Livestock & Feed Trends

VOLUME - 17 • NUMBER - 3 • OCT. - DEC. 2019

Enhancing Visibility – CLFMA participation @ PDFA Expo 2019 & Poultry India 2019

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के लिए सहायता करता है.

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3 रे सप्ताह से 6 महीने की उम्र तक

- निरंतर विकास
- सेहत

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काफ ग्रोअर

6 महिनों से गर्भधारणा तक

- निरंतर विकास
- सेहत
- प्रजनन अंगों का विकास

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- भ्रूण का विकास
- थनों का विकास
- प्रसव के बाद दूध के उत्पादन में सुधार

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दूध देने वाले गाय भैंसो के लिए (लॅक्टेशन पिरीयड)

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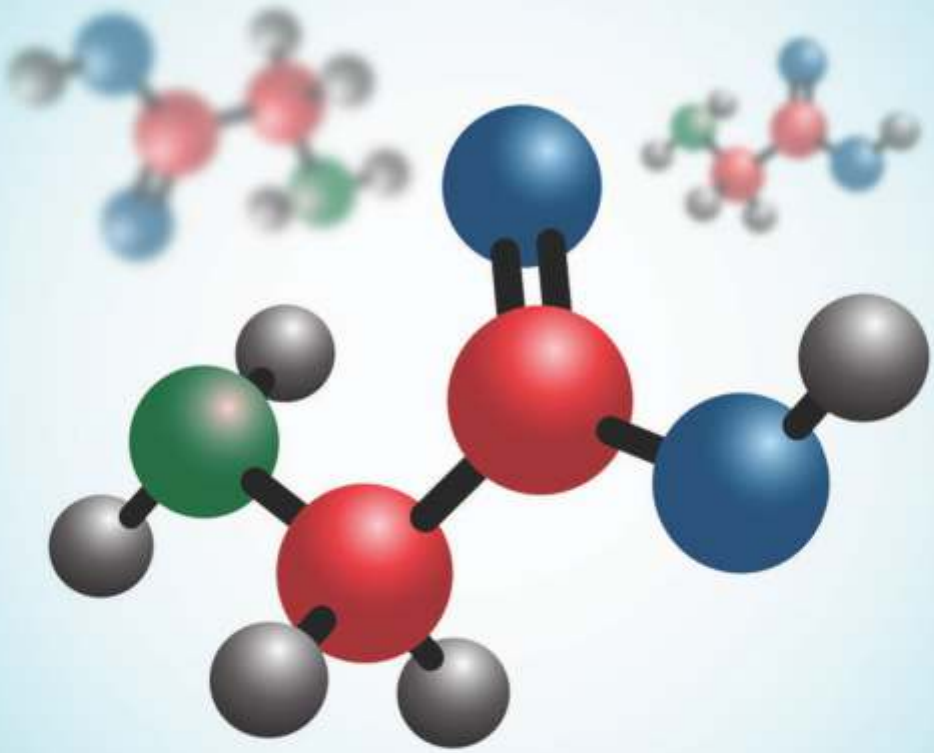

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From the Chairman's Desk.....

Dear Friends,

Greetings!

CLFMA had a fantastic year ending quarter with full of Activities, Events, Meetings with Government of India. It was quite an eventful quarter.

Since our industry is heavily dependent upon the agro-commodity sector such as maize and grains, in this issue, we have covered in-depth analysis of the maize and soybean crops under the section "Commodity Updates".

Further to CLFMA Representation of "Release of Wheat and Rice Stocks for Livestock Feed Industry", Joint Secretary (NLM), Shri. O. P. Chaudhary asked for clarification regarding the same from CLFMA Office. After getting the same clarified from CLFMA, the representation as well as clarification is pending at PMO Office for further action.

With regard to DDGS Imports of Corn and Soya and as per the discussion with various stakeholders regarding this issue, we understand that, both Ministry of Agriculture and Animal Husbandry Department has conveyed the same positively to the PMO Office and is pending with PMO office for further action.

On 10th October, 2019, CLFMA Executive Director Ms. Chandrika Venkatesh attended FSSAI Meeting on "Establishing Feed Regulations & Standards". In-Pursuant of this meeting, CLFMA had attended few more meetings and had discussions with FSSAI and got the update that the feed quality standards shall be developed by BIS and would be regulated by FSSAI and FSSAI will be monitoring mainly the mycotoxin and antibiotics levels in feed.

CLFMA's Executive Director participated in World Egg Day on 11th October, 2019 for enhancing brand visibility.

On 15th October, 2019 Mr. Suresh Deora – President-West Zone, CLFMA, had attended a meeting under the Chairmanship of Dr. Shri. O. P. Chaudhary, Joint Secretary (NLM) and with all the NER Secretaries / Principal Secretaries – Animal Husbandry and Veterinary Sciences or their representatives to discuss about establishing a centralized cattle feed mill for entire North Eastern Region.

Poultry Industry Meeting was held on 15th November, 2019 on the subject of retaining the present duty of 100% on Import of Chicken Legs from USA & Brazil as against the proposed import duty of 30% on chicken leg imports". From CLFMA, the meeting was attended by Mr. Prashant Vatkar, CEO of Godrej Tyson Food Ltd. and CLFMA MC Member

CLFMA OF INDIA participated in 13th Edition of Poultry India 2019 and had its stall from 26th November to 29th November, 2019.

Progressive Dairy Farmers Association successfully organized 14th PDFA International Dairy and Agri Expo 2019, which was held on 7-9th Dec, 2019 at Punjab, I have attended the same, as a Panelist of the "PDFA Dairy Industry Outlook - 2020".

CLFMA participated in INDO DANISH SEMINAR organized by Danish Veterinary and Food Administration in collaboration with FSSAI on 11-12th December 2019 and Dr.Anup Kalra, CLFMA Member attended the seminar.

19th Meeting of Animal Husbandry, Feeds and Equipment Sectional Committee, FAD 5 was held at BIS Office, which was attended by 40-45 people (mainly from Govt institutions) on 13th December 2019. The Meeting was attended by Dr. Devender Hooda -CLFMA President- North Zone.

Further, under CLFMA updates, we have presented the highlights of CLFMA efforts on various issues in detail.

In this issue, you will find some very interesting research articles, which would enhance your knowledge on Livestock Sector.

CLFMA continues to participate in all high-level discussions with zeal and discuss about industry's concerns and expectations.

Also, we would be grateful for your feedback or inputs anytime for our improvement.

Wish you a very Happy and Prosperous New Year 2020!

With warm regards,

For CLFMA OF INDIA,

S. V. Bhave
Chairman

CONTENTS

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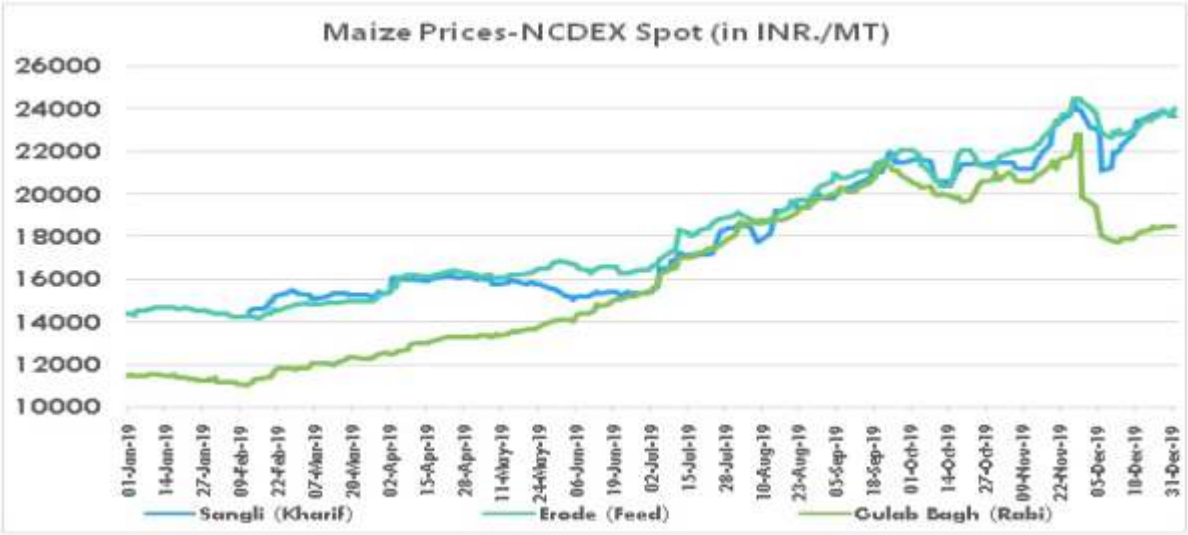
Commodity Updates

Index

Domestic Prices in INR/Qtl:
Maize NCDEX Spot Price (in INR/Qtl.):

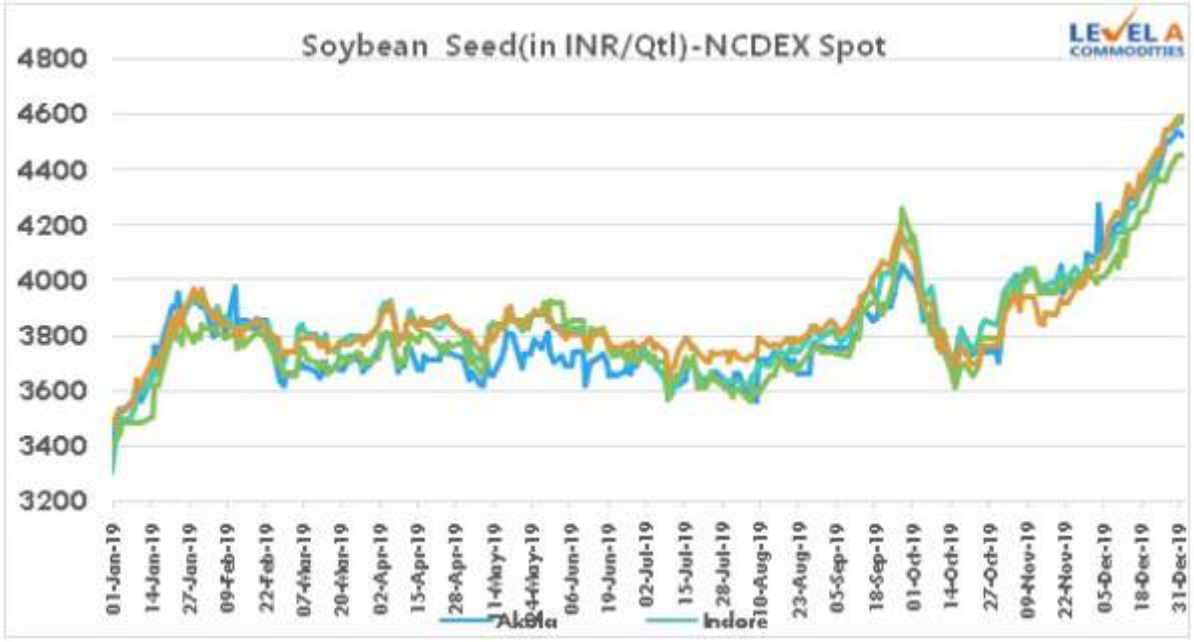
Location	31-12-2019	29-11-2019
Gulab Bagh	24700	21830
Sangli	20040	18720
Erode	20970	19330



Soybean:
Soybean Complex Prices-NCDEX Spot:

Commodity (Unit)	Location	31-12-2019	29-11-2019
Degummed Soy oil (in INR/10kg)	Kandla	-	-
Ref Soya Oil (in INR/10kg)	Indore	928	811
	Mumbai	928	801
	Nagpur	958	814
Soymeal (in INR/MT)	Indore	37,588	33,500
Soybean Seed(in INR/Qtl)	Akola	4,534	4,095
	Indore	4,568	4,057
	Kota	4,453	4,040
	Nagpur	4,585	4,022

Soybean Seed



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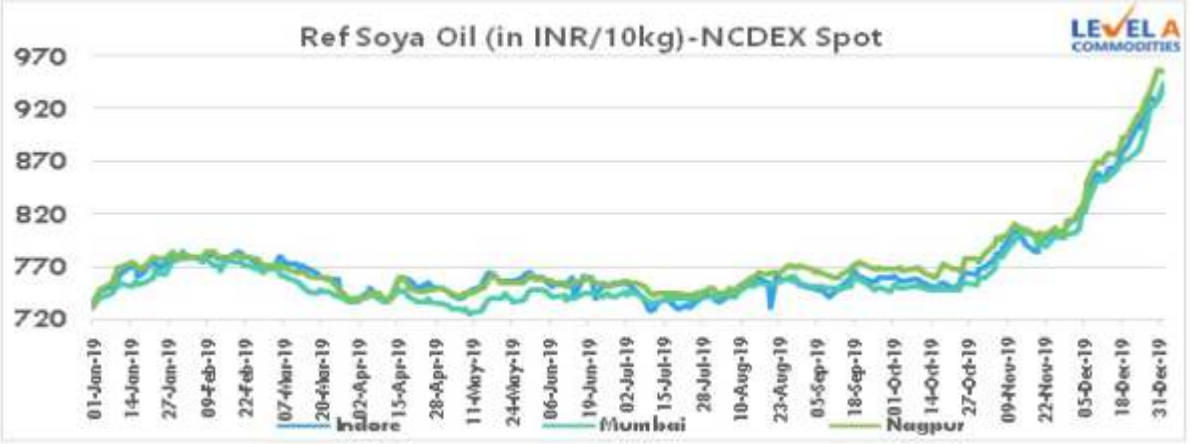
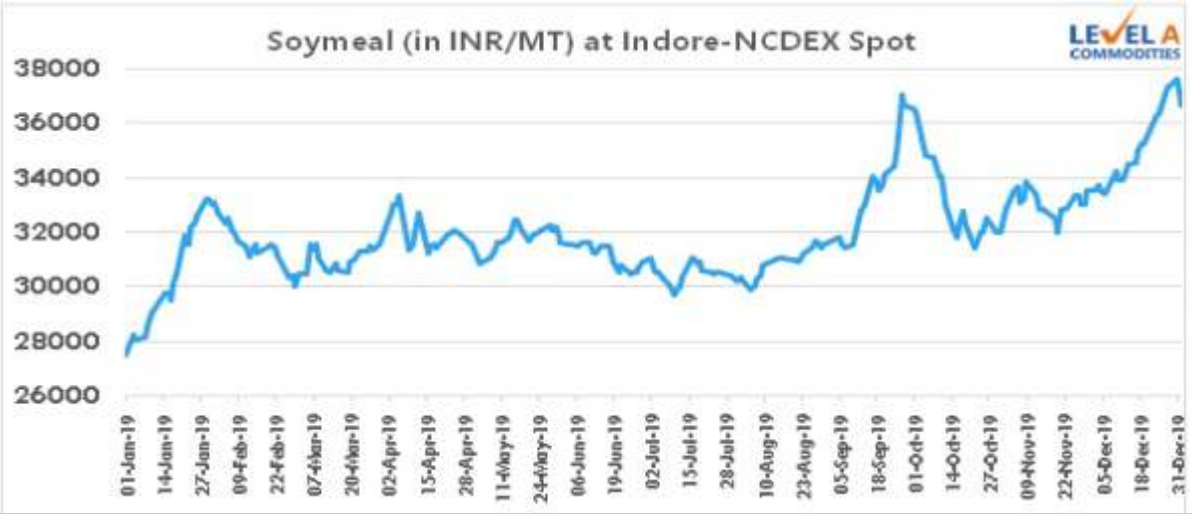


Soymeal Prices-NCDEX Spot:



Egg Prices

Egg Rates

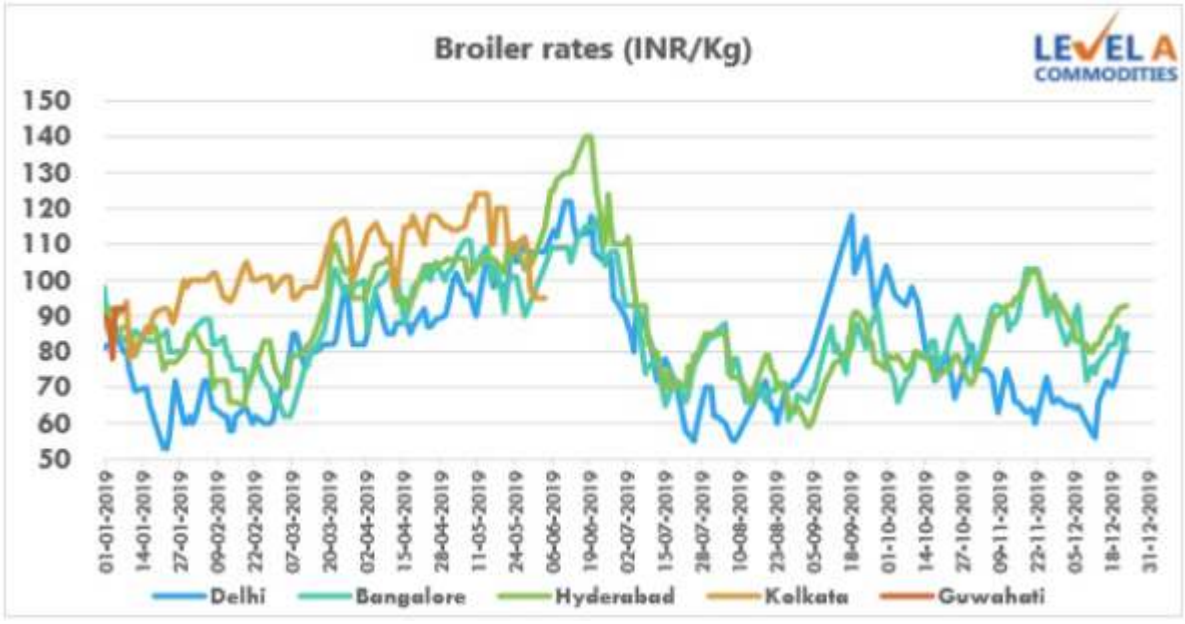
NECC Prices

Market	31-12-2019	29-11-2019
Ahmedabad	510	482
Ajmer	489	463
Asansole	519	-
Barwala	486	-
Banglore (CC)	481	463
Brahmapur (OD)	480	-
Banglore (CC)	520	-
Chennai (CC)	495	473
Chittoor	488	466
Delhi (CC)	510	485
E.Godavari	470	455
Hyderabad	462	441
Ludhiana	486	-
Midnapur (KOL)	520	-
Miraj	-	-
Mumbai (CC)	515	494
Muzaffarpur (CC)	538	-
Mysore	485	467
Nagpur	470	460
Namakkal	448	430
Patna	543	-
Pune	515	495
Ranchi(CC)	545	-
Vijayawada	470	455
Vizag	485	455
West Godavari	470	455
Warangal	463	442

Prevailing Prices

Market	31-12-2019	29-11-2019
Allahabad (CC)	524	488
Bhopal	495	475
Hospet	446	428
Indore(CC)	480	-
Jabalpur	491	477
Kanpur (CC)	519	486
Kolkata (CC)	508	493
Lucknow (CC)	540	510
Raipur	501	490
Surat	520	-
Varanasi (CC)	537	517

Broiler Rates



Broiler rates (INR/Kg)		
Market	**31-12-2019**	**29-11-2019**
Delhi	-	67
Punjab	72	60
Raipur	88	78
Pune	80	83
Bangalore	95	89
Hyderabad	100	94
Gujarat	80	75
Kolkata	-	-
Lucknow	81	72
Guwahati	-	-

Chicks Price (INR/Unit)		
Market	**31-12-2019**	**29-11-2019**
Punjab	16	19
Chandigarh	16	19
Haryana	18	19
Himachal Pradesh	19	20
Rajasthan	19	20
Jammu & Kashmir	19	20
Uttarakhand	16	21
Uttar Pradesh	16	27
Madhya Pradesh	16	27
Chhattisgarh	16	27
Bihar	18	27
Jharkhand	18	28

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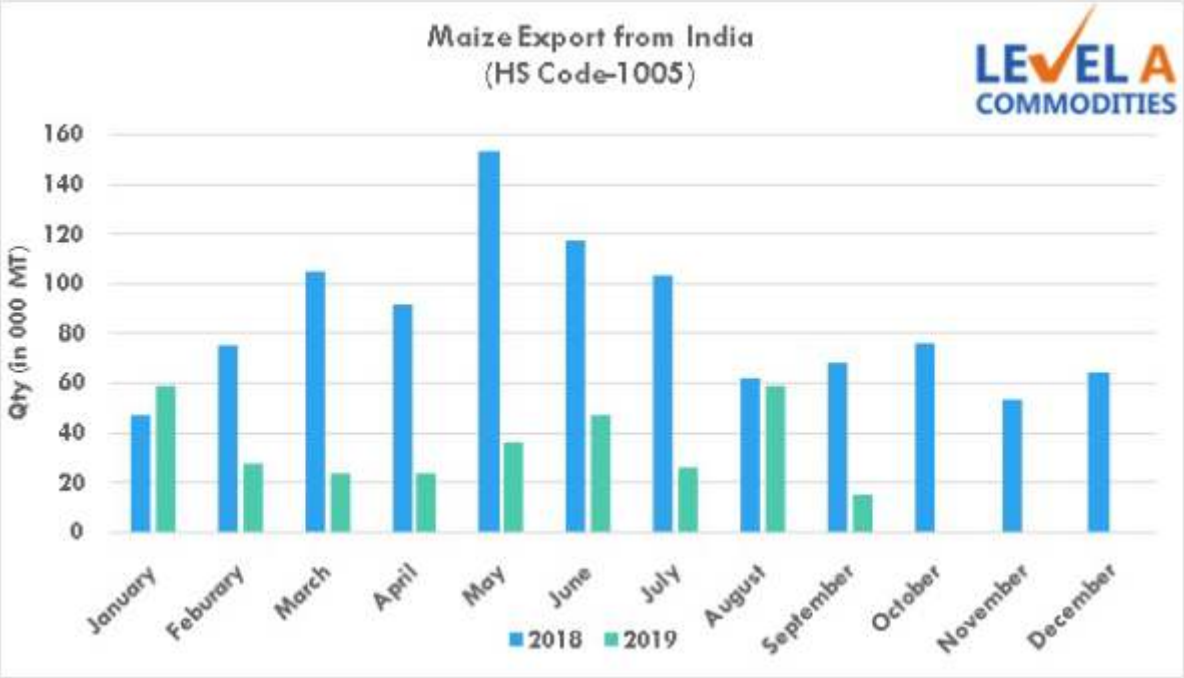
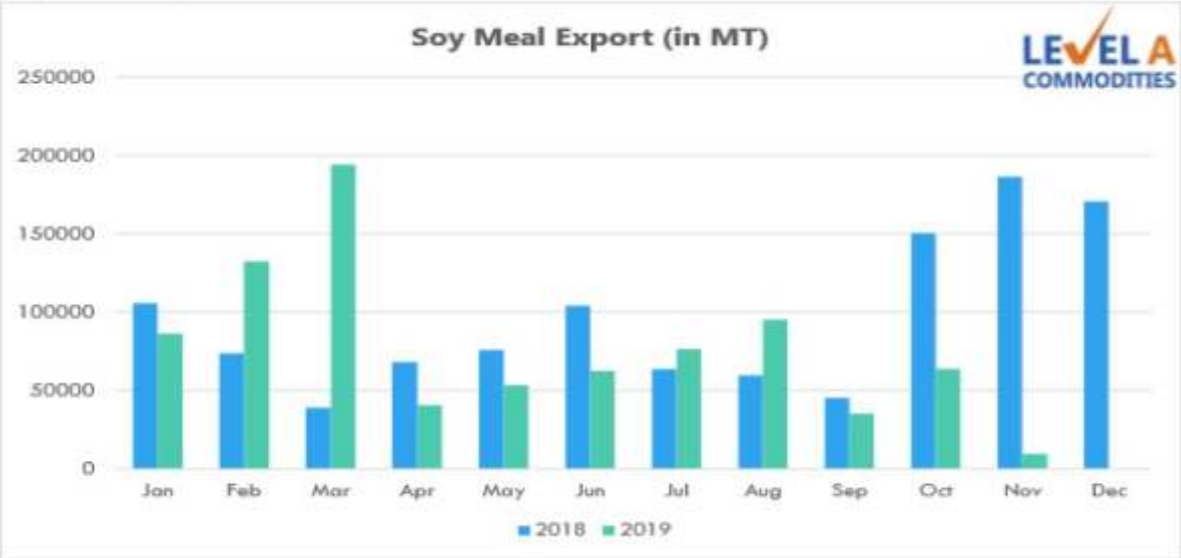
Trade Details

Maize export from India



Maize import to India

Soy Meal Export from India(In MT)



Market Updates

Maize Domestic

Traders to import 50,000 tn maize under advance licence scheme

A consortium of starch manufacturers and poultry feed producers will import around 50,000 tn maize under the advance authorisation scheme licence as imports are still more attractive compared with high spot prices, trade sources said. The consignment of 50,000 tn Ukranian non-genetically modified maize, bought at $198 per tn, cost and freight, may arrive next week, sources said. The consignment has been bought duty-free under the advance authorisation scheme that permits duty-free imports, provided the processed product is exported within a stipulated time frame. Import of maize, otherwise, attracts 60% customs duty.Maize imports are attractive as spot prices are still higher on year as bulk buyers see the crop to be smaller than what the government has estimated.

"An appreciation of the Indian currency against the dollar has also made imports cheaper. That is also attracting traders to import maize," said an official with multinational trade firm.Traders anticipate prices may rise further as maize production in 2019-20 (Jul-Jun) kharif season is seen sharply lower on year. Industry experts have pegged the 2019-20 kharif maize output at 16.1 mln tn, against the government's estimate of 19.9 mln tn. For the 2018-19 season, traders expect the output to be at 17.0-18.0 mln tn against the government's estimate of 27.2 mln tn.Spot maize prices are sharply higher on year at 2,000-2,050 rupees per 100 kg, while the delivered price for poultry and starch units has reached 2,200 rupees per 100 kg in parts of Maharashtra and Karnataka. The government has also permitted import of 500,000 tn of the coarse grain in 2019-20 (Apr-Mar) under the tariff rate quota at a concessional duty of 15%. The National Agricultural Cooperative Marketing Federation of India Ltd so far has only imported 150,000 tn. It is permitted to import up to 250,000 tn more maize. State-owned MMTC Ltd also can import up to 250,000 tn maize this financial year.

Fall armyworm attack on 2019-20 kharif maize 40% more vs last year

Fall armyworm has infested 700,000 ha under maize crop in 2019-20 (Jul-Jun) kharif season, 40% more than the affected area of around 500,000 ha last year, an official with Indian Council of Agricultural Research said."Attack of fall armyworm is deterring farmers to grow maize this rabi. Around 9-10% of total area under rabi crop was found infested with the pest," the official said. Of 8.1 mln ha, kharif maize crop standing across 700,000 ha area has been damaged.Attack by the pests was reported in 14 states in kharif with major damage in Karnataka and Maharashtra. Infestation of fall armyworm kharif maize crop was reported across 263,000 ha in Karnataka and 232,000 ha in Maharashtra, the official said.

Farmers in the country have sown rabi maize across 788,300 ha as of Dec 5, down 10% on year, according to farm ministry data. The acreage is down mostly in south India as farmers in Andhra Pradesh, Karnataka, Telangana, and Tamil Nadu have moved to other crops fearing infestation of fall armyworm in maize crop.Currently, maize farmers are seen shifting to wheat and it is evident in higher area under the latter, he said.Farmers across the country had planted wheat across 20.3 mln ha as of Thursday, up more than 4% on year, according to the farm ministry data.The fall in acreage in both kharif and rabi crops would hit overall production and also fuel prices of the coarse cereal, the official said.

Maize crop in 2019-20 kharif was pegged at 19.9 mln tn, up from 19.0 mln tn a year ago, according to the first advance estimate by the farm ministry.The ministry may lower the projection in the second advance estimate, he said.The pest, responsible for widespread food shortages in sub-Saharan Africa last year, was identified by scientists in Karnataka's Chikkaballapur district in July. In Chikkaballapur, pest infestation was found on 70% of the maize crop, before it quickly spread to other areas.The pest can hide within growing leaves, making early detection difficult. It is also resistant to many insecticides and has very few natural predators, making infestation tough to control.Originally found in North and South America, fall armyworm made its way to Nigeria in 2016. Within two years, it had spread to 44 countries in Africa, damaging up to 40 mln tn of maize.

NAFED gets 7 bids in tenders to import maize at Tuticorin, Mangalore

The National Agricultural Cooperative Marketing Federation of India Ltd received three bids for its tender to import 50,000 tn of maize at Tuticorin port and four bids for its tender to import 50,000 tn of the grain at Mangalore port. Sierentz Global Merchants was the lowest bidder at $231.9 per tn for the tender at Tuticorin port. Hakan Agro emerged as the lowest bidder at $226.6 per tn for the tender at Mangalore port. NAFED postponed the last date of bidding to from Tuesday as the government agency did not receive any bid for its tender to import maize at Tuticorin port.The delivery is expected between Jan 10 and Jan 31, according to the tenders, and the bids have to remain valid on Dec 24.

Maize imports are necessary now as domestic end-users have been urging the government to allow maize imports due to a smaller crop in 2018-19 (Jul-Jun) and the kharif season of the current year. The government has pegged 2018-19 maize output at 27.2 mln tn compared with 28.8 mln tn in 2017-18, while industry players had pegged the output at 15.1 mln tn.For 2019-20 kharif season, poultry feed and starch manufacturers, the key industrial users of maize, peg maize output at 16.1 mln tn, lower than the government's estimate of 19.9 mln tn.

On Jul 9, the Directorate General of Foreign Trade had allowed import of 400,000 tn of maize under the tariff rate quota at a reduced import duty of 15%. The government had said that applications for imports had to be submitted to state trading enterprises, according to an earlier trade notice. MMTC Ltd and National Agricultural Cooperative Marketing Federation of India were allocated an import quota of 200,000 tn each for maize during the current financial year. Due to the estimated decline in output, maize prices had surged and hit a record high of 2,450 rupees per 100 kg in July. Market players anticipate a jump in prices once the current kharif arrivals dry up. Currently, maize is sold at 1,860-1,880 rupees per 100 kg at Nizamabad, largely unchanged on year.

Maize International

WASDE:

This month's 2019/20 U.S. corn supply and use outlook is unchanged from last month. The projected season-average farm price is unchanged at $3.85 per bushel.Global coarse grain production for 2019/20 is forecast 6.8 million tons higher to 1,401.7 million. The 2019/20 foreign coarse grain outlook is for larger production, increased consumption, and higher stocks relative to last month. Foreign corn production is forecast higher with increases for China and Bolivia more than offsetting a reduction for Canada.

China's corn production is raised, reflecting increases to both area and yield, based on the latest data from the National Bureau of Statistics. Canada's corn production is lowered, as an increase in harvested area is more than offset by a reduction in yield. Corn exports are lowered for Canada, Laos, and Mexico. Foreign corn ending stocks are raised from last month, largely reflecting increases for China, Bolivia, and Taiwan that more than offset declines for Canada, Colombia, and Paraguay. Global corn stocks, at 300.6 million tons, are up 4.6 million from last month.

Canada Outlook:

For 2019-20 , corn production in Canada decreased by 3% from 2018-19 to13.4 Mt largely due to lower average yields, despite an increase in harvested area. Production in Canada's two leading corn producing provinces, Ontario (ON) and Quebec, decreased by 1% and 7%, respectively. Total production in Western Canada declined by 5% compared to last year and dropped by 23% for Atlantic Canada. The harvest rate in Eastern Canada was slightly higher than last year, while it was much lower in Western Canada. The average provincial yield fell for each province compared to last year.

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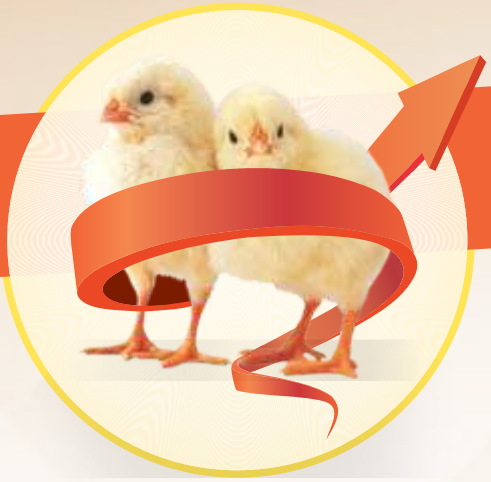

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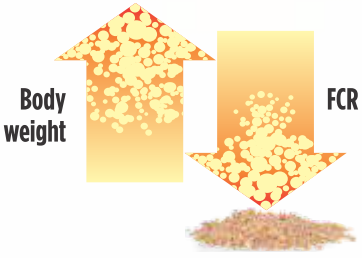

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The total supply of corn decreased by 9% from 2018-19, as a result of lower carry-in stocks, production and imports. Corn imports for 2019-20 into Western Canada are expected to fall sharply, because of the significant increase in barley production in Western Canada where barley is the major feed grain. However, in Eastern Canada, where corn is the major feed grain, corn imports are expected to increase due to lower corn production. Domestic use is expected to decrease from 2018-19 due to reduced food and industrial use, as well as lower feed use. Exports are expected to decrease due to lower supply and the reduced export pace to-date. Carry-out stocks are forecast to decline mainly due to smaller supplies.

The average price of corn for 2019-20 is expected to be higher than last year due the expected increase in the US corn price and a significant decline in domestic corn supply.

US corn production for 2019-20 decreased by 5% from 2018-19 largely due to a decline in yields. The average farmgate price for corn in the US is forecast to increase to US$3.85/bu from US$3.61/bu last year. Corn production in the other major world exporters, including Brazil, Argentina, Russia and Ukraine, remained ample, which will put pressure on corn prices.

Soy meal Domestic

SOPA developing industry norms for sustainable soya

Apex industry body — Soyabean Processors' Association of India (SOPA), along with the Indian Institute of Soyabean Research and Solidaridad, is developing Indian Standards for Sustainable Soya. These standards would provide India's own sustainability benchmark for sustainable soya production and trade. The standards incorporate practices and measures for sustainable production practices, long-term economic viability, environmental and social responsibility.

Stakeholders representing the government, research institutions, businesses, industry and farmers met recently to discuss the draft standards.India has acquired fourth place in area coverage and fifth in production of soya globally. However, the average productivity hovers around 1 tonne per hectare since last few decades, SOPA chairman Davish Jain said. "Bridging the yield gap through sustainable crop production practices will enhance domestic availability of edible oils through higher production of soya and enhance the livelihood of farmers. Therefore, the development of "Indian Standards for Sustainable Soya" would enhance the competitiveness of Indian soya industry in global markets," he said.

"Our efforts towards improving the productivity and sustainability in the supply chain through the Indian Standards for Sustainable soya, would really help in a big way in achieving the goal of inclusive growth and sustainability in the sector. Improving the productivity in mission mode with the target of achieving 2 tonne per hectare would be a game changer in the soy sector," Jain said.

"Indian Standards for Sustainable Soya can be instrumental in transforming the domestic soya sector. The development and implementation of such national sustainability standards for soya, would provide potential opportunity to contribute towards national priorities and commitments while facilitating joint action towards addressing the real issues of productivity enhancement, small holders' livelihood security and related sustainability challenges", said DN Pathak, executive director, SOPA.Transfer of appropriate technologies and sustainable practices with the objectives of increasing soya productivity and improving farm profitability would enhance the income and livelihood of farmers. This would also safeguard the environment and help industries in the marketplace to find qualitative and sustainable supplies" said Girish Matlani, secretary, Sopa.

Soy prices may hit record high on crop woes

Prices of soybean, which are already hovering around 4,200 rupees per 100 kg, may hit an all-time high of 4,900 rupees within a month due to fall in supply and rally in global prices of palm oil.On Tuesday, the January contract of the oilseed hit a fresh three-year high of 4,228 rupees per 100 kg on NCDEX. In Indore, a key market, prices are hovering at 4,150-4,200 rupees per 100 kg, way above the minimum support price of 3,710 rupees, traders said. Prices had hit 4,818 rupees per 100 kg in May 2014."Soybean may hit 4,900 rupees in a month bolstered by lower production," industry expert and GGN Research Managing Partner Govindbhai Patel said, adding that a likely uptick globally would also push up the prices.Soybean is a crucial kharif oilseed that accounts for over 30% of total Indian oilseed basket.

"Concerns that soybean crop may be lower than what the government and trade bodies estimated would also support the prices," Kohinoor Feed and Food Ltd Managing Director A.J. Panjwani said.According to the farm ministry data, domestic output of the oilseed is pegged at 13.4 mln tn in 2019-20 (Jul-Jun), down from 13.7 mln tn last year. The Soybean Processors Association of India has estimated the crop at 8.9 mln tn this year, down 18% from 2018-19.Heavy rains in major growing regions of leading producer states--Madhya Pradesh, Maharashtra, and Rajasthan--have taken a toll on the crop this year, a scientist with Indian Council of Agricultural Research said.Currently, daily average arrivals of soybean across the country are 400,000-500,000 bags (1 bag = 100 kg), nearly half of what was seen previous year, Indore Traders Association President N.K. Aggarwal said.

"Looking at the sharp fall in arrivals of the fresh crop, traders are now anticipating soybean crop at 8.0-8.2 mln tn. It is way lower than SOPA's estimate," said an official with a China-based edible oil firm."Improved buying of soyoil would also buoy the oilseed's prices in the coming days," said an official with a fast-moving consumer goods company. Refined soyoil hit an all-time high of 860.60 rupees per 10 kg on Monday. Bullish sentiment for

crude palm oil on Bursa Malaysia Derivatives has also lent support to the entire edible oil basket, including soybean, in the domestic market, Intellitrade and Monetary Services analyst Suresh Mantri said.The price of crude palm oil on the Malaysian bourse has rallied to a near three-year high of 2,929 ringgits (49,845 rupees) a tn on fears of a sharp fall in supply amid robust demand for biodiesel blending in the southeast Asian countries, Mantri said.Prices of palm oil and soyoil, a derivative of soybean, typically take cues from each other. They are used as cooking oils, as well as in blending with crude oil to manufacture biofuels. A likely decline in edible oil imports in the coming days is expected to lift soyoil prices further in the domestic market, traders said.The domestic output of soybean usually fails to meet soyoil demand in India, which leads to higher imports.

During 2018-19 (Nov-Oct), imports of crude soyoil rose 1.5% to 3.1 mln tn, the Solvent Extractors' Association of India said.A slew of government measures to reduce the edible oil import bill of around 750 bln rupees annually have also pushed up the domestic prices of such oils. India is the world's largest buyer, and it imports 15 mln tn of edible oil annually.The Centre is mulling imposition of quantitative restriction on imports of refined edible oil, primarily refined palm oil, by removing it from the free category.The government may allow import of refined edible oils in 5-kg consumer packs, which would make the imports costlier and uncompetitive for Indian buyers, Solvent Extractors' Association President B.V. Mehta had said earlier. A likely strength in key contracts of the oilseed on the Chicago Board of Trade may also stoke bullish sentiment on NCDEX, analysts said.

Soybean prices in the Indian market take cues from the Chicago bourse as the US is the world's leading producer of soybean.Hopes that China may waive import tariff on imports of US soybean may buoy its prices on the Chicago bourse. Over a year ago, China, the largest importer, had slapped a 25% import tariff on the oilseed from the US, a Mumbai-based analyst said.Some traders, however, believe that uncompetitive export prices of Indian soymeal may limit soybean prices to 4,500-4,600 rupees per 100 kg. During Oct-Nov, soymeal exports plunged over 75% to 113,000 tn as price of the Indian oilseed turned unattractive in the world markets, according to Soybean Processors' Association of India data.

MahaFPC to procure 10,000 tn soyabean at farm gate level

After a successful pilot last season, Maharashtra Federation of Farmer Producer Companies (MahaFPC) — the apex body of farmer producer companies in the state — has commenced soyabean procurement at farm gate level for the new season. MahaFPC has procured 1,000 tonne so far and has targeted procurement of 10,000 tonne in the state, said Yogesh Thorat, MD, MahaFPC.Soyabean is currently trading at around Rs. 4,100 per tonne. The government has fixed soyabean MSP at Rs. 3,410 per quintal for 2019-20 as compared to Rs. 3,399 per quintal last season. MahaFPC has been promoting itself as a business facilitator between corporates and farmers and receives a service charge of Rs. 50-60 per tonne from corporates.

Last year, MahaFPC had procured around 678 tonne as a pilot and after seeing the response from corporates it has decided to go into this business on a commercial scale, he said.The country's leading soyabean trade body, Indore-based Soybean Processors Association (Sopa), has forecast India's total soyabean output at 89.8 lakh tonne for the 2019-20 season, as against 110 lakh tonne for the previous year.Soyabean is a leading kharif oilseed crop, which sets the benchmark for edible oil availability for India. In major mandis of Madhya Pradesh, prices ruled between Rs. 4,000-4,100 a quintal, while in Maharashtra it was in the range of Rs. 3,900-4,100 a quintal earlier this month.Floods in key producing regions resulted in major damage to standing kharif soyabean crop.Thorat said it will explore forward market linkages to trade in soyabean. MahaFPC is a federation of around 60 farmer producer companies. According to him, MahaFPC has been registered as a vendor with solvent extraction plants and is a business enabler by facilitating the purchase orders, assuring a delivery mechanism and the payments are received into the bank account of MahaFPC since the apex body is registered as a vendor with the corporate. We are not charging the farmers but only taking a service charge from corporates, Thorat said. The FPC assures delivery within 7 days in addition to a payment mechanism in days, he added.

Last season, solvent extraction plant ADM Latur had responded positively to FPCs and has made various interventions in their procurement model so as to ease the business of FPCs. MahaFPC has set up 15 points for collection and aggregation of soyabean this season at Latur, Beed and Osmananbad. The FPC plans to purchase around 8,000 quintal from Latur, a major soyabean producing region.Last season, six FPCs from Latur started procurement centres for soyabean. These FPCs were collecting the commodity from their member farmers and supplying it to ADM as per its quality standards formula of 10:2:2 (10% moisture, 2% broken grains, 2% foreign matter).Thorat said that price discovery is done on a daily basis based on the reference of mandis and rates are circulated to FPCs. If FPCs agree to the rate then contracts are signed and commodity is delivered within seven days. FPCs receive the payment three days after the delivery of the commodity. Farmers are getting money through this process, he said.Since the spot market rates are same as market rates, this time, MahaFPC is not tapping derivatives markets. Thorat said that FPCs are now in direct competition with traders in APMC since they are also suppliers to solvent extraction plants.This model of procurement is developing alternate marketing system for the farmers, he added.As a result of the various initiatives taken by NCDEX, farmer groups are futures contracts to hedge against price dips during the harvest season and are getting better realisations.

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Soy meal International

WASDE:

Total U.S. oilseed production for 2019/20 is forecast at 107.6 million tons, down slightly due to a decrease for cottonseed. Soybean supply and use projections for2019/20 are unchanged from last month. The U.S. season-average soybean price for 2019/20 is forecast at $8.85 per bushel, down 15 cents. The soybean meal price forecast is reduced $15.00 to $310.00 per short ton. The soybean oil price forecast is unchanged at 31.0 cents per pound.

Global 2019/20 oilseed production is forecast up 3.3 million tons to 574.6 million, with greater soybean, sunflowerseed, and peanut production partly offset with lower rapeseed and cottonseed forecasts. China's soybean production is projected up 1.0 million tons to 18.1 million reflecting higher area and yield reported by the National Bureau of Statistics. Sunflowerseed production is forecast higher for Russia and Ukraine. Sunflower yields for both Ukraine and Russia established new record highs based on a continuing strong upward yield trend, seasonably cool temperatures, and timely mid-summer rainfall. Other changes include increased peanut production for India, lower rapeseed production for Canada, higher cottonseed production for Brazil, and lower cottonseed production for Pakistan.

Global 2019/20 soybean exports are reduced 0.6 million tons to 149.0 million on a lower forecast for Argentina. Soybean imports are reduced for Vietnam, offset by higher soybean meal imports. Global soybean stocks are forecast higher this month on increases for China and Brazil.

Canada Outlook:

For 2019-20 , production is estimated at 6.05 Mt, a 7% drop from the 6.49 Mt estimated from STC's mid-harvest report and an 18% drop from the 7.42 Mt grown last year. This is due to a significant drop in planted area and sharply lower yields with about one-half of the losses from the expected levels occurring in Western Canada due to difficult growing and harvesting conditions. Total Canadian soybean supplies are estimated at 7.1 Mt, a 22% drop from last year, as sharply lower imports supplements the drop in output.

Domestic processing of soybeans is forecast to decline marginally to 1.8 Mt as some processors shift to crushing canola. Exports are forecast to fall sharply to 4.4 Mt due to lower supply compared to the record of 5.6 Mt in 2018-19. Feed, waste and dockage is also forecast to fall sharply to 0.29 Mt while carry-out stocks are estimated at 0.40 Mt. The average soybean price is forecast at $395 to $425/t versus $406/t in 2018-19 and $434/t in 2017-18.

The USDA estimates that the world supply of soybeans will decrease to 447 Mt as a decrease in North American production more-than offsets a slight rise in production for the rest-of-world. By country, Brazil re-emerges as the world's largest grower of soybeans for 2019-20 with an output of 123 Mt, up from last year. US soybean production declined sharply from 2018-19 to 97 Mt due to a sharp drop in planted area and significantly below normal yields due to adverse growing conditions. Argentina is the world's number three soybean grower with an expected output of 53 Mt supported by early season reports of favourable growing conditions. China is the world's fourth largest soybean planter with an output of 18 Mt, up slightly from the 16 Mt grown in 2018-19. Paraguay is expected to grow 10 Mt of soybeans while India produces 9 Mt. Canada rounds up the list of largest soybean growers with an expected output of 6 Mt. Other countries are expected to produce an additional 21 Mt of soybeans.

Market Drivers

Maize

Market Drivers	Monthly Outlook
Higher supplies of new crop in spot markets	Bearish
Strong demand from traders and stockists	Bullish
Lower acreage under current Rabi Season Dec-19.	Bullish
Estimation of lower production by trader and Government	Bullish

Soymeal

Market Drivers	Monthly Outlook
Soybean arrivals in local markets	Bearish
Lower supply of new crop	Bullish
Steady to firm trend continued in soymeal complex	Bullish
Global 2019/20 soybean exports are reduced 0.6 million tons to 149.0 million on a lower forecast for Argentina	Bullish
Rupee appreciation	Bearish

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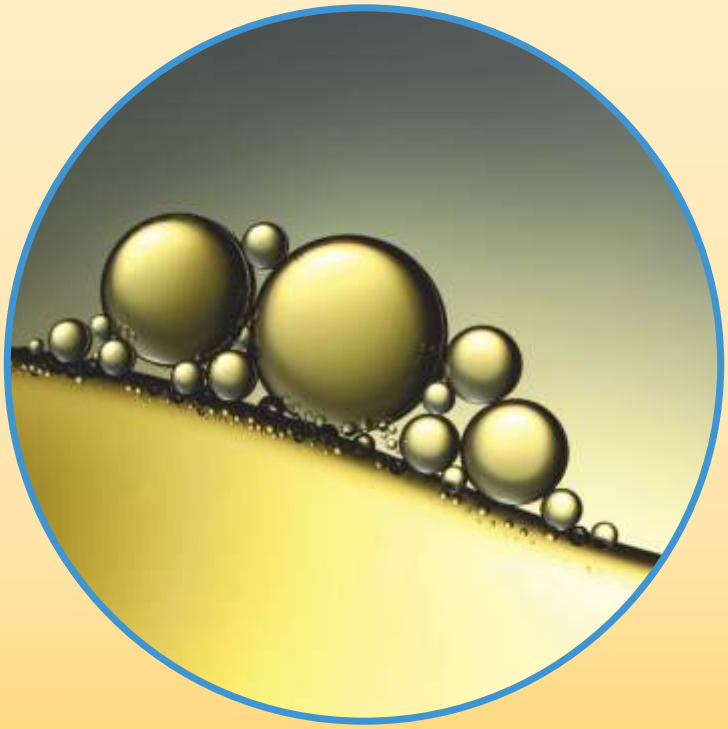

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FSSAI Meeting, FDA Bhawan, New Delhi – 10th October 2019:

CLFMA Executive Director, Mrs. Chandrika Venkatesh attended FSSAI Meeting on "Establishing Feed Regulations & Standards" on 10th October, 2019. During the meeting, the stakeholders deliberated on draft regulation, standards for feed ingredients, feed additives and premixtures, hygiene requirements at processing establishments, testing infrastructure available in the country, auditing and capacity building of feed business operators.

In-Pursuant of this meeting CLFMA had attended few more meetings and had discussions with FSSAI and got the update that, the feed quality standards shall be developed by BIS and would be regulated by FSSAI and FSSAI will be monitoring mainly the mycotoxin and antibiotics levels in feed.

World Egg Day 2019 – 11th October, 2019:

CLFMA enhanced its brand visibility by participating in World Egg Day on 11th October, 2019. Mrs. Chandrika Venkatesh, Executive Director participated in the World Egg Day celebration at Mumbai Veterinary College organized by Dr. A. S. Ranade, Associate Dean, Mumbai Veterinary College.

Meeting at Krishi Bhawan, New Delhi – 15th October, 2019:

On 15th October, 2019 Mr. Suresh Deora – President-West Zone, CLFMA had attended a meeting under the Chairmanship of Dr. Shri. O. P. Chaudhary, Joint Secretary (NLM) and with all the NER Secretaries / Principal Secretaries – Animal Husbandry and Veterinary Sciences or their representatives. In the meeting, participants had a discussion on establishing a centralized cattle feed mill for entire NER after identification of compact fodder cultivation areas and to send the same to NITI Aayog for their action.

Industry Meeting at Poultry India Office, Hyderabad on 15th November 2019:

Poultry Industry Meeting was held on 15th November, 2019 on the subject of retaining the present duty of 100% on Import of Chicken Legs from USA & Brazil as against the proposed import duty of 30% on chicken leg imports", wherein major stake holders of the Poultry Industry were invited. From CLFMA, the meeting was attended by Mr. Prashant Vatkar, CEO of Godrej Tyson Food Ltd. and the other participants were Mr. B. Soundararajan, Suguna Foods & Immediate Past Chairman, CLFMA, Mr. C. Vasanthkumar, Quality Poultry Products Ltd., Past Chairman, CLFMA, Mr. Harish Garware,

President, IPEMA & Mr. Anil Dhumal, Director, IPEMA and other renowned personalities of the Poultry Industry. This was followed by submission of representation to Shri. Giriraj Singh, Honorable Minister of Fisheries, Animal Husbandry & Dairying, GOI.

Poultry India 2019 Event- 26th November 2019- Knowledge Day & 27-29th November 2019 Exhibition

CLFMA OF INDIA participated in 13th Edition of Poultry India 2019 by having its stall Y67 in Hall No. 5.

Poultry India 2019, an international exhibition for the Poultry Industry concluded the 13th Edition of the show in the City of Hyderabad, India. The Exhibition featured the most innovative and reputed National and International Companies across the continent from the Poultry Sector to showcase their businesses and interact with potential partners, clients and investors. This event provided valuable information about poultry industry, poultry feeds, poultry equipment, technology, chicken breeders, egg farming, poultry nutrition, animal health and international poultry production. It also offered information about latest advances in poultry research, science and technology and importance of feed milling.

It provided advanced knowledge and understanding of poultry industry via scientific forums, trainings and career opportunities in the Poultry Industry. Poultry India 2019 exhibition has reached a pinnacle, where it is an one stop forum for the Indian Poultry industry to experience 'live' display of the products and services to the right decision makers of international companies and reach to a wide global market.

More than 1500 delegates was welcomed on the Knowledge day. 381 exhibitors from all over the world participated. Key Note Address was delivered by Shri. Ranjith Reddy Garu, Member of Parliament, Government of India. Poultry India 2019 had over 20,000 visitors during the 3-day event.

Hon'ble Shri. Talasani Srinivasa Yadav Garu, Minister of Animal Husbandry Dairy and Fisheries, Government of Telangana & Shri. AKP Chinaraj, Member of Parliament, Government of India actively participated in the Poultry India 2019 event.

CLFMA Chairman, Mr. S. V. Bhave was present at the inaugural of the Poultry India Event. CLFMA Members visited CLFMA OF INDIA stall and CLFMA had got a good response.

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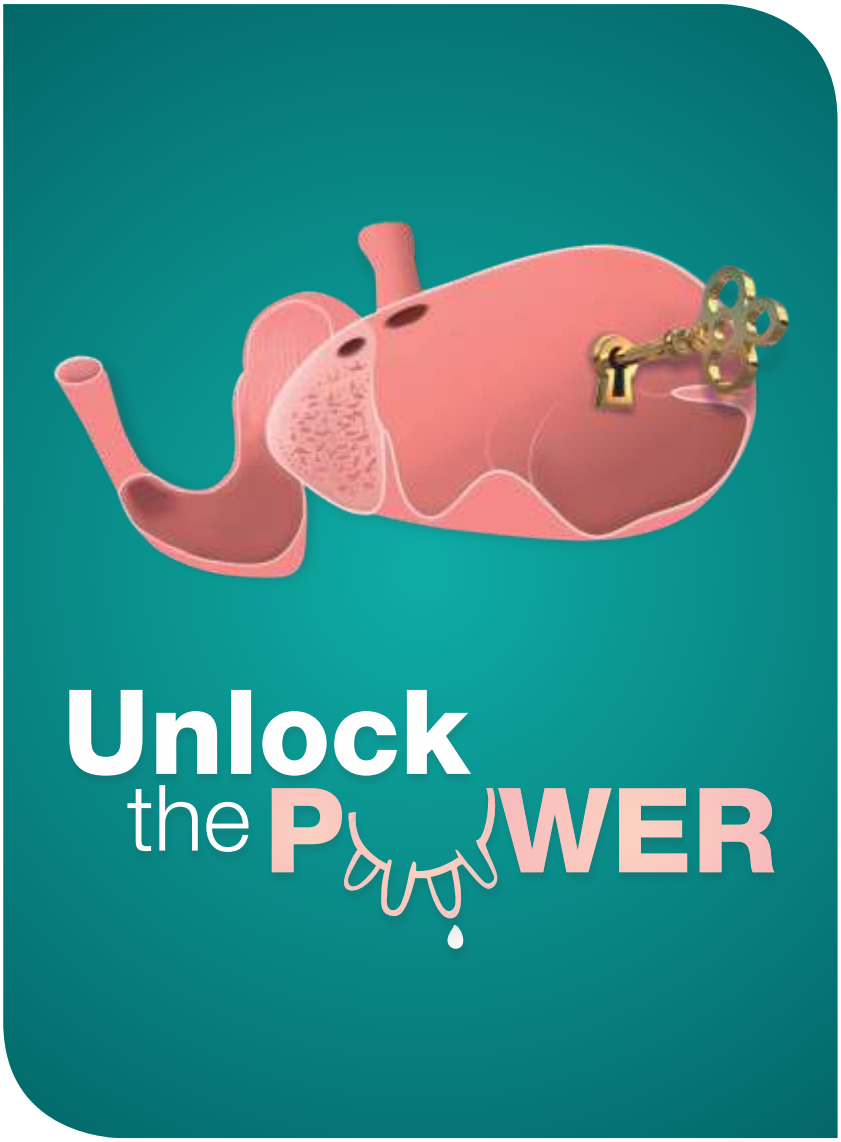

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14th PDFA Dairy & Agro Expo 2019 held at Jagraon, Ludhiana - Punjab

CLFMA Participated at 14th PDFA Dairy & Agro Expo 2019 held at Jagraon, Ludhiana – Punjab and Mr. S. V. Bhave , Chairman CLFMA was the speaker at Dairy Industry Outlook -2020, which had discussion about the progress of the dairy industry and it's future in India

About 14th PDFA Dairy & Agro Expo 2019

Progressive Dairy Farmer's Association, a prime institute of dairy farmers in Asia, South East Asia and African region, conducted its 14th Dairy and Agro Expo 2019, at Jagraon, Punjab from 7th to 9th December, 2019.

According to Shri. Daljit Singh, Sadarpura, President of PDFA, it was an international level show, in which more than 200 companies related to dairy and agro industries took part in this number one Asia Level Expo. Farmers from more than 20 countries e.g. from all states of India, Bangladesh, Sri Lanka, China, USA, Germany, England, Holland, Japan and other European and African countries, took part in this expo. Different International Companies exhibited their products, related to dairy and agriculture.

Shri. Giriraj Singh, Hon'ble Minister of Fisheries, Animal Husbandry & Dairying, Shri.Ajayveer Singh, Chairman, Punjab Farmer's Commission, many M.L.A.s and Ministers from Punjab, inaugurated the expo and took special interest in all the stalls. They visited different Company's stalls and asked them different type of questions as per their curiosity. Maximum visitors were from South India and Gujarat. Shri. Giriraj Singh, Hon'ble Minister, took special interest in competitions being conducted under 20 categories of animal's breed and milking contests. It is to be mentioned here that prizes worth 20 Lac Indian rupees were given to winners in different categories of competitions. Cows and Buffalos' competitions were worth watching. So many buyers of quality cows, heifers and buffaloes were also seen during the expo, enquiring about the availability of the best cows for purchase.

In cow milking competition, HF breed cow of Shri. Paramjit Singh village Lamme (Moga) – Punjab, was the winner with 58.290 kg of milk per day.

In HF cows breed competition, cow of Shri. Amarjit Singh was adjudged the best adult cow and got first prize. In Jersey breed milk competition, cow of Shri. Baldev Singh from village Galib Kheri won the first prize with 41.503 litres of milk. Similarly, in buffalo milk competition world record was broken. Buffalo of Shri. Sukhbir Singh of village Latarri

(Hissar) won the first prize with 32.066 litres of milk per day (New world record). Previous record was from Pakistan in same Murrah category buffalo with per day milk 32.050 litres.

Shri. Daljit Singh Sadarpura, President PDFA said that this expo was similar to "World Dairy Expo'. He said in a year or two "International World Dairy & Agro Expo" will be conducted at same place, if the government (Central & State) give us more enthusiasm. This show was a great success in spite of inclement weather. Approximately 10 lakh farmers visited the expo in three days.

CLFMA participated in INDO DANISH SEMINAR organized by Danish Veterinary and Food Administration in Collaboration with FSSAI on 11-12th December 2019 and Dr.Anup Kalra, CLFMA Member attended the Seminar.

Indo- Danish seminar on the challenges of Antimicrobial Resistance and Food Production was organized by Danish Veterinary and Food Administration in collaboration with FSSAI on 11th & 12th Dec. 2019.

HE ambassador of Denmark to India, joined the team for inaugural remarks.

Participating organization were as follows:

1) Danish Veterinary and Food Administration
2) FSSAI
3) Department of Animal Husbandry and Dairying
4) CDSCO
5) ICAR
6) DBT
7) Danish Agricultural and Food Council
8) Danish Technical University
9) CLFMA
11) Experts from Fisheries and Meat Research
12) LUVAS Hisar

During the two-day Seminar, various presentations from stakeholder Ministries from India and the Danish perspectives on Antibiotic Microbial Resistance were shared and discussed. The Danish experts shared one health approach, voluntary commitment by industry, the Ministry and legislative framework for monitoring antimicrobial use and resistance. The expert from India shared the AMR challenges in poultry sector and way forward to prevent AMR in Dairy Farming. They also shared the significance of

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surveillance of antibiotic in India.

The key points emerged out of the panel discussions were:

1) India to have an integrated / all Ministries approach towards control of AMR.

2) Building of the data base on the current usage trends in Dairy & Poultry to be examined and notified.

3) The industry should be involved for creating awareness amongst the stakeholder towards control of AMR.

4) Policy guidelines do exist but the executions of the polices needs to be evaluated.

5) The Danish experts invited the Indian Govt./Ministries to join hands with International Center for AMR Solutions (ICARS).

6) FSSAI has taken lead to control the AMR by banning Colistin. Now they have come up with order to control the feed quality. All related stakeholders, can write to CEO FSSAI, if they have any observation.

7) The feed quality standards shall be developed by BIS and would be regulated by FSSAI

The program ended with the panel discussion and Vote of thanks.

The Delegation would be coming to India in 2020 and would take tour to understand the field perspective and make their plan accordingly.

India-Denmark Government to Government Seminar on the challenges of Antimicrobial Resistance in Agricultural and Food Production

19th Meeting of Animal Husbandry, Feeds and Equipment Sectional Committee, FAD 5 held at BIS Office, which was attended by 40-45 people (mainly from Govt institutions) on 13th December, 2019. The Meeting was attended by following officials:

A) Dr. Devender Hooda -CLFMA President- North Zone and Director – Sales and Technical, Huvepharma India Private Ltd.

B) Mr. Sandeep Bansal - Tiwana Feeds

C) Dr. Natrajan - Namakkal Vet. College - Feed Lab

D) Dr. S.V. Rama Rao – ICAR-Directorate of Poultry Research, Hyderabad

E) Dr. Rajput - Represented Breeders Association

F) PETA Officers, ISO Officers, various Senior Scientists from NDRI, IVRI, NRCs.

Meeting was chaired by Dr. S. Singh, Director IVRI. BIS Standards for the Products viz Block Making Machine, Animal Lifting machine, Dung Cleaner, Equine Housing Standards and Animal Feed Specification Standards were discussed in detail

Release of Wheat & Rice Stocks for Livestock Feed Industry" Representation by CLFMA submitted to the honourable secretary AH & D

Further to CLFMA Representation of Wheat and Rice Stocks for Livestock Feed Industry, Joint Secretary (NLM) Shri. O. P. Chaudhary asked for clarification regarding the same from CLFMA Office. After getting the same clarified from CLFMA, the representation as well as clarification is pending at PMO Office for further action.

As per the discussion with various Stakeholders, we understand that with regard to DDGS Import of Corn and Soya, both Ministry of Agriculture and Animal Husbandry Department has conveyed the same positively to the PMO Office and is pending at PMO office for further action.

Aquaculture market expected to witness CAGR of 7.7% between 2019 & '27

The global aquaculture market accounted for $264,470 million in 2018, and is expected to grow at a CAGR (compound annual growth rate) of 7.7 per cent between 2019 and 2027, to account to $509,743 million by 2027.

This was among the findings of the recent global aquaculture market report that gave a meticulous investigation of current scenario of the market size, share, demand, growth, trends, and forecast in the coming years.

Aquaculture includes farming of fish, aquatic plants, algae, crustaceans, molluscs, and other organisms. The small-scale aquaculture market in developed and developing countries make critical contributions to employment.

According to the FAO (Food and Agriculture Organization), aquaculture provides employment to more than over 41 million people globally. The vast majority of aquaculture activities are carried out in developing countries working in fish production.

Fish and other seafood species constituting an important source of nutrients for the poor and is among the cheapest form of animal protein.

As most capture fisheries worldwide considered fully exploited or overexploited, aquaculture is considered as an important sector to meet rising fish demand, which will continue to increase with population growth, rising incomes and increasing urbanisation. These factors are anticipated to boost the growth of the aquaculture market.

The overall global aquaculture market size has been derived using both primary and secondary source. The research process begins with exhaustive secondary research using internal and external sources to obtain qualitative and quantitative information related to the aquaculture market.

Also, multiple primary interviews were conducted with industry participants and commentators in order to validate data and analysis.

The participants who typically take part in such a process include industry expert such as vice-presidents, business development managers, market intelligence managers, and national sales managers, and external consultants such as valuation experts, research analysts, and key opinion leaders specialising in the aquaculture market.

Aquaculture is significantly contributing to the production of fish, and the adoption of aquaculture is growing at a steady rate. The increase in demand for fish for human consumption is majorly meet by aquaculture, marine fisheries, and inland fisheries.

However, an increase in fish production by inland and marine fisheries generate the situation of overfishing and impacts the environment. Aquaculture owns huge potential for future expansion, and it is a great source of fish production.

Government initiatives and favourable policies play an important role in generating a suitable environment for entities involved in aquaculture. This further provides a lucrative opportunity for the key players operating in the aquaculture market.

Some of the players present in global aquaculture market are Bakkafrost, Blue Ridge Aquaculture, Inc, Cermaq, Group AS, Cooke Aquaculture Inc, Danish Salmon A/S, Farallon Aquaculture Group, Fifax AB, HESY Aquaculture BV, Lery, Mowi ASA, Niri AS, Selonda Aquaculture SA, Stolt-Nielsen Limited, TASSAL, and Thai Union Group PCL, among others.

The report has segmented the aquaculture market on the basis of species, nature, culture environment and region.

Aquaculture market size and forecast, by species

- Aquatic plants
- Fish
- Crustaceans
- Molluscs

Aquaculture market share and forecast, by nature

- Land-based
- Offshore

Aquaculture market growth and forecast, by culture environment

- Fresh water
- Brackish water
- Marine

E-com cos-FSSAI agree over mandatory licensing; discuss products shelf life

The Food Safety and Standards Authority of India (FSSAI) recently held a meeting with e-commerce companies to assess their compliance with FSS Regulations. The two sides agreed that guidelines for e-commerce FBOs must be complied with in letter and spirit and FBOs and third-party e-commerce platform providers must apply for FSSAI licence, if not yet procured.

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Further, the e-commerce platforms made a representation before the FSSAI officials regarding provisions of guidelines stipulating delivery of products with shelf life of 30% or 45 days. The e-commerce players told the apex food regulator that they were facing problems in meeting this condition and requested to reduce this shelf life period required.

However, the FSSAI replied that this condition was laid down to ensure that consumers do not get products with very limited shelf life and these need to be adhered to strictly.

The meeting chaired by the Executive Director, Compliance Strategies, Dr Shobhit Jain, witnessed the two sides agreeing further on making efforts to comply with the regulations particularly identifying food businesses operating without licences on e-commerce platforms through mutual sharing of information of such FBOs.

Dr Jain stated that third-party e-commerce platform providers can share the data with FSSAI, which can be verified for validity of licences and followups while such platforms can themselves check about FBOs through FBO search facility on food licensing portal of the apex food regulator.

It was also agreed that the sellers on such platforms will display the licence or the registration number prominently to help the customers make informed choices. And the platforms should take immediate steps on the issue of complaints forwarded to them by the FSSAI.

"The third-party e-commerce platform providers with their unique business model and website being in public domain always remain under the public glare and scrutiny which puts additional onus on them to ensure demonstrable and expeditious compliance," said Dr Jain.

He pointed out that a majority of food related complaints could be avoided by them by ensuring compliance to the FSSA, rules and regulations not only themselves but also by their partners and the products put up for sale on their websites, while it was observed that FBOs had already taken several steps to ensure compliance on their counts.

Palm Industry Adopts Sustainability Standards

Stakeholders of the domestic palm oil sector have started adopting sustainability standards — the Indian Palm Oil Sustainability (IPOS) Framework — on a voluntary basis.

Godrej Agrovet Ltd became the first company in India to cover about 2,000 small holder palm oil suppliers under the IPOS certification by Control Union, said the Solvent Extractors Association (SEA) of India, the apex trade body, in a statement. The IPOS Framework has been jointly developed by the SEA, Solidaridad and the Indian Institute of Oil Palm Research.

Oil palm is grown in about 3.49 lakh hectares in India, while the potential exists in about 1.93 million hectares as of October 2019. The current crude palm oil production is estimated at 2.8 lakh tonnes.

"Edible oils are a big drain on foreign exchange with India being one of the biggest net importers and 60 per cent of total oil imports is palm oil. Also, with larger emphasis given on increasing the income of farmers, this framework will help. India's North-East offers great potential for oil palm plantation with nearly 2,80,000 hectares land suitable for oil palm. Currently, only 30,000 hectares is in oil palm plantation. This framework will assist the Central government to encourage oil palm plantation in North-East under various schemes," said SEA President Atul Chaturvedi.

Shatadru Chattopadhayay, Managing Director of Solidaridad Asia, said the IPOS framework was created by the Indian palm oil industry, for the Indian palm oil industry and owned by Indian palm oil stakeholders. "The IPOS programme would facilitate the Indian palm oil industry to be ready for facing future customer demands, safeguard the competitiveness, improve relationships and loyalty in the supply chain within and outside the country and position India as one of the global leaders in sustainable production and trade in palm oil," he said.

BV Mehta, Executive Director, SEA, said oil palm was the most efficient oil crop in terms of land use. The crop has become an increasingly important driver of economic development, improved food security and poverty reduction in various countries. "India is the world's largest consumer of palm oil. Framework and guidelines based on Indian conditions and ground realities are needed to address different aspects of sustainability in production and trade of palm oil. The IPOS framework has the potential to address key sustainability concerns and barriers, while fulfilling the commitment of Indian palm oil industry towards sustainability," Mehta said.

The IPOS standard was recently recognised by the Indonesian and Malaysian Palm Oil Board through an agreement with SEA and Solidaridad. The agreement recognises IPOS as India's national sustainability framework for palm oil and considers it equivalent to Indonesian and Malaysian national sustainability standards for palm oil production and trade between the Asian countries.

Calcium Metabolism Of Peri-parturient Dairy Cattle And Prevention Of Milk Fever By Strategic Supplementation Of Calcium

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The transition period (three weeks before to three weeks after parturition) is critically important for health, production and profitability of dairy cows. This period is characterized by tremendous metabolic and endocrine adjustments that the cows must experience from late gestation to the early lactation. The most important physiological changes occurring during this period are the reduction in dry matter intake around parturition and a sudden increase in demand nutrients that the cows need for milk production. Milk fever (parturient paresis) is a hypocalcemic disorder associated with the onset of lactation in dairy cows. Hypocalcaemia may be clinical or subclinical. Clinical hypocalcemia, also known as milk fever and is a particular concern for the newly calved cow. Most of cases of milk fever occur within 24 hours of calving. Generally cows with milk fever are recumbent and are unable to rise as a result of low blood Ca, whereas cows with subclinical stage have no clinical signs of hypocalcemia. Hypocalcemia reduces dry matter intake, milk production and fertility and increases the risk of secondary diseases such as ketosis, retained fetal membranes, displaced abomasum and mastitis and the incidence of dystocia and uterine prolapse.

Milk Fever and Subclinical Hypocalcemia

Parturient hypocalcaemia is a disease of considerable importance for dairy cow's welfare and economy of the farmers however it appears when the sudden demand for Ca of colostrums and milk production cannot be met by dietary Ca absorption, bone Ca mobilization and renal Ca resorption. Most dairy cows have some degree of hypocalcemia (milk fever or subclinical) during the early postpartum period. Hypocalcemia occurs because Ca leaves the extracellular fluid pool to enter the mammary gland faster than it can be replaced by intestinal Ca absorption, bone Ca mobilization and renal Ca resorption. Blood Ca in the adult cows is maintained between 8.5 and 10 mg/dl (2.0 and 2.5 mmol/L). Maintenance of blood Ca within the acceptable range is a balancing act between the Ca demand of milk production and the cow's homeostatic mechanisms to maintain blood Ca levels. Clinical signs of milk fever often are not seen until serum Ca concentration is about 4 mg/dl whereas subclinical hypocalcemia appears when <7.5mg/dl serum Ca concentration reach.

Intestinal Ca absorption and bone Ca resorption are controlled by parathyroid hormone, which is secreted by the parathyroid glands and 1, 25-dihydroxyvitamin D_3, which is produced in the kidney. As there is a decline in blood Ca concentration, parathyroid hormone concentration is increased. When blood Ca is within the normal range, parathyroid hormone secretion is decreased. Parathyroid hormone initiates renal production of 1, 25-dihydroxyvitamin D_3 to permit Ca homeostasis. In addition, renal resorption of Ca is enhanced by parathyroid hormone. Metabolic alkalosis blunts the response of the cow to parathyroid hormone and predisposes dairy cows to milk fever and subclinical hypocalcemia. Metabolic alkalosis largely occurs as the result of diets high in cations, especially sodium and potassium and low in anions, especially chlorine and sulfur. Pre-calving diets high in anions and low in cations or containing anionic salts such as ammonium sulfate, magnesium sulfate and ammonium chloride can decrease the occurrence of hypocalcemia. In addition, many strategies including feeding a pre-calving diet containing a low Ca concentration, administration of vitamin D at approximately 1 week before calving and supplementation of Ca at calving have been used for the prevention of hypocalcemia. Cow's intestine and bone rapidly adapt to the Ca demand of lactation. As cows become older age, Ca homeostatic mechanisms reach more slowly to the Ca demand of lactation. Oral administration of Ca salts prior to and at parturition has been suggested to prevent hypocalcaemia in dairy cows. The use of a source of Ca that has no adverse effects, such as necrotic lesions in the abomasum, on the digestive tract is preferable.

Method of calcium Supplementation

1. **Traditional method: restriction of dietary calcium intake**
   - Main aim is to limit calcium intakes below 30-50g per

cow per day in last 3 weeks of pre-calving. It is Impossible to do if significant amounts of either grazed grass or grass silage in dry cow diet is offered.

- Be careful when feeding milking cow rations to "close up" dry cows, as levels of calcium will be high.
- Alternative method is to use calcium binders such as zeolite to limit calcium absorption.

2. Supplementation of calcium by mouth at calving

- The Scandinavian approach to control milk fever is to give "at risk" cows a large dose of calcium at calving, which supplies a readily available source of calcium just when the cow needs it most.
- This method can work well in small herds, where altering the "close up" dry cow diet is impractical.
- A number of products are available either as boluses (eg. Bovikalc, Calcium boluses), drenches (eg. Maxacare Reviva, BoviCal), gels or in-feed products (eg. Mike Lemmy's, Easy Calver).
- Giving all older cows a bottle of calcium under the skin at calving is short-acting and may be counterproductive as it will switch off hormone mechanisms that control blood calcium levels just when needed.

3. Prevent excessive drain of calcium reserves immediately after calving

- Once the cow calves, their calcium requirements increase by 2-3 folds due to high calcium levels in milk. Excessive or inappropriate milk withdrawal can drain too much calcium from the system resulting in milk fevers especially if cases occur 24 hours or more after calving.
- Do not milk cows pre-calving.
- Remove calf at birth and only provide sufficient colostrums to the calf in the first 24 hours.
- Consider reduced or no milking of cows for 3-4 days after calving. Check cow regularly for mastitis.

4. Supplementation of calcium propionate as source of calcium and energy

- Calcium propionate is a satisfactory source of Ca and propionate is the major glucose precursor in ruminants that are in positive energy balance and is anti-ketogenic in nature.
- Depressed dry matter intake during the transition period leads to a lack of propionate supplied for glucose synthesis in the liver. Nutritionally, propionate can be supplied orally in the form of calcium propionate.
- Calcium propionate is a white crystalline powder. Molecular formula, molecular weight, density and pH of calcium propionate are C6H10CaO4, 186.22, 0.56 g/cm3 and 8.5 to 10, respectively.
- Calcium propionate, as a source of both Ca and energy, has been administered to transition dairy cows for prevention and or treatment of hypocalcaemia and ketosis.
- Calcium propionate can be used by oral drenching, adding to total mixed ration or concentrate mixture and in a paste or gel form.

5. Phosphate supplementation

- Some milk fever cases do not respond to calcium alone, but also require phosphorous injections.
- These cows are often described as "creeper" or "crawler" cows as they frequently attempt to get up.
- Phosphorous is intrinsically linked with calcium in the bone stores, as so prevention of such cases involves the standard approach to milk fevers as highlighted above.
- Too much phosphorous can also cause problems. Do not feed over 0.5% phosphorous in the dry cow diet.

Conclusions

The art of feeding dairy cattle is basic and applied science of dairy cattle nutrition. Huge economic losses occur due to medicines, veterinary services and reduced production of dairy animals due to metabolic diseases. Losses are also associated with increased incidence of secondary diseases such as ketosis, mastitis, retained placenta, displacement of abomasum, uterine prolapse, limb injuries and pneumonia can further inflate losses. So strategy for supplementation of nutrients is necessary for optimum production and prevention of losses in peri-parturient dairy cattle.

Manipulations In Milk Composition

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Health conscious people are extremely particular of their daily diet in order to maintain a healthy life style. Elite class which can afford to pay the price of quality milk is being advised not to drink milk. Similarly, children who are forced to drink milk every day don't relish the taste and particularly fat content in the milk. The 'ideal' milk fat for human well being would contain <10% polyunsaturated fatty acids (PUFA), <8% saturated fatty acids (SFA) and more than 82% mono saturated fatty acids (MUFA). Although it may not be possible to achieve this 'ideal' milk fat composition, manipulation of milk fat is possible through altering the dietary practices. The concept of designer or enriched milk are coming up in which the various nutrients have been modified from the standard constituent of the milk. This milk may be classified as humanized milk, milk with high therapeutic properties towards specific needs e.g. low fat or low cholesterol milk, low lactose or lactose free milk etc.

Fairly good positive relationship between level of fat and SNF in milk exist. Of the two, the SNF is of great nutritional importance as it contains valuable animal protein. Fat content is much more variable than SNF. Attention to improve fat percent becomes more rewarding when payment is based on its level in the milk. Milk yield and total solids percentage are related inversely, yet correlation is not so good that improvement of both yield and total solid percent cannot be made. Some feel that improvement in yield is more difficult to achieve when total solid concentration is to be maintained or improved.

Close to 70% of milk sold in India is considered adulterated as it doesn't conform to standards set up by Food Safety and Standards Authority of India (FSSAI). The standards of milk and milk products have undergone amendment since 2nd August 2017. The fat content of milk ranges between 1.5% and 6%; as the definition says that Milk which is adjusted for milk fat or SNF content or both, may also be named 'milk'. Another major difference is with regard to 'milk' when offered to sale without indication of class shall have the standards of mixed milk (4.5% fat and 8.5% SNF) instead of buffalo milk. The standard of cow milk is on all India bases, now. The minimum standards are 3.2% fat and 8.3% SNF. Similarly buffalo milk should have 6% fat and 9.0% SNF in northern states and 5 % fat in southern states with same SNF.

The amount of money a milk producer gets for his milk depends upon firstly, the quantity of milk produced, secondly fat and solid not fat (SNF) content and thirdly the levels of other quality parameters such as drug residues, somatic cell account, M1 levels and off flavor etc. The higher the fat and SNF content of the milk, the higher the price paid. The various genetic, management and nutritional approaches which alter the milk yield and composition are discussed below:

1. Breed

A change in milk composition using traditional breeding techniques occurs slowly, although new techniques of genetic manipulation may allow faster progress in the future. Yields of milk, fat, protein and total solids are not easily impacted by genetics; heritability estimates for yield are relatively low at about 0.25. Meanwhile, heritability estimates for milk composition are fairly high at 0.50. Conversely, environmental factors such as nutrition and feeding management will impact yield more than the actual percent composition of the major milk constituents. The priority placed on each genetic trait depends upon its economic or profit impact. Milk yield per cow tends to receive the most attention by producers. However, component yields should not be overlooked. Genetic selection should be directed toward increasing fat, protein and nonfat solids yields. But, because component percentages tend to have negative genetic associations with yield traits, a change in these percentages is not likely to be achieved through genetic selection alone. Zebu cows have more fat percentage than the Taurus cows. Cow calving in an extremely fat condition may produce milk of unusually high fat percentage during the first several weeks after calving. There is clear tendency for breeds producing high yields to give lower fat percentage. Table 1 contains the breed averages for percentage of milk fat, total protein,

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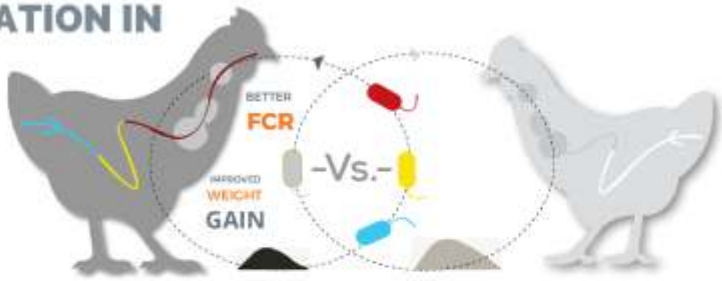

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lactose and ash content of bovines.

Table 1. Breed averages for % of milk fat, total protein, lactose and ash content of bovines

Breed	Fat	Protein	Lactose	Ash
Sahiwal	4.55	3.33	5.04	0.66
Tharparkar	4.55	3.36	4.83	0.68
Red Sindhi	4.90	3.42	4.91	0.70
Gir	4.73	3.32	4.85	0.66
Holstein Frisian	3.40	3.22	4.87	0.68
Jersey	5.37	3.92	4.93	0.71
Murrah	7.25	4.10	5.10	0.76

2. Stage of Lactation

Both the fat and SNF content of milk are at maximum at the beginning of the lactation. The concentration of fat and SNF falls rapidly over first few days of lactation then falls more slowly to reach minimum approximately at 6 and 8 weeks for SNF and fat respectively. From then onward the concentration of both constituents increases. SNF increases more slowly than fat until the end of lactation. These changes in SNF relate to cow becoming pregnant during the lactation. There is much individual variation partially associated with the condition of cow at calving. At the end of lactation, fat may be as much as 0.5 to 1.5% higher than at the beginning. Size of fat globule in milk tends to decrease towards the end of lactation. The bulk fat percentage varies drastically either up or down without any consistent pattern on the day of heat and the following day.

3. Number of Lactations

There are evidences to show that fat and SNF content decreases as lactation number increases up to the fifth lactation. The SNF percentage falls by about 0.4% during the same period and the rate of decline is more rapid in early lactations. There is little change in milk quality after five lactations, but older cows may continue to show a decline in SNF% due to greater incidence of mastitis. The total solid content of milk produced by an aged herd may go so slow that culling and introduction of younger cows may be necessary.

4. Season

The seasonal variation in milk quality is the consequences of changes in nutrition associated with the time of year and calving pattern. Extremes of temperature affect the quality of milk. The comfort zone ranges for temperate breeds between 0 to 15^0 C and for tropical breeds 10 to 27^0 C. The yield is reduced when temperature exceeds 28^0 C in temperate and 35^0 C in tropical breeds. At a high temperature there is marked increase in fat% and a decrease in SNF%. High temperature results in reduced appetite which decreases SNF content and increases the fat percentage accompanied by decrease milk yield.

5. Milking

Variation in the frequency, interval between the completeness of milking affects both quality and quantity of milk. Increase in the yield on an average is 15% as a result of milking three times in place of twice. When cows are milked at unequal intervals milk produced after short interval has higher fat percentage and low milk yield particularly with high yielding cows. The same may not be true in average producers. Incomplete milking reduces fat content but is compensated in subsequent milking. In situations where weaning is not practiced, this will not hold true. However, SNF content of milk does not vary in the same way as fat content. It is also observed that fat percentage remains more in the last portion of milk drawn from the udder which is left by farmer for calf. It is therefore essential to leave the calf first before milking so that the milk drawn in the last may be available to the farmers, rather giving to calf in case weaning is not the practice. Similarly fat also varies in milk drawn from different quarters as each quarter is independent of each other.

6. Mastitis

Mastitis infections reduce fat and casein but increase blood protein content of milk. Somatic cell count (SCC) also is elevated during mastitis. Herds that have continuous mastitis and SCC problems take a double or triple hit on milk price. Milk fat and protein depression also can occur from mechanical errors, such as cooling problems in the bulk tank, sampling problems, and over agitation in the pipeline. The extent of the change depends on organisms, severity of infection, speed with which trouble is detected and remedy applied. Fat and SNF% return to nearly normal in many cases with suitable therapy.

7) Body Score

Proper body condition is essential so that high producing cows can draw on body stores of nutrients to support milk production. If body stores are minimal, yields of milk and milk components will suffer. On the other hand, excessive body condition increases the risk of metabolic problems and calving difficulty. Weight loss in early lactation can increase milk fat content for a short period of time. Both thin and fat cows tend to have low milk fat in later lactation. Protein can be depressed at calving if animals are overly obese or underweight. In addition, some research shows that underfeeding protein during the last three weeks before calving can depress milk protein.

8. Feeding

Of all the factors affecting milk composition, nutrition and feeding practices are most likely to cause problems; however, management changes made here are able to quickly and

dramatically alter production of fat and protein. Milk fat depression can be alleviated within seven to 21 days by changing the diet. Milk protein changes may take 3 to 6 weeks or longer if the problem has been going on for a prolonged period. Nutrition or ration formulation changes are more strongly correlated to milk fat content than milk protein. For these reasons, nutrition and feeding management are considered the best solutions to a milk fat or protein problem other than genetics.

a) Rumen

Digestion of fiber in the rumen produces the volatile fatty acids (VFAs) acetate and butyrate. Butyrate provides energy for the rumen wall, and much of it is converted to betahydroxybutyrate in the rumen wall tissue. About half of the fat in milk is synthesized in the udder from acetate and betahydroxybutyrate. The other half of milk fat is transported from the pool of fatty acids circulating in the blood. These can originate from body fat mobilization, absorption from the diet, or from fats metabolized in the liver. Rumen microbes convert dietary protein into microbial protein, which is a primary source of essential amino acids. These amino acids are used by the mammary gland to synthesize milk proteins. Glucose is required to provide energy to support this protein synthesis. Glucose is either formed from the VFA propionate in the liver, or absorbed directly from the small intestine. If too little propionate is absorbed from the rumen, the cow will have to breakdown amino acids and convert them to glucose (a process called gluconeogenesis); this can reduce the supply of amino acids available to make milk protein. In addition, some albumin and immunoglobulin protein is transferred directly to milk from the blood. The relative amounts of protein and energy that are available in the rumen at a given time is the major factor affecting rumen fermentation and therefore milk components. Any diet or management factors that affect rumen fermentation can change milk fat and protein levels. Consistently providing adequate energy and protein and balanced amounts of rapidly fermentable carbohydrate and effective fiber are keys to maintaining optimum levels of milk components.

b) Feeding Management

Any situation that causes animals to eat abnormally or limits feed intake may affect milk components. Examples include: overcrowding at feed bunks, housing heifers with older cows in facilities at or near full capacity, feeding rations that encourage sorting, feeding infrequently in a conventional system (non- TMR), failing to push feed up or feed TMR often enough, feeding protein feeds before energy feeds and feeding grain before forage in non-TMR systems. These conditions can create slug feeding (one or two meals per day versus 5 to 6) or allow cows to eat high grain meals part of the time and high forage meals the remainder of the day. Ensure that fresh feed is available 18 hours each day, spoiled feed is removed from bunks, and shade or cooling is provided during hot weather to help maintain normal intake and normal meal patterns. Poor ventilation or cow comfort also can depress milk fat and protein production by reducing intake. Finally, make ration changes gradually to allow rumen microorganisms time to adapt. Any reduction in rumen microbial protein production from nutrition or feeding management imbalances will reduce milk protein by way of less microbial protein for the cow to digest and depress fat by limiting VFA production in the rumen.

c) Energy

In general, as energy intake or ration energy density increase and/or fiber decreases, milk fat content will be reduced, while protein is increased. In contrast, as ration fiber levels increase and/or energy is reduced, milk protein is depressed and milk fat is increased. Lack of energy intake or lower ration digestibility may reduce milk protein by 0.1 to 0.4%. This reduction may result from underfeeding concentrates, low forage intake, poor quality forage, and failure to balance the ration for protein and minerals, or inadequately ground or prepared grains. Shifting rumen fermentation so that more propionic acid is produced is apt to increase milk protein and decrease fat content. However, excessive energy intake, such as overfeeding concentrate, may reduce milk fat content and increase milk protein. Normal protein levels can be expected when energy needs are being met for most of the cows. Often this is impossible to achieve with high producing animals.

d) Protein

A deficiency of crude protein in the ration may depress protein in milk; marginal deficiency could result in a reduction of 0.2%, while more severe restriction of diet crude protein would have greater impact. However, feeding excessive dietary protein does not increase milk protein, as most of the excess is excreted. Dietary protein has little effect on milk fat levels within normal ranges. Diet protein type also could affect milk protein levels. Use of non-protein nitrogen (NPN) compounds, like urea, as protein substitutes will reduce protein in milk by 0.1 to 0.3% if the NPN is a main provider of crude protein equivalent. Rations higher than recommended in soluble protein may lower milk protein by 0.1 to 0.2 points. NPN levels in milk will be increased by excessive protein or NPN intake, heavy feeding of ensiled forages, ensiled grains, immature pasture and lack of rumen undegradable protein in the diet. Balance rations for crude

protein, rumen undegradable protein, rumen degradable protein, and soluble protein. For high producing cows, balancing for amino acids also may be required.

e) Concentrate

An increase in the intake of concentrates causes a decrease in fiber digestion and acetic acid production. This creates an increase of propionic acid production. Propionic acid production encourages a fattening metabolism that is in opposition to milk fat. Addition of buffers to some rations may help to prevent acidosis; this will not change milk protein, but will increase milk fat content. Animals that eat a substantial amount of concentrates or a low ratio of dietary forage to concentrate may develop acidosis even when buffers are added to the ration. The non fiber carbohydrate (NFC) portion of the diet is highly digestible and can influence both fat and protein in milk. Excessive amounts of NFC can depress fiber digestibility, which reduces the production of acetate and leads to low milk fat (1% or more reduction). At the same time, greater propionate production allows higher milk protein levels of 0.2 to 0.3%. Generally an NFC of 32 to 38% of ration dry matter is recommended to optimize production of milk fat and protein.

f) Fodder

Balance rations for lactating cows to contain at least 40 to 45% of ration dry matter from forage. This may be altered by the level of corn silage in the ration and the level of high-fiber by-product feeds in the ration. Low forage intake can cause a major reduction in the fat content of milk due to low fiber levels. Several potential reasons for low forage intake are inadequate forage feeding, poor quality forage, and low neutral detergent fiber (NDF) content in forage that was cut too young or late in the fall. Target a forage NDF intake of 0.9% of bodyweight daily. Although low forage (high energy) diets increase milk protein production, this strategy is not recommended. The low forage levels contribute to acidosis and laminitis; they do not promote good health for the rumen or the cow in the long run. Protein and fat content also can be changed due to the physical form of forage being fed. Much of this is related to ration sorting and failure to provide a consistent diet throughout the day. Coarsely chopped silage and dry hay are the most common causes of sorting. At the other extreme, very finely ground diets negatively affect rumen metabolism and depress fat and protein production. Monitor ration particle size to ensure that adequate effective fiber is provided, TMRs are mixed properly, rations are distributed evenly to all cows, and sorting is minimal.

g) Dietary Fat

Adding fat to the ration can affect milk component levels depending on the amount and source of fat. Fat is generally toxic to rumen microbes and may reduce fiber digestibility when fat from natural sources exceeds 5% of ration dry matter. If rumen inert or bypass fat is used, total fat content may safely reach 6 to 7%. At low levels of dietary fat, milk fat content could increase slightly or show no change at all. Milk fat is reduced at higher levels, especially with polyunsaturated oils. If fat or oil is rancid, milk fat content decreases even at low levels of consumption. Milk protein content may be decreased by 0.1 to 0.3% in high-fat diets. This may occur due to reduced blood glucose levels.

High milk fat content often occurs in herds that are off in feed and may have ketosis problems. Percent fat may be reduced for sick animals, but total fat may be higher for the herd. This may occur in herds fed large amounts of good quality forage combined with moderate concentrate levels. Producing an abnormally high level of fat is not economically feasible, because it usually indicates that total milk production is low. Herds that depend primarily on milk income would be better served to increase total milk yield and keep fat percentage somewhat below the attainable maximum. Herds with unusually high milk fat are encouraged to reduce forage intake if it is on the high side, increase concentrate feeding, and manage the nutrition of dry and transition cows more closely to control problems with low intakes and ketosis.

h) Feed Additives

Rumen buffers increase milk fat and possibly yield, when low-fiber, high-grain rations are fed. Feed sodium bicarbonate with or without magnesium oxide when concentrate contain more than 30 kg grains or high levels of rumen fermentable fiber. This will not only help milk fat percentage, but also maintain a healthy rumen environment. Rations in which all the forage is berseem generally do not benefit from buffers.

Niacin can alleviate the milk protein percentage but can also slightly reduce fat percentage. Niacin notably prevents ketosis in early lactation, especially with over conditioned animals.

Maximum feed intake is the most important factor for improving and stabilizing the milk protein and fat content. Yeast supplement helps to increase the number of beneficial bacteria which stabilize the rumen pH and improve the digestibility of ration and its fiber fractions.

i) Practical feeding suggestions

Feed a combination of Non Starch Carbohydrates (NSC) and coarse fiber to maximize dry matter intake and provide rumen available energy for microbial cell production plus adequate amount for rumination, chewing, and saliva

production. Another rule is to feed between 0.9% and 1% of body weight as forage neutral detergent fiber. High moisture grains and fine grinding may increase the rapidity of starch availability in the rumen (may or may not be a benefit). Fats can change feeding patterns and should be introduced slowly at reduced rates. Some change in milk composition is to be expected, especially protein. However, yield of protein should be the same because of increased milk production. Whole seeds (soybean and cottonseed) many times are good, economical sources of at least part of the supplemental fat. Do not exceed 7% of the ration dry matter as fat.

Avoid extremes in amount of Rumen Undegradable Protein (RUP) in rations. Indications are that levels in excess of 40% should be avoided. Probably 35% to 38% of the total protein as RUP is desirable for higher producers. Also, remember that excess protein degradability can be bad. Urea for instance should not be fed at greater than 100 g /cow/day and limits should be placed on using Berseem and Lucerne fodder and corn silage. In other words, balance the rumen degradable and undegradable protein.

9. Designer Milk

i) Reduction of saturated fat in the milk

Feeding of unsaturated fats in an encapsulated or protected form results in quick rise in the degree of unsaturation of the serum lipids, tissue fat and milk fat. Feeding of high unsaturated oil causes depression in total fat, but increases the proportion of unsaturated fatty acids (USFA) to saturated fatty acids (SFA) in milk. There is increase of linoleic (18:2) and linolenic (18:3) acids in milk by feeding oil in encapsulated form. As the melting point of milk fat containing USFA is less, the spread ability of butter made from such milk is improved tremendously. When taken out of fridge at 5^0 C, the butter was nearly as spreadable as margarine, without compromising its special eating qualities. Efforts are underway to determine if genetic difference among breeds and individual animals are translated into ratios of SFA and USFA.

ii) Escalating conjugated linoleic acid (CLA) levels in milk fat

Dairy products are rich in CLA, a product synthesized in the rumen during the bio-hydrogenation of linoleic acid. Diets rich in linoleic acid lead to increase the CLA levels in the milk fat two folds. Milk from grass/fodder fed animals has five times more CLA than milk from a grain fed animal. CLAs reportedly inhibit carcinogens, proliferation of leukaemia, colon, prostate, ovary and breast cancers. They are the only natural fatty acids accepted by the National Academy of Sciences, USA as exhibiting reliable antitumor properties. The other valuable health beneficial effects of CLA are anti-atherogenic effect, altered nutrient partitioning and lipid metabolism, immune enhancement and improved bone mineralization.

iii) Enhancement of Omega fatty acids

Milk from pasture fed cows contains an ideal ratio of essential fatty acids (EFAs). It is evident that replacing grass in the diet with grains or other supplements increases the proportion of omega-6 to omega-3 fatty acids. Too much omega-6 in the diet creates imbalance that can disturb the production of prostaglandins leading to increased tendency to form blood clots, inflammation, high blood pressure, irritation of the digestive tract, depressed immune function, sterility, cell proliferation, cancer and weight gain. On the other hand deficiency of omega-3 is associated with asthma, heart disease and learning deficiencies. There are reports that roughly equal amounts of these two fats in the diet will result in lower risk of cancer, cardiovascular disease, autoimmune disorders, allergies, obesity, diabetes, dementia and some mental disorders.

Scientists are on the verge of running a novel concept of designer milk into reality for the needs of modern consumers. Designer milk is designed by changing the feeding system or expressing or suppressing the target genes in milch animals. Table 2 summarizes the feeding practices which influence milk solids. Correct feeding is the only way to produce milk with maximum levels of milk fat and protein.

Table 2 Feeding management changes witch alter milk solids

Management Factor	Milk Fat %	Milk Protein %
Dry Matter Intake	Increase	Increase
Frequency of feeding	Increase	May increase
Underfeeding	Little effect	Decrease
High Non Fiber Carbohydrates	Decrease	Increase
Small Particle size	Decrease	Increase
High crude protein	No effect	Increase
Escape protein	No effect	Increase
Added fat	Variable	Decrease

Summary

Many factors can influence milk composition. This is an important point to remember when evaluating the potential to improve a herd's milk composition and component yields. Certainly, genetics plays an important role, but changes here are slow. Producers, who pay attention to detail, keep disease to a minimum and adjust their management program as the seasons dictate will be in the best position to take advantage of nutrition management changes that maximize rumen function. The resulting increase in milk components should help improve their bottom line.

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Polyphenols: Newer Additive for Amelioration of Heat Stress in Poultry

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Introduction

Heat exposure affects poultry production on a worldwide basis and has a significant impact on their production and welfare. Heat stress (HS) occurs when the amount of heat produced by body weight surpasses the animal's capacity to dissipate the heat to its surrounding environment. Heat stress has been a great concern among nutritionist and poultry producers, particularly in arid, in tropical due to surge in temperature. The heat stress leads to oxidative stress in birds. The oxidative stress is defined as the presence of reactive species (RS) in excess of the available antioxidant capacity of the cells. Many radicals and metabolic substances are described as potentially toxic and are defined as reactive oxygen/nitrogen/chlorine species. These substances are highly reactive and could affect several biologically active cellular macromolecules, such as proteins, lipids, lipid bilayer and even nucleic acids (DNA and RNA). These sequential reactions leads to the development of severe metabolic dysfunctions, including cell death by causing oxidative stress and oxidative damage. The management of heat stress can be done through the use of genetically more heat tolerant birds, housing management but more convenient approach will be dietary manipulations. Among the nutritional approaches the use of antioxidants (either endogenous or exogenous) has provided promising results. Over the past decade, researchers and food manufacturers have shown interest in polyphenols. The chief reason for this interest is the recognition of the antioxidant properties of polyphenols, their great abundance and their role in the prevention of various diseases associated with oxidative stress, such as cancer and cardiovascular and neurodegenerative diseases.

Polyphenols

Polyphenols are bioactive compounds characterized by the presence of large multiples of phenol structural units. The polyphenols are defined as a phenolic compound containing benzene ring with one or more hydroxyl groups. Commonly are classified according to its chemical structures into non-flavonoids as phenolic acids and phenolic amides or flavonoids, subdivided by their substituents into isoflavones, neoflavonoids, chalcones, flavones, flavonols, flavonones, flavononols, flavanols, proanthocyanidins and anthocyanidins. These compounds are frequently found in beverages, fruits and vegetables, in which they provide the color and flavor, while also contributing in responses to UV radiation, pathogens and other damage in plants. Polyphenols contain active ingredients; they exert non-specific effects on living organisms and regulate the activity of enzymes and cell receptors. They have anti-inflammatory, anti-allergic, immunomodulatory and antimutagenic activities. Most importantly, polyphenols are powerful antioxidants that prevent oxidative stress and reduce the risk of neurodegenerative and cardiovascular diseases.

Types and distribution of polyphenols in foods

Several thousand molecules having a polyphenol structure (i.e. several hydroxyl groups on aromatic rings) have been identified. These molecules are secondary metabolites of plants and are generally involved in defense against ultraviolet radiation or aggression by pathogens. These compounds may be classified into different groups as a function of the number of phenol rings that they contain and of the structural elements that bind these rings to one another. Distinctions are thus made between the phenolic acids, flavonoids, stilbenes and lignans. Individual compounds are classified based on different ring substituents created during hydroxylation, methylation, glycosidation and acylation. The polyphenols are abundant in the pulps and pericarp of the fruits and grains. Among the various sources, the peels of the fruits especially pomegranate which has about 40% of its weight was constituted by the peels or outer layer.

Pomegranate peels are one of the agricultural wastes which are available in huge amounts around the world from canning plants, juice production and food processing units. Pomegranate peels are possessing variety of elements and substances such as protective agents, antimicrobials, enzymes and antioxidants which can be extracted from the residue in many easy and simple ways. Beneficial health effects of pomegranate fruit are due to the components in flowers, seeds, arils and peels. The peels constitute approximately 40% of the whole fruit and are rich in ellagic acid derivatives such as the ellagitannins, punicalagin, and punicalin. In addition, some ellagic acid derivatives (ellagic acid hexoside, pentoside, etc.) are also present, although in lesser amounts. Aqueous extracts of pomegranate peel has been shown to display antioxidant and antibacterial activity. Pomegranate peels are characterized by an interior network of membranes and are characterized by substantial amounts of phenolic compounds, including flavonoids (anthocyanins,

catechins and other complex flavonoids) and hydrolyzable tannins (punicalin, pedunculagin, punicalagin, gallic and ellagic acid). Punicalagin, the main phenolic compound of the peel, has shown remarkable biological activities including anti-inflammatory, hepatoprotective and anti-genotoxic activities.

Impact on heat stress alleviation

Polyphenols could reduce heat stress, oxidative stress and improve the growth rate of heat-stressed broilers. Adding polyphenols extracted from *Tamarindus indica* seed coats did alleviate the oxidative damage upon increased temperatures. The polyphenols like genistein, lycopene and epigallocatechin-3-gallate were found beneficial in alleviating the heat stress and activated the host defense system at the cellular level, substantiated by up-regulation of the transcription factor Nrf2 and down-regulation of NF -κB under stress conditions. The heat-stressed chickens fed grape seed extract at the tune of 300 and 450ppm of feed were characterized by lower ileal counts of Escherichia coli and coliform bacteria on 42d as compared to control group. The *Forsythia suspensa* extract improved the growth performance of broiler chickens under high temperature conditions. The aqueous extract of beetroot improved overall body weight gain, while adding ginger root extract to broiler diets decreased feed consumption under environmental temperatures of 35 to 41◦C and humidity of 30 to 45%.

The diet supplemented with chestnut wood extract improved the average daily gain and improved the feed efficiency in rabbits during summer time. Reduction in mortality due to heat stress in meat type chickens by the supplementation of polyphenols extracted from *Castaneamollissima blume* and chestnut wood extract in rabbits. The reason for this could be that, heat stress modified the metabolism and enzymatic response of broilers and supplementation of these extracts mitigated those modifications. Few studies have been carried out with polyphenols on the alleviation of heat stress in birds (Table 2.2).

Table 1. Studies on polyphenols to assess their impact on heat stress mitigation in birds

S.N.	Polyphenols Origin	Experimental birds	Observations
1.	Polyphenols extracted from Tamarindus indica seed coat	Male broilers exposed to cyclic chronic heat stress @ 38 ± 2°C for 6 h/d	Reduction in the levels of serum malondialdehyde levels in broiler fed with polyphenol extract @ 100ppm
2.	Epigallocatechin-3-gallate (EGCG)	Female Japanese quails exposed to cyclic chronic heat stress @ 34°C for 8 h/d	In liver, malondialdehyde, NF-kB decreased by EGCG. Catalase, Superoxide dismutase, glutathione peroxidase activity were increased by supplementation of EGCG @ 200ppm.
3.	Grape seed extract (GSE,40% proanthocyanidins)	Ross 308 broilers exposed to cyclic chronic heat stress @ 34°C for 8 h/d with RH of 55%.	The oxidative stress (hydrogen peroxide) levels in Pectorial superficialis of broilers were reduced by the supplementation of grape seed extract @ 40ppm.
4.	lemon peel extract (LPE) at 200, 400ppm, orange peel extract (OPE) at 200ppm,	Ross 308 broilers exposed to cyclic heat stress	The erythrocyte glutathione peroxidase activity was increased by lemon and orange peel extract which consisted for polyphenols.
5.	Grape seed extract @100, 200ppm	Hubbard broilers exposed to heat stress	Liver superoxide dismutase, reduced glutathione levels were increased and heterophils: lymphocyte ratio, triglycerides and liver malondialdehyde were reduced in supplemented groups.
6.	Extract from dried fruits of Forsythia suspense (FSE) at 100ppm	Male Arbor Acres broilers to cyclic chronic heat stress @ at 32 ± 1 °C, (RH = 44 ± 6 %)	Serum total anti-oxidant capacity was increased by FSE. The malondialdehyde levels reduced and increased the SOD. In liver, malondialdehyde levels were reduced and increased SOD. At the tissue level the activity of superoxide dismutase was increased.
7.	Methanolic extract of pomegranate peels	Broilers maintained under heat stress condition	Improved the growth performance, heat stress indicators and welfare in broilers fed with pomegranate peels extract @ 50ppm.

Conclusion

The polyphenols are widely used in human treatment especially for the intestinal disorders due to its potent antioxidant activity. With the annual rise in global temperature, even the temperate countries are now started to discuss about the negative effect of heat stress in birds. Among the dietary approaches, the polyphenols could be the newer feed additive for alleviation of heat stress in birds.

Literatures cited: Available on request.

Nutritional Enrichment Of Adult Ruminant Ration Using Urea

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Abstract

In India, out of total available land for agriculture, only 4-5 % is utilized for fodder production (Handbook of AH, 2016). The deficit of green and dry fodder was presented by Rathod and Dixit (2019) as 63.50 and 23.56 %, respectively in 2015 as per X five year plan report which is projected to increase further by 2020 and 2025. So, it is imperative that farmers must utilize the available feed resources in a best way to have maximum production. At present, total food grain production in India is more than 273 million tonnes and wheat along with rice contributes to about 200 million tons (around 73% of total food grains). This leads to availability of huge amount of wheat and paddy straw. Roughages like paddy and wheat straw being poor in nutrient content are mostly utilized for feeding farm animals. The digestible crude protein content of straw is nearly zero. One of the method that farmers can use is inclusion of urea in ruminant diet. Ruminant farm animals, which have four-chambered stomach, can utilize NPN (urea) as a source for protein synthesis with the help of rumen microbes.

Feedstuffs that contain Nitrogen in a form other than proteins or peptides are called non protein Nitrogen (NPN) sources. An inorganic NPN compound includes a variety of ammonium salt and ammoniated by-products among which urea is widely used for feeding of animals with a functioning rumen as a substitute of protein feeds. Urea is an organic compound with chemical formula NH_2CONH_2, also known as carb-amide. Physically, it is a colorless, odourless solid ,being highly soluble in water. It is found in urinary excretion (urine) of mammals, amphibians and fishes. Being an important source of Nitrogen, it is used as a fertilizer and is now produced on an industrial scale from synthetic ammonia and carbon dioxide.

In mammals, body urea is produced from ammonia in liver. The protein after digestion is converted to amino acid which are absorbed in intestine and excess amino acids, which are not utilized by the body, are metabolized in liver by de-amination and Nitrogen of the amino acids is converted to ammonia. Urea is produced as ammonia which is more toxic to the body.

Protein contains 16% Nitrogen. If a compound containing Nitrogen somehow gets converted to protein , crude protein yield will be Nitrogen % multiplied by factor 6.25, thus urea having average of 45% Nitrogen would have crude protein equivalent to 281%. In ruminants, largest compartment of stomach (rumen) contains the micro floras which are capable of utilizing the Nitrogen of different sources into useful protein.

Factors affecting urea utilization: The efficiency of urea utilization depends upon feeding methods and composition of ration.

- Rumen micro-flora establishes within 6-12 weeks, thus urea must be included only after that period. Urea should be given in large ruminants only after 6 months of age.
- Adaptation period of 2-3 weeks is needed when urea is included in diet.
- Frequent feeding helps to utilize urea better.
- Readily available sources of energy like molasses should be present.
- Methionine enhances urea utilization.
- Urea provided in low level is better utilized.
- High protein diet reduces the urea utilization.
- Sulphur is required to be supplemented with Nitrogen in N: S ratio 10:1
- The safe level of urea in concentrate feed is 2 – 3 % and 1% in the total DM consumed.
- The maximum level provided in adult cattle is 100 g/day.

Consequences of excess urea present in feed

Excessive urea in feed can lead to ammonia toxicity in animals. Excessive salivation, tetany, bloat, respiratory difficulties and even death may occur. These toxic effects appear when rumen level reaches to 80 mg/ 100ml.

Different methods of urea inclusion

Urea can be provided to ruminant by different methods with taking following factors in account: i) Protein need ii) Availability and cost of urea iii) Availability of energy sources iv) Cost of mixing and processing

1. **Urea treated straw**

For every 100 kg straw, a solution of 40 kg water and 4 kg urea is sprayed uniformly and entire stock is then covered by polythene sheet or by gunny bags or by banana leaves for about 3- 4 weeks. The treated straw will then be ready for serving adult cattle and buffaloes with more palatability, digestibility and will then be used for protein synthesis by rumen microbes after the enhancement of Nitrogen content of straw. Substantial improvement in milk production and growth has been reported after feeding of urea-treated straw.

2. **Starea**

"Starea" is a product which was developed by Bartly and co-workers in Kansas University, USA by cooking mixture of starch and urea at optimum temperature, moisture and pressure and extruding the material in the form of a pellet. Grains like corn, barley, wheat, sorghum etc can be used as a starch source. Starea makes energy available to the rumen micro-organismns at a rate similar to that at which urea releases ammonia, so the micro-organisms are simultaneously provided with the main components for microbial protein synthesis.

3. **Urea molasses liquid feed**

Liquid molasses containing 2-3% urea fortified with vitamins and minerals named as liquid feed can be used as ruminant feed. Normally, it is prepared by dissolving 2.5 parts of urea in equal amount of water. The mixture is then fortified with vita blend at the rate of 25 gm per 100 kg liquid feed. Common salt @ 1 part and mineral mixture @ 2 part are sprinkled over 92 part molasses. (2.5 parts urea + 2.5 parts + 1 part salt + 2 parts mineral mixture + 92 parts molasses = 100).

4. **Urea molasses mineral block lick**

Urea-molasses feed blocks can be prepared by incorporating 10% urea in molasses. It should not be very hard or very soft. If UMMB will be soft, its consumption will be more and chances of getting toxicity will be more. Cement and calcium oxide were found to be good binding material for UMMB preparation.

National dairy development board popularized this block and gave it a name "Buffalo chocolate"

Ingredient	Molasses	Urea	Bran	Soybean	Cement	Salt
Proporation Requirement (kg)	39	10	25	13	10	3
For 50 blocks (kg)	97.5	25	62.5	32.5	25	7.5
For 100 blocks (kg)	195	50	125	65	50	15

Ingredients used in standard UMMB
(Source : www-naweb.iaea.org/nafa/aph/faq-ummb.pdf)

5. **Biuret**

Biuret is a NPN compound produced by heating urea. Its Nitrogen content is 40.8% and CP equivalent to 255% lower than urea, but it is not toxic even at high levels than recommended. The more gradual release of Biuret in the rumen gives better forage digestion throughout the day than a urea supplement. It is not toxic even at very high level than recommended. Its disadvantage is that it is a little bit expensive.

6. **Urea in urine**

Urine is a free source of urea and can be utilized as a source of non protein Nitrogen which also contains creatinine and uric acid. Majority of urine (95%) is water, 2.5% urea and the remaining 2.5% is a mixture of minerals, salt, hormones and enzymes (Bhaduria, 2002). Soaking of straws with water before feeding have beneficial effects through removal of oxalates, silica and pebbles and at the same time, straw becomes soft. If urine is used for soaking straw, it will have two beneficial effects – first, the water of urine removes oxalates, silica and pebbles and second, urea improves the Nitrogen content, thereby, improving the quality of straw.

Roughages being poor in nutrient content like paddy and wheat straw are mostly utilized for feeding farm animals and urea can be used for improving the nutritional quality of paddy and wheat straw which are available in huge amount in our country. Over the last three decades, average productivity of Indian cattle and buffaloes has grown from 1.9 to 3.9 kg per day, and from 3.7 to 6.2 kg per day, respectively. The average daily milk yield for crossbred cattle is better at 7.1 kg per day, but still significantly lesser than the best of global standards — UK, US and ISRAEL are at 25.6, 32.8 and 38.6 kg per day, respectively. So, we can say the productivity in the sector is six times below its potential.

Hence, improving the nutritional quality of available feed and fodder will certainly improve the production in farm animals. Urea inclusion in recommended rate in ruminant ration, therefore, can serve the purpose of filling the deficiency of good quality ration for ruminant farm animals of the country.

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AB Vista: NIR tools can reduce losses linked to feed ingredient variability

By Aerin Einstein-Curtis, 14-Feb-2017

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NIR technology is moving beyond analysis of traditional components such as fibre and protein to include measurements of phytate, energy and reactive lysine, says AB Vista.

The company works with near infrared (NIR) technology as way to help customers format their feeds more precisely and avoid wasting essential nutrients, said Glison Gomes, global technical manager, AB Vista.

We caught up with him at the International Processing and Packaging Expo (IPPE) in Atlanta to hear more about how the technology can be used for precision feeding, and what new uses may be in available in the future.

"This [NIR analysis] service allows the customer to better understand the key ingredient that is the cereal, and therefore utilize it wisely," he said. *"We don't want our customers to have to put in an extra safety margin, we want them to be precise [and] to have better profitability."*

NIR analysis can be used to screen amino acids now, he said.

"In the past it was not possible to analyze amino acids, and then with better technology, better computational software we're able to measure tiny things in the feed or in the feedstuffs," he added.

"In the beginning everyone was skeptical about NIR; it is only recently that everyone has been keener to use and understand it," he said. *"Also computational technology has evolved a lot – you are now able to carry out data transformation to increase the precision of this technique."*

AB Vista: *"Currently used for basic raw material and feed quality control, new advances in NIR software and hardware are set to deliver commercially viable systems capable of in-line and real-time monitoring of feedstuff and feed nutrient content and physical characteristics. Losses associated with feed ingredient variability can be reduced, feed formulations can be amended and the quality of completed diets continuously monitored."*

Energy capture

One goal of using NIR tools in feed formulation is to ensure that nutritional elements in a feed are not wasted, said Gomes. For example, if a producer knew that two loads of corn being used to make a feed offered different energy levels, they could select the one required for optimal animal performance, he said.

The energy value of different cereals can vary by 360 kcal/kg, said AB Vista, while phytate levels vary not just between feedstuffs but also within a single raw material.

The technology also allows producers to evaluate feed ingredients coming from different locations, said Gomes. It also allows them to both specify and verify that feed ingredients contain certain elements.

"We have a big database of raw materials coming from different countries and for instance some companies import corn from the US, from Argentina, and from Brazil and then you can see the differences," he said. *"I can pay a little bit more for supplier a, b or c because the quality of their feedstuff is a little bit better, or there is more protein or more energy."*

Mixed feed analysis

One recent advancement in NIR technology has been to allow for the analysis of mixed feeds rather than single feed ingredients, said Gomes. However, it is still a common misconception that ingredients have to be examined individually.

"There is still misunderstanding about NIR," he said. *"The technology picks up the vibration of molecules, so organic molecules vibrate and this happens regardless of if they are alone or if they are in a mixture. So in reality, if you have a very good database and a very good calibration, you will be able to pick up differences or vibrations even in complete feed."*

Although NIR technology to track potential anti-nutrients, such as mycotoxins, is not available yet, that is being explored, said Gomes.

Eventually the ability to analyze the nutritional elements or qualities of a feed ingredient could allow feed mills the chance to channel ingredients by grade, said Gomes. But facilities would likely need to significantly increase the number of silos or storage options to make use of that process, he added.

He said improved computer processing speeds would enable feed mill mixing systems to both evaluate feed ingredients as they are brought into a facility and to modify feed formulations as needed: *"We don't have fast enough computers and*

systems to make all of this happen, but people are using these technologies in milk [analysis] – so you have this sort of inline stuff going on with more simple models and that I do believe this will happen soon in the feed industry."

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Indicator Sensors For Monitoring Meat Quality: A Review

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Food safety and control requires the application of analytical techniques capable of producing reliable data in order to establish if food complies with the regulatory organization criteria. As society is becoming more complex, users (food producers, food processors, logistic operators, retailers and consumers) continuously demand innovative and creative food packaging to guarantee food safety, quality and traceability of end products. This requires appropriate technologies that can be integrated in food packaging. As a result, over the last decades, researches have shown a growing interest in developing different food safety measures to ensure security and quality of food. The food industry throughout the world is constantly trying to enhance the safety of products by acquiring new technologies.

Indicators are devices that give some information about the presence or absence of a substance or the degree of interaction between two substances by changing in characteristics, like color, texture, order, flavour etc. The difference between sensors and indicators is that the latter do not have receptor and transducer components and instead communicate information through direct visual changes. There are three categories of well known indicators that are time-temperature, gas and dye based freshness indicators.

Time temperature indicator

Time-temperature indicator (TTI) is a simple quality recording device that is able to show irreversible visual response to monitor and record critical parameters throughout the entire supply chain from production to the storage and distribution of products including domestic storage. Consumers can easily check the quality of food using TTIs, expressing a visible response of colour development that correlates to the shelf life of food stuff at a target temperature (Kerry et al., 2006). TTIs are applied to reflect the time-temperature history of the chilled and frozen food such as marine food products, meat and poultry products. TTIs have also been applied to assess the pasteurization and sterilization process to estimate the remaining shelf life of food products.

TTIs can be sub divided into three groups based on the working principle:

1. Physical systems
2. Chemical systems
3. Biological systems

Commercially available TTIs include a number of diffusion, enzymatic, polymer based, solid state reaction and microbiological systems. Diffusion-based TTIs such as Monitor Mark TTI, commercialized by the 3 M Company are based on temperature-dependent diffusion reaction of a coloured fatty acid ester along a porous wick made of high quality blotting paper. Its measurable response is the distance of the advancing diffusion front from the origin.

Polymer-based systems such as the fresh check TTI produced by the company Temp-Time are based on solid state polymerization of a thinly coated colourless acetylene monomer that changes to a highly coloured opaque polymer at a temperature-dependent rate. Solid state reaction systems represented by on Vu™ TTI produced by the Ciba company are based on photosensitive compounds such as benzyl pyridines. It once exposed to allow wavelength light, they become coloured and this coloured state reverses to the initial colourless state according to temperature.

Enzymatic systems such as the VITSAB Check Point TTI are based on a colour change in the TTI induced by a pH drop of product resulting from controlled enzymatic hydrolysis of a lipid substrate which changes colour of the chromatic indicator from green over yellow to orange red. Active Chitosan/PVA Films with anthocyanins from Brassica oleraceae (Red Cabbage) was prepared which acted as time-temperature indicators in intelligent food packaging applications. Other microbiological TTIs are proposed by the French company CRYOLOG, TRACEO and eO made of selected strains of lactic acid bacteria. Prior to utilization these TTIs are stored in a frozen state (-18°C) to prevent the bacterial

growth in the TTI medium. As they are very thin, their activation is obtained simply by defrosting them for a few minutes at the room temperature. Once they are put on the food, and in case of temperature abuse or when the product reaches its use by date, the temperature-dependent growth of the TTI microorganisms causes a pH drop in the tags leading to an irreversible colour change of the medium chromatic indicator which becomes red.

Dye based Indicator/Sensors

Chemical Indicator dyes

Indicators use as an indicator dye and a carrier for indicator dye which will hold and carry it. Intelligent packaging applications have been used for monitoring spoilage of meat and its product to predict its remaining shelf life. A chromogenic sensor array was prepared for monitoring boiled marinated turkey meat freshness using 13 indicators (including pH indicators, nucleophilic sensing dyes etc.) and three different inorganic supports i.e. UVM-7, alumina and silica gel.

Several attempts have also been made for utilizing different chemical dyes used as an indicator solution for the development of an indicator sensor. Mixture of bromothymol blue and phenol red was proposed for fabrication of the indicator sensor responsive to TVBN released from chicken meat during storage. Polyaniline (PANI) film-based chemical sensor was developed for real-time monitoring of microbial breakdown products in the headspace of packaged fish that responded through visible colour change to a variety of basic volatile amines specifically to TVBN released during fish spoilage. Bromocresol green was used to monitor the production of TVBN and prediction of fish freshness. A novel on-package sticker sensor based on methyl red as an indicator solution was developed to monitor broiler chicken freshness. Boscher et al. (2014) described the detection of volatile amines such as trimethylamine (TMA), triethylamine (TEA) and dimethylamine (DMA) using a novel metalloporphyrin-based coating applied onto PET films.

Natural Indicator dyes

Chemical indicator dyes are synthetic chemicals which are harmful to the consumers if leaked and are difficult to handle also. Moreover chemical dyes are difficult incorporate in indicator carrier. In recent years different natural dyes have been used for development of indicator sensors. There are many reports of the use of dyes contained in plant tissues for colorimetric determination of pH. It has been found that colour changes in such dyes are due to the presence of phenolic or conjugated substances such as anthocyanins, which are subjected to structural changes when there is a variation in pH.

Some natural pigments from fruits and vegetable sources like anthocyanins have great potential as indicators in intelligent packaging systems because the color expression of anthocyanins is strongly influenced by its structural conformation which is highly influenced by its pH. This color instability of anthocyanins makes these pigments especially useful as a tool to monitor food quality and therefore can be used as an indicator of food spoilage in intelligent packaging systems. Anthocyanin extracted from Ripen black mulberry (Morus nigra) was used for developing quality indicator for monitoring quality of fresh chicken meat during storage at room temperature. The sensor changes its colour from yellow to orange and then to reddish orange during spoilage. Chitosan based intelligent film mixed with anthocyanin was developed as fast pH-colorimetric device for spoilage detection of food based on pH variation. Curcumin based indicator sensor which showed colour response in reaction to TVBN was developed to monitor the spoilage level in shrimp. Active Chitosan/PVA Films with anthocyanins from Brassica oleraceae (Red Cabbage) was developed as Time-Temperature indicators for application in intelligent food packaging. A colorimetric pH indicator film was developed using natural dye anthocyanin extracted from purple sweet potato (Ipomoea batatas).

Carrier for dye based indicator/sensor

Agarose was used as carrier for myoglobin to detect hydrogen sulphide production during spoilage of un-marinated broiler cuts. Different types of papers (untreated cellulose), polyamides, cellulose acetate, gel, foam and resins were used as carriers with most preferred thickness of about 1 mm. Poly-tetrafluoroethylene (PTFE) solid substrate was used to immobilize ammonia-sensitive indicator dye which showed change in spectral characteristics on exposure to volatile acidic and basic compounds. Bacterial cellulose membrane made from acetobacter xylinum culture was used as an indicator carrier for curcumin. Biodegradable materials derived from natural resources can be used as interesting potential substitutes for traditional non-biodegradable plastic polymers due to their low cost, easy availability from reproducible resources and biodegradability. As biodegradable films acts as barriers to control the transfer of moisture, oxygen, lipids and flavour, they can be used as self standing films for indicators.

Gas Sensors

Gas sensors are devices that respond reversibly and

quantitatively to the presence of a gaseous analyte by changing the physical parameters of the sensor and are monitored by an external device. An optochemical CO_2 sensor which uses a phosphorescent reporter dye and a colourimetric pH indicator showed robust optical responses to CO_2. The sensor is designed as film coatings to be applicable in meat packaging. In recent years, a number of instruments and materials for optical oxygen sensing have been described. Such sensors are usually comprised of a solid-state material, which operate on the principle of luminescence quenching or absorbance changes caused by direct contact with the analyte. These systems provide a non-invasive technique for gas analysis through translucent materials and as such are potentially suitable for intelligent packaging applications. The solid-state sensor is inert and does not consume analyte or undergo other chemical reactions. Optochemical sensors have the potential to enhance quality control systems through detection of product deterioration or microbial contamination by sensing gas analytes such as hydrogen sulphide, carbon dioxide and amines.

Conclusion

In the food sector, one of the most important problems is the time-consuming and laborious process of food quality-control analysis. Innovative devices and techniques are being developed that can facilitate the preparation of food samples and their precise and inexpensive analysis. From this point of view, the development of colorimetric sensors to detect spoilage is a particularly promising application of food microbiology. Intelligent packaging applications in the meat industry are still limited. It could be expected that the continuous advances in biotechnology, analytical chemistry, microelectronics, and materials science will contribute to the development of new intelligent packaging solutions. The growing need for information on packaging points to a step change in the way this information is provided, driving the need for smart packaging use, particularly for food products. Consumers increasingly need to know what ingredients or components are in the products and how they should be stored and used. Another important need is consumer safety assurance, particularly for perishable food products. In the future, the use of smart packaging in food products will give a clear, accurate, and unambiguous indication of product quality, safety and shelf-life condition.

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