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Clarias batrachus, the medicinal fish: An excellent c&idate for aquaculture & employment generation.

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Abstract. Traditional wisdom a propos the nutritional benefits of Indian catfish *Clarias batrachus* is the domino effect into its high consumer demand (global market value ≈800000 USD). Analytical studies also indicated towards easily digestible protein, mineral & adequate good cholesterol (HDL concentration >150 mg/dl, HDL > 60% of Total Cholesterol) content of the fish species. The species is well adapted in virtually all Indian aquatic ecosystems, though production remains low. This paper reviews recent developments in catfish physiology with respect to *Clarias batrachus* and its aquaculture significance.

Keywords: *Clarias batrachus,* Indian catfish, Fish physiology, Nutritional benefits, High Density Lipoprotein, Aquaculture.

1. Introduction

Candidates of the genus *Clarias* has been traveled to many continents, adapting itself successfully & found throughout Asia & Africa. *Clarias batrachus* in some parts of India, particularly in West Bengal & Tripura is considered as a medicinal fish & traditionally remained a strike among the pregnant & lactating mothers, the elderly & children.Many a times consumption of "Magur" (Local name of *C.batrachus*) is prescribed prophylactically to the anemic & malnourished individuals as well as for the convalescent of the patients due to the nutritional superiority. Intensive *C.batrachus* culture in several Indian states as in rural Bengal & Tripura have much potential towards livelihood development, employment generation & ensureing nutritional enrichment in the regular diet among of the people.

This rough & tough species has been studied extensively by many workers in terms of physiology, biochemistry, toxicology, host parasite interaction, pathology, culture characters as well as its population genetics. This paper illustrates the significant content of serum HDL (High Density Lipoprotein) and reviews the major studies carried out by the physiologists, biochemists & aquaculturists throughout the world that contributed immensely in our understanding the life & biology of *Clarias batrachus.*

2. Why intensive culture of *Clarias batrachus*?

Successful aquaculture of this species may bring about socioeconomic sustainability of the rural people. Intensive *C.batrachus* culture will gain popularity mainly because the species require no special treatment with respect to the conditioning and the growth factors unlike many other aquaculture species. A comparatively simple culture characteristic with efficient food conversion (Ali & Jauncey 2005) & excellent nutritional profile (Rui et al 2007) makes *Clarias* very suitable for commercial intensive culture. A common perception of easily digestible high grade protein, high concentration of iron & beneficial lipid content may be instrumental towards its high acceptance as medicinal fish. A yearlong study on the blood

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plasma lipid of *C.batrachus* in a population (logW= - 0.8628+2.097 logL, Debnath 2008) revealed that the HDL content ranges from 150 mg/dl – 180 mg/dl which is more than 60% of total cholesterol (Fig 1).

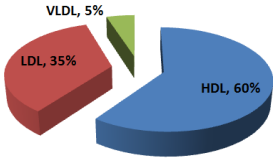

Figure 1: Lipid Fraction in the blood plasma of *C batrachus*.

According to the data released by the Fisheries & Aquaculture department, Food & Agriculture Organization of the United Nations, *C.batrachus* has been propagated throughout the Asia from Thailand & Indonesia (Java). The species has been introduced to as far as Europe (United Kingdom), USA & Australia (Papua New Guinea) from various pockets of South Asia & South East Asia. FAO data also divulge the regular growth in the global production, processing & subsequent earning from different catfish varieties (global market value ≈800000 USD) (Fig 2).

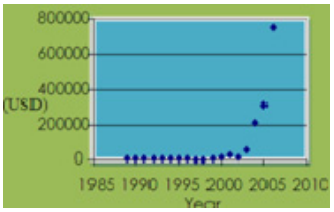

Figure 2: Global market value of Catfish produced worldwide (FAO, 2010).

3. Recent advances *in physiology & aquaculture of Clarias batrachus*

3.1 Reproductive and developmental physiology of Clarias batrachus

Our knowledge & understanding of the reproductive physiology, breeding & culture of fishes has been constantly upgrading because the dynamics of nature sometimes bring about unique combinations of factors, that generates diversification of experimental conditions. Aquaculture is a very efficient system for conversion of low grade raw materials into high grade protein via poikilotherms, accordingly study of breeding biology & culture practices in fishes are of fundamental importance both for economics and ecology as well.

The mechanisms of endocrine regulatory pathways involving reproductive physiology (Mazumdar et al 2007) & culture of *C.batrachus* in wild or controlled environment (Ghosh 2004) are well studied. Induced breeding in order to develop cost-effective & protractable practices is imperative in aquaculture (Muir 2005). In search of an effective & economical inducer of spawning & related changes, arificial spermiation, ovulation and maturation of gamates in *C.batrachus* a number of modulators & methods (Raghuveer & Senthilkumaran 2009, Sahoo et al 2007) have been scanned.

Observations & studies of post spawning, post fertilization events & developments (Nath & Maitra 2001) are equally significant for successful outcome. *C.batrachus* is much popular in Asia as a model to study various aspects of its physiology,organ function as well as molecular biology since it has its origin in this continent.Recent studies on the developmental biology in the species describes nural and sense organ (Gaikwad et al 2009) generation. Majumdar et al (1999) studied the phosphorus containing metabolites of the developing embryos of *C batrachus* (L.) by NMR. FAO has published several reports of culture & production of *C.batrachus*.Traditional knowledge of culture practices integrated with our new findings on the intricacies of various physiological mechanisms will enable sustainable development in the yield and therefore can ensure good-food availability in the future.

3.2. Environmental adaptation in toxicity & stress response of *Clarias batrachus*

C.batrachus has exceptionally well tolerance level in varied environment that suggests an advantageous evolutionary trait. Toxicity & stress studies can through light on the adaptation strategy of a species according to the vibrant changes of the environment and the changed character of the wild habitat,much of

which is altered by now due to increasing human intervention & exploitation.Observations by Manna et al (2008) worth mentioning in this regard where a negative confounding effect in the evaluation of toxicity has been reported in fishes.Among the other observations conducted ; Naqvi et al(1993) evaluated the severe hematotoxic effect of the commonly used farm fertilizer diammonium-phosphate compared to urea in *C.batrachus.* Effect of pollutants as pesticides, drugs, radionucleids (Joy & Sathyanesan 1981)& heavy metals(Panigrahi et al 1990) on factors like hematological indices, histopathological characters(Ray etal 1990)injuring the liver (Goel & Agrawal 1981) , brain (Kirubagaran&Joy1990), kidneys (Kirubagaran & Joy 1988) are well acknowledged in *C.batrachus.*Organ & system specific effects as on neural system (Jyothi & Narayan 2004),immune system(Datta etal 2009),endocrine level(Kirubagaran & Joy 1991),etc and general metabolism (Begum & Vijayaraghavan 1995) are also well documented in *C.batrachus*.

Latest studies on oxidative stress (Bhattacharya & Bhattacharya 2007), DNA damage & apoptosis (Datta et al 2007), gonadal development (Singh & Joy 2000), reproductive cycles, etc influenced by allogens are indicating towards the immediate need to preach & practice habitat protection and implement stringent regulation against tampering with the environment.

3.3. Immune response & Host parasite interaction in *Clarias batrachus*

Studies on the immune response of *C.batrachus* by experimental or wild infection as well as by microbial toxins enable our understanding of host parasite interaction,disease resistance mechanism and risk factors of culture practices.Effects on a host with a pathogen load may be useful to propose preventive protocols & vulnerability assessment.Dash et al (2003) studied immune system in the species.Observations relating to infection load with that of the environmental parameters can through light on the modification on cultural aspects to maintain yield.Immunological response to foreign substances & dietary supplements (Kumari & Sahoo 2005)will help to evaluate therapeutic possibilities.Observation of molecular (Joshi 1982)& organ specific responses (Ruhela et al 2008) to pathogens (Majumdar et al 2007) & parasites (Sharma & Saxena 2001)will help to standardize symptomatic diagnosis.Swain et al(2004)reported the purification & characterization of immunoglobulins from *C.batrachus*. Immunological response to microbial toxins (Majumdar et al 2007) may be extended for the appraisal of perspective immunization protocols.

3.4. Rythmicity & Behavior in *Clarias batrachus*

Biological rhythms ensure the balance of numerous fundamental processes sustained in nature. Seasonal changes influence physiology of animals in terms of cellular (Tripathi et al 2005)& molecular (Sarkar & Subhedar 2001)cascades in various ways. Selections of mate, breeding ground, endocrine secretion (Mazumdar et al 2007)etc follow an inherent natural instinct & rhythm.The timeliness of sexual maturation & gravidity ensures that environment is conducive for the newcomers & guarantees survival.Several workers(Singh & Lal 2008) observed seasonal influence on reproductive physiology of *C batrachus*. Responses to the environmental factors (Srivastava 2003)like photoperiod, temperature, water current etc & internal physiological parameters (Sahu&Shedpure 2006)are also studied in *C.batrachus*.These studies has enriched our knowledge on the factors influencing rhythmcity & related changes in *C.batrachus*. Modulator substances thus can be evaluated with their beneficial response actions. Behavioral responses as frequency and aggression for feeding (Siddiqui 1975) & mating also follow some rhythms & have precise adaptive advantages.

4. Recent studies on Population Genetics & diversity of *Clarias batrachus*

In order to find ways for stock improvement & conservation for any fish species genetic makeup & its variations in terms of whole genome or a loci (Insulin Like Growth Factor–I, Debnath 2010;Growth hormone, Debnath 2009) can disclose crucial attributes.Khedkar et al (2009) studied genetic similarity & diversity of catfish *C.batrachus* populations of three Indian riverine system using randomly amplified polymorphic DNA-polymerase chain reaction (RAPD-PCR) & reported that the populations lack diversity.This may be due to rearing in the same environmental conditions,migration or by inbreeding during several generations.In nearer future, the lack in genetic diversity can lead to depression in growth & disease resistance.Islam et al(2007) described the genetic formation of different populations of *C.batrachus* in Bangladesh & mentioned the potentialities for improving the species through selective breeding.Their study

revealed a recent bottleneck in some wild populations of this species that necessitates habitat protection to increase the population size & lower the vulnerability of *C.batrachus* in the future.To evaluate diversity Padhi et al(1998)characterized the MboI satellites in *C.batrachus*.Phylogenetic inference from the correlation of some microsatellite DNA segments for indirect assessment of genetic diversity in *C.batrachus* has also been described (Debnath & Gupta 2009).In a study Ahmad & Hasnain (2006) reported correlation between biochemical properties & adaptive diversity of skeletal muscle myofibrils & myosin of some air-breathing teleosts including *C.batrachus*.

5. Conclusion

Fisheries & aquaculture is gaining additional emphasis due to our concern in sustainability, greener solutions, conservation & food security.Detail studies on physiology, genetics & general biology are therefore in a fish species very much relevant in order to put forward conservation protocols and to propose newer & improved culture practices.Establishment of *Clarias batrachus* in several continents & its popularity as a freshwater culturable fish species among consumers made the species suitable for meticulous reviews with respect to various parameters.According to FAO estimates the demand for catfishes throughout the world is increasing & *Clarias batrachus* with its several beneficial aspects remain as a hit among the Asians in particular. Besides in order to protect the genetic resources of this species from unwanted hybridization, which the species is very much vulnerable, the fish geneticists & the government bodies should work together. Habitat protection & sustainable consumption of this excellent fish species is the call of the day.

Intensive aquaculture of *C.batrachus* in the rural water bodies with very little infrastructure development may bring-about socioeconomic development in many parts of Bengal & Northeast India. Coordination between government bodies with respect to skill up gradation of the workers, market regulation etc together with the scientific community ensuring timely delivery of better quality seed stock will generate success stories in intensive *Clarias batrachus* culture. Since the species is a part of the natural fauna in this region therefore culture practices will be much easier to follow & therefore much more viable in economic point of view. Government bodies & organizations should come forward for training of the rural unemployed youth & women for human resource development & dexterity enhancement related to technical know-how of culture & disease management. Regional rural banks & agro finance bodies may be approached for capital requirement & the local governance of Panchayats may forward financial help to the rural entrepreneurs.

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