

高原环境下不同养殖密度对三倍体虹鳟苗种生长性能及肠道健康的影响¹

张耀琼¹, 武梦雨¹, 王壮壮^{2,3,4}, 王万良^{2,3,4}, 周建设^{2,3,4*}

(1. 广东海洋大学, 广东湛江 524000; 2. 西藏自治区农牧科学院水产科学研究所, 拉萨 850032; 3. 西藏自治区渔业与种质资源利用重点实验室, 拉萨 850032; 4. 西藏土著鱼类繁育与利用技术工程研究中心, 拉萨 850032)

摘要: 为探究高原环境下三倍体虹鳟苗种培育的最适养殖密度, 本研究设置了三种不同养殖密度(低密度组(LD) 100尾/桶中密度组(MD) 200尾/桶; 高密度组(HD) 300尾/桶), 开展了为期60天的养殖试验。结果显示, LD组终末体重(Wt)和特定生长率(SGR)显著高于HD组($P<0.05$); LD组的存活率显著高于HD组($P<0.05$); 不同养殖密度水体和肠道菌群 α 多样性存在一定差异; PCA结果显示不同养殖密度水体和肠道菌群存在显著差异($P<0.05$); 水体和肠道菌群中的优势菌门均为变形菌门(Proteobacteria)、厚壁菌门(Firmicutes)、拟杆菌门(Bacteroidetes); HD和MD假单胞菌属(*Pseudomonas*)占比显著高于LD; 共现网络分析显示, 在三种不同养殖密度在LD与MD中共现网络显示出较高的平均度, 说明LD与MD肠道菌群与水体菌群环境更为稳定。综上, 高原环境下更适合低密度养殖, 该结果为高原环境下三倍体虹鳟生态高效、健康养殖提供参考。

关键词: 养殖密度; 虹鳟; 生长指标; 水体; 肠道菌群; 共现网络

The effects of different aquaculture densities on the growth performance and intestinal health of *triploid rainbow trout* seedlings in high-altitude environments

Zhang Yaoqiong¹, Wu Mengyu¹, Wang Zhuangzhuang^{2,3,4}, Wang Wanliang^{2,3,4}, Zhou Jianshe^{2,3,4*}

(1. Guangdong Ocean University, Zhanjiang Guangdong 524000; 2. Tibet Academy of Agricultural and Animal Husbandry Sciences, Institute of Fishery Sciences, Lhasa Tibet 850032; 3. Key Laboratory of Fishery and Germplasm Resources Utilization of Xizang Autonomous Region, Lhasa Tibet 850032; 4. Xizang Indigenous Fish Breeding and Utilization Technology Engineering Research Center, Lhasa Tibet 850032)

Abstract: To investigate the optimal breeding density for triploid rainbow trout seedlings in high-altitude environments, this study set three different stocking densities (Low-Density group (LD) 100 fish/barrel, Medium Density group (MD) 200 fish/barrel, High-Density group (HD) 300 fish/barrel) and conducted a 60-day cultivation experiment. The results showed that the final body weight (Wt) and specific growth rate (SGR) of the LD group were significantly higher than those of the HD group ($P<0.05$). The survival rate of the LD group was significantly higher than that of the HD group ($P<0.05$). There are certain differences in the Alpha diversity of water bodies and gut microbiota among different aquaculture densities. The PCA results show significant differences ($P < 0.05$) in water and gut microbiomes between different aquaculture densities. The dominant phyla in both aquatic and intestinal microbiomes are Proteobacteria, Firmicutes, and Bacteroidetes. The proportion of *Pseudomonas* genera in HD and MD is significantly higher than that in LD. The co-occurrence network analysis showed that the co-occurrence network showed a higher average degree in LD and MD at three different aquaculture densities, indicating that the intestinal and aquatic microbiota environments in LD and MD were more stable. In conclusion, a low-density aquaculture is more suitable in plateau environments. This result provides a reference for ecological, efficient, and healthy aquaculture of *triploid rainbow trout* in plateau environments.

Key words: Stocking density; *Oncorhynchus mykiss*; growth indicators; water body; intestinal microbiota; co-occurrence network

¹ 通讯作者, 周建设, 男, 博士, 副研究员, 主要从事鱼类健康养殖与遗传育种, Tel:13232513114, E-mail: zjianshe@163.com。 第一作者, 张耀琼, 女, 硕士, 学生, 主要从事鱼类健康养殖与遗传育种, Tel:15984487077, E-mail: 15984487077@stu.gdou.edu.cn