Oxidative stress studies applied to the farmed shrimp *Litopenaus stylirostris* in New Caledonia

Liêt CHIM, Mathieu CASTEX, Pierrette LEMAIRE et Nelly WABETE

Ifremer

Département Lagons Ecosystèmes Aquaculture Durable, BP 2059, 98846 Nouméa, New Caledonia
lietchim@ifremer.fr

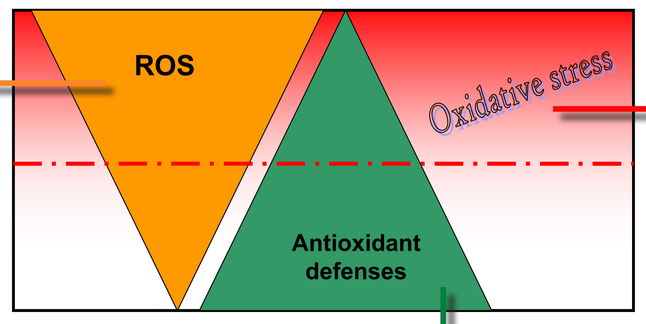
Reactive oxigen species (**ROS**)

Free radicals

$O2^{\circ-}$: superoxide
$HO2^{\circ}$: perhydroxyl
$^{\circ}OH$: hydroxyl
$RO2^{\circ}$: peroxyl
RO° : alkoxyl

Activated oxigen species

$^1O_2$: singlet oxygen
H_2O_2 : hydrogen peroxide
ONOOH : nitroperoxide
$ONOO^-$: peroxinitrite



Oxidative stress is an imbalance in a cell's production of ROS of intrinsic or extrinsic origin and its ability to reduce them with antioxidants. The production and accumulation of ROS can damage lipids, proteins and DNA.

Antioxidant defenses
- dietary antioxidants (eg. Vit C, vit E, carotenoids…)
- SOD, Catalase
- Glutathione/Glutathione peroxidase system

Antioxidant complex and oxidtive stress status in *Litopenaeus stilyrostris*.

It has been shown that the shrimp *L. stylirostris* has a very high metabolism rate compared to other crustacean (Wabete, 2005). This particularity may lead to high ROS production and increased sensitivity of this species to oxidative stress. In this frame we investigated the antioxidant defenses and oxidative stress of the shrimp *L. stylirostris* and the effects of environmental rearing stress and bacterial challenge.

Tissue, molt stage and developmental stage specificity of the antioxidant system

- **The antioxidant complex of the shrimp *L. stylirostris* exhibited well-pronounced tissue specificity (Fig 1). For example, the antioxidant defenses in gills were higher compared to muscle. This may be determined by the structural and functional characteristics of the gills which directly interact with the marine environment.**
- **The molt stage of the shrimp had a significant effect on antioxidant and oxidative stress status of the shrimp. The trend was a higher oxidative stress level in premolt than in intermolt shrimp. Indeed, this last stage is considered as the resting stage in natural growth cycle of crustacean.**
- **The antioxidant system evolved with the developmental stage of the shrimp (Fig 2). In juveniles (BW < 10 g), for which metabolism is exacerbated, the antioxidant defences and oxidative stress levels were higher.**

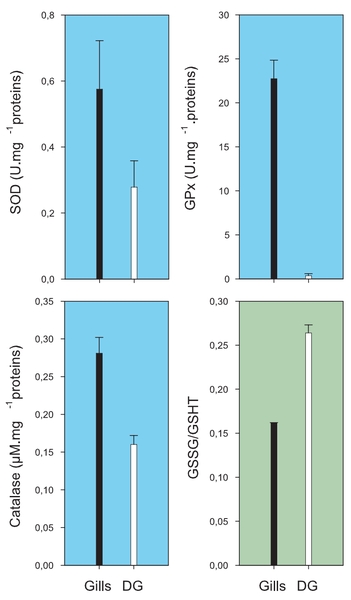


Fig 1 : *Antioxidant enzymes activities (SOD, Calalase and GPx) and oxidized glutathione/total glutathione ratio (GSSH/GSHT) in gills and in digestive glande (DG) of the shrimp L. stylirostris.*

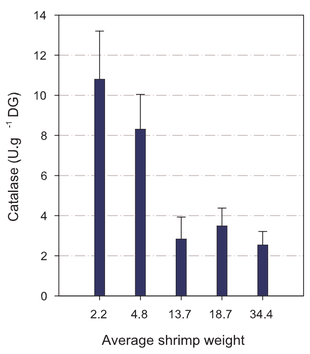


Fig 2 : *Catalase activity in the digestive gland according the size of the shrimp.*

Effect of environmental stress and bacterial infection on antioxidant defenses and oxidative stress.

- **Within the thermopreferendum of *L. stylirostris* (20 – 28°C; wabete, 2005), we showed that pro- and antioxidant processes were balanced whereas at the low side of this thermopreferendum, antioxidant molecules and enzymes equilibrium change significantly leading to oxidative stress (Lemaire et Chim, 2007).**
- **When shrimps were exposed to sublethal concentrations (2000 and 4000 $\mu m.l^{-1}$) of hydrogen peroxide (H_2O_2) (Fig 3), they developed an oxidative stress within 4-6 hours. This stress level and the recovery period are dose dependent (Givaudan et al., in prep).**
- **Shimps challenged with pathogen *V. nigripulchritudo* exhibited oxidative stress after 24-48h post infection (Castex et al., submitted). This stress was characterized by a rise of lipids (MDA) and proteins (carbonyl) oxidation and an elevation of the oxidized glutathione/total glutathione ratio (GSSG/GSHT) (Fig 4).**

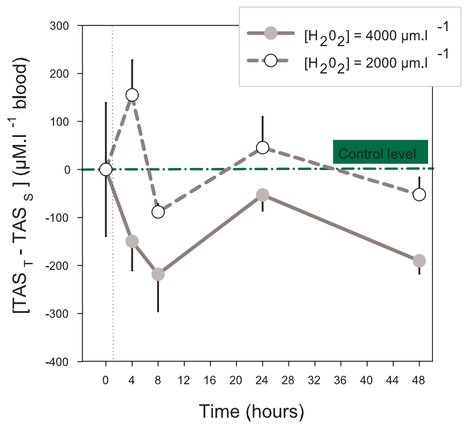


Fig 3 : *Blood total antioxidant status (TAS) according time after shrimp exposure to 2 dosis of hydrogen peroxide (H_2O_2)*

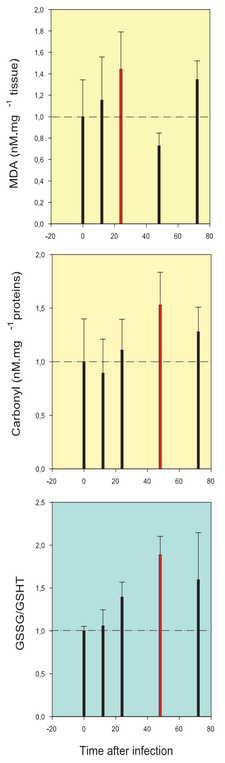


Fig 4 : *MDA, Carbonyl and oxidized glutathione/total glutathione ratio (GSSG/GSHT) in digestive gland of the shrimp according time post-infection by Vibrio nigripulchritudo.*

Conclusion.

The study of the antioxidant status and oxidative stress in shrimp *L. stylirostris* make it possible to assess risk factors (temperature, shrimp size, pathogen, ..) associated with shrimp farming. From a practical view, this research should lead to zootechnical and/or nutritional recommendations to improve the antioxidant status of the shrimp during their growout stage in farm.

References.

Lemaire, P., Chim, L. 2007. Effect of experimental temperature fluctuations on some «oxidative stress» bio-indicators in the digestive gland of the shrimp *Litopenaeus stilirostris*. Third workshop in comparative aspects of oxidatie stress in biological systems - October 16-19 - Cuantla Morelos Mexico.

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