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Single and multiple site Cu(II) catalysts for benzyl alcohol and catechol oxidation reactions

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Highlights

- Cu(II) with mononuclear, dinuclear and multinuclear active sites.
- Selective oxidation of benzyl alcohol and catecholase activity.
- Superior activity of single site catalyst over the multinuclear one.
- Mechanistic study with spectroscopic and theoretical evidences.
- Good recyclability of CuO-nanocatalyst in benzyl alcohol oxidation.

Abstract

Cu(II) catalysts both in homogeneous and heterogeneous form were synthesized to bring the distinction between the single and multiple site catalysis. The single site mononuclear complexes with axial occupancy of Cl⁻ and CH₃COO⁻ ligand and the acetate, imidazolite bridged dinuclear Cu(II) complexes were tested for selective oxidation of benzyl alcohol and catechol oxidation. The reactivity of the complexes was compared with the multiple site copper oxide (CuO) nanocatalyst derived from the metal complex precursor. The single site Cu(II) catalyst showed much superior activity in the selective oxidation of BA compared to the dinuclear and the CuO-nanocatalyst. The oxidation of catechol to *o*-benzoquinone was however found to be catalyzed more preferably by the di-nuclear systems. The high lability of Cl⁻ and ⁻OOCH₃ groups in the mononuclear complexes allowed the incoming oxidant, substrate as well as the solvent (acetonitrile, CH₃CN) molecules to interact with the active Cu-centre and thereby favoured the benzyl alcohol oxidation. Both the experimental and theoretical studies provided a conclusive idea about the reaction mechanism of benzyl alcohol and catechol oxidation. UV-vis, cyclic voltammetric study and density functional theory (DFT) calculations provided the strong evidence for the formation of Cu-CH₃CN complex during benzyl alcohol oxidation. FTIR and Raman study substantiated by the theoretical calculations indicated for the formation of Cu-hydroperoxo species during the catalytic studies. The kinetics study revealed for the 1st order kinetic for the catechol oxidation and the DFT study predicted for the exothermic nature of the catechol oxidation process.

Graphical Abstract



Differential expression of aquaporin genes and the influence of environmental hypertonicity on their expression in juveniles of air-breathing stinging catfish (*Heteropneustes fossilis*)

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ABSTRACT

Aquaporins (AQPs) are a superfamily of transmembrane channel proteins that are responsible for the transport of water and some other molecules to and from the cell, mainly for osmoregulation under anisotonicity. We investigated here the expression patterns of different AQP isoforms and also during exposure to hypertonicity (300 mOsmol/L) for 48 h in juvenile stages of air-breathing stinging catfish (*Heteropneustes fossilis*). A total of 8 mRNA transcripts for different isoforms of AQPs and their translated proteins could be detected in the anterior and posterior regions of S1, S2, and S3 stages of juveniles of stinging catfish at variable levels. In general, more expression of mRNAs for different *aqp* genes was seen in the S2 and S3 juveniles than in the S1 juveniles. Most interestingly, exposure to hypertonicity of S2 juveniles for a period of 48 h led to increased expression of most of the *aqp* genes both at transcriptional and translational levels, except for *aqp3* in the anterior and posterior regions and *aqp1* in the anterior region, showing maximum expression at later stages of hypertonic exposure. Thus, it is evident that AQPs play crucial roles in maintaining the water and ionic balances under anisotonic conditions even at the early developmental stages of stinging catfish as a biochemical adaptational strategy to survive and grow in anisotonic environment.

1. Introduction

All living organisms try to maintain their internal osmolarity by involving specific channel proteins that control the concentrations of inorganic ions, some organic solutes, and water inside their cellular systems. A relatively limited number of solutes seem to serve the function of osmolytes, which include inorganic ions like K^+ , Na^+ , Cl^- , and also some organic osmolytes such as polyols like inositol and sorbitol, methylamines like betain and α -glycerophos, phorycholine, and certain amino acids like taurine, and also urea (Goldstein and Perlman, 1995; Häussinger, 1996). The adaptive responses to osmolarity changes mainly deal with the involvement of water channels, electrolyte, and osmolyte transporters for the movement of water, ions, and osmolytes in and out of various cellular systems, thereby maintaining the constancy in cellular volume. Out of these, aquaporins (AQPs) are the essential transmembrane channel proteins involved mainly in facilitating water

transport and, in some cases, small solutes across the membrane (Verkman and Mitra, 2000; Takata et al., 2004). AQPs exist as homotetramers embedded in the lipid bilayer, and each monomer functions independently as a single pore channel (Gomes et al., 2009). Very little information is available on the expression of AQPs in freshwater teleosts, except for some information on euryhaline species (Yang et al., 2021; Engelund and Madsen, 2011). Cutler and Cramb (2000) reported for the first time the expression of AQPs in some marine and freshwater fishes, the expression of which is said to be regulated that allow them to survive in their respective environments with various salinity changes (Watanabe et al., 2009; Kim et al., 2014; Tipsmark et al., 2010; Lee et al., 2017; Madsen et al., 2020). Various researchers have reported the ubiquitous presence of different isoforms of AQPs in different tissues of certain teleosts. A total of 11 AQP sub-families are reported in the genome of zebrafish (*Danio rerio*), which include mammalian isoforms AQP 0–1, 3–5, and 7–12 (Cerdà and Finn, 2010). Teleosts have up to 18

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লক্ষ্মীনন্দন বৰাৰ চুটিগল্পৰ নাৰী চৰিত্ৰৰ বিশ্লেষণ (“কঠিন মায়া”, “ঈশ্বৰৰ পৃথিৱীত” আৰু “সম্ভ্ৰম-চেতনা”ৰ বিশেষ প্ৰসংগত)

ড° সংযুক্তা বৰুৱা

সহকাৰী অধ্যাপক, অসমীয়া বিভাগ,
এছ বি দেওবা মহাবিদ্যালয়, গুৱাহাটী-৭, কামৰূপ

সংক্ষিপ্তসাৰ :

ভাৱৰ একমুখিতা (singleness of thought) আৰু পৰিণতিৰ ঐক্য লক্ষ্মীনন্দন বৰাৰ গল্পৰ বিভিন্ন চৰিত্ৰসমূহৰ মাজত প্ৰত্যক্ষ কৰিব পৰা যায়। মূলতঃ গ্ৰাম্য জীৱনৰ বাস্তৱ চৰিত্ৰ উপস্থাপনেৰে তেওঁৰ গল্পৰ আংগিক সমৃদ্ধ যদিও গল্পৰ কাহিনীয়ে চৰিত্ৰৰ গতি নিৰ্মাণ কৰে অথবা চৰিত্ৰৰ লক্ষণৰ ৰূপান্তৰ কৰে। গল্পৰ শেষত চৰিত্ৰৰ চাৰিত্ৰিক সংশোধনৰ জৰিয়তে ঘটনা-পৰিঘটনাবোৰ, সমস্যাবোৰৰ সমাধানৰো আভাস উপলব্ধ হয়। লক্ষ্মীনন্দন বৰাৰ গল্পসমূহৰ আংগিক তথা কাহিনী অনুসৰি আমি যিবিলাক চৰিত্ৰ দেখিবলৈ পাওঁ সেই চৰিত্ৰবোৰে অসমীয়া সমাজখনৰ স্থিতি, পৰিৱৰ্তন আদিৰ গুণবোৰ প্ৰতিভাত কৰে। ব্যক্তিগত আৰু সামাজিক দিশত লক্ষ্মীনন্দন বৰাৰ পুৰুষ চৰিত্ৰ আৰু নাৰী চৰিত্ৰ প্ৰত্যেকেই প্ৰতিনিধিত্বমূলক চৰিত্ৰ। নাৰী চৰিত্ৰসমূহে বিভিন্ন পৰ্যায়ত তেওঁলোকৰ মানসিক অৱস্থাটোক কেনেদৰে পৰিচালনা কৰে তাৰো প্ৰতিফলন লক্ষ্মীনন্দন বৰাৰ গল্পসমূহত ঘটিছে। “কঠিন মায়া”, “ঈশ্বৰৰ পৃথিৱীত”, “সম্ভ্ৰম-চেতনা”ৰ দৰে গল্পসমূহত উপস্থাপন হোৱা নাৰী চৰিত্ৰকেইটাই সমাজৰ বহু কথা কৈ গৈছে। একে সময়তে অন্তৰত বিভিন্ন ভাৱৰ দোলন ঘটিলেও বাহ্যিক অভিব্যক্তিত যেন তেওঁলোক প্ৰতিগৰাকী সাধাৰণ নাৰীহে। গল্পকাৰে নাৰীৰ চৰিত্ৰৰ অৱতাৰণা কৰাৰ সমান্তৰালকৈ নাৰীৰ মনস্তত্ত্বকো প্ৰকাশ ঘটোৱাত গুৰুত্ব দিছে।

বীজশব্দ : নাৰী, সমাজ, চৰিত্ৰ, আংগিক, চুটিগল্প

১.০ অৱতৰণিকা :

“পাতাল ভৈৰৱী” (১৯৮৫), “কায়কল্প” (২০০২), “যাকেৰি নাহিকে উপাম” (১৯৯৩), “কাল বলুকাত খোজ” আদিৰ স্ৰষ্টা, অসমৰ বিশিষ্ট ঔপন্যাসিক, গল্পকাৰ তথা সাংবাদিক, শিক্ষাবিদ, বিজ্ঞানী লক্ষ্মীনন্দন বৰাই (১৯৩২-২০২১) গল্পকাৰ হিচাপে ‘ৰামধেনু যুগ’ত আত্মপ্ৰকাশ কৰিছিল। লক্ষ্মীনন্দন বৰাৰ গল্পসমূহ ‘ৰামধেনু’, ‘নতুন অসমীয়া’, ‘অৰুণাচল’ আদিত প্ৰকাশ হৈছিল। “নিশাৰ

Computational Design of Crescent Shaped Promising Nonfullerene Acceptors with 1,4-Dihydro-2,3-quinoxalinedione Core and Different Electron-withdrawing Terminal Units for Photovoltaic Applications

Labanya Bhattacharya, Alex Brown, Sagar Sharma, and Sridhar Sahu*

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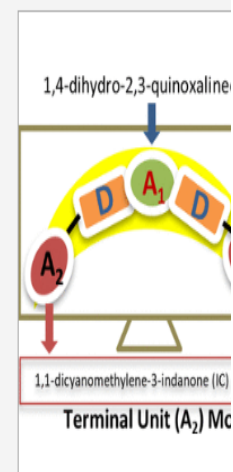


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Abstract

This study aims to design a series of nonfullerene acceptors (NFAs) for photovoltaic applications having 1,4-dihydro-2,3-quinoxalinedione fused thiophene derivative as the core unit and 1,1-dicyanomethylene-3-indanone (IC) derivatives and different π -conjugated molecules other than IC as terminal acceptor units. All the investigated NFAs are found air-stable as the computed highest occupied molecular orbitals (HOMOs) are below the air oxidation threshold (ca. -5.27 eV vs saturated calomel electrode). The studied NFAs can act as potential nonfullerene acceptor candidates as they are found to have sufficient open-circuit voltage (V_{oc}) and fill factor (FF) ranging from 0.62 to 1.41 V and 83%–91%, respectively. From the anisotropic mobility analysis, it is noticed that the studied NFAs except dicyano-rhodanine terminal unit containing NFA, exhibit better electron mobility than the hole mobility, and therefore, they can be more promising electron transporting acceptor materials in the active layer of an organic photovoltaic cell. From the optical absorption analysis, it is noted that all the designed NFAs have the maximum absorption spectra ranging from 597 nm–730 nm, which lies in the visible region and near-infrared (IR) region of the solar spectrum. The computed light-harvesting efficiencies for the PM6 (thiophene derivative donor selected in our study):NFA blends are found to lie in the range of 0.96–0.99, which indicates efficient light-harvesting by the PM6:NFA blends during photovoltaic device operation.



Endophytic fungi associated with *Brucea mollis* Wall. ex Kurz.: a hidden source of antimicrobial and antioxidant metabolites

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Affiliations + expand

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Abstract

Geosmithia pallida (KU693285) was isolated from *Brucea mollis* an endangered medicinal plant of North-East India. The secondary metabolites, produced by the endophytic fungi, extracted by ethyl acetate were screened for antimicrobial activity. *G. pallida* extract displayed the highest antimicrobial activity against *Candida albicans* with a minimum inhibitory concentration of 80.5 ± 1.25 $\mu\text{g/mL}$. *G. pallida* also showed the highest antioxidant activity which differed insignificantly from *Penicillium* sp. ($P > 0.05$). The *G. pallida* extract also exhibited the highest cellulase activity and also amylase and protease activities. The cytotoxicity assay of the ethyl acetate extract of this endophyte showed negligible effect ($1.93 \pm 0.42\%$) on chromosomal aberration as compared to the control (cyclophosphamide monohydrate) ($7.20 \pm 1.51\%$). The internal transcribed spacer rDNA sequence of *G. pallida* was submitted to the NCBI (Accession number KU693285) from India for the first time. The FT-IR spectrophotometry of the bioactive metabolite of *G. pallida* showed the presence of different functional groups such as alcohol, carboxylic acids, amines, aromatics, alkyl halides, aliphatic amines and alkynes. The GC-MS analysis revealed the presence of acetic acid, 2-phenylethyl ester; tetracosane; cyclooctasiloxane hexadecamethyl; cyclononasiloxane octadecamethyl; octadecanoic acid; phthalic acid, di(2-propylpentyl) ester and nonadecane, 2,6,10,14,18-pentamethyl as the major compounds in the metabolite. The findings of the present work indicated *G. pallida* as a potential source of important biomolecules without mammalian cytotoxic effects, which can be utilized for pharmaceutical purposes.

Keywords: Endophytic fungi; antimicrobial activity; antioxidant activity; enzyme activity, cytotoxicity assay; metabolite profiling.

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জীবনানন্দ দাশৰ 'বনলতা সেন' আৰু নৱকান্ত বৰুৱাৰ 'এটি প্ৰেমৰ পদ্য' কবিতাত নাৰীসত্তা : এক তুলনামূলক বিশ্লেষণ

ড° সংযুক্তা বৰুৱা, সহকাৰী অধ্যাপক
অসমীয়া বিভাগ, এছ বি দেওবা মহাবিদ্যালয়, গুৱাহাটী

সংক্ষিপ্তসাৰ : ঠাঠৰ শতিকাৰ শেষৰ ফালে আৰু ঊনৈছ শতিকাৰ আৰম্ভণিলৈকে পশ্চিমীয়া দেশত অব্যাহত থকা এক কাব্যিক আন্দোলনৰ ফল হৈছে ৰোমাণ্টিকতাবাদ (Romanticism)। ৰোমাণ্টিক কবিতাই পূৰ্বৰ সাহিত্যৰ ধাৰাৰ ধাৰণাবোৰক প্ৰত্যাহান জনাই আদৰ্শবাদ, শাৰীৰিক আৰু আৱেগিক ব্যক্তিবাদ, প্ৰকৃতিৰ প্ৰতি শ্ৰদ্ধা আদি লক্ষণসমূহ ৰোমাণ্টিক কবিৰ বাবে অত্যন্ত আলোক উজ্জ্বল ৰূপত আঁকোৱালি লৈছিল। উইলিয়াম ৱাৰ্ডছৱৰ্থ (১৭৭০-১৮৫০), জন কীটছ (১৭৯৫-১৮২১), শ্যালী (১৭৯২-১৮২২), উইলিয়াম ব্ৰেক (১৭৫৭-১৮২৭), চেমুৱেল টেইলৰ ক'লেৰিজ (১৭৭২-১৮৩৪), এডগাৰ এলেন পো (১৮০৯-১৮৪৯), আলেকজেণ্ডাৰ পুস্কিন (১৭৯৯-১৮৩৭), ৱাল্ট হুইটমেন (১৮১৯-১৮৯২), উইলিয়াম শ্যেক্সপীয়েৰ (১৫৬৪-১৬১৬) আদি কবিসকলে ইয়াৰ গুৰি ধৰিছিল। ভাৰতীয় প্ৰেক্ষাপটত বাংলা সাহিত্যত এক নতুন মাত্ৰা প্ৰদান কবি মানুহ আৰু প্ৰকৃতিৰ বৰ্ণনাৰে কবিতা লিখিছিল জীবনানন্দ দাশে (১৮৯৯-১৯৫৪)। বংগৰ ববীন্দ্ৰনাথ ঠাকুৰ আৰু কাজী নজৰুল ইছলামৰ পাছত আটাইতকৈ জনপ্ৰিয় বাংলা কবিজন হৈছে জীবনানন্দ দাশ। ববীন্দ্ৰনাথ ঠাকুৰৰ ৰোমাণ্টিক কবিতাৰ দ্বাৰা প্ৰভাৱিত হোৱা সময়ত বাংলা সাহিত্যত আধুনিকতাবাদী কবিতাৰ প্ৰৱৰ্তন কৰা উদ্ভাৱকসকলৰ ভিতৰত তেওঁক অন্যতম বুলি গণ্য কৰা হয়।

সৰুৰে পৰা সাহিত্যৰ চৰ্চা চলি থকা এক পৰিৱেশত ডাঙৰ-দীঘল হোৱা জীবনানন্দ দাশে ১৯২১ চনত কলিকতা বিশ্ববিদ্যালয়ত ইংৰাজী বিষয়ত এম এ ডিগ্ৰী সম্পূৰ্ণ কৰে। পৰৱৰ্তী ৰাজনৈতিক অশান্তি আৰু ব্যক্তিগত পৰিস্থিতিৰ বাবে সঘনাই বাধাগ্ৰস্ত হৈ তেওঁ মাজে মাজে শিক্ষকতাৰ জীৱন আৰম্ভ কৰে। ১৯১৯ চনত তেওঁ প্ৰথম কবিতা প্ৰকাশ কৰে আৰু সমগ্ৰ জীৱন কবিতা, উপন্যাস আদিৰ ক্ষেত্ৰত সাহিত্য চৰ্চা কৰে। প্ৰকৃতিৰ লৌকিক দৈনন্দিন বস্তুবোৰক শ্ৰদ্ধা কৰি তেওঁ ইন্দ্ৰিয় আৰু যুক্তিৰ পৃথিৱীখন পৰিভ্ৰমণ কৰিছিল। অসমীয়া সাহিত্যত নৱকান্ত বৰুৱা (১৯২৬-২০০২) আছিল এজন বিশিষ্ট ঔপন্যাসিক আৰু কবি। তেওঁক 'এখুদ ককাইদেউ' নামেৰেও জনা গৈছিল। 'সীমা দত্ত' ছদ্মনামত তেওঁ বহুতো কবিতা লিখিছিল। নৱকান্ত বৰুৱাক অসমৰ আধুনিক কবিতাৰ নৱজাগৰণ বাটকটীয়া হিচাপে গণ্য কৰা হয়। দ্বিতীয় বিশ্বযুদ্ধৰ সময়ত উদ্ভৱ হোৱা বিভিন্ন পৰিস্থিতিৰ প্ৰভাৱ তেওঁৰ অধিক সংখ্যক কবিতাৰ বিষয়বস্তুত পৰিছিল। তেওঁ সাহিত্য অকাডেমী বঁটা বিজয়ী "ককাইদেউতাৰ হাড়" নামৰ উপন্যাসখনক এখন ইতিহাস আশ্ৰয়ী ক্লাছিক বুলি কোৱা হয়। জীবনানন্দ দাশ আৰু নৱকান্ত বৰুৱা দুয়োজন কবিৰ কবিতাত প্ৰকৃতিৰ উচ্ছ্বাস, সাধাৰণ বস্তু সম্ভাৱৰ প্ৰকাশ, পৌৰাণিক কাহিনী উদ্ধাৰ, গতানুগতিকতাৰ বিপ্লৱ, ছন্দ প্ৰয়োগৰ নতুনত্ব আদি বিশেষত্বসমূহ দেখিবলৈ পোৱা যায়। 'বনলতা সেন' আৰু 'এটা প্ৰেমৰ পদ্য' নামৰ কবিতা দুটাত বিশেষ দুই নাৰী সত্তাত প্ৰণয় উচ্ছ্বাস, মানৱ উচ্ছ্বাস, বাস্তৱ জীৱনৰ ঘাত-প্ৰতিঘাতত জৰ্জৰিত হৈ অন্তৰৰ আশা-আকাংক্ষা, কল্পনাৰ অভূতপূৰ্ব



From the journal:
Green Chemistry

Utilization of methanol and ethanol for 3,3'-bis(indolyl)methane synthesis through activation of peroxymonosulfate over a copper catalyst†

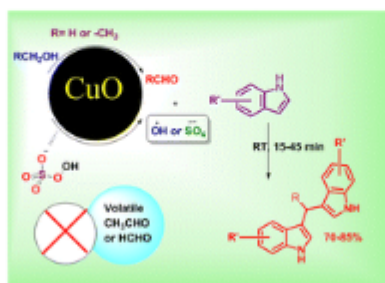


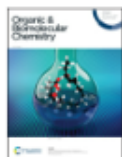
Arpita Devi,^a Mrinmoy Manash Bharali,^{bc} Subir Biswas,^d Tonmoy J. Bora,^a Jayanta K. Nath,^d Seonghwan Lee,^e Young-Bin Park,^e Lakshi Saikia,^{ib} Manash J. Baruah^a and Kusum K. Bania^{ib} *^a

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Abstract

A greener and simple catalytic system is developed for the synthesis of biologically important 3,3'-bisindolyl(methanes) (BIMs) using C1 and C2 alcohols as the carbon source for the bridging methylene group. The reaction occurred under very mild and environment friendly conditions without the requirement of any toxic solvents. The low cost CuO–peroxymonosulfate (CuO–PMS) system allows the reaction to be highly efficient, resulting in very good product yield.





From the journal:
Organic & Biomolecular Chemistry

Heterogeneous iron catalyst for C(1)-H functionalization of 2-naphthols with primary aromatic alcohols†

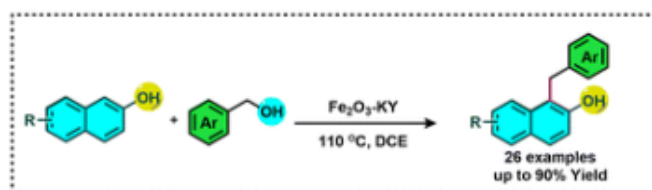


Subir Biswas,^a Dipankar Barman,^b Gautam Gogoi,^a Nazimul Hoque,^a Arpita Devi,^a Siddhartha K. Purkayastha,^c Ankur Kanti Guha,^{id} ^c Jayanta K. Nath^d and Kusum K. Bania^{id} ^{*a}

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Abstract

An iron oxide nanocatalyst supported on a potassium exchanged zeolite-Y ($\text{Fe}_2\text{O}_3\text{-KY}$) is an efficient and reusable catalyst that promotes the selective α -H functionalization of 2-naphthols with various aromatic primary alcohols. The reaction occurs at 110 °C in dichloroethane and requires 6 h for completion. The product yields were found to vary with respect to the nature of the substituents. Benzyl alcohols with electron-donating groups gave the highest yields of up to 90%.





A Study on the Food and Feeding Habits of the Chocolate Mahseer from Jiyabharali River of Sonitpur District, Assam, India

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ABSTRACT

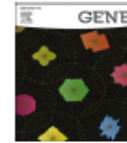
This paper embodies to investigate the food and feeding intensity of Chocolate mahseer (*Neolissochilus hexagonolepis*) with respect to season, maturity stages and length of the fishes. The diet composition of *Neolissochilus hexagonolepis* during different season were determined based on the analysis of 60 specimens, collected from Jiya Bharali River. The fish are found to be an omnivore with higher feeding preference for plant material than for animal material and high values of its gastro-somatic indices species to be a voracious feeder. The feeding activity of the fishes found to be increased with the increase in size of fish.

Keywords: Chocolate mahseer, food, feeding and Jiya Bharali

INTRODUCTION

Neolissochilus hexagonolepis widely recognized as a sport fish due to its tremendous size and strength facilities but this species is facing tremendous ignorance in terms of its habitat loss and over fishing, and becoming near threatened in IUCN Red list Data book. Originating from the Tawang border district in Arunachal Pradesh, Jiya Bharoli or Jiya Bharali is a habitat of many coldwater fishes of species. However, the population of different fish species is in decreasing mode over the years due to various anthropogenic factors. The study of the food and feeding habit of fishes provide keys for the selection of culturable species and necessary information for successful fish farming [1]. The present study deals with food and feeding habits of *Neolissochilus hexagonolepis* from Jiya Bharali River.





Transcriptome analysis of gills reveals novel insights into the molecular response of stinging catfish (*Heteropneustes fossilis*) to environmental hypertonicity

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ABSTRACT

The stinging catfish *Heteropneustes fossilis* is a champion survivor under hypertonic stress and is suggested to be a profitable candidate for culture in slightly saline water in coastal regions. Fish gills are an essential site of osmoregulation and other physiological processes. To investigate the stress responses and mechanisms of salinity tolerance in stinging catfish, we sampled gills tissues from control and hypertonicity (100 mM NaCl solution) treated adult catfish and assessed for transcriptomic profiling by high throughput sequencing. The raw data generated was filtered and assembled for *de novo* transcriptome assembly. The final contig assembly produced a total of 1,71,478 unigenes transcripts with an average transcript length of 898 bp and a GC content of 45%. A total of 22,231 transcripts matched with Chordata with BLAST search and were functionally annotated, out of which 21,814 were best-hit transcripts aligned with the UniProt database. Comparative transcriptomic analysis revealed that a total of 1951 genes were differentially expressed in the gills of NaCl-treated fish compared to the control. Functional and enrichment analysis of the Differentially expressed genes demonstrated that several GO pathway terms were significantly over-represented, such as 'catalytic activity', 'hydrolase activity' in molecular function category, 'membrane', 'integral component of membrane' in cellular component category and 'metabolic process', 'regulation of transcription' in biological process category. The functional analysis study of DEGs demonstrated that tolerance to hypertonic stress by stinging catfish is associated with a few pathways related to stress response, immune response, biosynthesis, metabolism, molecular transport, cytoskeleton remodeling, apoptosis, cell signaling, transcriptional regulation, etc. The present study provides a novel insight into the molecular responses of the air-breathing stinging catfish against salinity stress, which could elucidate the underlying mechanisms of adaptation of this stenohaline species under various environmental constraints.

1. Introduction

Aquatic environments tend to undergo periodic changes in salinity due to tides, seasonal rainfall, evaporation, terrestrial runoff, and groundwater seepage (Truchot, 1988). Freshwater organisms undergo anisotonic stresses during environmental changes, forcing them to regulate their metabolic processes to adapt well. The stinging air-breathing catfish (*Heteropneustes fossilis*) are commercially important freshwater fish species with high market, nutritional and medicinal values in Southeast Asian countries (Kohli and Goswami, 1989). The

stinging catfish are comparatively more resistant to desiccation, high environmental ammonia, salinity, hypoxic stresses, and other environmental challenges (Saha and Ratha, 2007). During different seasons, the catfish also faces the problem of osmolarity changes regularly in its natural habitat. Especially during dry seasons when the ponds and lakes dry up, the fish is compelled to migrate inside the mud peat to avoid total dehydration. During the monsoon season, the water gets diluted and becomes hypotonic in the same habitat. However, since the stinging catfish is known to be a champion in surviving various environmental challenges, and it can endure salinity up to 6 ppt (equivalent

Abbreviations: AQP, Aquaporin; GO, Gene ontology; DEG, Differentially expressed genes; RIN, RNA integrity number; NCBI, National Center for Biotechnology Information; FPKM, Fragments Per Kilobase of transcript per Million mapped reads; FDR, False discovery rate.

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