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AquaTrac in diets for white shrimp *(Penaeus vannamei)*

by Peibin Wang, Zhigang Zhou, Huiyuan Lv, Yang Deng and Franz-Peter Rebafka

Abstract

A dietary inclusion of 6% AquaTrac meal replacing 18.3% of fish meal in diets significantly improved growth and survival of juvenile white shrimp in trials in Hainan, China.

1. Introduction

White shrimp *Penaeus vannamei* is a widely cultured species in China due to its fast growth rate, good disease resistance, and strong international market demand. The output of white shrimp was 350,000 tonnes in 2004.

With the practice of intensive culture with high stocking density, *P. vannamei* production is consuming more and more formulated feed and thus fish meal.

A number of non-marine protein sources are being tested in feeds for the marine shrimp. One of these is hydrolysed and spray-dried poultry protein from fresh poultry by-products, AquaTrac sol SD, which has beneficial physiological (high amounts of highly digestible crude protein), technical (strong binder properties due to functional proteins) and palatability effects (attractants) for crustacean and fish diets.

The purpose of the following research was to investigate the effect of dietary inclusions of this poultry protein on the pellet stability, feed conversion and growth performance of white shrimp *Penaeus vannamei*.

2. Material and Methods

Juvenile white shrimp *Penaeus vannamei* was obtained from a local aquaculture farm in Haikou city, Hainan province, People's Republic of China.

After a two week acclimatization in a recirculation aquaculture system in the CAAS aquaculture station in Hainan Island, the shrimp (initial weight 0.77 ± 0.01g) were bulk-weighed and randomly distributed into 12 tanks of 0.5m x 0.5m x 0.5m at a density of 30 shrimp per tank. During the experimental period, 20% of the water in each aquarium was exchanged daily. Aeration was supplied in all the tanks.

Water quality was monitored throughout the feeding period and water temperature ranged from 22 to 26°C and pH was 8.2 to 8.6. The amount of ammonia nitrogen (NH_3-N) was less than 0.2 mgN l^{-1}, dissolved oxygen was above 7.0 mg l^{-1} and salinity averaged 18 ppt.

Table 1: Ingredients and chemical composition of the experimental diets (%)			
Ingredients	Diet 1	Diet 2	Diet 3
AquaTrac sol SD	0.00	2.00	6.00
Soybean meal	30.00	30.00	30.00
Fishmeal	35.00	32.86	28.59
Wheat flour	28.00	28.00	28.00
Cellulose	0.40	1.18	1.75
Soybean oil	2.60	2.46	2.16
$Ca(H_2PO_4)_2$	2.00	2.00	2.00
Choline chloride (50%)	0.20	0.20	0.20
Coated vitamin C	0.10	0.10	0.10
Vitamin premix [1)]	0.20	0.20	0.20
Mineral premix [1)]	1.00	1.00	1.00
CMC [2)]	0.50	0.00	0.00
Chemical composition			
Moisture (%)	6.52	5.40	7.45
Crude protein (% DM)	46.76	46.41	45.09
Crude lipid (% DM)	4.60	4.36	4.24
Energy (kJ/d DM)	18.27	18.50	17.99

1) According to NRC, 1983.

2) Carboxymethylcellulose as the binder in the practical shrimp feed

Diets

Three experimental diets with different inclusion rates of the hydrolysed poultry protein AquaTrac sol SD (0; 2%; 6%) were formulated (**Table 1**).

The diets were pelleted into 1.5mm pellets with a pelletiser after pulverizing the feed ingredients into 250 µm particles, fan-dried and stored in sealed bags for use.

The chemical composition including moisture, crude protein, crude fat and crude energy of the feedstuffs and the experimental diets were analysed according to Zhou et al. (2003). The diets were randomly assigned to the tanks. There were four replicates for each treatment.

Shrimp were initially fed at 6% body weight, four times/day at 06:00, 11:00, 18:00 and 23:00, and the feed ration was adjusted weekly.

Water stability of pellets

The water stability of pellets was evaluated by assessing the dissolving rates of the experimental diets. Weighed pellets (W_0) were placed in the aquarium without shrimp for 30min, 60min, 90min and 120min respectively.

Residual feed was collected, dried and weighed (W_t.).

The dissolved rate of pellets from diets 1, 2 and 3 was calculated as DR % = 100 x (W_0- W_t) / W_0.

Table 2: The dissolved rates (%) of the experimental diets in aquarium without shrimp			
Time (min)	Diet 1	Diet 2	Diet 3
30	9.18 ± 0.22 a)	9.60 ± 0.03 b)	11.68 ± 0.39 c)
60	9.07 ± 0.06 a)	10.19 ± 0.16 b)	11.15 ± 0.44 b)
90	10.11 ± 0.45 a)	10.50 ± 0.45 a)	13 74 ± 0.53 b)
120	11.26 ± 0.37 a)	12.91 ± 0.43 b)	19.90 ± 1.54 c)

Values are means ± S.E. of triplicate samples. Means in the same row not sharing a common superscript are significantly different (p<0.05)

Feed intake

The feed intake of the experimental diets was determined by the percentage of non-consumed pellets.

This was measured by the amount of feed left over every 20 min within 2 hours after feeding four times/day during the experimental period.

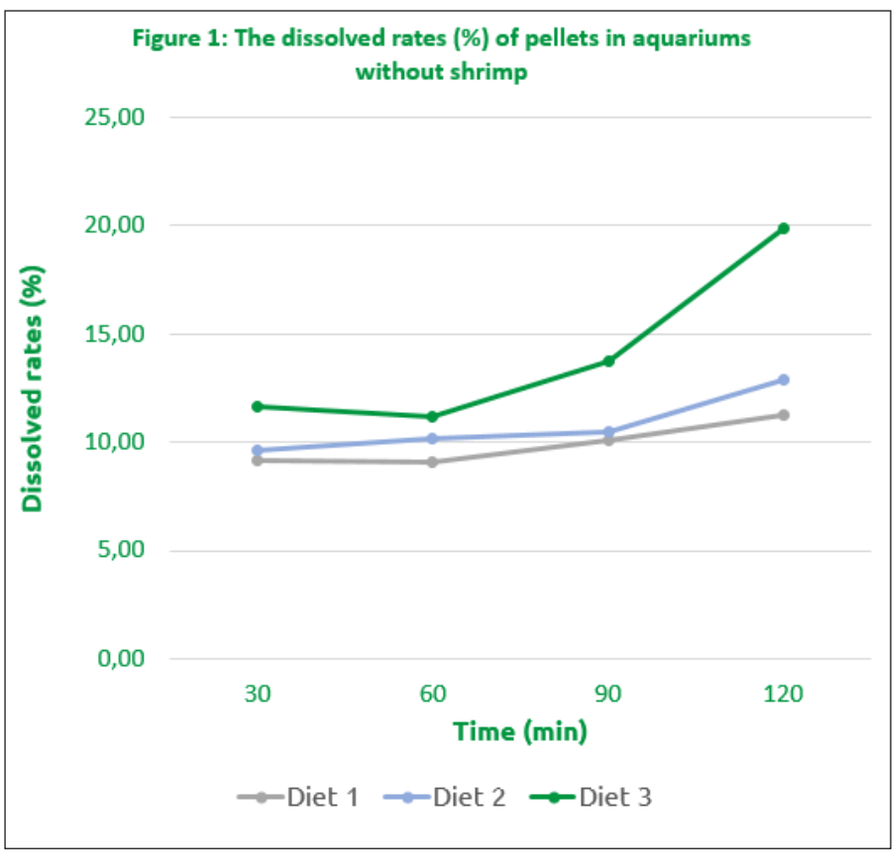
The non-consumed pellets (NCP, %) was calculated as % NCP =100 x N_n/N_f were N_f and N_n were the number of fed pellets and number of non-consumed pellets. Differences of all the data were analysed by one-way analysis of variance (ANOVA).

Table 3: Non-consumed pellets (% NCP) of the experimental diets during the feeding period (%)			
Time (min)	Diet 1	Diet 2	Diet 3
0	100.0 ± 0.0	100.0 ± 0.0	100.0 ± 0.0
20	86.6 ± 10.4 a)	77.5 ± 13.5 b)	45.3 ± 19.5 c)
40	80.2 ± 12.5 a)	67.8 ± 20.1 b)	24.2 ± 24.7 c)
60	74.3 ± 13.8 a)	58.3 ± 24.2 b)	15.7 ± 22,1 c)
80	68.7 ± 64.8 a)	53.7 ± 25.6 b)	13.0 ± 21.4 c)
100	64.8 ± 19.2 a)	49.6 ± 26.7 b)	11.5 ± 20.0 c)
120	60.6 ± 19.9 a)	46.0 ± 27.3 b)	10.4 ± 18.7 c)

Values are means ± S.E. of triplicate samples. Means in the same row not sharing a common superscript are significantly different (p<0.05)

Growth performance

At the end of the 8 week feeding trial, shrimp from each tank were bulk- weighed after a one day starvation period.
Data on the weight gain, specific growth rate and survival rates were obtained.



Other data included daily feed intake and feed conversion ratio. Duncan's multiple range tests were used to compare the differences among the means.

3. Results

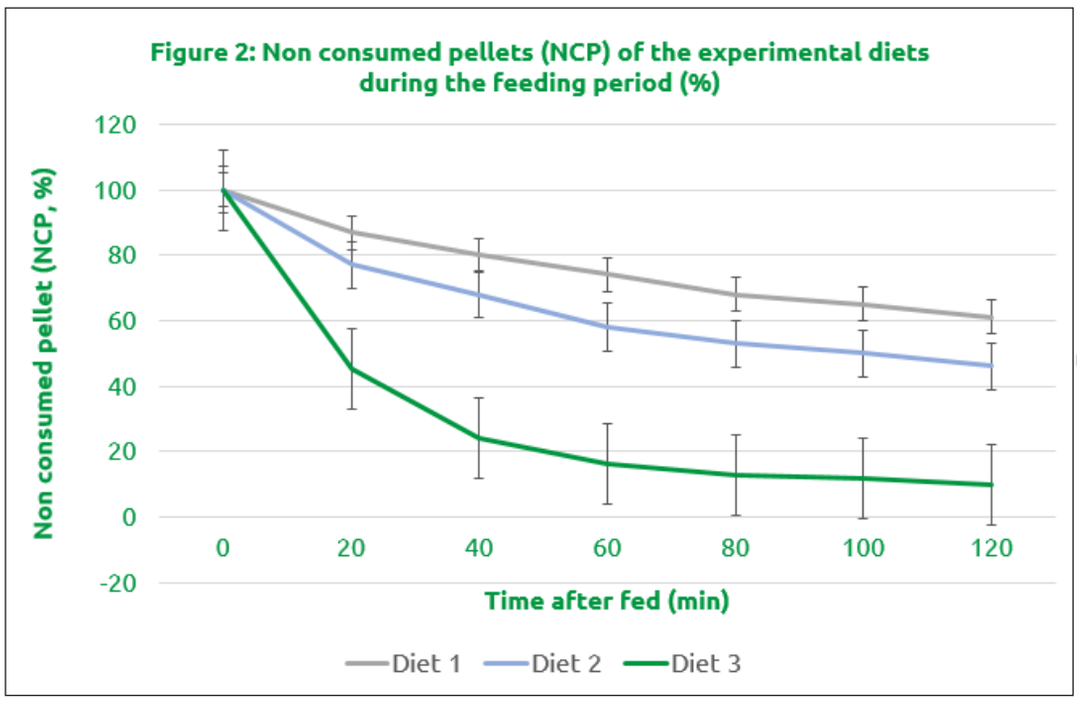
Table 2 showed the variation in dissolved rates of the pellets in the aquarium tank.
Significant differences ($p<0.05$) were found in the dissolved rates of all three diets after 30min and only between diet 1 and 2 at 60min ($p<0.05$). It was clear that the rate of disintegration was less than 14% for all diets with the exception of diet 3 at 120 min.
This demonstrated that AquaTrac has good binding properties and closely similar as carboxyl methyl cellulose or CMC, which is commonly used as a binder for aqua feeds in China.
Table 3, **Figure 2** showed that the inclusion of AquaTrac in the practical feed of white shrimp obviously improved the palatability of diets, as the % of non-consumed in Table 4, it was shown that dietary AquaTrac at 6% inclusion level clearly improved the weight gain, survival rate and specific weight gain. These were significantly higher ($p<0.05$) than shrimp fed with diet 2.

It is recommended that 6% is the optimal inclusion level of hydrolysed poultry protein in the practical feed of white shrimp. Feed conversion ratio was also high at 1.60:1 as compared to 2.75:1 with shrimp fed diet 2. Daily feed intake of diet 2 and 3 was higher that diet 1 but was not significantly different ($p<0.05$) .

Table 4: Growth performance, survival rate and feed conversion ratio of white shrimp *Penaeus vannamei* fed the experimental diets

	Diet 1	Diet 2	Diet 3
Initial body weight (IBW) (g)	0.78 ± 0.01	0.76 ± 0.02	0.78 ± 0.01
Final body weight (FBW) (g)	1.76 ± 0.13 a)	1.76 ± 0.23 a)	2.48 ± 0.06 b)
Weight gain (%)	127.14 ± 17.66 a)	129.70 ± 27.28 a)	217.88 ± 7.57 b)
Specific growth rate (%/d)	1.45 ± 0.22 a)	1.45 ± 0.22 a)	2.06 ± 0.04 b)
Daily feed intake (g/d/shrimp)	0.037 ± 0.003 a)	0.042 ± 0.002 ab)	0.049 ± 0.002 b)
FCR	2.22 ± 0.27	2.75 ± 0.60	1.60 ± 0.07
Survival rates (%)	38.34 ± 2.89 a)	40.00 ± 3.60 a)	70.83 ± 5.99 b)

Values are means ± S.E. of triplicate samples. Means in the same row not sharing a common superscript are significantly different ($p<0.05$)



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Authors Address

a) Peibin Wang, Zhigang Zhou, Huiyuan Lv, Yang Deng,
Feed Research Institute of Chinese Academy of Agricultural Sciences,
P.R. China,
Beijing, 100081.

b) Franz-Peter Rebafka
GEPRO Geflügel-Protein Vertriebsgesellschaft mbH & Co.KG,
Im Moore 1, 49356 Diepholz,
Germany,
franz-peter.rebafka@ge-pro.de