Natural free amino acids influence shrimp behaviour and feed attractiveness

Careful and repeated observations help to understand how shrimp behave toward feeds enriched with natural free amino acids.

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In a previous article (Aqua Culture Asia Pacific March/April 2018) we described the results obtained when a mix of natural free amino acids (MFAA) was added to feeds distributed in tanks and brackish water ponds in Vietnam. A positive impact was seen with shrimp growth, feed conversion ratio (FCR) and feed consumption.

To better understand how Kera-Stim 50®, a product of poultry keratin hydrolysis rich in free amino acids, can influence shrimp feed intake, a collaboration with Kasetsart University was recently launched. The study was designed to answer two critical questions raised in the previous work: how does MFAA influence shrimp feeding behaviour when included in a feed? Secondly, what is the impact of the mode of application on shrimp behaviour?

Treatment diets

A range of three control diets was formulated with decreasing amounts of fish meal (15%, 7.5% and 0%). Feed formulation (Table 1) and processing was done at Kasetsart University.

Each of the three diets was supplemented with 0.5% of MFAA. The product was added into the ingredient mix prior to pelleting (Mix Group) or coated over the pellet (Coa Group). Post pellet coating was carried out using a hand-held sprayer containing 200mL of water plus 50g of MFAA. It was sprayed onto 10kg of feed. All control feeds were treated in the same way, with application of 200mL of water. The experimental plan included nine treatments (Table 2) and each treatment was replicated four times.

Experimental shrimp

A total of 360 juvenile white shrimp, *Litopenaeus vannamei*, initial body weight (IBW) of 2.5g were divided among 36 aquariums of 100L capacity (10 individuals/aquarium). Each aquarium was filled with brackish water (15ppt salinity).

	FM 15%	FM 7.5%	FM 0%
Fish meal 60%	15	7.5	0
Soy concentrate	13	21.5	30
Soybean meal dehull	16	16	16
Wheat flour Thai	30.13	26.83	23.63
Wheat gluten	10	10	10
Poultry meal	5	5	5
Fish oil	2	2.8	3.5
Soy oil	1	1	1
Lecithin	3.5	3.5	3.5
Premix +Phosphate	4.37	5.87	7.37

Table 1. Feed formulation of three control diets with decreasing levels of fish meal

Fish meal content		FM15%	FM7.5%	FM0%
Control diets		F15-Ctrl	F7.5-Ctrl	F0-Ctrl
Kera-Stim 50®	Coated	F15-AA-Coa	F7.5-AA-Coa	F0-AA-Coa
	Mixed	F15-AA-Mix	F7.5-AA-Mix	F0-AA-Mix

Table 2. Experimental plan with the different feeds and product inclusion levels

Shrimp were fed 3 times/day for 8 weeks. Feed was given using a feeding tray. Daily feed amount distributed was equivalent to 4.5% of biomass (1.5% at each meal).

Once every week the behaviour of shrimp from each aquarium was observed by trained technicians during the second meal of the day. To do so, shrimp were gathered to one end of the aquarium behind a net and a feed tray containing appropriate quantities of feed was plunged at the other end of the aquarium. At this time the separation between animals and the feed was removed and the following parameters were recorded:

- Attractiveness: Time (in seconds) between shrimp release and first pellet attack.
- Global attractiveness: Number of shrimp consuming feed after 15 minutes.
- Feeding stimulant: Amount of feed consumed (g) within an hour.

To estimate the amount of feed consumed within an hour, the remaining pellets were collected, dried and weighed. Observations were performed eight times (once every week).

Individual attractiveness

Results show the positive effect of MFAA on feed attractiveness. Whether mixed with other raw materials or sprayed over pellets, MFAA had positive impacts on all behavioural parameters. As can be seen in Figure 1, the necessary time for the first shrimp to reach the pellets placed in the feed tray is shortened. Firstly, it is noteworthy that this duration increases when the fish meal level decreases for the control group, validating attractive effect of this ingredient for *L. vannamei*.

Whatever the fish meal level in the feed formula, MFAA significantly shortened the approach time. Figure 1 also shows the effect of MFAA application mode. When sprayed over the pellet (AA-Coa groups) the approach time (-41.5% on average for the Coa group) was even shorter than when MFAA was mixed with other raw materials (AA-Mix group).

Global attractiveness

The number of shrimp consuming feed after 15 minutes is another interesting observation made during those 8 weeks. Figure 2 details this parameter for the nine treatments. Even if it was less obvious than for the previous parameter, there was a correlation between fish meal content and global attractiveness of the feed. In all cases, and irrespective of fish meal level, MFAA was able to increase the number of shrimp eating 15 minutes after being released in comparison with the respective controls. In this case, influence of the application mode on shrimp behaviour was not so clear as the AA-Coa group performed better for the FM 15% feed and the AA-Mix gave significantly better results in the two other groups.

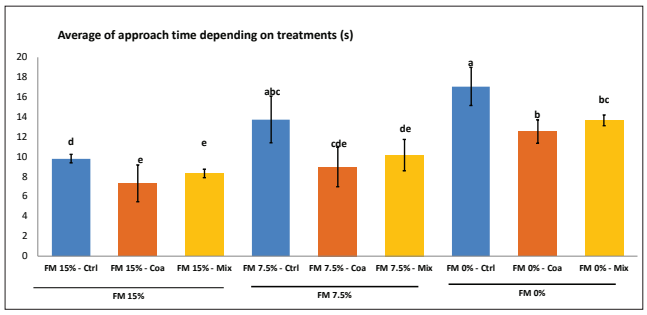

Figure 1. Feed attractiveness depending on fish meal content and treatment

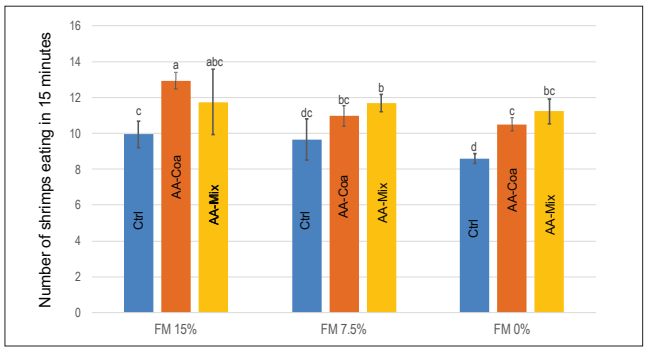

Figure 2. Average cumulative number of shrimp consuming pellets 15 minutes after the separation between feed and shrimp was removed (data are average of observations made in 4 aquariums per treatment for eight weeks).

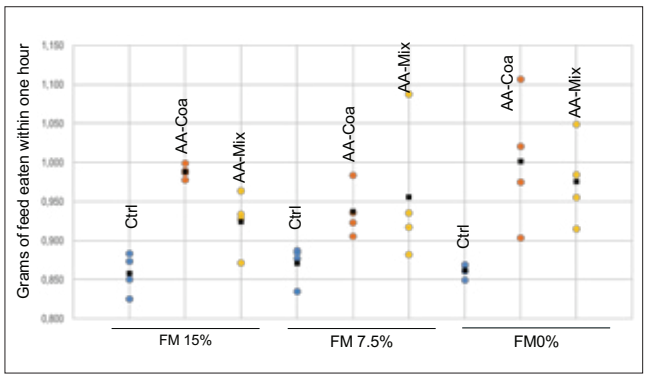

Figure 3. Average quantity of feed consumed within one hour after the separation between feed and shrimp was removed (each dot represents the average consumption for eight weeks in each aquarium; square symbols are average values for the four aquariums).

Feed consumption

Astonishingly, feed consumption after an hour of immersion was not influenced by fish meal levels. This parameter was nevertheless influenced by the use of MFAA either applied on or in the feeds. Figure 3 details the average feed amount consumed in each of the 36 aquariums used for this experiment. The tendency is always the same with an increasing amount of feed eaten by the shrimp fed with AA-Coa feed, followed by the AA-Mix group and the control group.

Discussion

This trial enabled us to understand how MFAA influences shrimp feed intake. Feed attraction parameters clearly underline the product's ability to attract *L. vannamei* shrimp toward feeds. These findings are in line with the available bibliography on amino acid effects and feed palatability (NRC, 2011). Such functionality can reasonably be seen as an efficient way to reduce feed waste as pellets will be eaten in a shorter time.

Another interesting result of this trial is the link made between the addition of MFAA and the amount of feed eaten by the animals. Such an observation underlines another functionality of the product. Taking the behavioural model proposed by Lee & Meyers (1996), MFAA can be considered as a palatant (facilitating the initiation of feeding) and a feeding stimulant (supporting the continuation of feeding).

The third main information provided by this experiment is linked to the influence of the mode of application of MFAA on the feed. Application by coating seems to be more efficient on all behaviour parameters measured during this trial (better individual and global attractiveness and higher feed consumption in all cases). This trend is consistent with the theory that free amino acids act as attractants because of their water solubility and low molecular weight. Soluble compounds and small molecules are better detected by shrimp chemoreceptors. We can then hypothesise that application by coating allows a better MFAA diffusion around pellets than their inclusion in the feed.

Those results have positioned Kera-Stim 50® as an efficient functional ingredient for shrimp feed. Its ability to support feed intake in low fish meal diets is particularly interesting. In the next article, we will demonstrate results on growth and other performance parameters obtained during the same experiment.

References

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