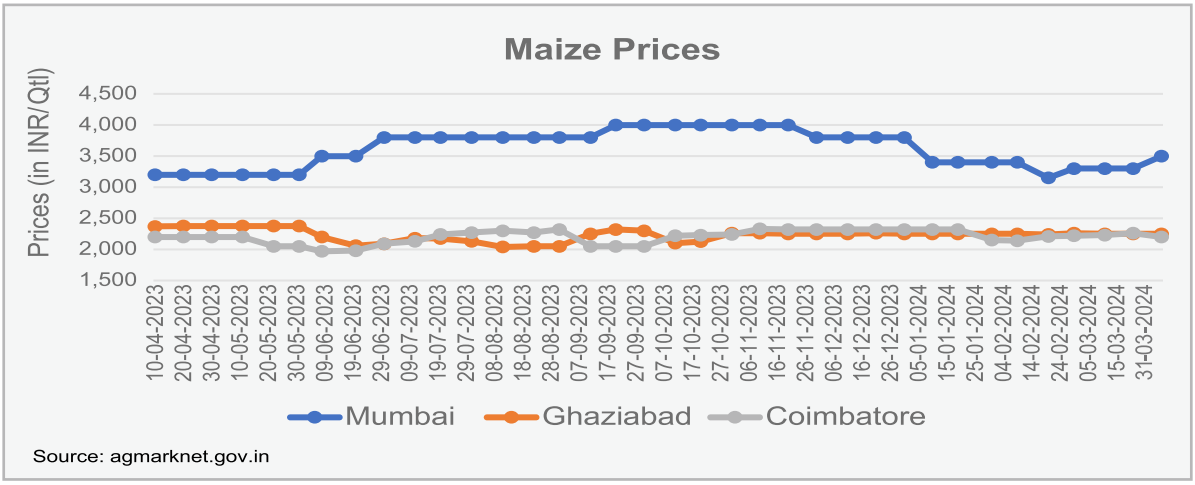
• website : www.clfma.org • E-mail : admin@clfma.org

Commodity Updates

1. Domestic Prices

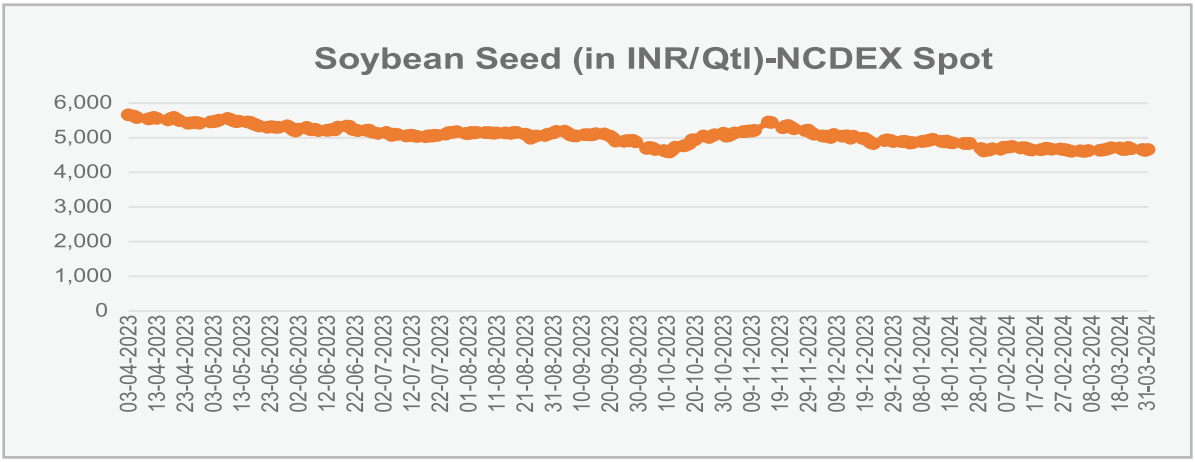
I. Maize



Source: agmarknet.gov.in

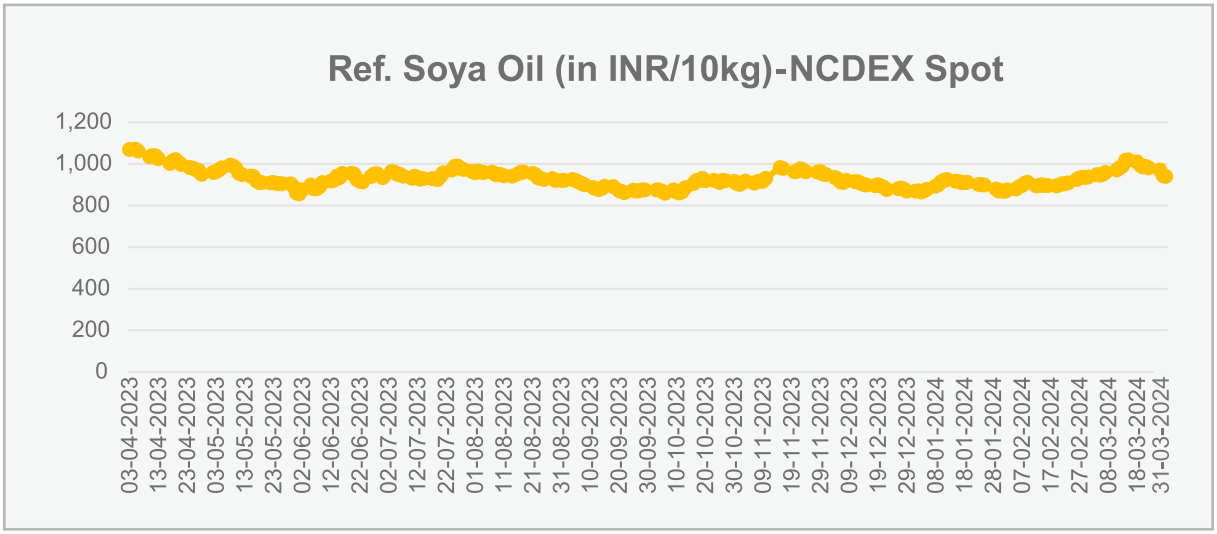
Maize Prices (INR/Quintal)		
City	**31/03/2024**	**29/02/2024**
Mumbai	3,500	3,300
Ghaziabad	2,250	2,260
Coimbatore	2,200	2,220

II. Soybean

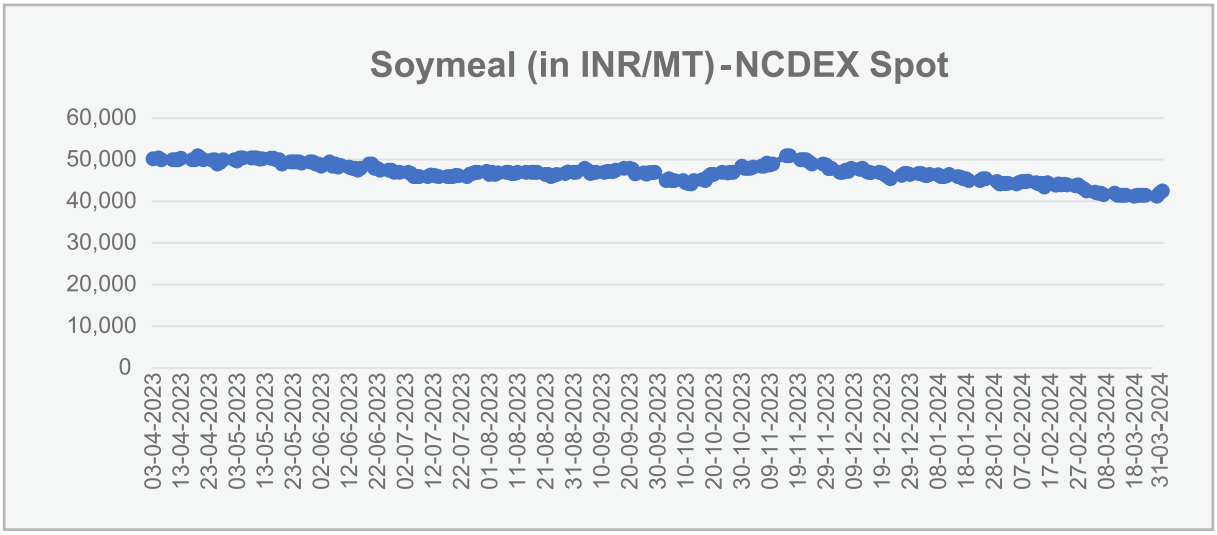


Soybean Complex PricesNCDEX Spot		
Commodity (Unit)	**31/03/2024**	**29/02/2024**
Soybean Seed (in INR/Qtl)	4,661	4,623
Ref. Soya Oil (in INR/10kg)	939	935
Soymeal (in INR/MT)	42,500	43,000

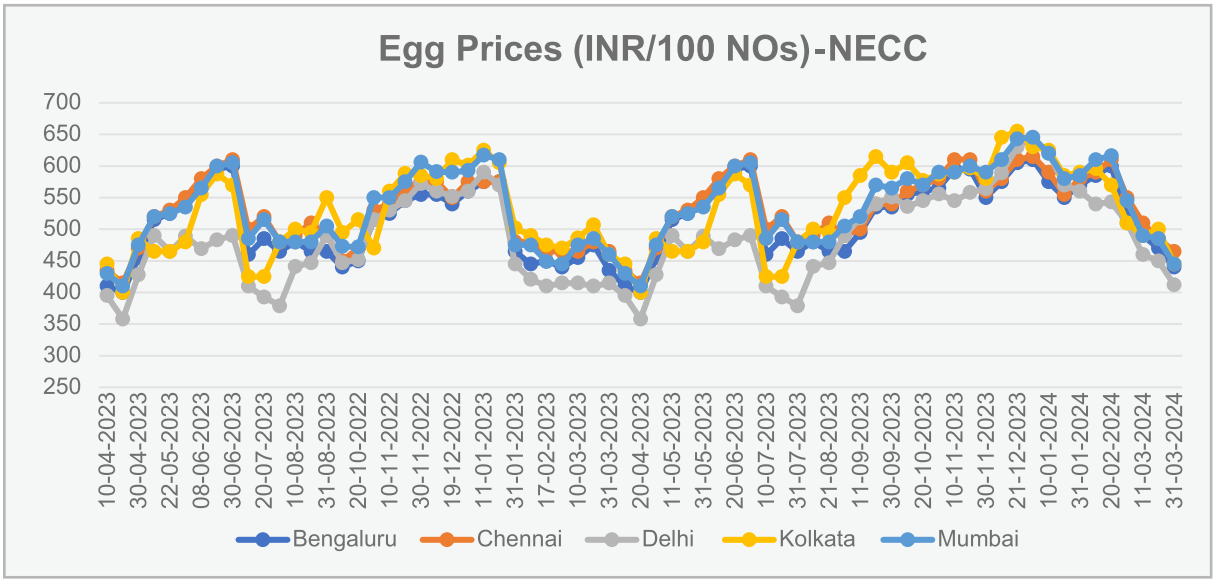
Ref Soya Oil



Soymeal



III. Egg Rates



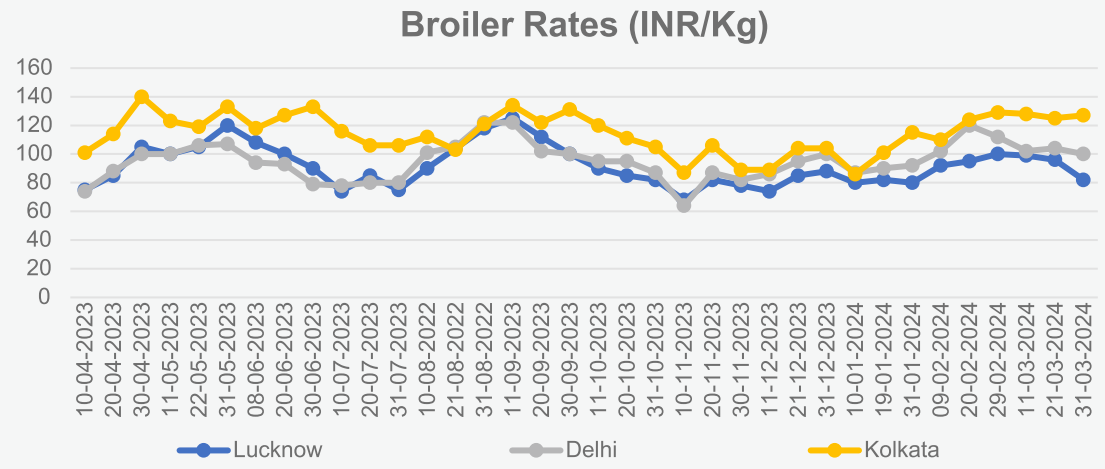
EGG PRICES (INR/100 NOs)		
Name of Zone	**31/03/2024**	**29/02/2024**
NECC Prices		
Ahmedabad	435	530
Ajmer	465	465
Barwala	390	450
Bengaluru (CC)	440	520
Brahmapur (OD)	423	475
Chennai (CC)	465	550
Chittoor	458	543
Delhi (CC)	412	510
E.Godavari	400	460
Hospet	400	480
Hyderabad	375	460
Jabalpur	490	490
Kolkata (WB)	445	510
Ludhiana	400	455
Mumbai (CC)	445	545
Mysuru	520	520
Namakkal	415	480
Pune	445	550
Raipur	410	470
Surat	445	560
Vijayawada	400	460
Vizag	415	500
W.Godavari	400	460
Warangal	377	462

III. Egg Rates

EGG PRICES (INR/100 NOs)		
Name of Zone	**31/03/2024**	**29/02/2024**
Prevailing Prices		
Allahabad (CC)	438	529
Bhopal	410	490
Indore (CC)	420	500
Kanpur (CC)	429	529
Lucknow (CC)	467	550
Muzaffurpur (CC)	455	510
Nagpur	500	500
Patna	455	510
Ranchi (CC)	448	524
Varanasi (CC)	453	523

Source: NECC

IV. Broiler Rates



BROILER RATES (INR/Kg)		
Location	**31/03/2024**	**29/02/2024**
Delhi	100	112
Punjab	95	104
Raipur	108	112
Pune	129	128
Bengaluru	120	130
Hyderabad	127	135
Guwahati	127	120
Kolkata	127	129
Bihar	112	120
Madhya Pradesh	128	133
Lucknow	82	100

Source: SRP (Wholesale Rates)

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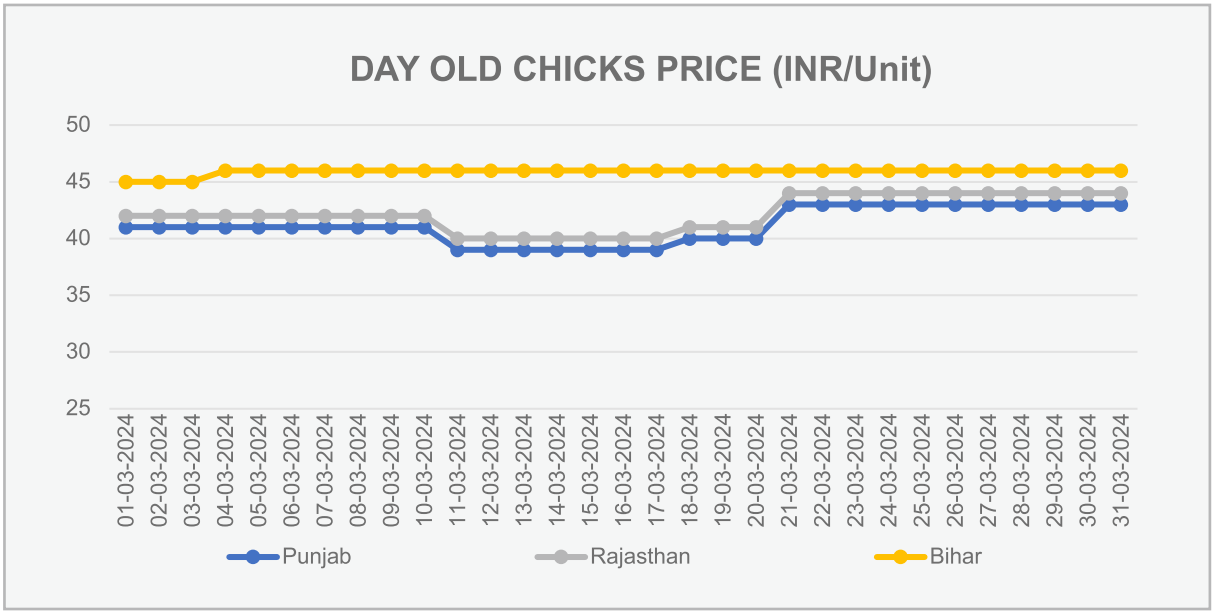
V. Day old Chicks Price

DAY OLD CHICKS PRICE (INR/Unit)		
State	**31/03/2024**	**29/02/2024**
Punjab	43	41
Dehradun	44	41
Haryana	43	42
Himachal Pradesh	44	42
Rajasthan	44	43
Jammu	45	43
Andhra Pradesh	45	45
Uttar Pradesh	46	45
Madhya Pradesh	42	42
Telangana	45	45
Bihar	46	45
Jharkhand	46	45
Gujarat	42	42

Source: Poultry India TV/ SRP



VI. Fish Prices

Fish Prices Average Price (INR/Quintal)		
Fish Type	**31/03/2024**	**29/02/2024**
Bata Putti	8,500	8,500
Black Dom	12,000	12,000
Blue Dom	13,500	13,500
Chilwa	9,000	9,000
Halwa	26,000	26,000
Hilsa	52,500	52,500
Katla (Small)	17,500	17,500
Malli (Big)	21,500	21,500
Malli (Small)	16,500	16,500
Pangass	7,500	7,500
Katla (Big)	17,500	17,500
Singhra (Big)	22,500	22,500
Singhra (Small)	12,500	12,500
Surmali (Small)	32,500	32,500
Surmai (Big)	47,500	47,500
Sol	25,000	25,000
Soli	15,000	15,000
White Dom	13,000	13,000
Rahu (Andhra)	11,500	11,500
Zinga (Zambo-A)	52,500	52,500
Zinga (Zambo-B)	45,000	45,000
Zinga (Zambo-C)	35,000	35,000

Source: agmarknet.gov.in
The Prices are of Delhi (Gazipur Mandi)

2. Global Commodity Prices

Commodity (Unit)	PRICE (31/03/2024)
Milk (USD/CWT)	16.34
Rapeseed (Euro/Ton)	438.50
Soybean Meal (USD/Ton)	337.50
Soybean Oil (USD/lb)	0.48
Live Cattle (USD/Lbs)	1.85
Poultry (USD/Kgs)*	1.46
Eggs US (USD/Dozen)	2.39

Source:tradingeconomics; markets.businessinsider

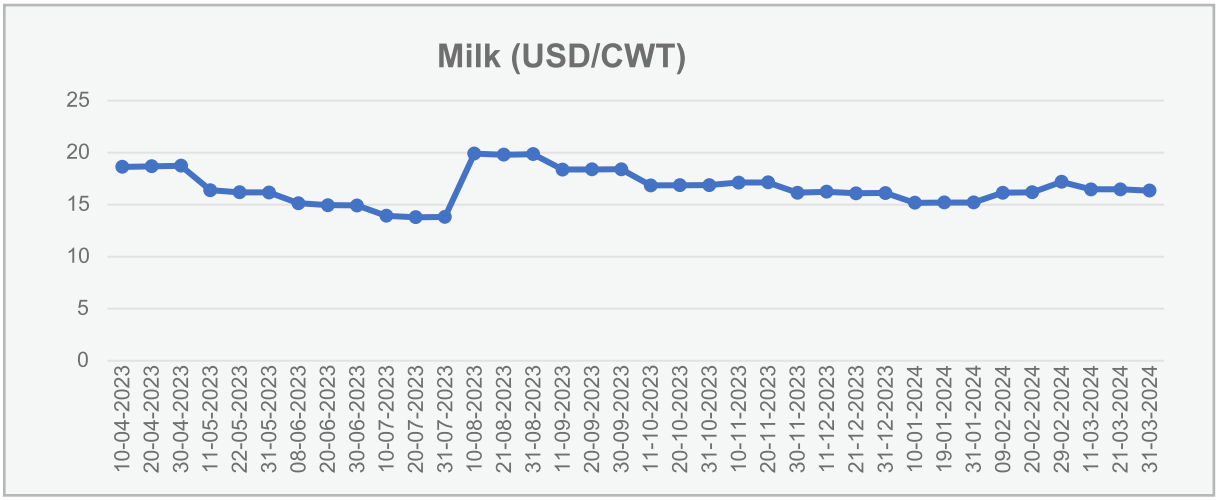
USD: United States Dollar

CWT: Short Hundredweight

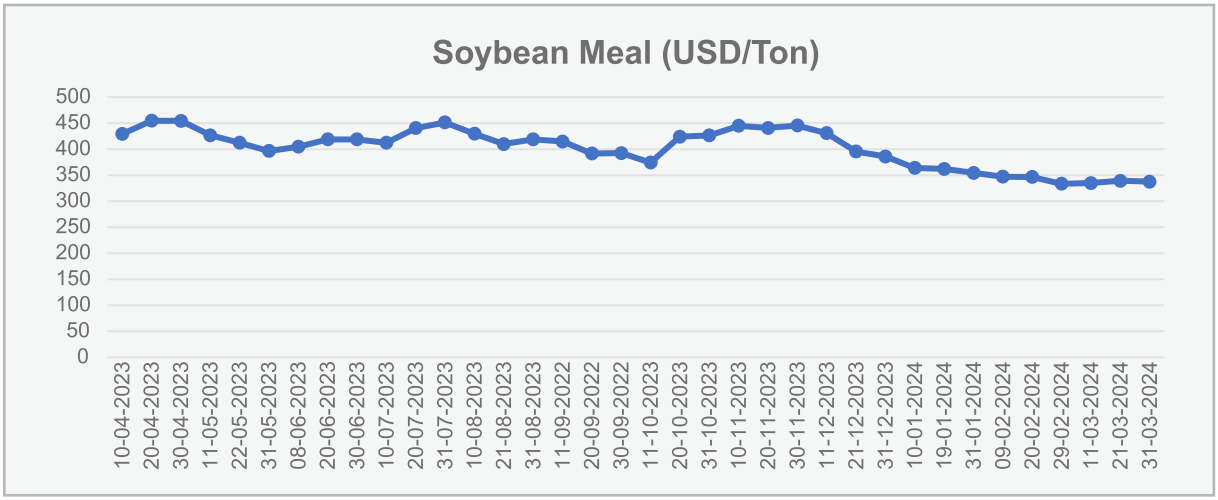
Lbs: Pounds

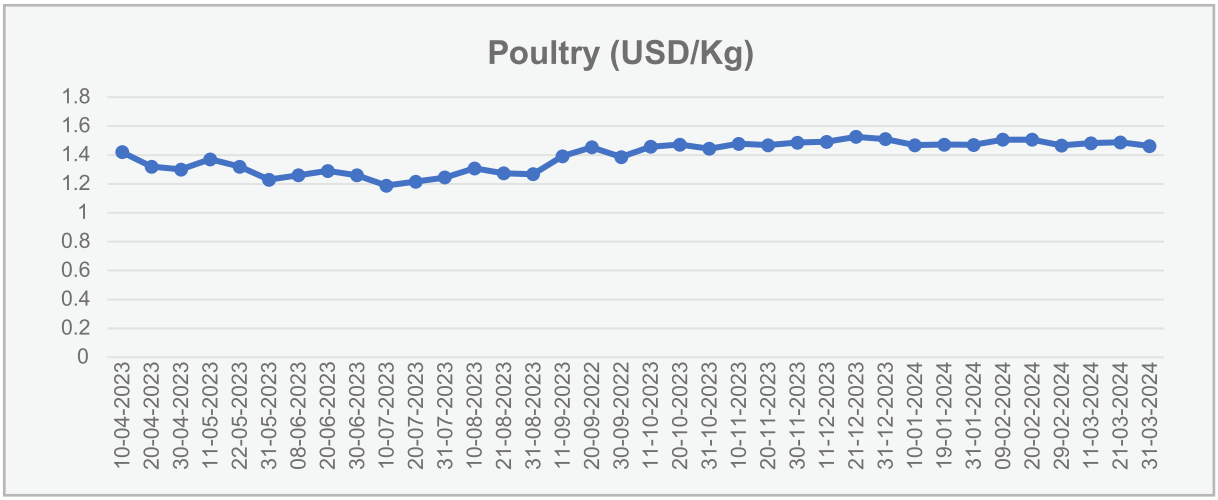
1 BRL (Brazilian Real) = 0.20 USD

*-Poultry price refers to the cost of the chicken in the wholesale market of São Paulo, Brazil. The price is converted from BRL to USD using above conversion rate.



2. Global Commodity Prices





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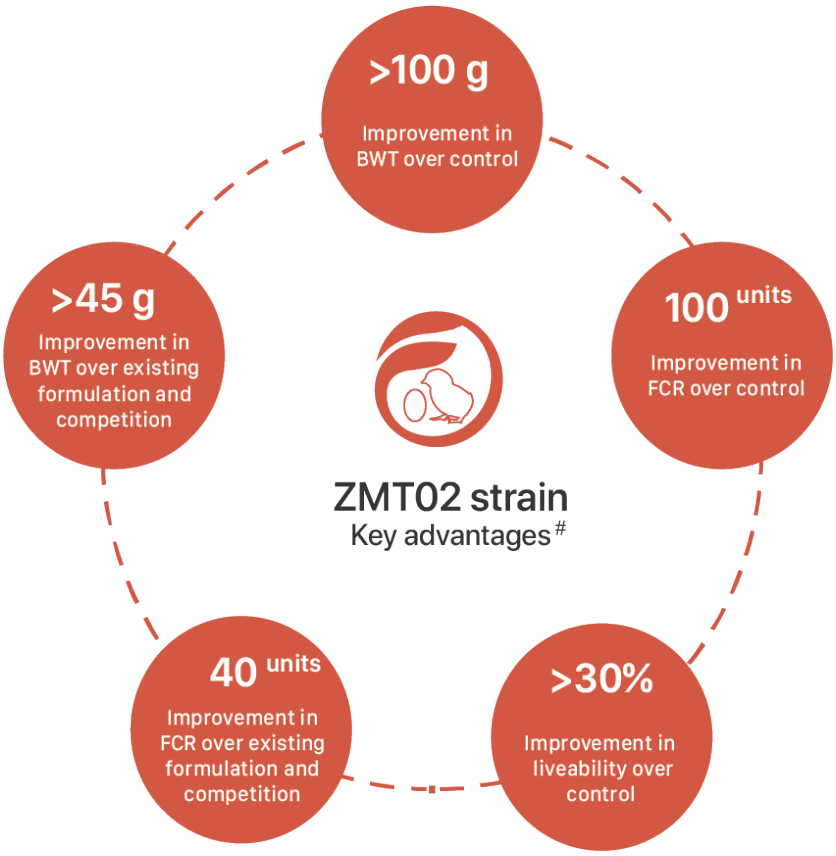

#The indicated performance improvement refers to the data generated in controlled field trial involving male birds (Vencobb 430Y) in an experiment lasting for 35 days

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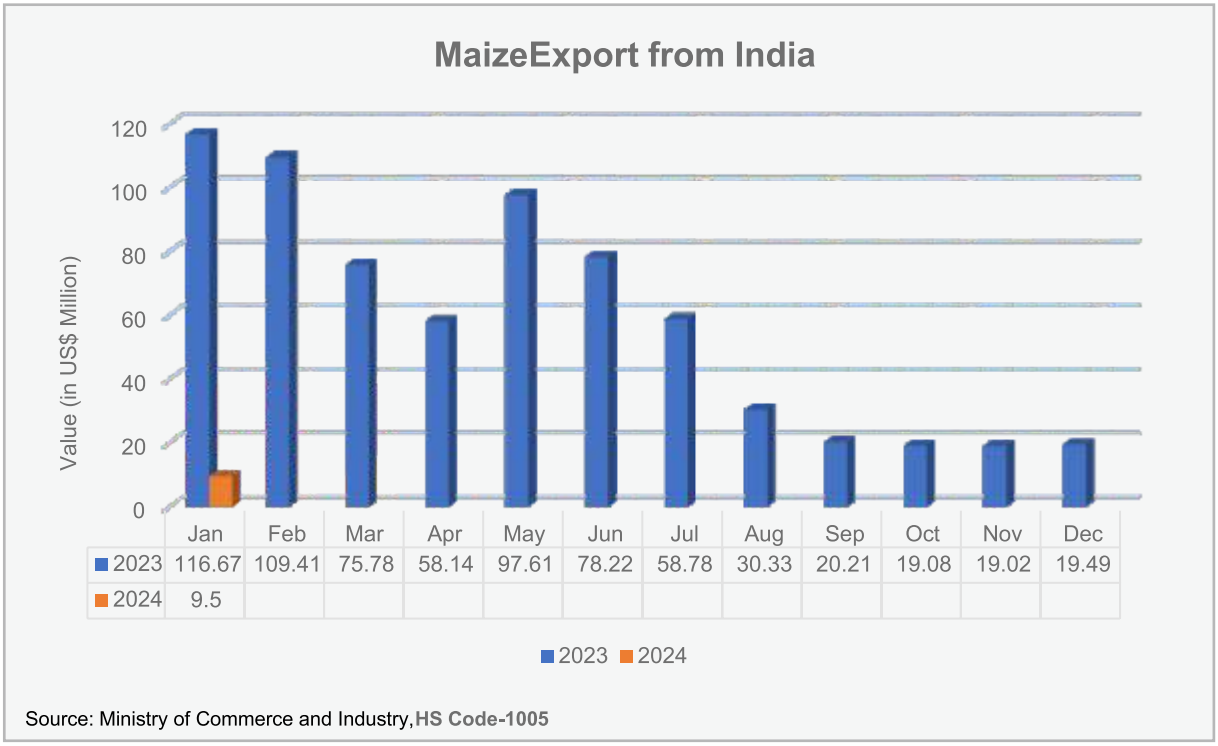
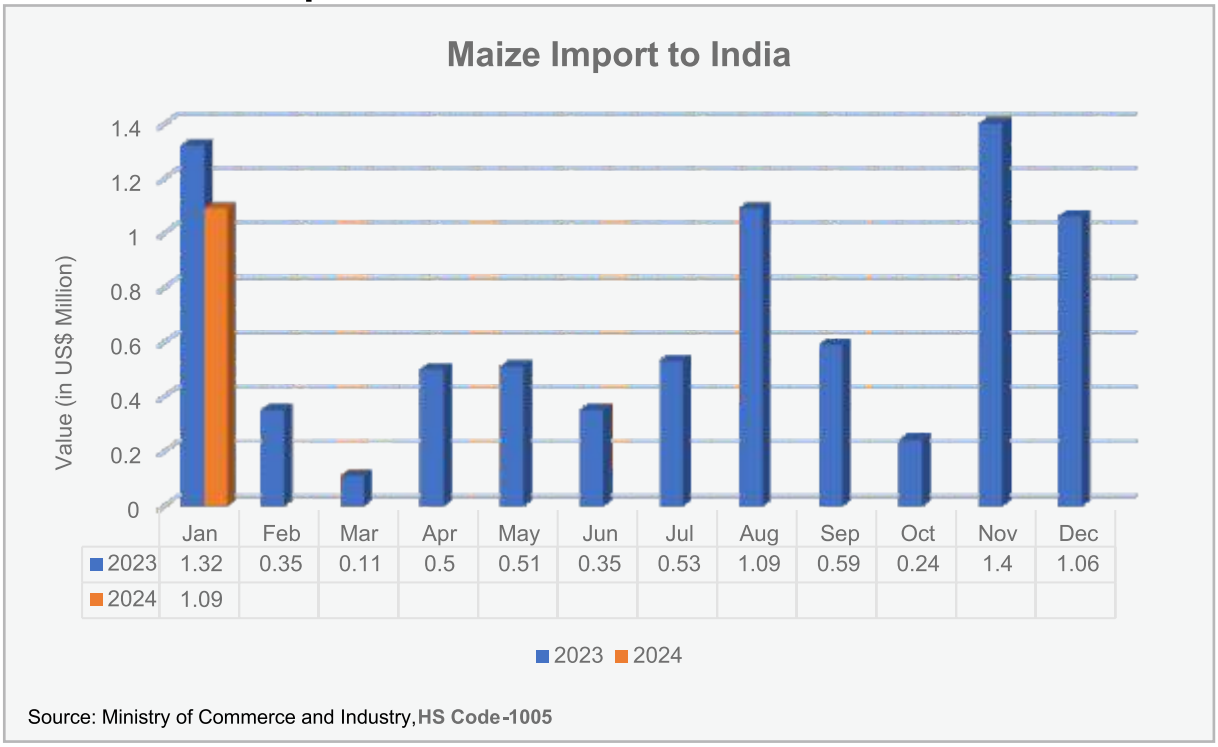
3. Trade Details

India: Maize Export



Source: Ministry of Commerce and Industry,**HS Code-1005**

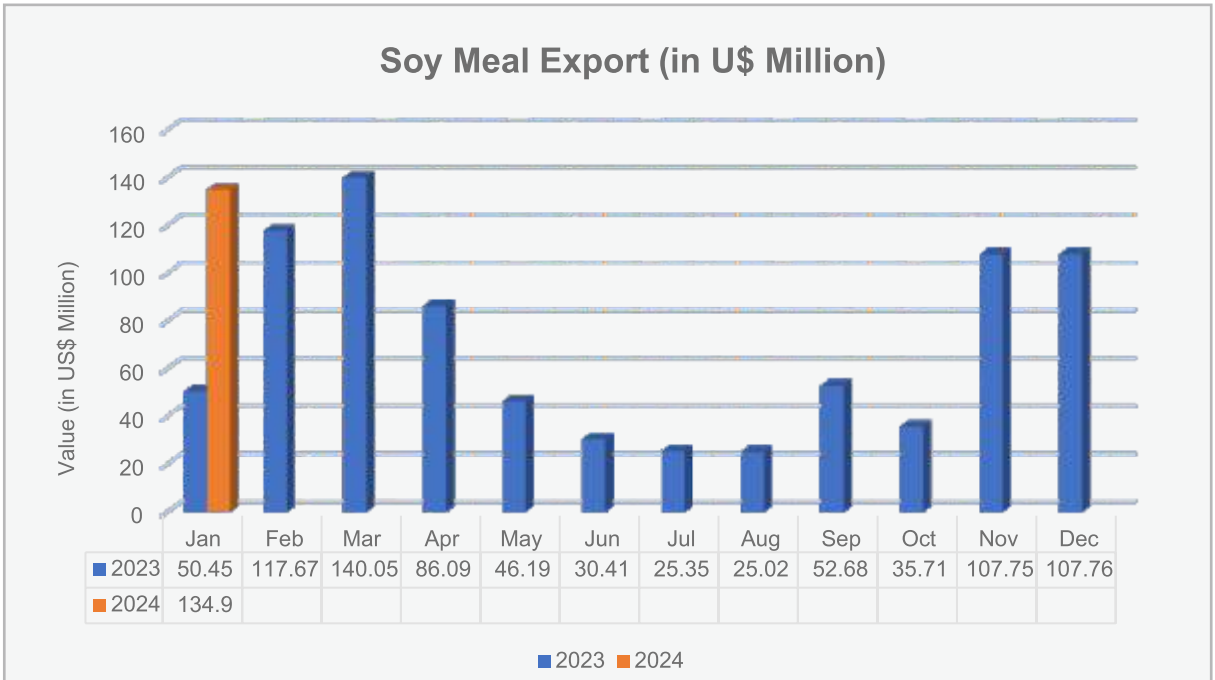
India: Maize Import



Source: Ministry of Commerce and Industry,**HS Code-1005**

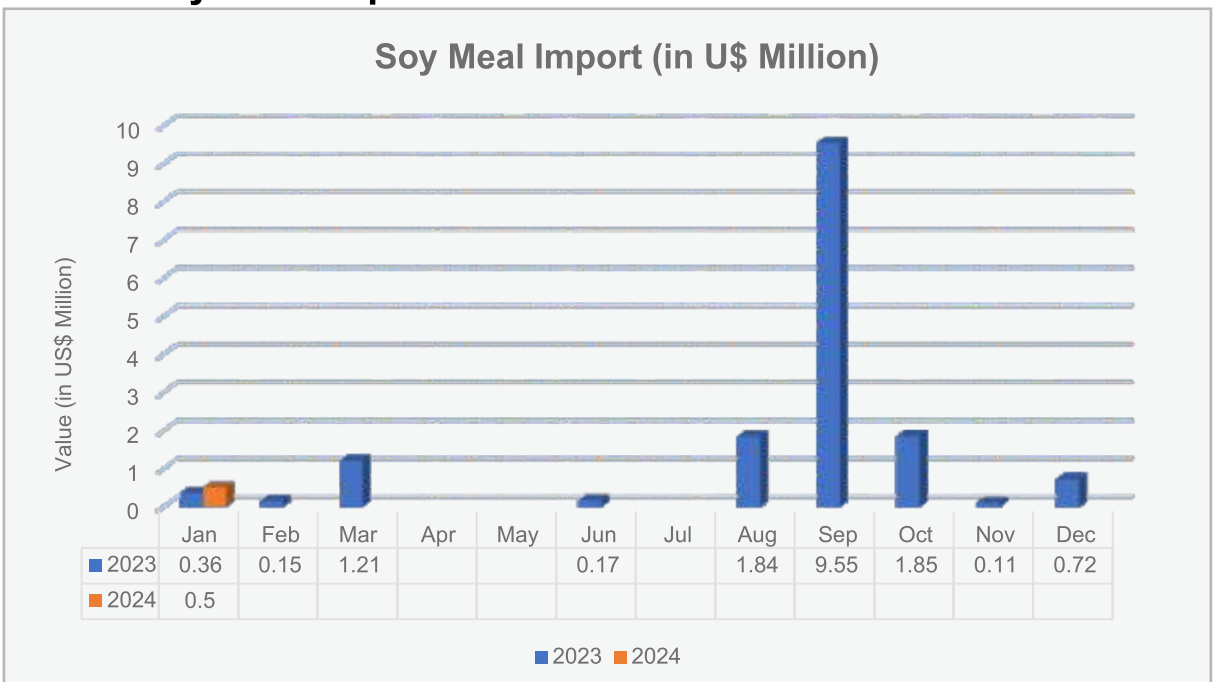
Note: This Data is sourced from the Ministry of Commerce and Industry, which was last updated in January.

India: Soy Meal Export



Source: Ministry of Commerce and Industry, **HS Code -23040030**

India: Soy Meal Import



Source: Ministry of Commerce and Industry, **HS Code-23040030**

Note: This Data is sourced from the Ministry of Commerce and Industry, which was last updated in January.

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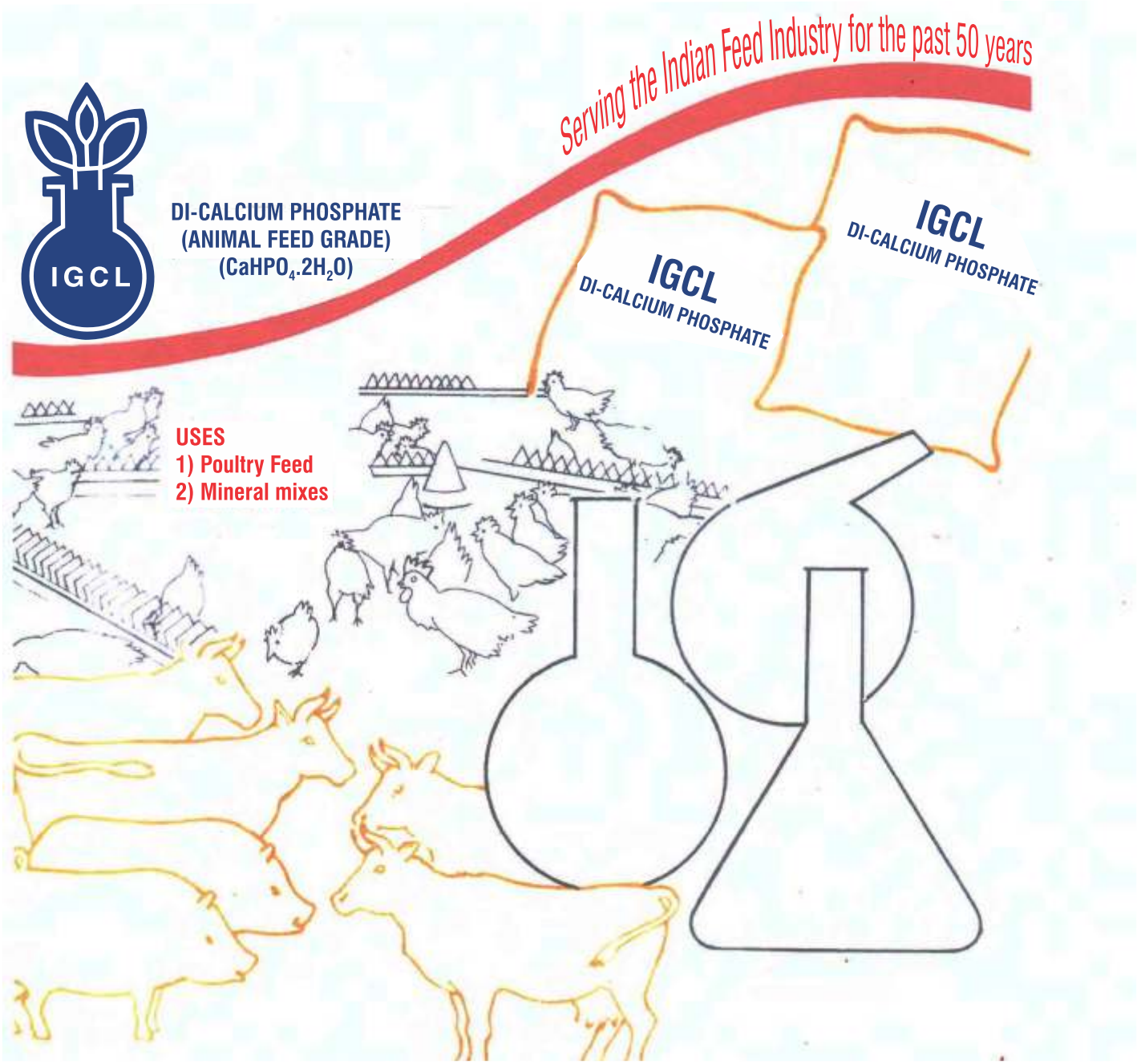

SPECIFICATIONS

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(2) Phosphorous as "P"(Total)	16.6-18.3 %
(3) P205 (Total)	38-41 %
(4) Calcium as CA	23.0 % Min
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5. Market Drivers

Maize	
Market Drivers	**Monthly Outlook**
Growing Demand for Poultry and Livestock Feed	Bullish
Rising demand for Ethanol in Auto-fuels	Bullish
Increasing Demand as a Wheat Substitute due to Wheat Export Ban	Bullish
Increasing Food Inflation	Bearish
Commercialization of Genetic Modified Maize Crop	Bullish
Increasing demand for Coarse Cereals	Bullish

Poultry	
Market Drivers	**Monthly Outlook**
Rapid Growth in Consumer Demand for Livestock Products	Bullish
Rising Demand for White Feather Broilers	Bullish
Increasing Broiler Chicken Price Increases Due to Higher Feed Cost	Bearish
Increasing Food and Feed Inflation	Bearish
Enhancement of Backyard Poultry Farming	Bullish
Increasing the Demand of Organic Poultry Farming	Bullish

Regards,
CLFMA OF INDIA
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CLFMA ACTIVITY UPDATES

CLFMA Chairman Mr. Suresh Deora sent a Best Wishes Message to the West Bengal Poultry Federation on 11th January 2024 for the Souvenir of the 10th Kolkata International Poultry Fair, 2024, which was scheduled from 7th to 9th February 2024 at Eco Tourism Park, Kolkata.

On 16th January 2024, CLFMA OF INDIA provided input on the request of Ms. Rashmi Minocha, Dy. Program Manager, Sustainable Food Systems, Centre for Science and Environment (CSE), New Delhi on the current status/challenges in reducing antibiotic use in the Poultry Sector.

Meeting:

CLFMA OF INDIA had a meeting in its Mumbai Office with the USGC Team (US Grains Council) and US Sorghum Team on 17th January, 2024 to discuss the ways to collaborate. Mr. Suresh Deora, Chairman, and Mr. Divya Kumar Gulati Dy. Chairman were present during the meeting. From USGC, Norma Ritz Johnson, United Sorghum Checkoff Program, Florentino Lopez, United Sorghum Checkoff Program, Adam Schindler, United Sorghum Checkoff Program, Craig Meeker, National Sorghum Producers, Shelee Padgett, United Sorghum Checkoff Program, Jace Hefner, Manager of Global Trade, DC, Reece Cannady, U.S. Grains Council, Regional Director – New Delhi, Amit Sachdev, U.S. Grains Council, Consultant – New Delhi, Nayantara Anandani Pande, U.S. Grains Council, Marketing Specialist – New Delhi were present during the meeting. US Sorghum is a low Tannin Grain, Indian Sorghum, and is also a non-GM grain and can replace part of Corn in the Poultry/Dairy diets. It is being used extensively in US and other countries. There could be a possibility to get this grain in India as a non-GM variant, but work will need to be done and a discussion took place on the same lines and also on the ways to collaborate.

CLFMA OF INDIA Meeting with USGC Team (U.S. Grains Council)
&
US Sorghum Team

Industry-Academia Meet of IVRI held on 12.1.2024

Training and Education Centre, ICAR-Indian Veterinary Research Institute (ICAR-IVRI) Pune arranged Industry-Academia Interface Meet #3, which was held at the Commissionerate of Animal Husbandry, Aundh, Pune. CLFMA OF INDIA's Dr. Devender Hooda was present on behalf of CLFMA OF INDIA and showed active engagement and added immense value to the success of the event.

Meeting on Price Policy for Kharif Crops held on 18.01.2024

Meeting on Price Policy for Kharif Crops 2024-25 Marketing Season with concerned organizations/associations related to Rice, Maize, Millets held on 18th January, 2024 at Krishi Bhavan, New Delhi under the chairmanship of Chairman Prof. Vijay Paul Sharma, CACP. CLFMA and All India Rice Exporters Association represented from Industry. All other participants were from ICAR – Rice, Jowar, Millets, and Maize. Dr. S.S. Pattabhirama, Group Nutritionist, Nanda Group represented CLFMA OF INDIA. From CACP, other participants were Mr. Anupam Mitra, Mr. Naveen Prakash Singh, other attendees were advisors Dr. Seema, Dr. R. Sathish, Mr. Vivek Shukla, Research Institutions Directors, DD's, AD's of ICAR – Rice Research, Cuttak, ICAR – Rice Research, Hyderabad, ICAR – Jowar & Millet Research, ICAR – Maize Research, Ludhiana. Dr. S.S. Pattabhirama, CLFMA's representative updated on quantities of various feeds produced/annum, quantities of milk, egg, broiler meat, and fish production/annum, India's ranking position in the above sectors. He insisted on considering the view of CLFMA as almost 50% of maize produced and 6 mmt of SBM is consumed by the sector. Apart from this, broken rice, Jowar & other byproducts are also used in feeds. All representatives from ICAR spoke about new varieties that they have developed in their institutions in the last 3 years. All

participants insisted that good price assurance is a must for all crops as farmers are facing either drought or flood situations. Mr. Krishnakumar from ICAR-Maize research mentioned that the estimated crop of Maize this year is 34 mmt. We need 10 mmt for Ethanol. He suggested some measures to increase Maize cultivation i.e. Contract farming of Maize, Direct purchase having dryers at the site, Increased cultivation in high-yielding districts, Industry to collaborate with Maize farmers. Chairman Prof. Vijay Paul Sharma thanked all participants for their valuable inputs. The Meeting was concluded by thanking all participants by Member Secretary Mr. Anupam Mitra.

INDIA-US Meet on Win-Win Agriculture held on January 30, 2024 at the Imperial Hotel, New Delhi:

Two U.S. Agricultural Cooperators, U.S. Grains Council and the U.S. Soybean Export Council hosted the open session with the primary motive to showcase the collaborative efforts between the United States and India in promoting the rapid growth and expansion of the agricultural sector in both Countries. As India strives to position itself as a leader in agri-products and processing, this event served as a platform to strategize and deepen a commitment to mutual success and support for one another. Distinguished dignitaries traveled from Washington, DC for the event, including USDA Chief Economist Seth Meyer.

CLFMA supported the INDIA US Meet. Opening Remarks were delivered by Clay M. Hamilton, Minister Counselor for Agricultural Affairs, New Delhi, US Department of Agriculture, Dr. Seth Meyer, Chief Economist, US Department of Agriculture shared views on the topic "Opportunities and Challenges in the Global Agricultural Space" and shared insights on US agri policies, trade and commitment to feed the world.

Mr. Suresh Deora, Chairman of CLFMA OF INDIA participated in the industry discussion on the topic "Strategies for the future – maintaining India's Agribusiness Growth". Along with CLFMA Chairman Mr. Suresh Deora, Industry discussion panelists were Dr. C. K. Jain, Chairman and Managing Director, Gulshan Polyols, Mr. Chandan Shirgaonkar, President, All India Distillers' Association, Mr. Sumit Agarwal, Chairman, Soy Food Promotion and Welfare Association. The session was moderated by Clay M. Hamilton, US Department of Agriculture.

Dr. Vijay Singh, a Distinguished Professor of Agriculture and Biological Engineering, the University of Illinois Urbana – Champaign delivered a speech on the topic India-US Collaboration in Industrial Starch Processing and provided information on the USGC's project on testing of Indian maize on starch extractability. Indian maize though has the same starch content as other origins, but its extractability is lower, hence low energy for livestock and low starch yields. It is possible to improve these by using new technologies.

Panel Discussion was on the topic – Win/Win Agriculture: Aspirations for Future Collaborations & the panelists who shared their views were Kevin Roepke, Regional Director of South Asia & Sub-Saharan Africa, USSEC, Reece H. Cannady, Director, US Grains Council, New Delhi, Mr.Naveen Pasuparthy, President, KPFBA, Ramakant V Akula, CEO, The Waterbase Ltd. The panelists were of the opinion that for India to be competitive in the world market for chicken, eggs and fish/aqua, raw material supplies at a reasonable price must be available, be in GM. The world has moved ahead and India needs to do the same.

Fireside Chat took place on the topic of farming a Biofuels Partnership: US and India Collaboration to Achieve Global Biofuels Aspirations Aman Raj Khanna, India Country Director, The Asia Group, Mr. Shantanu Gupta, Executive Director, Alternate Energy and Sustainable Development, IOCL, wherein India's energy security, ethanol and as well as other projects were discussed. India's energy needs will increase as its population increases and India moves towards a developed nation.

The question though will be, Can India fulfill all its needs on its own, or need a hand to fulfill its aspirations?

Overall, **Win Win Agriculture India US** meet was appreciated by all the participants.

IPPE 2024

The International Production and Processing Expo (IPPE) 2024 held at the Georgia World Congress Centre in Atlanta from January, 30 – February, 1, 2024:

The International Production & Processing Expo (IPPE) 2024 held at the Georgia World Congress Center in Atlanta from January 30-February 1, 2024 was a significant event in the poultry and egg, meat, and animal food industries. Boasting over 1,200 exhibitors and spanning more than 590,000 square feet of exhibit space, IPPE facilitated a dynamic platform for industry leaders to connect, discover solutions, and explore the latest technological advancements.

Sponsored by the U.S. Poultry & Egg Association, the American Feed Industry Association, and the Meat Institute, IPPE attracted 31,353 registered attendees from various sectors of the industry. Notably, there were 9,063 international visitors from 133 countries, marking a new record. Canada represented the largest group of international attendees outside the U.S., comprising 14.9% of registered participants. Latin America continued to demonstrate a strong presence, constituting 45% of international visitors. **Among the distinguished attendees was Mr. Divya Kumar Gulati, Deputy Chairman of CLFMA OF INDIA, who engaged with Mr.Brent Crafton, Director of Feed Ingredient Utilization at United Sorghum Checkoff Program, to explore opportunities for collaboration and exchange ideas.**

The 2024 IPPE served as a vital platform for networking, knowledge-sharing, and fostering international partnerships within the poultry and egg, meat, and animal food industries.

Govt launches realigned Animal Husbandry Infrastructure Development Fund Scheme on 14th February, 2024 in New Delhi

Department of Animal Husbandry & Dairying, GOI recently approved the extension of the Animal Husbandry and Infrastructure Development Fund (AHIDF) with the merger of Dairy Processing and Infrastructure Development Fund. This also enabled Co-operatives to avail the benefits under the AHIDF scheme.

The Department of Animal Husbandry and Dairying (DAHD) organized an event for the launch of the revamped AHIDF Portal. Hon'ble Minister of Fisheries, Animal Husbandry and Dairying, Shri. Parshottam Rupala was the chief guest for the event and re-launched the AHIDF portal. Mr.Naveen Pasuparthy, Dy. Chairman of CLFMA OF INDIA & some of the CLFMA Members graced the event.

Stakeholder Outreach:

CLFMA OF INDIA's participation in National Workshop on Harnessing Potential of Fisheries in Inland States on 15th and 16th February, 2024 at The Park, Vishakhapatnam, Andhra Pradesh

NITI Aayog under its State Support Mission in association with the Govt. of Andhra Pradesh hosted a National Workshop on "Harnessing Potential of Fisheries in Inland States" in Vishakhapatnam on 15th and 16th February, 2024. The workshop aimed to address the challenges and opportunities in the inland fisheries sector and foster regional cooperation among the states. It is a collaborative effort aimed at maximizing the potential of fisheries in India's inland states.

On 15th February, 2024, the inaugural session was graced by the presence of Shri. Parshottam Rupala, Hon'ble Minister of Fisheries, Animal Husbandry and Dairying, Prof. Ramesh Chand, Hon'ble Member, NITI Aayog, Shri. Gvlnarasimharao, Hon'ble Member Rajya Sabha, Shri. Vaddi Raghuram, Hon'ble Co-Vice Chairman, Andhra Pradesh State, Aqua Development Authority, and Dr. Neelam Patel, Sr. Adviser (Agri) NITI Aayog, shared their valuable insights and suggestions on the National Vision and State collaboration for the advancement of the Sector.

Prof. Ramesh Chand, Member of NITI Aayog, highlighted the achievements of Andhra Pradesh in the fisheries sector and stressed the importance of addressing regional disparities in production and productivity and the topics were Innovations for Sustainable Inland Fisheries delivered by Dr. J. K. Jena, DDG (Fisheries), ICAR, Transforming Aquatic Food Systems for achieving SDG's delivered by Dr. Arun Padiyar, Fisheries and Aquaculture Specialist, World Fish delivered by Shri. Pawan Kumar, President, All India Shrimp Hatcheries Association, bridging gaps across the fisheries value chains to boost demand delivered by Dr. Edward Danish, Chief R&D Officer, Fresh to Home.

The second day of the workshop featured technical sessions on "Sustainability in Inland Fisheries: FFPOs/Cooperatives Led Development Models" and "Issues and Challenges in Inland Fisheries Industry in India." These sessions facilitated discussions among policymakers, industry players, and fisheries startups, identifying actionable recommendations and future roadmaps for the sector's growth.

Technical Session I session Moderator was Dr. Rajeev Ranjan, Former Secretary of Fisheries, Ministry of Fisheries, Animal Husbandry and Dairying (MoFAH&D) and Former Chief Secretary, Government of Tamilnadu & the topic was "Status, Challenges, and Best Practices in Harnessing Potential of Inland Fisheries", Government of India. State Fisheries Secretaries, Officials from the Department of Fisheries from Andhra Pradesh, Kerala, Uttarakhand, Bihar, Assam, Jharkhand, Karnataka, Uttar Pradesh, Punjab, Haryana, and Other States. They exchanged their views & discussion went well on the said topic. It was a very good session.

Technical Session II moderator was Mr. Sagar Mehra, Joint

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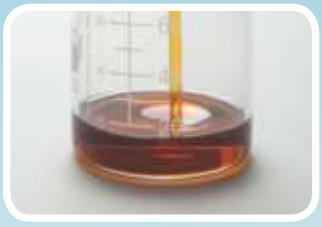
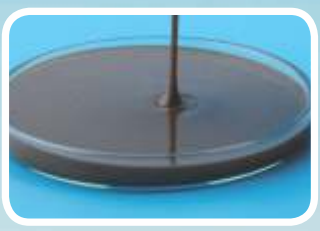

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Secretary (Inland Fisheries & Administration), Department of Fisheries, Ministry of Fisheries, Animal Husbandry & Dairying, Government of India. Community Engagement for Sustainable Development was delivered by Ms. Farida Tampal, State Director of WWF-India. Shri. Rohit Gupta, Deputy Managing Director, of National Co-operative Development Corporation (NCDC) shared the views on Potential, Role & Skill Development for Fisheries Co-operatives. Dr. P. K. Pandey, Director, ICAR – Directorate of Coldwater Fisheries Research Nainital, Uttarakhand shared their views on the topic of Potential, issues, and challenges in Coldwater Fisheries.

Technical Session III moderator and first panelist was Dr. L. Narasimha Murthy, Senior Executive Director, National Fisheries Development Board, GOI, and shared his views on the topic "Issues and challenges in Inland Fisheries Industry in India", as a panelist he also shared views on the Policies for addressing the issue and challenges in Inland Fisheries. Ms. Jyothi Pilla, Igloo Frozen Foods Pvt. Ltd., Andhra Pradesh was another panelist who shared her views. On behalf of CLFMA OF INDIA, Mr. Nissar F. Mohammed, Treasurer shared his views on the Challenges of Fish Feed Industry. Overall, the session was very good and appreciated by all. Several Startups also exchanged the knowledge. The concluding remarks of the workshop was delivered by Dr. Rajeev Ranjan, Former Secretary, the Ministry of Fisheries, Animal Husbandry & Dairying (MoFAH&D) and former Chief Secretary, the Government of Tamilnadu.

A total of 13 states showcased their accomplishments, potential, challenges, and best practices during the workshop. The workshop concluded with convergence on actionable recommendations and a future roadmap, emphasizing the importance of inter-state and center-state cooperation in realizing the immense growth potential of India's inland fisheries sector. The relationships forged and the next steps identified during the event would lay a strong foundation for the sector's significant growth opportunities in the future.

Overall, the workshop was a significant platform that brought together key stakeholders from various sectors to address the challenges and opportunities in the inland fisheries sector. The valuable insights shared by distinguished speakers, moderators, panelists, and participants contributed to fostering regional cooperation and advancing the vision for the sustainable development of the fisheries industry in India. NITI Aayog expressed their heartfelt gratitude to all attendees for their active participation and meaningful contributions, looking forward to continued collaboration and collective efforts in harnessing the potential of inland fisheries for the benefit of the nation.

CLFMA OF INDIA's participation in the Coastal Aquaculture Authority Meeting:

CLFMA OF INDIA got an invitation for the meeting scheduled on 20th February, 2024 at 11:00 am for all the stakeholders of coastal aquaculture including stakeholder associations such as All India Shrimp Hatcheries Association, Prawn Farmers Federation of India, Society of Aquaculture Professionals. The purpose of the Meeting was to sensitize the member convenors of the SDLCs/DLCs and the stakeholders on the amendments made in the CAA Act and its rules. The question and answer session went well. All participants actively participated in the said meeting. Once CLFMA will receive the PPT of the meeting, it will be shared to all members. Dr. Devender Hooda, CLFMA OF INDIA's North Zone President-I & Ms. Shilpa Utekar, Manager of CLFMA attended the said meeting.

CLFMA OF INDIA's participation in Fodder Symposium 2024, New Delhi organised by the Department of Animal Husbandry and Dairying under the Ministry of Fisheries, Animal Husbandry and Dairying, Government of India:

Fodder Symposium 2024 attended by CLFMA Representative Dr. Someshwar Zadbuke, Vice President, Technical, Noveltech Feeds Pvt. Ltd. The fodder symposium was held on 28th February 2024 at Vigyan Bhavan. The symposium was the first of its kind in India focussed solely on forage production and associated technologies.

The Symposium was inaugurated by Shri. Purushottam Rupala, Honourable Minister for Fisheries, Animal Husbandry and Dairying in the presence of Ms. Alka Upadhyaya, Secretary, AHD, Dr. O.P. Chaudhary Joint Secretary, NLM, Dr. Abhijeet Mitra, Commissioner, Animal Husbandry and Ms. Sarita Chauhan, Joint Secretary LH.

Honourable Minister for Fisheries, Animal Husbandry and Dairying Shri. Purushottam Rupala in his opening remarks

stated that the Central Government is focussing on supporting animal husbandry with emphasis on fodder development. The current fodder deficit needs to be addressed urgently. The focus of the Government will be developing newer varieties of fodder suitable to local conditions. He announced that four zones will be created as North, East, West, and South and each one will have a larger fodder storage depo. Further, every state will have localized facilities that can then percolate up to the district level. There will be competition within the zones and within the states for fodder production and the best zone will be rewarded. The government is focused on bringing in the private sector to potentiate the rate of change. He also stressed on minimizing the risk in agriculture. In this regard, the Government has fixed charges for livestock insurance fees at fixed 15% with no further categorization. The charges above this level will be borne by the state and center. He also felicitated the entrepreneurs in the feed and fodder sectors.

Ms. Alka Upadhyay, Secretary, AHD opined that the feeding practices in India need to change towards mechanization. She stressed that the fodder growing area needs to be increased from the current 4% with the development of a variety of new fodders. This needs the silage-making to be boosted. She asked the Department to conduct regional conferences on fodder development in the coming months.

The Symposium comprised technical sessions by eminent speakers and focused on inviting the projects under the National Livestock Mission. Key eminent speakers gave their presentations on their respective fields which were very well received. The key message was to use the technology to increase fodder production both by area and productivity and in turn make milk production sustainable for the rising population with limited resources. The notable inputs also come from ISRO and the ISRO appealed to come forward for collaboration.

Looking ahead, we remain persistent in our commitment to advancing the interests of the livestock sector. Together, we can overcome challenges, capitalize on opportunities, and drive sustainable growth for the benefit of all stakeholders.

CLFMA OF INDIA Delegation Meeting with Soybean and Corn Grower Farmers from USA on March 22, 2024 at New Delhi

Participants:

- CLFMA OF INDIA Chairman Suresh Deora
- Gary Berg from United Soybean Board
- Kimberly Atkins, Director - Strategic Partnerships, USSEC
- Jerry Slocum, Director, USB
- Courtney B. Kingery, CEO, Indiana Soybean Alliance
- Mike McCranie, US Farmer and Board Director, USSEC
- Dennis D. Hupe, Director of Field Services, Kansas Soybean Association
- Tom Griffiths, Director, USB
- Kevin Roepke, USSEC Regional Director, South Asia and Sub-Saharan Africa
- Jaison John, Managing Committee Member, CLFMA OF INDIA & Team Lead-India, USSEC

Discussion Points:

The US farmers provided updates on the US soybean and corn crops.

CLFMA OF INDIA Chairman Mr. Suresh Deora briefed the delegation on the status of the Indian Poultry Industry and the current and projected consumption of grains and soybean meal in poultry, dairy, and aquaculture.

The US farmers extended an invitation for the CLFMA delegation to visit agricultural farms in the USA that cultivate soybeans and corn crops.

Future Engagement:

The US farmers expressed their willingness to host the CLFMA delegation whenever they visit the USA, offering to showcase their agricultural farms specializing in soybeans and corn.

This meeting likely aimed to foster collaboration and information exchange between the Indian and US agricultural sectors, particularly regarding soybean and corn production and their applications in the poultry industry.

CLFMA Participated in the Right to Protein Run organized by the Veterinary Association of Nepal and supported by USSEC on March 23, 2024 at Kathmandu, Nepal

Also, Mr. Suresh Deora visited Kathmandu, Nepal on 23rd March, 2024 to witness the Right to Protein Run Organised by the Veterinary Association of Nepal and supported by USSEC. This event likely aimed to raise awareness about the importance of protein in the diet and promote health and nutrition in the community.

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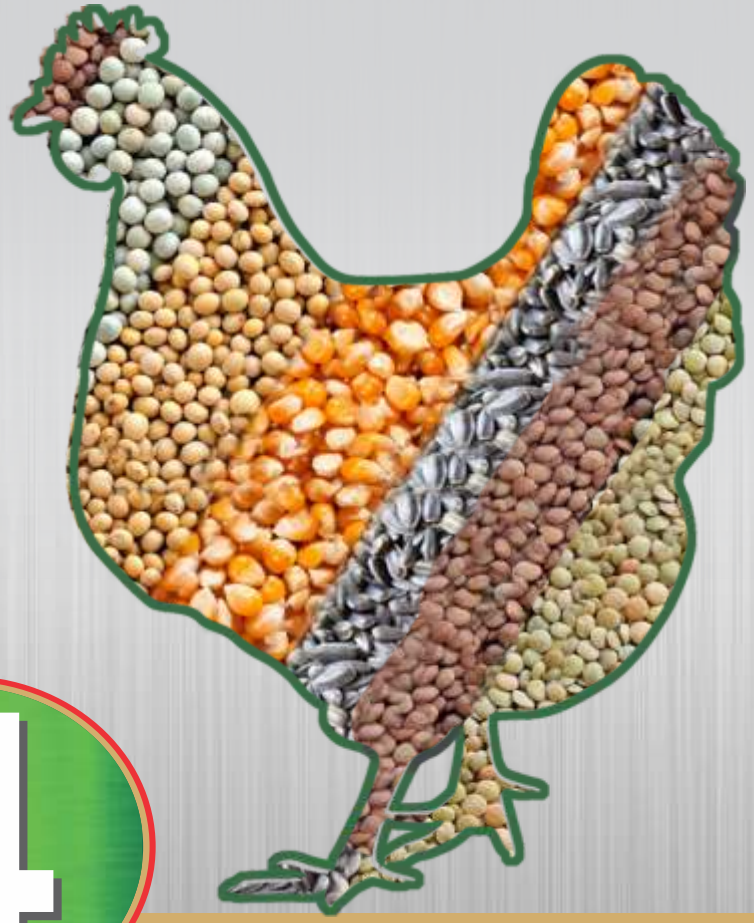

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India Expects Record Rapeseed Output due to Bigger Area, Favorable Weather

India's rapeseed and mustard output is likely to reach a record high in 2024 due to an expansion in the planted area and favourable weather conditions in key producing states, industry officials said. Higher rapeseed output will help the world's biggest vegetable oil importer to cut back on expensive imports of palm oil, soyoil and sunflower oil. "Farmers have expanded area under rapeseed. Our recent survey is showing the crop is in good condition in almost all states," B.V. Mehta, executive director of Solvent Extractors' Association of India, told Reuters. Area under rapeseed has risen by around 5% from a year ago to 10 million hectares, Mehta added. India produced 11.5 million metric tons of rapeseed in 2022/23 and in the current year production could rise by 300,000 to 500,000 tons industry officials said. "The crop is in excellent condition. If things keep rolling smoothly in the next couple of weeks, production of 12 million tons is possible," said Anil Chatar, a trader based in Jaipur in the north-western state of Rajasthan, the biggest producing state in the country. Until last week, the weather was favorable, but temperatures have started to rise, raising fears of a heatwave that could lead to the early maturity of crops and reduce the size of the seeds, said a New Delhi-based dealer with a global trade house. In the past, higher temperatures in February and March have dashed prospects of high yields, he said. In some districts of Rajasthan, the maximum temperature this week was nearly 6 degrees Celsius above normal, data from the weather department showed. New season supplies would pick up from the next month, said Chatar.

Telangana's ARSK set to Release New Maize Seed Type

On the back of the success of the Makka and Makka-1 maize seed varieties, the Agriculture Research Station, Karimnagar (ARSK), affiliated with the Professor Jayashankar Telangana State Agriculture University (PJTSAU), is now set to release a new maize seed variety with enhanced wilt tolerance in a hybrid form. A team of five agriculture scientists, led by ARSK principal scientist G. Manjulatha, is working on the development of this hybrid maize seed variety. Currently, farmer field tests are underway in 15 villages across Karimnagar, Jagtial and Rajanna-Sircilla districts, said sources, adding that these tests are instrumental in gauging the adaptability and performance of the proposed variety. ARSK had previously introduced the Karimnagar Makka in 2017, designed specifically for the kharif season and resistant to pests. Similarly, the Karimnagar Makka-1 hybrid variety seed was released in 2016, suitable for both kharif and rabi seasons. Speaking to TNIE, principal scientist Manjulatha said, "Building on the experiences gained from the releases of these two varieties, along with additional research conducted at the station level, the groundwork has been completed. The focus has now shifted to field-level monitoring." The new hybrid variety, still in its nascent stage, awaits approval, and once successful, it will be officially named. The process to release the new seed variety is expected to take about one year, factoring in official approvals and technical procedures, said Manjulatha.

Oilmeal Exports up 1% in January

An increase in the export of soyabean meal helped India register 1 per cent growth in total oilmeal exports during January. Data compiled by the Solvent Extractors' Association of India (SEA) showed that India exported 4.77 lakh tonnes (lt) of oilmeals in January 2024, against 4.72 lt in January 2023. However, overall export of oilmeals was at 39.74 lt during April-January of 2023-24, against 32.88 lt in the corresponding period of 2022-23, registering 21 per cent growth. B.V. Mehta, Executive Director of SEA, said India's price competitiveness and shortage in Argentine export supplies in recent months were behind the international demand for Indian soyabean. Crushing is expected to stay below potential in Argentina during the current quarter, limiting the export of Argentine soyabean meal, he said. Soyabean meal exports from India increased to 15.86 lt during April-January 2023-24, against 5.57 lt in the year-ago period. India exported 3.75 lt of soyabean meal in January 2024, against 1.10 lt in January 2023. South-East Asia and the West Asian countries are the major consumers of Indian soyabean meal. India has a logistic advantage in these destinations, and it can supply in small lots, he said. Iran imported 2.56 lt of soyabean meal during April-January 2023-24, against 1,284 tonnes in April-January of 2022-23. However, export of rapeseed meal from India has reduced by 70 per cent during January. India exported 71,472 tonnes of rapeseed meal during January 2024 (2.38 lt in January 2023). Mehta attributed the decline in export of rapeseed meal to the lean crushing season and high local prices. These factors made Indian rapeseed meal expensive for export, he said. India exported 18.95 lt of rapeseed meal during the first 10 months of 2023-24 (19.07 lt a year ago). South Korea imported 7.66 lt of oilmeals from India during April-January 2023-24 (8.06 lt in April-January 2022-23). This included 5.19 lt of rapeseed meal, 2.07 lt of castorseed meal and 39,688 tonnes of soyabean meal. India exported 3.78 lt of oilmeals to Vietnam during April-January 2023-24 (7.52 lt). This included 90,540 tonnes of ricebran extraction, 2.36 lt of rapeseed meal, 50,760 tonnes of soyabean meal, and 905 tonnes of groundnut meal. During April-January 2023-24, Thailand imported 5.25 lt of oilmeals from India.

Govt Targets 10% Rise in Maize Output in 2025-26

To meet rising demand from animal feed and bio-fuel makers, the government is aiming to increase production of maize by 10% to 42 million tonne (MT) by 2025-26 from 38 MT in 2022-23 crop year (JulyJune) through initiating measures such as crop diversification, cluster development for ethanol plants and involving private sector in seed development. Sources said the agriculture ministry is currently working with Indian Institute of Maize Research, Punjab to boost maize production through developing high yielding varieties which have higher recovery for ethanol. The agriculture ministry also identified 53 districts high yielding districts in Andhra Pradesh, Karnataka, Madhya Pradesh, Tamil Nadu, Telangana, Uttar Pradesh, West Bengal, Punjab and Bihar for expanding maize area. The development of maize clusters around ethanol plants is being initiated by the agriculture ministry. The ministry has urged private sector to leverage public private partnership for integrated agriculture value chain development scheme for maize to ethanol production. Currently 10.74 million hectare (MH) is under maize output and the aim is to expand area by one MH in the next couple of years. Under the crop diversification paddy, the focus is being given to divert paddy grown in Indo-Gangetic plains and north-western plans to maize. In addition, under a plan approved, the farmers cooperative Nafed and National Cooperative Consumers Federation (NCCF) will purchase maize from the farmers at the Minimum Support Price (MSP) and supply to companies for ethanol production. While globally maize is the primary feed-stock for ethanol production, it is used in India mostly for animal feed and industrial use. Following the projected decline in sugar production this season (2023-24) which forced the government to restrict syrup supplies for ethanol making, the government is aiming at alternative feed-stock. "Use of sugar for ethanol has is limitations unless the area under sugarcane goes up, so we are looking to boost maize production," an official told FE. Meanwhile Ramesh Chand, member, Niti Aayog has stated there is a need to increase maize productivity to meet the target demand for ethanol production. For increasing productivity, the agriculture ministry is focussing on improving kharif output through increasing use of climate resilient and pest resistant seeds and increasing area under hybrids. Maize is grown during both kharif and rabi seasons. Karnataka, Madhya Pradesh and Maharashtra have close to 40% share in total output. About 60-65% of the output of maize is used as poultry and animal feed while 20% is used for industrial use.

Assam to set up Milk Processing Units in Six Districts, Targets 10 Lakh Litres Production

Assam Chief Minister, Himanta Biswa Sarma has announced a comprehensive strategy aimed at revolutionizing the dairy sector in the state. In a recent announcement made on March 3, Sarma outlined plans to establish milk processing units across various districts, signaling a significant leap towards achieving the goal of producing 10 lakh litres of milk and empowering dairy farmers with fair prices. Earlier on March 2, the Chief Minister inaugurated the expanded dairy plant of West Assam Milk Producers' Cooperative Union Ltd., famously known as Purabi Dairy, where he emphasized the importance of supporting local dairy farmers. Sarma expressed pride in unveiling the first batch of Purabi Ice Creams, highlighting its superior taste derived from locally sourced milk. With the inauguration of the new plant, the state's milk processing capacity will increase to 1.5 lakh litres, promising a boon for thousands of dairy farmers who will gain improved market access. The Assam Government's joint venture with NDDB has already launched its first commercial product, marking a significant milestone in the state's dairy industry. Sarma also announced substantial support measures for dairy farmers, including an additional Rs 5 benefit per litre of milk provided by the state government, on top of existing rates offered by dairy cooperatives. Moreover, WAMUL (West Assam Milk Producers' Cooperative Union Ltd.) has increased the basic milk procurement price by Re 1 per liter, effective from March 1.

GCMMF to Invest ₹11,500 Crore to Expand Operations Across Six states: MD

The Gujarat Cooperative Milk Marketing Federation (GCMMF), an apex body of milk cooperatives that owns the brand Amul, will be investing ₹11,500 crore in the next three years, which includes setting up milk processing and ice-cream manufacturing plants in Goa, Maharashtra, Madhya Pradesh, Haryana, Uttar Pradesh, and West Bengal. "In the next 2-3 years, Amul will be investing ₹11,500 crore. Most of the investments are in the area of milk processing. Though most of the investments are meant for Gujarat, our milk unions will be setting up modern dairy plants in different

States," said Jayen Mehta, Managing Director of GCMMF. Mehta was at the Narendra Modi stadium in Ahmedabad on February 21, where he had come to review the preparations for GCMMF's Golden Jubilee celebrations, where over 1.25 lakh milkproducing farmers from across the State are expected to participate.

According to Mehta, GCMMF will focus its future investments on setting up bulk milk coolers in villages, ultra-modern processing in dairy plants, and new product development. When asked as to which geographies the investments will be focussed on, the official said, "Banas Dairy is setting up a plant in Varanasi, which will be inaugurated by Prime Minister Narendra Modi on February 23. Sabar Dairy is setting up a similar dairy plant in Rohtak (Haryana). It is also close to being inaugurated. Our Panchmahal Dairy is setting up a milk processing plant at Ujjain, while Bharuch Dairy is setting up a plant in Mumbai.

Our dairy in Surat is setting up a new plant in Goa, while Amul ice-cream plants are being set up in Pune and Kolkata." GCMMF, which is an umbrella organisation consisting of 18 district milk unions, is expected to cross a turnover of ₹80,000 crore this financial year. The federation, established in 1973-74, collects an average of 300-lakh litres of milk daily from over 36 lakh members. In the year 2022-23, GCMMF reported a turnover of ₹72,000 crore. During the year, GCMMF's largest product category, Amul fresh milk, reported a sales volume growth of 20 percent. The same year, Amul ice creams saw a record 40 percent growth, while Amul milk-based beverages grew by 34 percent and Amul butter by 19 percent. "GCMMF is the world's largest dairy co-operative, owned by farmers. In the next 10 years, India is expected to account for one-third of the total milk produced in the world, and Amul has a chance to become a dairy to the world," Mehta added.

Gujarat Dairy Sector Booming as 3.6 mn Farmers get Rs 200 Cr: Officials

Gujarat's focus on animal husbandry has contributed significantly to the prosperity of the state's people as 3.6 million milk producers collectively receive Rs 200 crore daily from the Gujarat Cooperative Milk Marketing Federation (GCMMF), officials said. The dairy sector in the state has grown to Rs 1 trillion, they said. The upcoming 10th edition of the Vibrant Gujarat Global Summit, to be held in Gandhinagar between January 10 and 12, will provide a platform for the government to showcase the state's exponential growth in agriculture, horticulture and animal husbandry, Chief Minister Bhupendra Patel has said. As per a statement issued by the government, the agriculture, horticulture and animal husbandry sectors in the state are experiencing significant growth through a combination of natural farming and advanced technologies, contributing to the circular economy of Gujarat and advancing its global reputation in the dairy sector. "The upcoming Vibrant Gujarat Summit 2024 will showcase the state's exponential growth in agriculture, horticulture and animal husbandry, thanks to a combination of natural farming practices and cutting-edge technology. This holistic approach is not only boosting the circular economy but also elevating the state's global standing in the dairy sector," CM Patel said at a function held recently. The dairy industry in Gujarat has exceeded Rs 1 trillion, with Rs 200 crore being paid daily to 3.6 million milk producers through the GCMMF, a government release said. "The globally recognised Amul brand, under which the GCMMF markets milk and dairy products, stands as a testament to the hard work of millions of dairy farmers," it said. Amul's organised dairy procurement from Gujarat has grown from 3 million litres to 27 million litres in 27 years, a nine-fold growth, showing the leap the state's rural economy has taken over the years, said R S Sodhi, president of the Indian Dairy Association and former managing director of GCMMF.

India to Import Bull Semen from Brazil to Boost Milk Production

India has imported 40,000 doses of bull semen from Brazil for the first time to boost milk output via artificial insemination, a top official at the Brazilian embassy said. The National Dairy Development Board (NDDB), which has imported the doses, aims to increase the number of Indian native breeds, Gir and Kankrej, and raise their milk production. NDDB is a government-owned cooperative that owns and operates the Mother Dairy brand. "The first imports of 40,000 semen doses just took place this month by India's NDDB. It's been a project for a long time. For three to four years, they have been discussing it. Though it was a tough discussion, we managed to solve it and now import has taken place," said Angelo de Queiroz Mauricio, agricultural attaché at Brazil's embassy in New Delhi. It is unclear if India will import more doses in future.

The development comes at a time when the government is targeting to produce 330 mt of milk per annum by FY34. India produced 230.6 mt of milk in FY23, a 3.8% increase from a year ago and a 22.8% rise from FY19, according to an Indian

government statement. India is the world's largest milk producer, contributing 24% to global output, followed by the US and China. However, the country's current milk production is on par with its consumption and, therefore, it needs to find ways to increase output as demand is expected to continue rising. "NDDB is going to use the doses in an existing research project to get animals that have Brazilian genetics with a capacity of producing more than 80 litres of milk per animal," said Mauricio. "The average here is eight litres. Some animals in Brazil can even produce up to 40 litres of milk. However, the average is 20-22 litres per animal." A senior official from the animal husbandry and dairying ministry confirmed that the import took place. NDDB's plan to import Brazilian bull semen faced strong resistance over the past four years from indigenous cow breeders over concerns about spoiling Indian breeds. In 2017, the government tried to import frozen semen from Brazil, but postponed the decision due to objections from cattle breeders. Gir or Gyr is one of the principal Zebu breeds that originated in India.

98% of Fish for Assam Produced Locally: Minister

The monthly requirement of fish for consumption in Assam is over 37,000 metric tonnes (MT), of which around 98% is produced here in the state, said fisheries minister Parimal Suklabaidya in the assembly on February 14. The minister, while replying to a question raised by All India United Democratic Front (AIUDF) MLA from Jania assembly constituency, Rafiqul Islam, told the house that the total estimated monthly requirement of fish in the state is 37,469 MT. The minister added that around 90% of the total population of the state consumes fish. "The average monthly production of fish was over 36,000 MT during 2022-23. The state purchased over 2,000 MT fish every month from other states in 2022-23," he added. He said state govt has taken several steps to increase the production of fish in the state and minimise purchase from other states. "The department of fisheries has implemented different schemes, including Pradhan Mantri Matsya Sampada Yojana in order to enhance the infrastructure system that are related to the fish production of the state," he added. The minister said various support or assistance for construction of Fin Fish Hatchery, construction of new rearing pond, fish farming, integrated fish farming, fingerling stocking in wetlands and rivers, cage culture and carp polyculture among others have been provided to the fish producers by govt in the last two years. "

Cabinet Approves Rs 6,000 Crore Fishery Scheme

The government on February 08 announced a Rs 6,000 crore scheme to formalise the unorganised fisheries sector, facilitate institutional finance to micro and small enterprises and promote aquaculture insurance. The government also decided to extend the Fisheries Infrastructure Development Fund (FIDF) for another three years up to 2025-26 within the already approved fund of Rs 7,522.48 crore and budgetary support of Rs 939.48 crore. The Union Cabinet, chaired by Prime Minister Narendra Modi, approved the Pradhan Mantri Matsya Kisan Samridhi Sah-Yojana (PM-MKSSY), which is a central sub-scheme under the Pradhan Mantri Matsya Sampada Yojana (PMMSY). Briefing media, Information and Broadcasting Minister Anurag Thakur said the new sub-scheme will be for fishermen, fish farmers, fish workers, micro and small enterprises, and fish farmers' producers organisations, among others. The scheme aims to formalise the fisheries sector while focusing on micro and small enterprises with an investment of over Rs 6,000 crore over four years from 2023-24 to 2026-27 fiscal years in all states and Union Territories. Out of which, about 50 per cent i.e. Rs 3,000 crore will come from public finance including the World Bank and the AFD external financing. The remaining 50 per cent is expected from the beneficiaries and private sector, an official statement said. The sub-scheme is projected to generate about 1.7 lakh new jobs, with a special emphasis on employing 75,000 women. It also aims to generate 5.4 lakh continued employment opportunities in the micro and small enterprises (MSME) value chain. It will create a 'National Fisheries Digital Platform' to provide 40 lakh small and micro-enterprises work-based identities. It will also support 6.4 lakh micro-enterprises and 5,500 fisheries cooperatives, providing access to institutional credit. It will also address issues of aquaculture crop losses due to disease through insurance and enhance export competitiveness through value addition, value realization and value creation. The sub-scheme will not only increase incomes due to enhanced profit margins due to value chain efficiencies but will also improve the quality of fish and fishery products in the domestic market. There will be a gradual shift from conventional subsidies to performance-based incentives in fisheries. The programme will focus on improving value-chain efficiency and ensuring safe, quality fish by supporting 55,000 targeted MSMEs. It will also promote environmental and sustainability initiatives; facilitates ease of doing business and transparency. In a separate statement, the government said it created the Fisheries and Aquaculture Infrastructure Development Fund (FIDF) in 2018-19 with a total fund size of Rs 7,522.48 crore to address the infrastructure requirement for the fisheries sector.

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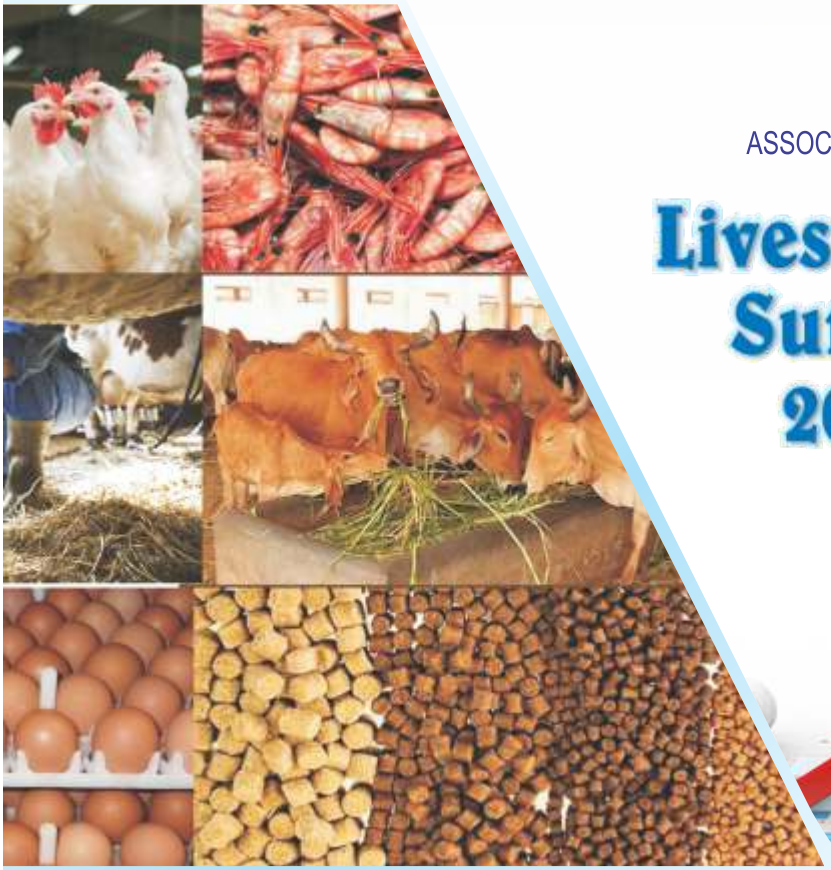

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Probiotic Power: Revolutionizing Gut Health in Calves and Taming Diarrhea Challenges

*Mokshata Gupta, Vinod Kumar, Muneendra Kumar, Shalini Vaswani, Raju Kushwaha, Avinash Kumar and Ram Dev Yadav

Introduction

Ensuring the health of calves is crucial for successful intensive breeding, impacting both mortality rates and economic factors such as antibiotic and feed costs. In the early weeks of life, calves are vulnerable to bacterial infections and experience reduced resistance if weaned too early. Early nutrition is a key, as it positively affects their long-term productivity.

The calf's gut, the largest immune organ, is primarily occupied by bacteria vital for nutrition and health. Newborn calves lack fully developed mucosal microbiota and immune systems, making them susceptible to infections and gastrointestinal diseases like diarrhea, leading to low digestion rates and nutrient absorption. Neonatal diarrhea is a major cause of calf mortality, causing significant economic losses. Calves failing to ingest colostrum or experiencing stress factors like dietary changes, transportation, other stressors are more prone to infections due to impaired immune development. Traditionally, antibiotics are used to treat calf diarrhea, but this poses risks like antimicrobial resistance and residue presence in animal food. Since the ban on antibiotic growth promoters in Europe from January 2006, there's a growing interest in improving livestock health without mass antibiotic treatments. Probiotics are emerging as a novel alternative, especially for newborn animals, to enhance immune status and overall health.

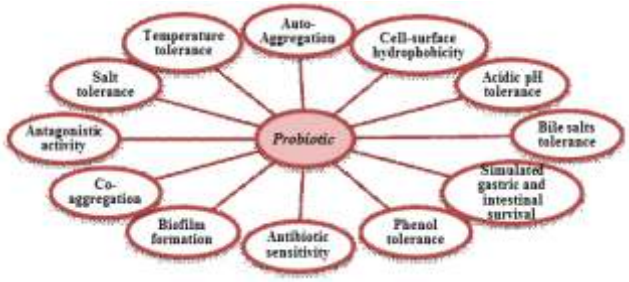

Fig. 1: Characteristics of a potential probiotic

Probiotics are live microorganisms that confer a health benefit to the host when administered in adequate amounts. The chosen probiotic strain should have specific characteristics, as shown in Fig. 1. These microorganisms offer positive effects such as producing substances that fight against harmful agents, competitive exclusion, enhancing adhesion between cells, stabilizing the mucosal barrier, stimulating mucus production by goblet cells, and modulating both local and systemic immunity. In animals, commonly used probiotic genera include Lactobacillus, Bifidobacterium, Enterococcus, and Saccharomyces. Among lactobacilli, Lactobacillus acidophilus is frequently utilized. Lactic acid bacteria (LAB) are natural components of the normal intestinal microbiota and are employed to counter the effects of pathogens like E. coli and Salmonella spp., which are common causes of bacterial infections in young calves, particularly within the first week of life. Reducing the prevalence of gastrointestinal infections in young calves is crucial because illness during this stage can lead to delayed growth, impacting their overall productivity. Numerous studies have explored the impact of probiotics on the gut health of calves, and the summarized findings are presented in Table 1.

Table 1: Effect of Probiotics on gut health of calves

Age	Probiotic used	Dose	Effects	References
4-5 days	LAB, Bacillus Strains, yeast, and a nonpathogenic *E. coli*Nissle 1917	10^9 cfu each of eight different species	Decreased overall fecal score & incidence of diarrhea	Kim et al. (2011)
10 days	*Enterococcus faecium* strain SF68 (2×10^9 cfu/g)	0.17 g/L of milk replacer	Improved fecal consistency	Masucci et al. (2011)

Age	Probiotic used	Dose	Effects	References
Newborn	Multi-strain probiotic (7 bacteria and 2 yeast strains)	1 g ($2x10^9$ cfu/g)	Decreased *E. coli* count	Roodposhti and Dabiri (2012)
3 days	*CPP (Lactobacillus acidophilus, L. casei, Bifidobacterium bifidium and Enterococcus faecium)*	2 g	• Reduced fecal pH and higher lactate • Lower incidence of diarrhea	Bayatkouhsar et al. (2013)
2-28 days	*Lactobacillus animalis, L. paracasei and Bacillus coagulans*	1 g	• Higher faecal LAB/E. coli • Improved fecal score & lower incidence of diarrhea	Agazzi et al. (2014)
Newborn	*Saccharomyces cerevisiae var boulardii*	5 g/day	• No effect on fecal biomarkers of gut health	He et al. (2017)
Newborn	*Streptococcus faecalis (1×10^8 cfu/g), Clostridium butyricum (1×10^6 cfu/g) & B. mesentericus (1×10^6 cfu/g)*		Reduces the severity of diarrhea	Kayasaki et al. (2021)
Newborn	*Lactobacillus acidophilus, Bacillus subtilis, and Saccharomyces cerevisiae*	2 g/day	• Reduction in calf diarrhea • Balance in the fecal microbiota	Wu et al. (2021)
2 days	*Bifidobacterium animalis, Lactobacillus casei, Streptococcus faecalis, and Bacillus cerevisiae*	2-6 g/calf/day	• Reduced fecal consistency index & diarrhea • Alter the composition of the fecal bacteria	Guo et al. (2022)
Newborn	*Lactobacillus plantarum, Pediococcus acidilactici, Pediococcus pentosaceus, and Bacillus subtilis*	10^7-10^8 cfu/g	Decreased fecal score at 3 wk age and medicine treatment	Wang et al. (2022)
5-7 days	*Limosilactobacillus reuteri , Ligilactobacillus salivarius*	10^8 cfu/g/calf/day	• Increase in the abundance of beneficial intestinal microbiota & Reduced fecal score • Improvement in fecal biomarkers like lactate and ammonia	Varada et al. (2022)
Newborn	*L. reuteri*	6-8x10^8 cfu/d	Reduces frequency, and duration of diarrhea	Schwaiger et al. (2023)

Gut Health Markers

In intensive farm systems, newborn calves are generally separated from the dam before the completion of gut microbial colonization. This make calves more susceptible to GIT infections and hence increases the risk of diarrhoea and weight loss, which is a major cause of morbidity and mortality during their early life.

Faecal pH and Lactate

Faecal pH can help us understand gut health because it reflects the presence of harmful gut bacteria like E. coli. Additionally, fermentation pattern in the intestines affects fecal pH. The intestinal pH and lactic acid concentration are inversely related. The probiotic supplementation reduces faecal pH due to higher production of lactate, indicating its role in inhibiting the development of pathogenic bacteria. The increased lactic acid may be a result of lactic acid bacteria (LAB) fermenting carbohydrates that are resistant to indigenous bacteria.

Faecal Ammonia

Supplementation of probiotics reduces the amount of faecal ammonia, and at the same time, it increases the production of lactate. Ammonia is created when protein ferments in the colon. During limited energy supply, microbiota ferment amino acids to SCFA and ammonia to obtain energy. Probiotic bacteria increase SCFA production by accelerating the breakdown of carbohydrates that are resistant to indigenous bacteria. These SCFA become an energy source for host, and the increased production of SCFA and lactic acid by probiotics

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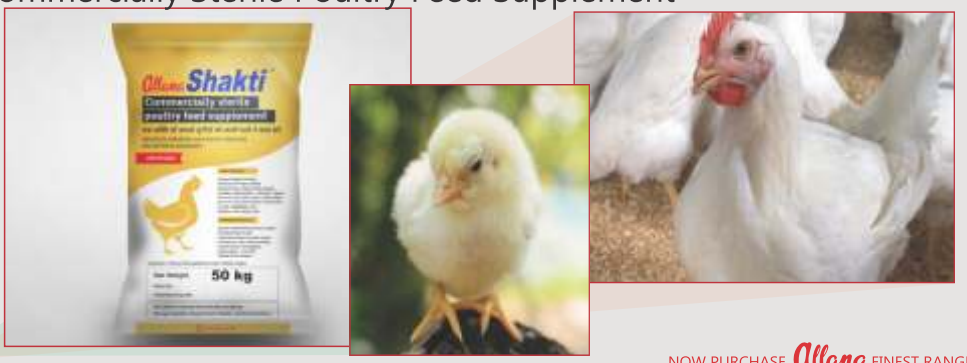

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helps decrease the overall production of ammonia in the gut.

Faecal SCFAs (Short-Chain Fatty Acids)

When calves are given probiotic supplementation, there is an improvement in the production of certain fatty acids in their feces, namely acetate and butyrate. This suggests that the probiotics are effectively adapting to the calf's gut. The increased production of these fatty acids is attributed to the probiotics speeding up the breakdown of resistant carbohydrates, which are not easily broken down by the calf's existing gut bacteria. This boost in VFA production leads to a more stable rumen internal environment. As a result, there is a subsequent rise in the activities of enzymes like amylase and protease in the calf's ruminal fluid. This increase in enzyme activity enhances the availability of nutrients for the calf. Specifically, butyrate, a product of the breakdown of concentrates, plays a crucial role in promoting the development of the calf's rumen mucosa, which is more effective than the development stimulated by roughage. The higher levels of butyrate also indicate an early stage of rumen development in the calves.

Faecal BCFAs (Branched-Chain Fatty Acids)

BCFAs are generated through the fermentation of proteins, specifically through the breakdown of valine and leucine, resulting in the formation of isobutyrate and isovalerate, respectively. This process is commonly considered putrefactive, leading to the production of harmful metabolites for the host. When there is a decrease in BCFAs and ammonia, along with a simultaneous increase in SCFAs and lactate in feces, it indicates a reduction in protein breakdown and fermentation. This shift reflects the promotion of beneficial saccharolytic activity over detrimental proteolytic activity by the colonic microbiota, ultimately contributing to an improvement in the host's health.

Faecal Microbiota

The gut microbial balance is one of the most important factors to provide good health status in young animals, particularly calves, where the immature immune system is prone to debilitating diarrhea & respiratory diseases. The disorder of the intestinal flora is a major cause of malabsorption. The probiotics increases the count of healthy bacteria i.e. Bifidobacterium and Lactobacillus but inhibiting the growth and proliferation of pathogenic bacteria like coliform and clostridia by interfering with the spatial structure of the pathogenic bacteria and secreting antimicrobial substances, thus rebuilt normal gut ecological environment and absorptive function will be improved accordingly. Several other mechanisms for the inhibition of pathogenic bacteria by probiotics includes competition for nutrients and adhesion sites, production of direct inhibitory compounds and lowering of colonic pH by the production of SCFAs.

Maintaining a healthy balance of gut microbes is crucial for the well-being of young animals especially calves with vulnerable immune systems prone to issues like diarrhea. Dysbiosis in gut flora can lead to poor absorption of nutrients. Probiotics play a key role by increasing the levels of beneficial bacteria such as Bifidobacterium and Lactobacillus, while also suppressing the growth of harmful bacteria like coliform and clostridia. They achieve this by disrupting the structure of pathogenic bacteria and releasing antimicrobial substances. This helps restore a normal gut environment, improving absorption functions. Probiotics also inhibit pathogenic bacteria through competition for nutrients and adhesion sites, the production of inhibitory compounds, and the reduction of colonic pH through the release of short-chain fatty acids.

Conclusion

Supplementing probiotics can help prevent diarrhea by improving the balance of good bacteria in the gut and enhancing digestion and nutrient absorption. The impact of probiotics, however, can differ based on factors such as the dosage, specific probiotic strain, calf health, management practices, and environmental conditions.

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Alternative Approach for Fish Feed Formulation in Aquaculture Industries: The Example of Black Soldier Fly Larval

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Abstract

The demand for alternative protein sources in animal feeds, particularly in aquaculture, has intensified due to increased demand for fish and soybean meal. Insect-based feeds are being considered as viable alternatives, with particular attention on the black soldier fly (BSF), Hermetia illucens. BSF larvae offer a promising solution due to their ability to thrive on organic waste materials, reducing waste volume significantly. They boast a protein content of around 42% and a fat content of up to 35%, making them a valuable source of nutrients. However, there is limited information on their suitability for carnivorous cold-water fish species. This study explores the nutritional characteristics of BSF larvae, including their protein, amino acid, and fatty acid compositions. It also discusses BSF larvae production techniques and their potential as a substitute in fish feed formulations. Various studies have shown that BSF larvae meal can replace conventional protein sources in fish diets without compromising growth performance. Furthermore, the cost-effectiveness of BSF larvae production, coupled with their sustainable utilization, presents a promising avenue for enhancing food security and supporting ecological balance in aquaculture.

Keywords

Black soldier fly, aquaculture, fish feed, protein, fish, insect.

Introduction

The growing demand for fish and soybean meal in livestock and aquaculture feeds has made the animal feed sector more worried about alternative protein carriers. Apart from the EU Regulation (EC) 56/2013, which allows animal leftovers of non-ruminant origin to be used in aqua feeds, producers of fish feed, scientists, and legislators are discussing the usage of insect-based feeds more and more. Hermetia illucens, commonly known as the black soldier fly (BSF) and prevalent in warm and temperate regions circumpolarly, was a great option (Bondary and Sheppard, 1981). Because of their capacity to develop on a wide range of organic waste materials, the larvae of this species can reduce trash volume by 50%. According to Sheppard et al. (1994), biomass produced by this growth has a protein content of around 42% and a fat content of up to 35%. While several warm-blooded fish species have shown that BSF larval meal is a suitable source of protein for feedstuff (Bondari, Sheppard, 1981), there is not enough information available regarding carnivorous cold-water species, including trout and turbot (Kroeckel et al. 2012; St-Hilaire et al. 2007). This report presents the feeding trial results for rainbow trout fed two BSF-larvae meals with organic ingredients.

Black soldier fly larvae's nutritional characteristics and body composition

Early research indicates that the BSFL is the greatest resource for recycling organic wastes into premium feeds and valuable biomass. The BSF larvae's proximate composition, which includes protein, lipids, and carbohydrates, varied greatly depending on the organic materials they consumed. Among the many organic waste types employed in BSF larval rearing are fruit and vegetable wastes as well as manure from pigs, cows, and chickens. Crude protein makes up 50%–60% of BSFL's body, with lipids and amino acids making up the remaining 30%–35% (Tomberlin et al., 2002; Liu et al., 2017). The maximum proportion of crude protein was discovered to be present in five-day-old (BSFL) larvae (61%)

with a steady drop in protein content observed with increasing age (Rachmawati Buchori et al.,2010.)

Crude protein, crude fat, ash and amino acids contents of black soldier fly larvae.

CP %	CF %	Ash %	Amino acids % DW						References
			LYZ	MET	THR	ARG	VAL	ILE	
36.2	19	9.3	2.75	0.54	1.95	2.98	2.28	2.1	Barroso et al., 2014
55.3	18	9.9	2.1	0.65	1.7	2.2	2.7	1.9	De Marco et al., 2015
54.8	15.6	7.7	2.1	0.66	2.04	1.73	3.8	2.38	Cullere et al., 2016
39.9–43.1	21.8–38.6	2.7–19.7	2.34–2.57	0.71–0.87	1.54–1.68	1.99–2.03	2.41–2.82	1.72–1.91	Spranghers et al., 2017
62.7	4.7	8	4.14	1.33	2.37	n.d.	5.13	3.18	Marono et al., 2017
43.6	33.1	15.5	2.62	0.74	1.78	2.65	2.79	2.03	St-Hilaire et al., 2007b
57.5	7	n.d.	3.3	0.92	2.32	2.79	3.47	2.44	Mwaniki et al., 2018
32	37.1	19	2.3	0.60	1.49	1.96	2.4	1.47	Caligiani et al., 2018
14.6	2.8	14.7	2.22	0.58	1.42	1.94	2.25	1.57	Kawasaki et al., 2019
42	36.2	n.d.	6.45	2.72	4.48	5.22	5.80	5.08	Huang et al., 2019
23.8	3.1	6.4	5.92	1.60	3.92	4.80	5.68	4.16	Tschirner and Simon, 2015
39.2	28.4	8.3	2.32	2.24	1.84	2.05	1.87	1.56	Liu et al., 2017
17.20	5.83	n.d.	1.22	4.51	3.91	3.43	8.09	1.12	Marco et al., 2021
41.1	n.d.	9.3	4.1	6.1	2.2	1.1	7.2	1.6	Shumo et al., 2019

n.d. – Not detected, CP- Crude protein, CF- Crude fat, LYS- Lysine, MET – Methionine, THR – Threonine, ARG – Arginine, VAL - Valine, ILE – Isoleucine

Protein composition

The BSF has a somewhat greater crude protein (CP) content than other insects that have been utilized to make animal feeds, such mealworm beetles (Tenebrio molitor), crickets (Gryllus campestris), drone flies (Eristalis tenax), and beetles. Previous studies have reported that BSF larvae can contain up to 64% protein (St-Hilaire et al., 2007a; Zheng et al., 2012). The larvae's body composition is mostly determined by the quantity and quality of substrate they consume. Protein levels were higher in larvae fed swine dung (43.6%) than in larvae fed cow manure. Furthermore, the crude protein content of BSF larvae is influenced by the processing method. Higher CP concentrations have been seen when comparing fully fattened larvae to partially fattened and defatted larvae (Schiavone et al.,

Crude protein contents in raw BSF (H. illucens) compared to mealworm beetle (Tenebrio molitor), cricket (Gryllus campestris) and Drone fly (Eristalis tenax), (g/100 g dry matter)

Insect	Crude protein	References
Mealworm beetle (Tenebrio molitor)	38.3	Kuntadi et al., 2018
Cricket (Gryllus campestris)	32.6	Kuntadi et al., 2018
Drone fly (Eristalis tenax)	40.9	Barroso et al., 2014
BSF (H. illucens)	42.0	Huang et al., 2019

Amino acid composition

Variations in body composition have been noted according on the culture substrates employed, and the BSFL provides an abundant supply of amino acids. Significant amounts of amino acids have been found in the BSFL fed cow manure (St-Hilaire et al., 2007a; Al-Qazzaz and Ismail, 2016; Kim et al., 2021). The amino acids alanine, arginine, aspartic acid, cystine, glutamic acid, histidine, isoleucine, leucine, lysine, methionine, phenylalanine, proline, serine, threonine, tryptophan, and tyrosine have been shown to be present in BSFL, according to studies conducted by Makkar et al. (2014) and Shumo et al. (2019).

Fatty acids composition

According to Kroeckel et al. (2012), the average content of mono and polyunsaturated fatty acids (PUFAs) in BSF larvae is 19%–40%, whereas the concentration of saturated fatty acids is 58%–72%. Growing BSF larvae on an organic substrate supplemented with 10% Schizochytrium sp. resulted in a significant increase in the PUFA content of the insects. Studies have shown that BSF prepupae biomass is enhanced when an organic substrate with the appropriate concentrations of PUFA is used. This indicates that the growth substrate used has a significant impact on the nutritional quality of BSF biomass. Above all, in BSF larvae generated utilizing coffee silver skin by product augmented with (10% W/W) Schizochytrium sp., the content of PUFAs in BSFL biomass was considerably raised (Zarantoniello et al., 2020). A separate research states that triglycerides make up the majority of the lipid content of BSFL, which ranges from

8% to 60% of its dry weight (Caligiani et al., 2019). Lauric, palmitic, α-linolenic acid—also referred to as eicosapentaenoic acid—and oleic acid are among the fatty acids from the BSFL that have been reported to exist (Surendra et al., 2016; Starcevic et al., 2019). The only things that alter the amount of fatty acids are the feed given to the larvae and the nutritional value of the food.

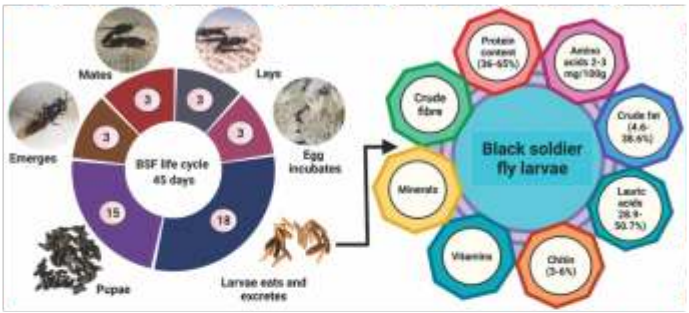
Fatty acid contents of black soldier fly larvae.

Fatty acid contents (%)															References
12:00	14:00	16:00	18:00	16:1n-7	18:1n-9	18:2n-6	18:3n-3	20:5n-3	22:6n-3	SFA	MUFA	PUFA	Ω-6	Ω-3	
0	2.4	16.6	43.5	2.2	0	0	0	0	0	65.8	32.6	1.1	1.1	0	Barroso et al., 2014
14.4	3.3	16	25.1	2	23.9	4.99	24.3	0.2	3.2	0	0	0	0	28.5	Spranghers et al., 2017
14.1	1.9	5.3	0.9	1.1	7.3	2.7	0.2	0.3	0	22.9	8.6	3.2	0	0	Kawasaki et al., 2019
61.4	10.2	7.8	1	2.5	0.1	7.2	0.4	0	0	0	0	0	0	0	Liu et al., 2017
41.96	7.05	18.02	3.68	5.82	17.93	57.25	3.19	0	0	0	17.7	13.43	0	0	Marco et al., 2021
49.34	6.83	10.48	2.78	3.45	11.81	3.68	0.08	0	0	0	0	0	0	0	St-Hilaire et al., 2007b
7.5	2.3	19.2	6.9	0.8	26.6	31.4	3.6	0	0	36.2	28.7	35	0	3.6	Ewald et al., 2020

12:0-Lauric Acid; 14:0-Myristic Acid; 16:0-Palmitic acid; 17:0-Heptadecanoic acid; 18:0-Stearic Acid; 16:1n-7-Palmitoleic acid; 18:1n-9-Oleic Acid; 18:2n-6-Linoleic Acid; 18:3n-3-Alpha-linolenic Acid; 20:4n-6-Arachidonic Acid; 20:5n-3-Eicosapentanoic Acid; 22:6n-3-Docosahexanoic Acid; SFA- Saturated fatty acids; MUFA- Monounsaturated fatty acids; PUFA- Polyunsaturated fatty acids

Black soldier fly training techniques

The increased requirement for protein fish meal in aquaculture has led to a rise in the usage of insect meal due to its high energy content and nutritional value. The black soldier fly, or H. illucens, is used as a replacement source of protein in aquaculture. Around the world, there are several facilities available for the bulk growth of H. illucens. Black soldier flies are the best source for decomposing organic items including leftover fruits and vegetables. According to Sheppard et al. (2002) and Cannella et al. (2016), H. illucens has a 45-day life cycle that consists of four different stages:



eggs, larvae, prepupae, and pupae, or adult flies. an outline of the food, physiology, and life cycle of the black soldier fly.

In addition, BSFL have been produced using a variety of rearing substrates. Eggs must hatch in a minimum of 48 hours. Prepupae larvae's dorsal side has a dark brown to black color that may be utilized to identify different growth stages (Sheppard et al., 2002). In another investigation, the optimal temperature for BSFL cultivation was determined and reported. The lifespan of BSFL eggs may vary greatly depending on the temperature. Temperature was shown to alter the eclosion ratio, as evidenced by the low (<11%) eclosion rate of eggs at 15◦C, 37◦C, and 40◦C, and the high (80%) eclosion rate at 30◦C. Moreover, the sole thing that affects the body weight of BSFL larvae is their larval diet.

BSF Larvae Usage in Fish Feed Formulation

Insect meals have been used in fish feed diets for a very long time (Barragan et al., 2017). Because of their exceptional ability to reproduce, short life cycle, ability to convert organic matter into high-quality protein, and adaptability to a variety of settings, BSF larvae have garnered a lot of interest for their use in fish diets (Barragan et al., 2017). Furthermore, the BSF larvae are a common meal choice for fish diets due to their high protein content, digestibility, and amino acid profiles. The BSF meal has successfully replaced other conventional protein sources in the diets of Channel catfish (Ictalurus punctatus) (Bondari and Sheppard, 1981, 1987; Zhang et al., 2014a,b), blue tilapia (Oreochromis aureus) (Bondari and Sheppard, 1981, 1987), Nile tilapia (Oreochromis niloticus) (Muin et al., 2017), O. niloticus crossed with Sabaki tilapia (Oreochromis spilurus) (Furrer, 2011), rainbow trout (Oncorhynchus mykiss) (St-Hilaire et al., 2007b; Sealey et al., 2011), Atlantic salmon (Salmo salar) (Lock et al., 2015), turbot (Psetta maxima) (Kroeckel et al., 2012), yellow catfish (Tachysurus fulvidraco) (Zhang et al., 2014a) and African catfish (Clarius gariepinus) (Adewolu et al., 2010; Idowu and Afolayan, 2013).

The body weight gain (BWG) and specific growth rates (SGR) of O. niloticus did not experience any adverse impacts from the addition of BSF larvae meals to their diets (Devic et al., 2018; Toriz- Roldan et al., 2019). Similar to this, there were no

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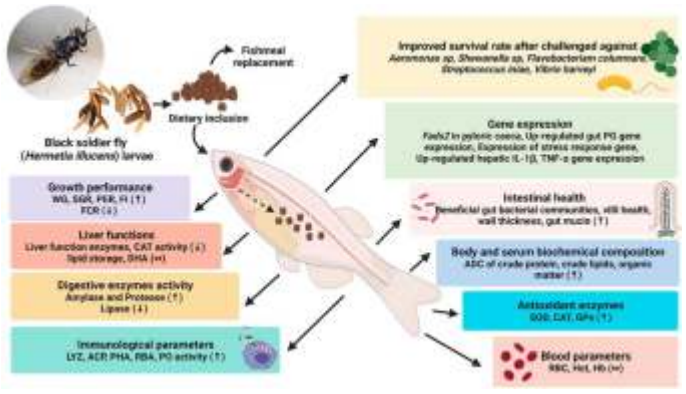
alterations in the BWG and SGR of juvenile Japanese bass (Lateolabrax japonicus) and rainbow trout (Oncorhynchus mykiss) when FM was partially or completely replaced with BSF larval meal (Wang and Shelomi, 2017; Belghit et al., 2019).In a study on C. gariepinus, Fawole et al. (2020) found that when 50% of FM was replaced with BSF larvae, the final weight (19.84g, 14.79g), BWG (15.83g, 10.82g), protein efficiency ratio (1.62, 1.29), SGR (2.66%, 2.19%), and feed intake (23.26, 20.09) were significantly higher than when the control diet which contained 0% BSF larvae meal was administered. Similarly, when BSF larvae meal was substituted for FM in the diets of O.niloticus at 0, 25, 50, 75, and 100%, Muin et al. (2017) reported the greatest weight growth and SGR values of 8.74 and 2.43%, respectively. Furthermore, at a 25% inclusions level, BSF meal has been demonstrated to be a good substitute for fish meal in the diets of Pacific White Shrimp (Litopenaeus vannamei) (Cummins et al., 2017).Additionally, as compared to traditional feed sources like FM and soyabean meal, the use of BSF larvae in fish diets has demonstrated the ability to reduce production costs. In Kenya, fish meal costs between 1.2 and 1.5 U$D/kg, soybean meal costs between 0.9 and 1.6 U$D/kg, and BSF larvae cost between 0.8 and 1.2 U$D/kg. The cheap cost of feeding BSF larvae, which consume low-value organic wastes, and the ease of use of the culture systems are linked to their low costs (Diener and Trockner, 2009; van Huis, 2013).

An overview of the growth performance of various fish species fed diets including BSF larvae meal. The suggested replacement levels are shown by bolded values.

Fish species tested	Attribute/element tested	Replacement levels (%)	Author (s)
Jian carp (Cyprinus carpio)	A study by Li et al. 2017 suggested that it is possible to substitute up to 100% FM by BSF larvae meal in diets for Jian carp without negative effect on growth performance and feed utilization efficiencies	0, 25, 50, 75, **100**	Li et al. (2017)
Mearger (Argyrosomus regius) juvinilles	10% of Hermetia illucens, can be included in Meagre diets without major adverse effects on growth, feed utilization, whole-body composition and fatty acid profile, further increase in the substitution rates lead to a negative effect on the growth performance parameters	**10**, 20, 30	Guerreiro et al. 2020)
Nile tilapia (Oreochromis niloticus)	Replacement of soya protein concentrate by partly defatted BSF larvae meal up to a level of 50% had no negative effect on growth performance and improved the dietary protein quality of tilapia feeds under study	25, **50,** 100	Dietz and Liebert (2018)
Siberian sturgeon (Acipenser baerii)	Overall, this study showed that it is possible to replace up to 25% of FM with BSF larvae meal in the diet of Siberian sturgeons (equal to 18.5% HIM inclusion level) without affecting the growth performance	**25**, 50, 100	Caimi et al. (2020)
Rainbow trout (Oncorhynchus mykiss)	The maximum inclusion of BSF larvae meal recommended in rainbow trout diets is 13% further increase in the substitution lead to a decrease in the growth parameters	0, 6.6, **13.2,** 26.4	Dumas et al. (2018)

Fish species tested	Attribute/element tested	Replacement levels (%)	Author (s)
Nile tilapia (Oreochromis niloticus)	The study suggests that substitution of FM with BSF larvae upto 100% is possible without any negative effects on the growth performance, feed utilization efficiency, body composition	0, 25, 50, 75, **100**	Muin et al. (2017)
European sea bass (Dicentrarchus labrax)	With the 3 substitution levels of FM with BSF larvae meal at (25, 35, 50 %), BSF larvae meal can effectively replace FM upto 50% without any negative effects on the growth performance	25, 35, **50**	AbdelTawwab et al. (2020)
Rice field eel (Monopterus albus)	Lower substitution rates (5.26, 10.52%) of FM by BSF larvae meal in the diets of Rice field eel, exhibited low values of the growth performance parameters as compared to a higher substitution rate of FM by BSF larvae meal made at 15.78%	5.26, 10.52, **15.78**	Hu et al. (2020)
African catfish (Clarius gariepinus)	Substitution of FM by BSF larvae up to 75% lead to no negative effects on the growth performance and nutrient utilization	0, 25, 50, **75**	Fawole (2020) et al.
Juvenille turbot (Psetta maxima)	The maximum inclusion of BSF larvae meal recommended in Juvenile turbot diets is 33% further increase in the substitution lead to a decrease in the growth performance parameters and nutrient utilization	0, 17, **33,** 49, 64, 76	Kroeckel et al. (2012)



Conclusion

The BSF larvae have a great potential to add high-quality protein to fish diets because of their exceptional nutritional properties, which support healthy growth and reproduction rates. The BSF can be sustainably used to improve fish growth performance, reduce aquaculture production costs, and maximize resource utilization all of which support food security, livelihoods, and ecological balance—by using appropriate culture systems and processing methods, primarily to remove chitin.

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Nutrition Based Health (NBH) In Poultry Production

Prof. Dr. R.N.Sreenivas Gowda*

Introduction

'Health is wealth', an old saying still holds good for any living being on earth. Similarly, Livestock and poultry health is determined by its genetic makeup, nutrition and health care management. 'Nutritional health' is maintained by a state of equilibrium in which nutrient intake and requirements are balanced. Nutritional science deals with the organism's responses to the diet. It includes studies not only on the nutrients themselves but also on molecular interactions, metabolic and signaling pathways, physiology, pathology, and toxicology. The role of nutrition in animal health and production includes the basics like metabolism of proteins, carbohydrates, fats, minerals and vitamins. Protein helps with the animal's growth, supporting the development of muscles and other parts of the body. These components form the building blocks for the animals to grow and sustain themselves. Nutrition is also required for reproduction and immunity development (fig1).

In the poultry industry, the feed is the major component of the total cost for meat and egg production. Depending on the species and countries considered, the share of feed makes up 40 to 70% of cost production. The feed exposes the birds to a wide variety of factors through the gastrointestinal tract (GIT), and affect poultry health and production. The GIT is a highly complex and dynamic organ, which plays a critical role in nutrient absorption and maintenance of immune response.

Gastrointestinal tract(GIT)

The GI tract of the chicken includes the crop, proventriculus, gizzard, duodenum, jejunum, ileum, caeca, large intestine, and cloaca. Each GI tract section has different metabolic functions that shape the microbial community. The intestinal epithelia are exposed continuously to a wide variety of potentially harmful substances and act as a selective barrier between the tissues and luminal environment of the GIT. There are several stressors such as feed toxins; infectious agents induce the cellular free radicals' generation results in redox imbalance. This stress can negatively affect the delicate balance among the components of the chicken GIT, which in turn, affect the health status and productivity of poultry.

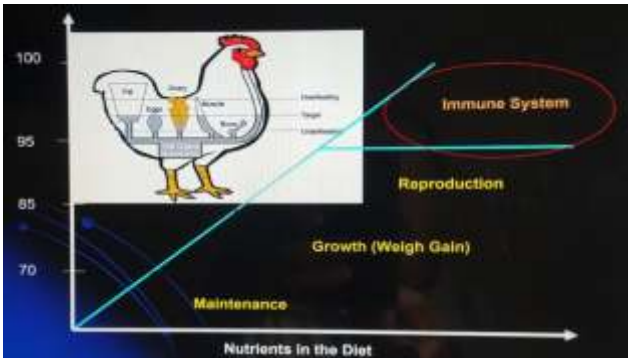

Fig.1.The role of nutrition in health and immunity

Nutrition based health (Nbh) problems are considered under four main sub headings:

1. Nutrition and gut health
2. Nutrition and Respiratory health.
3. Nutrition and joint disorders.
4. Nutrition and Immunity

1.Nutrition and Gut health

The gastrointestinal tract (GIT) provides the biological environment for nutrient digestion and absorption, and protection from pathogens and toxins. Broilers are fast growing because of the great potential of intestinal epithelia for nutrient absorption, and efficient conversion of nutrient to muscle. Physiologically, reactive oxygen species (ROS) and reactive nitrogen species (RNS) are generated by GIT epithelial cells either from oxygen metabolism or by enteric commensal bacteria and regulate gut health. However, increased production of ROS elevates free radical production and antioxidant insults resulting in **oxidative stress.** Both reactive oxygen species (ROS) and reactive nitrogen species

(RNS) at certain levels are signaling molecules involved in homeostasis. However, excessive production of ROS and RNS or their inefficient scavenging leads to oxidative stress.

Oxidative stress in the cells/tissues results from an imbalance between free radical production and endogenous antioxidant defense and leads to lipid peroxidation, protein nitration, DNA damage, and apoptosis. Cells are exposed continuously with the free radicals generated during the physiological oxygen metabolism. These Stresses in commercial poultry result from environmental, nutritional, microbiological, and management factors which negatively impact poultry health, production and quality of meat and eggs.

Poultry feeds/feed ingredients are often contaminated with a wide range of environmental toxicants, bacterial and fungal toxins, and known to affect the gut health. The intestinal luminal epithelial cells and the tight junction proteins between two adjacent epithelial cells from the barrier and thus preventing paracellular absorption of toxins. Oxidative stress alters not only the cellular processes but also the intestinal barrier function. Mycotoxins are metabolites produced in a strain-specific way by a wide range of fungi, particularly molds. The common mycotoxins are aflatoxin, zearalenone, deoxynivalenol, trichothecenes, fumonisin, T-2 toxin, and ochratoxin. Once these toxins come in contact with the epithelial cells or during the absorption, the GIT is greatly impacted by the induction of oxidative stress.

Supplementation of exogenous vitamins, antioxidants, and plant extract having antioxidant properties scavenge ROS and are beneficial in mitigating oxidative stress in the GIT.

2. Nutrition and Respiratory health

What is Respiratory Oxidative stress?

Production of Reactive Oxygen Species (ROS), due to various exposures, such as air pollution (ammonia, Carbon dioxide, Carbon monoxide, Methane). These airborne irritants cause damage in Lung airways and cause inflammatory reactions, alters defense mechanism and detoxification process leading to the failure of cell defense mechanism against oxidants. Apart from this, ROS negatively influences the enzymes' expression, which are involved in crucial processes.

Dietary antioxidants are an important dietary factors in protecting against the damaging effects of oxidative stress in the airways. Antioxidants comprise of both non-enzymatic low molecular weight (e.g., vitamin C, GSH, and uric acid) and enzymatic high-molecular-weight [e.g., superoxide dismutase (SOD), glutathione peroxidase (GSH-Px), and arylesterase] complexes. They reduce the rate and development of oxidation and thereby guard cells against oxidative damage.

What is the effect of oxidative damage in chicken and meat?

- Oxidative stress triggers biological malfunctioning, organ damage, poor performance, health issues, and altered meat quality. Oxidative damage in poultry impairs the normal metabolism, which leads to the development of meat abnormalities such as wooden breast and white striping.
- Lipid oxidation is one of the significant challenge to the poultry meat processing industry
- Lipid oxidation in meats is a process whereby polyunsaturated fatty acid react with reactive oxygen species leading to a series of secondary reactions which in turn lead to degradation of lipids and development of oxidative rancidity.
- Free radical oxidation is also called autoxidation and is the most important form of lipid oxidation in meat and results in the production of off-odor and the formation of toxic compounds (e.g., carcinogens), causes loss of functional properties and nutritional value, and changes the color of meat.

3. Nutrition and Leg and joint disorders.

Broiler leg disease is characterized by leg muscle weakness, leg bone deformation, joint cysts, arthritis, femoral head necrosis, and other symptoms that result in lameness or paralysis. These conditions significantly affect movement, feeding and broiler growth performance.

The most common condition is rickets. Rickets occurs most commonly in young meat birds; the main characteristic is inadequate bone mineralization. Calcium deficiency at the cellular level is the main cause, although feeding a diet deficient or imbalanced in calcium, phosphorus, or vitamin D3.

A deficiency of either calcium or phosphorus in the diet of young growing birds results in abnormal bone development. A deficiency of either calcium or phosphorus results in lack of normal skeletal calcification.

Rickets occurs in young birds while cage layer fatigue (osteomalacia) occurs in mature females. It can be mistaken for other causes of deforming leg weakness in poultry. A vitamin E deficiency results in a condition known as 'crazy chick disease' or encephalomalacia (softening of the brain).

A dietary manganese deficiency in immature chickens and turkeys is one of the potential causes of perosis and chondrodystrophy and also the production of thin-shelled eggs and poor hatchability in mature birds.

Table:1. Common non -infectious leg problems in broilers: Cause and prevention

Sl. no	Leg problems	Causes	Prevention
1	Lameness & not walking with leg deformities & bone deformities	Management Nutrition	Vitamin D
2	Twisted legs Varus/ Valgaris, Rickets	Nutrition Infection	Ca,P,& Vit D
3	Osteomyelitis& Femoral Head Necrosis(FHN)	Infection (Nutrition)	Ca,P,& VitD
4	Osteomyelitis, Kinkey back, Spondilisthesis ,Absecess in vertebra & spinal cord	Infection (Nutrition)	Ca,P,& VitD
5	Podo dermatitis	Management Nutrition	Ca,P,& Vit D
6	Tibiodyschonroplasia	Genetics Nutrition	Ca,P,& Vit D

4. Nutrition and Immunity

Nutrition is a key factor in immunity, disease control, and prevention. Passive and active immunity and building antibodies are affected by nutrition, quantitative and qualitative feed constituents, and hygiene. Fatty acids, protein/amino acids, minerals, and vitamins are vitally important for enhancing immunity and health Overcrowding negatively modulates the immune response of poultry by suppressing the growth of immune organs. It is considered as a predisposing factor that induces enteritis, decreases nutrient absorption, and thus reduces growth performance.

Feeding adequate amounts of vitamins and minerals is important for good health, and deficiencies of certain vitamins and minerals—including vitamins A, B6, B12, C, D, E, and K; folate; and copper, iodine, iron, magnesium, selenium, and zinc—might adversely affect immune function (table.2).·

Nutrition induce the function of Immune system in several Ways:

- Anatomical development of lymphoid tissues.
- Mucus production.
- Synthesis of immunologically active substances.
- Cellular proliferation.
- Cellular activation and movement.
- Intracellular killing of pathogens.
- Modulation and regulation of the immune process

Table 2. Requirement of trace minerals on immune system

Trace Minerals	Involvement of Systems
Cu, Zn,Fe,Se.	The Immune system
Cu, Fe	Blood production
P, Cu, K, Mn.Zn,Mg	Reproduction
Fe, Mn,Zn,Cu, Mg, K	Hormone system
Mg, P, Mn,	Energy metabolism
Zn, Cu ,Mn, Mg, Fe	Enzyme system, Bone formation

Feeding Dietary Anti -oxidants help in correction

- Supplementation of Vitamin A, Vitamin C, Vitamin E, Vitamin D3, Flavonoids and Carotenoids will correct these biochemical reactions in the body system
- Feeding α-tocopherol(is a form of vitamin E), helps in maintain the integrity of membrane fatty acids, by inhibiting lipid peroxidation.
- Flavonoids are potent antioxidants and have anti-inflammatory as well as anti-allergic actions due in part, to their ability to neutralize Respiratory oxygen species.
- Vitamin D3 has beneficial effects for the normal function of lung epithelium.
- Optimum Vitamin Nutrition" (OVN) is about feeding animals and birds with high quality vitamins in the right amounts and ratios appropriate to their life stage and growing conditions.

Table3. Interaction of feed additives in building immunity

Feed additive	Description of the product	Advantages
Probiotics	Live bacteria and yeasts	Improves digestion and enhance Immunity
Prebiotics	Non digestible fibers stimulates the growth of healthy bacteria	Improves mineral absorption and enhance immune function
Hyperimmune IgY	Produced through live animals	An antibody that help transfer passive immunity.
Antimicrobial peptide	Proteins with broad spectrum antimicrobial activity	Broad spectrum antimicrobial activity on bacteria, Virus and fungi. Improves immunity.
Organic acids	Different acids that have antimicrobial activity	Improves growth performance and strengthens immunity.
Phytogenic(Oleoresins and essential oils)	Derived from natural herbs	Improves growth performance
Enzymes	Breakdown fiber and other components of the diet	Improves growth performance and strengthens immunity.
Clay	Used as binding agent in making pellet feed acts as lubricating agent	Enhance growth performance and combats bacterial and protozoal infections

Conclusions

Nutrition based Health problems in chicken are related to gut health. Feeding chicken with good quality and the requirement in terms of protein, carbohydrate, fat,vitamins and minerals help in proper maintenance of health and immunity.

Providing the right nutrition is important for poultry growth, production and health. Different energy requirements are required, depending on factors including bird age, production status and type (e.g. laying hen, meat chicken, duck, turkey).

(*Founder and Former VC,KVAFSU, Bidar, Former Director, IAH&VB,Bangalore,and Former Prof & University Head, UAS,Bangalore)

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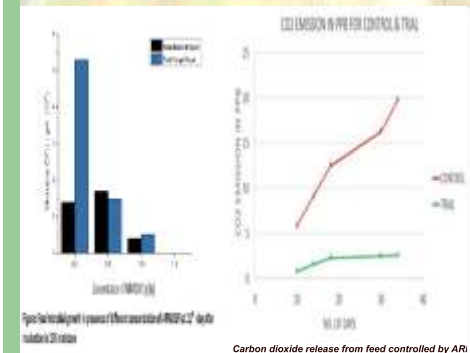
- Prevents lump formation in stored processed feed.
- Prevents aflatoxin (AFB1) production in commercial pellets (NDDB Lab study).
- It acts as pellet binder. Reduced fines to 8-10%, Improves texture and shining of feed with complete Mould inhibition.
- Improves growth and feed utilization efficiency.
- Helps in increasing bypass protein by 2% unit.
- Retains nutritional value and aroma of feed intact.
- Reduces aflatoxin M1 concentration in milk of dairy animals.

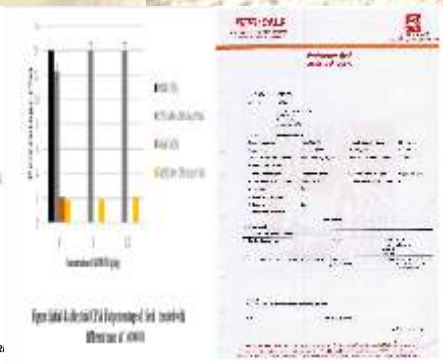
Mould Inhibitor to improve quality of FEED PELLETS

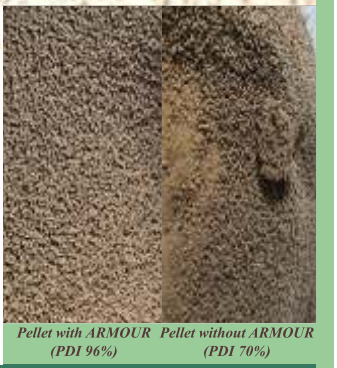
- Active Ingredients: Organocarbonyl Diamidomethylol
- Use Level: Varies depending on feed moisture content

  0.5-1 kg/ton for Feeds up to 12% moisture
  1-1.5 kg/ton for Feeds more than 12% moisture
- Packaging: 25 kilogram, tied inner polybag with sewn outer woven nylon bag.
- Storage: Store in cool and dry place.



Carbon dioxide release from feed controlled by ARi





Pellet with ARMOUR (PDI 96%) *Pellet without ARMOUR (PDI 70%)*

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Use of Remote Sensing and Geographic Information System in Animal Nutrition Research

Sarita Kaushal, Chander Datt*, Antra Gupta, Gunjan Sharma and Sumit Narayan

REMOTE SENSING

Remote sensing refers to the process of collecting information about an object, area, or phenomenon from a distance, typically using sensors and instruments mounted on aircraft, satellites, drones, or other platforms. It is based on the fact that every object on the earth surface reflects a specific wavelength characteristic of the reflecting surface and is called ''spectral signature of the object''. Remote sensing works by detecting and recording electromagnetic radiation (such as visible light, infrared, microwave, and radio waves) emitted or reflected by objects on Earth. It has numerous applications in environmental monitoring, resource management, disaster assessment, agriculture, animal feeding, urban planning etc.

Types of remote sensing

i. **Active sensor based remote sensing-** Sensors present in the satellite provides energy to the object (act as source of energy). Reflected energy/wavelength is then recorded by the sensor & the recorded data is transmitted to ground station via antenna for computer analysis.

ii. **Passive sensor based remote sensing-** It detects naturally emitted energy by the object and here, sun acts as a source of energy. Reflected energy/wavelength is then recorded by the sensor & the recorded data is transmitted to ground station via antenna for computer analysis.

GEOGRAPHIC INFORMATION SYSTEM (GIS)

A Geographic Information System (GIS) is a powerful computer-based technology used to collect, store, manage, analyze, and visualize geographic or spatial data. It creates visual representations of data and performs spatial analysis in order to make informed decisions. Digital maps are created when collected enters into the GIS system. GIS allows users to explore and interpret data, make informed decisions, and solve complex spatial problems.

Remote sensing and Geographic Information Systems (GIS) can play valuable roles in animal nutrition research by providing spatially explicit data and analytical tools to study and understand the relationships between the environment, vegetation and animal nutrition. These technologies can be applied in the following contexts:

1. **Forage quality assessment:** Remote sensing can be used to monitor vegetation health and quality, which directly affects the nutritional value of forage for grazing animals. Satellite or aerial imagery can help assess factors like plant biomass, vegetation cover, and chlorophyll content, which are indicators of forage quality.
2. **Land cover analysis:** GIS can assist in classifying and mapping land cover types, including different types of grazing lands, crop fields and natural vegetation. This information is crucial for assessing the availability and suitability of forage resources for animals.
3. **Grazing management:** Remote sensing can help monitor grazing patterns, animal foraging behavior (traveling, grazing or resting) and intensity by tracking changes in vegetation cover over time. This information can guide rotational grazing strategies to ensure that animals have access to fresh and nutritious forage.
4. **Nutrient analysis:** GIS can incorporate soil data to analyze nutrient availability and distribution across different grazing areas. Combining this with remote sensing data can provide insights into the relationship between soil nutrients, vegetation growth, and animal nutrition.
5. **Water resources:** GIS can be used to map and monitor water sources, ensuring that animals have access to clean and sufficient water, which is crucial for their nutrition and overall health.

6. **Animal movement and behavior:** GPS tracking and GIS can be employed to monitor the movement and behavior of animals in their environment. This data can help researchers understand how animals select grazing areas and interact with their surroundings, impacting their nutritional intake.
7. **Disease management:** GIS can assist in mapping disease outbreaks or areas with higher disease risk. Animals that become ill may often be treated as quickly as possible because disease animal may be at rest for long time. Remote sensing can provide information about factors that might contribute to disease prevalence, such as vegetation density and moisture.
8. **Environmental impact:** Combining remote sensing and GIS data can help assess the environmental impact of animal grazing on ecosystems, providing insights into sustainable grazing practices that support both animal nutrition and environmental conservation.
9. **Predictive modeling:** By integrating historical remote sensing data with nutritional data and other environmental variables, researchers can develop predictive models to anticipate changes in forage quality and animal nutrition in response to various environmental conditions.
10. **Data integration and visualization:** GIS provides a platform for integrating diverse datasets, such as satellite imagery, soil data, animal health records, and nutritional data. This integration enables researchers to visualize and analyze complex relationships.

Advantages

- ✓ Helps to avoid man animal conflict.
- ✓ Easy to collect automatically a greater number of more accurate location points of animal.
- ✓ Fast, convenient and accurate method as compared to other system.
- ✓ Monitoring the migratory patterns and preservation of endangered species
- ✓ Allows positions in bad weather when other approaches can be restricted.

Limitations

- ✓ GIS tools are expensive.
- ✓ Learning curve on GIS software can be long.
- ✓ It shows spatial relationships but does not provide absolute solutions.
- ✓ Integration with traditional map is difficult.

CONCLUSIONS

Awareness of the strategic and economic benefits derived from geographic information systems is rising with industry-wide adoption and innovative use of GIS applications and solutions. Remote and GIS technology offers benefits to organizations in nearly every industry and field of endeavor. Improved site selection greatly benefits all decision-makers in the early stages of development. Standardized data collection and reporting benefit geographic accounting, dramatically improving authoritative and administrative record-keeping and some forms of inventory control. Visualizations produced by RS & GIS are game-changers, powerfully impacting communications between stakeholders in ways that are enabling and facilitating positive changes all around the globe.

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Yak Rearing: Sign of Prosperity for High Altitude People

Jui Lodh[1], Rashmi Kumari[1] and D C Sen[2]

Introduction

Livestock rearing is primary occupation of the population living at high altitude. The large area of high altitude is under pasture and the land offers gentle slope while rest of the areas under steep hills which limit the scope of cultivation. At high altitude (of 2500–6000 meters above Mean Sea Level) with snow-bound areas of the mountain region, normal bovine species cannot survive. Unique hill species like yak can only thrive with harsh climatic conditions where the temperature is as low as -40°C. In some areas, sheep, goats and herdsmen's horses are also coexist with yak. Yak mainly found in the highlands of the Hindu Kush Himalayan region of India, China, Pakistan, Nepal, Afghanistan, and Bhutan. China has the largest population of yak in the world, comprising 13 million, which accounts for 93.7 % of the total world population and annually produces over 1.2 million tonnes of yak milk and 140,000 tonnes of yak milk products. As per India's 20th livestock census, in India the number of yak is approximately 57, 570. Yak is mainly present in Lay, Ladakh, Arunachal Pradesh, Sikkim, Himachal Pradesh, Uttarakhand and West Bengal. Due to versatile nature of yak, it provides milk, meat, transportation, dung for fuel, fur and hide for clothing, shelter, etc. Though the milk produced from yak is not much high and it ranges from 0.7 to 40 million tonnes annually. Milk products made from yak milk are not much economically significant but very important to the pastoral nomads living in the habitats on the Himalayan regions. Yak is an integral part of culture, religion and social life of the people of high altitude.

Yak Breed and Characteristics

Yak is considered as the “Ship” of high altitude people. The breed listed as Bos grunniens. It is also known as tartary ox, grunting ox or hairy cattle. Yak is a heavy body animal with bulky frame, sturdy legs, rounded cloven hooves and densed long fur that hangs down lower than the belly. Wild yak is dark, black to brown in colour while domestic yak is variable in colour, having patches of rusty brown or cream colour. Both the types of animals have a short neck with a pronounced hump over shoulder. The weight of males ranging from 350 to 585 kg whereas females ranging from 225 to 355 kg. Wild yaks are substantially heavier than domestic one. Milk production of yak is highly affected by the type of animal, type of feed and its availability, seasons, environmental conditions including management practices. The average milk yield of yak ranges from 1-3 kg/day while the lactation yield ranges from 100-300 kg.

Figure (1): Picture of Yak

Figure (2): Yak Milk Butter

Figure (3): Churpi from Yak Milk

Yak Milk

It is a nutrient dense product, rich in lipids, proteins, minerals, lactose, vital amino acids including many functional and bioactive substances. These provide a good nutrition to new-borns and elderly persons. Fat present in yak milk is varying from 5.8-7.9 per cent. Owing to its particular grazing habit, compared to other bovine milk fat, yak milk fat contains certain distinctive fatty acids which have been linked to potential health advantages such as anti-carcinogenic and anti-diabetic effects. The amino acid profile of yak milk is comparable with other bovine milk though the protein content is high in yak milk. Generally, milk obtained from yak is used by the herders and their families as a source of milk or for conversion it into different products. Little amount, if remains after household utilization, is sold in the market. Yak milk caseins are also considered as a good source of antihypertensive peptides and a typical dietary protein which are already applied in various value-added functional formulations. Several probiotic strains have also been identified in yak milk and its products which have many health benefits. Most of the people in the world are not well aware regarding the nutritional and physiological merits of yak milk.

Yak Milk Products

Usually, yak milk is not directly consumed. Herders of Himalayan regions have been using yak milk for centuries to make churpi (soft or hard variety), ghee, butter (mar), and other fermented products like yoghurt, alcoholic beverages, etc. By tradition methods these can be stored for a long period under the prevailing climatic conditions. These products have essential nutrients for people who live in high altitude and face harsh winter. Fermented products made from yak milk provide several vitamins and minerals which are helpful for preventing chronic diseases and nutrient deficiencies. On selling these products, the farmer can earn revenue for their livelihood. The brief description of these products are given below:

Butter and Ghee: These two are the most important products obtained from yak milk. For all the yak breeding communities, butter is one of the main sources of income. Butter is used as currency by yak herders to buy or fulfil their daily needs. Raw butter is utilized for making salted tea and Zanba. It is a staple food of tibetan people. For making zanba, a little ghee, bolied water and some roasted flour are mixed in a bowl and kneaded manually to a doughy consistency. After this, the dough is made into ready-to-eat balls which are consumed along with butter or tea. The cost of yak butter is approximately Rs. 750 to 900 per kg. This butter is used for conversion into ghee which is sold at a premium price ranges from Rs. 1660 to 2300 per kg.

Churpi: It is considered as the hardest cheese in the world. It is traditional fermented cheese type product prepared from skim or whole yak milk by pastoralists in the highlands of the Eastern Himalayas. It is rich in protein, with smoky flavour and hard texture that gradually becomes chewy during storage. This traditional fermented milk product is wet in nature and usually not eaten as such. Churpi is consumed by converting it into chutney or added into vegetable preparations as a substitute for vegetables in the vegetation-starved cold and hilly mountainous regions. For making churpi, yak milk is heated to 50-60˚C followed by mixing with curdled or sour milk for fermentation. After this, the sour milk mixer is filtered through muslin cloth. The obtained curd mass is dried and cut into small pieces. Now-a-days, the cost of 1 kg churpi ranges from Rs. 750-1000. Churpi, prepared from the milk of Arunachal yak specially found in West Kameng and Tawang districts, is unique in nature and has been given recognition as a Geographical Indication (GI) of Arunachal Pradesh. It is an excellent source of protein with health beneficial bioactive components which provide benefits to the tribal herders against cold and hypoxia during harsh winter. Churpi mixed in vegetable or meat curry and eaten with rice, are considered as a staple food in tribal households. ICAR-National Research Centre on Yak, Dirang, Arunachal Pradesh is working with Brokpas, rearing Arunachal yaks and helping them through research and extension for yak conservation and yak pastoralists' socio-economic development.

Khoya and Toffee: Tribal yak herders usually boil the whole yak milk to dehydrate completely. After solidifying, it is cut it into small piece of a toffee. The toffee made from yak milk has hard body and chewy texture. Sometimes, they made khoya from yak milk by gradual removal of moisture on applying heat.

Churkam is a hard type candy. It is relished by the yak rearing community. It is made of yak milk from which paneer is prepared by using local method but with high pressure for pressing the coagulum. The hard paneer obtained, is cut into small pieces. The whey collected during paneer making, is heated separately and concentrated. The paneer cubes are added into the concentrated whey with continuous heating to get a concentrated mass and the cubes are coated with concentrated whey. These are taken out and placed on a tray covered with parchment paper and dried at 45°C for 16 hrs to get a completely hard mass.

Sour Milk: It is the most liked traditional dish made from yak milk. It is a butter milk like product made from yak milk but more viscous and sour than the butter milk made from cow or buffalo milk. Here, milk is boiled and then cooled to about 50˚C. Very little amount of sour milk is added into the milk. It is stored in a warm place at about 40˚C. After 5-6 hours, the whole mixture becomes sour and develops a typical flavour and taste.

Whey: This is obtained as a byproduct after churning of butter or during making of churpi. Tribal herders soak barley in whey and allow it to ferment for making the local alcoholic beverage.

Serkam: This is a tribal delicacy prepared by boiling the buttermilk or whey. After boiling, the liquid portion is drained off and the coagulum thus obtained is known as serkam. It is consumed as fresh or can be used after keeping for certain periods, ranging between days to months.

Milk Skin: It is like malai obtained from yak milk. It is expected to be firm and thick due to high fat and casein contents. It is a delicacy prepared in yak grazing areas of China, especially for muslim communities for direct consumption.

Other Value Added Yak Milk Products

Many other yak milk products are prepared locally. Some of the common products are Orom (the creamy layer of yak milk obtained by slow cooling of heated milk), Sartos (butter like product), Tarag (fermented yak milk), Arts and Eden (coagulated milk and cheese), Arkhi (fermented alcoholic beverage), etc.

Yak Meat: Yaks are used as source of meat for human consumption. For meat production, animals are selected at any stages of growth preferably at 2-4 years of age. For sacrifice, the weight of males and female are in the range of 300-500 kg and 200-350 kg, respectively. Usually, the dressing percentage ranges from 45-55%. Potassium, calcium, iron, zinc, and magnesium contents are relatively high in yak meat. The meat is also rich in amino acid and unsaturated fatty acid contents but low in saturated fatty acid contents which made the yak meat beneficial to human health.

Fur/Hair Production: The long hair of yak are plucked at the end of winter. The coat hair of yak may be of white, black, brown, grey, red, tanny colour or with several combinations. The finer coat hair is used for weaving rough fabrics and rugs while the rough hair is used for making of rope, tent, felt, etc.

Conclusion

Since ages, yak has been serving as a source of livelihood and financial security to a large section of the poor of high altitude regions. Under such chilly, harsh climatic conditions, yak has tremendous potential as the "Future Animal" of these regions. Yak milk is a nutrient rich food with multiple functional ingredients. As a unique food of high altitude, yak milk provides many health beneficial effects. Yak milk is used for preparation of various products like butter, ghee, milk skin, churpi, etc. Among these, churpi has obtained the GI tag in Arunachal Pradesh and has become very popular now. Yak milk and its products have lots of potentials for entrepreneurship development in the high altitude regions. It is also used for the production of meat and wool. These will boost the economy of the poor yak rearers and will help to improve their income from yak farming. In view of these, various governmental organizations, private players and NGOs can play a pivotal role to popularize the rearing of yak, its milk and products among the high altitude dwellers.

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Pixie Expomedia with Infinity Expo
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International Feed Industry Federation
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27-29 16th POULTRY INDIA 2024

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