

---

# Protective effects of dietary $\alpha$ -lipoic acid on abalone *Haliotis discus hannai* against the oxidative damage under waterborne cadmium stress

---

Shuoli Ma, Dong Huang, Yanju Lei, Wei Xu, Yanjiao Zhang,  
Huihui Zhou, Wenbing Zhang\*, Kangsen Mai

Ocean University of China

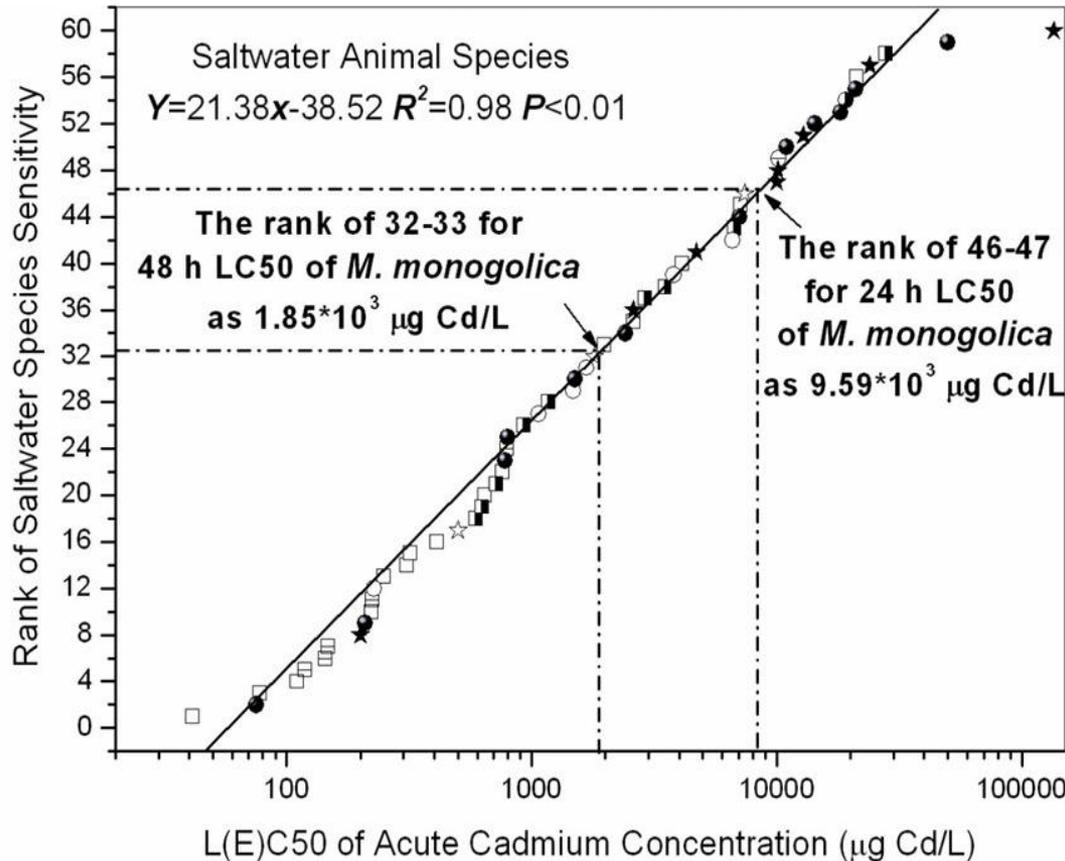


Email address: [wzhang@ouc.edu.cn](mailto:wzhang@ouc.edu.cn); 312554386@qq.com

中國海洋大學 

- 
- **Background**
  - **Materials and methods**
  - **Results and Discussion**
  - **Conclusion**

# Cadmium (Cd) and abalone



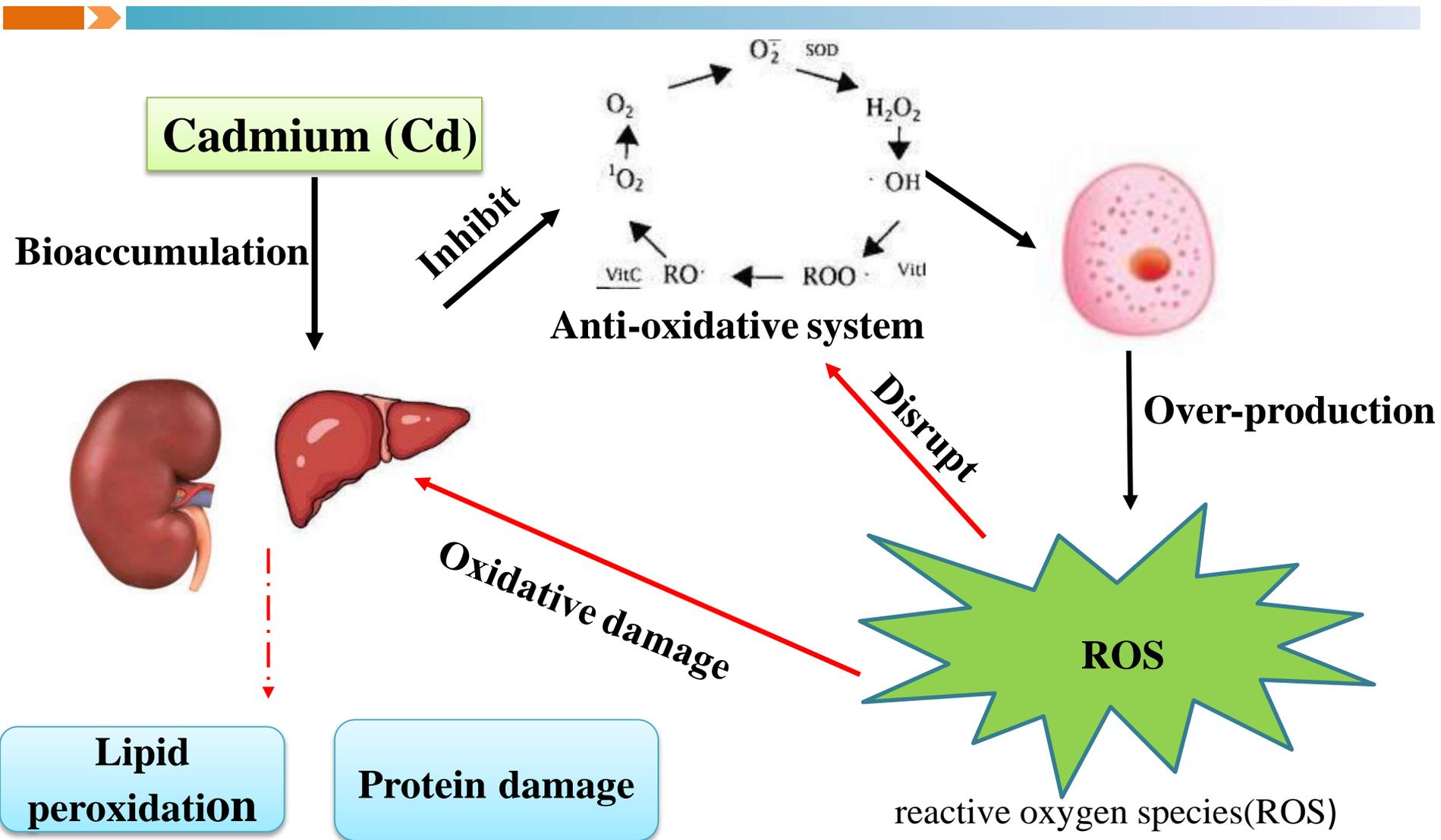
- Arthropoda, Crustacea    ◻ Arthropoda, Copepod    ■ Arthropoda, Amphipod
- Mollusca, Bivalve    ⊖ Mollusca, Cephalopoda    ● Mollusca, Gastropoda
- Chordata, Osteichthyes    ★ Annelida, Polychaeta    ☆ Echinodermata, Echinoidea

A research from the US Environmental Protection Agency (USEPA, 2001) shows that Mollusca is very sensitive to cadmium.

The longer the Mollusca was exposed to cadmium stress, the lower the half lethal concentration was.

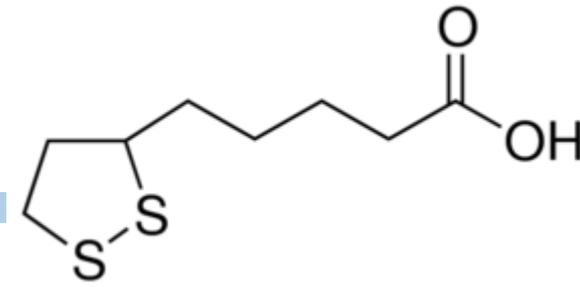
Distribution of acute cadmium toxicity data from various saltwater organisms of different phyla or class (USEPA, 2001)

# Cadmium and oxidative damage

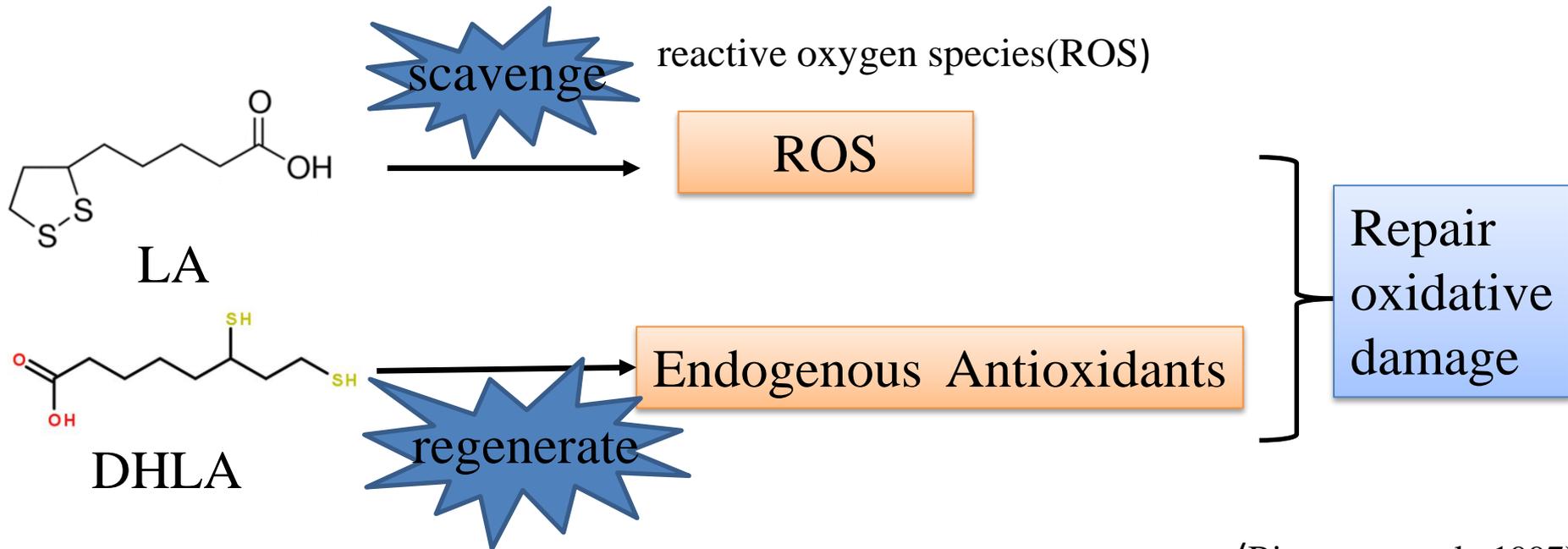


(Sato and Bremner, 1993, Vařák, 2005)

# $\alpha$ -lipoic acid (LA)



$\alpha$ -lipoic acid (LA) and its reduced form, dihydrolipoic acid (DHLA) act as antioxidants in environments .



(Biewenga et al., 1997)

Glutathione peroxidase (GPx);Superoxide dismutase (SOD);Glutathione S-transferases (GST);Thioredoxin peroxidase (TrxP);Thioredoxin reductase (TrxR);Malondialdehyde (MDA);Metallothionein (MT);Protein carbonyl (PC);Catalase (CAT)

# Metallothionein and MTF-1 gene

(1) Metallothionein (MT) belongs to a superfamily of metalloproteins possessing a unique type of sulfur-based metal clusters. It presents in a range of aquatic organisms and is important in chelating heavy metal ions, especially Cd.

(2) Metal-responsive transcription factor-1 (MTF-1) is a key gene in chelating process.

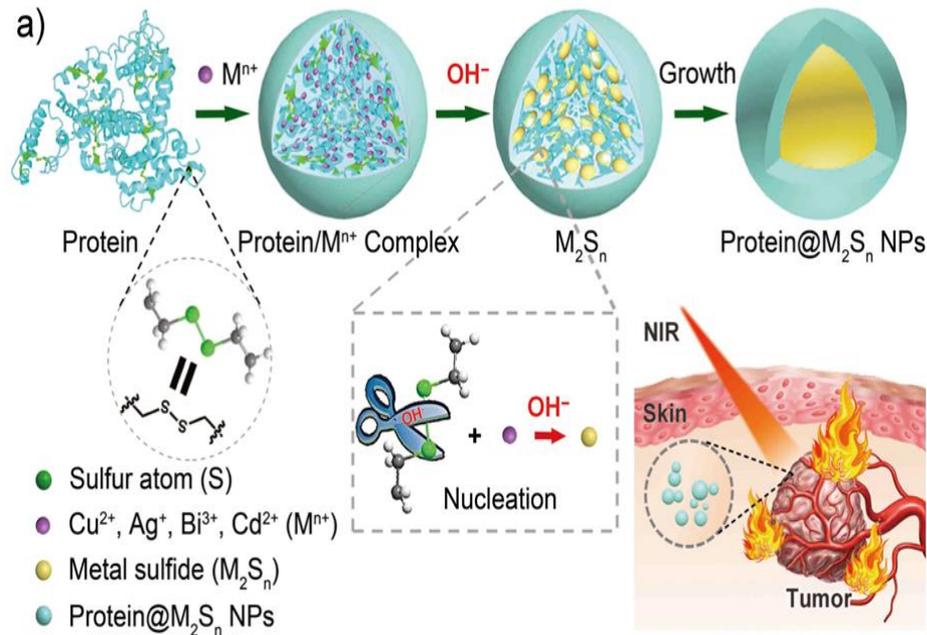


Fig. 1 The process of metallothionein (MT) chelating heavy metal ions (Coyle, Philcox et al. 2002).

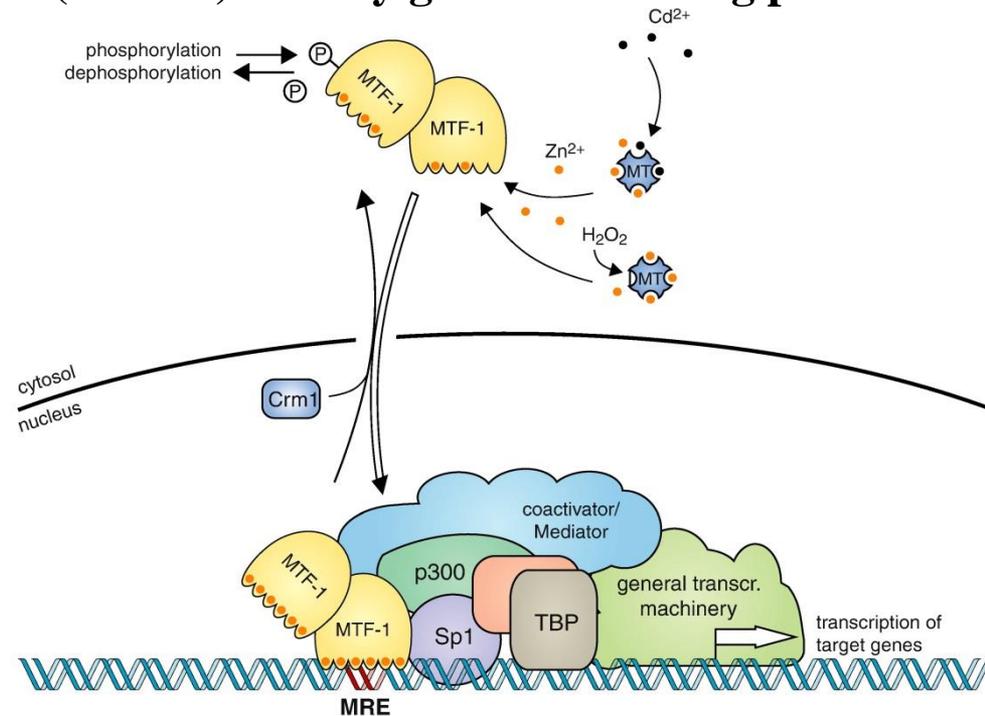


Fig. 2 Overview of the regulation mechanisms of MTF-1 in mammalian (Günther, Lindert et al. 2012)

# Basal diet



Ingredient	Contents (%)
------------	--------------

Casein <sup>a</sup>	25
---------------------	----

Gelatin <sup>b</sup>	6
----------------------	---

Dextrin <sup>b</sup>	33.5
----------------------	------

CM-cellulose <sup>b</sup>	5
---------------------------	---

Sodium alginate <sup>b</sup>	20
------------------------------	----

Vitamin mix <sup>c</sup>	2
--------------------------	---

Mineral mix <sup>d</sup>	4.5
--------------------------	-----

Choline chloride <sup>b</sup>	0.5
-------------------------------	-----

SO/MFO <sup>e</sup>	3.5
---------------------	-----

Proximate analysis (dry weight %)	
-----------------------------------	--

Crude protein	29.41
---------------	-------

Crude lipid	3.26
-------------	------

Crude ash	10.01
-----------	-------

## ➤ Test site

Aquaculture system of Ocean University of China

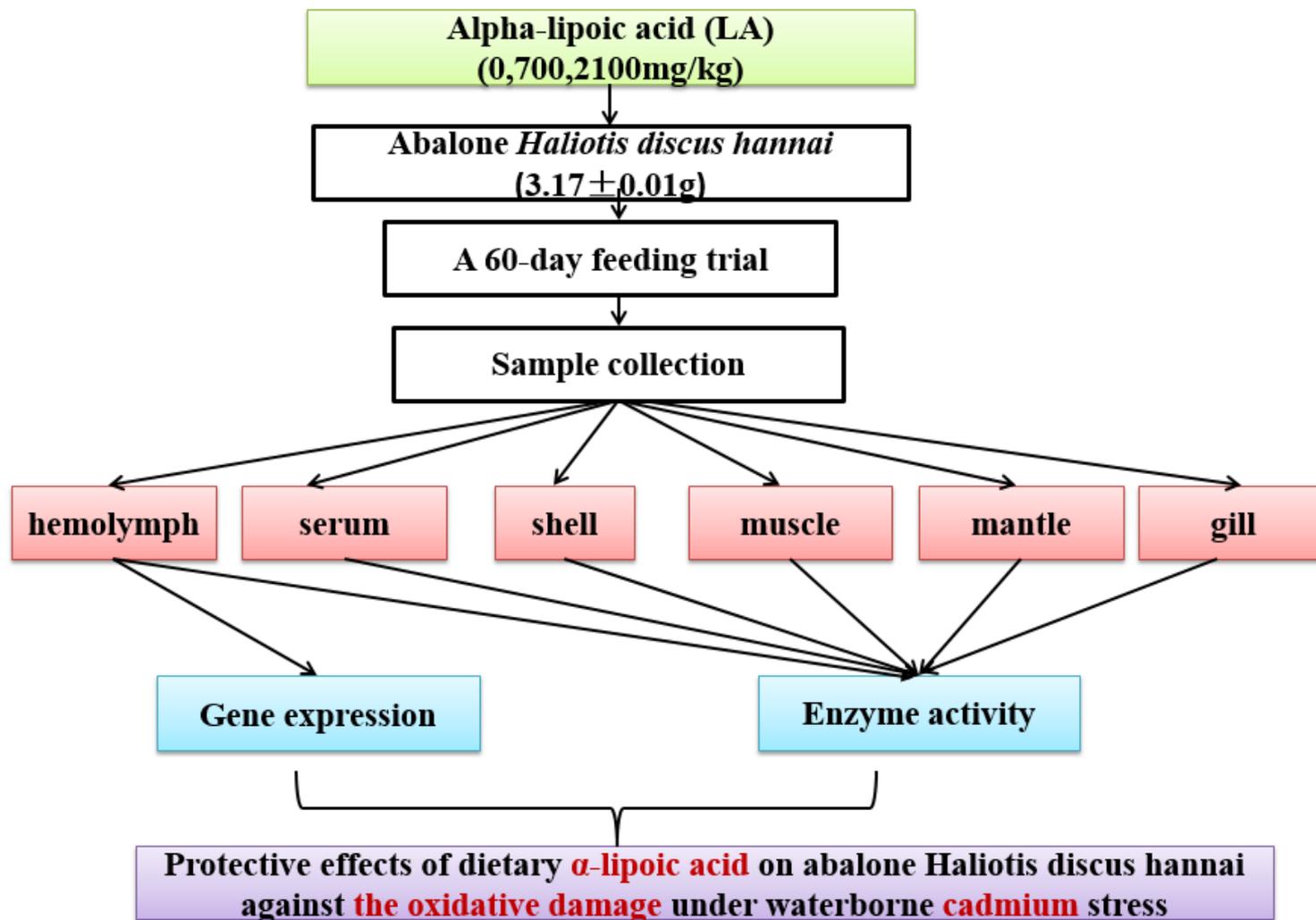
## ➤ Test conditions

- Water temperature : 18-21°C
- Salinity: 22-28
- pH value: 7.4-7.9
- Dissolved oxygen: above 6.0 mg/L
- **Waterborne Cd concentration: 0.34 mg/L**

## ➤ Management

- Feeding trial lasted for 60 days;
- Diets were hand-fed to abalone to satiation once daily at 18:00.;
- Change the water twice a day and the quantity of exchanged water was half the experimental tank.

# Experiment flow



# 1、 Specific growth rate (SGR) and Survival rate

SGR

Survival rate

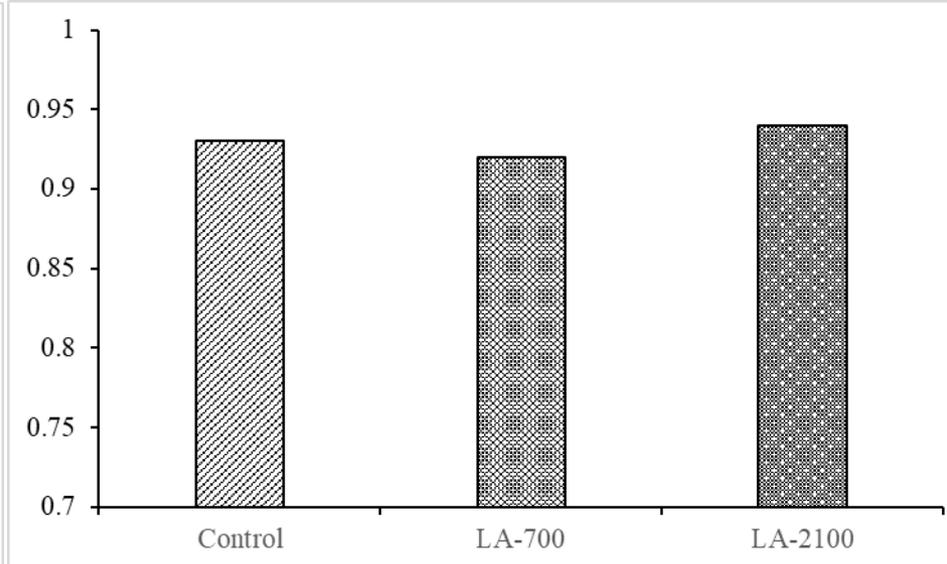
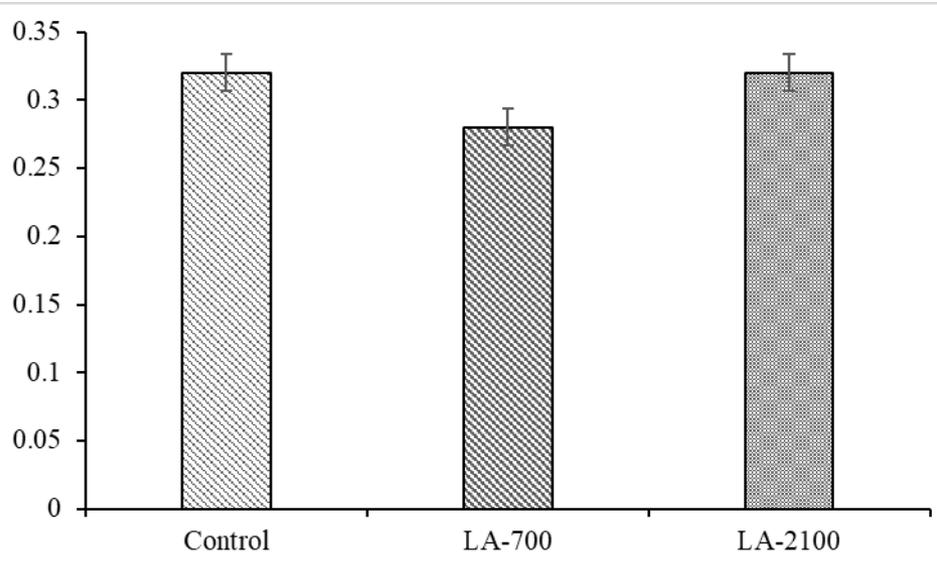


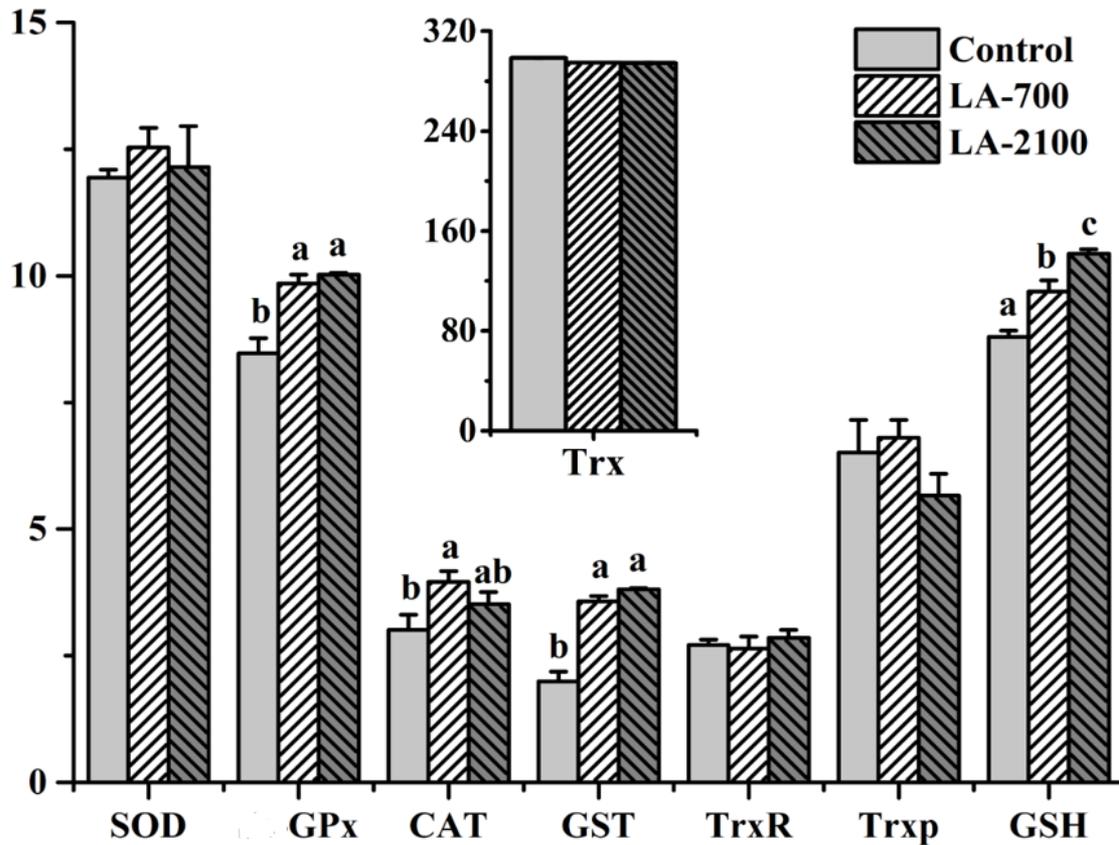
Fig. 1 Effects of dietary lipoic acid on growth of juvenile abalone *Haliotis discus hannai* exposed to waterborne Cd for 60 days

Fig. 2 Effects of dietary lipoic acid on survival of juvenile abalone *Haliotis discus hannai* exposed to waterborne Cd for 60 days

Indicate

**Adding  $\alpha$ -lipoic acid (LA) to the diet had no effect on the SGR and survival rate of abalone.**

## 2、Antioxidant-related parameters in hepatopancreas



Indicate

**$\alpha$ -lipoic acid (LA) could rescue the anti-oxidative capacity which was damaged by Cd in abalone hepatopancreas.**

Fig. 3 Effects of LA on activities of SOD, Se-GPx, CAT, GST, TrxR, Trxp and the content of GSH in hepatopancreas of abalone

Glutathione peroxidase (GPx); Superoxide dismutase (SOD); Glutathione S-transferases (GST); Thioredoxin peroxidase (TrxP); Thioredoxin reductase (TrxR); Malondialdehyde (MDA); Metallothionein (MT); Protein carbonyl (PC); Catalase (CAT)

### 3、Cd concentration in tissues

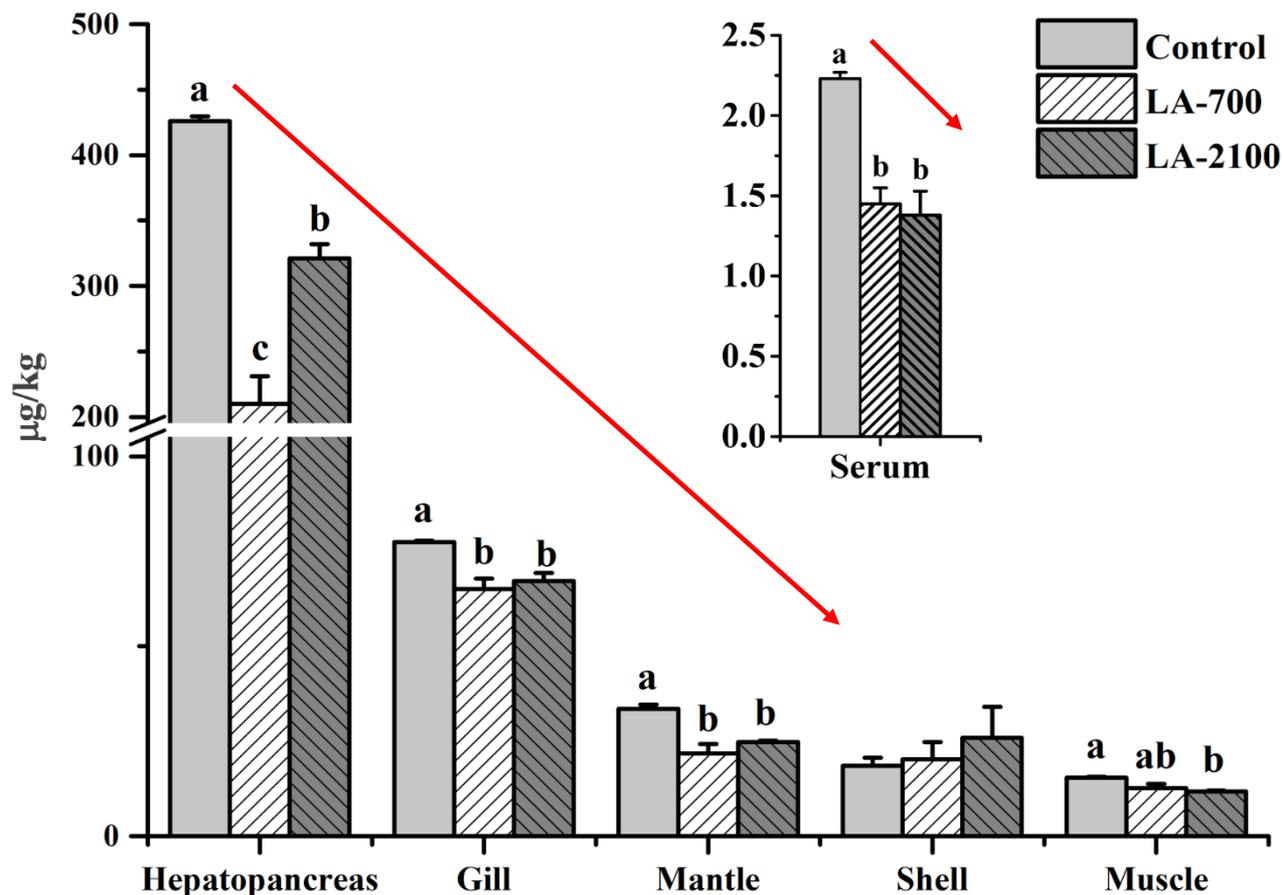


Fig. 4 Effects of LA on Cd concentration in tissues of abalone

Indicate

**$\alpha$ -lipoic acid (LA) decreased toxicity of Cd through decreasing Cd concentration in tissues of abalone.**

# 4、Oxidant-related parameters in hepatopancreas

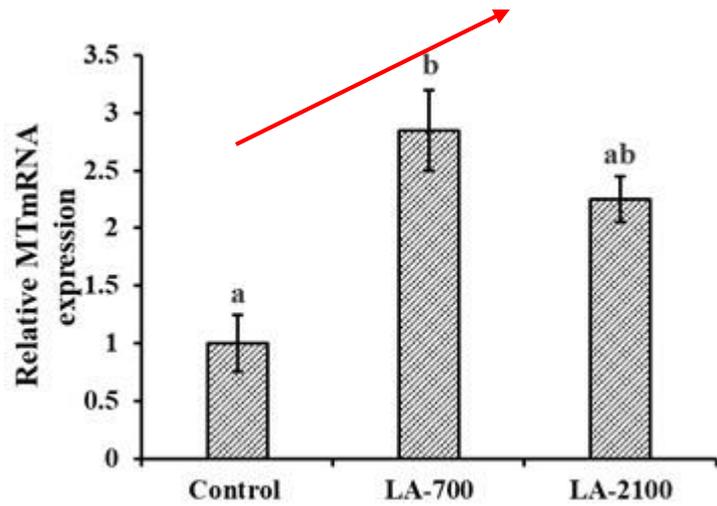


Fig. 5 Effects of LA on MT mRNA expression in hepatopancreas of abalone

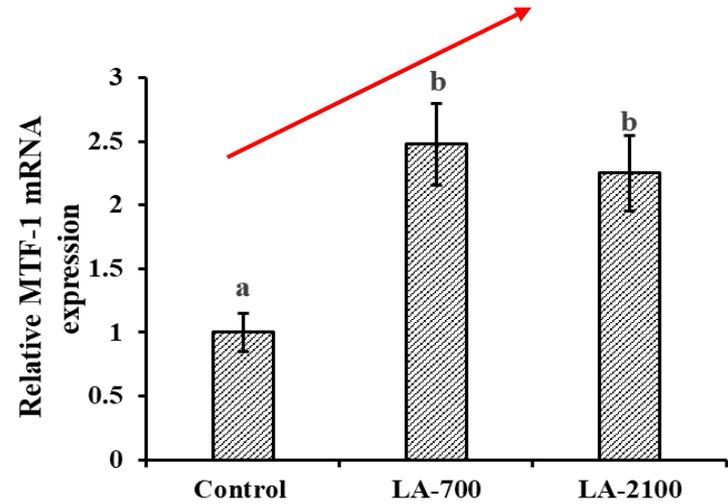


Fig. 6 Effects of LA on MTF-1 mRNA expression in hepatopancreas of abalone

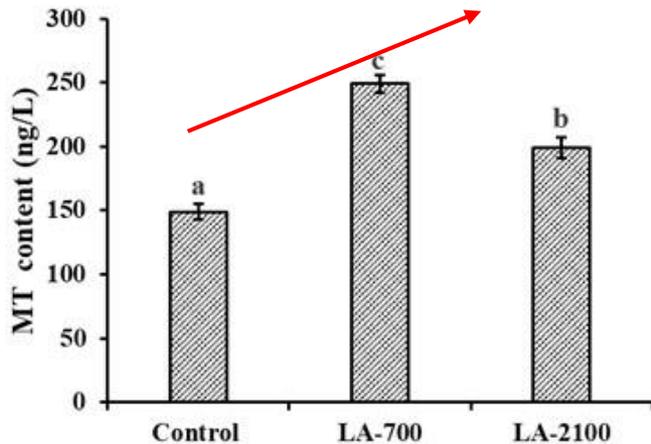


Fig. 7 Effects of LA on MT concentration in hepatopancreas of abalone

Indicate

$\alpha$ -lipoic acid (LA) decreased toxicity of Cd might be related to MT (Metallothionein).

# 5、Oxidant-related parameters in hepatopancreas

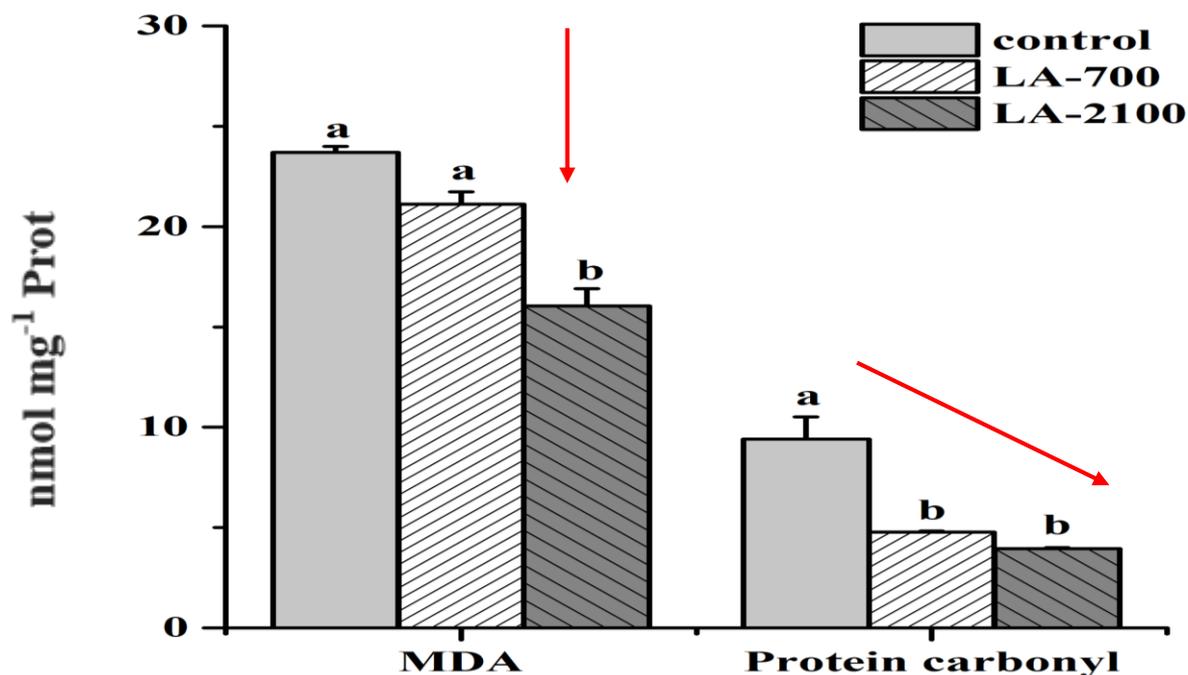
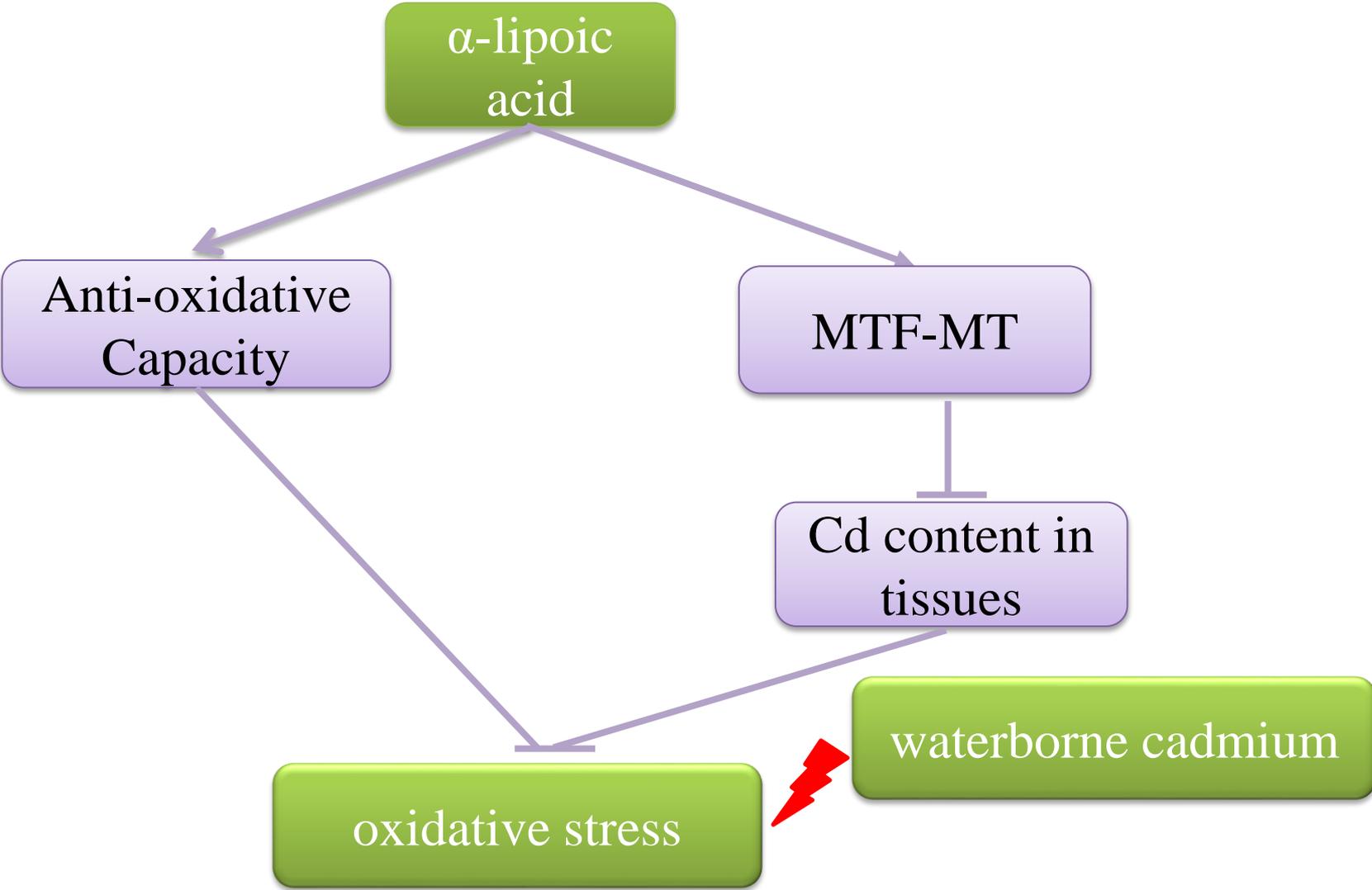


Fig. 8 Effects of LA on contents of MDA and PC in hepatopancreas of abalone

Indicate

**$\alpha$ -lipoic acid (LA) could decrease oxidative stress in hepatopancreas of abalone.**

# Summary



---

**Thanks for your  
listening**

---

