



Central Marine Fisheries Research Institute







Dr. E. G. Silas Centre of Excellence and Innovations

India's first research centre for marine fish microbiome and nutrigenomics

Dr. E. G. Silas Centre of **Excellence and Innovations** in Marine Fish Microbiome and Nutrigenomics

supported by the Department of Biotechnology, Govt. of India





CMFRI Booklet Series No.40/2024

The Central Marine Fisheries Research Institute (ICAR-CMFRI), with Head Quarters at Kochi, India is one of the leading tropical marine fisheries research institutes in the world. Established on 3rd February 1947, the institute has completed 75 glorious years of service to the nation in 2022. Over the past 7 decades, ICAR-CMFRI has played a pivotal role in India's marine fisheries development through significant contributions in the fields of research, extension and education. Dr. E. G. Silas Centre of Excellence and Innovations (Dr.EGS–CoEI) in Marine Fish Microbiome and Nutrigenomics is one key facilities in ICAR-CMFRI acting as a platform for the national fish microbiome, immunome and nutrigenomics research and attracting foreign collaborations on advanced research in the field.

Dr. E. G. Silas Centre of Excellence and Innovations in Marine Fish Microbiome and Nutrigenomics has been implemented in the ICAR-CMFRI with the financial support from the Department of Biotechnology (DBT), Govt. of India during 2020 (Sanction Order No.BT/AAQ/3/SP28267/2018 dated 11. 05. 2020). This Centre has been named as 'Dr. E. G. Silas Centre of Excellence and Innovations' considering the matchless contributions of Dr. E. G. Silas to the development of fisheries and mariculture in India. Dr. E. G. Silas served as the director of CMFRI during 1975-1985



CMFRI

The Centre of Excellence has two research components:

Unravelling larval microbiome and immunome of targeted fin fishes for improved mariculture production

This component aims to decipher the microbiome and immunome profiles during early life stages of the most commercially important marine fish species of India namely, cobia (*Rachycentron canadum*) and silver pompano (*Trachinotus blochii*). Better microbial management and immunomodulation strategies/ protocols/products will be explored to address the poor growth and survival rates during the larval stages of the fish. The products and strategies/protocols evolved through the research will also be evaluated in orange-spotted grouper (*Epinephelus coioides*), another commercially important marine fish species to check the enhancement in cross species fish larval survival.

Application of nutrigenomics for improved growth and immune functions of larval stages in targeted marine fin fishes

This component primarily envisages to study the interplay between marine fish larval nutrition, genome and health. The nutrigenomics tools will be applied to precisely predict the critical nutritional requirements of cobia and silver pompano larvae. Suitable feeds/feed supplements/ feeding strategies will be developed through the identified nutritional gaps for enhancing the growth, survival and quality of targeted fish species. The products developed through the research will also be evaluated in orangespotted grouper to check the enhancement in cross species fish larval survival.







Vision

The centre of excellence aims to address the poor larval growth and survival of commercially important maricultured finfishes of India through a holistic approach incorporating microbiome, immunity, nutritional and genetic factors, and their interactions. The approach is initially applied in the most commercially significant maricultured finfish species of India such as pompano and cobia. The products and strategies/protocols developed through the research will be later evaluated in orange-spotted grouper, another commercially important species to check the enhancement in cross species fish larval survival.

The centre has the state-of-the-art facilities in aquaculture microbiome and nutrigenomics and contributes to expertise within India. The facility functions as a platform for national fish microbiome, immunome and nutrigenomics research, attracting foreign collaborations on advanced research.

Deliverables

- Higher survival of larvae and juveniles of the candidate species
- Microbial community management strategy
- Probiotics/prebiotics/synbiotics
- Immunostimulants & protocol for improved immunity of larvae (trained immunity approach)
- Species specific larval feeds & feeding strategies for the target species
- Feed additives/functional feeds, viz. Growth promoters, Digestibility enhancers & Promoters for early
 post infection recovery



Project team

Dr. Gopalakrishnan A: Project coordinator

Dr. Krupesha Sharma S. R. Dr. Sumithra T. G. Dr. Reshma K. J. Dr. Rameshkumar P. Dr. Sanil N. K. Dr. Abdul Nazar A. K. Dr. Pradeep M. A. Dr. Jeena N. S. Dr. Eldho Varghese Dr. Anikuttan K. K.

Dr. A. G. Ponniah: Scientific advisor

- Dr. Anil M. K. Dr. Ambarish P. Gop. Dr. Adnan Hussain Gora Dr. Saima Rehman Dr. Sanal Ebeneezar Dr. Linga Prabu D. Dr. G. Tamilmani Dr. Boby Ignatius Dr. Sakthivel M Dr. Ritesh Ranjan
- Dr. Sekar Megarajan Dr. B. Santhosh Dr. P. Gomathi Dr. Bavithra R. Dr. Surya S. Dr. Chandrasekar. S. Dr. Sajina K. A. Ms. Gayathri Suresh Mr. Sudarsan K



Infrastructure

The centre has been set up with the cutting-edge infrastructure facilities to implement cost-efficient and holistic research activities on fish microbiome, nutrigenomics and allied fields.

Wet laboratory facilities: Hatchery facility, RAS facility, in door rearing and experimentation facility & sea cage farming units

Microbiome laboratory: contains state-of-the-art facilities like anaerobic chamber, biosafety cabinets, bacteriological incubators, refrigerated incubators, shaking incubators, bench top fermenter, centrifuges (refrigerated and ultracentrifuges), sonicators, homogenizers, thermal cyclers- gradient and real time), electrophoretic units (vertical and horizontal), gel image analyzers, laboratory freezers, automatic tissue processor for histology, rotary microtome, microscopes (compound with photomicrography and scanning electron microscope), high precision weighing balances, sterilization facilities, lyophilizers, spectrophotometers, microplate reader, etc.

Nutrigenomics laboratory: contains different equipment like, ball mill, spheronizer with extruder, fluidized bed dryer with compressor, grindometer, sieving shaker, HPLC unit with accessories, GLC-FID with accessories, laboratory scale extruders, water quality analysers, automatic protein, fat and fibre analysers, feed sampler mill, pulverizer, feed mixer, muffle furnace, rotary evaporator, etc.

NGS & Bioinformatics infrastructure facilities: nanopore sequencer, high performance computing facility with four compute nodes and three TFLOPS computing capacity with 8 processors, 96 cores and 64 GB memory per node. Total usable storage capacity is 4 TB and works in Linux RHEL operating system.

Co-working spaces & meeting rooms: designed to foster the creativity, collaborations and meetings



Research Highlights

- Established a dedicated national facility for the fish larval microbiome and nutrigenomics research in India
- Developed a reliable and precise fish larval preservation method for microbiome and transcriptomics research
- Documented the standard operating protocols for larviculture practices of cobia (*Rachycentron canadum*) and silver pompano (*Trachinotus blochii*)
- First report on the full-length transcriptome in different life stages, *viz.* larvae, juveniles and adults of *R. canadum* using Pac-Bio sequel II platform
- Published the first report on the application of PacBio system targeting full-length 16S rRNA sequences, for deciphering fish (*R. canadum*) microbiome
- First report on the full-length transcriptome in different life stages, *viz.* larvae, juveniles and adults of *T. blochii* using Pac-Bio sequel II and Illumina platforms





- Identified the specific storage conditions for profiling the antioxidant biomarkers of marine fish larvae
- Recorded the microbiome profiles in different larval stages of *R. canadum* in comparison to the resident water and microbiome profiles of juveniles under standard operating protocols
- Provided first-hand mechanistic insights into the microbiome and its governing eco-evolutionary processes in the early life stages of *T. blochii*
- Identified that rotifer microbiome manipulations before 12 DPH would be the optimal medium for the marine larval microbiome manipulations
- Completed the full gene characterization of three immune genes (IL-10, tnf- α and hsp-70) from *T. blochii*
- Detailed the sequence and expression characteristics of a novel tnf- α 1 gene from *T. blochii*
- Reported the list of predicted miRNAs that play a key role in teleost IL-10 expression
- Provided the first experimental evidence of the coexistence of two IL-10 mRNA transcripts in Carangidae
- Preserved the pure cultures of 90 morphologically distinct symbiotic marine microbes associated with *R. canadum & T. blochii* larval stages
- Optimized the methodologies for the screening of microbes for PUFA production. Five microbes from the larval symbiotic collections were shortlisted for future applications
- Recorded the changes in the microbiome profiles of cobia larvae following exposure to transport stress (10 h). The results provided the prospective metagenomic signatures of health and stress, critical dysbiotic

events, and novel possible explanations for increased disease susceptibility post-transportation in larval stages.

- Identified critical key species/core microbes from the whole microbial profiles of early and late larval stages and gut of juvenile *R. canadum & T. blochii*
- Identified the optimal concentration and exposure time for three chemicals (hydrogen peroxide, glutaraldehyde, and povidone-iodine) meant for egg disinfection of *T. blochii*, thus improving larval quality, immunity and survival
- Optimized the preparation of micro-feeds using an extruder and spheronizer using fluidized bed processing technology (Patent application no. 202411051697)
- Identified the nutritional composition of currently used imported larval feeds at CMFRI
- Deciphered the growth and digestive enzyme activities in *T. blochii* larvae fed with micro-feeds
- Evaluated the effect of microalgae (*Aurantiochytrium* sp.) as a larval feed in *T. blochii* and identified its effect on the tissue-specific expression patterns of *fads2* and *elov15* genes
- Identified the optimal dietary protein (49%), lipid (10%), and essential fatty acid (EPA, DHA and its ratio) requirements in *T. blochii* larvae for ideal growth and survival
- Analyzed the effect of dietary emulsifier supplementation in T. blochii larvae
- Completed the characterization and tissue-specific expression patterns of nutritionally important genes (*fabp6, fabp4, dgat, cpt, ppara, ifab, fads, elovl5, cpt1* and proliferator-activated receptors PPARs) in *T. blochii*
- Feeding strategies were optimized for *T. blochii* larvae up to 32 dph with early weaning protocol through the formulated and live feeds
- Standardized two bone staining methods (direct staining and whole staining) for application in larval staining of *T. blochii*
- Optimized the production protocols for protein hydrolysates from animal sources (fish meal, shrimp meal, clam meal, *etc.*) and plant sources (ground nut oil cake, soybean meal, *etc.*)



Research metrics



Publications

Metagenomic signatures of transportation stress in the early life stages of cobia (*Rachycentron canadum*) to aid in mitigation strategies (2022), Aquaculture (559), 738407. https://doi.org/10.1016/j.aquaculture.2022.738407

Comparative evaluation of fish larval preservation methods on microbiome profiles to aid in metagenomics research (2022). Applied Microbiology and Biotechnology 106, 4719-4735. 10.1007/s00253-022-12026-6

Full-length transcriptome from different life stages of cobia (*Rachycentron canadum, Rachycentridae*) (2023) Scientific Data 10, 97. https://doi.org/10.1038/s41597-022-01907-0

Deciphering the microbial landscapes in the early life stages of a high-value marine fish, cobia (*Rachycentron canadum, Rachycentridae*) through high-resolution profiling by PacBio SMRT sequencing (2024). Aquaculture (582) 740503. https://doi.org/10.1016/j.aquaculture.2023.740503

Profiling the antioxidant biomarkers in marine fish larvae: a comparative assessment of different storage conditions to select the optimal strategy (2024). Fish Physiol Biochem. doi: 10.1007/s10695-023-01290-6

Mechanistic insights into the early life stage microbiota of silver pompano (*Trachinotus blochii*) (2024). Front. Microbiol. 151356828. https://doi.org/10.3389/fmicb.2024.1356828

Insights into the methodological perspectives for screening polyunsaturated fatty acids-containing bacteria (2024) Arch. Microbiol. https://doi.org/10.1007/s00203-024-04155-5

Molecular features and expression kinetics of interleukin-10 gene from the marine teleost, Snubnose pompano (Trachinotus blochii). Mol Biol Rep 52, 79 (2025). https://doi.org/10.1007/s11033-024-10180-w

Molecular features and expression characteristics of a novel tumour necrosis factor- α paralog from snubnose pompano (*Trachinotus blochii*). J. Fish Biol (2025). DOI: 10.1111/JFB70077

Technical article: Post-transportation changes in the microbiome of cobia linked to increased disease susceptibility. Mar. Fish. Infor. Serv., T & E Ser., No. 252, 2022

Book chapter: Nutrigenomics tools to address the emerging issues in marine fish larviculture. In: Advances in Agricultural, Animal and Fisheries Sciences (Eds: Devi Dayal and Shamsudheen M), 2022, ZNAN Publishers, Society for Technology, Environment, Science& People, pp: 20-29. ISBN: 978-81-956227-2-6. https://eprints.cmfri.org.in/16856/

Mandard and Mandard Annual Annua Annual Annual Annu	scientific data	Mechanistic insights into the early mean life stage microbiota of silver pompano (Tacchinotus blochi)	An Apartments MERCARCE Profiling the antioxidant biomarkers in marine fish larvae: a comparative assessment of different storage conditions to select the optimal strategy
Deciphering the microbial kandscapes in the early life stages of a high value marine flab, cobia Glodycentrue canodaes, Rodycenridar) through high resolution profiling by Partice SMIT requestions	ATADESCRIPTOR ATADES	Instrument a strume strume strume March Strument Strumen	Auricha Lapanistana ¹⁰ - Sanniko Tanapatet Gapalama ¹⁰ - Krapate Barra A 87 - Gradel Vinne - Hannik Nichi Karondonakar- Spind PAr- Anisekh Porckate Gep ⁹ - Opiekt-Mana - Anna - Maria - Grada - Maria - Ma
Comparison of the Article	Rachycentridae) Word Rowsen, Ull, S. & Young and J. & Vieward, "A Vieward, "When between the sector of the sector	Sector 2015 Control 100 Con	E la dudini, sior Andrea Marce Nagree Marc N. 2007. Henry C. Marcello and
A share and the second	All and address the same of your and an address that address the same of the s	Biological States and States a	Single: Division status, parata das inversos de radio de la construcción de la construcción de la construcción la constru

Research opportunities

The centre offers vacancies for PhD in the Marine Biotechnology, Fish Nutrition and Health Division, ICAR-CMFRI. The investigators are recognized PhD supervisors of Kerala University of Fisheries and Ocean Studies, Cochin University of Science and Technology, and Mangalore University. Hence, the interested candidates can register for PhD in any of these universities by availing their own fellowship (CSIR/ UGC/ ICMR/ ICAR/ Inspire/etc.) under the guidance of any of our team members. Areas of proposed work will be microbiology, biotechnology, fish nutrition, biochemistry or molecular biology. The registered scholars have to give full-time commitment to the work allotted for PhD and other part-time jobs will not be entertained during the study period. The applications should reach the Director/Pls by email (director.cmfri@icar.gov.in, krupeshsharma@gmail.com, sanalebeneezar@gmail.com).

The state-of-the-art facilities and expertise established through the centre in aquaculture microbiome and nutrigenomics also invite research collaborations from various national and international researchers working in this field. The interested researchers email to the above mail IDs so that novel proposals can be made through discussions and interactions, that can be submitted to potential funding agencies.

The Centre also provides need-based training programs for researchers, academicians, officials of state fisheries department, administrators and students on various aspects of marine fish microboiome and nutrigenomics. The applications should reach the Director/HRD cell through director.cmfri@icar.gov.in and hrdcellcmfri@yahoo.com



Published by: Dr.Grinson George

Director, ICAR- Central Marine Fisheries Research Institute, Kochi, Kerala, India.

Prepared by: Dr. Sanal Ebeneezar, Dr. Sumithra T. G., Dr. Krupesha Sharma S. R, Dr. Sajina K. A, Gayathri Suresh, ICAR-CMFRI

Contact Us

Dr. E. G. Silas Centre of Excellence and Innovations (Dr.EGS-CoEI) in Marine Fish Microbiome and Nutrigenomics

ICAR-Central Marine Fisheries Research Institute, Post Box No. 1603, Ernakulam North P.O., Kochi-682 018

Webpage: http://210.212.232.215/egscei/advisory.php

Phone: +91 484 2394357 /12, 2391407

E mail: director.cmfri@icar.gov.in, krupeshsharma@gmail.com, sanalebeneezar@gmail.com, sumithravet@gmail.com

CMFRI Booklet Series No.40/2024 Dr. E. G. Silas Centre of Excellence and Innovations in Marine Fish Microbiome and Nutrigenomics



Indian Council of Agricultural Research



Central Marine Fisheries Research Institute



Department of Biotechnology



Dr. E. G. Silas Centre of Excellence and Innovations