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2nd International Conference on Fisheries and
Aquaculture
ICFA – 2015

25th - 27th August 2015

The International Institute of Knowledge Management (TIKM)

Colombo, Sri Lanka

Committee of the ICFA- 2015

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2015

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MESSAGE FROM PROFESSOR K. PANI PRASAD
CONFERENCE CHAIR ICFA 2015

It gives me immense pleasure and privilege to send this message as the Chair of the 2nd International Conference on Fisheries and Aquaculture (ICFA-2015) organized by the International Institute of Knowledge and Management (TIKM) in collaboration with World Aquaculture Society, USA, which will be held from 25-27 August 2015 at Colombo, Sri Lanka.

The contribution of aquaculture to total fisheries has steadily increased over the last few decades and is continuing to increase around the globe. Fish is essential for the protein requirement and also to the nutritional security especially in the increasing world population. The varied and important conference tracks will ultimately lay emphasis on future strategies, technology upgradation, novel techniques in aqua production marketing avenues, consumer trends, risk management, innovation, climate change management, motivation and social relevance etc. During the Conference, large number of scientists and researchers from different countries will participate in sharing their findings in the theme of "Aquaculture in Global Age". This Conference is unique in the sense that it try to link traditional and modern thinking in aquaculture and fisheries together for sustainable development. The Conference provides opportunity to interact and integrate for networking research scientists of repute. I sincerely hope that the deliberations would assist in future policy directives, and planning and implementation of programs in relation to the theme of the conference.

As the conference Chair, I congratulate all those involved for the success of the conference in planning and organizing both the technical program and supporting social arrangements. In particular, I thank the Chief Guest and Keynote speakers, all presenters, program and publication chairs and entire TIKM team for their hard work to stage ICFA-2015.

I welcome you all to the ICFA-2015 and wish the Conference all success!

Professor K. Pani Prasad

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India

MESSAGE FROM PROF (DR) H SHIVANANDA MURTHY
KEYNOTE SPEAKER ICFA 2015

It gives me a great pleasure and privilege to send this message as the Keynote Speaker and Member of the Scientific Committee of the 2nd International Conference on Fisheries and Aquaculture (ICFA-2015) organized by the International Institute of Knowledge and Management (TIKM) during 25-27 August, 2015 at Colombo, Sri Lanka.

Fisheries and aquaculture is a source not just of health but also of wealth. World per capita fish consumption was increased from an average of 9.9 kg in the 1960s to 19.2 kg in 2012. Global aquaculture production attained another all-time high of 90.4 million tonnes including 66.6 million tonnes of food fish with a total world fish production of 158 mmt (FAO, 2014). Global fisheries production particularly from capture fisheries is showing stagnation or declining trends in the recent years in some years/countries. To meet the growing requirement of fish for human consumption and also for industrial and other uses, a lot more depends on aquaculture and importance is given to this sector by various Government and Non-Government organizations worldwide. In view of this background the organization of ICFA-2015 is quite apt.

The technical program is quite impressive with few keynote addresses and a large number of oral and poster presentations. Hundreds of scientists/administrators/officials involved in research, development, education and extension, and outreach programmes from different countries will participate in sharing their findings and presentations. These discussions and deliberations will help to achieve to some extent 'Sustainable Aquaculture and Fisheries' practices. The Conference, in addition to providing opportunity to present and share recent research findings of scientists, enable to integrate and formation of network groups of scientists and international collaborations in fisheries and aquaculture in the world. I sincerely hope that the deliberations and recommendations would help in future policy directives, and planning and implementation of programs worldwide in relation to the theme of the conference.

As a keynote speaker, I know that the success of the conference depends ultimately on the many people who have worked hard in planning and organizing both technical program and supporting social arrangements. In particular, I thank the organizers and entire TIKM team for their hard work to stage ICFA-2015, for the second successive year.

I wish a great success for the Conference!

Prof (Dr) H Shivananda Murthy

MFSc, Ph D (Aqua), Post Doc (USA, UK& Spain)

Professor & Head

Department of Aquaculture & Former Director of Extension;

Member, Karnataka Biodiversity Board

Karnataka Veterinary & Fisheries Sciences University

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ORAL PRESENTATIONS



[01]

**WILL THE PROTEIN SOURCE TO MAN ACT AS AN INDICATOR OF
POLLUTION IN AN ECOSYSTEM? A CASE STUDY ON THE FISHES FROM
BAHIA MAGDALENA, BAJA CALIFORNIA SUR, MEXICO**

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ABSTRACT

Evaluation of metal concentrations in fish samples was carried out to understand the bioavailability of metals to marine organisms in the lagoonal complex of Bahía Magdalena in Baja California Peninsula, Mexico. 40 fish species from diverse feeding guilds were collected during September 2012 and October 2014 to know the accumulation of metals. The study area is well-known for the presence of Sea Lions, its close proximity to the subduction zone and the strong upwelling waters all through the region. The concentrations of 11 trace metals (Fe, Mn, Cr, Cu, Ni, Co, Pb, Zn, Cd, As, Hg) were analysed in all the fish samples an Atomic Absorption Spectrometer using suitable standards. Based on the average concentrations of metals for both the seasons they could be hierarchically ordered as: Fe > Zn > Ni > Cr > Mn > Pb > Cu > Co > As > Cd > Hg. High levels of pollutants in this zone are due to the influence of fertilisation process, phosphatic rock formations and the upwelling phenomenon of the nutrient rich lagoon waters. Correlation studies on metal concentrations of the fish species suggests that the process of bioaccumulation is species dependent with a strong reliance to its metabolism, dwelling habitat and feeding mechanisms. An innovative approach of identifying the presence of microplastics in the digestive organ of fish species from the region was also carried out. Results revealed that the fish species are substantially enriched from various natural and anthropogenic sources in the study area.

Keywords: Fish, metals, enrichment, subduction zone, Baja California, Mexico

[02]

IMPACT OF ARMORED CATFISHES (*PTERYGOPLICHTHYS* SPECIES) ON INLAND FISHERIES SECTOR IN SRI LANKA: NEED FOR IMMEDIATE ACTION TO ERADICATE THEM?

R. H. G. R. Wathsala ¹, G.G.N. Rathnayake ², A. P. S. Fernando ³, T. V. Sundarabharathy ⁴,
D. S. B. Dissanayake ⁵

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ABSTRACT

Tank cleaners or Armored Catfishes (Family: Loricariidae) are becoming a problem to inland fisheries sector in Sri Lanka. According to the records, Huruluwewa reservoir is one of the inland water bodies heavily infested by Armored Catfishes. This study was carried out to study their feeding habit and assess the impact of them on fishing. The feeding habit of tank cleaners were determined by gut content analysis using 20 fish samples fortnightly collected from areas with decaying logs, grasses, mud and boulders in the reservoir. Animal matter (41.48%), sand (17.02%), phytoplankton (15.95%), stones (14.89%) and unidentified materials (10.64%) were observed in their gut and their omnivorous feeding behavior was confirmed. Comparatively higher percentages of eggs, scales and bones were found among in the animal matter. A questionnaire survey was conducted to examine their impact on fishing using a sample of sixty fishermen from the reservoir. Significant correlations ($p < 0.05$) existed between fish revenue (negative), cost of fishing (positive) with tank cleaners. The results revealed that Armored Catfishes have increased the cost of fishing by increasing the effort of fishing while decreasing the fishing revenue. Cost of fishing was increased as a result of heavy damages to nets and increase of fishing time due to proliferation of Armored Catfishes in the reservoir. More than 76% of fisherman claimed that the damages to nets are severe after the invasion of Armored Catfishes and presently the nets last for about six months which otherwise were used for more than a year. These results conclude that Armored Catfishes have become a potential threat to inland fisheries sector.

Keywords: tank cleaner, feeding behavior, gut content, fishing

[03]

FALSE ALARM: IS FISHING REZONING NECESSARY IN MALAYSIA?Mohd Fadzil Shuhaimi bin Ramli ¹¹ *Quest International University Perak, Malaysia****ABSTRACT***

At first glance, the decision by the Department of Fisheries (DOF) to introduce new zoning system justifies the need to enhance the protection of coastal areas not only in curbing the encroachment of trawlers but also to provide safe haven for fish juveniles as the areas are known to be the breeding and nursery grounds for most fishes. However, the move is not without cost; the creation of no-fishing zone or designated as “conservation zone” (0-1 nm) prohibits any fishing activity including by those fishermen using sampan either with or without out-board engines. They may have to opt for bigger sampan or switch to vessel with in-board engine resulting increased fishing costs. Trawlers, on the other hand, have to fish further away from their previous designated areas which clearly had agitated their feelings. The question raised here is whether the new zoning regime is justified to be there in the first place. This paper studied fishing data as published by DOF and made an assessment on the success of the old zoning regime by comparing other fisheries in the region. It is demonstrated that there is no immediate need for the implementation of the new zoning regime and the suggestion is for the authority to step-up their enforcement measures. The old zoning regime still hold and effective for many years to come as Marine Protected Area.

Keywords: fishing zones, new zoning regime, Marine Protected Area

[04]

**THE CENTRALITY OF ‘RELATIONSHIPS’ IN COPING WITH SHOCKS AND
IMPROVING WELLBEING IN SMALL SCALE FISHING COMMUNITIES OF
SOUTHERN SRI LANKA**

Jayasinghe A.D.¹, Amarasinghe O.²

^{1, 2} *University of Ruhuna*

ABSTRACT

Shocks attached with the Fishery effect on wellbeing of fishers while the strategies adapted to cope with the shocks again do affect the wellbeing of fishers. There, the possible way to prudently face for shocks is to find the precise coping strategy which will promise to maintain or to enhance the wellbeing of an individual or a particular fishing community. In fact the study was aimed at identifying different coping strategies adapted by the small scale fisheries in Southern Sri Lanka with the key consideration to the relationships that they make at the face of shocks mainly Hurricanes, rapid increase in input prices and the Gear destruction. Based on the field studies this paper shows the centrality of the bond among the fisherman and his family members, neighbors, friends, community groups and cooperatives which are the key components out of all the relationships that a fisherman is having at the face of shocks. Also this paper reveals the weak relationship in-between the fisherman and the government authorities and certain other responsible parties at the face of shocks. Furthermore the results highlight a clear difference to the centrality of attaching towards social capitals basically cooperatives developed within fishers themselves in coping with the shocks by mean of comparison between communities which have higher access to social capital and of those who do not have a higher level of accessibility. The importance of strengthening the relationships among the social networks of fishermen finally came out as the core recommendation of the study.

Keywords: Relationships, coping, shocks, wellbeing

[05]

THE DIVERSITY OF THE TILAPIA (*CICHLIDAE*) IN YEWA LAGOON, NIGERIABamidele, N.A.¹, Taiwo, I. O.², and Olopade, O. A.³

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³ *Department of Animal Science and Fisheries, University of Port-Harcourt, Nigeria*

ABSTRACT

The study was carried out to determine the composition and abundance of the family Cichlidae in Yewa Lagoon. The fish samples were collected from local fishermen using gill net and cast net of different mesh sizes ranging from 6.35 to 12.7cm for two seasons (dry and wet). Correlation and regression analysis were used to determine the type of relationship that exist between total length, standard length and body weight of fish species. The result revealed three species of Tilapia namely: *Hemichromis fasciatus*, *Tilapia zilli* and *Sarotherodon galilaeus*. *H. fasciatus* was relatively more abundant in the two seasons than *T. zilli* and *S. galilaeus*. The seasonal distribution showed that *S. galilaeus* (39.60%) were evenly distributed in the wet season than *T. zilli* (29.79%) and *H. fasciatus* (30.69%) while they were all evenly distributed in the dry season. In the first two months of the wet season, the correlation was high ($p = 0.879, 0.8845$). It became very high in June to about 0.972, however, in the dry season, the correlations in the two months was very high (0.995, 0.972). The percentage distributions during the wet season were 29.7% (*T. zilli*), 39.6% (*S. galilaeus*) and 30.69% (*H. fasciatus*) while the percentage distribution during the dry season was uniform (33.3%). It could be concluded that the Cichlidae are more abundant during the wet season.

Keywords: Cichlids, diversity, abundance, seasonality

[06]

EFFECT OF TEMPERATURE ON THE DIGESTIVE PHYSIOLOGY, IMMUNE SYSTEM, LIPID PEROXIDATION AND EXPRESSION OF SELECTED GENES IN *CATLA CATLA*

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ABSTRACT

Water temperature is a master abiotic factor that influences the other water quality parameters. The study of impact of changing water temperature on the physiology of fish is essential for the development proper husbandry of the cultivable species with respect to climate change. Indian major carp *Catla catla*, catla (7.52±0.22 g) were acclimated at 28±1°C for 21 days and then exposed at six different temperatures: 10, 15, 20, 25, 28 and 35°C. Blood and tissue samples were collected after 12 h and 7 days of reaching the assigned temperature. Significantly (P<0.05) higher mortality was recorded at 10°C. Water temperature affected the food consumption and digestive enzyme activities of catla. Significantly (P<0.05) lower serum lysozyme, myeloperoxidase, nitric oxide synthase and respiratory burst activities were found in fish exposed at temperature 10-20°C compared to the acclimation temperature. Thiobarbituric acid reactive substances level was significantly (P<0.05) higher in catla exposed at 10°C compared to other treatments. The expression of heat shock protein genes Hsp60, Hsp70 and Hsp90 and LDH-A was evaluated in hepatopancreas and muscles. Tissue-specific expression was recorded in fish exposed at different temperatures.

Keywords: catla, water temperature, digestive enzyme activity, immune system

[07]

OPTIMISING FLUID FLOW FOR LOBSTER AQUACULTUREDr P. Halswell ¹, Prof L. Johanning ², Dr C. Daniels ³^{1,2} *University of Exeter, United Kingdom*³ *National Lobster Hatchery***ABSTRACT**

Lobster Grower is a multi-organisation, interdisciplinary research project (funded by Innovate UK and BBSRC), which aims to develop an offshore, sea based lobster (*Homarus gammarus*) aquaculture system. The key to success is ensuring lobsters have the optimal environment to maximise growth; this paper focuses on the effect of flow velocity. As part of Lobster Grower, the University of Exeter are completing an experimental hydrodynamic study of four aquaculture designs, termed Sea Based Container Culture (SBCC), and will study various design aspects including fluid flow, shape and biofouling. High flow velocities have been shown to reduce feeding and cause physical damage to the lobsters [1]. Low flow rates reduce the oxygen availability and thus reduce growth rates [2]. Scale models are moored in a current flume using a model-bracket, end plates (to mitigate against 3D effects) and a sliding lid (to keep the container sealed). Internal fluid velocities with and without biofouling are measured using an Acoustic Doppler Velocimeter. The internal velocity measurements will generate design graphs to assess each model against performance indicators (mainly oxygen consumption and feeding rates). The design graphs will consider input flow velocity, internal flow velocity, flow distribution, angle of attack and biofouling. The effect of biofouling will ensure that the performance of the SBCC will not deteriorate during its life time at sea. Design graphs will allow fair comparison between the prototypes SBCC and help confirm which of the three novel SBCC will be taken forward to full-scale sea trials in Lobster Grower 2.

Keywords: lobster, aquaculture, fluid flow, design criteria and design assessment

[08]

PRODUCTION OF ALL MALE TILAPIA (*O. NILOTICUS*) BY IMMERSION OF FRY IN DIFFERENT CONCENTRATIONS OF 17 α -METHYL TESTESTORONEAthauda A.R.S.B ¹, D.M.C.R. Kumara ²

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Sri Lanka*

ABSTRACT

The aim of the present study was to modify the normal pathway of sexual differentiation of Nile tilapia during its labile period. The combination effect of both sex hormone and high water temperature on sex differentiation process of Tilapia was tested here to produce all male tilapia. Precocious sexual maturity which resulted large number of small fry production in culture facility is the major impediment in tilapia culture since it stunts the growth of entire population which causes considerable loss of expected yield and economic profitability. To overcome above mentioned problems, culturist can practice mono-sex culture of tilapia. Of the various techniques that have been developed to all male tilapia production, immersion of fry in androgen hormones is an emerging technique for direct sex inversion of tilapia towards male. Tilapia fry at 11th and 13th days of post fertilization were immersed 3h time period for each day in three different concentrations of 17 α -MT (500 μ g/L, 750 μ g/L and 1000 μ g/L) at 36 °C. Each treatment had three replicates and consisted with 150 fry including control that did not subjected to the hormon treatment. Treated fry were placed into 12 hapa as 50 fry per each and fed (30% CP) according to the body weight. The gonadal status was examined using light microscope (10x40) after stained by aceto-carmin at the age of 14 weeks for treated fish. Results showed that there is a significant ($p < 0.05$) difference between control and treatments. The highest percentage of male (97.34%) has resulted at 1000 μ g/L, followed by 93.34% and 89.34% at 750 μ g/L and at 500 μ g/L hormone concentrations, respectively. The 1000 μ g/L of 17 α -MT gave the highest percentage (97.34%) of male tilapia production while control gave the lowest (58.67%). Hence, the 1000 μ g/L of 17 α -MT immersion which resulted >95% male production can be adopted as a new technique to produce all male Tilapia in commercial hatcheries.

Keywords: *Oreochromis niloticus*, 17 α -MT, immersion, sex inversion, all male Tilapia

[09]

FACTORS GOVERNING OYSTER (*CRASSOSTREA MADRASENSIS*) BREEDING AND GROWTH AT LOCATIONS SELECTED IN PUTTALAM AND KALPITIYA AREA

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ABSTRACT

Oyster culture is an economically viable venture with the development of the tourism industry. However environmental conditions determine the growth as well as breeding of oysters. Oyster culture is tried out in the Puttalam lagoon as *Crassostrea madrasensis* is naturally available in the lagoon. Therefore 2 sites were selected, namely Gangewadiya and Kandakuliya to introduce oyster culture to the community. A pilot project was carried out by selecting 4 sites in each location & one site each at Kalpitiya and Anawasala, to study growth and breeding of oyster with respect to the water quality parameters. Growth was monitored by placing 25 individuals in a plastic culture basket. Breeding was monitored by placing coconut shells, pieces of fiber glass sheets, asbestos, pvc dead oyster shells, and tiles as collectors. These were monitored biweekly together with water quality parameters. Results indicated that salinity change with temperatures around 30°C and pH levels close to 8 helped in spat falling. Frequent salinity changes in Gangewadiya caused changes in salinity and resulted in several spat falling periods. Growth between Gangewadiya, Kandakuliya, Anawasala and Kalpitiya showed a significant difference ($p < 0.05$). Highest growth was recorded at Anawasala (5.902 ± 1.639 mm/month) where salinity changes were gradual. Growth rate at Kandakuliya and Gangewadiya were affected by water quality fluctuations (mean Salinity 35.73 ± 0.209 & 15.98 ± 1.56 ppt, pH 7.703 ± 0.009 & 7.829 ± 0.019 ammonia 0.051 ± 0.005 & 0.069 ± 0.004 mg/l, nitrite 0.007 ± 0.0002 & 0.012 ± 0.0002 mg/l, nitrate 0.651 ± 0.03 & 0.809 ± 0.046 mg/l, and phosphate 0.299 ± 0.038 & 0.311 ± 0.004 mg/l, temperature 28.942 ± 0.031 & 28.65 ± 0.057 °C, Total suspended solids 0.071 ± 0.007 & 0.043 ± 0.004 g/l respectively). However it could be concluded that the oyster culture activities are economically feasible at all locations. Gangewadiya was the best site for spat collection as several spat falling seasons were observed, while all other locations were suitable for culture.

Keywords: Oyster culture, water quality, oyster growth and spat collection

[10]

DIGESTIVE ENZYME PROFILE OF COLD WATER CARP *SCHIZOTHORAX RICHARDSONII* DURING ONTOGENIC DEVELOPMENT

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ABSTRACT

A thorough knowledge of digestive physiology during ontogenic development is most essential for the development of appropriate culture technique of a species. The onset of digestive system and its physiological consequence in the fish larvae is a key parameter to understand the basic aspects of larval nutrition. Snow trout, *Schizothorax richardsonii* (Family: Cyprinidae) is an important species in the Himalayan and Sub-Himalayan regions. Snow trout constitutes a principal subsistence food fishery. The present investigation aimed to study the digestive enzyme profiles of snow trout during ontogenic development. Brooders were collected from Gandi River, Champawat, Uttarakhand and were bred in the wet laboratory of Directorate of Cold Water Fisheries, Champawat. Digestive enzyme profile of eggs and larvae were studied. The amylase activity was first recorded in day-0 old larvae (222.80 ± 32.16 mU mg protein⁻¹ min⁻¹). Amylase activity showed a polynomial six degree relationship ($R^2 = 0.907$) with the age of larvae. Total protease activity was observed in both unfertilized eggs and fertilized eggs. The activity increased during ontogenic development showing a power function ($R^2 = 0.9$) with the age of larvae. The trypsin and chymotrypsin activities were first detected in day-1 and day-4 larvae, respectively. Trypsin activity increased up to day-28. Chymotrypsin activity showed polynomial four degree relationship ($R^2 = 0.863$) with the age of larvae. The lipase activity was observed in unfertilized eggs (50.09 ± 0.51 mM MU mg protein⁻¹ min⁻¹). The enzyme activity was significantly ($P < 0.01$) higher on day-24 and day-32 compared to the other days of sampling.

Keywords: *Schizothorax richardsonii*, digestive enzymes, ontogenic development

[11]

REPRODUCTIVE PERFORMANCES OF BROOD STOCKS OF BLACK TIGER SHRIMP, *PENAEUS MONODON* WHEN DOCOSA HEXAENOIC ACID (DHA) AND EICOSA PENTAENOIC ACID (EPA) ARE ADDED TO THE MATURATION DIET

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ABSTRACT

Sri Lankan shrimp hatcheries use WSV and MBV free (after screening) wild caught brood stocks of black tiger shrimp, *Penaeus monodon* which are discarded after 3 or 4 spawning and therefore 2 maturation diets were tested compared to the normal diet, squid flesh and beef liver (1:1), as the control diet-1 (CD 1) to find out whether improved nutrition could enhance reproductive performances. A semi-solid formulated feed was prepared and 50% of the CD 1 was substituted by it and was considered as control diet-2 (CD 2) while experimental maturation diet (ED) consisted of 50% CD 1 and 50% of the same semi-solid formulated feed with added DHA and EPA (1:1). Three groups of shrimp brood stocks (four replicates; twenty females per replicate) were fed separately with the three maturation diets for seventy days and the reproductive performances were assessed. Mean values of number of eggs spawned, fertilization rate, hatching rate and number of healthy nauplii resulted per female recorded for ED were 7.59×10^5 , 80.5, 72.28 and 5.39×10^5 respectively which were significantly higher ($P < 0.05$) than those recorded for CD 1. Females that received ED were productive even after the 4th spawning and therefore brood stocks could be used for an extended period; reproductive performances of *Penaeus monodon* could be enhanced by the provision of DHA and EPA with diet.

Keywords: *Penaeus monodon*, reproductive performances, DHA, EPA

[12]

**IN VITRO DIGESTIBILITY STUDY OF PLANT PROTEINS IN DIETS OF
VARIOUS FISH SPECIES**Jai Gopal Sharma ¹, Ravi Kumar Goswami ², Rina Chakrabarti ³¹ *Department of Zoology and Applied Aquaculture, Barkatullah University, Bhopal, India*^{2, 3} *Aqua Research Lab, Department of Zoology, University of Delhi, India***ABSTRACT**

Identification of economically viable and environment friendly alternatives to fish meal is a great challenge to the Aquafeed industry. The evaluation of bioavailability of nutrients, especially protein, present in the feed ingredients is essential before their application in the feed industry. The pH-Stat assay method estimates the proteolytic enzyme hydrolysis of a test protein substrate. The aim of the present investigation was to evaluate the in vitro digestibility of various plant ingredients using carps *Labeo rohita* (rohu) and *Cyprinus carpio* (common carp) and *Oreochromis niloticus* (tilapia) as test species. The digestibility of plant ingredient supplemented diets was also tested. The protein content of feed ingredients was evaluated. The protein content of duck weed, almond oil-cake and soybean product were 39.75, 47.78 and 57.48%, respectively. The degree of hydrolysis (DH) of these ingredients was 1.79-17.30 and 1.34-14.06% for rohu and common carp, respectively. The diet prepared with almond oil-cake showed the highest digestibility compared to the other plant ingredient incorporated diets for rohu and tilapia. Species-specific digestibility was found for the same plant ingredient and diet in the present study.

Keywords: plant proteins, in vitro digestibility, carp, tilapia

[13]

**COMPARATIVE STUDY OF BIOCHEMICAL PROPERTIES OF NON-
CONVENTIONAL PLANT SOURCES TO PREPARE LOW COST FISH FEED**

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ABSTRACT

Biochemical analysis of non-conventional plant sources, Bermuda grass, Nursery Grass (sages), Typha and Maize Spike (without grains) was done to determine the nutritional value to replace conventional sources such as rice bran, wheat bran and rice polish to prepare low cost fish feed. Analysis was carried out in the research lab of Institute of Biochemistry, University of Sindh, Jamshoro. It was observed that Bermuda grass and Nursery grass (sages) have good protein value as 2.84 and 10.97, respectively. It is also observed that these non-conventional plants are a good source of energy and easily available around the year.

Keywords: Biochemical analysis, Bermuda grass, Sages, Fish nutrition

[14]

**FERMENTED UNRIPE PLANTAIN (*MUSA PARADISIACAL*) PEEL MEAL AS A
REPLACEMENT FOR MAIZE IN THE DIET OF NILE TILAPIA (*OREOCHROMIS
NILOTICUS*) FINGERLINGS**

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ABSTRACT

A feeding trial was conducted to investigate the effect of fermented unripe plantain peel meal (FUP) on growth performance, nutrients digestibility and economic indices of production of Nile tilapia, *Oreochromis niloticus* fingerlings. Fingerlings (150) of Nile tilapia (1.70 ± 0.1 g) were stocked at 10 per plastic tank. Five iso-nitrogenous diets containing 40% crude protein in which maize meal was replaced by fermented unripe plantain peel meal at 0% (FUP0), 25% (FUP25), 50% (FUP50), 75% (FUP75) and 100% (FUP100) were formulated and prepared. The fingerlings were fed at 5% body weight per day for 56 days. There was no significant difference ($p > 0.05$) in all the growth parameters among the treatments. Feed conversion ratio of 1.35 in fish fed diet FUP25 was not significantly different ($P > 0.05$) from 1.42 of fish fed diet FUP0. Apparent protein digestibility of 86.94% in fish fed diet FUP100 was significantly higher ($p < 0.05$) than 70.37% in fish fed diet FUP0 while apparent carbohydrate of 88.34% in fish fed diet FUP0 was significantly different ($p < 0.05$) from 70.29% of FUP100. Red blood cell (4.30 ml/mm^3) of fish fed diet FUP100 was not significantly different from 4.13 ml/mm^3 of fish fed diet FUP50. The highest percentage profit of 88.85% in fish fed diet FUP100 was significantly higher than 66.68% in fish fed diet FUP0 while the profit index of 1.89 in fish fed diet FUP100 was significantly different from 1.67 in fish fed diet FUP0. Therefore, fermented unripe plantain peel meal can completely replace maize in the diet of *O. niloticus* fingerlings.

[15]

COMPARISON OF DIFFERENT DRYING TECHNIQUES FOR PHILIPPINE SANDFISH [*HOLOTHURIA ((METRIATYLA)) SCABRA* JAEGER]Mark Jude F. Trondillo ¹, Kevin F. Yaptenco ², Engelbert K. Peralta ³, Ernesto V. Carpio ⁴¹ *Agricultural Engineering Department, Southern Philippines Agri-business and Marine and Aquatic School of Technology, Digos City, Davao del Sur, Philippines*^{2,3} *Agricultural and Bio-Process Division, Institute of Agricultural Engineering, University of the Philippines Los Baños, Laguna, Philippines*⁴ *Institute of Food Science and Technology, College of Agriculture, University of the Philippines Los Baños, College, Laguna, Philippines***ABSTRACT**

In the Philippines, traditional sun drying of sandfish [*Holothuria ((Metriatyla)) scabra* Jaeger] takes a longer period of time, low in quality and little price valuation in the market. In this study, four methods of drying (smoke-sun, hot air-solar, oven and freeze) were employed. The drying characteristics, quality in terms of the physical quantity and microstructural changes; and profitability were examined using traditional and modified methods. The results obtained showed that the primary stage drying using smoking slowed down the drying rate compared to hot-air drying. The freeze-drying had the fastest drying rate among drying methods and significantly different by Tukey HSD Test at 0.05%. The effect of different drying methods on microstructure using scanning electron microscopy (SEM) revealed that hot-air drying had a more defined cell structure compared to smoke drying after first stage drying. The micrographs of final stage dried sea cucumber of freeze-dried samples were coagulated and partially altered but comparatively retained the cell structures compared with smoke-sun, hot air-solar and oven drying methods which showed poor definition and images of cell membranes at any point location of dried sea cucumber. Among the dried samples, hot air-solar drying method was economically and profitability accepted which also demands higher price valuation from the processor, buyer and exporter.

Keywords: sea cucumber, solar, sun drying, freeze drying, scanning electron microscopy

[16]

**PRODUCTION OF LOW SALTED AND SPICE ENRICHED GOLDSTRIPED
SARDINELLA DRIED FISH**

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ABSTRACT

Dried fish is generally considered as a cheap source of protein that is readily affordable to low income families. Traditionally, 10 kg of dressed fish is treated with 3 kg of salt. Any over use of salt in dried fish production creates economic and marketing costs and serious health burden. Because of the positive correlation between sodium intake and hypertension, it is desirable to substitute salt with other substances. The current research was conducted to evaluate the use of low salt concentrations and spice enriched low salt concentrations on the quality of dried fish. Fresh fish samples of Goldstriped Sardinella were collected from Peliyagoda Central Fish Market. These were divided into 5 groups for different treatments. Treatment 1(T-1) contains 1% salt, 0.2% turmeric, 0.5% chilli and 0.5% pepper. Treatment 2(T-2) has 2% salt, 0.2% turmeric, 0.2% chili and 0.2% pepper. Treatments 3(T-3), 4(T-4) and 5(T-5) were treated only with 10%, 5% and 0% salt, respectively. For quality evaluation chemical, physical, microbiological and sensory attributes of different treatments were determined. It was observed that chemical properties for all treatments were significantly different ($p < 0.05$) while physical properties were not ($p > 0.05$). The T-1, T-3 and T-4 treatments were found to be microbiologically acceptable while T-2 was unacceptable only for yeast and mould count. T-2 had the highest preference in all sensory attributes. T-4 had the best chemical properties and also preferable microbiological and sensory attributes. Values for moisture, a_w , salt, TVN, texture and rehydration parameters of T-4 were 11.6584 ± 0.03 , 0.591 ± 0.002 , $12.43\% \pm 0.15$, $59.43 \text{ mg}/100 \text{ g} \pm 12.86$, $1.54 \text{ kg} \pm 0.14$ and 12.70 ± 3.54 respectively. It can be concluded that 5% salt is the minimum level to produce a low salt dried fish.

Keywords: Dried fish, low salt, Fish quality, Spices addition

[17]

**ASSESSMENT OF SAFETY OF OYSTERS (*CRASSOSTREA MADRASENSIS*)
HARVESTED FROM GANGEWADIYA AND KANDAKULIYA IN PUTTALAM
DISTRICT**

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ABSTRACT

The microbiological and chemical quality of the harvested oysters and the surrounding water was tested using standard techniques for enumeration of the indicator organisms, pathogenic microorganism and heavy metals. Oyster samples (n=34) contained Aerobic Plate Count (APC) in the range of 3.0×10^3 to 4.6×10^5 cfu/g. In oyster, Faecal coliforms varied between not detected (ND) to 110 MPN/g whereas *Escherichia coli* ranged from ND to 90 MPN/g. *Salmonella* spp. and *Vibrio cholerae* was absent in all the tested oyster samples. *Vibrio parahaemolyticus* was not found in any of the oyster sample (<3cfu/g). Faecal streptococcus varied between 23 and 200 MPN/g. APC of water samples (n=28) ranged from 2.0×10^2 to 7.0×10^4 cfu/g whereas Coliforms counts varied between ND to 1800+ MPN/g. Faecal coliforms as well as *E. coli* varied from ND to 1600 MPN/g. Water samples tested were free from *V. parahaemolyticus* (<1cfu/g) and *V. cholerae* and *Salmonella* spp. *F. streptococcus* varied from 2.1 to 500 MPN/100ml. Levels of some heavy metals (such as Mercury (Hg), Cadmium (Cd), Arsenic (As) and Lead (Pb)) were also analyzed and they were in the range of 2.93 to 138.86 ppb for Hg (n=21), for Cd (n=21) from 3.95 to 917.36 ppb, for As (n=21) 117.64 to 1458.05 ppb and for Pb (n=18) from ND to 1178.93 ppb. According to obtained results levels of heavy metals in oysters were found below the maximum permissible limits. Care should be taken to deurate oysters harvest from these areas efficiently before consumption.

Keywords: Oysters, microorganisms, heavy metals

[18]

**PRODUCTION OF SAUCE FROM MUD CLAM (*GELOINA COAXANS*) MUSCLE
AS A VALUE ADDED PRODUCT**H.M.S.M.Wijerathna ¹, Kumudu Radampola ², H.W.Cyril ³^{1, 2} *Department of Fisheries and Aquaculture, Faculty of Fisheries and Marine sciences & Technology, University of Ruhuna, Sri Lanka*³ *Department of Animal science, Faculty of Agriculture, University of Peradeniya, Sri Lanka***ABSTRACT**

The present study was carried out to investigate the potential of using *Geloina coaxans*, low-cost highly abundant bivalve species found in North east area in Sri Lanka to produce a sauce. *G. coaxans* were collected from Tambalagam bay. Morphometric data were collected from 100 samples of *G. coaxans*, and proximate analysis was done for the muscle samples. The sauce was prepared using accelerated fermentation method. Shell length, height, inflation, total weight of the animal with shell, weight of the body without shell, and % total yield were 6.3±0.4cm, 5.3±0.3cm, 3.5±0.3cm, 83.1±13.4g, 14.9±1.3g and 14.9±1.3% respectively. Moisture, crude protein, crude fat, and ash (in dry weight basis) of *G. coaxans* were 80.45±0.89%, 64.14±0.96%, 3.55±0.39% and 7.54±0.61% respectively. In sauce preparation, bivalve meat (100g), papaya crude extraction (60g), and salt (40g) were mixed and allowed to ferment in an incubator for 10days. Liquid yield, Energy value, %Brix value, pH, % NaCl, total nitrogen, moisture and ash content of final product were 98.3± 5.5ml/100g, 2124±133J/g, 24.3±0.9%, 5.02±0.04, 14.53±0.27%, 0.27±0.01%, 74.06±0.56% and 19.66±1.99% respectively. Total nitrogen and pH were in acceptable range which was described by Thai Industrial Standards for fish sauce. Cost of production of clam sauce was Rs. 250.30/1000ml. Therefore the present study revealed that, *G. coaxans* can be successfully utilized to produce clam sauce and future studies are needed to evaluate the quality of the sauce and the suitability of it for human consumption.

Keywords: Accelerated fermentation, *Geloina coaxans*, clam sauce, sauce quality

[19]

**PROXIMATE COMPOSITION AND CALCIUM CONTENT OF *THUNNUS OBESUS*
(BIG EYE TUNA) PROCESSING WASTES**

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ABSTRACT

Present study was carried out to investigate the proximate composition and Calcium content of fish wastes which were discarded from *Thunnus obesus* (Big eye tuna) processing factory in Sri Lanka. Fork lengths and weights of 68 Big eye tuna fish samples and waste components (head, back bone, fins, belly flap, and skin) were measured. Further, wastes samples of 07 fish were collected to analyze proximate composition, energy and calcium content. All the wastes were grouped together for analyzing. Mean fork length of the fish sample was 127 ± 7.12 cm and weight was 36.54 ± 1.96 Kg. Wastes components of head, back bone, fins, belly flap, and skin were $15.66\pm 1.96\%$, $13.67\pm 1.22\%$, $2.06\pm 0.63\%$, $2.70\pm 0.73\%$, and $7.23\pm 0.99\%$ respectively. Relationships between % head, % back bone, and % total wastes to fish weight indicated negative correlations. However % weight of fillets to fish weight indicated positive correlation. Muscle component attached to head and back bone were $5.63\pm 1.52\%$ and $1.65\pm 0.26\%$ respectively. Dry matter content of head bones, head muscles, back bones, back bone muscles, belly flap, skin, and fins were $51.04\pm 2.12\%$, $32.70\pm 2.60\%$, $46.37\pm 3.55\%$, $35.33\pm 2.85\%$, $35.81\pm 2.22\%$, $35.95\pm 3.58\%$ and $50.92\pm 2.84\%$ respectively. Moisture, protein, fat, ash, calcium content and energy amount of the fish waste samples were $73.24\pm 2.05\%$, $64.56\pm 3.95\%$, $34.4\pm 3.71\%$, $20.76\pm 3.07\%$, 3.26 ± 0.82 g/Kg and 19.69 ± 1.9 KJ/g respectively. Nearly half of the weight of big eye tuna fish discarded as wastes during the processing. But those waste components are rich sources of nutrients, calcium and energy. Therefore there is a potential to use these wastes as alternative products in different industries.

Keywords: *Tunnus obesus*, Fish processing, Fish wastes, proximate composition, calcium, energy

[20]

UTILIZATION OF FERMENTED WATER HYACINTH (*EICHHORNIA CRASSIPES*) MEAL AS FEED INGREDIENTS IN THE DIETS OF FRESHWATER CATFISH *MYSTUS NEMURUS* (C &V) FINGERLINGS

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ABSTRACT

With increasing price of soybean meal, great efforts are made in seeking alternative protein for fish feed. Therefore, a 56 day feeding trial was conducted to investigate the alternative effects of fermented water hyacinth meal (FWHM) on the growth performance and feed utilization of freshwater catfish *Mystus nemurus* (with initial body weight of 6.5 g). 300 fingerlings of *Mystus nemurus* randomly divided into 15 net cages were fed five different experimental 30% isonitrogenous diets, a control (0% FWHM) and four diets containing different levels of FWHM (10%, 20%, 30% dan 40%) in place of soybean meal as protein source. The results showed that with increasing levels of inclusion of FWHM, specific growth rate (SGR), feed efficiency (FE) and protein retention (PR) decreased gradually. The highest SGR (2.68%), FE (42.19%) and PR (19.52%) were recorded from fish fed 10% FWHM inclusion. Results of the present study suggested that FWHM can be used at 10% in a practical diet for *Mystus nemurus*.

Keywords: feed utilization, fermented water hyacinth, growth performance, *Mystus nemurus*, soybean meal

[21]

**UTILIZATION OF TELESCOPIUM MUSSEL MEAL AS AN ALTERNATIVE
PROTEIN SOURCE IN THE DIET OF BLACK TIGER SHRIMP, *PENAEUS
MONODON***

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ABSTRACT

The availability of telescopium mussel meal (TMM) as a substitute for fish meal (FM) was evaluated in black tiger shrimp (initial weight: 0.0134±0.02) diets containing several levels of TMM (from 0 to 100%). After 42 days, live weight averages were 0.37, 0.33, 0.29, 0.27 and 0.24 g for fish fed diet in which FM was partially substituted with 100, 75, 50, 0 and 25% TMM, and feed conversion ratios were 3.20, 3.05, 4.01, 3.65 and 4.46, respectively. No differences were obtained in weight gain, FCR, FE and SR for all treatments. The shrimp fed diet E (100% TMM) was highest in FE and followed by the shrimp fed diet D (75% TMM), diet C (50% TMM), diet B (25% TMM) and diet A (0% TMM), respectively. SR was highest in the shrimp fed diet A and the lowest was found in the shrimp fed diet D. This study concluded that TMM could replace FM up to 100% in the diet without compromising growth and feed efficiency of black tiger shrimp larvae.

Keywords: Fish meal; Telescopium mussel meal; Substitute fish meal; Black tiger shrimp larvae

[22]

GROWTH AND SURVIVAL OF SEAHORSE FRY (*HIPPOCAMPUS KUDA*) USING TWO DIFFERENT LIVE FEEDMallawaarachchi M.A.J.C ¹, Pahalawattaarachchi V. ², Kithsiri H.M.P. ³^{1, 2, 3} *National Aquatic Resources Research and Development Agency, Sri Lanka***ABSTRACT**

The strong reduction in wild seahorse population developed elevated demand for seahorse aquaculture. Low fry survival is the major bottleneck in seahorse culture procedures. The aim of this investigation was to identify economically viable live feed that improve growth and survival of seahorse fry. The effectiveness was compared using two most common live feed; *Artemia* sp. and *Moina* sp. The experiment was conducted fry age in 0-91 days. The experiment consisted with three treatments which were (T1) *Moina* one ration (noon) *Artemia* two rations (morning and evening), (T2) all three rations with *Artemia* and (T3) one ration (noon) a combination of *Moina* and *Artemia* (1:1) two rations (morning, evening) only with *Artemia*. As the growth parameter the fry length were measured. There was not any significant difference between three treatments in fry length increment while there were significant differences in fry survival in three treatments. Variation between T1 and T2 shown significant difference ($p < 0.05$). But the variation between T1 and T3 as well as between T2 and T3 did not show any significant difference in survival. The fry survival rates of treatment 01, 02 and 03 were 64%, 43% and 45% respectively. In conclusion in terms of fry survival *Moina* is recommended to use in *Hippocampus kuda* fry rearing as an economical feed compared to *Artemia* which cost is very high.

Keywords: *Hippocampus kuda*, *Moina*, *Artemia*, feed

[23]

**AQUA-FEED BASED ON SHRIMP WASTE MEAL FOR THE GROWTH
PERFORMANCE AND COLOUR ENHANCEMENT OF GOLD FISH
(*CARASSIUS AURATUS*)**

M.H.S. Ariyaratne ¹¹ National Aquatic Resources Research & Development Agency, Sri Lanka**ABSTRACT**

Shrimp processing waste could lead to diverse environmental problems. Shrimp waste meal (SWM) derived from this waste could be used in fish feed preparation as a protein provider and a colour enhancer. The trial was carried out in 12 glass tanks (volume= 40 L). Twenty Goldfish (*Carassius auratus*) fry (Mean weight=0.3577±0.0992 g) were stocked in each tank with a stocking density of 0.13 kg/m³. Rearing period was 105 days. Three feed types (Feed-A, Feed-B and Feed-C) containing 32% crude protein were prepared. In Feed-A, SWM was the sole protein source. In Feed-B and Feed-C the SWM was partially replaced with Soybean meal (Sbm) and fishmeal (Fm) respectively. Completely Randomized Design (CRD) was used to test these 3 feed types and a commercial feed (Cf) (control), in triplicate to evaluate the growth and colour of Goldfish. The weight gains(WG) of 1.7987±0.1316, 2.2924±0.2435, 2.4457±0.1102, 5.3063±0.3403 g, the Average Daily Growths(ADG) of 0.0198±0.0012, 0.0258±0.0030, 0.0273±0.0017, 0.0537±0.0027 g day⁻¹ and the Specific Growth Rates(SGR) of 1.9648±0.4565, 1.7804±0.0585, 1.8307±0.1044, 2.9133±0.0722 were observed for Feed-A, Feed-B, Feed-C and Cf respectively. The WG, ADG, SGR and % survival of the fish fed on Feed-A, Feed-B and Feed-C were significantly lower than the Cf (p<0.05). Temperature, pH, Dissolved Oxygen and Total Ammonia Nitrogen levels in the tanks were within the acceptable levels. The Food conversion ratio (FCR) of Feed-A, Feed-B, Feed-C and Cf were 2.5, 2.4, 2.1 and 1.6 respectively. The price of Feed-A, Feed-B, Feed-C and Cf were Rs.71.00, Rs.85.00, Rs.78.00 and Rs.200.00. According to the colour panel test, the fish fed on Cf showed the highest colour intensity and Feed-C showed the next colour intensity. The colours of fish fed on Feed-B and Feed-A were lower than fish fed on Feed-C and Cf. Considering all these facts, the Feed-C could be recommended for the production of Gold fish fingerlings. It has shown the possibility of using SWM in the preparation of fish feed mixing with Fm.

Keywords: Shrimp waste meal, Gold fish, Aqua feed, fish colour

[24]

MICROBIOLOGY IN AQUACULTUREW. A. A. D. Lanka Wickramasinghe ¹, K.Pani Prasad ², S. P. Shukla ³*^{1, 2, 3} Aquatic Environment and Health Management Division, Central Institute of Fisheries
Education, Mumbai, India***ABSTRACT**

Microorganisms are accountable for a bulky section of the re-mineralization of organic nutrients, all of the anaerobic respiration and huge portion of aerobic respiration in any type of ecosystem where one of the largest fluxes of carbon, is that from the pool of organic matter into microorganisms. In aquatic systems, especially those receiving some allochthonous organic input, the secondary production of planktonic bacteria can be co-equal or even larger than that of the primary production of phytoplankton. Aquatic ecosystems are greatly affected by human infringement at an exceptional rate and natural perturbations, the frequency and extent of which may be increasing. Microbial bio-indicators play a major role in detecting and characterizing the impacts of natural and human stressors for understanding environmentally driven change of microbial diversity and function. Aquaculture is one of the fastest growing industries in the world. The need for enhanced disease resistance, feed efficiency, and growth performance of cultured organisms is substantial for various sectors of this industry. Thus, various means of altering the intestinal microbiota (probiotics) to achieve favorable effects such as enhancing growth, digestion, immunity, and disease resistance of the host organism have been discussed in this review in various research findings. In aquaculture, microbial mats which are laminated, cohesive microbial communities, composed of a consortium of bacteria dominated by photoautotrophic cyanobacteria are shown to produce protein, via nitrogen fixation, and are capable of supplying nutrition to cultured fish. Those mats in the nitrification of nutrient enriched effluents from aquaculture have a significant role.

Keywords: microorganisms, aquaculture, microbial bio-indicators, probiotics, nitrification

[25]

EFFECT OF TEMPERATURE ON THE ABUNDANCE OF AMMONIA OXIDIZING BACTERIA AND ARCHAEA IN RECIRCULATING AQUACULTURE SYSTEM

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ABSTRACT

Ammonia oxidizing bacteria (AOB) and archaea (AOA) play significant role in reducing the nitrogenous species load in recirculating aquaculture system. The presence of alpha amino monooxygenase (amoA) makes them efficient to maintain the biological nitrogen cycle in the culture units. The metabolic rate of this enzyme is influenced by environmental factors, such as, temperature, pH, dissolved oxygen, light intensity, etc. The effect of temperature on the abundance of AOB and AOA were evaluated in the present study. A culture medium of mineral salts supplemented with 2 mM ammonium chloride was prepared and taken in twelve tanks (5 L each); 5 pieces of broken earthen pot (5 cm x 5 cm) incubated in a mature filtration unit for 60 days, were introduced in each tank. These tanks were exposed at four different temperatures: 10, 20, 30, 40°C for 40 days. Rate of nitrification was recorded in every alternate day. Total genomic DNA was extracted before the incubation and after 40 days of exposure. The amount of amoA of both bacteria and archaea were quantified using real-time PCR. The highest copy number of amoA gene for bacteria was recorded at 30°C followed by 20, 40 and 10°C. In archaea, highest copy number was also recorded at 30°C followed by 20 and 40°C.

Keywords: ammonia oxidizing bacteria, ammonia oxidizing archaea, amoA, temperature

[26]

THE EFFECT OF FEED-BASED VACCINE ON STREPTOCOCCOSIS IN ENDEMIC TILAPIA FARMM.S Ismail ¹, A. Siti-Zahrah ², M.N.A. Amal ³, M. Zamri-Saad ⁴^{1, 4} *Faculty of Veterinary Medicine, Universiti Putra Malaysia, Malaysia*² *National Fish Health Research Centre, Batu Maung, Malaysia*³ *Faculty of Science, Universiti Putra Malaysia, Malaysia***ABSTRACT**

A tilapia farm experiencing endemic streptococcosis was selected to study the effect of using feed-based killed vaccine on naturally occurring streptococcosis. A total of 4,800 tilapia fish of 80 ± 10 g were divided into 6 cages. Fish of cages 1 and 2 were not vaccinated. Those of cages 3 and 4 were vaccinated on days 0, and 14 (single dose) while cages 5 and 6 were vaccinated on days 0, 14 and 42 (double dose). Vaccination was done by oral administration at 4% body weight. Blood for antibody study and brain, eyes and kidney for bacterial isolation were collected at 14-day intervals. Following vaccination and booster, there was significant ($p < 0.05$) increase in antibody levels that started to decline gradually from week 6 post-vaccination until week 14 (single dose). Second vaccination on week 6 (double dose) significantly ($p < 0.05$) increased the antibody level that remained high until week 16. *Streptococcus agalactiae* was successfully isolated on week 0 from 20%, 10% and 0% of the sampled fish from the control, single vaccination and double vaccination groups, respectively. On week 2, the isolation rate was 20%, 10% and 10%, respectively. *Streptococcus agalactiae* was again isolated on week 8 from 25%, 20% and 10% of fish, respectively and on week 10 from 35%, 25% and 15% of the fish, respectively. Vaccinating endemic farm might not eliminate the disease but able to significantly reduce the incidence of streptococcosis from an average of 25% in control to 16% in single dose and 9% in double dose groups.

Keywords: Vaccination, feed-based vaccine, streptococcosis, endemic

[27]

WATER QUALITY INFLUENCES THE PRESENCE OF BACTERIA IN CAGE-CULTURED RED TILAPIA (*OREOCHROMIS SP.*)*Aliya NII¹, Amal MNA², Shohaimi S³, Zamri-Saad M⁴, Siti-Zahrah A⁵**^{1, 2, 3} Department of Biology, Faculty of Science, Universiti Putra Malaysia, Malaysia**⁴ Department of Veterinary Laboratory Diagnostics, Faculty of Veterinary Medicine, Universiti Putra Malaysia, Malaysia**⁵ National Fish Health Research Center, Malaysia***ABSTRACT**

This study was conducted in order to determine the association between water quality and the presence of bacteria in cage-cultured red tilapia (*Oreochromis sp.*). Water quality measurements and bacteria isolation from red tilapia were conducted at monthly interval for 24 months of study period in Pedu Lake, Kenyir Lake and Terengganu River. Principal component analysis (PCA) and canonical correspondence analysis (CCA) were utilized in order to identify water quality parameters that influenced the presence of bacteria. A total of 973 bacteria strains from 45 different species were isolated from all the sampling sites, while 25, 25 and 41 species of bacteria were isolated from Kenyir Lake, Pedu Lake and Terengganu River, respectively. Three major isolated bacteria species were *Streptococcus agalactiae* (28.5%), *Lactococcus lactis* (8.4%) and *Micrococcus sp.* (7.3%). Multivariate analyses showed that water temperature, ammonia, iron, sulfide, nitrite, phosphate, pH, dissolved oxygen and conductivity play the role in at least one of the study site, while each sampling site has different water quality parameters that associated with the presence of bacteria. However, water temperature and ammonia has been identified as the most significant parameters, as they observed to have strong associations with the bacteria presence in all of the three sampling sites.

Keywords: bacteria, presence, water quality, tilapia, aquaculture

[28]

**INHIBITION OF QUORUM SENSING FROM BACTERIA ASSOCIATED WITH
*ARTEMIA***F.M.I Natrah ¹, Murni Karim ², Noorashikin Md. Noor ³, Lim Yan Li ⁴^{1, 2, 3, 4} *Department of Aquaculture, Faculty of Agriculture, Universiti Putra Malaysia, 43400
Serdang, Selangor, Malaysia*^{1, 2, 3} *Laboratory of Marine Biotechnology, Institute of Bioscience, Universiti Putra Malaysia,
43400 Serdang, Selangor, Malaysia****ABSTRACT***

Quorum sensing (QS) degrader that disrupt the pathogenic bacterial cell-to-cell communication has become an interesting alternative to replace antibiotics. The present study screened and identified different bacterial QS degrader strains from Artemia. The result showed that the different bacterial isolates are able to degrade acylated homoserine lactone (AHL) using *Chromobacterium violaceum* CV026 bioassay. One isolate, *Bacillus* BP-ART/6 fully degraded 10 ppm (AHL) from 9 hours onwards. The bacterial strains were also shown to improve the survival and total length of Artemia and are able to form endospores. These result indicated that bacterial strains isolated from Artemia could be a potential candidate for disease control.

Keywords: Quorum sensing degrader, Artemia, *Bacillus*

[29]

**FIRST RECORD OF CESTODE PARASITE LARVAE BELONG TO ORDER:
TRYPANORHYNCHA ISOLATED FROM SWORD FISH CAPTURED IN SRI
LANKA**

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ABSTRACT

Parasitic infestations cause severe economic loss to the marine fish export industry in Sri Lanka. Present study is to identify the parasites found in fish in order to determine its public health importance. Parasites were isolated from sword fish (*Xiphias gladius*) muscles. Specimens were fixed in formalin and observed under confocal microscope. Parasites were identified based on its morphological characteristics. Total length of the parasites were 1.7 – 3.5 cm (2.27 cm), the proglottid length was 1.97 mm, elongated acraspidote scolex length was 6.23 mm and width at pars bothridialis was 2.4 mm. Length and width of the pars bulbosa were 1.12 mm and 1.17 mm respectively. Curved, apically inverted, and thick edged bothridia and four tentacular armature were characteristics of the Order Trypanorhyncha. Basal armature with corona of falciform hooks and the metabasal armature with heteromorphous hooks in a half spiral arrangement indicated the genus *Molicola*. This is the first record in Sri Lanka of Trypanorhynch larvae (genus: *Molicola*) isolated from sword fish. Marine teleost serve as intermediate hosts for Trypanorhyncha and no serious impacts on human health has observed except mild allergy to some people.

Keywords: Trypanorhyncha, *Molicola*, Sword fish, scolex, larvae, cestode, parasite

[30]

**IMMUNITY ENHANCEMENT IN CULTURED BLACK TIGER SHRIMP,
PENAEUS MONODON BY ETHANOL EXTRACT OF PRICKLY CHAFF FLOWER,
*ACHYRANTHES ASPERA***

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ABSTRACT

Enhancement of immunity is accepted as the best way to protect cultured organisms from viral diseases. Therefore, ethanol extract of *Achyranthes aspera* was incorporated to feed, fed to experimental *Penaeus monodon* while shrimp in control group received normal feed and some innate immunological parameters in haemolymph of both groups (4 replicates and 18 shrimp in each) were measured using spectrophotometric methods at the end of 2nd weeks of feeding to see whether the plant extract could enhance the immunity. Clotting time of haemolymph and superoxide dismutase (SOD) activity in haemolymph of experimental shrimp were significantly lower (5.27 Sec and absorbance value of 0.231 respectively) than those of control shrimp (230 Sec and 0.456; $P < 0.05$). Prophenoloxidase (PO) activity and intracellular superoxide anion (ISA) activity of haemolymph of experimental shrimp were significantly higher (respective absorbance values were 0.264 and 0.228) than those values of control shrimp (0.035 and 0.014; $P < 0.05$). Ethanol extract of *Achyranthes aspera* could significantly enhance the tested innate immunological parameters of cultured shrimp, *Penaeus monodon* when it was incorporated to pelleted shrimp feed and fed to shrimp for 2 weeks.

Keywords: *Achyranthes aspera*, enhanced immunity, *Penaeus monodon*

[31]

**ANTIGENICITY ANALYSIS OF OUTER MEMBRANE PROTEINS (OMPs) OF
VIBRIO SP. ISOLATED FROM DISEASED TIGER GROUPER FOR VACCINE
DEVELOPMENT**

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ABSTRACT

Vibriosis is one of the major bacterial disease problems caused by *Vibrio* sp. leading to high mortality and severe economic losses in aquaculture industry. The outer membrane protein (OMPs) in Gram-negative bacteria are highly immunogenic bacterial components and play significant roles in inducing host immune response, infection and pathogenicity to host as well as potential candidates for vaccine development. In the present study, the enriched OMPs of four selected bacterial strains isolated from diseased grouper, which were *V. harveyi*, *V. vulnificus*, *V. alginolyticus*, and *Photobacterium damsela* were characterized by SDS-PAGE. The major and minor protein bands of these strains were mainly distributed in the range from 25 to 55 kDa and the bands with equal locations could be found between the strains. Western blot analysis using homogenous and heterogeneous rabbit antisera against OMPs of *Vibrio* strains revealed that 33 kDa of *V. harveyi* OMP is antigenic among its strain and could offer cross-protection against the other *Vibrio* strains. Analysis of N-terminal amino acids showed the antigenic protein is a heat shock chaperone, which involved in promoting protein folding, preventing protein aggregation and protecting cells from stress caused by infection and inflammation. Hence, the antigenic 33 kDa OMP of *V. harveyi* is selected as promising vaccine antigen against multiple *Vibriosis* in grouper culture.

Keywords: Aquaculture, grouper, vibriosis, OMP, heat shock chaperone, vaccine

[32]

**EVALUATION OF LOCAL PROBIONT *BACILLUS* SP. I24 AS A BIOCONTROL
AGENT AGAINST PATHOGENIC *VIBRIO ALGINOLYTICUS***

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ABSTRACT

Probiotic is known as a bacteria that able to act as health promoter of other organisms by enhancing the host response towards diseases and able to inhibit the growth of harmful microorganisms. In this study, we investigated the potential of *Bacillus* sp. I24 isolated from healthy adults *Penaeus monodon* against target pathogen *Vibrio alginolyticus* using in vitro and in vivo assay. *Bacillus* sp. I24 demonstrated antagonistic activity against *V. alginolyticus* in stagnant in vitro spot assay. Meanwhile in liquid co-culture assay, probiont I24 were prepared in three different concentrations (10^4 , 10^6 and 10^8 CFU ml⁻¹) and each of the concentration was inoculated with *V. alginolyticus* at 10^5 CFU ml⁻¹. Results were observed based on the pathogen counts at 6 interval hours (0h, 6h, 12h, 24h, 48h and 96h). The co-culture assays showed a significantly reduction of pathogen numbers when compared with the control (no probiont added). In the in-vivo assay, *Artemia* was used as host and treated with different concentrations of potential probionts (10^4 , 10^6 and 10^8 CFU ml⁻¹) and challenged with *V. alginolyticus* at 10^5 CFU ml⁻¹ respectively. Results indicated the ability of probiont I24 to increase the survival of *Artemia* at all concentrations tested. However, the best protection was shown at 10^8 CFU ml⁻¹ with 70 % of survival after challenged. Thus, we suggest *Bacillus* sp. I24 is a good candidate of probiotics for aquaculture.

Keywords: probiont, *Bacillus* sp. I24, *Vibrio alginolyticus*, in vitro, in vivo

[33]

FIRST DETECTION OF *MEGALOCYTVIRUS* IN OYSTERS (*CRASSOSTREA IREDALEI*) AND MUSSELS (*PERNA VIRIDIS*) FROM MARUDU BAY, SABAH, MALAYSIA

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ABSTRACT

Sabah is known as the largest producer of molluscs' including oyster and mussels in Malaysia. Based on the statistics data collected by Department of Fisheries Malaysia from 2005-2012, the highest production of oysters was recorded in 2009 with approximately 1075.15 tonnes. However, the total production of reduced to 695.20 tonnes was observed in 2012 due to the mass mortalities of oysters and mussels affecting few farms in Marudu Bay, Sabah. A preliminary study conducted by a group from Universiti Malaysia Terengganu, Universiti Malaysia Sabah and Department of Fisheries Sabah reported that the green mussels (*Perna viridis*) in Marudu Bay were suspected to be caused by co-infections of Megalocytivirus, bacteria and parasites (unpublished data). Megalocytivirus infections have been previously reported in grouper farms located nearby the oysters and mussels farms (Razak et al. 2014). Thus, this study was aimed at detecting the presence/absence of Megalocytivirus in oysters and mussels from Marudu Bay, Sabah using molecular analysis. In this study, a total of 4 oysters and 19 mussels' samples in 2012-2013 and 80 samples of oysters and 30 samples of mussels in 2013-2014 were tested for the presence of Megalocytivirus. The PCR analysis showed that 70% of the oyster and 10% of the mussels (2012-2013) were positive for the presence of Megalocytivirus. Some of samples collected from 2103-2014 showed amplification at an unexpected size of the gene sequence related to Megalocytivirus. To date, Megalocytivirus have not been known to infect both oysters and mussels as most of the infections related to Megalocytivirus were reported among fish species.

Keywords: MCP gene, Megalocytivirus, first detection, *Crassostrea iredalei*, *Perna viridis*, Marudu Bay, Sabah

[34]

**TO STUDY TRACE ELEMENTS IN FEMALE *OREOCHROMIS MOSSAMBICA* IN
RELATION TO CONDITION FACTOR FROM PAKISTAN**

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ABSTRACT

The main focused of this study was to estimate the concentrations of six metals (Cd, Cu, Mn, Zn, Fe and Cr) in female *Oreochromis mossambica* from Dera Ghazi Khan, Pakistan. The relationship between metal concentration and fish biological aspects as size and condition factor was aimed to be determined. The concentrations of these heavy metals (Cd, Fe, Cu, Mn, Cr, and Zn) were detected in female *O. mossambica* through FAAS (flame atomic absorption spectrometer). The contents of investigated trace metals in fish samples were found to be in the range for 0.16 ± 0.04 cadmium, for 1.26 ± 0.23 copper, for 0.32 ± 0.14 manganese, for 4.49 ± 2.12 zinc, for 24.34 ± 13.67 iron and for 6.09 ± 1.29 chromium $\mu\text{g/g}$ wet wt, respectively. The relationships among the various elements with body size (weight and length) and condition factors were schematized in tables.

Keywords: metals, *Oreochromis mossambica*, atomic absorption, biological aspects

[35]

EFFECTS OF SUBSTRATE SURFACE AREA ON INCREASING LOADING CAPACITY OF HALF-DRUM CAGES FOR REARING THE ABALONE *HALIOTIS SQUAMATA* IN COASTAL AREA OF WEST TIMOR-INDONESIA

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ABSTRACT

Abalone *Haliotis squamata* require substrate for attachment and thus availability of substrate surface area in the inside of cage determines their growth rate. In this study, hatchery-produced abalone with initial shell length of 21.20 ± 1.19 mm and wet weight of 1.62 ± 0.22 g were reared in floating half-drum cages deployed in coastal water. In the inside of cages a number of 2, 4, and 6 fibreglass plates was set up transversely and evenly spaced. These plates, together with inner surface area of cage body provided an area for attachment that corresponded to 1.35 m^2 , 1.89 m^2 , and 2.43 m^2 . As stocking density per surface area was maintained at $200 \text{ abalones m}^{-2}$, the number of plates corresponded to a load of 270, 378, and 486 abalones cage^{-1} . Abalones were provided with algal food of *Ulva* sp at 4-day intervals over a 90-day culture period. ANOVA showed that growth rates in weight of the abalone in the cage was affected significantly by the number of loads. The growth was the lowest at 486 abalones cage^{-1} (40 mg day^{-1} vs 60 mg day^{-1} at 378 and 70 mg day^{-1} at 270 abalones cage^{-1}). Abalones at the highest loaded cages consumed $0.82 \text{ g Ulva abalone}^{-1} \text{ day}^{-1}$, while those in cages loaded with 270 and 378 individuals consumed 0.92 g and $0.90 \text{ g abalone}^{-1} \text{ day}^{-1}$ respectively. At the highest load, abalones could not make use the available substrate effectively and exhibited stacking behaviour. These reduced their access to food and lowered their growth rate.

Keywords: abalone, *Haliotis squamata*, half-drum cage, substrate, growth rate

[36]

STATUS OF FISHERIES AND AQUACULTURE EDUCATION IN UNIVERSITY OF THE PUNJAB, LAHORE. PAKISTANZafar Iqbal ¹¹ *Department of Zoology, University of the Punjab, Pakistan***ABSTRACT**

According to Higher Education Commission of Pakistan (HEC), University of the Punjab, Lahore is ranked as a top university in the country. There are 13 faculties comprising of 63 departments, with an enrollment of approximately 30, 000 students. Zoology department is on top amongst all academic departments of the University on the basis of PhD's produced and research papers published. Fisheries and Aquaculture is the strongest academic group in Zoology department which offer basic and specialized fisheries courses at undergraduate, postgraduate and doctorate level. The female students enrolled in these courses (such as: Fish biology, Fish Physiology and breeding, Applied fisheries, Aquaculture, Fish diseases) are significantly high. The teaching staff is very senior and foreign qualified. Recently seven scholars completed their PhD's in various areas of fisheries and Aquaculture such as; Biology of catfish; Biology of a carp *Tor macrolepis*; Aquatic toxicology; Intensive farming of *Labeo rohita*; Parasitic diseases of fishes; Heavy metal toxicity; Genetic diversity of fish). Currently fourteen students are doing PhD degrees in fisheries. The high class laboratory facilities (histology/aquarium/ fish farm/ PCR/Real time PCR/Atomic Absorption Spectrophotometer, HPLC; microscopes with camera etc.) are available to students. PhD projects are funded by the university. The faculty and alumni of this university have made significant contribution in fisheries extension, conservation and education in the country. This presentation will highlight the present and future perspective of "Fisheries Education" in the rapidly changing aquaculture industry in country and Asia.

Keywords: University of the Punjab, Lahore, Pakistan, Fisheries, Education

VIRTUAL PRESENTATIONS

<http://aquaconference.com/2015/virtual-icfa-2015/>



[37]

**EFFECT OF COMPLETE REPLACEMENT OF FISHMEAL BY SESAME SEED
CAKE MEAL AND NEEM SEED CAKE MEAL IN DIETS FOR GUPPY, *POECILIA
RETICULATA* FRY**

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ABSTRACT

A feeding trial was carried out to develop a non-fishmeal practical diet for Guppy (*Poeciliareticulata*) by gradually replacing fishmeal (FM) protein with selected agricultural by products. Five diets differing in the level of replacement of FM by sesame seed cake (SD) and neem seed cake (ND) were prepared: - Control diet (CD-16% FM), 10SD (8% FM, 10% SD), 10ND (8% FM, 10% ND) and 14SD (0% FM, 14% SD), 14ND (0% FM, 14% ND). Twenty one days old male guppy fry (0.07 ± 0.00 g; 2.01 ± 0.00 cm) were stocked in 15 glass tanks ($60 \times 30 \times 30$ cm), at a rate of 12 fish per tank and each treatment had 3 replicates. Fish were fed respective diet up to satiation three times/ day for 56 days. Fish on CD, 10SD, 10ND and 14 SD treatments were not significantly different from each other when compare growth performance data. Final body weight and final length of fish on CD, 10SD, 10ND, 14SD, 14ND were 0.24 g, 0.25 g, 0.23 g, 0.23 g, 0.21 g and 2.89 cm, 2.89 cm, 2.84 cm, 2.84 cm, 2.77 cm respectively. However, fish on 14ND treatment showed poor growth compare to fish on CD. Hepatosomatic Index was not significantly different among diets and survival rate was 100% for all diets. It is concluded that sesame seed meal can be used to replace FM completely in diets for guppy without any adverse effects on growth. However, further study should be done to evaluate the potential of those diets at later stage of the fish in different culture systems.

Keywords: fishmeal, guppy, growth performance, feed conversion ratio, sesame seed cake

[38]

EFFECT OF EXPOSURE TIME ON THE TOTAL BACTERIAL COUNT AND THE SHELF LIFE OF CANNED FISH UNDER AMBIENT AND COLD STORAGEP.A.S.A.Weerasiri ¹, S.P.S.D. Senadheera ²^{1, 2} *Faculty of Fisheries & Marine Science, Ocean University, Tangalle, Sri Lanka***ABSTRACT**

Present study investigated the effect of exposure time on Aerobic Plate Count (APC) and shelf life of canned mackerel under ambient and cold storage conditions. Eighteen cans (425g) with an expiration date of 3 years (August14, 2014 to August14, 2017 of batch no: 1184) were purchased and 6 cans each were stored at ambient (28^oC) and cold (4^oC, -4^oC) storage for 6 weeks. In 7day intervals, one can at each storage was opened and analyses for APC was performed using pore plate method at the end of exposure times of 6h, 24h, 48h. As expected, APC in fish was significantly higher ($p < 0.05$) at ambient storage than those in cold storage at each exposure time. Nevertheless, APC detected from canned fish exposed for 6 hours at 28^oC (2.42×10^3 CFU/g) was within acceptable levels ($< 5.0 \times 10^5$ CFU/g) for human consumption stipulated by international standards. However, the mean APC recorded from the sample exposed for 24 hrs at 28^oC exceeded the acceptable level but, was less than rejected level (1.0×10^7 CFU/g) Fish kept under 4^oC storage and exposed for 48 hrs showed a similar trend. The APC of canned fish stored at -4^oC demonstrated safety levels at each exposure time. In relation to APC, opened canned fish samples at 28^oC were of acceptable quality only up to 6 hour exposure, samples at 4^oC, up to 24 hours and samples at -4^oC even at 48 hours. No significant difference in APC ($p > 0.05$) was noted in canned fish with elevated storage time at any storage temperature.

Keywords: Exposure time, Shelf life, Canned fish, Ambient, Cold storage

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DIVERSITY OF BATOID FISHES LANDED AT THREE MAJOR LANDING CENTERS IN THE WEST COAST OF SRI LANKAE.G.T.P. Wijesinghe ¹, R. Maldeniya ², H.A.C.C. Perera ³, S.P.S.D. Senadheera ⁴^{1, 4} *Ocean University, Sri Lanka*^{2, 3} *The National Aquatic Resources Research and Development Agency (NARA), Sri Lanka***ABSTRACT**

A preliminary investigation was undertaken to determine the diversity of batoid fishes along the West coast of Sri Lanka. Observations were made at three landing sites; Negombo, Chilaw and Beruwela fishery harbours, from July to September 2014. Samples were collected from trawls, multi-day and single-day boats as target species and by-catch where bottom set gill nets “madu dal” (18') were used for target fishery. Even though, the batoid fishes basically belong to four orders, viz, Myliobatiformes, Rajiformes, Torpediniformes and Pristiformes, all the species noted belonged to the Myliobatiformes and Rajiformes. High species diversity was represented in the order of Myliobatiformes belonging to Myliobatidae, Dasyatidae, Gymnuridae and Mobulidae families. Of these, 45% of batoids were of family Dasyatidae. Except Mobulidae, specimens belonged to other families were caught from single-day boats and trawls. Batoids belonged to Mobulidae family was dominant in multiday-boat catches. Of the observed three landing sites, Negombo fishery harbour demonstrated relatively higher species diversity that that in Chilaw and Beruwela fishing harbours demonstrating 52% of species diversity; a total of 23 species of ray, 3 guitar fish and one shark ray belonging to 5 families and 2 orders. Members of family Dasyatidae were dominant in single-day boats in Negombo where *Dasyatis kuhlii* and *Dasyatis zugei* were the most prominent species. *Dasyatis kuhlii* was the most dominant species in Chilaw. Species belonged to Mobulidae family were abundant in Beruwela. No records of skates were made during survey period despite their presence during previous biological studies in Sri Lanka.

Keywords: Batoid fish, Diversity, West coast, Sri Lanka

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**EFFECT OF GIRTH AND STANDARD LENGTH ON RECOVERY PERCENTAGE
OF CANNED *SCOMBER JAPANICUS***Jayrathna B.G.S.¹, Priyashantha T.V.H.² and Vidanarchchi J.K.³^{1, 2, 3} *Department of Animal Science, Faculty of Agriculture, University of Peradeniya,**Sri Lanka***ABSTRACT**

Fish canning is an emerging strategy for fish preservation in Sri Lanka. Fish wastage and recovers from caning are major concerns. Sustainable fishing and prerequisites for determination of sustainable fishing yield is progressively demanding. Determination of the optimum body composition of fish in relation to the canning would enable to minimize the wastage and improve percentage of recovering from canning, and then for enhancing the sustainable fishing. Higher variation of girth and standard length were observed from imported Pacific Mackerel fish (*Scomber japonicus*) bulk used for canning. Girth sizes and standard lengths were measured in randomly collected fish samples within one day. Subsequently fish were grouped according to girth sizes and then fish were canned. Recovery of fish canning was determined after evisceration and removing of offal. Girth size varied from 9 to 20 cm (75% girth variation). Standard length varied from 19 to 35cm (70% standard length variation). Recovery percentage for fish canning lies in between 60%-70%. Maximum Recovery (70.6%) from 17.2 cm girth sized Pacific Mackerel fish. Hence, recovery percentage was improved with increasing girth size. Wastage percentage ranges between 36%-28%. Minimum wastage (28.3%) was from 20.3 cm girth group. Therefore, it is important to maximize the recovery percentage by selecting appropriate girth sized fish. Harvesting parameters and conditions have to be decided accordingly to ensure the sustainability of fish harvesting and fisheries industry.

Keywords: Canning, Girth, Standard length, Recovery, Sustainability

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INDIAN SHRIMP INDUSTRY: DRIFT FROM BLUE REVOLUTION TO RED REVOLUTIONManisha Pradhan ¹, Dr. T.R. Rajeswari ²¹ *Sri Sathya Sai Institute of Higher Learning Anantapur Campus, India*² *Department of Management & Commerce, Sri Sathya Sai Institute of Higher Learning, Anantapur Campus, India****ABSTRACT***

India, a country with one of the largest coastlines in the world, nurtures a diverse array of piscine species. Among this assortment is the Shrimp aqua culture which contributes to the socio economic welfare of the country ranging from providing livelihood to the poor in coastal regions to bringing in foreign currency through international trade. While the country takes pride over this industry, the anthropogenic threat it causes is a matter of great concern. This sector will soon take to southward journey if proper corrective measures are not taken in time. The extemporization espoused must be viable and consistent to reap the benefits of this potential segment. This paper makes an attempt to identify ways to make this industry sustainable in the long run. It focuses on the key problems caused by this industry such as mangrove degradation, loss of agricultural land etc., and suggests ways to overcome them. The study is descriptive in nature and the required data is collected through secondary published sources.

Keywords: Piscine Species, Shrimp, Mangrove Degradation

