The Effect of Feeding AquaTrac of Performance on Black Tiger Shrimps (*Penaeus monodon)*

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Abstract

In a 60-days trial, juvenile black tiger shrimps (*Penaeus monodon*) were fed with a control diet (Group 1), treatment Diet 1 (Group 2) and Diet 2 (Group 3) which were fortified with 1.0 % and 2.0% AquaTrac respectively.

Shrimps fed with the control diet had attained a weight gain of 4.37g compared to 5.29g for Diet 1 (1.0% AquaTrac).
Thus the weight gain of 21.1% of the shrimps fed with Diet 1 was significantly higher ($p<0.05$). Compared with the control group, the Diet 2 (2.0% AquaTrac) have attained the highest weight gain of 5.60g and developed 28.1% statistically significant faster ($p<0.05$). However, the weight development between Diet 1 and Diet 2 was only 5.9% different which is statistically non-significant at the 5.0% level.
The specific growth rate (SGR) indicates that it is statistically significant greater ($P<0.05$) in the treatment groups with 18.9% (Diet 1) and 30.6% (Diet 2) compared to the control. Speediness of feed intake (feed consumption in first 30 minutes) was statistically significant faster ($p<0.05$) for the Diet 2 (59%) and Diet 1 (54%) than for the control group (42 %).
The feed conversion ratio (FCR) of 1.40 for Diet 2 and 1.41 for Diet 1 are statistically significant ($p<0.05$) superior to that of control (1.67). The protein efficiency ratio (PER) for the two "AquaTrac" groups were also statistically significant higher ($p<0.05$) with 1.48 for Diet 1 and 1.52 for Diet 2 in comparison to control diet (1.29).

Under the conditions of this experiment, trial results demonstrate that fortification of feed with "AquaTrac" improves the performance of black tiger shrimps (Penaeus monodon) in terms of growth rate, FCR and PER.

1. Introduction

Shrimp culture is heavily dependent on fish meal to provide the quality protein and the flavour that attracts them to feed and grow. With finite restrictions in fish meal production, other protein sources must now be incorporated to meet the increasing growth in aquaculture demand.

The pressure to use alternative protein sources such as animal by-product meals and plant proteins as dietary fish meal replacers is mounting. However, in general these protein

sources are deficient in one or more essential amino acids and palatability suffers when fish meal is substantially reduced. What is needed is an attractant that induces the shrimps into eating protein, they would otherwise reject. Moreover, less feed wasted improves water quality and reduces the cost of production.
The use of biotechnology by using beneficial bacteria and enzyme in hydrolysed protein offers several advantages. These include the enhancement and more constant nutritional characteristics of hydrolysed proteins. It can also provide for pre-digestion of the ingredient to improve digestibility (Khajarem et al.2005).
There is production of organic acidifier (lactic acid) for enhancing the digestive enzyme and to inactivate the anti-nutritional compounds in the gut of animals (SriSathapom et al., 2005).

Khajarem et al. (2005) have reported that the best growth can be obtained for marine shrimps Penaeus monodon and Penaeus vannamei fed diets with hydrolysed de-hulled soybean meal. Anggawati et al. (1990) used fish hydrolysate to supplement feeds of Penaeus monodon and found that replacing fish meal with 3.0% dry fish hydrolysate was sufficient to enhance shrimps growth.
Cordova-Murueta and Garcia-Cerreno (2002) with Penaeus vannamei compared diets containing between 0-15% fish hydrolysate, and reported that 3.0% fish hydrolysate (equivalent to 6.0% liquid hydrolysate), produced the highest growth and best feed efficiency. Beatrice and Rosamma (2002) have indicated that hydrolysed shrimp shell waste product, incorporated in feed gave a better performance compared to control feed.
Mishra and Venu Gopala (2004) have demonstrated that fortification of shrimp diet with hydrolysed shrimp waste has i mproved the feed intake, growth rate, feed conversion and protein efficiency ratio.

In follow-up results of hydrolysed proteins in aquarium trial in shrimps has been conducted on behalf of GEPRO Geflügel-Protein Vertriebsgesellschaft m.b.H & Co.KG, Diepholz, Germany, in order to test the efficacy of their product AquaTrac on performance of black tiger shrimps (*Penaeus monodon*). AquaTrac is traded as AquaTrac® sol SD.

2. Material and Methods

Six (6) glass aquaria of about 0.9 m² with a water capacity of 450 l each at “The Waterbase LTD's” (TWL) R&D trial facilities were used for this trial. One hundred and twenty (120) juvenile black tiger shrimps Penaeus monodon of about 0.54 g (±0.06) live weight were divided into three (3) groups of 40 shrimps with two (2) replicates each of 20 shrimps.
The stocking density is equal to 24 shrimps/m². For sanitary reasons the animals were dipped for five (5) minutes in 10 ppm $KMnO_4$ solution.

For this experiment, TWL pelletised starter feed (ULTRAXL-3P) for semi-intensive shrimp farming was used. The experimental substance AquaTrac was used as indicated below:

- **Group 1: Feed without "AquaTrac"**
- **Group 2: Feed with 1.0% "AquaTrac"**
- **Group 3: Feed with 2.0% "AquaTrac"**

Chemical analysis of the feed was carried-out by TWL Quality Control Department as per AOAC (1990).
The daily feeding rate was 10% of animal's body weight, divided into five (5) feeding times at 06:00 h, 10:00 h, 14:00 h, 18:00 h and 22:00 h.
The left-over feed has been collected two (2) hours after each feeding time. It has been dried in a hot-air oven for two (2) hours at 130°C for the calculation of true feed consumption. The weight of animals has been recorded every 10 days. The speediness of the feed intake was observed for half-an-hour.

The parameters used for analysing the water quality are given in the table below. About 25% of the water was exchanged every 3rd day. Topping-up of water was done as required. The triallasted for 60 days.

At the end of the trial, ten (10) shrimps from each group were sacrificed for carcass study. Shrimps were divided into head, meat and shell. The weight of each portion has been recorded. The meat has been analysed for its chemical composition.
All recorded data were statistically analysed and significance tests were carried-out using the "one way analysis of variance" by Kapur (1982).

3. Results

In a 60-days trial, juvenile black tiger shrimps (*Penaeus monodon*) were fed with a control diet (Group 1), treatment Diet 1 (Group 2) and Diet 2 (Group 3) which were fortified with 1.0% and 2.0% AquaTrac respectively.

3.1 Nutrition

According to the literature on black tiger shrimp nutrition, protein level in formulated feed should be more than 36% and the lipid level should be more than 4.0% (Jorry, 1995; Karpaganapathy et al.1995; Das, 1999; Jain, 1999).
The tested diets have had crude protein and crude fat levels of more than 41% and 7.0%, respectively (**Table 1**).

3.2 Water Quality

The trial was carried-out under stable ambient conditions. For the entire trial period, salinity was maintained at 30.0 ppt (±1.5) with mean pH level of 8.1 (±0.2) and dissolved oxygen at 5.5 ppm (±-0.5). At the same time water temperature was maintained at 30.0° C (±1.5) (**Table 2**). All water quality and microbiological parameters were well within the optimum Moriarty (1998). The differences between the groups were statistically non-significant at 5.0% level.

Table 1: Proximate composition of feeds

		Group 1 [1]	Group 2 [2]	Group 3 [3]
Moisture	%	9.2	10.6	9.9
Crude Protein	%	41.9	42.7	42.9
Pepsin digestibility	%	90.2	91.0	91.6
Crude fat	%	7.0	7.3	7.2
Crude fibre	%	1.8	1.7	1.9
Crude ash	%	10.6	10.5	10.5
N-free extract	%	29.5	27.2	27.6
Calcium	%	2.71	2.82	2.70
Phosphorus	%	1.70	1.81	1.69
Ca:P ratio	1:	1.59	1.56	1.60
Digestible energy [4]	Kcal/kg MJ/kg	3.611 15.1	3628.5 15.2	3.616 15.1
Water durability	Points [5]	8.1	8.2	8.2

[1] Ultra XL-3P without AquaTrac
[2] Ultra XL-3P with 1.0% AquaTrac
[3] Ultra XL-3P with 2.0% AquaTrac
[4] Calculated
[5] TWL standard at least 8.0 points of a maximum of 10 points

3.3 Weight Performance

Shrimps fed with the control diet had attained a weight gain of 4.37g compared to 5.29g for Diet 1 (1.0% AquaTrac). Thus the weight gain of 21.1% of the shrimps fed wit Diet 1 was significantly higher ($p<0.05$). Compared with the control group, the Diet 2 (2.0% AquaTrac) have attained the highest weight gain of 5.60g and developed 28.1% statistically significant faster ($p<0.05$). However, the weight development between Diet 1 and Diet 2 was only 5.9% different which is statistically non-significant at the 5.0% level **(Table 3)**.The weight development for Diet 2 was superior for the entire trial, but closely followed by Diet 1 **(Figure 1)**.The standard deviation was higher (±1.25) for control group than for the shrimps fed with Diet 1 (±1.08) and Diet 2 (±1.06).
The specific growth rate (SGR) indicates that it is statistically significant greater ($p<0.05$) in the treatment groups with 18.9% (Diet 1) and 30.6% (Diet 2) compared to the control. On the other hand, no significant difference is observed between the 1.0% and 2.0% inclusion rates of AquaTrac. The SGR for Diet 2 was better for the entire trial period but closely followed by Diet 1 (**Figure 2**).

3.4 Feed Conversion

Total feed consumption for the control group of 7.31g is 2.3% and 7.1% lower, respectively, in comparison with Diet 1 (7.48 g) and Diet 2 (7.83 g).
The feed conversion ratio (FCR) of 1.40 for Diet 2 and 1.41 for Diet 1 are statistically significant ($p<0.05$) superior to that of control (1.67). The FCR for Diet 2 and Diet 1 is superior through-out the trial period than that of control (**Figure 3**).
The protein efficiency ratio (PER) for the two "AquaTrac" groups were also statistically significant higher ($p<0.05$) with 1.48 for Diet 1 and 1.52 with Diet 2 in comparison to control diet (1.29).
Speediness of feed intake (feed consumption in first 30 minutes) was statistically significant faster ($p<0.05$) for the Diet 2 (59%) and Diet 1 (54%) than that of control group (42%).

Table 2: Average water quality parameters recorded during the trial period of 60 days

Parameter		Group 1 [1)]			Group 2 [2)]			Group 3 [3)]			Recommendation [4)]
		n	Mean	SD ±	n	Mean	SD ±	n	Mean	SD ±	
Salinity	ppt	60	30.0	1.5	60	30.0	1.5	60	30.0	1.5	25.0 - 35.0
pH		60	8.1	0.2	60	8.1	0.2	60	8.1	0.2	7.5 - 8.5
Temperature	°C	60	30.5	1.0	60	30.5	1.0	60	30.5	1.0	26.0 – 32.0
Dissolved oxygen	ppm	60	5.5	0.4	60	5.5	0.4	60	5.5	0.4	>3.0
Alkalinity	ppm	20	165.0	20.5	20	165.0	20.5	20	165.0	20.5	<200.0
Ammonia	ppm	20	0.0	0.0	20	0.0	0.0	20	0.0	0.0	<1.0
Hydrogen sulphide	ppm	20	0.0	0.0	20	0.0	0.0	20	0.0	0.0	<1.0
Green colonies	cfu/ ml	6	10.0	0.5	6	10.0	0.5	6	10.0	0.5	<200.0
Yellow colonies	cfu/ ml	6	80.0	20	6	80.0	20	6	80.0	20	<500.0

[1)] Ultra XL-3P without AquaTrac
[2)] Ultra XL-3P with 1.0% AquaTrac
[3)] Ultra XL-3P with 2.0% AquaTrac
[4)] Calculated

The number of moltings were statistically significant higher ($p<0.05$) in Diet 2 (98 no.) and Diet 1 (86 no.) compared to the molting of the control (74 no.) (**Table 3, Figure 4**).

3.5 Carcass composition

Carcasses were divided into head, meat and shell showed that head portion was less than 37% of the total shrimp carcass. The major portion was meat and shell. Shrimps fed with AquaTrac have better protein retention in the body with 82.7% (1.0% AquaTrac) and 84.1% (2.0% AquaTrac) than that of control (80.6%) **(Table 4)**. However, the differences in the meat protein were statistically non-significant at 5.0% level.

4. Discussion

In this experiment the efficacy of "AquaTrac" on the performance of shrimps, has been evaluated. This study shows that infusion of AquaTrac in shrimp diets significantly improved the production performance of juvenile Penaeus monodon. The results are in line with the findings of Anggawati et al. (1990) and Cordova- Murueta and Garcia- Cerreno (2002). They have reported that replacing fish meal with 3.0% dry fish hydrolysate was sufficient to enhance shrimps growth substantially, Khajarem et al. (2005) have reported that the best growth can be obtained for marine shrimps. Penaeus monodon and Penaeus vannamei fed diets with hydrolysed de-hulled soybean meal. Sri Sathapom et al. (2005) have found that a 10% substitution of the soybean component with hydrolysed soybean meal was sufficient to improve growth performance by 25% in hybrid cat fish and 40% in freshwater tilapia. Beatrice and Rosamma (2002) have shown that hydrolysed shrimp shell waste product, incorporated in feed improved the shrimps performance substantially compared to control feed. The

Table 3: Performance of black tiger shrimps *(Penaeus monodon)* fed with a control diet and fortified diets with "Hydrolysed Poultry Protein Concentrate" HPPC at 1.0% and 2.0% level

		Control [1)]		1.0 HPPC [2)]		2.0 HPPC [3)]	
		Mean	SD ±	Mean	SD ±	Mean	SD ±
Animals Replicates	no. no.	40 2		40 2		40 2	
Initial live weight	g	0.54	0.03	0.55	0.04	0.53	0.04
Final live weight	g	4.91	1.25	5.84	1.08	6.13	1.06
Weight gain	g rel. rel.	4.37^{a} 100.0		5.29^{b} 121.1 100.0		5.60^{b} 128.1 105.9	
Specific growth rate	%	809.26^{a}		961.82^{b}		1056.60^{b}	
Feed consumption	rel. rel. kg rel.	100.0 7.31 100.0		118.9 100.0 7.48 102.3 100.0		130.6 109.9 7.83 107.1 104.7	
Feed conversion rate	1:	1.67^{a}		1.4^{b}		1.40^{b}	
Protein efficiency ratio	rel. 1: rel. rel.	100.0 1.29^{a} 100.0		84.4 1.48^{b} 114.7 100.0		83.8 1.52^{b} 117.8 102.7	
Speediness of feed intake (feed consumed in 30 minutes)	% rel.	42^{a} 100.0		54^{b} 128.6		59^{b} 140.5	
Molting	no. rel.	74^{a} 100.0		86^{b} 116.2		98^{b} 132.4	
Mortality	no.	0.0		0.0		0.0	

[1)] Ultra XL-3P without AquaTrac
[2)] Ultra XL-3P with 1.0% AquaTrac
[3)] Ultra XL-3P with 2.0% AquaTrac
Different letters in the superscript in any one row denotes statistically significant different between means ($p<0.05$)

results also corroborate with the finding of Mishra and Venu Gopala (2004). They have demonstrated that fortification of shrimp diet with hydrolysed shrimp waste has significantly improved the feed intake, growth rate, FCR and PER.

Miller (1989) has reported that trial with AquaTrac on growth rate and feed efficiency of broiler chicks shows that it aids digestion of exogenous proteins shortly after hatching in a day old chicks. Just 2.5% of these proteins stimulate the production of enzymes in the pancreas, bringing forward the build-up of muscles and encouraging growth.

The speediness of feed intake for the Diet 1 and Diet 2 were 28.6% and 40.5% statistically significant better ($p<0.05$), respectively, than that of control. This is most probably due to the chemo-attractant effect of "HPPC". Results are in line with the findings of Mishra and Venu Gopala (2004). They have reported that hydrolysed shrimp waste is an excellent chemo-attractant along with good protein source for shrimp feed. Pittel et al. (1996) found that shrimps responded better to a feed that contains chemo-attractant. Mishra (2000) showed that Penaeus monodon performed remarkably better when fed with feed fortified with a nature-identical chemo-attractant. Anggawati et. aL. (1992) have reported that the "hydrolysed fish protein concentrate" (HFPC) has a strong characteristic smell that allowed shrimps to detect the feed at a distance and juvenile shrimp approached the feeding site as soon the feed being poured in. This minimized the feeds staying time in the water or leaching of nutrients before being consumed by the shrimps. And thus, feed efficiency was improved. It is apparent that consumption of formulated feed in shrimp is enhanced by the presence of feeding stimulants in the feed and that inclusion of AquaTrac in shrimp feed obviously increased the attractiveness of the feeds.

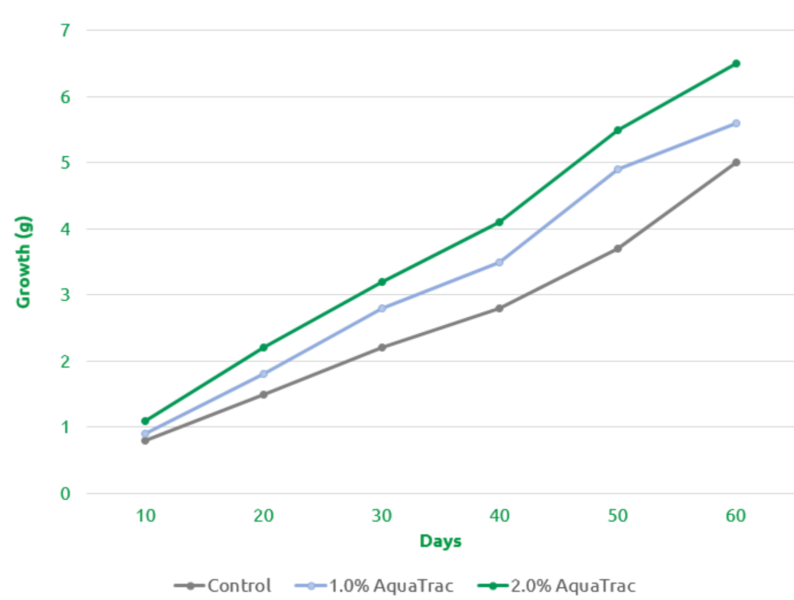
However, the chemical nature of this feeding stimulants in the "AquaTrac" has not been identified. Mackie (1977) studied the chemical nature of feeding stimulants for lobster and found that amino acids in feed served as chemical attractants. They stressed that "hydrolysed shrimp by-product"

Table 4: Carcass composition and chemical composition of shrimp meat after feeding AquaTrac at two different inclusion level

		Control [1]			1.0 AquaTrac [2]			2.0 AquaTrac [3]		
		Mean	SD ±	%	Mean	SD ±	%	Mean	SD ±	%
1. Carcass composition										
Shrimp weight	g	4.8	1.3	100.0	5.8	1.1	100.0	6.2	1.0	100
Head weight	g	1.8	0.8	37.5	2.1	0.9	36.2	2.3	0.8	37.1
Meat weight	g	2.2	1.0	45.8	2.7	1.1	46.2	2.9	1.0	46.8
Shell weight	g	0.8	0.6	16.7	1.0	0.7	17.2	1.0	0.8	16.1
2. Chemical composition of shrimp meat (dry matter) (%)										
Moisture	%	74.8			73.7			73.9		
Crude protein	%	80.6			82.7			84.1		
Crude fat	%	3.1			3.1			3.1		
Crude fibre	%	0.3			0.4			0.3		
Crude ash	%	5.7			5.3			5.2		

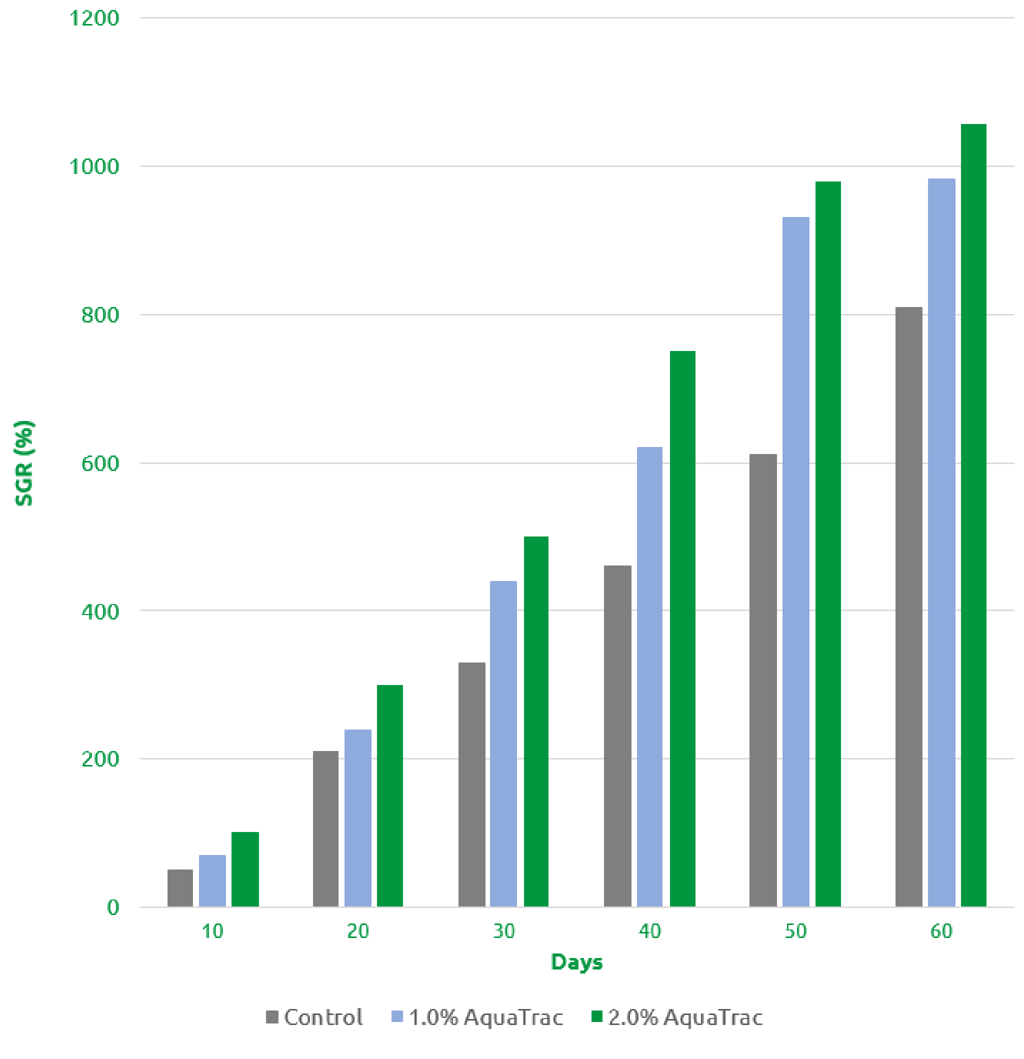
[1] Ultra XL-3P without AquaTrac
[2] Ultra XL-3P with 1.0% AquaTrac
[3] Ultra XL-3P with 2.0% AquaTrac

Figure 1: Performance of black tiger shrimps *(Penaeus monodon)* when fed with AquaTrac fortified diets



has substantially better chemo-attractant properties than other shrimp by-products.
This finding might be true for shrimps. Compared to the control, diets supplemented with “HFPC" had higher contents of some amino acid, like glutamic acid, and this might explained why the latter feeds were more attractive to shrimps (Anggawati et al., 1992). Results are also in line with the findings of Chin and Gunasekera (2000).
The PER for the treatment diets are 14.7% and 17.8% statistically significant higher ($p<0.05$) than that of control diet. The higher PER indicates greater conversion of food proteins into body protein (Taron et. al., 1995). This clearly shows that treatment groups have a better protein efficiency in feed conversion than that of control.

Figure 2: Specific Growth Rate (SGR) of black tiger shrimps (*Penaeus monodon*) when fed with AquaTrac fortified diets



The carcass study also indicates that there is a non-significant tendency for a better conversion and utilisation of crude protein in the treatment groups. The improved protein utilisation is the result of the improved PER of the treatment groups as reported by Tacon et al. (1995). Negret (2003) reported that use of hydrolysed fish attractant improved shrimp carcass quality and beneficial immune health effects.

5. Conclusion

Under the condition of this experiment, trial results demonstrate that fortification of feed with "AquaTrac" improves the performance of black tiger shrimps (Penaeus monodon) in terms of growth rate FCR and PER.
“AquaTrac”, therefore, is an excellent chemo-attractant and also a protein source for shrimp feed.

Figure 3: Feed Conversion Rate of black tiger shrimps (*Penaeus monodon*) when fed with AquaTrac

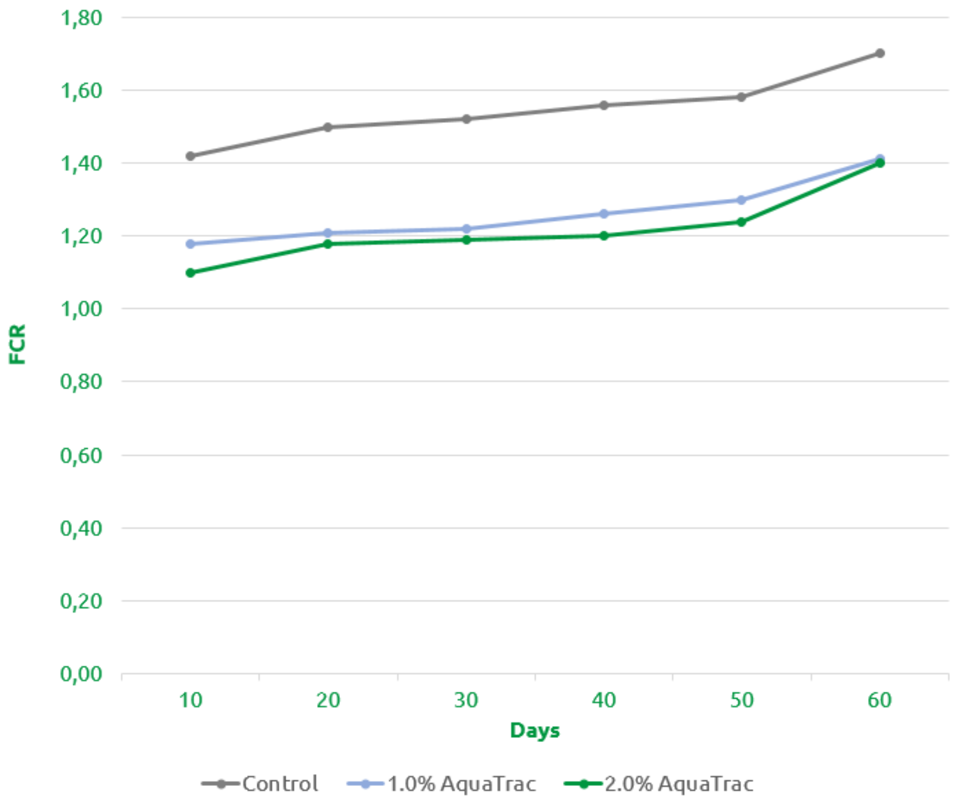


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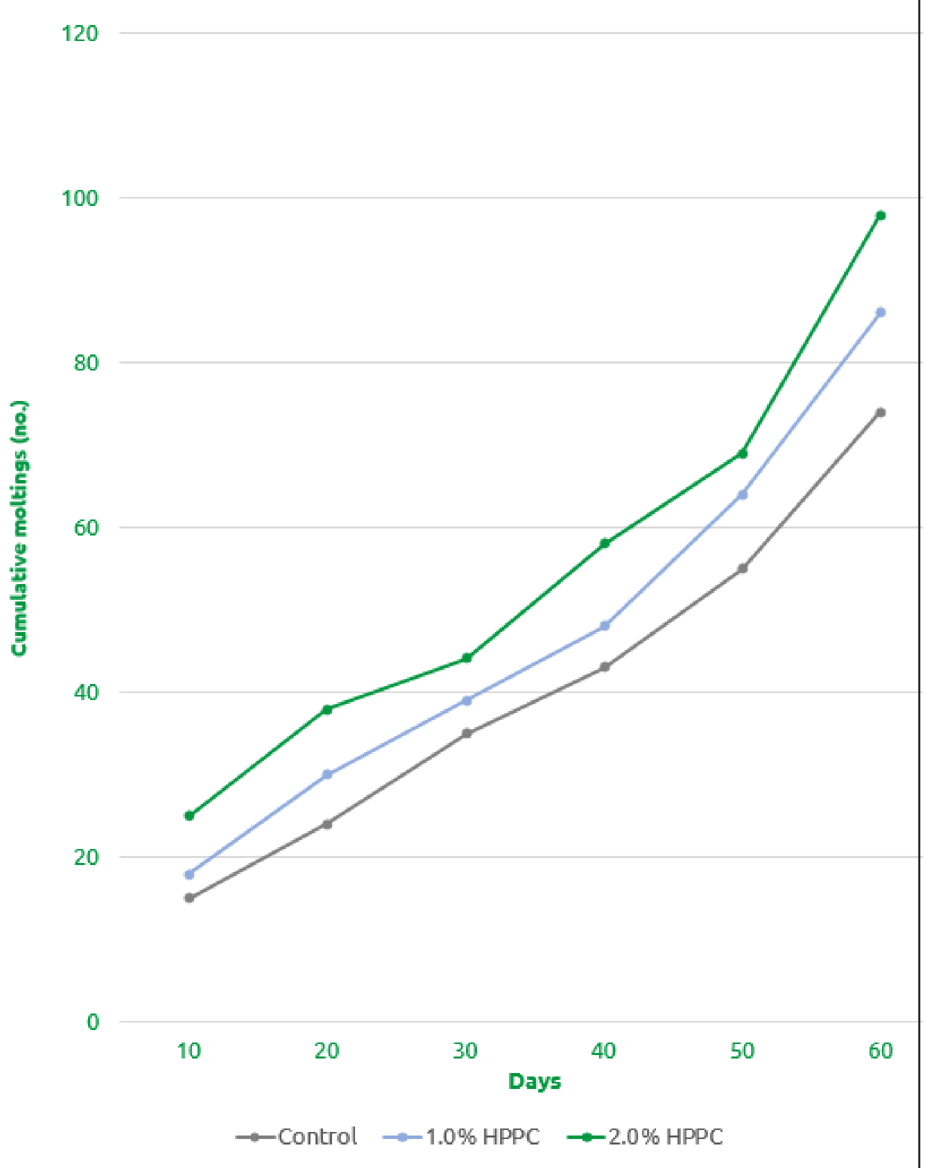
Figure 4: Cumulative numbers (no.) of molting of black tiger shrimps when fed with "Hydrolysed Poultry Protein Concentrate" (HPPC)



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