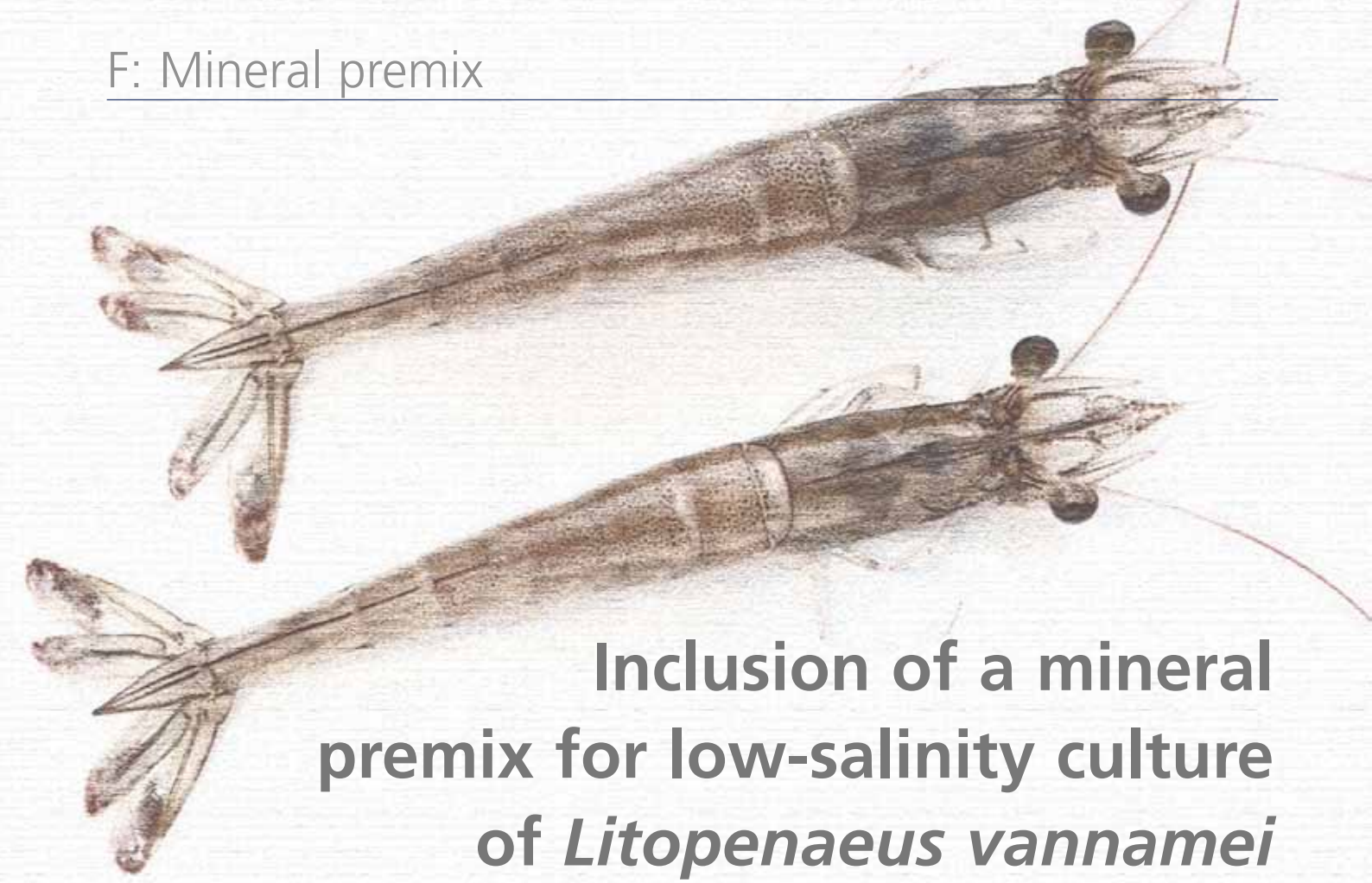

Inclusion of a mineral premix for low-salinity culture of *Litopenaeus vannamei*

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The white shrimp *Litopenaeus vannamei* has widely replaced *Penaeus monodon* as the cultured species. One of the reasons for this change is the fact that *L. vannamei* can be cultured in higher densities and with a lower exchange of water, which increases the bio-security.

L. vannamei is a euryhaline species and can be cultured in salinities from 0 to 50ppt, although the best growth is obtained in salinities between 10 and 25ppt.

In lower salinity culture, there is an osmotic pressure between the shrimp body and the surrounding water, resulting in automatic water uptake mainly through gills and intestine. With lower salinity the shrimp face more difficulties to uptake macro-minerals from the water.

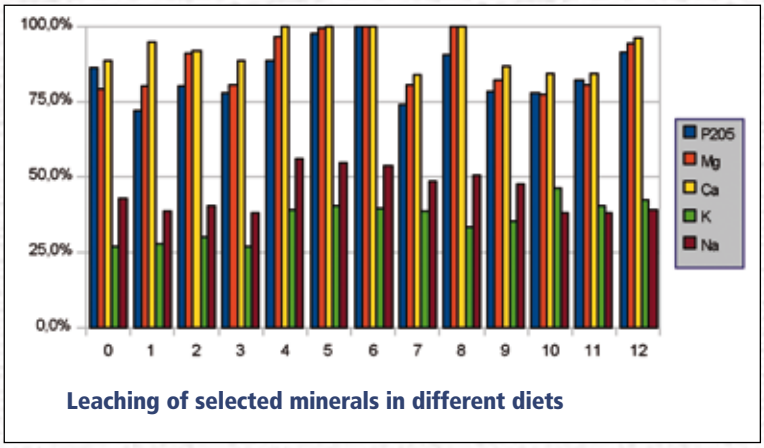
It has been shown that inclusion of these minerals through the feed can be a solution.

However, leaching of these minerals, which are often highly water soluble reduces this option.

Therefore, a mix of specific minerals was developed which shows increased retention in the pellets and is available for the shrimp. A growth trial confirms that shrimp show good growth even at low salinities when minerals are added in the feed.

Table 1: Apparent digestibility of selected minerals K and P in different diets

Diet	ADC P	ADC K
0	94,99%	99,85%
4	96,46%	99,93%
6	96,74%	99,93%
10	99,46%	99,98%
12	99,63%	99,98%



Leaching of selected minerals in different diets

Leaching of minerals from feed pellets

In the first experiment, 12 diets were produced with a different mix of minerals. 98 percent of the ingredients used are the same and two percent minerals were added.

Samples of feed were put in water with 0ppt salinity and 25°C for one hour. The minerals in the feed were analysed before and after leaching and corrected for moisture content and overall leaching. A reference diet, (0) without added minerals, was also analysed to have an idea of the retention of minerals from the other ingredients. This gave a retention percentage for each mineral for each sample, which can be seen in Graph 1.

It is clear that leaching of minerals is especially important for Na and K, although we can see that some samples show a higher retention than others.

Table 2: Growth results during week 1 and 2

		average weight			total
salinity	feed	start	day 7	day 14	growth (g/week)
10 ppt	1	6,72	8,57	10,05	1,67
10 ppt	2	6,83	8,62	10,76	1,97
10 ppt	3	6,64	8,21	9,79	1,58
10 ppt	4	7,27	9,16	10,83	1,78
5 ppt	1	6,27	7,99	9,78	1,75
5 ppt	2	5,21	6,86	8,64	1,72
5 ppt	3	6,31	7,49	9,18	1,44
5 ppt	4	6,47	8,17	10,00	1,77
10 ppt	average	6,87	8,64	10,36	1,75
5 ppt	average	6,06	7,63	9,40	1,67
average	1	6,49	8,28	9,91	1,71
average	2	6,02	7,74	9,70	1,84
average	3	6,48	7,85	9,49	1,51
average	4	6,87	8,67	10,42	1,78

Table 3: Growth results during week 3 and 4 with lower feeding frequency

		average weight			total
salinity	feed	day 14	day 21	day 28	Growth (g/week)
10 ppt	1	10,05	11,68	12,82	1,39
10 ppt	2	10,76	12,20	13,12	1,18
10 ppt	3	9,79	11,24	12,44	1,33
10 ppt	4	10,83	11,74	13,02	1,1
4 ppt	1	9,78	11,05	11,97	1,1
4 ppt	2	8,64	10,06	11,38	1,37
4 ppt	3	9,18	10,64	12,16	1,99
4 ppt	4	10,00	11,50	12,34	1,17
10 ppt	average	10,36	11,71	12,85	1,25
4 ppt	average	9,40	10,81	11,96	1,28
average	1	9,91	11,36	12,39	1,24
average	2	9,70	11,13	12,25	1,28
average	3	9,49	10,94	12,30	1,41
average	4	10,42	11,62	12,68	1,13

Solubility and digestibility

The lower leaching rate (higher retention) could be the result of a lower solubility of the mineral; which could affect the digestibility of this minerals for the shrimp.

Therefore, the apparent digestibility was tested for some selected growth trials. It is clear from Table 1 that for all diets, the digestibility of selected minerals is not the problem.

Material sand methods

From the leaching experiment, the most promising combinations were used for a feed trial. Four diets were produced on a small pellet mill with a diameter of two millimeters.

Table 4: Growth results during week 5 and 6: influence of leaching of pellets before feeding

		average weight			total
leaching	feed	day 28	day 35	day 42	Growth (g/week)
no	1	11,16	12,43	14	1,42
no	2	12,36	13,36	14,61	1,13
no	3	10,77	11,7	12,93	1,08
no	4	13,04	14,31	15,73	1,35
0 ppt	1	13,69	14,46	15,62	0,97
0 ppt	2	13,95	14,69	15,59	0,82
0 ppt	3	13,18	14,38	14,94	0,88
0 ppt	4	12,99	13,75	14,38	0,7
10 ppt	1	13,60	14,47	15,68	1,04
10 ppt	2	13,04	14,66	15,65	1,32
10 ppt	3	13,36	13,77	15,13	0,89
10 ppt	4	13,02	13,89	14,97	0,98
no	average	11,83	12,95	14,32	1,25
0 ppt	average	13,45	14,32	15,13	0,84
10 ppt	average	13,25	14,2	15,36	1,06

Table 5: Overall growth results

		average weight		total	FCR
salinity	feed	start	day 42	Growth (g/week)	
10 ppt	1	6,72	15,10	1,4	2,01
10 ppt	2	6,83	15,28	1,41	2,06
10 ppt	3	6,64	14,33	1,28	2,12
10 ppt	4	7,27	15,02	1,29	2,29
5-2 ppt	1	6,27	13,83	1,26	2,23
5-2 ppt	2	5,21	12,55	1,38	1,6
5-2 ppt	3	6,31	13,63	1,22	2,09
5-2 ppt	4	6,47	14,07	1,27	2,28
10 ppt	average	6,87	14,94	1,35	2,12
5-2 ppt	average	6,06	13,52	1,24	2,05
average	1	6,49	14,46	1,33	2,12
average	2	6,02	13,92	1,4	1,83
average	3	6,48	13,98	1,25	2,1
average	4	6,87	14,55	1,28	2,28

Shrimp (Litopenaeus vannamei) were imported from Thailand and raised to two grams. They were then transferred to the CreveTec-AFT Research station in Venray and divided over 20 nets (volume 150L) in two separate tanks. Shrimp were acclimatised for several weeks to a lower salinity.

Each tank is connected to a biofloc reactor to control water quality. This way, the water quality is equal for all nets. One tank was running on a salinity of 10ppt and the other on five ppt. Each diet was used in three replicates for the 10ppt salinity and two replicates for the five ppt salinity.

Each net is equipped with a belt feeder. Feeding was adjusted daily to an estimated growth and percentage of biomass.

Results

During the first two weeks (see table 2) the shrimp were fed continuously through a belt feeder. Growth was good for all replicates. Average growth loss between 10ppt and five ppt was 4.3 percent.

The most promising diets were diet number two and four. For diet four there was no growth diffference between salinities.

These results show that *Litopenaeus vannamei* can easily be grown at good growth rates in lower salinities if minerals are added in the diet.

For week three and four the feeding frequency was lowered to only four times per day. This will result in slower feed uptake, longer interaction of feed and water and higher leaching of minerals from the feed. The salinity of tank number two was lowered from five to four ppt.

Growth was affected negatively by the lower feeding frequency and dropped to 1.25g/week (see table 3).

There was no negative influence of lower salinity anymore, maybe because shrimp adapted to this condition. The best growth was obtained with diet number three.

For week five and six the feeding frequency was further lowered to only two times per day.

To understand the influence of leaching on growth, the feed for the three replicates in tank number one was treated before feeding: Four nets received normal feeds; four nets received feeds which were first soaked in fresh water for one hour before feeding and four nets received feeds which were first soaked in tank water (10ppt) for one hour before feeding (see table 4).

There was a clear influence of leaching on growth, indicating that leaching of nutrients is an imported factor in the growth of shrimp. Leaching for one hour in 10ppt water reduces the growth by 15 percent and leaching in fresh water reduces growth by 33 percent.

Week one to six – overall performance (see table 5).

- Growth is negatively affected by lower salinity.
- The best growth was observed with diet number two for 10 and lower salinities.

Conclusion

Growth and survival are negatively affected by lower salinity of pond water and by decreasing feeding frequency.

The addition of various minerals in feeds makes it possible to still obtain growth in those conditions.

Diet number two seems to be the best source of minerals in both 10ppt and lower salinity, which confirms earlier results of leaching and digestibility. Based on these results a special mineral premix was developed jointly by companies Prayon and CreveTec.

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