

# Lead-induced effects on hematological parameters and red cell indices of *Cirrhinus mrigala* (Hamilton, 1822) and *Ctenopharyngodon idella* (Steindachner, 1866)

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## ABSTRACT

The function of blood is to maintain tissue stability by keeping the internal environment of the body constant. However, changes in the values of blood parameters take place in fish inhabiting water polluted with heavy metals. The objective of this study was to evaluate the sublethal effect of lead on red blood cell (RBC) and white blood cell (WBC) counts, hematocrit, hemoglobin, mean corpuscular volume (MCV), mean corpuscular hemoglobin (MCH), and MCH concentration (MCHC) of *Cirrhinus mrigala* and *Ctenopharyngodon idella* exposed to 0.06 mg/l Pb and 0.04 mg/l Pb, respectively, during 28 days exposure. Static bioassay method was employed for the study. Fingerlings were sampled for the selected parameters, on the 7<sup>th</sup>, 14<sup>th</sup>, 21<sup>st</sup>, and 28<sup>th</sup> days. Lead induced changes in the present study were a reduction in the RBC, WBC counts, hematocrit, and hemoglobin, and fluctuating MCV coupled with an increase in MCH and MCHC in both the species. MCV values of *C. mrigala* have showed an increase during the 7<sup>th</sup> and 14<sup>th</sup> days and subsequent decrease during the 21<sup>st</sup> and 28<sup>th</sup> days, while *C. idella* exhibited an intermittent rise and fall till the end of the exposure period. MCH and MCHC have increased in both species at all exposure periods.

## 1. INTRODUCTION

Metals are one of the pollutants which pose a potential hazard to the water bodies, and aquaculture ponds are no exception. The elements which pose the greatest risk are those that accumulate in the body. Fish have been used as bio-indicators of metal pollution since a long time, as their biochemical and hematological parameters are sensitive to heavy metals [1]. Lead is a non-nutritive trace metal. It is released into the aquaculture ponds by neighbouring chemical and fertilizer industries, ore refineries, the electroplating process, and fuel containing lead that leaks from fishery boats [2]. Lead ions enter the body of fish through gills, after binding to the mucous layer. It is also ingested along with food and water and is finally absorbed in the intestine [3]. After absorption, it is distributed particularly to the heart, liver, and kidneys. It also affects the immune system [4]. Studies with various fish species revealed that lead is neurotoxic, since it passes the blood-brain barrier. It causes changes in hematologic parameters, and structural deformations of tissues such as bones [5]. The concentration of metals in water and time of exposure, determines the alterations in hematological parameters causing both reversible and irreversible

changes in the homeostasis of fish. Blood cell responses are important indicators of changes both within the body, as well as in the external environment of fishes. These changes depend on fish species, age, the cycle of sexual maturity of spawners, and diseases [6]. The primary stress responses, i.e., release of adrenalin and cortisol, trigger biochemical and physiological alterations called secondary stress responses [7]. The secondary responses of these early stages to lead can be evaluated by the measurement of secondary biochemical indicators such as variations in hematological parameters and red cell indices [8], which are non-invasive and permit regular check-up. A number of studies have been undertaken to investigate the effects of nutritive metals such as copper in carps, but only a few have been carried out with non-nutritive metals as lead, in carp fingerlings or juveniles under sublethal conditions. Studies on the effect of lead in fishes are restricted to the hematological parameters in tench *Tinca* on short-term exposure to lead [8], hematological changes in common carp after short-term lead exposure [9], and biochemical effects of sublethal lead concentrations in common carp [10].

*Cirrhinus mrigala* and *Ctenopharyngodon idella* are commercially important carp fishes widely cultured in India. Hence, an attempt has been made to study the sublethal effect of lead on the red blood cell (RBC) and white blood cell (WBC) counts, hematocrit, hemoglobin, mean cell volume (MCV), mean corpuscular hemoglobin (MCH), and MCH concentration (MCHC) in fingerlings of both these species.

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# Modelling the structural and reactivity landscapes of tucatinib with special reference to its wavefunction-dependent properties and screening for potential antiviral activity

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## Abstract

HER-2 type breast cancer is one of the most aggressive malignancies found in women. Tucatinib is recently developed and approved as a potential medicine to fight this disease. In this manuscript, we present the gross structural features of this compound and its reactivity and wave function properties using computational simulations. Density functional theory was used to optimise the ground state geometry of the molecule and molecular docking was used to predict biological activity. As the electrons interact with electromagnetic radiations, electronic excitations between different energy levels are analysed in detail using time-dependent density functional theory. Various intermolecular and intermolecular interactions are analysed and reaction sites for attacking electrophiles and nucleophiles identified. Information entropy calculations show that the compound is inherently stable. Docking with COVID-19 proteins show docking score of  $-9.42$ ,  $-8.93$ ,  $-8.45$  and  $-8.32$  kcal/mol respectively indicating high interaction between the drug and proteins. Hence, this is an ideal candidate to study repurposing of existing drugs to combat the pandemic.

**Keywords** DFT · Tucatinib · Docking · NCI · LIE

## Introduction

Breast cancer is one of the most common type of neoplasm found in women and it is divided basically into different subtypes, viz., Luminal A, Luminal B, HER2-enriched, Basal-like and the human epidermal growth factor receptor-2-enriched (HER2-E) is indicated by the overexpression of growth factor receptor-related genes and cell cycle-related genes along with low presence of oestrogen-related and basal-related genes [1–3]. Always, there is a risk of metastatic spread to other interorgans like lungs, brain and bone [4, 5].

HER2 tyrosine kinase inhibitor Lapatinib is widely used for the management of this disease [6]. Tucatinib is recently developed as a promising drug for the management of HER2-positive breast cancer [7]. It is also used along with trastuzumab in patients with HER2-positive colorectal cancer [8]. Tucatinib even showed extensive anti-tumour activity and tumour regression in N87 gastric cancer cell line and HER2-amplified colorectal, oesophageal and gastric cancers [9, 10]. The drug is also well tolerated in patients also along with trastuzumab [11].

Recently, the new strain of coronavirus, n-CoV-2, is devastating human life in entire globe which now emerged to the dimensions of a pandemic and had impacted the life style and health of almost all the people [12]. Scientists through the globe are tirelessly working for establishing the pathology [13], epidemiology [13] and many are try to develop novel molecules, antibodies and vaccines [14]. As it is difficult to come with a new magic molecule which could cure this disease in a short period of time, scientists are looking to reroute the existing drugs with known pharmacokinetics and pharmacodynamics for the management of COVID [15–17]. Chloroquine was once highlighted as a wonder medicine for the management of COVID, in spite of several differences in

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# PM<sub>2.5</sub>/PM<sub>10</sub> ratio characteristics over urban sites of India

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## Highlights

- PM<sub>2.5</sub>/PM<sub>10</sub> ratio characteristics over India using multi-site and multi-year data.
- Suppressed PM<sub>2.5</sub>/PM<sub>10</sub> ratio variations compared to that observed in PM concentrations.
- MERRA-2 derived PM<sub>2.5</sub>/PM<sub>10</sub> ratio found to be overestimating during colder months.
- Weak relationship between the PM<sub>2.5</sub>/PM<sub>10</sub> ratio and meteorological parameters.

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## Abstract

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# Ethnomedicinal plants for Piles by the *Bagata* tribe of Andhra Pradesh, India

Bonela Sandhya Sri and T. V. V. Seetharami Reddi✉

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## Abstract

The paper contains information on 34 species of plants used by the Bagata tribe of Andhra Pradesh for curing piles. Leaf is used in 8 practices followed by root (6). *Canna edulis* and 12 practices were found to be new.

## Keywords

Affected areas, Bleeding, Constipation, Efficacy

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