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Effects of Two Different Feeds on the Growth of Australian Freshwater Lobster

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Abstract

The main objective of this study was to investigate the effects of two different feeds on the growth of Australian freshwater lobster. The experimental data clearly showed that the different feeds had significant effects on the growth rate and weight gain of freshwater lobsters. In particular, feeds rich in microorganisms had the most obvious effect on the growth of lobsters and could effectively promote the rapid increase of their weight. the selection of appropriate feed types and formulations is crucial in freshwater lobster culture. This study not only revealed the effects of two different feeds on the growth of Australian freshwater lobster, but also provided a strong theoretical guidance for freshwater lobster culture practice. In order to improve the breeding efficiency and promote the sustainable development of the industry, we can improve freshwater lobster culture continue.

Keywords: Australian freshwater lobster, types of feed, growth

1. Introduction

Australian freshwater lobster (Cheraxquadricarinatus), a valuable aquatic resource, plays an important role in the high-end aquaculture industry due to its unique cultured potential and market value, showcasing broad prospects for cultivation. Renowned for its special taste and high nutritional value, the freshwater lobster has become a significant export aquatic product favored by international markets [1]. Currently, the Australian freshwater lobster aquaculture industry has gradually developed into an industry with considerable scale and potential. This not only promotes local economic development but also provides numerous opportunities for employment [2]. The breeding of Australian freshwater lobsters is primarily concentrated in inland regions, particularly Western Australia, New South Wales, and Victoria. These regions, as prime aquaculture zones, are endowed with advantaged breeding conditions that provide an optimal environmental foundation for lobster cultivation. Meanwhile, to promote industry development, local governments have formulated a series of supportive policies and regulations to ensure the stable growth of aquaculture. With advancements in breeding technologies and rising market demand, the industry will have a promising future [3]. In China, the introduction of Australian freshwater lobsters dates back to 1992, with Hubei Province pioneering its cultivation through types such as intensive pond breeding and rice paddy breeding. In recent years, the lobster aquaculture industry has rapidly expanded in the Pearl River Delta region of Guangdong. Building on existing techniques, Northern Guangdong mountainous areas have innovatively explored an eco-friendly aquaculture model of "lotus-lobster co-cultivation," while Zhongshan City has created a "rice paddy-lobster breeding model" based on symbiotic relationships between organisms. This approach not only maintains normal production of Australian freshwater lobsters but also yields high-quality rice [4].

The selection and quality of feed directly affect the growth and breeding efficiency of Australian freshwater lobsters (Cheraxquadricarinatus). Rational utilization of nutrient-rich feed can enhance growth rates, improve immune capacity, reduce mortality, and ultimately improve yield and quality [5]. Prioritizing feed quantity over quality not only leads to resource waste, environmental problem, but also impairs the disease resistance and growth performance of lobsters. Careful selection of feed types and components, regarding nutrient balance and formulation integrity, can significantly enhance growth efficiency and utilization rates [6]. Studies have shown that different types and compositions of feed have varying effects on lobster growth, with some feeds even enhancing stress resistance and improving reproductive success rates. Therefore, feed quality and feeding strategies should be prioritized in Australian freshwater lobster farming. This will be of great importance to improving aquaculture efficiency, reducing production costs, and maintaining the sustainable development of the aquaculture industry. By strengthening feed-related scientific research, optimizing feed formulations, and enhancing feed utilization efficiency, we can contribute to the advancement of the Australian freshwater lobster aquaculture industry [7-8].

The continuous development of modern biotechnology and animal nutrition technologies has facilitated the widespread use of microbial feeds in aquaculture. Microbial feeds, as a new eco-friendly feed, can enhance animal propagation and health [9]. However, there is still controversy over which kind of microbial feed has the optimal efficacy for different animal species. Therefore, research findings on the addition of two distinct microbial feeds still need to be further popularized, particularly for aquatic organisms such as Australian freshwater lobsters.

Previous studies have demonstrated that microbial feeds can enhance animal growth by improving gut microbial diversity and digestive enzyme activity [10]. However, existing research findings also have certain limitations, such as small sample sizes and significant interference from bioenvironmental factors. Therefore, it is necessary to conduct more comprehensive and in-depth studies to identify which microbial feed is more beneficial for the growth of Australian freshwater lobsters.

2. Materials and Methods

2.1 Experimental Site

The experiment was conducted in canvas-lined experimental ponds within the greenhouse facility of the College of Modern Agriculture and Industry, School of Biological Sciences and Agriculture, Qiannan Normal University for Nationalities. The water quality was pure and pollution-free.

2.1.1 Base Feed

The base feed consisted of a formulated feed specifically designed for Australian freshwater lobsters [11], with detailed feed composition provided in Table 1.

Table 1. Ingredient composition of Australian freshwater lobster baits

Ingredient	**Content /%**
Fish meal	14
Wheat flour	20
Wheat bran	4
Rice bran	5
Shrimp meal	11
Soybean meal	19
Peanut meal	10
Brewer’s yeast	5
Fish oil	2
Soybean oil	1
Soybean lecithin	1
Bentonite	1
Choline chloride	1
Calcium lactate	2
Premix (vitamins/minerals)	3.5
Binder	0.5
Total	100

2.1.2 Microbial Fermented Feed

The primary components of the microbial fermented feed included fermented soybean meal, fermented rapeseed meal, and fermented mixed fish meal. The fermentation strains (laboratory-prepared yeast, lactic acid bacteria, and *Bacillus*) were used for mixed fermentation. The fermentation method followed Yang Shuhao [12], with specific procedures as follows:

Fermentation Procedure:

1) Ingredients (soybean meal, rapeseed meal, mixed fish meal, and wheat bran) were fully blended according to the ratios specified in Table 2.
2) The mixture was homogenized with water at a raw material-to-water ratio of 1:2.5 (w/v).
3) After steaming and cooling, the blended substrate was inoculated with the strains.

Fermentation Conditions:

- Temperature: 25–30°C
- Duration: 72 h
- Termination criteria: Distinct sauce flavor and pH < 4.8
- Storage: Fermented material was stored in a cool, light-protected environment for later use.

Table 2. Microbial fermented feeds and main ingredient contents

ingredient	Proportion (%)
Soybean meal	45
Rapeseed meal	30
Mixed fish meal	10
Wheat bran	15

2.1.3 Yeast Extract Feed

The main ingredient is brewer's yeast. The yeast extract originates from brewing by-products of Jianjiang Liquor Industry Development Co., Ltd. in Duyun City, Guizhou Province.

Preparation method:

- Prepare yeast mud with an appropriate amount of water to form a thick consistency.
- Add hydrochloric acid to adjust the pH to 2.6.
- Maintain the mixture in a 60°C water bath for 4-6 hours.
- Add NaOH to adjust the pH to 6.4-6.5.
- Dry the product for storage and future use.

Detailed nutritional parameters of the yeast extract feed are provided in Table 3.

Table 3. Main parameters of yeast paste feeds

ingredient	Proportion (%)
Crude Protein	≥40
Crude Fiber	≤5
Crude Ash	≤16
Crude Fat	≥5

2.2 Experimental Methods

2.2.1 Experimental Setup

Twenty-seven shrimp cages were placed in aquaculture ponds with an average water depth of 0.25 m.

- The yeast extract feed trial was divided into 4 groups: Groups A, B, C, and D.
- The fermented feed trial was divided into 4 groups: Groups E, F, G, and H.
- Each experimental group was paired with one control group and further subdivided into three parallel groups.
- Data collection continued for 60 days.
- The control groups were fed a specialized formula feed for Australian freshwater lobsters, with detailed composition provided in Table 1.

2.2.2 Experimental Design

A comparative experimental design was employed. Under consistent environmental conditions:

- Control groups be fed with the same amount of basic feed.
- Treatments for the two experimental feeds are detailed in Table 4.
- The feed ration during the trial was determined as 5% of the weight of the lobster.

Table 4. Experimental feed placement

Feed Type	Group	Dietary Composition
Yeast Paste Feed	Trial A	90%formulated feed + 10% yeast paste
	Trial B	80% formulated feed + 20% yeast paste
Microbial Feed	Trial C	70% formulated feed + 30% yeast paste
	Trial D	60% formulated feed + 40% yeast paste
	Trial E	90% formulated feed + 10% fermented feed
	Trial F	80% formulated feed + 20% fermented feed
	Trial G	70% formulated feed + 30% fermented feed
	Trial H	60% formulated feed + 40% fermented feed

2.3 Aquaculture Management of Australian Freshwater Lobsters

Before the trial:

- The ponds and shrimp cages were thoroughly cleaned and disinfected.
- Experimental Australian freshwater lobsters were temporarily put in aquariums for one week for acclimatization before the formal trial.

During the trial:

- Environmental water parameters were regularly monitored, with pH maintained at 7.0-8.0 [5] to enhance calcium absorption and facilitate molting.
- Uneaten feed was periodically cleaned.
- Approximately one-third of the water was replaced weekly.

2.4 Measurement of Experimental Indicators

During data collection, Lobsters from each group were captured, individually weighed, and recorded. Growth rate and weight gain rate of each experimental group were calculated relative to the control group.

Growth parameter measurement: Lobsters were fasted for 24 hours after the feeding trial to minimize the impact of gastrointestinal contents on measurements, ensuring accurate and reliable growth data.

Data collection:

- The number of surviving lobsters per group was recorded.

- Three lobsters per group were selected for measurement of total length and body weight.

Measurement methods:

- **Total length:** Straight-line distance from the tip of the extended cheliped to the center of the tail fan.
- **Body weight:** Measured after blotting surface moisture with absorbent paper.

Calculation formulas:

- **Growth rate (%)** = [(Final length − Initial length) / Initial length] × 100%
- **Weight gain rate (%)** = [(Final weight − Initial weight) / Initial weight] × 100%

2.4 Experimental Data Analysis

The recorded length and weight data of Australian freshwater lobsters were categorized and counted using Excel spreadsheets. Statistical analysis was performed using SPSS 23.0 software, with $P<0.05$ indicating statistically significant differences and $P<0.01$ indicating highly statistically significant differences.

3. Result and Analysis

Table 5. Effects of yeast paste diet on the growth of Australian freshwater lobster

Group	Initial body length/cm	Final body length/cm	Growth rate/%	Initial body weight/g	Final body weight/g	Weight gain rate/%
Control group	14	19.4 ± 0.4^{c}	39%	55	60.8 ± 0.2^{b}	11%
A	14	20.4 ± 0.1^{b}	46%	55	61.7 ± 0.3^{b}	12%
B	14	21.0 ± 0.3^{a}	50%	55	61.7 ± 0.3^{b}	12%
C	14	21.4 ± 0.4^{a}	53%	55	64.8 ± 0.2^{a}	19%
D	14	19.3 ± 0.4^{c}	38%	55	59.9 ± 0.2^{c}	9%

Note: Different letters (a, b, c) indicate significant differences ($P < 0.05$), while the same letters denote no significant differences ($P > 0.05$). The same applies to the following tables.

The results of the yeast extract feed experiment in Table 5 showed that one-way ANOVA indicated:

Body length:

Experimental groups A, B, and C captured shrimp with significantly greater length than the control group, while group D showed lower values than the control.

Groups B and C exhibited significantly greater shrimp length than group A, though group B was significantly lower than group A.

Body weight:

Group C demonstrated significantly higher shrimp weight compared to the control group, whereas group D showed significantly lower weight than the control.

The shrimp weight in group C was significantly greater than that in group D.

No significant differences were observed in shrimp weight between groups A, B, and the control group.

In conclusion, the yeast extract feed dosage used in experimental group C could effectively promote both body length and weight growth in Australian freshwater lobsters.

Table 6. Effects of microbial diets on the growth of Australian freshwater lobster

Group	Initial body length/cm	Final body length/cm	Growth rate/%	Initial body weight/g	Final body weight/g	Weight gain rate/%
Control group	14	19.4 ± 0.4^{bc}	39%	55	60.8 ± 0.2^{b}	11%
E	14	19.7 ± 0.2^{b}	40%	55	61.1 ± 0.1^{b}	11%

F	14	19.5±0.2[b]	39%	55	62.5±0.2[a]	14%
G	14	22.5±0.1[a]	60%	55	63.7±0.1[a]	16%
H	14	19.1±0.1[c]	36%	55	59.4±0.3[c]	8%

In Table 6, "Effects of Microbial Feed Experimental Groups on the Growth Potential of Australian Freshwater Lobsters," one-way ANOVA results demonstrated the following:

Body length:

Experimental Groups E, F, and G exhibited significantly higher shrimp lengths compared to the control group (P<0.05), whereas Group H showed a significantly lower length than the control (P<0.05).

Group G surpassed both Groups E and F in shrimp length (P<0.05), while the difference between Groups E and F did not reach statistical significance.

Body weight:

Groups F and G had significantly higher shrimp weights than the control group (P<0.05), whereas Group H was significantly lower than the control (P<0.05).

Group H showed significantly lower weights compared to Groups F and G (P<0.05), but no significant difference was observed between Groups F and G.

Conclusion

The microbial feed used in Group G significantly promoted both body length and weight growth in Australian freshwater lobsters.

4. Discussion

Microbial feed utilizes the metabolic activity of microorganisms to ferment fibers that are difficult for animals to absorb into more digestible, absorbable, and utilizable feed. Consequently, microbial-treated feed can enhance the growth of animals. This approach also reduces costs in China's graziery and improves meat quality [14]. Microbial feed is a kind of fermented organic feed containing biofertilizers. From an economic perspective, high quality aquaculture animals should grow up healthily without excessive financial burdens, thereby maximizing economic benefits.

Recent studies indicate that antinutritional factors in feed can be effectively decomposed through microbial fermentation. During this process, proteins are hydrolyzed into small peptides and amino acids that are readily absorbed by animals. The fermented biological feed is rich in chelated compounds, minerals, and growth-promoting factors. Its special aroma also stimulates animal appetite, optimizing nutritional value and fostering growth [15]. According to Wang Yajun [16], feeding 15 percent of fermented soybean meal significantly increased their final body weight while reducing the feed coefficient, demonstrating statistically significant effects. (P<0.05)

In this experiment, Groups C and G showed significantly greater harvested body length and weight in Australian freshwater lobsters compared to the control and other experimental groups (P<0.05). In contrast, Groups D and H showed the least improvement in growth metrics. The results revealed a increase in harvested length and weight across Groups A, B, C, E, F, and G. This suggested that moderate supplementation of yeast extract feed and microbial feed can improve lobster growth. However, excessive amounts of yeast extract or fermented feed (as seen in Groups D and H) limited growth rates. Due to water eutrophication, yeast proliferates in large quantities in water, which reduces dissolved oxygen levels and subsequently impairs lobster growth. Furthermore, the experimental results show that both insufficient and excessive usage amount of yeast extract or fermented feed adversely affects the growth of Australian freshwater lobsters. These findings emphasize the importance of balanced feed formulation in breeding lobster.

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