

**THE EFFECTS OF PETROLEUM ON THREE SPECIES OF THE  
AMAZON: PIRARUCU, TAMBAQUI AND BOARI.**

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**EXTENDED ABSTRACT ONLY - DO NOT CITE**

**Introduction**

Petroleum pollution has disastrous consequences with radical chemical, physical and physiological changes in the aquatic environment. The same strategies developed by fishes during the evolutionary process to minimize the periodic low oxygen availability of the aquatic environment can also be activated when fishes are under some other stress situations, for instance, when exposed to petroleum (Val, 1997). According to Freedman (1984) pollution can be characterized as such when the concentration of the pollutant agent in the environment is sufficient to cause physiological effects on the exposed organisms, and, consequently, to cause an ecological effect. It is noteworthy that the physiological effects can be the result of the exposure to high pollutant concentrations or of a long period of exposure to sublethal concentrations. Aquatic contamination by crude oil is a world environment problem of enormous proportions and even extremely remote regions are not free of its

disastrous consequences. Amazon fishes developed many metabolic pathways in order to keep body homeostasis during the extreme environmental variations that occur in the Amazonian water bodies. In the present work we evaluated the effects of petroleum exposure on the haematological parameters of three species of Amazon fishes, *Arapaima gigas* (pirarucu), *Colossoma macropomum* (tambaqui) and *Mesonauta insignis* (boari). These species have been chosen because they developed different mechanisms to survive low concentrations of oxygen commonly found in the Amazon waters. *Arapaima gigas* is a obligate air-breather; *Colossoma macropomum* developed Aquatic Surface Respiration (ASR); and *Mesonauta insignis* is an advanced teleost, which shows a high degree of hypoxia tolerance.

### **Material and Methods**

In a series of experiments, pirarucus (n=5) were exposed to 0.000, 0.004, 0.019, and 0.053mm petroleum layers in 4 aquaria with the following dimensions: 39x68x50cm during 24 hours. Some authors consider these the most critical period of time for fish under oil exposure (Sydnes *et al.*, 1985). Pirarucu could not survive higher petroleum concentrations and longer periods of exposures that would permit to determinate CL<sub>50</sub>. Dissolved oxygen and pH were kept, respectively, at normoxic and neutral conditions during the whole experiment at all aquaria. Blood was used for lactate (Sigma Chemical Co. kit # 826 UV), glucose (Doles S.A. kit Glucox # 500) and hematological analysis. Tambaqui and Boari (n=8) were exposed to crescent oil volumes until reached 2.262mm and 1.131mm petroleum layers, respectively, during 96 hours (time required to determinate CL<sub>50</sub>). Blood was used for the same analysis as in pirarucu blood.

### **Results and Discussion**

Initially, all fish exposed to crude oil present a series of adjustments similar to those exhibited by fish exposed to hypoxia. In other words, fish start to adjust physiological parameters in order to maximize their oxygen uptake and transfer to tissues. This is due to the fact that, in aquaria, the presence of petroleum results in decrease of oxygen availability. These responses occurred in all three analyzed species. To avoid these effects, all aquaria were aerated.

The air-breather Pirarucu presented an increase in circulating erythrocyte numbers (1.92 to 2.47 x 10<sup>6</sup>mm<sup>3</sup>), which can be explained as a response to compensate for the decrease in oxygen carrying capacity, since a concomitant increase in the methaemoglobin amounts (42.93 to 118.99 %) was also

observed. We may then suggest that the oxygen transport to other tissues was severely compromised in this species, particularly when exposed to the highest petroleum layer. Pirarucu depends on the water surface to breathe air. In this process it ingests some petroleum and may present some degree of intoxication. However, analysis of plasma glucose, lactate, chloride, and lipid contents, revealed no changes in such blood metabolites. Several other experiments have shown that a prolonged exposure will result in the death of these animals. We, thus suggest that these animals are very sensitive to petroleum. Other experiments are in course in our laboratory to verify behavior changes and the main metabolic adjustments Pirarucu presents when exposed to petroleum.

As regard as Tambaqui and Boari we have observed that these species are highly tolerant to petroleum exposure, showing no changes in their hematological parameters for 96 hours of exposure to the highest petroleum level. However, both species presented changes in plasma glucose levels. While Tambaqui presented an increase in glucose levels (from 46.06 to 64.90 mg/dl), indicating some degree of stress in response to oil exposure, Boari presented a decrease in plasma glucose (from 48.37 to 28.79 mg/dl), which might be explained as the result of a general metabolic suppression. Boari belongs to Cichlid family, a highly hypoxia tolerant group (Chippari-Gomes et al., 2000). Such tolerance is supposed to be due to its ability to suppress metabolism. So, we may confirm that this species will use the same strategy to survive an environmental challenge as petroleum exposure by the same mechanisms it copes with natural hypoxia.

Summarizing,  $CL_{50}$  was not determined to Pirarucu due to its excessive sensitivity to petroleum exposure, while Tambaqui and Boari presented  $CL_{50}$  higher than 2.262mm and 1.131mm, respectively, at neutral pH and normoxic conditions, showing a high degree of tolerance to this pollutant.

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