7. Jährlicher DAbG Workshop



Contribution ID: 29

Type: Oral presentation

A focus on the physiological adaptations of the brine shrimp A. salina exposed to space simulated parameters: a new model for astrobiological studies.

Wednesday 6 September 2023 15:20 (20 minutes)

Astrobiological studies are fundamental to understanding how extraterrestrial environments might alter the survivability of complex biological systems. An optimal biological model for space research would need to lower its metabolic rate, possess enhanced defenses against the space environment, and be able to survive prolonged periods of space flight [1]. The crustacean Artemia salina has interesting characteristics for space applications because in instances of adverse developmental circumstances, it generates cysts capable of entering cryptobiosis, possibly enabling it to endure even the harsh conditions prevalent on other planets like Mars. The aim of my research was to conduct preliminary experiments on physiological responses of nauplii (larval forms) of A.salina hatched after 72h of cysts' exposure to low atmospheric pressures that reproduce those of the Martian surface, by using a Mars simulator located at Parthenope University of Naples. After determining the hatching percentage, in vivo respiration was performed polarographically to obtain information on the whole metabolism of the larval forms. Subsequently, in vitro respiration was performed on nauplii homogenates using succinate and a mixture of pyruvate plus malate as electron transport chain-related substrates, in the absence and presence of ADP, to obtain information on mitochondrial functionality. ROS content [2], total antioxidant capacity [3], oxidative damage to lipids (HPs) and proteins (CO) [2], in vitro susceptibility to oxidants [4], lactate content [5], NADPH oxidase (NOX) activity [6] and mitochondrial complexes activity [4] were also performed. Low pressure exposure induced a significant increase in hatching rate and in vivo respiration, to which the increased NOX activity seems to contribute. This result suggests an improvement of the protective mechanisms of larvae exposed to low pressure, as suggested by the increased NOX activity of hemocytes in metamorphic transitions of larvae exposed to external stimuli [7]. Instead, mitochondrial respiration appears not to contribute to the increased in vivo respiration as suggested by the reduction during both basal and ADP-stimulated respiration, which may be explained by reduced Complex I activity of the mitochondrial respiratory chain. Moreover, the reduced lactate content also highlighted a decreased anaerobic pathway after low-pressure exposure. The reduced aerobic pathway can be responsible for reduced ROS content that parallels the reduced HPs level. Since ROS are regulators of antioxidant defense system, the enhanced susceptibility to oxidants observed after low-pressure exposure could be explained by the reduced ROS content. In conclusion, one hour of low-pressure exposure affects A.salina nauplii metabolism by inducing adaptations that are compatible with its survival, thus suggesting that it is suitable for further astrobiological studies.

- [1] Marthy, H. J. (2002) Vie et Milieu/Life & Environment, 149-166
- [2] Napolitano, G., Venditti, P., Agnisola, (2022) Journal of Cleaner Production, 374, 133978
- [3] Erel, O., (2004) Clinical biochemistry 37 (4), pp.277-285
- [4] Napolitano, G., Fasciolo, G., Magnacca, (2022) Journal of physiology and biochemistry, 78(2), 415-425
- [5] Rees, B. B., Boily, P., Williamson, L. A. C. (2009) Advances in Physiology Education, 33(1), 72-77
- [6] Fasciolo, G., Napolitano, G., Aprile, (2022) Antioxidants, 11(7), 1295
- [7] MartÃn, L., Castillo, N. M., Arenal, (2012) Aquaculture, 358, 234-239

Primary author: MUSCARI TOMAJOLI, Maria Teresa (Parthenope University of Naples)

Co-authors: Dr PETITO, Adriana (Department of Biology, Univ. Federico II, Naples, Italy.); Prof. RO-

TUNDI, Alessandra (Parthenope University of Naples, INAF-Istituto di Astrofisica e Planetologia Spaziali, Rome, Italy.); Dr ZONA, Ernesto (INAF-Istituto di Astrofisica e Planetologia Spaziali, Rome, Italy.); Dr GEREMIA, Eugenio (Parthenope University of Naples); Dr NAPOLITANO, Gaetana (Parthenope University of Naples); Dr FASCI-OLO, Gianluca (Department of Biology, Univ. Federico II, Naples, Italy.); Prof. COVONE, Giovanni (Department of Physics, Univ. Federico II, Naples, Italy.); Dr TONIETTI, Luca (Parthenope University of Naples); Prof. DI DONATO, Paola (Parthenope University of Naples, Institute of Biomolecular Chemistry, CNR-Pozzuoli, Naples, Italy.); Prof. VENDITTI, Paola (Department of Biology, Univ. Federico II, Naples, Italy.); Dr DELLA CORTE, Vincenzo () Department of Physics, Univ. Federico II, Naples, Italy.,) INAF-Osservatorio Astronomico di Capodimonte, Naples, Italy.)

Presenter: MUSCARI TOMAJOLI, Maria Teresa (Parthenope University of Naples)

Session Classification: HABITABILITY