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## 饲料中添加3种不同投入品对筏式浅海网箱刺参(Apostichopus japonicus)养殖生长的影响

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摘要:

以刺参的存活率、增重率、特定生长率和肠道蛋白酶、淀粉酶、纤维素酶及肠道组织结构变化为评价指标,通过42 d的养殖实验,研究了在基础饲料(空白组)中添加20%生物胶为粘合剂制备粘性饲料(粘性饲料对照组),通过添加浒苔干粉(浒苔组)、微生态制剂(微生态制剂组)、中草药(中草药组)3种投入品对浅海筏式网箱养殖刺参生理及生长的影响。结果显示,在散失率方面,粘性饲料比空白组饲料散失率降低33.42%,添加浒苔干粉、微生态制剂、中草药对饲料散失率的影响差异不显著( $P>0.05$ );在生长方面,中草药组的增重率和特定生长率均为最高,分别达到 $(41.50\pm 1.39)\%$ 和 $(0.82\pm 0.02)\%/d$ ,显著高于其他4个实验组;在存活率方面,微生态制剂组和中草药组的存活率显著高于空白组和粘性饲料对照组。其中,中草药组存活率最高,达到 $(94.03\pm 2.28)\%$ ;在消化酶活性方面,浒苔组、微生态制剂组和中草药组的淀粉酶活性分别在第10、20、30天达到峰值,峰值分别为 $(1.70\pm 0.05)$ 、 $(1.60\pm 0.04)$ 、 $(1.77\pm 0.04)$  U/mg prot;粘性饲料对照组的蛋白酶活性波动最大,其活性在第10天达到峰值为 $(1.78\pm 0.09)$  U/mg prot;空白组、粘性饲料对照组和浒苔组的纤维素酶活性均呈现先升高后降低的趋势,在实验周期内中草药组的纤维素酶活性表现为持续上升,而微生态制剂组刺参的纤维素酶活性表现出先下降后上升的趋势,最低值为 $(0.14\pm 0.01)$   $\mu\text{g/g}\cdot\text{min}$ ;肠道组织结构方面,粘性饲料对照组的肠道黏膜上皮层厚度显著增加( $P<0.05$ ),浒苔组的肌肉层厚度显著增加( $P<0.05$ ),中草药组和微生态制剂组刺参肠道组织结构完整,上皮细胞分泌旺盛。研究表明,通过添加生物胶所制作的粘性饲料可显著降低饲料散失率,添加微生态制剂和中草药可显著提高网箱养殖刺参的成活率,并显著提高刺参个体的消化酶活力和增重率,添加浒苔对刺参生长影响不显著。

关键词: [刺参](#) [浅海网箱](#) [生物胶](#) [浒苔](#) [微生态制剂](#) [中草药](#) [生长](#)DOI: [10.11758/yykxjz.20150514](#)

分类号:

基金项目:国家“十二五”“863”项目(2012AA10A412-4)、国家自然科学基金项目(31202016)、山东省农业良种工程重大课题“速生、抗病、耐高温刺参良种选育”、青岛市战略性新兴产业培育计划项目(13-4-1-65-hy)和青岛市民生科技计划项目(14-9-3-3-hy)共同资助

## The Effects of Three Types of Feed Supplements on the Growth of *Apostichopus japonicus* Cultured in Cages

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Abstract:

High scatter ratio (ScR) of feed diets and the lack of effective disease prevention and control method have been hindering the cage culture of sea cucumbers (*Apostichopus japonicus*). In this study we used adhesive feed with bio-gel and 3 types of feed supplements (Enteromorpha, microecologies and Chinese herbal medicine) to evaluate their effects on the growth and survival of the cultured sea cucumbers. We designed two categories of feed (adhesive feed with 20% bio-gel and control feed without bio-gel), and divided them into eight groups including the blank adhesive feed (AF-b), the enteromorpha adhesive feed (AF-en), the microecologies adhesive feed (AF-mi), the Chinese herbal medicine adhesive feed (AF-h), the blank control feed (CF-b), the enteromorpha control feed (CF-en), the microecologies control feed (CF-mi), and the Chinese herbal medicine control feed (CF-h). The survival rates (SR), the weight gain rates (WGR), the specific growth rates, the activities of protease, amylase, cellulase, and the microstructure of foregut were measured as the indicators of the effects of feed supplements during the 42-day feeding experiment. The average ScR of the adhesive feed groups (AF-b, AF-en, AF-mi, and AF-h) was reduced by 33.42% compared to the control groups (CF-b, CF-en, CF-mi, and CF-h). There was no significant difference between the 3 groups with food supplements ( $P>0.05$ ). The WGR and SGR of AF-h were  $(41.50\pm 1.39)\%$  and  $(0.82\pm 0.02)\%/d$  respectively, which were the highest among all groups and the values were significantly different from other 4 groups (CF-b, AF-b, AF-en, and AF-mi) ( $P<0.05$ ). The SR of AF-h  $(94.03\pm 2.28\%)$  was the highest among all groups. The SRs of AF-h and AF-mi were significantly higher than that of CF-b and AF-b ( $P<0.05$ ). The activity of amylase of AF-en, AF-mi and AF-h reached the maximum on the 10th, 20th and 30th day during the experiment, and the peak values were  $(1.70\pm 0.05)$  U/mg prot-1,  $(1.60\pm 0.04)$  U/mg prot-1 and  $(1.77\pm 0.04)$  U/mg prot-1 respectively. Compared to the other 4 groups, the activity of protease of AF-b fluctuated tremendously and reached  $(1.78\pm 0.09)$  U/mg prot-1 on the 10th day during the experiment. The activity of cellulase of CF-b, AF-en and AF-b first increased during the early stage and decreased later; the activity of cellulase of AF-h continued to increase during the entire experiment; the activity of cellulase of AF-mi decreased during the first 20 days and then increased in the later 20 days. The microstructures of the foregut of the 5 groups (CF-b, AF-b, AF-en, AF-mi, and AF-h) were normal. The microscopic observation revealed an intense secretion activity of the epithelial cells in AF-mi and AF-h. The relative thickness of the mucosa of AF-b and the muscular layer of AF-en increased significantly ( $P<0.05$ ). These results indicated that the adhesive feed with bio-gel could effectively decrease ScR of feed diets, and that WGR, SR and digestion activities

could be increased with the addition of microecologics and Chinese herbal medicine. Furthermore, Enteromorpha did not affect the growth of cage-cultured sea cucumbers, which indicated that it could be used as a substitute in the feed diets for sea cucumbers.

**Key words:** [Apostichopus japonicus](#) [Cage-culture](#) [Bio-gel](#) [Enteromorpha](#) [Chinese herbal medicine](#) [Growth](#)[Microecologics](#)

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