English Monthly from Hyderabad, India

RNI Regn. No. 52899/93

Aqua International

Estd. 1993

Health • Nutrition • Management • Processing

May 2021

Annual Subscription: Rs 800 Foreign $ 100

Inside...

SDC Solutions for optimizing your Aquaculture business performance

HEALTHY ANIMALS, HEALTHY FOOD, HEALTHY WORLD

Pervic-A™

Ultimate high level Disinfectant

SDC Biobac-N®

Water & Soil Probiotic

ODOCLEAR-A40®

Natural protection for super natural growth

For Details Contact:

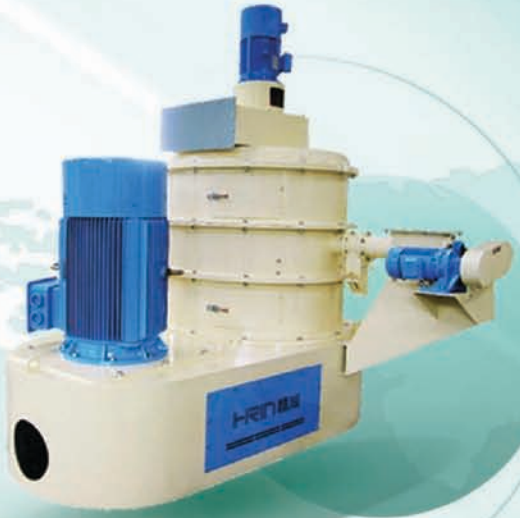
SDC AGRO-VET (INDIA) PVT. LTD.,

#103 & 104, SDC HOUSE, D. NO. 12-13-97, Tara Tycoon,Tarnaka,
SECUNDERABAD-500 017. T.S. INDIA.
Ph: +91-40-27006075, Fax : +91-40-27006076.
email : info@sdcagrovet.com www.sdcagrovet.com

An ISO 9001 : 2015 Certified company

SDC Products Registered with CAA as Antibiotic-free product

Professional Feed Machinery Manufacturer



Hengrun SWFL Series Vertical Pulverizer

Vertical shaft with no-screen grinding, Bearing no maintenance. The production is uniform and the fineness is adjustable (Range from 40~200 mesh.)

Hengrun HRYTZ Series Vacuum Sprayer

Totally enclosed spraying space, Precision & Efficient spraying proportion widely ranged from 2%-30%.

Spiral Stopper

Bevel Gear Box

2 HP Motor

Spiral

Worm Shaft & Wormwheel

Spiral [Helical] Gear Box

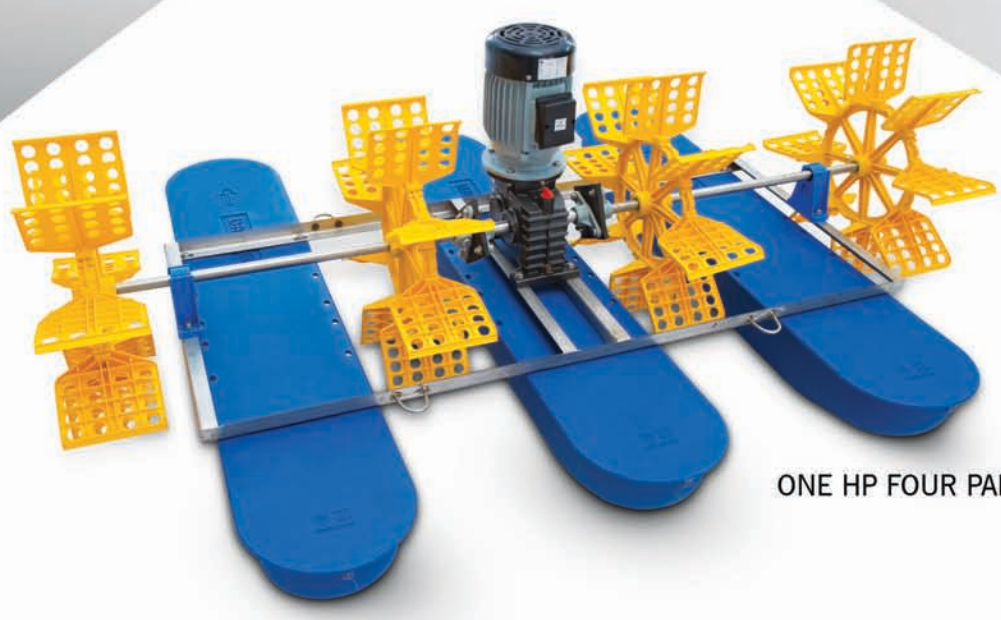
1 HP Gear Box

Paddle Wheel

Long Arm Gland

2 HP Gear Box

2 HP Out Put Shaft



ONE HP FOUR PADDLE WHEEL AERATOR

1 HP Two Paddle - 2 HP Four Paddle - 2 HP Six Paddle

High Productivity - Excellence Performance - Easy Installation - Low Maintenance - Long Life

Aqua International

English Monthly Magazine
(Established in May 1993)

Volume 29 Number 01 May 2021

Editor & Publisher
M. A. Nazeer

Editorial & Business Office:
AQUA INTERNATIONAL
NRS Publications,
BG-4, Venkataramana Apartments,
11-4-634, A.C.Guards,
Hyderabad - 500 004, India.
Tel: 040 - 2330 3989, 96666 89554
E-mail: info@aquainternational.in
Website: www.aquainternational.com

Annual Subscription
India : Rs. 800
Foreign Countries : US $ 100
or its equivalent.

Aqua International will be sent to the subscribers in India by Book Post and to the foreign subscribers by AirMail.

Edited, printed, published and owned by M. A. Nazeer and published from BG-4, Venkataramana Apts., 11-4-634, A.C.Guards, Hyderabad - 500 004, India. Printed at Srinivasa Lithographics.

Registered with Registrar of Newspapers for India with Regn. No. 52899/93. Postal Regn. No. L II/ RNP/HD/1068/2021-2023.

NRS PUBLICATIONS
www.aquainternational.in

CONTENTS

ADVERTISERS' INDEX

Subscriptions for Aqua International, English monthly, should be sent to:
The Circulation Department, Poultry Fortune, BG-4, Venkataramana Apartments, 11-4-634, A.C.Guards, Near Income Tax Towers, Hyderabad - 500 004, India. Email: info@aquainternational.in

MM Gears Pvt Ltd.
Delivering Innovation

A' Series - Aqua Culture Gearbox

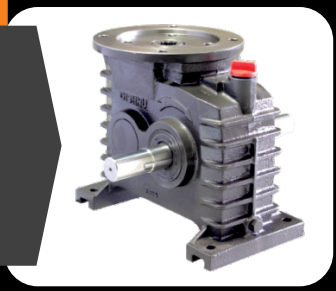
GISHNU
Transforming Innovation

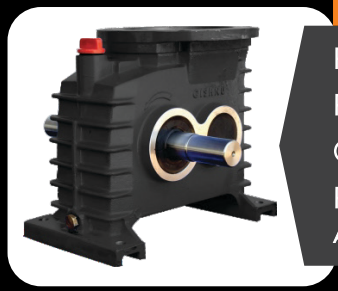
Gishnu Gears, an ISO 9001-2015 certified company is a leading manufacturer of gearboxes in India, backed by expertise spanning to three decades - The company offers superior products of international standards

FLOATING BEVEL GEAR BOX

Type : A3 Power (Casting)

Range : 1 hp to 3 hp
Pedals : 4, 6 & 8
O/p RPM : 105, 120, 140 & 160
Power savings : 75%





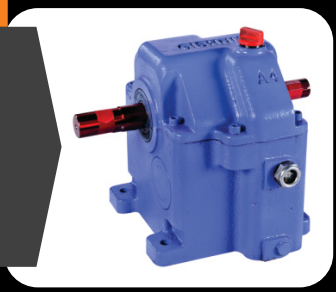
Type : A3 Aero RF (Aluminium)

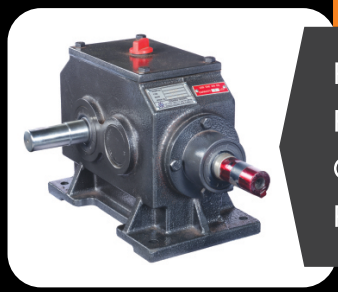
Range : 1 hp to 3 hp
Pedals : 4, 6 & 8
O/p RPM : 105 & 120
Power savings : 75%
Aluminium housing with Anti-rust coating

LONG ARM GEAR BOX

Type : A4 Single Side

Power savings : 70%
O/p RPM : 72 & 115
2 hp = 12 Pedals
3 hp = 16 Pedals





Type : GBH

Range : 3 hp & 5 hp
Pedals : 8+8 & 20+20
O/p RPM : 105 & 120
Power savings : 60%

Delivering More than Expectation

A' SERIES SPARES


Spiral Bevel Pair


Helical Pinion


Helical Gear


Worm Wheel Pair

SF No: 796/1B, Near Hotel Le Meridien,
Neelambur, Coimbatore - 641 062,
Tamil Nadu.

Mob : 99439 17774 | 96558 63638

E : marketing@gishnugears.in / marketing@mmgears.in
www.gishnugears.com I www.mmgearsindia.com

Stakeholders together should meet the Govt and take time target to resolve issues of the industry

Dear Readers,

The May 2021 issue of ***Aqua International*** is in your hands.

Most of us want to get benefited with our activity in Aquaculture sector which is logical, but it is possible when the sector as a whole with different segments is doing well. In order to know the issues of the industry the stakeholders should join together and discuss. Welfare and sustainable growth of this sector is possible when all the prominent stakeholders of the industry come together on a common platform.

The Government run by politicians and bureaucrats can do greatly for the development of this sector, but is it happening ? You have separate ministry and the department for Fisheries and you have planning department also.

There are thousands and lakhs of farmers, employees and the entrepreneurs dependant on aquaculture sector. If the sector is affected, what would be the fate of their future ? I saw it in 2005 to 2009 in Indian aquaculture sector.

We have four important segments like farming, seed, feed and processing-cum-exports with supporting segments like health and nutrition etc.

Basic thing is that the decision making people and the stakeholders in the private sector should meet together on a common platform and discuss the issues of the sector, and meet concerned Ministers and the Bureaucrats together at state and central government level and make effective submission on the issues of the industry. Take a time target to resolve the issues. Every one's prospects and future depends on the good performance of the industry as a whole.

I am submitting the facts and the happenings in the industry in front of you all, so that all of you think and work in the interests of the industry and all of us.

✦✦✦✦✦

As I feel there is a sense in talks and messages by experts on **Steam Inhalation** to get rid of Corona Virus from human body, I put the below message for you to take your choice of decision.

Can steam inhalation save you from Covid-19 virus? The hot water you drink is good for your throat. But this Corona virus is hidden behind the Paranasal sinus of your nose for 3 to 4 days. The hot water we drink does not reach there. After 4 to 5 days this virus that was hidden behind the paranasal sinus reaches your lungs, which triggers breathing issues. That's why it is very important to take steam, which reaches the back of your Paranasal sinus. If you want to stay safe and kill the corona virus, which could be hiding inside your nose, then you should start taking steam which will reach to your nose and kill the virus.

✦✦✦✦✦

In the News section, you may find news about – ***Centre to certify shrimp farms.*** The move is aimed at building exporter's confidence in India's frozen produce. To bolster confidence in India's frozen shrimp produce, the country's biggest seafood export item, the Centre has kicked off a new scheme to certify hatcheries and farms that adopt good aquaculture practices. India exported frozen shrimp worth almost $ 5 billion in 2019 – 20 to the U.S. and China - its biggest buyers. But a combination of factors had hurt export volumes in recent months, including container shortages and incidents of seafood consignments being rejected because of food safety concerns.

Mechanised fishing boat operators in Kerala are insisting that they be allowed to carry out fishing in deep sea waters like their counterparts in other states and countries. The operators, who are curbed by the state government not permitting them to venture out into the deep sea, have pleaded their case with the Union Government. While fishing boats in the State are not allowed, trawlers, particularly from China, are allowed to venture into deep sea.

CLFMA OF INDIA organized Online Panel discussion on Soybean and other Oilmeals Demand and Supply Outlook- Present & Future on 12 April 2021. It was held with the objective to discuss the Present Raw Material Situation (Demand & Supply) of Soybean and other Oil meals in India and to enable all industry players to come together and show solidarity for representing the government in all matters, as an expert opinion about this burning topic was the need of the hour.

Contd on next page

NRS GROUP

Aqua International

Our Mission

Aqua International will strive to be the reliable source of information to aquaculture industry in India.

AI will give its opinion and suggest the industry what is needed in the interest of the stakeholders of the industry.

AI will strive to be The Forum to the Stakeholders of the industry for development and self-regulation.

AI will recognize the efforts and contribution of individuals, institutions and organizations for the development of aquaculture industry in the country through annual Awards presentation.

AI will strive to maintain quality and standards at all times.

TALK TO US

SEND AN EMAIL:

info@aquainternational.in

Please do not send attachment.

FOLLOW US:

facebook.com/aquainternational.nrs

twitter.com/nrspublications

Send a letter: *Letters to the Editor must include writer's full name, address and personal telephone and mobile numbers. Letters may be edited for the purposes of clarity and space. Letters should be addressed to the Editor:*

AQUA INTERNATIONAL, BG-4, Venkataramana Apartments, 11-4-634, A.C.Guards, Near Income Tax Towers, Masab Tank, Hyderabad - 500 004, T.S, India.
Tel: +91 040 - 2330 3989, 96666 89554. Website: www.aquainternational.in

Global food major Cargill sees India emerging a 'strategic market' for its growth. Indian arm's chief Simon George views the country as a focus region. Cargill India Pvt Ltd, a unit of the privately held US-based global food company Cargill, sees Asia as the biggest growth region in the coming decade with China and India being the "growth-centric" ones. Simon George, President, Cargill India says "China accounts for a substantial percentage of Cargill's global business which has a turnover of $115 billion. And India is equally important with its economy set to become $ 8 trillion by 2030".

Blue Aqua International launched the Doctor Shrimp Academy and Clinic on the 8 April 2021 to provide practical skills training and shrimp diagnostics services for the shrimp farming industry globally. The company claims that it has been at the forefront of super-intensive shrimp farming with more than 4,000 customers worldwide.

In the Articles section -- Article titled ***Mobile Feed Mill: An innovative approach for transforming farm-made feed to quality feed,*** written by Mr Krishna Pada Singha and other authors highlighted that Mobile Feed Mill could be a transit step between farm-made feed and commercial feed based aquaculture. Employment generation and entrepreneurship development through MFM. Production of nutritionally balanced feeds for fish using locally available ingredients. Great opportunity to utilize the Pradhan Mantri Matsya Sampada Yojana to strengthen the fish farming in India.

Another article titled ***Blue Carbon Ecosystem: A strategy to mitigate global climate change,*** written by Suman Nama and other authors highlighted that the Global climate change raising threats for the coastal areas. Climate change causing sea level rise, Tsunamis etc that damage the coastal ecosystem. Blue carbon ecosystem such as mangroves, the salt marsh has got huge potential to sink the atmospheric carbon and mitigate the global climate change.

Article titled ***Mechanisms of Antimicrobial Resistance in Bacteria,*** written by Petchimuthu M. and other authors highlighted that Antimicrobial resistance develops when microorganisms change when they are exposed to antimicrobial drugs. The main cause of antimicrobial resistance is due to indiscriminate use of antibiotics. When we use antibiotics, some bacteria can survive and even multiply. The frequent use of antibiotics, the more chances bacteria have to become resistant to them. Intrinsic resistance, circumstantial resistance and acquired resistance are the types of resistance found in animals.

Another article titled ***Plastic Eating Bacteria- A solution to plastic pollution ?*** written by Abarna Krishna Moorthy and other authors highlighted that Plastic accumulates not only on beaches worldwide, but also in "remote" open ocean ecosystems. Globally, we generate around 57 million tonnes of plastic waste per year with between 5 and 13 million tonnes of this ending up in our surrounding environment, particularly in the oceans.

Readers are invited to send their views and comments on the news, special feature and articles published in the magazine which would be published under "Readers Column". Time to time, we shall try to update you on various aspects of Aquaculture sector. Keep reading the magazine regularly and update yourself. Wish you all fruitful results in your efforts.

M.A.Nazeer
Editor & Publisher
Aqua International

FAMSUN

Integrated Solution Provider

Vacuum coater

Exceptional design & Flexible operation

Vacuum coater for the application of oil or fat, pigments, flavors, functional improver, vitamins, etc. onto pellets after drying and/or cooling. Aquafeed and pet food in particular.

FAMSUN Co., Ltd.

Add: No.1 Huasheng Road, Yangzhou, Jiangsu, China 225127
T:+86-514-87848880
E-mail:mypublic@famsungroup.com
www.famsungroup.com

India Office

Add: No 401 , Dega Towers , Raj Bhavan Road , Somajiguda , Hyderebad , Telangana - 500082
T: +62-21-30027458; 30027459
Contact: Arun Kumar K
E-mail : arunkumar@famsungroup.com
Mob: +91 9901916554

Contact: Shelby
E-mail: lxb@famsungroup.com
Mob: +91 9100436652

Centre to certify shrimp farms

The move is aimed at building exporter's confidence in India's frozen produce.

New Delhi, 11 April 2021: To bolster confidence in India's frozen shrimp produce, the country's biggest seafood export item, the Centre has kicked off a new scheme to certify hatcheries and farms that adopt good aquaculture practices.

The Marine Products Exports Development Authority (MPEDA) has developed a certification scheme for aquaculture products called 'Shaphari', a Sanksrit word that means superior quality of fishery products suitable for human consumption.

India exported frozen shrimp estimated at almost $ 5 billion in 2019-20

India exported frozen shrimp worth almost $5 billion in 2019 – 20 to the U.S. and China - its biggest buyers. But a combination of factors had hurt export volumes in recent months, including container shortages and incidents of seafood consignments being rejected because of food safety concerns.

"We have seen some recent consignments sourced from Indian shrimp farms being rejected due to the presence of antibiotic residue and this is a matter of concern for exporters," a Commerce Ministry official said.

India exported frozen shrimp estimated at almost $ 5 billion in 2019-20

"We already have a National Residue Control Programme for food safety issues in farm produce and pre-harvest testing system in place, but this certification was proposed as a market-based tool for hatcheries to adopt good aquaculture practices and help produce quality antibiotic-free shrimp products to assure global consumers," the official said.

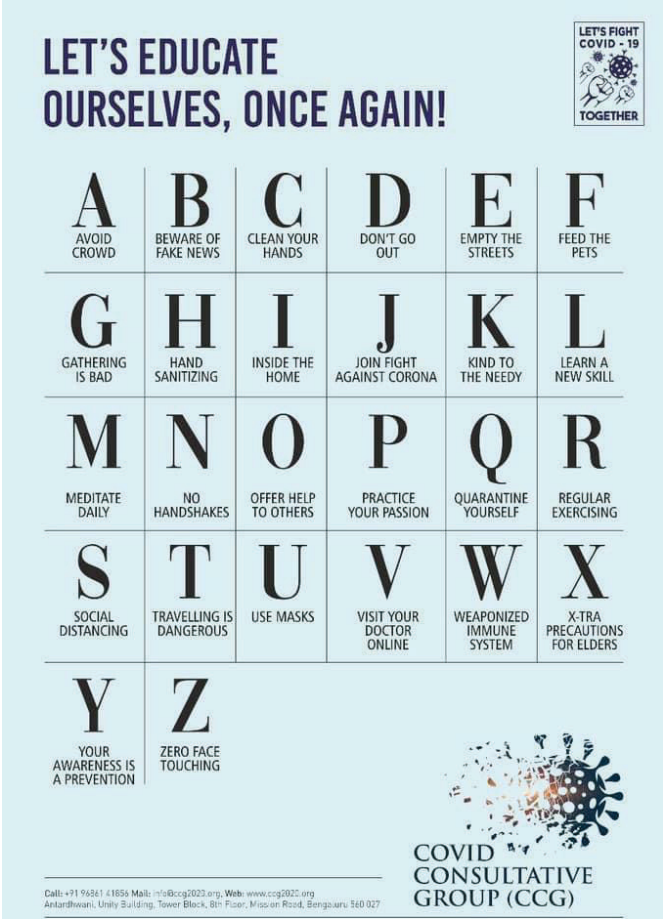
Frozen shrimp is India's largest exported seafood item. It constituted 50.58% in quantity and 73.2% in terms of total U.S. dollar earnings from the sector during 2019 - 20. Andhra Pradesh, West Bengal, Odisha, Gujarat and Tamil Nadu are India's major shrimp producing States, and around 95% of the cultured shrimp produce is exported.

"Overall, certified aquaculture products will help exporters to export their consignments to markets under stringent food safety regulations without the fear of getting rejected," the official explained.

The Shaphari scheme is based on the United Nations' Food and Agriculture Organization's technical guidelines on aquaculture certification and will have two components — certifying hatcheries for the quality of their seeds and, separately, approving shrimp farms that adopt the requisite good practices.

The certification of hatcheries will help farmers easily identify good quality seed producers. Those who successfully clear multiple audits of their operations shall be granted a certificate for a period of two years.

"The entire certification process will be online to minimise human errors and ensure higher credibility and transparency," the official said, adding that guidelines for certification of farms are under preparation in consultation with stakeholders, says a report in The Hindu.



Uni-President

AQUACULTURE PROBIOTICS EXPERT

Nu Ri
NET 200 g BSL

Probiotics for water treatment

1. WATER QUALITY CONDITIONING

Best choice of *Bacillus* spp. that rapidly decompose uneaten feed, feces and other organic substances in pond water, keeps water quality optimal

2. HIGH ACTIVITY OF SPORES

No cultivation is needed. Easily adapt to the changes of surroundings and grow fast in freshwater or seawater culture farming, even under low oxygen environment

3. DECREASE AMMONIA CONTENT

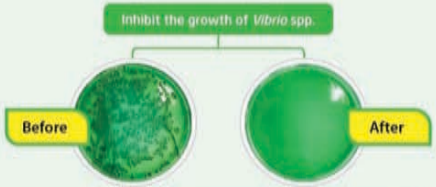
Prevent the accumulation of toxic substances such as NH_3, NO_2, etc.

4. IMPROVE WATER COLOR

Improve water color regulate the algae and bacteria balance in water, turning your pond from green to clear

5. ESTABLISH BALANCED POND BACTERIA SYSTEM

Compete nutrition with vibrio and inhibit them to grow. Provide nutrition for probiotics in the pond, to establish a well-balanced farming system.



6. INCREASE AQUACULTURE PRODUCTION

Good quality of water prevents fish/prawn infections, making high profit of production

* COMPOSITION:

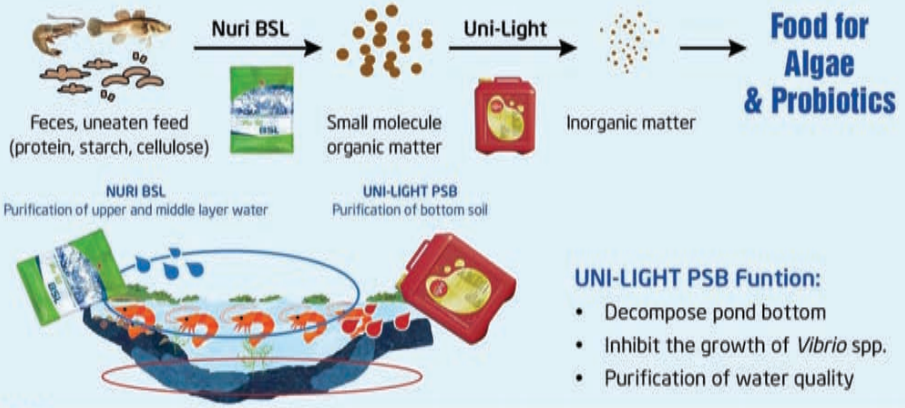
Bacillus spp. > 1x 10^{11} cfu/kg	15%
(Bacillus subtilis, Bacillus amyloliquefaciens, Bacillus licheniformis)	
Carrier (rice bran, corn gluten)	75%
Moisture	10%

* STORAGE:

Keep at dry, well-ventilated condition. Avoid direct sunlight exposure and use as soon as possible once opened for best quality.

* DIRECTION OF USE:

No cultivation is needed. Apply Nuri BSL with water-soluble bag near to the working water wheel or pour into the pond evenly. Recommend apply Uni-Light PSB together with Nuri-BSL on sunny day to achieve a clear pond more efficiently.



UNI-LIGHT PSB Funtion:

- Decompose pond bottom
- Inhibit the growth of *Vibrio* spp.
- Purification of water quality

BSL Dosage:

/10,000 m³ Quantity	10 - 30 pl/m² tiger prawn or < 80 pl/m² Vannamei	For >30 pl/m² tiger prawn or > 80 pl/m² Vannamei	For > 150 pl/m² Vannamei
7 days before stocking	800 g - 1,000 g	1,200 - 1,500 g	1,200 - 1,500 g
Day of stocking	300 g - 500 g	800 g - 1,000 g	800 g - 1,000 g
Every 7 - 10 days after stocking	300 g - 500 g	800 g - 1,000 g	3 - 5 days / use 1,000g - 2,000g

****Dosages can be adjusted according to the water conditions and practices.*

UNI-PRESIDENT VIETNAM CO., LTD

No. 16-18-20, DT 743 Road, Song Than II Ind Zone, Di An Ward, Di An City, Binh Duong Province, Vietnam.

aquafeed@upvn.com.vn
www.uni-president.com.vn

Global food major Cargill sees India emerging a 'strategic market' for its growth

Indian arm's chief Simon George views the country as a focus region

Chennai, 8 April 2021: Cargill India Pvt Ltd, a unit of the privately held US-based global food company Cargill, sees Asia as the biggest growth region in the coming decade with China and India being the "growth-centric" ones, the company's top official has said.

"China accounts for a substantial percentage of Cargill's global business which has a turnover of $115 billion. And India is equally important with its economy set to become $8 trillion by 2030," said Simon George, President, Cargill India.

The Indian market would witness a significant change in size in next 3-4 years and has become a focus market for the US global food corporation, he said.

Cargill, which had begun its operations in India in 1987 by setting up a liaison office in New Delhi, has made rapid strides since then. Currently, the US firm has a mix of business in India spanning across commodities trade, agricultural supply chain, edible oils and fats, animal nutrition, bio industrial, starches and sweeteners and trade financing.

Cargill's journey in India has been one of learning a lot and understanding the local market needs, having to do business "significantly different", George told BusinessLine in an exclusive interview.

"The business-to-consumer presence in India is unique model Cargill has adopted for the Indian market, different from other worldwide markets where it is present. Of course, local and global acquisitions have helped us grow in India," he said.

For Cargill, India is a long-term strategic market, and the company is looking at the changes in government reforms and laws in India on the basis of which we will plan our future strategies. "India is a huge consumer market and a strategic one in perspective of our global operations," he said.

Simon George, President, Cargill India

Bangladesh, a key market

The Cargill India President said that Bangladesh has become a strategic market for Indian companies. "Bangladesh, as a country, is doing well and its economy has done well in the last 10 years," George said.

A lot of Indian companies are doing business in the neighbouring nation. India could become a manufacturing destination for Bangladesh, which is emerging to be an exciting market, he said.

Last year, Bangladesh imported significant volume of non-basmati rice, corn and wheat from India. "Now, Bangladesh has emerged as a biggest buyer of Indian corn," the Cargill India President said.

Grain business

To a question on how the company's grain business was shaping up, George said that the company had been procuring corn (maize) in Rajasthan, Bihar, Madhya Pradesh, Maharashtra, Karnataka, Tamil Nadu, Andhra Pradesh and Odisha.

Cargill has become one of the biggest sources for corn and value-added products produced from corn. The company is also exporting corn to South-East Asian countries such as Vietnam and Malaysia.

"Cargill is primarily in the domestic grain business and this year we handled approximately eight lakh tonnes of commodities which includes grains, wheat, soyabean meal and oilseed meal. Of this, a small percentage constitutes the export business. Cargill exports non-genetically modified corn and soyameal, besides registering its presence in the domestic wheat market," he said.

The way the wheat market operates is that the commodity's exports and imports are guided by the Union Government's policies. "Since the Government has a role to play in the trade besides the minimum support price being a factor, Cargill plays a role whenever an opportunity arises. Our role depends on the Government policies," George said.

Corn storage, starch

The US multinational firm had set up a storage for corn, a first in India for Cargill, in September 2019 with a capacity of 60,000 tonnes at Davanagere in Karnataka. This has been set up next to the corn processing plant started in 2016.

"We have brought the best of global knowledge for storage, so that the corn is chilled and has the right aeration to ensure a longer shelf-life. We want to support farmers by helping them store their produce in best-in-class conditions and getting better prices," he said.

Cargill has also begun producing starch derivatives in three centres across India. Starch and its derivatives play a key role in food processing industry. "We buy corn from local farmers and are processing it to take finished goods to global customers across Asia," George said.

A key sustainability feature of Cargill's operations in Davangere is that 85 per cent of the plant's power requirements are met through solar and wind energy, says the Indian arm chief proudly. We are looking at similar initiatives across our plants in India as well.

વિતરકો જોઈએ છે

સંપર્ક કરો શ્રી સી. વી. રાજેશ નો મોબાઈલ નં. +91–8356901105

ઝીંગાની ફાર્મિંગ માટે મેગાપ્લાસ્ટના લાઈનર્સ

- ચારાનું કોઈ નુકસાન નહીં: માછલીઓ કેટલો ખોરાક લે છે તે જાણો
- પાણીનો કોઈ બગાડ નહીં: પાણી અને વીજળીની બચત કરો
- પાણીની ગુણવત્તા જાળવી રાખો, પીવાના પાણી માટે પણ
- સફાઈમાં સરળ: પરિણામે વધુ પાક મળે છે
- 8 મીટર પહોળી: ઓછાં સાંધા, લગાડવામાં ઝડપી
- ઉત્પાદનના દરેક તબક્કે ગુણવત્તી ry નિરીક્ષણ
- નક્કર ઉપાયો (ટર્નકી સોલ્યૂશન્સ) પૂરાં પાડી શકે છે
- ગ્રાહકની પસંદગી મુજબના રંગો પૂરાં પાડી શકે છે

21(A), C-Wing, Mittal Tower,
Nariman Point, Mumbai - 400021.

T: +91 22 6106 6000 | F: +91 22 6106 6066
W: www.megaplast.in | E: geomembranes@megaplast.in

MEGAPLAST

Entering B2B biz in cocoa

Cargill's latest venture in India is its entry into the cocoa and chocolate business, announced last year. "India is one of the fastest growing chocolate markets, among the top three globally witnessing a high growth rate. Consumers here are seeking unique flavours, taste and textures, yet per capita consumption of chocolate is still low in India compared to global markets. We want to cater to this growth potential in India," George said.

Towards this end and fulfilling Indian Prime Minister Narendra Modi's objective of Atmanirbhar Bharat (self-sufficient India), the US firm will collaborate with Indian industry. "In India, we have built a different model and are building this business in collaboration with a local manufacturer to accelerate our speed to market," the Cargill India President said.

"In collaboration with our Indian partner, we will produce 10,000 tonnes of compound chocolate and enter the business-to-business (B2B) market by July-August this year. World-wide, we are a B2B company," George said, adding Cargill's chocolate business in India will also focus on this segment. "We will help our B2B customers operating in the business-to-consumer segment deliver premium chocolates to consumers in India."

"We will provide compound chocolates to large confectionery customers, bakeries and ice cream manufacturers. Cargill will also help customers tap into its research and development network of food scientists and experts for product innovation," he said.

Asked if the company was working with Indian growers, the Cargill India chief said that it may happen at a later stage. India is not among the top producers of cocoa. Currently, it imports cocoa powder.

Edible oil

George said that Cargill's edible oil business both as a bulk importer and leading branded cooking oil player in the country, forms a significant part of the company's business.

"We established our edible oil business 20 years ago and created a brand. We have expanded in well in the north and west. During Covid-19, we witnessed good consumption at homes. With a health focus, our brands like Gemini and Leonardo olive oil are doing well," he said.

Even during bad times when the economy registered a negative 23 per cent growth, Indian agriculture witnessed positive growth mainly since the global food supply chain was maintained.

Animal nutrition

"We have a pretty large presence in the animal nutrition sector. We have plants in many States including Punjab, Haryana, Andhra Pradesh and Karnataka. Our focus is on bringing in the right innovation and feed products and solutions to farmers," the Cargill India President said.

Cargill is present in fish, dairy and poultry sectors of the animal nutrition business and it is "doing extremely well" in all the three.

Last year, animal nutrition business was "pretty encouraging" and along with edible oils emerged as one of the best performing ones.

Entry into cotton sector

Cargill has entered the cotton business, too, recently as part of its plan to expand its agri-business. The company sees good prospects in the export market.

"Cargill India been present in cotton business for a few years now. We serve the domestic customers and also cater to export demand of Indian cotton," George said.

China, Bangladesh and Vietnam are the three biggest export markets this year. "We will be scaling up the opportunity in the coming years," he said.

For now, the US-headquartered firm's Indian arm has 4,500 employees out of Cargill's worldwide staff strength of 1.55 lakh with its presence expanding to 12 manufacturing locations. It owns six consumer brands, three animal nutrition brands and is present across 100 locations in India. It also has a global capability centre in Bengaluru.

During the previous financial year (June 2019-May 2020), Cargill India earned a revenue of $1.3 billion and India is among the top 20 countries that Cargill operates in.

Courtesy: *The Hindu Business Line*

Online Panel discussion held on

Soybean and other Oilmeals Demand and Supply Outlook- Present & Future

Dr Davish Jain, Chairman, SOPA

12 April 2021: CLFMA OF INDIA, the apex organization and the voice of the country's dynamic livestock sector conducted an "Online Panel Discussion with the objective to discuss the Present Raw Material Situation (Demand & Supply) of Soybean and other Oil meals in India and to enable all industry players to come together and show solidarity for representing the government in all matters, as an expert opinion about this burning topic was the need of the hour.

The online panel discussion started with a welcome address by Mr Neeraj Kumar Srivastava, Chairman, CLFMA OF INDIA, who moderated the session, he started by introducing CLFMA OF INDIA to the panellists and participants.

The panellists were Dr Davish Jain, Chairman, Soybean Processors' Association of India (SOPA), Dr B. V. Mehta, Executive Director, Solvent Extractors' Association of India, Mr Bahadur Ali - IB Group and President of All India Poultry Breeders Association (AIPBA), Mr B. Soundararajan - MD, Suguna Holdings and Former Chairman of CLFMA OF INDIA, Dr B. Masthan Rao, Chairman, BMR Group, Dr P. Krishnaiah, IAS (Retd.), Advisor, Shrimp Feed Manufacturers Association and Dr Dinesh Bhosale - Regional Sales Director, AB Vista South Asia and Former Chairman of CLFMA OF INDIA.

Dr Davish Jain, Chairman, Soybean Processors' Association of India (SOPA), thanked CLFMA OF INDIA for inviting him as the panellist and appreciated CLFMA OF

Dr B. V. Mehta, ED, SEA

INDIA to organize the panel discussion at the relevant time and gave an update of the demand and supply outlook of Soybean and meal keeping in mind the backdrop of covid crisis. He said that, the poultry and aquaculture put together requires 5 million tons of soya meal annually and to produce this a processor

Dr B. Masthan Rao, Chairman, BMR Group

requires 6.5 MT/65 lakh tonnes of soya seeds, he said that, though the soya bean crop has been good the prices of the meal have gone up by 50% from Rs. 35/-to Rs. 58/- per kg. the demand from the poultry industry for soymeal has declined, He also said that, the soymeal consumption for feed industry has declined to 27 lakh tonnes as against 29 lakh tons during the same period last year in the period October 2020 to March 2021.

He said that, during the covid crisis year, most of the people invested in the commodity markets and real estates. With the huge stimulus packages introduced by all the countries all over the world lot of funds are seen pouring around in the commodity markets and in physical markets and in stock and real estate markets. There was a loss in the soyabean market of Argentina also, which is the largest exporters of soya bean oil in the world.

This year 104 MT of soyabean has been produced as per SOPA estimates. There will be 93.5 lakh tons available for crushing and sowing needs and other direct consumption, hence the residual meal after taking care of 18 lakh ton of exports should suffice i.e. 16 lakh tons has already been exported in first six months and for the remaining period exports should not be more than 2-3 lakh tons and the reason is that, the Indian exports contract has already been completed and as mentioned earlier the consumption of 27 lakh tons was estimated for the first 6 months and next 6 months the estimates of the consumption from feed industry is 23 lakh tons and the residual soya bean crop as per the SOPA's estimates at the end of March2021 is 36.64 lakh tons of soya, which accounts roughly about 3 MT of soymeal or 30

B. Soundarajan, MD, Suguna Holdings

lakh tons of soymeal for exports.

Mr B. Soundararajan gave the consumer perspective of the reason for spurt in the prices of soymeal even though there is availability. As per his overall estimation in India the broiler feed production is 14.5 MT, Breeder Feed accounts for about 3.3 MT

Bahadur Ali,
Chairman, AIPBA

and Layer Feed is 10.22 MT.

Poultry alone will require the total consumption of estimated soymeal of 56 lakh tones excluding aqua and dairy feed and is estimated based on the prices which may go up or down by another 10%. if prices are lower than the consumption will be 60 lakh tons and if high it will be around 50 lakh tons.

Currently 4.5 MT of meal is required in the country and overall, we are paying around Rs 20,000 to Rs 25,000/- more than the normal market prices. This is the excess price premium presently paid by the poultry industry.

Mr Bahadur Ali said, that the poultry industry has reacted late and the poultry industry has asked for import of 12 MT and the govt has to consider this or not was questionable. He added that the price hike is due to the NCDEX commodity trading and the govt. should control this forward trading and we have to approach the govt. and ask them to support the soyabean farmers and the poultry industry as well.

Also, the poultry industry has started utilizing other alternate feed like DOGS, sunflower, maize protein and are not dependent on soya meal alone, but the price hike is artificially created on the social media. He also said that, the Feed Consumption in the poultry has reduced by 20% to 25% due to summer (April, May, June) and due to corona, the poultry production is reduced by 20%.

Dr P. Krishnaiah, said that, the Shrimp Feed Manufacturers Association has estimated the requirement of soymeal including aquaculture to be 9 lakh tons.

Sudden surge of prices of soya meal directly impacts the cost of aqua feed and the major reason is soymeal constitutes 60% of the feed volume of aqua feed and in

Dr P. Krishnaiah
IAS Retd., advisor, Shrimp Feed Manufacturers Association

shrimp culture, feed cost alone is 60-75% and in this, 60% is by way of soymeal, hence, there is a direct impact on the aqua culture industry. Main reason for price hike is due to hording by certain states. He suggested to request import of soymeal of up to 9 lakh tons. He added that Fish and Shrimp has provided an employment opportunity for about 20 lakh individuals in the rural areas.

Dr B. V. Mehta appraised that there is a surplus availability of other oil meals in the country.

Neeraj Kumar Srivastava,
Chairman, CLFMA of India

This year, we had a bumpersoyabean, ground nut and cotton crop.

Rice bran production is 8.5 to 9 MT out of this 5.5MT is processed for rice bran oil. 3 MT of rice bran is used by cattle and poultry feed .out of 5.5 MT, we produce about 1 MT of the rice bran oil, 4.5 MT of rice bran extraction, out of 4.5 MT, we export about 2-3 MT mainly to Vietnam. This year there is a failure of crop in Bangladesh and export demand came from Bangladesh and hence export demand from India increased but now Bangladesh will be harvesting a new crop and hence the demand will reduce from Bangladesh. Overall Rice bran is at comfortable level. Out of 8.5 MT of rice bran, if we take out 1 MT of rice bran oil, the availability will be 7 MT of rice bran extract and is consumed by cattle feed industry.

Due to soyabean price increase the mustard oil has become cheaper than the soya bean oil. In the next 4-6 month there will be lot of availability of rape and mustard oil. He said that, to curb the false price rise, NCDEX trading should be regulated.

Also, to address the sentiments of the poultry industry govt. should allow import of at least 0.5 MT of soymeal and this will caution the hoarders.

The govt number of availabilities of soymeal is 13.5 MT as against 9 MT estimated by the industry association and it really a challenging situation to establish imports because of this gap.

Also, world production is not less. He added that, this shortage is a temporary, he advised to slow down distress buying and try to use alternated meals which ever is available in the lean period (March to August).

Dr B. Masthan Rao, commented that, the

Dr Dinesh Bhosale
RSD, AB Vista, SA

Aqua culture particularly shrimp economy is very sensitive to price variation, since 70 -75% of the cost of cultivation of shrimps is feed and any price fluctuation in the feed cost make the cultivation unviable. The BMR group being an organized sector survived with bare minimum margins. Also, Aqua culture employs about 20 lakh farmers and farm workers and another 25 lakhs from non-farm sector are also supported by the aquaculture industry. Most of the shrimp and fish farmers are dependent on the aquaculture.

Suresh Deora, Honourable Secretary, CLFMA of India

Shrimp sowing of seeds in the pond will start from the month of Feb. This year the price of feed has gone up and hence shrimp industry is affected. He gave the suggestion to import certain quantity of DOC as it is the main ingredient i.e., 50% for shrimp and 20% offish feed production and the shrimp &Aqua feed industry requirement is around 0.9 mt out of this 46% is soya meal. So far, our consumption of soya meal in Feb and March was hardly 1 lakh MT and another 8 lakh MT we need before Sep. Last year during the same time the prices of soya meal was 37,000/- per Mt ex-factory and now the price is 69,000/- per Mt soymeal. Since in the inclusion of preparation of compound feed 50% is protein, it is not viable, apart from this the ocean freight charges and transportation charges has also gone up. He suggested to present the case to the PMO. He said that the, hoarding is to be prevented first in the states of Maharashtra and MP.

Dr Dinesh Bhosale gave the insights about of impact of soymeal being used as animal feed and compared the use of other meals with soymeal as alternatives and their limitations. He thanked CLFMA OF INDIA for organizing this online discussion. he said that, if farmers are protected then only our poultry industry can also be protected.

He added that 70% is the feed cost for cattle, fish, shrimp and poultry. If we consider broiler then, we have 35% inclusion of soymeal considered as starter, finisher feed- 30% is used as soymeal inclusion. One broiler gets ready after eating 3500 gms feed and out of this 1 kg is soymeal. Apart from soymeal the regularly used feed is meat and bone meal and synthetic amino acids like lysine, methionine and tryptophan is added while preparing compound feed. Soymeal digestibility is very good, as methionine is less in this.

He said that though, all the panelists are of the opinion that, we have to manage the industry with other alternative feeds, but govt should allow import especially in south India, as it makes the cost cheaper compared to other areas. Hence in south India govt. should allow at least 1MT of soymeal imports, we can discourage GM seeds. but GM soybean DOC can be imported.

Layer feed has a very complicated ingredients and in this the soymeal inclusion is 5-10% and in the complete life cycle layer bird consumes 48 kg feed and out of this 5 kg it consumes soybean DOC and since the prices of soya has increased and there is a shortage in availability of soya it is only used in chick mash and in the grower mash and layer mash the soybean doc has been completely suspended. If we talk about cattle feed soybean DOC, 100 MMT is required and 12 MMT of cattle feed is manufactured by our industry and remaining 88 MMT raw material is fed to animal directly. The 12 MMT of soybean doc for cattle feed is very less, as calf starter, milk replacer, transition feed, all these high-cost feed uses soymeal DOC. In shrimp and fish feed dehulled soybean is required. He advised all SOPA members to manufacture de-hulled soybean meal and sell it to poultry and shrimp feed industry. He also said that NCDEX should encourage only actual buyers and speculators have no role to play.

Vote of thanks was proposed by Mr Suresh Deora, Secretary, CLFMAOF INDIA. **The main points summarized by him are as follows**

- Govt statistics shows that, there is 30 lakh ton of soya availability for the feed industry and the largest consumer for both this industry is poultry and aqua.
- The prices of soya have gone up by 50% and the biggest culprit for this price increase is speculation by the NCDEX and is fuelled by social media, to ease this we should ask the govt. to allow a lesser quantity of import of soymeal to bring the sentiment down and cool the market.
- The panic buying should be discouraged
- We have to approach the govt collectively on all these issues.
- We have to approach jointly to SEBI for the purpose of regulating the NCDEX from doing speculations but move to real market and examine the controls we have to bring in.-

INDIA SOYBEAN: SUPPLY/USAGE/STOCK

MTH	PRDN 2020-21 : 104.55 LT OPENING STOCK: 5.16 LT MP 41.72/MAH 45.44/RAJ 8.58/TELNGN 1.64/KTK 3.72/IMPORT 3.00 LT TOTAL SUPPLY 100.71 LT			PRDN 2019-20 : 93.06 LT OPENING STOCK: 1.70 LT MP 40.10/MAH 36.29/RAJ 6.56/AP 1.50/ CG 0.53/ GUJ 0.86 LT/IMPORT 3.00 LT TOTAL SUPPLY 97.76 LT			PRDN 2018-19 : 109.33 LT OPENING STOCK: 1.50 LT MP 59/MAH 38/RAJ 9.45/AP 1.57/ CG 1.10/ GUJ 1.2 LT/IMPORT LIKELY 1.80 LT/TOTAL SUPPLY 112.83 LT		
	ARRIVAL	CRUSH	STOCK FARMER +MILL	ARRIVAL	CRUSH	STOCK FARMER +MILL	ARRIVAL	CRUSH	STOCK FARMER +MILL
OCT	18.00	9.00	87.48	12.00	7.20	82.32	21.00	9.50	88.74
NOV	19.00	11.00	76.22	18.50	9.00	73.01	20.00	10.50	77.86
DEC	15.00	12.00	63.75	15.00	9.80	62.96	15.00	11.50	65.82
JAN	12.00	12.50	51.19	9.00	8.40	54.36	11.50	10.00	55.45
FEB	6.00	7.50	43.44	4.50	6.50	47.61	5.50	7.50	47.69
MAR	4.75	6.50	36.64	1.25	4.00	43.35	4.00	9.00	38.42
APR				0.20	3.70	39.41	4.00	6.00	32.18
MAY				2.00	6.50	32.65	3.75	5.50	26.46
JUNE				5.00	7.20	25.16	4.50	5.50	20.74
JULY				5.00	7.20	17.74	5.00	6.50	14.04
AUG				3.00	6.00	11.65	3.00	5.00	7.85
SEP				4.00	5.50	5.36	3.00	5.50	2.20
TOTAL	74.75	58.50	36.64	79.45	87.50	11.70	100.25	93.50	2.20
LAST YEAR	60.25	44.90	43.65	100.25	93.50	2.20	STOCK EXCLUDE FOR SOWING 12.00 LT NEW CROP ARRIVED IN SEP 2 LT. EXPORT 1.60 LT		

SOURCE : SOYBEAN PROCESSORS ASSN. OF INDIA, INDORE

Can steam inhalation save you from Covid-19 virus?

Madurai, Tamil Nadu: Symptoms appear from the third day after infection (viral symptoms).

1st Phase:

- Body pain
- Eye pain
- Headache
- Vomiting
- Diarrhea
- Runny nose or nasal congestion
- Decomposition Burning eyes
- Burning when urinating
- Feeling feverish
- Scuffed throat (sore throat)

▶ It is very important to count the days of symptoms: 1st, 2nd, 3rd.

- Take action before the onset of fever.
- Be careful, it is very important to drink plenty of fluids, especially purified water. Drink plenty of water to keep your throat moist and to help clear your lungs.

▶ **2nd Phase: (from 4th to 8th day) inflammatory.**

- Loss of taste and / or smell
- Fatigue with minimal effort
- Chest pain (rib cage)
- Tightening of the chest
- Pain in the lower back (in the kidney area)

▶ The virus attacks nerve endings;

- The difference between fatigue and shortness of breath:
- Lack of air is when the person is sitting - without making any effort - and is out of breath;
- Fatigue is when the person moves around to do something simple and feels tired.

▶ It takes a lot of hydration and vitamin C.

Covid-19 binds oxygen, so the quality of the blood is poor, with less oxygen.

▶ **3rd Phase – healing:**

- On day 9, the healing phase begins, which can last until day 14 (convalescence).
- Do not delay treatment, the sooner the better!

▶ Good luck everyone!

It is better to keep these recommendations, prevention is never too much!

- Sit in the sun for 15-20 minutes
- Rest and sleep for at least 7-8 hours.
- Drink 1 and a half liters of water per day
- All food should be hot (not cold).

▶ Keep in mind that the pH of the coronavirus ranges from 5.5 to 8.5.

So all we have to do to eliminate the virus is to eat more alkaline foods, above the acid level of the virus.

- Bananas, Lime → 9.9 pH
- Yellow lemon → 8.2 pH
- Avocado - pH 15.6
- Garlic - pH 13.2
- Mango - pH 8.7
- Mandarin - pH 8.5
- Pineapple - 12.7 pH
- Watercress - 22.7 pH
- Oranges - 9.2 pH

▶ How do you know you have Covid-19 ?

- itchy throat
- Dry throat
- Dry cough
- High temperature
- Difficulty breathing
- Loss of smell and taste

The hot water you drink is good for your throat. But this Corona virus is hidden behind the Paranasal sinus of your nose for 3 to 4 days. The hot water we drink does not reach there.

After 4 to 5 days this virus that was hidden behind the paranasal sinus reaches your lungs, which triggers breathing issues. That's why it is very important to take steam, which reaches the back of your Paranasal sinus.

If you want to stay safe and kill the coronavirus, which could be hiding inside your nose, then you should start taking steam which will reach to your nose and kill the virus.

At 50°C, the Covid-19 virus becomes disabled i.e. paralyzed. At 60°C the virus becomes so weak that any human immunity system can fight against it. At 70°C this virus dies completely. This is what steam does. The entire Public Health Department knows this.

But everyone wants to take advantage of this pandemic. So they don't share this information openly. One who stays at home should take steam once a day. If you go to the market to buy groceries, vegetables etc. take it twice a day. Anyone who has to step out or is a part of a workforce which belong to essential services should should take steam thrice a day.

According to doctors, Covid -19 can be killed by inhaling steam from the nose and mouth, eliminating the Coronavirus. If all the people started a steam drive campaign for a week,

the pandemic will soon end.

So here's a suggestion, start the process for a week from morning and evening, for 5 minutes each time, to inhale steam. If we all adopt this practice for a week, possibly, the deadly Covid-19 will be erased. This practice has no side effects & doesn't cost anything either.

Spread this information with your loved ones, relatives, friends and neighbours,

so that together we can kill the virus and make this world a covid-free and a beautiful place, again!

Courtesy: *Dr N. N. Kannappan, Madurai*

Allow Kerala fishing boats to venture into deep sea, plead operators

Kochi, 8 April 2021: Mechanised fishing boat operators in Kerala are insisting that they be allowed to carry out fishing in deep sea waters like their counterparts in other States and countries.

In a memorandum submitted to the visiting Union Fisheries Minister Giriraj Singh, the Association requested that fishing should be made an all-weather employment with many expatriates

migrating to fishing as a vocation after having lost their jobs.

The association also sought the Minister's intervention to urge the State Government to not impose a fee on fishing boats that operate beyond 12 nautical miles. Other State governments are not levying any such fee. The sea and its resources beyond 12 nautical miles from shore fall within the jurisdiction of the Union Government, Kalapurackal argued.

The operators, who are curbed by the State Government not permitting them to venture out into the deep sea, have pleaded their case with the Union Government. While fishing boats in the State are not allowed, trawlers, particularly from China, are allowed to venture into deep sea.

All-weather employment

Joseph Xavier Kalapurackal, general secretary of All Kerala Mechanised Fishing Boat Operators Association, said fishermen in the State are capable of fishing in deep waters, and to any extent, if permitted. If permission is granted to them, the presence of Chinese fishing trawlers could be deterred, he said, adding that there are about 800 Chinese fishing boats currently engaged in fishing in the Arabian Sea.

Subsidised fuel

Fishing has become a high-cost venture, in view of the rising price of diesel. The association urged the government to provide fuel to fishing boats at a reduced or subsidised rate to help the industry.

Courtesy: *The Hindu Bussness Line*

IDMA & VICTAM 2021 event postponed

19 April 2021: Due to covid restrictions around the world, with regret, we would like to inform you that the IDMA AND VICTAM 2021 event for May 27 - 29, 2021 has been postponed and will be rescheduled.

The decision to postpone the event was requested by our valuable associations that support IDMA AND VICTAM, exhibitors and visitors.

We will inform you with new dates as soon as possible. However, we would like to thank our business partners, associations, exhibitors and visitors for their support and cooperation in this challenging time. We believe that in the upcoming days, the circumstances for such events will be more fruitful and productive for our participants.

We trust that we will overcome the challenges of this pandemic situation together. Your health and safety is our priorty and in this regard we would like to emphasize that our decision to reschedule the fair is to have a successful fair in the future.

Bionetix International Releases New Micronutrient Blend to Stimulate Biogas Production!

09 April 2021: The biogas industry offers exciting possibilities as a form of "green" energy that converts waste into heat and electricity. However, there are many variables that can easily disrupt the anaerobic digestion process and reduce the efficiency of biogas production. Because of this, Bionetix International has developed a new micronutrient blend called BIOGAS BOOSTER 3™ that aims to boost biogas production, process stability, and efficiency by stimulating the micro organisms that do the work.

Biogas is produced when organic matter is broken down by microorganisms under anaerobic conditions. Microorganisms involved in the production of biogas not only require macronutrients such as nitrogen and phosphorus to grow; they also need micronutrients. While a lack of micronutrients leads to a decrease in biogas plant efficiency, the addition of micronutrients can improve biogas production by stimulating the anaerobic digestion of organic waste.

BIOGAS BOOSTER 3™ contains three important micronutrients in a stable soluble and bio available form that makes them easily accessible to microorganisms. Laboratory testing by York University in 2020 showed that the addition of BIOGAS BOOSTER 3™ increased biogas production in just one week and that biogas production was expected to continue to grow as time went on.*

In addition to boosting the production of methane, BIOGAS BOOSTER 3™ also increases process stability and improves the possibility for increased organic loading. There are many factors that can go wrong in the course of biogas production. For example, the presence of excessive ammonia inhibits normal hydrolysis of waste. Also, the addition of more waste feedstock to the anaerobic digester (although desirable in order to speed up biogas production) can be counterproductive by creating a higher concentration of biomass than the existing microorganisms can handle. BIOGAS BOOSTER 3™ helps stabilize the process by promoting the healthy growth of the microbial population and accelerating waste digestion to handle the load more efficiently.

BIOGAS BOOSTER 3™ can be used with a variety of feed stocks:

- Municipal waste
- Agricultural waste
- Food waste
- And many others!

As society looks more closely into expanding forms of renewable energy, it is important to offer solutions that increase the viability of biogas production. BIOGAS BOOSTER 3™ does so as an important source of micronutrients that stimulate anaerobic digestion and ultimately boost the efficiency of biogas production. Learn more about the new BIOGAS BOOSTER 3™ here: https://www.

Image courtesy of York University testing done in 2020

bionetix-international.com/products-2/biogas-booster-3/

**York University NSERC Engage Project Report, "Novel Bacterial Blend to Enhance Biomethanation of Municipal Sewage Sludge," 11 December 2020. Prepared by Prof. Brar's Team: Dr. Bikash Tiwari, Rahul Saini, and Mona Chaali.*

Need a High-Resolution Photo? Please Visit: www.cortecadvertising.com

Bionetix® International is a Canadian-based company that produces biological products used in thousands of field applications worldwide. We promote a healthy environment by providing superior, environmentally friendly alternatives to current treatment methods. Our customers are able to clean and remediate contaminated systems or boost agricultural productivity in a cost-effective, natural, and non-intrusive way through the application of our biological products. Headquartered in Quebec, Canada; Bionetix International is a subsidiary of Cortec® Corporation. ISO 9001:2015 Certified.

Correction

In Aqua International, April 2021 issue, Page 36, 2nd column, 25th line

News Titled: **CIFE's Kolkata Centre Organizes Online Training on Application of Drugs and Chemicals in Aquaculture.**

Published as: '.... 7 - 8 gm AI per 100 gm feed ....'

Corrected and to be read as: '.... 7 - 8 gm AI per 100 kg feed ....'

We regret for the inconvenience caused to the readers.

- Editor

Blue Aqua International launches Doctor Shrimp to Support Global Shrimp Farming industry with Skills Training and Shrimp Diagnostic Services

Singapore, 13 April 2021: Blue Aqua International launched the Doctor Shrimp Academy and Clinic on the 8 April2021 to provide practical skills training and shrimp diagnostics services for the shrimp farming industry globally.

Blue Aqua International has been at the forefront of super-intensive shrimp farming, with more than 4,000 customers worldwide. The global firm provides cutting-edge solutions for the management of the culture environment, health and the optimization of animal nutrition. While operating farms in both Singapore and Indonesia, it's now transferring its expertise in super-intensive shrimp farming worldwide.

Doctor Shrimp is a global platform and clearing house for technical and practical knowledge of the five species of shrimp, *Litopenaeusvannamei, Penaeus monodon, Fenneropenaeus indicus, Litopenaeusstylirostris, andMarsupenaeus japonicus.*

With ambitions to become a global center of excellence in the industry, Doctor Shrimp will hone in on three focus areas: (1) A technical and tools resource platform for shrimp farming, (2) Education and practical aquaculture skills training, (3) Shrimp disease diagnostic services.

The Doctor Shrimp Academy is specialized in all facets and practical skills transfer with technical courses designed for real-world shrimp farming. Partnering with Temasek Polytechnic, the Academy is rolling out a series of specialized courses with practicum at Blue Aqua's commercial shrimp farm in Singapore, which is well known for its super-intensive shrimp production numbers.

"The uncertainties in shrimp farming can now be better mitigated with the support from Blue Aqua's Doctor Shrimp Academy" said Dr Goh Lay Beng, Director of the School of Applied Sciences, Temasek Polytechnic.

The academy is exclusively for eligible applicants to gain skills transfer and knowledge from experts in the global shrimp farming industry to address the skills and education gap, particularly in markets like Singapore, which rely heavily on foreign talents. International and domain experts in the aquaculture industry will be brought in as mentors to work with students on deepening their knowledge base through case studies.

"The academy is a great combination of knowledge packed learning and rich experience acquisition bundled into one" said Ambassador Teng Theng Dar, Non-resident Ambassador to Oman. "By producing graduates over time, the academy aims to promote science based and sustainable shrimp farming globally".

The Doctor Shrimp Clinic & Laboratory in Singapore will serve the needs of shrimp farmers by offering quick and accurate disease diagnostic tests, along with prevention and treatment to assist farmers in their operations.

With Singapore's strategic location as a hub for South east Asia, the clinic is able to provide the shortest turn-around time to support farmers in the region. In addition to offering laboratory services such as qPCR, microbiology, post-mortem, and water quality testing, leveraging on Doctor Shrimp's knowledge base – The Clinic will also provide customized and targeted solutions and protocols to improve shrimp health, which ultimately will prevent future infections.

"Our Clinic aims to be a global shrimp reference laboratory to further support farmers around the world in the management of disease and to increase the productivity of their operations." said Dr Farshad Shishehchian, CEO & President of Blue Aqua International.

The Doctor Shrimp is a holistic platform which offers both knowledge sharing and practical shrimp farming experience. Mr Wong Lup Lai, CEO of Innovation Partner for Impact (IPI) said at the launch,"The success of this program will certainly put Singapore on the map of global aquaculture and position Singapore as a thought leader in this field".

More information on The Academy: http://www.doctorshrimp.com/academy/index.html

More information on The Clinic: http://www.doctorshrimp.com/academy/clinic.html

Contact: Nathalie Lim | VP (Marketing), Blue Aqua International Group nathalie@blueaquaint.com

Gassen Plus

Bon Ammonia and obnoxious Gasses

Shrimp / Fish performs all their body functions and growth in water. Good quality water and proper D.O. levels determines the success or failure. Good quality water, optimum D.O. level is of prime importance for health and growth of Shrimp / Fish.

Irregular water exchange, excess and leftout feed, dead algae, fecal matter, increases the organic load at the pond bottom. Accumulation of such waste absorbs available oxygen, creating anaerobic condition which leads to pollution of pond bottom. Polluted pond bottom and unhealthy environmental conditions triggers the release of toxic gasses like Ammonia, H_2S, Methane, etc, The toxicity of Ammonia, Hydrogen Sulphide, Methane attributed mainly due to unionized form. As the concentration in water increases, ammonia excretion by aquatic organism diminishes and the level of ammonia in blood and in other tissues increases. Ammonia increases oxygen consumption by tissues, damage gills and reduces the ability of blood to transport oxygen, and increases the disease susceptibility. To eliminate / overcome the above problems 'GASSEN PLUS' Yucca Schidigera, it contains Steroidal"Saponin" which help to reduce ammonia and other noxious gasses such as H_2S, Methane, etc., Microbial enzyme "Urease' Production inhibited by Saponin which leads to an increases D.O. and reduction of BODand COD levels.

Bacterial strains such as Bacillus Subtilis, Nitrobactor, Nitrasomonas, rapidly converts ammonia into Nitrates, Nitrites and finally non-toxic Nitrogen. Hydrogen Sulphide converts into Sulphates, Sulphites and finally non-toxic Sulphur, Methane into Non-toxic carbon. This conversion reduces the obnoxious gasses in the pond bottom. Reduction of this gasses improve the D.O. level in the water and bottom.

COMPOSITION:
YUCCA SCHIDIGERA
ALOEVERA
BACILLUS SUBTILIS
BACILLUS POLYMIXA
BACILLUS LICHENIFORMIS
NITRASOMONAS
NITROBACTOR
STABILIZERS

DOSAGE : 1 Kg per Acre or consult your Aqua Technician For Specific Usage & Dosage

PRESENTATION: 500 gms &1 kg

DOCTOR'S VET-PHARMA PVT. LTD

cG.M.P. Certified an ISO 9001:2008 Company
Survey No. 263/1, 264/1, P.R. Palem (V), Kovur (M),SPSR Nellore Dist.- 524137. A.P. INDIA.
Tel. 08622 - 210902. Email: dvpl33@yahoo.com, www.doctorlifesciences.com

ANTIBIOTIC FREE,
STEROIDAL FREE.

Mobile Feed Mill: An innovative approach for transforming farm-made feed to quality feed

krishnapadasingha5@gmail.com; npsahu@cife.edu.in

Shivangi Bhatt[1], Krishna Pada Singha[2], Dilip Kumar Chowdhury[1], Narottam Prasad Sahu[1],

[1]Fish Nutrition, Biochemistry and Physiology Division, ICAR-Central Institute of Fisheries Education, Mumbai- 400 061.
[2]Aquaculture Research Institute, Department of Animal Veterinary and Food Sciences, University of Idaho, Moscow, ID, 83844-3020, USA.

Highlight Points

- Mobile Feed Mill (MFM) could be a transit step between farm-made feed and commercial feed based aquaculture.
- Employment generation and entrepreneurship development through MFM.
- Production of nutritionally balanced feeds for fish using locally available ingredients.
- Great opportunity to utilize the Pradhan Mantri Matsya Sampada Yojana (PMMSY) to strengthen the fish farming in India.

Introduction:

Consistent growth of aquaculture production during last one decade is enough to highlight its importance in the food and nutritional security. The contribution from marine sector is almost static, hence, major fish production with a target of 10.4 million tons is expected from aquaculture sector by 2030. India is second largest aquaculture fish producer in the world accounting 7.07 million tons production in 2018.

The present aquaculture practices in India which include (i) use of industrially produced pelleted feed (intensive), (ii) use of industrial and farm-made feed (semi-intensive), and (iii) use of only farm-made feed consisting of a mixture of locally available feed ingredients. The production of commercial pelleted feed is 2.28 million ton in 2018 in which shrimp, pungasius, tilapia and some catfishes consume near about 2 million ton while rest 0.28 million are being used in Indian Major Carp (IMC) production. Importance of IMC production is inevitable as it contributes 70 - 75 % of the total inland fish production of the country.

The use of pelleted feed for fish production is in increasing trend, but it has yet to reach the remote areas of the country. However, more than 90% of the fish farmers in our country still rely on the farm-made feed alone as commercial feeds seem to be uneconomical for the fish farmers. India has around 40 aqua feed mills at present spread across the country. However, their production capacities are not enough to meet the estimated aqua feed demand in future, which is more than 7 million tons. The farm-made feed sector has the huge potential to develop into commercial feed sector with economical approach. Small and marginal farmers, constituting almost 85 %of the community, have limited capacity to set-up a feed mill. The lack of capital and scientific knowledge leads to the adoption of farm-made feed by the farmers, which results in low aquaculture production.

Outsourcing of feed mill may address this problem of the farmers. Hence, concept of a Mobile Feed Mill (MFM) appears to be best fit to this scenario which will cater the need of the small and marginal farmers at an affordable price. This will not only support economy of the farmers but also boost the aquaculture production of the country significantly.

Aquaculture production Vs Aquafeed production

China is at top in fish production with 47.56 million tonnes (57.93% of world total), followed by India with the production about 7.07 million tonnes from aquaculture (8.61% of world total) (FAO, 2020). Accordingly, China top in aquafeed production with 15.7 million tonnes per year (i.e., 39.7% of the global total) followed by Vietnam with 3.9 million tonnes and India occupying the third position with just a production of 2.28 million tonnes (Figure 1). This indicates commercial feed based fish production is less in

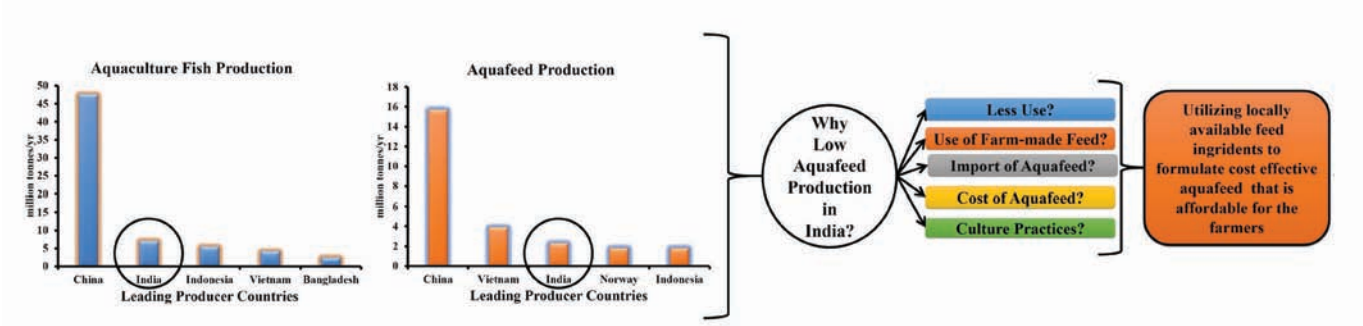


Figure 1: Aquaculture fish production vs. aquafeed production and possible reasons for low aquafeed production in India

India, suggesting a huge scope in promoting feed based aquaculture practice.

Possible reasons for low aqua feed production:

- **Less use of feed:** Fish farmers in India mostly rely on the natural food sources for culture systems, so the application of feeds in farms is very rare.
- **Use of farm-made feed:** Farmers prefer to use their own agricultural by-products like de oiled rice bran (DORB), oil cakes in the form of farm-made feed as they have to spend nothing in cash.
- **Import of aqua feed:** India imports huge quantity of aquafeed from other countries which raise the price. However, shrimp feeds are mainly imported from other countries.
- **Cost of aqua feed:** The feed prepared using costly ingredients like fishmeal and other conventional ingredients along with other recurring expenditure besides high investment in establishing a feed mill enhances cost of production which discourage the farmers to use commercial feed for fish farming.
- **Culture practices:** In India, fish farmers usually practice extensive or semi-intensive farming system where use of commercial feed is minimal.

Mobile Feed Mill:

Farm-made feed neither fulfills the nutritional requirement of fish nor maintains the healthy pond eco-system. Hence, traditional feeding method of "feed what you have" is just to support sub-optimal level of production. The proposed Mobile Feed Mill (MFM) has the ability to address all these limitations. The MFM is a mobile feed production unit (Figure 2) which will transform the locally available ingredients into a nutritionally balanced fish feed through scientific approach. The MFM is a small-scale feed mill which can be transported to the destination site on demand to prepare required amount of fish feed using locally available ingredients as per the convenience of the farmers.

Figure 2: Mobile Feed Mill (MFM) and its pre-requisites

Main concept: Producer, consumer and production

The main concept of MFM is to provide door to door pelletized fish feed to the farmers using their own agricultural byproducts or locally available ingredients. Here, the farmer need to contact the owner of MFM to inform about their demand, locally available ingredients, fish species etc. The qualified technical experts will make a feed formulation using the ingredients available with the farmer without compromising the nutritional quality of the feed. The additives like binders, oils, vitamin-mineral premix and other additives will be decided by the technical expert based on the culture condition (species, life-stage, type of culture system etc.). Besides the operating cost, the additional costs towards the additives will be added to the feed cost. The farmer need to contact the MFM owner few days before the production day, so that the owner of MFM will get sufficient time to do feed formulation and required study to provide the best quality feed to the fish farmers.

Features of MFM:

Mechanical unit:

Feed manufacturing unit: This portion is the main body of the whole MFM system. This units mainly consist of but not limited to grinder, mixer, automatic pelleting unit (pelletizer), a dryer system (conveyor belt system which can fit with the whole system). The feed manufacturing unit need to be designed in such a way which can be easily fit to the MFM system with maximum utilisation of the available space. The automatic pelletizer (various models are already available in market) has inbuilt system of preconditioning, extrusion cooking as well as cutter to make desired size feed pellets. This unit can be modified as per the owner's and technical needs.

Feed packaging unit: After proper drying through the conveyor system, the dried feed pellets will be packed in good quality feed bags (supplied by the MFM owner or previously used bags by the farmers) and sewed by a bag sewing machine in such a way that the bags can be re-used for future if properly kept after use.

Power unit: Both generator or electrically operated engine is preferred to produce feed on demand anywhere and anytime.

Mobile vehicle: Installation of these feed pelletizer on a trolley which can be connected with a tractor or lorry engine to make it portable. There should not be any connection between the engine of mobile vehicle and power unit of

the MFM to make it more flexible in terms of portability or mobility of the MFM system.

Production capacity: The production capacity of the MFM shall range from 60 kg / h to 800 kg / h based on the consumer's demand and market availability. However, installation of high production capacity will not be possible due to relatively small space. That's why, we have done the "Economic feasibility" evaluation based on production capacity of 200 kg/h (using an automatic feed pelletizer). A wide range of automatic pelletizers are already available in markets and those can be used in MFM with some modifications.

Technical know-how:

- **Feed ingredients:** Various locally available raw materials can be made into feed through the mobile feed mill, such as, grass, alfalfa, maize, soybean, straw meal,vegetables wastes, oil cake, filed pea, wheat, rice husk, rice bran etc. along with supplementation of vitamin-mineral premix and other additives.
- **Access to remote areas:** The main advantage of the MFMis farmer can see the process of feed preparation using their own local ingredients in their farm or home.
- **Quality feed:** The MFM will ensure the nutritionally balanced feed for fish by formulating the best combination of ingredients which are available to the farmers and supplementing different additives if needed.

Economic feasibility:

We have done a simple economic evaluation to show the cost of production using the MFM **(Table 1)**. The production cost per kg fish feed shall be Rs. 3.67 excluding the extra inputs of feed additives by the MFM owner.

Importance of MFM:

- **Employment generation:** For operating MFMs and feed formulation, staffs will be required such as hiring of drivers, fisheries professionals and other personnel.
- **Feed availability in remote areas:** MFMs can travel and get access to remote areas to make feed available to the farmers resulting in technology dispersal.
- **Resource utilisation:** Cost - effective aqua feed based on farmers demand by utilizing locally available ingredients.
- **Retaining the quality of feed:** Long term stacking of feed can be avoided by the farmers due to easy availability and access to MFM. So, anytime farmer can get nutritionally balanced feed for fish.
- **Enhancing the farmers income:** Farmers can enhance their income by using their own agricultural produce.
- **Environment protection:** Using pelleted feed will prevent leaching, thereby reducing the pollution of pond eco-system.

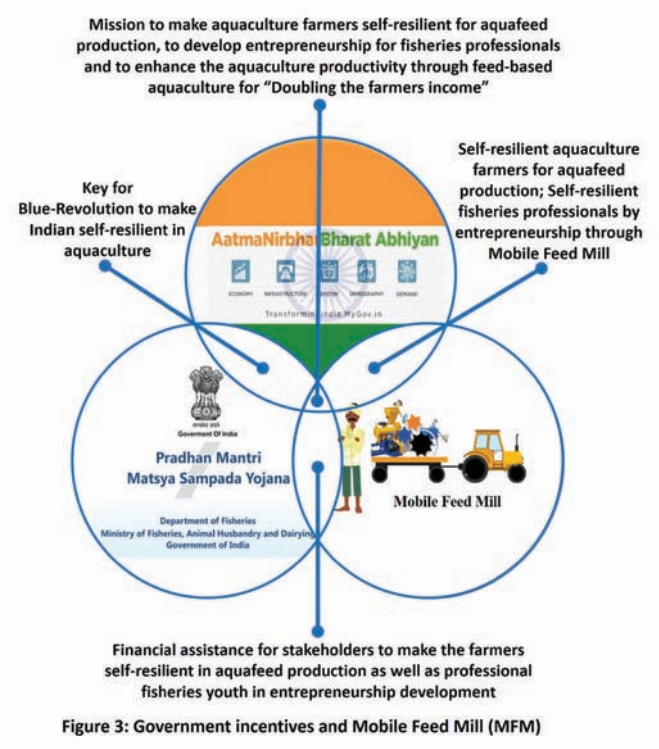


Figure 3: Government incentives and Mobile Feed Mill (MFM)

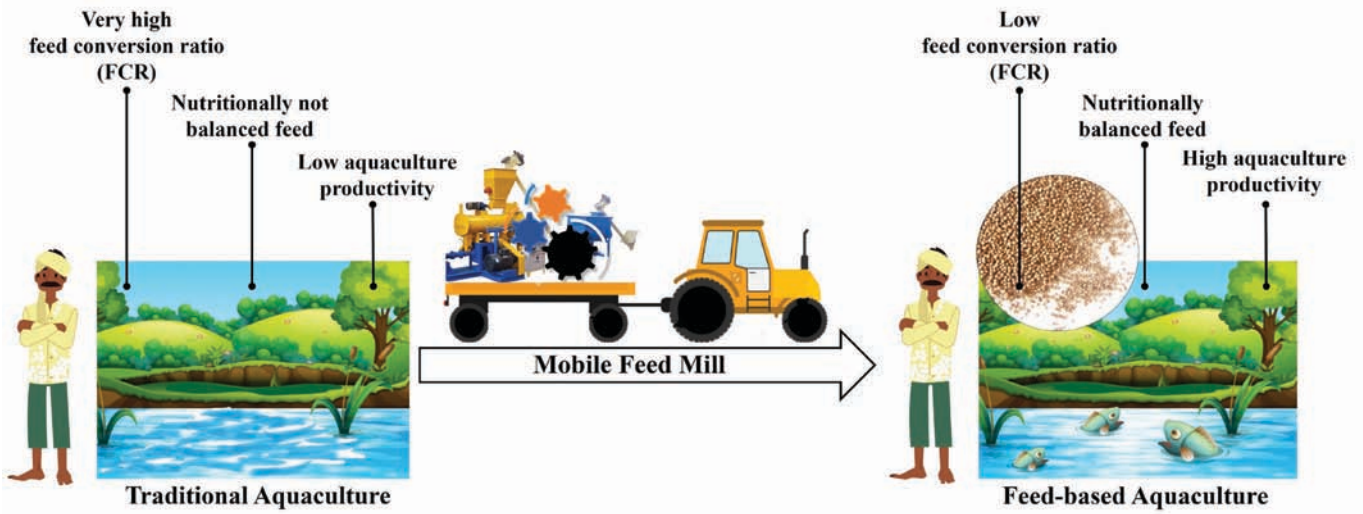


Figure 4: The Mobile Feed Mill (MFM) as a transitional step to convert fish farmers from "Traditional aquaculture" to "Feed-based aquaculture"

Some existing similar model to MFM in other sectors:

Mobile milk van or Milk ATM Machines are used to provide the fresh milk from farm directly to the customer. The flexibility of the volume of the milk container makes it perfect to be used by wide range of milk producers, even there are manufacturing units which makes the mobile milk containers based on the farmers demand. It reduces the unnecessary use of plastic packages for milk because the customers can take the milk in their own home containers (steel, glass or others). The quality of the raw milk is maintained in this containers. There are options to buy 250, 500, 1000 ml milk and so on based on consumer's need. Beside this, the success of "Artificial insemination" in India lies on the fact that the door-to-door supply of high quality sperm preserved in liquid nitrogen containers using mobile vans so that farmer do not need to go the Artificial insemination centers for insemination of their cattle. Additionally, the popularity of mobile thresher machines is well known. The mobile thresher machines which are available for rice, wheat, sun flower, corn, beans and many other agricultural crops which makes easy for farmers to use these machine for various purpose.

Government incentives and MFM:

Government of India's "Atma-Nirbhar Bharat Abhiyan" can be fulfilled through MFM by adopting this model to make the fish farmers self-resilient in fish feed production (Figure 3). Additionally, the entrepreneurship development as MFM owner or technical operator ensures the employment generation for scientific professionalsas well as skilled/ unskilled workers.The Pradhan Mantri Matsya Sampada Yojana (PMMSY) will become a boon for all professionals in the field of aquaculture to get financial assistance through adopting this model. The adoption of MFM model will ensure the use of better quality and nutritionally balanced feed by the farmers which definitely increase the production. The MFM can one step ahead towards the "Doubling the farmers income" of fish farmers by increasing their aquaculture productivity.

Conclusion:

Only 3% of the carp farmer use pelleted feed, whereas rest 97% use farm-made feed. This is practically impossible to transform this group of farmers into scientifically led aquaculture overnight. But our aquaculture sector, a sleeping giant, needs right type of intervention for a big reformation. The MFM shall be the transitional step to convert the Indian fish farmers from traditional fish farming to feed-based fish farming(Figure 4). Though an initial rough economic feasibility evaluation is done, a thorough economic evaluation and assessment need to be done to see the sustainability and future of MFM. Transforming the sector by bringing new and affordable resources is a pre-requisite to realize this potential. In this regard, the Pradhan Mantri Matsya Sampada Yojana (PMMSY) will definitely support the entrepreneurs financially to adopt this innovative feed production technology. Hopefully, this small intervention may bring a radical change to Indian aquaculture.

Table 1: Economic feasibility evaluation

Fixed/capital cost in INR	
Grinder (200 kg/h)	85000
Mixer (100 kg/batch)	60000
Automatic pelletizer (200 kg/h)	300000
Dryer (200 kg/h)	500000
Generator	200000
Bag sewing machine	10000
Tractor and trolley	600000
Subtotal	1755000
Miscellaneous (10%)	175500
Total fixed/capital cost (10 years period)	1930500
Recurring/running cost for single shift in INR	
Fuel for generator (5L/h)	2600
Worker (2 persons)	600
Salary of driver cum operator	500
Stationary	100
Depreciation cost*	643.5
Sub-total	4443.5
Miscellaneous (10%)	444.35
Total recurring/running cost for single shift (Rs.)	4887.85
***Depreciation cost in INR**	
Fixed/capital cost per year (Total fixed cost/10 year)	193050
Fixed/capital cost per month (25 working days)	16087.5
Fixed/capital cost per shift or 8 h (Fixed cost per month/25 days)	643.5
Recurring or running cost/month (Rs.) (25 working days × 4887.85 for one shift)	122196.3
Production cost per shift (Recurring cost+ Fixed cost for one shift)	5531.35
Total feed production for one shift (200 kg × 8 h × 94% productivity)	1504
Production cost/kg feed (Rs.)	**3.67**

References:

FAO, 2020. The State of World Fisheries and Aquaculture 2020. Sustainability in action. Rome. https://doi.org/10.4060/ca9229en

Blue Carbon Ecosystem: A strategy to mitigate global climate change

Sahina Akter; Suman Nama
Fisheries Resource Harvest and Post-Harvest Management Division,
ICAR-Central Institute of Fisheries Education, Pinch Marg, Off Yari Road, Versova, Mumbai 400061, India.
Email: sumancau2017@gmail.com

Highlight Points

Global climate change raising threats for the coastal areas. Climate change causing sea level rise, Tsunamis etc that damage the coastal ecosystem. Blue carbon ecosystem such as mangroves, the salt marsh has got huge potential to sink the atmospheric carbon and mitigate the global climate change. Unfortunately, the natural and anthropogenic activities (destruction of mangrove for shrimp farming) cause heavy destruction of the blue carbon ecosystem. As a result, the atmospheric carbon content is rising day by day and the earth became warmer. Conservation and protection of blue carbon ecosystems will mitigate CO2 emissions. Conservation of blue carbon ecosystems will also help in the conservation of biodiversity, protection of the community along coastal zones, conservation of valuable fisheries, prevent erosion, and also prevent the degradation of adjacent communities.

Abstract: Raising the carbon dioxide (CO_2) concentrations in the atmosphere leads to global climate change, and it causes the sea level to rise, Tsunami, and damage the coastal and marine ecosystem. Coastal vegetation such as mangroves, sea grass, and salt marsh called blue carbon ecosystem got the considerable potential to store the CO_2 from the environment to the root system, the soil below ground, and litter. Apart from carbon sequestration, it provides various ecosystems ecological services such as shelter for the various fishes, mammals, crabs, and migratory birds. However, due to anthropogenic and natural threats, the blue carbon ecosystem is destroying reducing its capability to store carbon. This system needs to be conserved to mitigate global climate change and also to obtain ecological services.

Keywords: Mangroves, Migratory, Salt marsh, Climate change

Introduction: The Earth's warming in recent decades has caused an overwhelming consensus amongst climate scientists because different human activities and anthropogenic activities have increased the number of greenhouse gases (GHGs) in the atmosphere. To mitigate the severe impact of climate change, we need to adopt a range of different strategies, among which Blue Carbon is an essential strategy. Blue Carbon is organic carbon that has been captured and sequestered by coastal marine plants. Sea grasses, mangroves, and tidal marshes ecosystems are highly productive and act as the largest carbon repositories in coastal ecosystems (Nellemann *et al.*, 2009; Sappal et al., 2016). Vegetated coastal ecosystems (mangrove forests, sea grass beds, salt marshes) are disproportionately important in sequestering carbon dioxide than terrestrial ecosystems. These ecosystems are exquisite carbon sinks and provide various ecological services such as shelter for the various fauna such as fishes, crabs, and migratory birds. According to the different researchers, the coastal blue carbon ecosystems have great potential in sequestering carbon within its living biomass and within the soil below ground (sediments), where roots, litter, and deadwood can be found. The potential for sequestering blue carbon is estimated to be decennial over the short term in biomass and millennial over six longer time scales in sediments (Duarte *et al.* 2005a; Lo Iacono *et al.* 2008; Mcleod *et al.* 2011).Oceans play a vital role in capturing and recycling atmospheric CO2 and globally absorbed over one-third of anthropogenic CO2 emissions through biological, physical, and chemical processes due to the gaseous exchange at the ocean and atmosphere interface (Siegenthaler and Sarmiento, 1993; Tamis and Foekema, 2015). Coastal ecosystems represent less than 5% of the earth's total surface but play a significant role in regulating the global carbon cycle (Twilley *et al.*, 1992). These ecosystems store around 3418.5 metric tons

of carbon dioxide equivalent per hectare (t CO2/ha) in their biomass and sedimentary carbon.

This coastal blue carbon provides benefits to climate change mitigation because of their ability to store carbon under adverse conditions. Due to this, it has got the attention of the scientific community at large. A significant portion of biogenic carbon reaches the seafloor, where it can be buried and effectively locked away from the atmosphere over long time scales constituting a sink of CO2 and contributing to mitigate climate change (Bowler *et al.,* 2009).OSPAR Biodiversity Committee (BDC) meeting in March 2015, considered a blue carbon ecosystem has colossal potential to mitigate the global climate change in the OSPAR maritime area (OSPAR, 2015). Marine and coastal ecosystems play a crucial role in carbon storage and sequestration and mitigate global climate change (Duarte et al., 2005a; Nelleman et al., 2009; Murray et al. 2011). Vegetated coastal habitats are widely distributed and are estimated to be globally responsible for the burial of 120–329 Tg C /yr, which accounts for at least half of the lower estimate for global carbon burial in marine sediments (Nellemann et al., 2009). In recent years "blue carbon" sinks are being lost at critical rates, and action is urgently required to prevent further degradation and loss of these blue carbon ecosystems. The high priority restoration and conservation management should be followed to understand the different factors that influence carbon sequestration and improve scientific activity to prevent these ecosystems' degradation.

Blue carbon ecosystem and biodiversity: Coastal blue carbon habitats are hot spots for biodiversity and provide valuable ecosystem functions, including a massive carbon sink capacity (Duarte *et al.,* 2008, Duarte*et al.,* 2009; Nellemann *et al.,* 2009). However, in recent years, this habitat's destruction and degradation are increasing due to different anthropogenic activities. Restoration of these habitats results in blue carbon development as well as the conservation of the biodiversity of these ecosystems. So, the protection of blue carbon habitats and large-scale restoration of lost blue carbon sinks is a win-win strategy as it mitigates CO2 emissions and improves coastal resources (Nellemann et al., 2009;) and biodiversity.

Blue carbon ecosystems and carbon storage: Blue carbon ecosystems remove CO2 from the atmosphere via photosynthesis, return some to the atmosphere through respiration and oxidation, and store the remaining carbon in two pools: living biomass (both above ground in the wood, leaf, and belowground vegetation in roots) and soil organic carbon. The carbon sequestration rate is the total amount of carbon is added to the biomass and soil annually. These ecosystems typically have mature vegetation that maintains steady biomass, and all the sequestration ends up buried in the soil carbon pool. Blue carbon ecosystems are hot spots for carbon sequestration because they convert CO2 into plant biomass, found in depositional environments, and soils have high accretion rates resulting in the rapid burial of organic matter in anoxic conditions, which accumulate both autochthonous and allochthonous particulate carbon (Kennedy *et al.,* 2010; Saintilan *et al.,* 2013; Donato et al., 2011; Lo Iacono et al., 2008; Serrano et al., 2016a).

Annual carbon sequestration rates vary in the different coastal habitats such as marshes and mangroves. Average carbon sequestration is between 6-8 tonnes/ CO_2e/ha/yr. Sea grasses tend to sequester carbon at approximately 4 t CO_2e/ha/yr(Lewis et al. 2009). The rate of carbon stored in living biomass in sea grasses is 0.4–18.3 t CO_2/ha, and salt marshes at 12–60 t CO_2/ha. Mangrove forests maintain 237–563 t CO_2/ha in living biomass. However, the long-term preservation and continuous accretion of carbon in a tidal marsh, mangrove, and sea grass soils result in the formation of organic-rich deposits several meters in thickness (Mateo et al., 1997; Donato et al., 2011). According to many researchers, the carbon storage and sequestration rate in the different blue carbon ecosystems are given below (Table 1).

Ecosystem	Global Extension (km^2)	Global C Burial Rate (Tg C/yr)	Global C Stock in Soil (Pg C)
Tidal marshes	22,000 - 400,000	4.8 - 87.3	0.4 - 6.5
Mangroves	137,760 - 152,3615	22.5 - 24.9	5 -10.4
Sea grasses	177,000- 600,000	48 - 112	4.2 - 8.4
Macroalgae	1,400,000 - 5,700,000	61 - 268	n/a

Table 1: Extension and Carbon Stocks and Burial Rates Within the top 1 m of Soil of Tidal Marsh, Mangrove and Seagrass Ecosystems, and Macroalgae C Buried in the Ocean (Source: Serrano et al., 2019).

The carbon storage rate in the soil and biomass of the blue carbon ecosystem is Sea grass: 512 Mg CO_2e/ha, Saltmarsh: 917 Mg CO_2e/ha, and Mangroves; 1028 Mg CO_2e/ha. Blue carbon ecosystems regularly remove CO_2 from the atmosphere and sequester them in the form of soil carbon. The average carbon sequestration rates of these ecosystems are Sea grasses: 138 gC/m^2/yr equal to 5.1 tCO_2/ha/yr, Salt marshes: 218 gC/m^2/yr equal to 8.0 tCO_2/ha/yr, Mangroves: 226 gC/m^2/yr equal to 8.3 tCO_2/ha/yr

Factors influencing carbon storage in blue carbon ecosystems: Organic carbon sequestered in the blue carbon ecosystem reaches the seafloor and gets covered by a layer of sediments. Carbon sequestration occurs when the sediments' burial rates are more significant than the long-term rates of erosion, bioturbation, and decomposition. Multiple factors influence carbon storage, including biotic and abiotic factors acting in the water column, canopy, the soils, and the landscape's history and past variation in sea level. The other factors are given in Table 2.

Factors	Influence and Discussion
1) Spatial variability in sedimentation I. Open ocean II. Coastal margins III. Submarine canyons	Sedimentation is the rate at which suspended particulate sink and accumulated on the ocean floor. The amount of suspended sediment and the rate of deposition vary drastically in the different places of the ocean like Open ocean-low sedimentation rate due to wind Coastal margins- high sedimentation rate due to input by rivers Submarine canyons- Carbon burial rate in the marine canyons are more significant than the adjacent continental slope.
2) Human changes in global sedimentary systems I. Agriculture/land cleaning II. Dams	Different numbers of human activity have done the modification of sediment cycles. Global sedimentary cycling started to change when humans started clearing the land for agriculture and constructing a dam. Land cleaning causes an increase in erosion rate. Dams are nearly 100% efficient sediment traps.
3) Density of vegetation	The density of vegetation in the mangrove forest, sea grass meadows, and tidal marshes sufficient to change water flows, which is enough to reduce erosion and increase sediment deposition because they exert primary control on carbon storage through the production of biomass and nutrient cycling (Lavery et al., 2013; Serrano et al. 2014, 2016a; Kelleway et al., 2016a; Atwood et al., 2018;2015)
4) Nutrient load	Both mangrove and sea grass ecosystems, which have been subjected to high nutrient loads, increase the carbon capture and sequestration rate.

Table 2: Factors influencing carbon storage in blue carbon ecosystems

Blue carbon and climate change mitigation:

Carbon storage in the blue carbon ecosystem is one of the cheapest, safest, and most comfortable solutions to sink the greenhouse gas emissions and promote adaptation to climate change (Jones *et al.,* 2012, Turner *et al.,* 2009). Two central primary mechanisms to reduce greenhouse gas emissions in this ongoing loss of coastal habitat and marine ecosystems is:

1) conserving historically sequestered pools of carbon. 2) restoring and rebuilding degraded carbon pools.

From the disturbance of blue carbon ecosystems, the rate at which carbon is lost is much more than the rate at which it can be restored. The other advantages of blue carbon ecosystems are like mangroves act as natural barriers, serving as the first defense from storm surges, stabilizing shorelines, and reducing coastal communities (Barbier, 2007; Das and Vincent, 2009). Sea grass meadows also reduce shoreline erosion by trapping suspended sediments in their root systems (Barbier, 2007).Coastal ecosystems absorb pollutants like heavy metals, nutrients, suspended matter, and pathogens, help maintain water quality, prevent eutrophication, and develop dead zones. A healthy coastal ecosystem also provides various recreational opportunities such as snorkeling, recreational fishing, and boating, and coastal ecotourism is one of the fastest-growing sectors.

Threats to Blue carbon storage: Mangrove, sea grass, and salt marsh areas have already been lost over the past several decades due to the intervention of different human activities like reclamation, deforestation, engineering, and urbanization, transformation to aquaculture ponds (Green and Short 2003; Duarte et al. 2005b; Silliman et al. 2009. Over the past decades' sea grass habitat decline due to coastal eutrophication, siltation, and development (Green and Short 2003; Duarte et al. 2005b; Waycott et al. 2009), whereas the mangroves and salt marshes habitats have been damaged by dredging, filling, drainage, trophic cascades, and also due to introduction or accidental invasion of invasive species (Valiela et al. 2001; Alongi 2002; Silliman et al. 2005; 2009). Sea-level rise and sea surface temperature increase due to the climate change is another threat to the coastal ecosystem which can erode and flood mangroves and salt marshes and increase water depths and reduce the availability of light to support photosynthesis (Björk et al. 2008; Woodroffe 1995; Silliman et al. 2009). The global average annual loss of blue carbon ecosystem losses reduces their carbon storage capacity. It has severe implications for human populations that depend on these ecosystems for food, livelihoods, and coastal protection. Considerable conservation and management strategies should be addressed to protect these blue carbon ecosystems and controls carbon dynamics in coastal systems (Middleton and McKee, 2001; Kristensen et al., 2008).

Current policies needed to safeguard carbon associated blue carbon ecosystems: Different policies exist to incentivize nature-based mitigation activities for blue carbon ecosystems by different carbon policies and financial mechanisms. A few examples are highlighted below in Table 3.

Policies and Opportunities	Description
UNFCCC Article 4	Promote sustainable management, conservation, and enhancement of sinks and reservoirs of all greenhouse gases, including oceans and other coastal and marine ecosystems.
Reducing Emissions from Deforestation	A framework for encouraging and financing activities that reduce emissions or enhance removals of GHGs from forest-related activities
Nationally Appropriate Mitigation Actions (NAMAs)	Part of the UNFCCC mechanisms for developing countries to access carbon finance and provide opportunities to include land-use change, conservation, and restoration activities in coastal ecosystems into national mitigation efforts.
Clean Development Mechanisms (CDM)	Developing countries can obtain funding for eligible projects with a net GHG benefit, including CO2 sequestration from forests. The CDM has approved a large-scale mangrove restoration methodology.
Voluntary Carbon Market	Provides the possibility of generating financial support for blue carbon ecosystems conservation or restoration activities and provides a framework for accounting GHGs emission reductions in coastal wetlands, mangroves, tidal and seagrasses, deltas, floodplains, and peatlands, among others.

Table 3: Current policies needed to safeguard carbon associated blue carbon ecosystems (Sources: Climate Focus, 2011; Conservation International, 2008; Pendleton et al., 2012).

Conclusion: In recent years blue carbon ecosystems have received international attention for its potential role in mitigating CO_2 emissions. Conservation and protection of blue carbon ecosystems will help maintain global carbon sequestration in the future and prevent emissions that are termed land-use change. Conservation of blue carbon ecosystems will also help in conservation of biodiversity, protection of community along coastal zones, conservation of valuable fisheries, prevent erosion, and also prevent the degradation of adjacent communities. We need to create mass awareness regarding the importance of blue carbon ecosystem so that the ecosystem can sustain.

References:

Antonius, A., 2000. Threats to and protection of coral reefs. *University of Vienna, Germany*.

Baswapoor, S. and Irfan, Z.B., 2018. Current Status of Coral Reefs in India: Importance, Rising Threats and Policies for its Conservation and Management

Bellwood, D.R., Hughes, T.P., Folke, C. and Nyström, M., 2004. Confronting the coral reef crisis. *Nature*, *429*(6994), pp.827-833.

Boström- Einarsson, L., Babcock, R.C., Bayraktarov, E., Ceccarelli, D., Cook, N., Ferse, S.C. Hancock, B., Harrison, P., Hein, M., Shaver, E. and Smith, A., 2020. Coral restoration–A systematic review of current methods, successes, failures and future directions. *PloS one*, *15*(1), p.e0226631.

Bowden-Kerby, A., 2001. Low-tech coral reef restoration methods modeled after natural fragmentation processes. *Bulletin of Marine Science*, *69*(2), pp.915-931.

Cairns, S.D., Gerhswin, L.A., Brook, F., Pugh, P.R., Dawson, E.W., Ocaña V, O., Vervoort, W., Williams, G., Watson, J., Opresko, D.M. and Schuchert, P., 2009. Phylum cnidaria; corals, medusae, hydroids, myxozoa. *New Zealand Inventory of Biodiversity. Volume 1. Kingdom Animalia: Radiata, Lophotrochozoa, Deuterostomia*.

Carpenter, K. E. et al. One-third of reef-building corals face elevated extinction risk from climate change and local impacts. Science 321, 560–563 (2008).

Epstein, N.R.P.M., Bak, R.P.M. and Rinkevich, B., 2003. Applying forest restoration principles to coral reef rehabilitation. *Aquatic Conservation: Marine and Freshwater Ecosystems*, *13*(5), pp.387-395.

Ferse, S.C., 2010. Poor performance of corals transplanted onto substrates of short durability. *Restoration Ecology*, *18*(4), pp.399-407.

Foo, S.A. and Asner, G.P., 2020. Sea surface temperature in coral reef restoration outcomes. *Environmental Research Letters*, *15*(7), p.074045.

Forsman, Z.H., Kimokeo, B.K., Bird, C.E., Hunter, C.L. and Toonen, R.J., 2012. Coral farming: effects of light, water motion and artificial foods. *Journal of the Marine Biological Association of the United Kingdom*, *92*(4), pp.721-729.

Hale, G., 1999. The classification and distribution of the class Scyphozoa. *Eugene: University of Oregon*.

Horoszowski-Fridman, Y.B., Izhaki, I. and Rinkevich, B., 2011. Engineering of coral reef larval supply through transplantation of nursery-farmed gravid colonies. *Journal of Experimental Marine Biology and Ecology*, *399*(2), pp.162-166.

More References can be provided on request.

Team Agrotech

YOUR STEPPING STONES IN SUCCESS!!

Country Representative
CPM ASIA

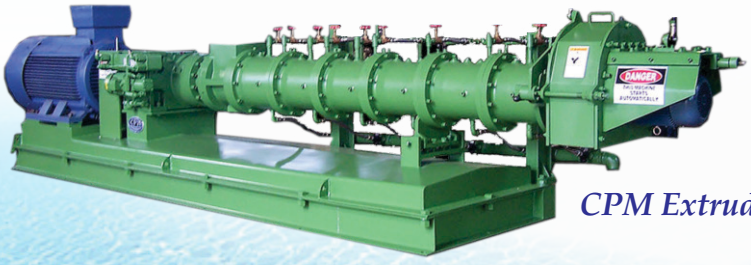
Your Single Stop Source for

Complete Project management of Turnkey Solutions in the following areas:

1. Integrated Feed plants for Poultry, Floating Fish, Sinking Fish, Shrimps, Cattle etc.
2. Balance of plant eqpuipments for Pre/Post processing
3. Complete Plant Automation Solution, on **GATE In to GATE Out concept.**
4. In-house design and manufacturing of Pre Fabricated steel structures for Plants, Warehouses etc.

CPM Dryer

CPM Pellet Mill



CPM Extruder

Contact Today

Team Agrotech Pvt. Ltd.

1- 4, 249, Hill Road, Gandhi Nagar, Nagpur-10 , Maharashtra, India.
M. : +91 9422803386, +91 9650559095
Ph. : +91 712 2222142
e-mail : teamagrotech@yahoo.com
Website : www.teamagrotech.com

For Queries Contact

Scan me

MECHANISMS OF ANTIMICROBIAL RESISTANCE IN BACTERIA

mpetchimuthumfsc@gmail.com

[1]Petchimuthu M, [1]Rujan J and [1]Jaculine Pereira J.

[1]Dr MGR. Fisheries College and Research Institute, TNJFU, Nagapattinam – 614 712

1. Introduction

Microorganisms have existed on the earth for more than 3.8 billion years and exhibit the greatest genetic and metabolic diversity. They are an essential component of the biosphere and serve an important role in the maintenance and sustainability of ecosystems. It is believed that they compose about 50% of the living biomass. In order to survive, they have evolved mechanisms that enable them to respond to selective pressure exerted by various environments and competitive challenges. The disease-causing microorganisms have particularly been vulnerable to man's selfishness for survival who has sought to deprive them of their habitat using antimicrobial agents. These microorganisms have responded by developing resistance mechanisms to fight off this offensive. Currently antimicrobial resistance among bacteria, viruses, parasites, and other disease-causing organisms is a serious threat to infectious disease management globally.

2. Antimicrobial Resistance

The World Health Organization (WHO) defines antimicrobial resistance as a microorganism's resistance to an antimicrobial drug that was once able to treat an infection by that microorganism. Resistant microbes are more difficult to treat, requiring higher doses, or alternative medications which may prove more toxic. These approaches may also be more expensive. Microbes resistant to multiple antimicrobials are called multidrug resistant (MDR). Resistance is a property of the microbe, not a person or other organism infected by a microbe. Antibiotic resistance is a subset of antimicrobial resistance.

3. Principle of Antimicrobial Resistance in Bacteria

Several factors have been reported to be responsible to antibiotics resistance in bacteria. Some of the reasons includes: Reduced access to target due to slow porin channels; increased antibiotics expulsion due to

Highlight Points

- Antimicrobial resistance develops when microorganisms change when they are exposed to antimicrobial drugs.
- The main cause of antimicrobial resistance is due to indiscriminate use of antibiotics. When we use antibiotics, some bacteria can survive and even multiply.
- The frequent use of antibiotics, the more chances bacteria have to become resistant to them. Intrinsic resistance, circumstantial resistance and acquired resistance are the types of resistance found in animals.
- The main mechanisms of resistance in bacteria cells are limiting uptake of a drug, modification of a drug target, inactivation of drug, active efflux of a drug and genetic transformation like mutation.
- Horizontal gene transfer, or the process of swapping genetic material between neighbouring contemporary bacteria, is a means by which resistance can be acquired.
- Antimicrobial resistance is one of the biggest threats to global health, food security today. It can affect anyone, of any age in any country. The understanding about antimicrobial resistance and its mechanisms helps to take the preventive measure against antibiotic resistance.

multiple drug efflux pumps; inactivating enzymes due to β-lactamases, aminoglycoside-modifying enzymes; mutational resistance due to regulatory mutations that increases the expression of intrinsic genes and operons which is variable in certain circumstances (Nikkado *et al.*, 2003). The antimicrobial agents in widespread clinical use were developed to inhibit targets unique to prokaryotic cells such as bacterial cell wall, the bacterial ribosome and bacterial DNA gyrase. These antibiotics have reduced the mortality resulting from infectious diseases. Use and often abuse of antibiotics has encouraged the evolution of bacterial towards resistance, resulting often in therapeutic failure. Resistance reflects the ability of a microorganism to avoid the inhibitory and lethal activity of antimicrobial agents. (Fraimow and Abrutyn, 1995).

4. Types of Resistance

4.1. Intrinsic Resistance

Whereby microorganisms naturally do not possess target sites for the drugs and therefore the drug does not affect them or they naturally have low permeability to those agents because of the differences in the chemical nature of the drug and the microbial membrane structures especially for those that require entry into the microbial cell in order to affect their action. With intrinsic resistance the organism possesses properties that make it naturally resistant to certain insults, e.g. the more complex outer layer of gram-negative bacteria makes it much more difficult for certain antimicrobials to penetrate. It is considered to be a natural and inherited property with high predictability. Once the identity of the organism is known, the aspects of its anti-microbial resistance are also recognized.

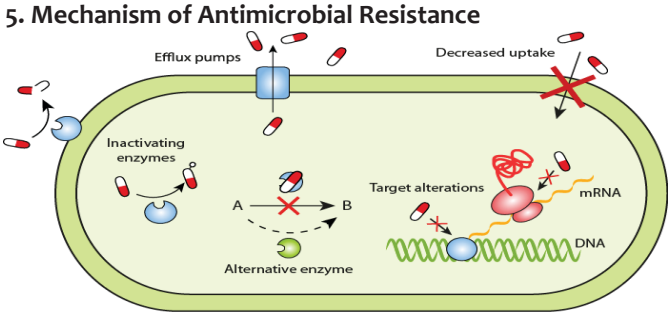
4.2. Circumstantial Resistance

It is the difference between the *in vitro* and *in vivo* effects of an antimicrobial agent. Agents that appear to be active in the laboratory may be ineffective *in vivo* because of failure to reach the site of infection, such as the inability of first generation cephalosporin to cross the blood-brain barrier.

4.3. Acquired Resistance

Acquired resistance is when a naturally susceptible microorganism acquires ways of not being affected by the drug. Any insult, physical or chemical, has the potential to induce changes in the organism. Microbes are more ubiquitous however, and can actually acquire resistance from each other by sharing genetic material. They can pass genetic material from one to another in various ways; thus, microbes have been performing their own genetic modification for millions of years.

5. Mechanism of Antimicrobial Resistance



The major resistance mechanisms of microbes are decreased drug uptake, efflux pumps, enzymes that inactivate an antimicrobial chemical and target alterations by mutation. There also are biofilms.

5.1. Decreased uptake

As stated above the more complex outer layer of gram-negative bacteria make it much more difficult for certain antimicrobials to penetrate. Gram positive bacteria have a cell wall composed mostly of peptidoglycan, a very rigid substance. This is a prime target of β lactam antimicrobials such as penicillin and cephalosporin. The antimicrobial locks on to the β lactam structure in the cell wall, preventing expansion, and the cell ruptures as it grows. Gram negative bacteria have a much thinner cell wall itself and this is protected by a lipopolysaccharide molecule in the capsule, an outer membrane and what is known as the periplasmic space. In short it is a much more heavily armoured vehicle. Porins are openings in the cytoplasm membrane through which antimicrobial agents can gain entry a reduced number of such porins is one means of antimicrobial resistance.

5.2. Efflux pumps

Some bacteria like *Pseudomonas*, have a system called an efflux pump. As its name suggests this is a system whereby the bacterium has a pump to expel ingested chemicals. Although some of these drug efflux pumps transport specific substrates, many are transporters of multiple substrates. Antimicrobial efflux pumps are believed to contribute significantly to acquire bacterial resistance because of very broad variety of substrates they recognize, their expression in important pathogens, and their cooperation with other mechanisms of resistance, such as decreased uptake. Their presence also explains high-level intrinsic resistances found in specific organisms. The designs of specific, potent efflux pump inhibitors appear to be an important goal for the improved control of infectious diseases in the near future. For example, in ear therapy tris-EDTA has the potential to partially inactivate the efflux pump but this is only a topical specified action not generally available in most situations.

5.3. Enzyme inactivation

Some microorganisms have developed the ability to produce enzymes that are able to inactivate certain antimicrobials. The most notable example is penicillinase that can inactivate penicillin, but there are others. Clavulanic acid can bind penicillinase leaving the antimicrobial amoxicillin to do its work, and also there are the penicillinase resistant penicillin such as methicillin and cloxacillin, but they are still subject to target alterations making them ineffective over time.

5.4. Mutation

When an antimicrobial attack a specific target, whether it be cell wall peptides, ribosome or nuclear DNA, it locks on to specific receptors on the target. Bacterial mutation results in the alteration of these receptors so that the antimicrobial can no longer fit and the organism is thus resistant to the effects of the antimicrobial.

6. Mechanisms of Resistance Gene Transfer

Drug resistance may be acquired by passage of the trait

vertically to daughter cells, but more commonly it is acquired by horizontal transfer of resistance by, Transduction, Transformation and Conjugation.

6.1. Transformation

Transformation refers to the ability of microorganisms to utilise snippets of free DNA from their surroundings. DNA from dead cells gets cut into fragments and exits the cell. The free-floating DNA can then be picked up by competent cells. Exogenous DNA is taken up into the recipient cell from its surroundings through the cell membrane. The exogenous DNA is incorporated into the host cell chromosome via recombination. Transformation results in the genetic alteration of the recipient cell.

6.2. Transduction

Transduction is acquisition of bacterial DNA from a phage that has incorporated DNA from a previous resistant host bacterium. e.g. strains of *S. aureus*. Bacteriophages can transmit genetic material from one organism to another.

6.3. Conjugation

Bacterial conjugation is the transfer of genetic material between bacterial cells by direct cell-to-cell contact or by a bridge-like connection between two cells. It is a mechanism of horizontal gene transfer as are transformation and transduction although these two other mechanisms do not involve cell-to-cell contact.

6.3.1. Transposons

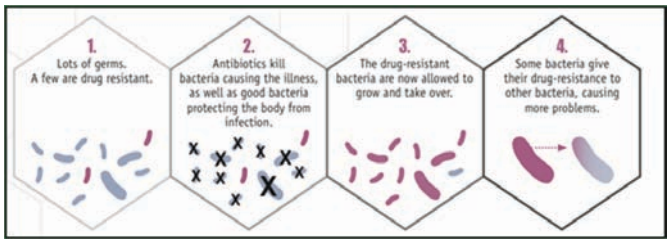
Transposons are sequences of DNA that can move around different positions within the genome of single cell. The donor plasmid containing the Transposons, co-integrate with acceptor plasmid. They can replicate during co integration. Both plasmids then separate and each contains the r-gene carrying the transposon. e.g. *Staphylococci, Enterococci*

6.3.2. Integrons

Integron is a large mobile DNA can spread Multidrug resistance. Each integron is packed with multiple gene cassettes, each consisting of a resistance gene attached to a small recognition site. These genes encode several bacterial functions including resistance and virulence, it cannot promote self-transfer.

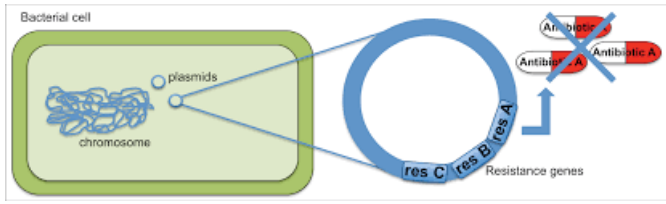
7. Selection for Resistance

Susceptible organisms are eliminated leaving resistant ones to multiply the pathogens. Organisms may be partially resistant and susceptible to higher levels of antimicrobials.



8. Co-Selection for Resistance

A crucial factor is the fact that integrons often carry the resistance genes for several anti-microbial at the same time. Thus, overuse of a less crucial antimicrobial, such as tetracycline may result not only in selection for resistance to tetracycline but also to other, possibly more critically important, antimicrobials. This is highly relevant as it means that, while overuse of antimicrobials deemed critically important should always be avoided.



9. Prevention of Antimicrobial Resistance

Resistance of bacteria against antimicrobial substance gives more strength for survival. Resistant microbes are more difficult to treat, requiring higher doses, or alternative medications which may prove more toxic. So, we have to reduce the resistance capacity of bacteria against antimicrobial substance. The following steps can be preventing the antimicrobial resistance of bacteria.

- No indiscriminate and inadequate or unduly prolonged use of antimicrobial agents.
- Prefer rapidly acting and selective (narrow spectrum) AMAs.
- Use combination of AMAs for prolonged therapy e.g. tuberculosis,
- Intensive treatment for notorious organisms.

Conclusion

Antimicrobial resistance is one of the biggest threats to global health and food security. It can affect anyone, of any age in any country. It occurs naturally, but misuse of antibiotics in human and animals is accelerating the process. So, proper understanding needs about how antimicrobial resistance develops the principles of horizontal gene transfer, selection for resistance and the interaction between humans and animals. This understanding helps to take the preventive measure against antibiotic resistance, So We can minimise resistance to antimicrobial therapy.

Plastic Eating Bacteria- A solution to plastic pollution ???

Abarna Krishna Moorthy[1], Dr V. Rani[1] and Dr Rathi Bhuvaneswari Govindarajan[2]
[1]Department of Aquatic Environment Management, Fisheries College and Research Institute.
[2]Division of Aquatic Environment and Health Management,
Central Institute of Fisheries Education.
E-mail: abarnalatha111@gmail.com

Highlight Points

- Plastic accumulates not only on beaches worldwide, but also in "remote" open ocean ecosystems.
- Globally, we generate around 57 million tonnes of plastic waste per year, with between 5 and 13 million tonnes of this ending up in our surrounding environment, particularly in the oceans.
- In March 2016, a Japanese research team found a bacteria *Ideonellasakaiensis* that could completely degrade Polyethylene terephthalate, or PET, within 6 weeks.
- Genetic engineering could be used to increase the production of PETase and MHETase, making each bacterium more efficient at decomposing the plastic.

Introduction

Plastic has become the most common form of marine debris since it entered the consumer arena less than 60 years ago, and presents a major and growing global pollution problem. According to the UN estimates, every year the world uses 500 billion plastic bags. The global plastic production in 2017 was around 348 million metric tonnes. In India, 70% of total plastic consumption is discarded as waste. Around 5.6 million tonnes per annum (TPA) of plastic waste is generated in country, which is about 15,342 tonnes per day (TPD). The current global annual production, estimated represents 35 kg of plastic produced annually for each of the 7 billion humans on the planet, approximating the total human biomass.Plastic accumulates not only on beaches worldwide, but also in "remote" open ocean ecosystems. Plastic pollution is the most widespread problem affecting the marine environment. It also threatens ocean health, food safety and quality, human health, coastal tourism, and contributes to climate change. The most visible and disturbing impacts of marine plastics are the ingestion, suffocation and entanglement of hundreds of marine species. Marine wildlife such as seabirds, whales, fishes and turtles, mistake plastic waste for prey, and most die of starvation as their stomachs are filled with plastic debris. They also suffer from lacerations, infections, reduced ability to swim, and internal injuries. Floating plastics also contribute to the spread of invasive marine organisms and bacteria, which disrupt ecosystems. Plastic, which is a petroleum product, also contributes to global warming. If plastic waste is incinerated, it releases carbon dioxide into the atmosphere, thereby increasing carbon emissions. Hence serious measures or actions has to be taken in controlling the plastic pollution inorder to protect our environment.

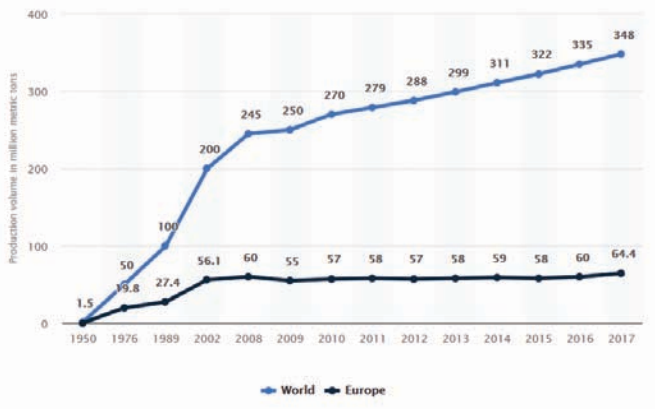


Fig 1: Global trend in plastic production (Production in million metric tonnes)

Plastic entering ocean:

It is estimated that about 348 million tonnes of plastic are produced each year across the globe, which includes 56 million tonnes of PET. Of all this plastic produced, only 10% is recycled. Globally, we generate around 57 million tonnes of plastic waste per year, with between 5 and 13 million tonnes of this ending up in our surrounding environment, particularly in the oceans. In 2015, it was estimated that more than

5 trillion plastic pieces weighing over 268,940 tons were afloat at sea, not including the larger plastic debris.In a trawling mission across the Pacific, Hayden K. Webb et. al. of Swinburne University of Technology found plastic debris in every ten-degree latitudinal belt.

Aquatic organisms at risk:

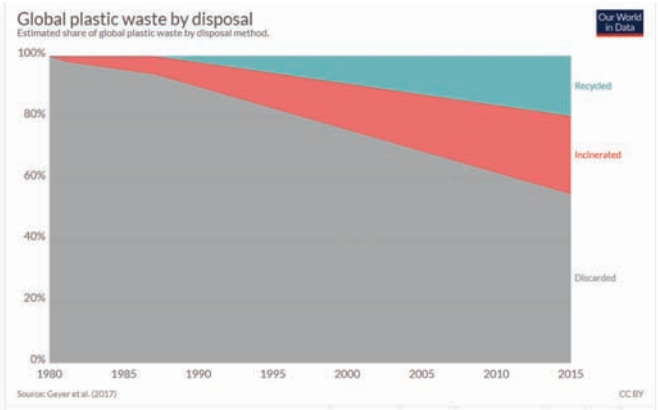


Fig 2: Estimated share of global plastic waste by disposal method

Most critically, the plastic in the ocean endangers marine life because it is a choking hazard and toxic. The plastics are not just thinly spread, either. The mass of microplastics -plastic chunks smaller than five millimeters long is six times greater than that of the world's zooplankton , a vital food source for thousands of marine species. Many of those marine species eat small objects indiscriminately, the plastic sticks around in the larger animal's digestive systems. Small as well as large marine life are affected, suffering from starvation or malnutrition along with hormonal problems.

Fig 3 and Fig 4: Aquatic organism at risk

Plastic eating fungi

A plastic comprised of harmful compounds, PET, has been degraded by different types of fungi in the past. *Fusarium oxysporum* and *F. solani*, two filamentous fungal species, have been grown on media enriched with minerals and PET yarn. The fungi use enzymes to break down the plastics into safe monomers and carbon dioxide to be used for their own growth. Depending on the efficacy of the enzymes, the leftover PET could be collected and recycled like it is now. The degraded humus digested by the fungus or other organism could also be repurposed in ornamental gardens or other organic purposes. Solutions like *Fusarium* fungi are not poisonous, so they could be used near people. Both types of fungi, though not toxic to humans, can be harmful to plants, making them unideal candidates for PET degradation. Also, *Fusarium oxysporum* can penetrate soils and attack plants, so the generated humus from the PET would be pathogenic and unusable until sterilized.

Plastic eating caterpillar

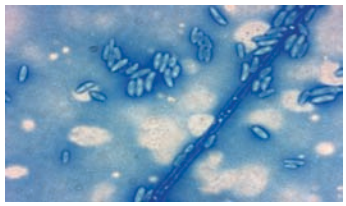


Fig 5: Plastic eating fungi- Fusarium oxysporum

In 2017 researchers in the UK and Spain reported that a particular species of caterpillar was able to degrade PE at a comparably faster rate than any observed previously. Caterpillars of the wax moth *Galleria mellonella* were found to be able to degrade PE at a rate of 0.23 mg cm–2 h–1, a greater rate than the one found for the PETase degradation of PET.The researchers provided a probable explanation as to why these caterpillars were able to digest an artificial substrate such as PE. Honeycomb contains a complex mixture of components, with one of the main ones being beeswax, which itself is composed of over 248 different compounds, many of which contain long alkyl chains. It therefore seems likely that the ability of these caterpillars to digest the C–C bonds in the alkyl chains of the beeswax translates into being able to digest the C–C bonds within PE. Introducing the wax worms and wax moths for plastic degradation into environments outside where they naturally occur cannot be done, as it would endanger other species in those ecosystems such as bees.However, the bacteria and their proteins responsible for the breaking down of the plastic can be cultured within a laboratory and have the potential to be used on a large scale for plastic recycling. Further research into optimising and understanding these enzymes could result in a solution to the problem of recycling and disposing of plastic.

Plastic eating bacteria

In March 2016, a Japanese research team found a bacteria that could completely degrade Polyethylene terephthalate, or PET, within 6 weeks. This plastic is found in water bottles, clothing, and packaging, and has known to be very non-biodegradable. Out of a variety of microbes, one was responsible for PET degradation: *Ideonella sakaiensis.* The most efficient *Ideonella sakaiensis* was responsible for breaking down three times more material than all the other microbes combined. *Ideonella sakaiensis* is a negative-gram

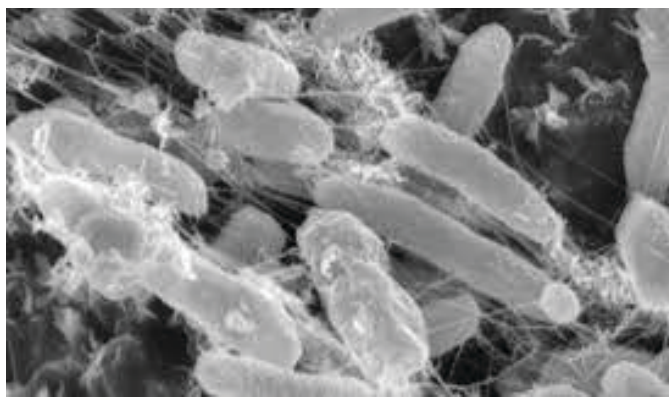


Fig 6: Plastic eating bacteria- Ideonella sakaiensis

bar-shaped bacterium. They are aerobic bacteria and have flagellum whichhelps it move quickly. The optimum temperature and pH for the better growth of this bacteria is30-37°C and 7-7.5 respectively. But it can survive in temperatures of 15°C and 42°C and in pH 5-5.9. This strain is positive to catalyse and cytochrome oxidation test.

Bacterial Enzymes for PET degradation

Ideonella sakaiensis damaged PET film extensively and almost completely degraded it after 6 weeks at 30°C. When sequencing the genome of this bacterium to find the main contributors to the PET hydrolytic activity, they found an enzyme this bacterium secretes: a PETase. This enzyme

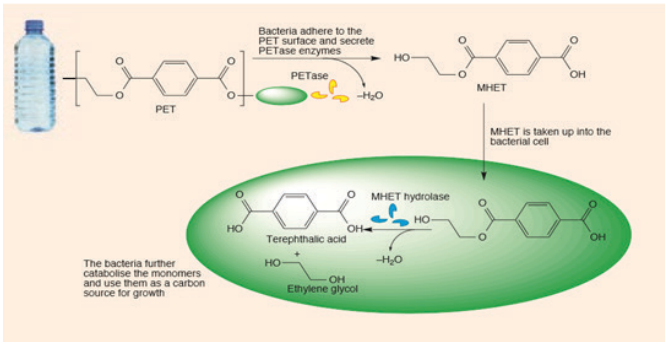


Fig 7: Hypothesised action of the I. sakaiensis which contain PETase and MHET hydrolase

generates and intermediate MHET, which is taken back up by the cell and hydrolyzed by a second enzyme.This second MHET hydrolase converts MHET into two environmentally benign monomers: terephthalic acid and ethylene gylcol. Both safe chemicals can be further reduced into carbon dioxide and water by more common enzymes and are then used as a carbon source by the bacterium.

Hypothesised action of the I. sakaiensis which contain PETase and MHET hydrolase

Genetical engineering

Genetic engineering could be used to increase the production of PETase and MHETase, making each bacterium more efficient at decomposing the plastic.Gene splicing involving CRISPR-Cas9 -- a biotechnology that can alter the genome of a living organism -- could also be used to place the PETase and MHETase production traits into sea-dwelling bacteria.If many bacteria in the ocean carry these enzymes, the South Pacific Garbage Patch could be reduced over time without a major clean-up operation. Waterborne plastic-degrading bacteria could also contribute to the reduction of microplastics suspended in the ocean, stemming tide of PET in the ocean.

Characterisation of PETase

Sequence analysis and recent structural studies of PETase highlight similarities to α/β-hydrolase enzymes including the cutinase and lipase families, which catalyze hydrolysis of cutin and fatty acids, respectively. This observation provides clues to the origin of PETase, but further insights into its structural and functional evolution are needed.A multiple high-resolution X-ray crystal structures of PETase, enable the comparison with known cutinase structures based on differences in the PETase and a homologous cutinase active-site cleft.As predicted from the sequence homology to the lipase and cutinase families, PETase adopts a classical α/β-hydrolase fold, with a core consisting of eight β-strands and six α-helices with an Open Active-Site Cleft. PETase has close sequence identity to bacterial cutinases, with Thermobifida fusca cutinase being the closest known structural representative (with 52% sequence identity) which is an enzyme that also degrades PET.Despite a conserved fold, the surface profile is quite different between the two enzymes. PETase has a highly polarized surface charge creating a dipole across the molecule and resulting in an overall isoelectric point (pI) of 9.6. In contrast, T. fusca cutinase, in common with other cutinases, has a number of small patches of both acidic and basic residues distributed over the surface, conferring a more neutral pI of 6.3 .

Improved Crystalline PET Degradation

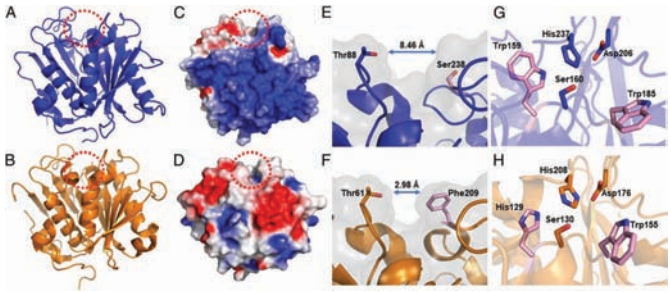


Fig 8: Improved Crystalline PET Degradation

Converting PETase to a Cutinase-Like Active-Site Cleft Enables Improved Crystalline PET Degradation, changes in the active site relative to the T. fusca cutinase resulted from the evolution of *I. sakaiensis* in a PET-containing environment, thus enabling more efficient PET depolymerization. Hence mutation done in PETase-active site to make it more cutinase-like. A double mutant was produced, S238F/W159H, based on homology modeling to narrow the PETase active site similar to the *T. fusca* cutinase. Additionally, W185A mutant was produced to examine the role of this highly conserved dynamic residue.

Source: Austina et al.,2018

A) Cartoon representation of the PETase structure at 0.92 A° resolution (Protein Data Bank (PDB) ID code 6EQE). The active-site cleft is oriented at the top and highlighted with a dashed red circle.

B) Comparative structure of the *T. fusca* cutinase (PBD ID code 4CG1).

C) Electrostatic potential distribution mapped to the solvent accessible surface of PETase compared with the *T. fusca* cutinase as a colored gradient from red (acidic) at -7kT/e to blue (basic) at 7kT/e(where *k* is Boltzmann's constant, *T* is temperature and *e* is the charge on an electron).

D) *T. fusca* cutinase in the same orientation.

E) View along the active-site cleft of PETase corresponding to the area highlighted with a red dashed circle

in *A* and *C*. The width of the cleft is shown between Thr88 and Ser238.

F) Narrower cleft of the *T. fusca* cutinase active site is shown with the width between Thr61 and Phe209 in equivalent positions.

G) Close-up view of the PETase active site with the catalytic triad residues His237, Ser160, and Asp206 colored blue. Residues Trp159 and Trp185 are colored pink.

H) Comparative view of the *T. fusca* cutinase active site with equivalent catalytic triad residues colored orange. Residues His129 and Trp155 are colored pink. The residues in PETase colored pink correspond to the site-directed mutagenesis targets S238F, W159H, and W185A.

In the original report describing the discovery of PETase, Yoshida et al.,2016 examined PETase digestions of amorphous PET films with a crystallinity of 1.9%, which is lower than that of most PET samples that would be encountered either in the environment or in an industrial recycling context. To examine the performance in the wild-type PETase relative to the two mutants, PET digestion was conducted with coupons of higher crystallinity. Specifically, PET coupons with an initial crystallinity of 14.8 ± 0.2% (for reference, a commercial soft drink bottle exhibits a crystallinity of 15.7% as measured by DSC) were synthesized and characterized by NMR spectroscopy to confirm their structure and by DSC to determine their crystallinity.Results of PET degradation,has wildtype PETase induces surface erosion and pitting of a PET film with a crystallinity of 13.3 ± 0.2%, resulting in a 10.1% relative crystallinity reduction (absolute reduction of 1.5%). Surprisingly, the PETase double mutant outperforms the wildtype PETase by both crystallinity reduction and product release. The absolute crystallinity loss is 4.13% higher, and the corresponding SEM images appear to show that slightly more surface ablation occurs.

Uses

- Bacteria are indiscriminate; they will degrade PET regardless of contamination.
- In this way, *I. sakeiensis* is superior to recycling, which can only reuse plastics that are sufficiently clean and sorted.
- Since bacteria can be grown easily, this technology is perfectly scalable, reducing the need to decrease plastic usage.
- The bacteria could also be added to landfills to accelerate the decay of disposed plastics. Also, *I. sakeiensis* is not malicious to plants; its byproducts can, therefore, be used horticulturally.

References:

- Koelmans, A. A., Bakir, A., Burton, G. A., & Janssen, C. R. (2016). Microplastic as a vector for chemicals in the aquatic environment: Critical review and model-supported reinterpretation of empirical studies. Environmental Science & Technology, 50(7), 3315-3326.
- Sahana Ghosh,2018. India to galvanise greater action against plastic waste on World Environment Day.
- www.hoddereducation.co.uk/chemistryreview
- Eriksen M, Lebreton LCM, Carson HS, Thiel M, Moore CJ, et al. (2014). Plastic Pollution in the World's Oceans PLoS ONE 9(12): e111913.
- H. K. Webb, J. Arnott, E. Ivanova. "Plastic Degradation and Its Environmental Implications with Special Reference to Poly(ethylene terephthalate)". Swinburne University of Technology. Date of publication 01.06.2016. Accessed 10.28.2016.
- http://www.mdpi.com/2073-4360/5/1/1/htm.
- R. Cho. "What Happens to All That Plastic?". Columbia University Earth Institute. Date of publication 01.21.2012. Accessed 10.28.2016.
- C. M. Rochman, E. Hoh, B.T. Hentschel, S. Kaye. "Long-Term Field Measurement of Sorption of Organic Contaminants." The American Chemical Society. Date of publication 12.27.2012. Accessed 10.28.2016.
- Shosuke Yoshida, KaKa zumi Hiraga, Toshihiko Takehana, Ikuo Taniguchi, Hironao Yamaji, Yasuhito Maeda, Kiyotsuna Toyohara, Kenji Miyamoto, Yoshiharu Kimura, Kohei Oda (2016). A bacterium that degrades and assimilates poly(ethylene terephthalate) Science 1196-1199.
- C. Morawski. "Single-stream Uncovered." Resource Recycling Magazine. Date of publication 02.2012. Accessed 10.28.2016. http://www.containerrecycling.org/assets/pdfs/media/2010-2SingleStreamUncovered.pdf.
- A. Reis. "CRISPR/Cas9 and Targeted Genome Editing: A New Era in Molecular Biology." New England Biolabs Expressions. Date of publication 01.2014. Accessed 10.28.2016.
- Han X, et al. (2017) Structural insight into catalytic mechanism of PET hydrolase. Nat Commun 8:2106.
- Joo S, et al. (2018) Structural insight into molecular mechanism of poly(ethylene terephthalate) degradation. Nat Commun 9:382.
- Roth C, et al. (2014) Structural and functional studies on a thermostable polyethylene terephthalatedegrading hydrolase from Thermobifida fusca. Appl Microbiol Biotechnol 98:7815–7823.
- Wagner A, Duman R, Henderson K, Mykhaylyk V (2016) In-vacuum long-wavelength macromolecular crystallography. Acta Crystallogr D Struct Biol 72:430–439.
- Harry P. Austina,2018 .Characterization and engineering of a plastic-degrading aromatic polyesterase.
- Roth C, et al. (2014) Structural and functional studies on a thermostable polyethylene terephthalatedegrading hydrolase from Thermobifida fusca. Appl Microbiol Biotechnol 98:7815–7823.
- Müller RJ, Schrader H, Profe J, Dresler K, Deckwer WD (2005) Enzymatic degradation of poly (ethylene terephthalate): Rapid hydrolyse using a hydrolase from T. fusca. Macromol Rapid Commun 26:1400–1405.
- Herrero Acero E, et al. (2011) Enzymatic surface hydrolysis of PET: Effect of structural diversity on kinetic properties of cutinases from Thermobifida. Macromolecules 44: 4632–4640.
- Yang Y, Yang J, Jiang L (2016) Comment on "A bacterium that degrades and assimilates poly(ethylene terephthalate)". Science 353:759.

Postal Regn. No. HD/1068/2021-2023
Published on 7 May 2021