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Abstracts

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GENOMICS OF LUMPFISH (CYCLOPTERUS LUMPUS): TOWARDS MARKER ASSISTED SELECTION

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Lumpfish Cyclopterus lumpus is a commercially important fish in several areas of its range in the North Atlantic Ocean. This species also plays a vital role in salmonid aquaculture where it serves as a biological agent of sea lice control. Recent investigations into the cleaning behaviour (sea lice grazing efficacy) and disease resistance in several families of lumpfish showed significant difference among families, of which, the genetic basis is yet to be investigated for selective breeding programmes. Despite the fishery and aquaculture importance of lumpfish, few genetic resources are currently available for the species. Here, a genomic approach with different next-generation sequencing platforms was used to gain insight into the patterns of genome-wide variation in a wild cohort (n=30) of lumpfish distributed along the Norwegian coastline. First, this study assembled a draft genome of lumpfish using two differently size-selected, from Illumina paired-end read libraries (MiSeq) and from a 400 bp single-end read library using the Ion Torrent sequencing platform. Second, single nucleotide polymorphisms (SNPs) and small structural variants (insert-deletions, INDELS; or complex variants) were isolated and characterized using a double digest restriction associate DNA sequencing (ddRAD) approach. Finally, the complete mitochondrial genome was assembled and annotated for lumpfish and its phylogenetic placement within the order Scorpaeniformes was determined. The extensive genomic information reported here will facilitate molecular ecology studies and many aspects of the selective breeding programme of lumpfish, especially for marker-assisted selection.

Biography

Albert K D Imsland finished his PhD degree in Aquaculture from University of Bergen, Norway in 1997 and has been an Adjunct Professor from this University since 2004. He is the Research Director in Aquaculture in the Tromsø based research company, Akvaplan-niva AS. Central in Imsland's research is the internal and external factors that control the growth and maturation process in fish, including how these are controlled by the genetic background of the fish and/or controlled by environmental factors. He has published more than 170 peer review papers in reputed journals.

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SATELLITE TECHNOLOGY FOR MONITORING CONTROL IN THE MEDITERRANEAN SEA

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This study presents a general evaluation of Monitoring Control and Surveillance of vessels (MCS) in the Mediterranean Sea. The MCS, with satellite technology, was applied to the Mediterranean, in order to achieve a comprehensive picture of the maritime traffic and presence of fishing vessels over a one-year period. Satellite data, as AIS (Automatic Identification System), was reviewed for the entire Mediterranean Sea for the period between 1st Apr' 2015 to the 1st Apr' 2016. Information concerning vessels, IUU lists and other fisheries regulations obtained from updated databases completed the analysis. Enforcement and regulatory expertise together with machine learning, 3D gaming and cyber security were used to empower fisheries enforcement and compliance. Maps are presented using QGIS software. As a result of the analysis, a total of 41,519 unique AIS vessel ID´s were detected in the Mediterranean area of interest during the review period. An intense traffic area, with shipping lanes running across the Western Mediterranean from the Strait of Gibraltar to Italy, South of Italy and Greece, and between Italy and Egypt were identified. Another area of intense traffic was detected between Greece and Turkey. AIS activity specifically identifying fishing vessels suggested that these commonly transit the area to fish on the coastal areas surrounding the Adriatic, Spanish coast, South Sicily and Greece. Results highlight that satellite monitoring technology can drastically reduce the time and cost associated with traditional means of surveillance at sea. It significantly improves the chances of detecting illegal fishing and serves to supplement patrol activities, through planning recommendations, based on the identification of targets and areas of investigation.

Biography

Laura Fontan Bouzas has completed an International MSc in Fisheries Management from Alicante University and a Degree in Oceanography from the University of Vigo. Her experience includes over 10 years in fisheries and a deep knowledge of fisheries law enforcement, illegal fishing/satellite technology and the application of the ecosystem approach to fisheries. She has academic and professional consultancy expertise at international level and has also worked aboard a variety of oceanographic vessels. She has held several lectures at international events covering her areas of expertise.

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EXPOSURE TO THIAMETHOXAM AT LOW CONCENTRATIONS INDUCES HAEMATOLOGICAL, GENOTOXIC AND HISTOPATHOLOGICAL CHANGES IN COMMON CARP *(CYPRINUS CARPIO)*

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A total of 60 fresh water fish *(Cyprinus carpio)* were obtained from a local fish breeding center and carefully transported in plastic bags having adequate amount of oxygen and water. After 7 days of acclimatization, all fish were randomly divided and kept in five equal groups (A-E). The experimental fish were exposed to various concentrations (0, 0.5, 1.0, 1.5 and 2.0 mg/L) of thiamethoxam for a period of 120 h. Blood and other tissue samples of each treated fish were collected after 72, 96 and 120 h. Various physical responses like operculum and bouncing movement, mucus secretion, darkening of fins, fin tremors, swimming in isolation on one side, surface breathing and erratic swimming were observed in fish treated with higher concentrations. Results indicated that the values of red blood cell counts, pack cell volume and haemoglobin concentrations were significantly lower and the white blood cell and neutrophil counts increased significantly in thiamethoxam treated fish as compared to unexposed fish. The frequency of various nuclear (micronuclei, erythrocytes with nuclear remnant, erythrocytes with condensed nuclei and erythrocytes without nucleus) and morphological changes (leptocytes, stomatocytes, dividing erythrocytes and tear shape erythrocyte) in treated fish was significantly higher as compared to control group. Microscopic analysis of gills tissues of various experimental fish exhibited atrophy of secondary lamellae, pyknosis of lamellar epithelial pillar cells, lamellar degeneration, congestion, aneurysm and curling of lamellae.

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MARINE SPONGES: WHAT FUTURE DO THEY RESERVE FOR AQUACULTURE AND BIOTECHNOLOGY?

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Sponges play diverse interactions with other organisms and support several ecological functions in marine ecosystems. For these reasons, sponges attract the attention of aquarium hobbyists and professionals, but also of scientific researchers. They produce and accumulate a great diversity of metabolites, which act as multipurpose bioactive compounds. Therefore, a successful culture of marine sponges represents the opening of a niche market, for scientific research, pharmaceutical industry and ornamental species trade. With this purpose in mind, a study was conducted to establish a methodology to allow maintaining sponges in captivity. Several specimens of one of the most common and abundant species on the South-western European coasts, *Dysidea fragilis*, were collected and acclimated in a water recirculation system (6 aquaria with a capacity of 12 L). They were fed with a mixed solution of microalgae and *Nanochloropsis salina* and faeces of gilt-head sea bream (*Sparus aurata* Linnaeus, 1758). Fifteen days after sampling, half of the aquaria were illuminated with a 12 hours photoperiod (2 fluorescent tubes 18w/765 daylight, with an illuminance level of 4990 lux), while the other half remained in the dark, protected by a black cloth. The water quality, the physical appearance, survival and growth of the sponges were monitored during 3 months. The results obtained were not entirely satisfactory. However, this study allowed inferring other alternatives that could contribute to improve the attempts to produce these organisms in captivity. The captured sponges *D. fragilis* presented low survival rates, showed no growth, either in terms of length or width. The acclimation to artificial light showed to be detrimental to the survival of these organisms and, therefore, they should not be suitable for the ornamental trade. Nevertheless, this species lodges other symbiotic organisms, with potential biotechnological applications, for which its breeding techniques should be developed and perfected.

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PRESENT STATUS OF MUD CRAB POPULATION IN BANGLADESH

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Apparent declines in abundance of mangrove crabs *Scylla spp*. in the coastal area of Bangladesh have prompted concern regarding long-term determination of this important cultural and economic resource. From the survey of ten districts of coastal area according to treatment T1, T2 and T3 the total production of the coastal area was decreased from 32255.06±178.18 mt to 25643.46±141.96 mt between 2013 and 2016 and the percentage of the total production of the experimental area was declined 9.55, 15.36 and 20.50% within the year 2013-14, 2014-15 and 2015-16. The decreasing trends or regression type was exponential and the equation was y = 6.724e0.81×; where R2 is 0.980. There is a significant trends in case of male, female and immature mud crab of coastal area. In case of female mud crab total catch percentage was decreased from 43.11% to 27.95% between 2013 to 2016. In case of male and immature mud crab total catch percentage was increased from 29.08% to 38.34% and 27.81% to 33.71% between 2013 and 2016. Rising pressure of trap, line and catch by hand, and decreasing pressure of catch by net was detected to catch mud crab in the experimental area. So, eco-friendly catch and juvenile culture of mud crab is to be practiced until established mud crab hatchery to minimize the requirement of seed production of crab in aquaculture crab field.

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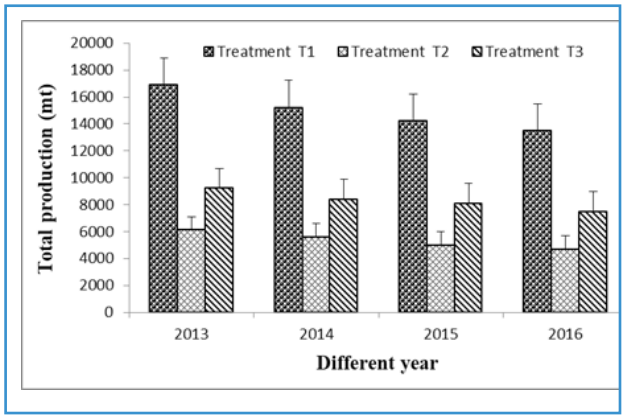

Fig.1. Catch composition of mud crab population between 2013 and 2016 in ten districts under treatment T1, T2 and T3

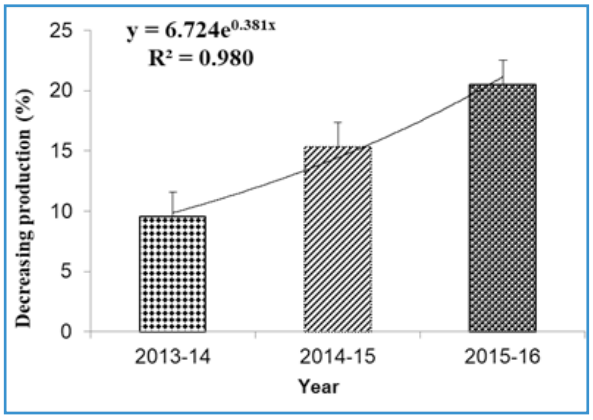

Fig.2. Decreasing catch percentage (%) of mud crabs between 2013 and 2016. Number of replicates for each sub-strate; crab collector n=169, crab fattener n=169 and Upazilla office n=36

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DETERMINANTS OF FISH AQUACULTURE IN SELECTED LOCAL GOVERNMENT AREAS OF TARABA STATE, NIGERIA

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The study was on determinants of fish aquaculture in selected Local Government Areas (LGA's) of Taraba State, Nigeria, specifically to; describe the socioeconomic characteristics of the respondents and determine the factors affecting fish output in the study area. The study area was selected LGA's in Taraba State, Nigeria. Data for the study was collected mainly from primary source; 186 structured questionnaires were administered through snowball sampling technique. The data was analyzed using descriptive statistics and multiple regressions. The results of socioeconomic characteristics results showed that 67% of the respondents were male, 74% were less than 46 years of age, 96% had one form of education or the other, 80% had more than 5 persons in their households, 78% had experience of maximum of 10 years and 83% had contact with extension services. The multiple regression results had a model summary of R^2 =0.992 and the F-value was high (2237.837) and significant at 1% level. The results of the multiple regressions showed that pond size, number of fingerlings, labour, feeds, drugs, water, sex, household size and education were positive and significant at 1% level. Meanwhile, extension service was negative and significant at 10% level. However age, farming experience and marital status were not significant at conventional level. The study recommends that; input such as pond, fingerlings, labour, feeds, drugs and water should be emphasized in fish aquaculture in the study area and related places, intending farmer should emulate socioeconomic characteristics such as sex, household size and education as it affects the business positively.

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IRAL NERVOUS NECROSIS (VNN) AS EMERGING FISH DISEASE IN WORLD MARICULTURE

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Viral nervous necrosis (VNN) is a fatal and worldwide fish disease, especially in economically fish. The disease affects more than 50 species, and about 70 fish species. Also, viral carriers have lacking clinical symptoms. Infected fish exhibit clinical signs such as spiral and darting swimming, low appetite, change in pigmentation, belly up and subcutaneous bleeding. In pathological studies, the main symptoms are vacuolar lesions in the brain, eye and spinal cord. The viral aetiology has been confirmed following the identification of small, non-enveloped, RNA agents definitively assigned to the *Nodaviridae* family, genus *Betanodavirus*. The family consists of two genera, the genus of *Alfanodovirus*, which is an insect-specific nodular virus. *Alphanodavirus* can also kill baby mice and hamster, causing paralysis and death in these animals. The genus *Betanodavirus* also affects the fish. Factors belonging to the genus beta-DNA virus are small particles with a diameter of about 25 to 30 nm without capsid and have a 20-fold shape, and their genome consists of two single-stranded RNAs. The disease has recently been reported from four African countries, Senegal, Libya, Tunisia and Algeria, but has not yet been reported on South American continents. The VNN disease was isolated and confirmed for the first time by the author in the Caspian Sea in 2004. The widespread victims in this species in recent years have led to a reduction in the reservoirs of this species in the Caspian Sea and as a threat to other valuable economic species in the Caspian Sea. This complication is mainly spread through horizontal transmissions. Vertical transmission is also proposed. So far no effective commercial vaccine has been developed for control of this disease, and there is virtually no way to cure it, but its familiarity with the characteristics of this disease can be effective in preventing its transmission.

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Figure-1

Figure-2

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ASSESSMENT OF PHYSICOCHEMICAL PARAMETERS AND HEAVY METAL LEVELS IN WATER, SEDIMENTS AND SELECTED FISH SPECIES FROM UPPER BENUE RIVER, ADAMAWA STATE, NIGERIA

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Statement of the problem: Upper Benue River receives a wide variety of waste from almost every significant human activity. These include mostly the dumping of domestic wastes, sewage and agricultural wastes. Extensive agricultural activities involving the usage of various forms of fertilizer contribute largely to contamination through run-off. Sediments have also been recognized as the ultimate sink for heavy metals that gives vital information such as the sources, distribution and degree of pollution. The ability to release back the sediment bound contaminants into the water column and consequently into the food chain within an aquatic environment pose a serious health and environmental hazard. In order to effectively control and manage water pollution, it is imperative to have its clear assessment.

Findings: Assessment of physiochemical parameters and heavy metal levels in water, sediments and selected fish species was conducted for the period of 18 months (May'2014 to Oct'2015). Data were collected and analyzed appropriately using standard procedures from four different sites monthly, in triplicate. Ranges of water parameters observed were within permissible limits recommended by the various environmental protection agencies and WHO. Copper, nickel and lead were found to be above permissible limits in water. This is the same for cadmium, chromium and lead in sediments. Lead was found to be above permissible limits in fish organs *A. occidentalis, C. gariepinus and O. niloticus* exhibited negative allometric growth (b<3) with significant correlation (P<0.05) between length and weight in A. *occidentalis while C. gariepinus and O. niloticus* did not correlate significantly (P>0.05) in the study area. The mean condition factor values indicated that not all the fish species were in good condition during the period of investigation. From this study, Upper Benue River is said to be moderately polluted with heavy metals contamination.

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EFFECT OF PHOSPHORUS DYNAMICS ON FISH GROWTH

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The present study was made to examine the phosphate dynamics on fish growth in poly culture system of *Labeo rohita, Chirrinus mrigala and Cyprinus carpio*, fed with 35% crude protein (CP) level diet. These fish species were stocked in six earthen ponds. Six ponds were treated with 2 strategies; 1) Fertilizers + no Feed, 2) Fertilizers + Supplementary feed. Inorganic and organic fertilizers; nitrophos, urea and cow dung were added at 5 kg/acre/week, 0.5 kg/acre/week and 280kg/acre/week respectively, and the feed of 35% C.P level was added at 2 % of body weight of fish twice a day. In the 3 months examination it was concluded that the best strategy for fish growth is strategy 2 and the species which shows the maximum growth was *Labeo rohita*.

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TEXTURE AND GRAIN SIZE OF SEDIMENT ANALYSIS OF THE KRISHNAPATNAM COASTAL MANGROVES IN SOUTH-EAST COAST OF INDIA

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Indian mangroves coverage accounts for about 5% of the world's mangrove vegetation, which occupies 0.14% of the country's total geographic area. Among this about 57% of them spread along the east coast, 23% along the west coast, and 20% in Andaman and Nicobar Islands. The present work is carried out to understand and provide baseline information on the texture and grain size of sediment of mangroves of Krishnapatnam coastal region. These dense mangroves situated on mudflats of Burada and Chintala and in the open estuarine areas with Conservation Priority Index (CPI) 0.57, which has been proposed as Community or Conservation Reserve (CCR). Sediment characteristics of the extreme Northern region have been influenced mainly by the influx of kandaleru creek, which increasing erosion rate in Northern region which is dominant than that of in the Southern region. The study revealed that the sediments are characterized by the abundance of silt and sand with minor amounts of clay. The nature of the soil texture has been characterized by the abundance of silt loamy, sandy clay. The observed sediments are poorly sorted, symmetrical skewed and kurtosis was platykurtic in nature. The present study region is of anthropogenic, developmental and industrial activities which are rationales for changing in the sediment nature and grain size.

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CLIMATE CHANGE AND ENVIRONMENTAL EFFECT ON PRODUCTION OF PALLA (*TENUALOSA ILISHA*) FROM INDUS RIVER

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The hilsa, *Tenualosa ilisha* (Hamilton 1822), belonging to the family Clupeidae, is locally known as *'ilish' and 'palla'* in Pakistan. Hilsa has a wide range of distribution and occurs in marine, estuarine and riverine environments. It is found in the Arabian Gulf, Red Sea, Arabian Sea, Bay of Bengal, Vietnam Sea and China Sea. The riverine habitat covers the Satil Arab, and the Tigris and Euphrates of Iran and Iraq, the Indus of Pakistan, the rivers of Eastern and Western India, the Irrawaddy of Myanmar, and the Padma, Meghna, Jamuna and other coastal rivers of Bangladesh. Hilsa is largely an anadromous species, capable of withstanding a wide range of salinity and capable of migrating great distances upstream. Nature of the climate change threat. Fisheries and aquaculture are threatened by changes in temperature and, in freshwater ecosystems, precipitation. The climate change effecting directly through changing water temperatures and associated phonologies, the lengths and frequency of hypoxia events, through on-going ocean acidification trends or through shifts in hydrodynamics and in sea level. In general temperature has great influence on change physiology as well as the composition and dynamic coupling of food webs in fish ecosystem. Hence, ongoing climate change is predicted to affect individual organisms during all life stages, thereby affecting populations of Palla species population.

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BIO-SECURITY IN FISH FARM

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Disease is an inevitable part of aquaculture production. Some pathogens are always present in farmed stock and only cause disease when the right conditions occur such as when animals are stressed or when environmental conditions are suitable. The purpose of an aquaculture biosecurity plan is to: reduce the risk of diseases being introduced into your farm (entry-level biosecurity), reduce the risk of diseases spreading within your farm (internal biosecurity), reduce the risk of diseases escaping from your farm (exit-level biosecurity), have emergency response protocols in place for serious disease outbreaks (all three levels of biosecurity), Critical control points are the physical locations or production steps at which the fish may be exposed to disease pathogens. Pathogens can enter aquaculture systems: (fish, water, the environment, other organisms and commercial feeds or live or frozen foods). Biosecurity plans need to be fit for purpose and balance practicality, cost and regulatory requirements.

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A WORLDWIDE RESEARCH UPDATE OF COBIA *(RACHYCENTRON CANADUM)* : A PROMISING FISH FOR WARM WATER MARINE AQUACULTURE

Rodriguez-Estrada Uriel

Secretariat of Agriculture, Livestock, Rural Development, Fisheries and Food outlook of Mexico´s government (SAGARPA), Mexico

Cobia *(Rachycentron canadum*), is considered to be one of the most suitable candidates for the future of warm, open-water marine fish aquaculture in the world. It represents one of the highest potential because of its most desirable traits, such as rapid growth rate (up to 10 kg in 1 year), good flesh quality, adaptation, and tolerance to variations in temperature and salinity. Throughout the years, cobia (R. canadum) has been researched since 1975. Currently, China is the leading country producing scientific publications in different aspects of cobia research. The first investigation on this species was reported in North Caroline, a collection of wild caught cobia eggs was conducted. Posterior researchers concluded that cobia *(R. canadum)*, had a good aquaculture potential because of its rapid growth and good flesh quality. Other initial studies were conducted in USA and Taiwan (late of 1980s and early 1990s) were researchers studied several aspects: spawning, large quantities of cobia *(R. canadum)* fry production and grow-out of juveniles in near shore cage systems. Since then, cobia *(R. canadum)* research has focused its interest in different aspects: species description (taxonomy, distribution, biology and life history), fisheries (environment, capture, processing), reproduction, physiology (metabolism, toxicology, health), pathology (bacterial diseases, viral diseases, parasites, diagnosis, prevention and treatment), nutrition (nutritional requirements, feed formulations, feeding regimes, live / fresh food, additives), genetics, and aquaculture practices (cage farming, inland farming, culture management, economics). This presentation, analyses the historical progress, most recent research advances and future prospects of cobia *(R. canadum)* research worldwide.

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LEAF OXIDATIVE STATUS AND ANTIOXIDANT RESPONSES IN HYDROPONICALLY GROWN PRIMED AND NON-PRIMED RICE SEEDLINGS UNDER DROUGHT AND N-, P-, OR K-DEPRIVATION

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University of Agriculture, Pakistan

With increasing frequency and episodes of extreme climatic events, the crop plants are sometimes exposed to multiple abiotic stress factors at the same growth stage. In the present study, we investigated the behaviour of growth, reactive oxygen species and antioxidant defence system in primed (60 µM selenium or 100 mg L-1 salicylic acid priming) and non-primed rice seedlings to the combinations of drought stress and N-, P- or K-deprivation. Results indicated that drought stress as well as deprivation of any mineral nutrient severely hampered the seedling growth of rice. The N-deprivation alone or in combination with drought stress caused the maximum reduction in shoot length and biomass accumulation, although the N-deprived roots were longer. The beneficial effects of seed priming on shoot and root growth of rice were well indicated under drought stress and different nutrient management regimes. Drought as well as nutrient deprivation caused pronounced changes in the oxidative metabolism of rice leaves. The marked increase in the accumulation of ROS (O_2•−, OH--, H_2O_2) and activities of ROS- producing enzymes under the individual as well as interactive effect of drought and N-, P-, or K-deprivation, led to higher lipid peroxidation. The interaction of drought stress and N-deprivation caused the maximum oxidative damage, and recorded poor antioxidant activity, suggesting that N-supply is more crucial under drought stress. The N-deprivation also significantly decreased the levels of non-enzymatic antioxidants (GSH, vitamin C, Vitamin E), which are crucial for the drought tolerance of plants. The oxidative stress evoked by drought or/and nutrient deprivation, was effectively alleviated after seed priming. The leaves of rice seedlings emerged from primed seeds, recorded significantly lower accumulation of ROS and MDA, and lower activities of MAO and XOD. These attributes were well linked to priming-induced enhancements in the activities/levels of SOD, POD, GR, GPX, GSH and vitamin C in the rice leaves.

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GREEN AQUACULTURE WITH HERBAL DRUGS

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Aquaculture is the fastest growing industry around the world, but there are various problems associated with aqua-cultural production. Due to the intensification of rearing methods and systems, diseases and pathogens have been an integral part and formidable obstacle to aquaculture industry worldwide. Many of the antibiotics and other synthetic drugs have serious side effects in biological system and therefore, natural products are safer because they are more in harmony with the biological system. Habitual use of antibiotics can lead to problems with bacteria resistance and with unacceptable residues in aquaculture products and environment. Resistant bacterial strains could have a negative impact on the therapy of fish diseases or human diseases and the environment of the fish farms. On the other hand, in regarding to executive program of export of aquaculture products to other points of the world, the use of natural chemical agents in aquaculture is necessary to establish the market. Different medicinal plants and herbs and/or combinations of them are known to have properties such as anti-viral, anti-bacterial, anti-fungal, physiological systems (immune system, digestive system) supporting, hormonal balancing and many other properties. Moreover, these substances are nontoxic, biodegradable and biocompatible. No herbal resistance immunity has been found by any pathogen to date. It is well known and documented that medicinal herbs have strong antibacterial effects. Polysaccharides, flavonoides, phenolics and proteoglycans are known to play important role in preventing and/or controlling bacterial infections. Several plant products have been found to have potent antiviral activity against fish and shrimp viruses (IPN, VSH, and IHN). In aquaculture several infectious diseases are reported that mainly belongs to species of *Pseudomonas, Aeromonas, Streptococcus and Vibrio* species and a few parasitic organisms like Protozoan, Helminthes and Arthropods. Bacterial species causes high mortality and severe economic loss during its outbreak in cultured fish. Many plant-derived compounds have been found to have non-specific immune stimulating effects, growth promoter and of antioxidant activity in aquatic animals, and also fertility enhancer in female brood stock, increasing fecundity and gonadal weight, effective on sperm quality of broodstock. Now, various medicinal plants have been evaluated in Iran to control fish diseases and have produced satisfactory results. Finally, we introduce new herbal drug with trade mark of "AVISHIT" instead of malachite green and without any side effect for human safety and environment. AVISHIT, as an antimicrobial agent, derived from extract of "*Zataria multiflora*" was approved and established in Iranian veterinary pharmacopeia. Its dosage is 50 ppm for disinfection of incubatory period of trout eggs.

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'BIOREMEDIATION' TO RESTORE THE HEALTH OF AQUACULTURE POND ECOSYSTEM

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Aquaculture is concerned with 'the propagation and rearing of aquatic organisms under complete human control involving manipulation of atleast one stage of an aquatic organism's life before harvest, in-order-to increase its production'. Fish catches from the marine environment have been steadily declining in many parts of the world due to overexploitation and pollution; many people are turning to aquaculture to improve the food production and to contribute for economic development. Aquaculture, in India, has made encouraging progress in the past two decades producing significant quantities of food, income and employment. Aquaculture, particularly, tiger shrimp *Penaeus monodon* culture, has extensively been practiced all along coastal regions of India. Increased production is being achieved by expansion of culture areas and the use of modern methods. This development of aquaculture in our country has led to not only severe disease problems but also alteration of the quality of our natural habitats through increased effluent discharges from aquaculture systems, which contains high quantities of hither-to-non-existent materials of both organic and inorganic forms. Since recent past it has been observed that the sustainable development of aquaculture sector can be achieved by adopting eco-friendly aquaculture practices by minimizing impact on the surrounding environment. To maintain healthy ecosystem in aquaculture ponds and hatchery tanks, bioremediation is the best biotechnology process. Many researchers have been demonstrated that the pathogens can be eliminated or minimized through this bio-control process and hence can achieve good yield by maximizing both survival rate and growth rate and by minimizing the disease problems in aquaculture systems.

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CURRENT STUDIES ON INDONESIAN MAHSEER *TOR TAMBRA* IN ACEH PROVINCE, INDONESIA

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Indonesian mahseer, Tor *tambra* is one of the commercial freshwater fish found in Aceh waters. This species has been cultured extensively by local farmers. However, several obstacles are still present such as low growth rate and parasites outbreak in the culture system. Therefore, several studies have been conducted to overcome these problems. Herein, we reporte some latest findings on Indonesian mahseer related to distribution and economic evaluation, genetic and morphometric variations, broodstock domestication, feeding habits, parasites infestations, feed and nutrition requirements, and breeding.

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