Corn protein concentrate allows for the removal or reduction of expensive binders while maintaining exceptional feed pellet quality, durability, and water stability

By Fabio Soller, PhD., Cargill Corn Milling

Pelleting or extruding animal diets is a good way to deliver complete nutrition to farmed livestock. These methods of producing animal feed reduces the energy expenditure by the animal searching for food, delivers all nutrients at once in a balanced "package", improves digestibility and growth performance, optimizes logistics and storage, and minimizes feed waste and water pollution.

In aquaculture, there are two very important aspects of the physical characteristics of feed pellets that will maximize the investment of feed, which usually is the largest portion of the production cost in any aquaculture enterprise: pellet durability index (PDI) and water stability (WS).

Pellet durability index is a measurement of how well the pellet maintains original form when subjected to mechanical stress. Feeds formulated to optimize animal performance and that have a high PDI translate to less losses due to fines (useless broken feed pellets and feed dust) and usually results in better water stability. This second factor, water stability, is an important physical characteristic for aquaculture feed, indicating that the feed pellet will last longer in the water without breaking down or dissolving, losing its nutritional value prior to animal consumption.

For this study, a series of extruded or pelleted diets were formulated alongside Dr. Orapint at Kasetsart University (Bangkok, Thailand), for Seabass and Shrimp (L. vannamei), respectively, with increasing inclusion levels of Empyreal® 75, a corn protein concentrate available form Cargill Corn Milling. Empyreal® 75 was used as a substitute for "natural binders" and protein sources such as wheat gluten, soy protein concentrate and soybean meal (Tables 1 and 2).

Materials and Methods

The various Seabass and Shrimp diets formulated (Tables 1 and 2) were tested for the pellet durability index. A 500g sample of feed was placed in a tumbling box rotating at 50 revolutions per minute (RPM) for 10 minutes. Afterwards, the fines were sieved out through a U.S. standard number 4 screen (nominal sieve opening 4.75mm; 0.187in) and the percentage of lost material calculated.

The Seabass and Shrimp diets formulated (Tables 1 and 2) were also tested for water stability. For the WS test, triplicate 50 g samples of pellet of each diet were placed on a sieve and slowly immersed in a 40-liter glass aquarium containing deionized water at 27°C for 10 min. The sieves were removed and the crumbles allowed to drain for 1 min, oven-dried at 105°C for 2 h, cooled in a desiccator and reweighed. Water stability was calculat-

Table **1.** Typical Seabass diet formulation for Southeast Asia with increasing inclusion of Empyreal 75 used in the PDI and WS tests. Formulated to have about 45% crude protein.

Seabass diet	**Control**	**5% E75**	**10% E75**	**15% E75**	**20% E75**
Empyreal 75	0	5.0	10.0	15.0	20.0
Wheat gluten	8.0	3.0	3.0	3.0	3.0
Soy protein concentrate	20.0	20.0	15.0	10.0	5.0
Fishmeal, tuna	15.0	15.0	15.0	15.0	15.0
Soybean meal	25.0	25.0	25.0	25.0	25.0
Squid meal	5.0	5.0	5.0	5.0	5.0
Wheat flour	19.0	19.0	19.0	19.0	19.0
Tuna fish oil	1.5	1.5	1.5	1.5	1.5
Soya oil	1.5	1.5	1.5	1.5	1.5
Squid liver paste	1.0	1.0	1.0	1.0	1.0
Soy lecithin	1.0	1.0	1.0	1.0	1.0
Choline	0.3	0.3	0.3	0.3	0.3
Vitamin C	0.2	0.2	0.2	0.2	0.2
Mono-calcium phosphate	1.0	1.0	1.0	1.0	1.0
Vitamin/Mineral premix	1.5	1.5	1.5	1.5	1.5
Total	**100.0**	**100.0**	**100.0**	**100.0**	**100.0**

Table 2. Typical Shrimp (*L. vannamei)* diet formulation for Southeast Asia with increasing inclusion of Empyreal 75 used in the PDI and WS tests. Formulated to have about 40% crude protein.

Shrimp diet	**Control**	**5% E75**	**10% E75**	**15% E75**	**20% E75**
Empyreal 75	0	5.0	10.0	15.0	20.0
Wheat gluten	5.0	0	2.0	2.0	2.0
Soybean meal	25.0	25.0	18.0	13.0	8.0
Fishmeal, tuna	25.0	25.0	25.0	25.0	25.0
Soy protein concentrate	5.0	5.0	5.0	5.0	5.0
Squid liver powder	3.0	3.0	3.0	3.0	3.0
Wheat flour	25.0	25.0	25.0	25.0	25.0
Wheat bran	5.0	5.0	5.0	5.0	5.0
Tuna fish oil	1.0	1.0	1.0	1.0	1.0
Soya oil	1.0	1.0	1.0	1.0	1.0
Soy lecithin	2.0	2.0	2.0	2.0	2.0
Mono-calcium phosphate	0.3	0.3	0.3	0.3	0.3
Vitamin/Mineral premix	2.0	2.0	2.0	2.0	2.0
Total	**100.0**	**100.0**	**100.0**	**100.0**	**100.0**

Results

The PDI number found for both species diets when substituting “natural binders” and other protein sources were exceptional (Table 3). The difference in PDI observed, from the lowest to the highest numbers, varied by only 0.33 points on the Seabass diets and 0.32 points on the Shrimp diets. With a lower and higher numbers of 98.81 and 99.14, respectively, for the Seabass diet, and 99.37 and 99.69, respectively, in the Shrimp diets.

The WS number seen here are very good, with no statistical differences among different diets (Table 4). The variance in WS observed, from the lowest to the highest numbers, varied by 2.28 points on the Seabass diets and 2.20 points on the Shrimp diets. With a lower and higher numbers of 91.70 and 93.98, respectively, for the Seabass diet, and 91.24 and 93.44, respectively, in the Shrimp diets.

Conclusions

Empyreal 75 is not only a reliable, consistent and concentrated protein source, but it is also a good “natural binder”, comparable to traditionally used ingredients such as wheat gluten and soy protein concentrate. The substitution of costly ingredients and binders by Empyreal 75 goes long way to reducing costs on the manufacturing of the diets while providing positive animal production performance.

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Table 3. Pellet durability index (PDI) averages (4 replicates) plus or minus the standard deviation (S.D.) for the various Seabass and Shrimp diets.

Diet		PDI		S.D.		PDI		S.D.
Control	Seabass	98.81	±	0.15	Shrimp	99.69	±	0.08
5% E75		98.86	±	0.10		99.42	±	0.16
10% E75		99.11	±	0.04		99.45	±	0.16
15% E75		98.96	±	0.05		99.66	±	0.10
20% E75		99.14	±	0.08		99.37	±	0.12

Table 4. Water stability (WS) averages (3 replicates) plus or minus the standard deviation (S.D.) for the various Seabass and Shrimp diets.

Diet		WS		S.D.		WS		S.D.
Control	Seabass	93.98	±	1.38	Shrimp	93.44	±	1.85
5% E75		93.72	±	3.40		91.24	±	3.59
10% E75		93.51	±	1.27		92.34	±	3.06
15% E75		92.20	±	2.30		92.07	±	1.18
20% E75		91.70	±	2.72		91.54	±	2.19

More information

Contact Cargill Corn Milling at http://www.empyreal75aquaculture.com/inquiries.php