Microbiome, transcriptome, and physiology analyses revealed the response of kuruma shrimp (Penaeus japonicus) to exposure to oxygen nanobubbles

Yi Chen^a, Rongwei Zhang^a, Yuntian Zhang^a, Jiadong Guo^a, Zhixu Guo^a, Yuzhe Han^{a,b}, Fuqiang Wang^{a,b}, Xiaoran Zhao^{a,b}, Tongjun Ren^{a,b,*}

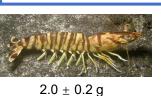
a College of Fisheries and Life Science, Dalian Ocean University. Address: 52 Heishijiao Street, Shahekou District, Dalian City, Liaoning Province, China, 116023

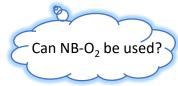
b Dalian Key Laboratory of Breeding, Reproduction and Aquaculture of Crustaceans, Dalian City, Liaoning Province, China, 116023



Background

- Penaeus japonicus, also known as Marsupenaeus japonicus, or kuruma prawn, belongs to the order Decapoda and family Penaeidae. It is economically valuable and renowned for its high-quality meat (Wang et al., 2023).
- Despite its global distribution, *P. japonicus* production remains low due to slow growth rates and feeding challenges. In 2022, it represented only 2.78% of the shrimp farming industry in China (CFLE, 2023).
- Oxygen nanobubble (NB-O₂) technology has been reported to increase the yield of aquatic animals (Mauladani et al., 2020), but no reports have been found on *P. japonicus*.





Objective

This study observed the response of P. japonicus exposed to NB-O₂ to evaluate the usability of this technology.

Design

The study comprised two groups, LS and HS, each housed in separate RAS, differing only in oxygen supply. The LS group used an aeration pump to maintain DO at 7.5 ± 0.5 mg/L, while the HS group used liquid oxygen to maintain DO at approximately 15.0 ± 0.5 mg/L through the form of NB-O₂.

Methods

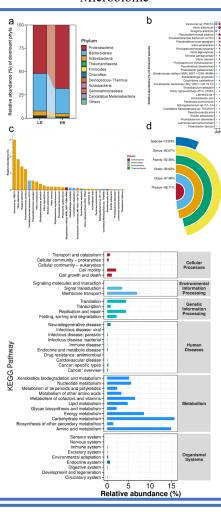
- Identification of composition and function of gut microbio me by 16S rRNA sequencing.
- High throughput sequencing technology reads the transcrip tome pathway of gills.
- Determination of biochemical indicators by spectrophotom etry method.

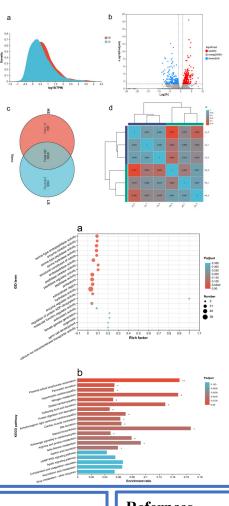
Results

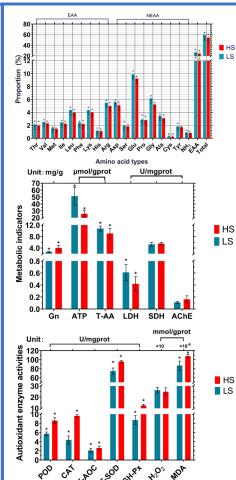
Microbiome

Transcriptome

Physiology







Conclusion

In the hyperoxic environment created by NB-O₂, the intestinal microbiota of P. japonicus remained generally healthy. Transcriptome analysis indicated that the adaptation to hyperoxia involved key metabolic adjustments, including the regulation of amino acid metabolism, maintenance of energy metabolism homeostasis, and increased antioxidant capacity, all of which were confirmed by physiological experiments. Overall, NB-O2 technology has played a positive role in the RAS aquaculture model of P. japonicus.

References

Wang, P., Yu, F., Li, X., Xie, S., Wang, L., Zhu, J., Zhou, X., Zhou, X., Yan, B., Gao, H., Xing, C., 2023. Muscle transcriptome analysis reveals molecular mechanisms of superior growth performance in Kuruma shrimp, *Marsupenaeus japonicus*. Fishes 8, 350. https://doi.org/10.3390/fishes8070350

CFLE, 2023. China Fisheries Statistic Yearbook. China Agriculture Press, Beijing. https://www.zgtjnj.org/navibooklist-n3023120419-1.html

Mauladani, S., Rahmawati, A.I., Absirin, M.F., Saputra, R.N., Pratama, A.F., Hidayatullah, A., Dwiarto, A., Syarif, A., Junaedi, H., Cahyadi, D., 2020. Economic feasibility study of *Litopenaeus vannamei* shrimp farming: nanobubble investment in increasing harvest productivity. Jurnal Akuakultur Indonesia 19, 30-38. https://doi.org/10.19027/jai.19.1.30-38