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- Title : **Recent advances in marine biotechnology**
: **Volume 5. Immunobiology and pathology**
Editors : **M. Fingerman and R. Nagabhushanam**
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Biotechnological processes are the interplay and interaction of microbiology and biochemistry and are known to humanity from time immemorial through microbial fermentation of starch and sugars to alcohol. Although this discipline has made tremendous strides in the pharmaceutical, chemical, agricultural and food/feed industries world over, its application in the marine biota is yet to catch up at commercial levels. The wide spectrum of marine organisms of mariculture

potential, biota yielding chemicals of pharmacological and toxicological importance, fishery products, fish feeds, pollution control, pathology, immunology etc are some of the areas wherein biotechnology owe and own vast potentials. The precipitous advances in Research and Development made in understanding marine biotechnology during the last few decades worldover have not properly reflected in the research works of developing countries of Asia, as they have yet to

learn more in this frontier area. The book under review 'Recent Advances in Marine Biotechnology' volume 5 Immunobiology and Pathology is fifth in a series with greater bearing on volume 4, Aquaculture. This volume on Immunobiology and Pathology consists of 13 chapters, written by internationally respected group of highly talented investigators from various countries and is edited most meticulously by the two globally respected scientists, Drs. M.Fingerman and R.Nagabhushanam. Each chapter is carefully structured with schematic drawings, histograms, polygons, scatter displays, photographs, photomicrographs, tables presenting data and with a rich list of references and keywords at the end of each chapter.

The global aquaculture is acquiring greater significance and relevance in the recent few decades as an alternative to supplement and compliment the declining or stagnating coastal capture fisheries production. Environmentally and economically successful aquaculture of shellfish/finfish species need understanding of diseases, pathogens and means of protection and disease control. Worldwide intensive cultures pose serious threats of environmental hazards, degradations, pollution and infestation of diseases of domestic and exotic nature, often the latter is imported through various inputs like seed/feed etc. The subject matters of direct relevance and with an authentic touch to immunobiology and pathology of marine bivalves, shrimps, invertebrates and teleost fishes alone are incorporated in this volume.

The first chapter on Defense mechanisms of marine bivalve contributed by Dr. Fu-Lin E.chu, an eminent professor from the college of Marine sciences, Virginia, USA, is an extensive review on the internal defense mechanisms in some economically important bivalves. The author has carefully moduled the recent findings about the cellular and humoral defenses of oysters, mussels and clams and focusses on hemocyte morphology and functions, humoral factors and their functions, variations of cellular and humoral components; environmental factors and hemocyte function and activity and defense against infectious disease organisms and their pathological effects. In this article the author summarizes the bivalve hemocytes' capability to distinguish 'nonself' and self materials and phagocyte and encapsulated microbial and abiotic 'nonself' materials and their role in inflammation and wound repair. Although the sequential biochemical processes of phagocytosis and intracellular killings are not

completely understood, new information in this line is forthcoming from different sources. The environmental temperature and salinity along with exposure to pollutants could be the potential stressors responsible for the elevated multiplication of protozoan parasites, on which the bivalves' antimicrobial defense factors to destroy the invaders, intracellularly and extracellularly, do not appear effective; the cellular and humoral factors also vary among individuals seasonally with habitat and the physiology and health of the organism. An exhaustive list of references further helps to introduce the reader to many works carried out till recently on the topic concerned.

The second chapter by Dr. Thomas C.Cheng of Marine Research Institute, South Carolina, USA, deals with the 'Cellular defense mechanisms of oysters'. The article reviews what is known in immune mechanisms of oysters, both cellular and humoral, and also attempts to point out what needs to be further demonstrated and experimented. All documented observational and experimental results by many workers from various parts of the world under different sub headings such as hemocyte type, factors involved in cellular defense, leucocytosis, chemotaxis, host cell surface contact, membrane receptors, lectins as opsonins, endocytosis, intracellular degradation, lysosomal enzymes and their release into serum, environmental influence, exocytosis, energy requirements, other cellular defense mechanisms, different types of encapsulations, necrocytosis, avoidance of destruction by parasites, recognition of self extracellularly, escape into cytoplasm and non fusion of lysosomes with parasitophorous vacuole are highlighted and the subjects are lavishly illustrated with schematic diagrams, microphotographs and histograms. In the conclusion the author has stressed the area for accelerated investigation on molluscan immunology with special emphasis on identifying receptor sites on phagocytes, transcytoplasmic messengers, transplant mechanisms in exomigration of lysosomes, post - antigenic challenge and possible roles of cytokines. The article also embodies an exhaustive list of latest references of much relevance to the topic dealt in the chapter.

'Application of flow cytometry to bivalve pathology' reviewed by Kathryn A.Ashton-Alcox, Bassem Allam, and Susan E. Ford of Hashkin Shellfish Research Laboratory, Institute of Marine and Coastal Sciences, USA, is a brief compendium of works on the subject reported from different laboratories. The flow cytometry has wider applicability in studies such as the nature of ploidy,

cell cycle in neoplastic disease, effect on temperature and phagocytic rates, individual variability in different hemocyte counts of bivalves, internal defense activities associated with resistance to disease, abundance of water borne pathogens, identification of viable and non viable cells etc. all of which are only a fraction of the possibilities available for flow cytometry in bivalve pathology. To a great extent the use of flow cytometric methodologies safely replaces time consuming and cumbersome microscopy in cellular related host - parasite interactions, probes for bivalve pathogens to rapidly quantify abundance. The flow cytometer is an excellent tool to detect pathogens or toxic algae in the environmental sample and hence facilitate to provide quick warning to shellfish farmers and resource managers. While reviewing the various areas of applicability, the author has incorporated the relevant data, graphs and scatter displays generated by the respective workers, along with a rich bibliography of most relevant papers.

The paper on 'Hemolymph biomarkers of crustacean health' contributed by Edward J. Noga of N.C. State University College of Veterinary Medicine, USA, reviews extensively the non-invasive clinical screening of hemolymph to assess the function of specific tissues and organs of crustaceans. These tools are needed for the reliable and accurate assessment of the health of crustacean in farms and in the wild. Often the prevalence of certain diseases is considered as a crude indicator of environmental degradation / stress in habitat condition or farming environment. The author has reviewed many literatures on hemolymph bioindicator and tabulated them indicating the factors that affect hemolymph clinical parameters on species and the effects. The review also conveys hemolymph as a health indicator, immunological factor, chemical constituents, and other health indicators along with a long list of references.

The next article on 'Cell culture techniques for detecting viral diseases of shrimp' is written by a team headed by Ya-Li Hsu Institute of Zoology, Taiwan. A review of this nature on a topic of vital importance to aquaculturists, is timely as there were many reports of disease outbreaks caused by pathogens like bacteria, virus, fungi, etc. from many centres of aquaculture concentration in Asia. Failure of shrimp aquaculture and the precipitous drop in production, causing great economic losses, in late eighties, the author feels, were seemingly due to stresses and poor planning and management. The prevailing diagnostic and detection methods

for the major viruses such as histopathological, electron microscopic observation, ELISA using antibodies, DNA probes and PCR for detecting viral particles are not capable to detect the infectivity of viruses and therefore *in vitro* culture techniques are necessary for detecting viral diseases. The paper also gives primary and sub cultures, basic culture conditions, supplementary nutrition, growth factors and virus susceptibility along with references.

'Application of immunostimulants, a recent step to prevent disease', is dealt in chapter six of this book. The author Yen-hing Sung and Chih-Chang Huang from the National Taiwan University, Taiwan, have reviewed works pertaining to the application of immunostimulants to prevent shrimp diseases. Since the immunostimulant cannot eradicate pathogens, the authors propose a scheme of multiple administration of immunostimulants via infection, immersion and feeding during a culture period to sustain enhanced, broad spectrum resistance to infections in a long duration. This review along with the list of references is highly informative and contemporary and would provide an insight into processes of non-specific disease causing opportunistic pathogens in highly stressed shrimp farms.

The next article on 'Immunotoxicity of environmental pollutants in marine invertebrates' presented in this book by Cal Baier-Anderson and Robert Anderson, University of Maryland, USA is a very valuable contribution, as there are widespread reports on the exposure of aquatic organisms to environmental pollutants, and their consequential effects on many physiological processes, which can impair the immune response and hence lower their resistance. The article reviews research works on the influence of chemical stresses on infectious disease, influence of test chemicals and other stresses on the total and differential hemocyte counts and modulations; assays to measure and modulation of phagocytosis, phagocyte-produced reactive oxygen species (ROS), assays to measure ROS and modulation of ROS production, cytotoxic enzymes and stress protein expression. The authors propose focussed researches to understand hemocyte types, function, relation between hemocyte receptors and phagocytosis, role of cytokines in hemocyte response etc. This review documents the effect of pollutants in disease and hence important to researchers, as they have been noticing instances of toxic pollutants reaching coastal waters, which support several aquaculture candidate invertebrates and frequent outbreak of diseases in farms.

The paper on 'Vaccination in salmonid aquaculture' by P.J. Midtlyng of National Centre for Veterinary Contract Research and Commercial Services, Norway, is a review of much importance, as 'the salmonids as candidates for sport fishing, for river restocking and for aquaculture and many fish immunological experimental works were conducted on salmon/trouts. The topics attained greater relevance with the increase of fish farming and occurrence of bacterial, viral and parasitic infestations often at epizootic dimensions. Research and development of vaccines to control infections have already provided encouraging results and even reached the fish farmers. The fish immunology and vaccinology have made tremendous strides in developing bacterias against gram-negative infections, to be administered as injections, immersion or oral; whereas immuno prophylaxis against gram-positive bacteria has not reached the stage of industrial implementation. Similarly vaccine development against viral diseases and parasite infestations needs further clinical evaluation and classification regarding the magnitude of protection they will confer in the field. This article seems to be of immense use to researchers in fish pathology, immunology and vaccinology.

The chapter nine on 'Nonspecific cytotoxic cells and innate cellular immunity in teleost fish' contributed by D.L.Evans and L.J.Friedmann of USA is yet another highly specialized area in microbiology and parasitology. The role of NCC to lyse a variety of tumor targets, protozoan parasites, virus infected cells and the molecular information about innate immunity have been reviewed in the article under various sub heads with the support of electron micrographs, diagrams and tables followed by a list of the latest relevant literatures.

In the tenth chapter Peter-Joachim Enzmann of the Federal Research Centre for Virus Diseases and Animals, Germany has reviewed at length the 'Molecular biology of fish pathogenic rhabdoviruses'. The contents include the taxonomy, genome structure, replication, nomenclature of genes, viral proteins, pathogenicity and vaccines, molecular epidemiology and the molecular approach to diagnosis of FPR.

The article on 'Biotechnology and diagnosis and control of fish diseases' by Brian Austin, Harriot-Watt University, UK, includes all aspects of the role of biotechnology in fish disease diagnosis and control of bacterial and viral diseases. Many aquaculture candidates, subjected to semi intensive farming practices, suffer diseases caused by bacteria, virus or parasites. Biotechnology could pay pivotal role in the design of serological tests, ELISA, FAT, molecular techniques and PAGE in the

disease diagnosis. Development of genetically disease resistant strains of cultivable species and immunostimulation compounds through biotechnological approaches. The review also describes various measures like antimicrobial compounds, dietary supplements, probiotics and vaccines to control bacterial diseases and suggests vaccine technology to ameliorate the impact of viral diseases, all with the support of 245 latest references.

The next review article on 'Pharmacokinetic studies of drugs against vibriosis in cultured fish' by Kaznaki Uno, Aichi Konan College, Japan presents the fisheries chemotherapeutants such as sulfonamides, tetracyclines, quinolones, β -lactams, macrolides, nitrofurans and chloramphenicol and their clinical dosage regimes in cultured fishes with special reference to vibriosis. The paper also provides relevant data along with the list of current references.

The last paper in this book on 'Interferon inducers: application in fish disease control' is contributed by Yurin S.Alikin *et al.* Russia. The role of Interferon Inducers to prevent the outbreak of viral diseases and to reduce the efficiency of a wide range of virus infections and the simultaneous secondary pathogenic bacterial microflora infections, usually caused due to immunodeficiency, has been reviewed thoroughly in this article with the help of suitable bibliography.

This book is an authentic record of research reviews on many areas of immunobiology and pathology mostly relevant to marine invertebrates and fishes of immense value and importance as cultivable species. The contents will be of great use to researchers in the respective fields and to student community at large. As there are not many work of this nature from India or abroad, which contains the recent information on the subjects, I hope that this book would form a worthy addition to College/University/Research Institution libraries. Therefore, I strongly recommend this volume to students and researchers in immunobiology and pathology and the list of references given after each article would further serve as an up to date bibliography on the topics of narrow specialization. In this context the editors deserve special mention for their vision in selecting topics as well as the authors. The editors' style of presentation, brevity and clarity of ideas, but without losing the sum and substance of each article presented in this noteworthy book are further commendable.

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